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Post-World War II Bombers 1945–1973

Marcelle Size Knaack

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The Author

MARCELLE SIZE KNAACK rejoined the Office of Air Force History in 1970, after serving on two occasions as Deputy Chief Historian of the United States Air Forces in Europe. She became a senior historian in 1980. Born and educated in France, Mrs. Knaack graduated from the College d'Artois and attended the University of Lille, where her interest focused on foreign policy and international relations. Her first book was *Post-World War II Fighters, 1945–1973,* Vol I, *Encyclopedia of U.S. Air Force Aircraft and Missile Systems* (Office of Air Force History, 1978).

Foreword

The second in a series of encyclopedias of U.S. Air Force aircraft and missile systems, this volume covers the development and fielding of bomber aircraft between 1945 and 1973, commencing with the Convair B-36 Peacemaker and ending with the development of the Rockwell International B-1A. Marcelle Knaack's detailed and comprehensive discussion of each bomber type provides a wealth of technical material painstakingly extracted from official Air Force sources. The researcher will find the information readily available and easy to use.

Equally critical to our understanding of bomber development, however, is the author's treatment of the policy issues and the technological decisions that molded each bomber program. During the postwar years, the nation's emerging nuclear capabilities placed new emphasis on developing bombers capable of delivering the atomic weapon. Subsequent military needs in Korea and Southeast Asia, however, required a return to conventional weapons. New technologies continually spawned modifications in the weapons systems. And throughout, the Air Force adapted developmental programs and modified production aircraft to fit new roles, from strategic reconnaissance to tactical operations for the Southeast Asia theater.

These pages contain essential data for a wide spectrum of audiences inside and outside the U.S. Air Force. Mrs. Knaack's exacting research and her ability to translate difficult and often conflicting documentation into clear and concise capsule histories will enable planners and those engaged in the research and development of aircraft to benefit from the Air Force's experience. As she points out, the success of the postwar bomber program has been the result of the Air Force's willingness to consider several different developmental pathways simultaneously, to modify existing aircraft as technology permits, and above all, to assume continually the development risks required to keep the service at the forefront of technology.

Richard H. Kohn
Chief, Office of Air Force History

Preface

This reference volume compiles basic information on all Air Force strategic, tactical, and experimental bombers developed or produced between World War II and 1973. The book begins with the Convair B-36 Peacemaker, the first long-range, strategic atomic carrier, and closes with the development of the Rockwell International B-1A. The main narrative covers eight bomber types, most of which weathered some 30 years of world crises and two wars—the conflicts in Korea and Southeast Asia. Included is the premier B-52 Stratofortress, due to remain a prime asset of the Strategic Air Command through the 1980s.

The volume's first appendix considers the Douglas B-26 Invader and the Boeing B-29 Superfortress, aircraft of World War II vintage which made important contributions in subsequent years. Appendix II, Experimental and Prototype Bombers, deals with 10 aircraft, including the controversial Northrop XB-35 and YB-49; the ill-fated North American XB-70A; and the Advanced Manned Strategic Aircraft (AMSA), redesignated as the B-1A in April 1969.

The origin of each bomber is traced as well as, whenever applicable, its most significant development, production, and operational problems. Also noted are production decision dates, program changes, test results, procurement methods, production totals, delivery rates, prominent milestones, and brief descriptions of special features of new aircraft versions and configurations. Selected technical data and operational characteristics are provided at the end of each section.

This volume follows the pattern established in *Post-World War II Fighters, 1945-1973,* Vol I, *Encyclopedia of U.S. Air Force Aircraft and Missile Systems* (Office of Air Force History, 1978). Like the first encyclopedia, the bomber volume does not provide complete consistency of data. This is particularly understandable in the bombers' case because every program was highly individual and far more complex than the fighter programs. Nevertheless, as the specific bomber programs evolved, their respective *raison d'être* and the planned interlacing of the various programs became obvious.

One cannot anticipate history's ultimate assessment of the Air Force's achievements through the mid-1970s. The passage of time seldom worked in favor of the young service. Caution did not always pay off: when at long last operational, the B-36 was obsolete. Conversely, rising world tensions prompted the hurried production of unsuitable B-47s, which had to be reworked. The threat, never ceasing to exist, assumed many guises. In the rapidly changing environment, the very factors that fueled the growth of specific weapon systems could also alter their intrinsic modes of operation. A case in point is the B-52. Singled out for the atomic role, these bombers in 1972 found themselves flying conventional bombing missions against military targets in the Hanoi and Haiphong areas of North Vietnam.

This volume's sketchy compendium of data does not do justice to the Air Force, which met extraordinary challenges from the start. At the end of World War II, the operational forces were sharply reduced, then increased, only to be cut again. Besides hindering planning, such changes disrupted the aircraft industry and made it far more difficult to procure, given the many variables, the best weapon systems possible, in timely fashion. Money was continually in short supply. New administrations might shift the emphasis afforded to certain weapons—whether missiles or manned aircraft—but the tight budgets remained a constant limitation. Undoubtedly, the Air Force made mistakes. Yet, the service did place a premium on getting the greatest return from each dollar spent. The knowledge gained from canceled experimental programs was quickly put to other uses. Old aircraft were stripped and sold. Valuable surplus equipment and still serviceable engines were carefully retained, and savings routinely ensured.

In the early and mid-sixties, recurring world crises and the high cost of new weapon systems and space programs added urgency to the demand for cost-efficiency. Moreover, as the tempo of activities rose in Southeast Asia, the Air Force's task grew even more difficult. Improvisation and versatility became the order of the day. Refurbished aircraft and their heroic crews soon proved their worth; and the Air Force again met its commitments. Above all, the Air Force's greatest achievement was its success in coping with revolutionary technological developments. This is not to say, as 1973 came to an end, that technology had reached a plateau. Scientific progress was not likely to stop. Still, the foreseeable future appeared to be more settled, concentrating on the refinement process. The pioneering spirit of the three turbulent decades following World War II was giving way to a new equilibrium.

This volume is based essentially on U.S. Air Force sources, and I alone am responsible for the many omissions, and possible distortions, in this compilation.

Marcelle Size Knaack

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The author owes a considerable debt to John Bohn, Command Historian of the Strategic Air Command, and his staff; to Robert J. Smith, formerly Command Historian of the Air Force Logistics Command and now Command Historian of Tactical Air Command; to Dr. Richard Hallion, formerly Chief of the Air Force Flight Test Center's History Office, now Director, Special Staff Office of the Air Force Systems Command's Aeronautical Systems Division, and his staff; to Albert E. Misenko, Chief Historian of the Aeronautical Systems Division, and his staff; to R. Cargill Hall, Chief, Research Division of the USAF Historical Research Center, who generously shared his thorough knowledge of the B-58 intricacies; and to colleagues in the Office of Air Force History: Capt. RitaVictoria DeArmond, Dr. Michael H. Gorn, Maj. John F. Kreis, Lt. Col. Vance O. Mitchell, Dr. Walton Moody, Dr. Daniel Mortensen, Senior Historian Bernard C. Nalty, Jack Neufeld, currently Chief of the Air Staff History Branch, and Dr. George Watson. Special mention is due to Lt. Col. Michael F. Loughran, Deputy Division Chief, Strategic Offensive Forces Division, Directorate of Plans, Headquarters, USAF, for his invaluable assistance during the security and policy review process.

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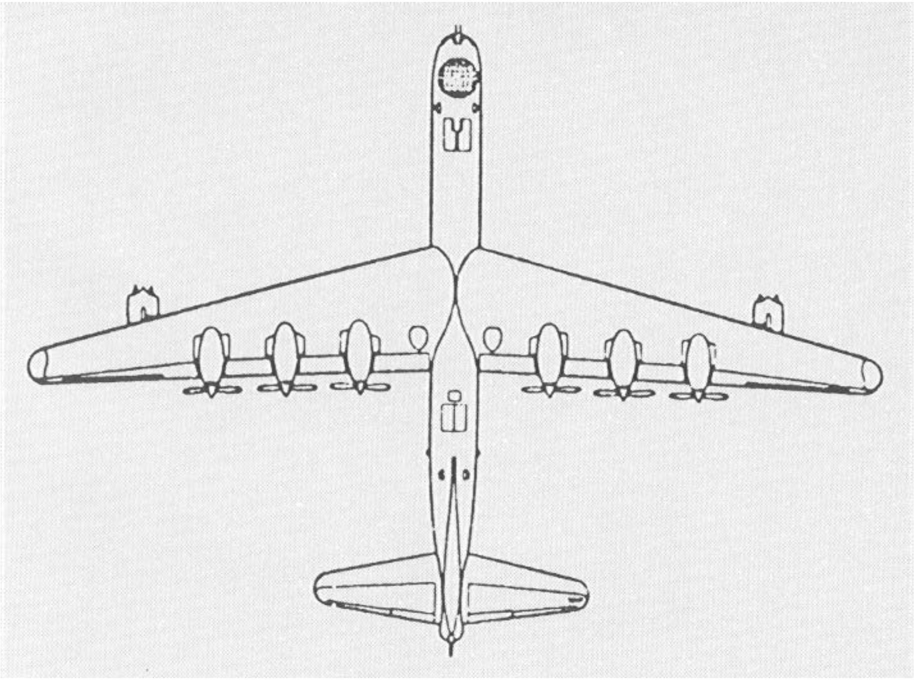
Post-World War II Bombers

B-36 Peacemaker

Consolidated Vultee Aircraft (CONVAIR) Corporation



B-36 PEACEMAKER
CONVAIR

Manufacturer's Model 36

Overview

The development of the B-36 was triggered by Nazi Germany's aggression and subsequently by the Japanese attack on Pearl Harbor. The Army Air Forces (AAF) required a long-range bomber to carry the war to the enemy. Despite the sense of urgency, the B-36 program progressed slowly. Existing technology failed to satisfy the military requirements of 1941, early wartime demands exceeded materials, and weapons more readily available received the highest priority during the war.

Military setbacks in 1942 led the AAF to concentrate on the Boeing B-29 (under production order since September 1941) at the expense of the B-36. However, growing concern in the spring of 1943, as China appeared near collapse, reversed the situation. Believing the B-36 might be the only bomber capable of attacking the Japanese homeland, the AAF called for 100 production model B-36s. Meanwhile, the contractor continued to struggle with various development troubles, serious engine problems, and significant weight increases. In mid-1944, engine problems reached a climax. Still, Convair's request for consideration of another engine was ignored because of the cost, time involved, and technical unknowns. In any case, the military position was no longer critical after the capture of Pacific bases and the deployment of the B-29, which would ultimately devastate Japan's home islands.

Yet, the B-36 did survive in the postwar environment. The United States Air Force (established as an independent service in September 1947) needed a long-range aircraft to carry the atomic bomb, and to further its claim on the atomic mission.

As the cold war intensified, deterrence through fear of atomic retaliation became the linchpin of American national security policy. Until air-refuelable, jet-powered bombers were operational, only the B-36, with its vast bombload capacity, could strike the Soviet Union, America's previous ally and now potential adversary. No matter the cost in effort or money, the B-36 had to be made to work. Just the same, the B-36 required technical innovations that were beyond the state-of-the-art. The experimental flight of August 1946, nearly 6 years after signature of the development contract, confirmed that the new bomber was underpowered. Improvement of the original R-4360 engine yielded little relief, and Convair's attempts to fit the engine with a variable discharge turbine failed. In 1949, the engine problem was somewhat alleviated by mounting turbojets under each of the B-36's wings. Still, throughout its entire operational career, the B-36 heavy bomber remained too slow, a shortcoming that increased its vulnerability and necessitated the protection of escort fighters.

In the early fifties, after modification of the landing gear, correction of the electrical system, and elimination of fuel tank leakages, the first B-36 remained highly troublesome. Other production models were not faring much better: the gunnery system was operationally unsuitable, the defensive armament was poor, and its fire-control system was barely adequate. At long last, in 1954, so-called "Featherweight" B-36s came into being. Whether new or reworked production models, the Featherweights proved fairly problem-free. The B-36s were also used for reconnaissance and served effectively. Perhaps the aircraft's most important contribution, though impossible to measure, lay in deterring a general war during the difficult years of its active life.

Basic Development — 1941

Development of a long-range bomber was spurred by Nazi Germany's spectacular campaigns at the outset of World War II.[1] Even though the scheduled invasion of the British Isles had been postponed, they seemed far from secure in the fall of 1940. The loss of Britain would leave the United States without European allies and with no bases outside the Western Hemisphere. The Air Corps[2] therefore needed a long-range bomber that could carry the war to any enemy from this continent. The early successes of the German offensive against Russia in June 1941 further deepened America's concern.

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[1] It took Hitler just 20 days to crush the Polish army in September 1939 and but a few weeks for the German forces to speed across the Low Countries and France in 1940. (The western campaign started on 10 May; the French surrendered on 22 June).

[2] The Army Air Forces was not formally established until 20 June 1941.

Requests for Proposals 11 April 1941

The Air Corps opened a design competition for a truly intercontinental bomber—a fast, high-altitude airplane with a heavy bombload and unprecedented range. Invitations for preliminary design studies were sent to the Consolidated Aircraft Corporation[3] and to the Boeing Aircraft Company on 11 April. Northrop Aircraft, Incorporated was contacted on 27 May, when it was also asked for further design studies on a "flying wing" bomber having a range of 8,000 miles at 25,000 feet, with 1 ton of bombs.[4] Not long afterwards the Douglas Aircraft Company took part in the long-range bomber competition.[5] Solicited much later, the Glenn L. Martin Company declined the invitation due to a shortage of engineering personnel.[6]

Revised Military Characteristics 19 August 1941

The preliminary characteristics set forth in the Air Corps requests for proposals of April 1941 called for a bomber with a 450-mile-per-hour top speed at 25,000 feet, a 275-mile-per-hour cruising speed, a service ceiling of 45,000 feet, and an overall range of 12,000 miles at 25,000 feet. These characteristics were revised during a conference on 19 August attended by Robert A. Lovett, Assistant Secretary of War for Air, Maj. Gen. George H. Brett, Chief of the Air Corps, and ranking officers of the Air Staff. Since the conference's main purpose was to accelerate the bomber project, the conferees decided to scale down their requirements. But their revision was

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[3] The Consolidated Aircraft Corporation and Vultee Aircraft, Inc., merged on 17 March 1943. The new Consolidated Vultee Aircraft (Convair) Corporation became the Convair Division of the General Dynamics Corporation on 29 April 1954.

[4] Until the early 1950s, the range and speed of aircraft were usually shown in statute miles. Afterwards, the Air Force began to measure speed in knots and range in nautical miles. Speed records, however, continued to be in miles per hour and distances were expressed in kilometers. (A knot—nautical mile per hour—is 1.1516 times swifter than a statute mile per hour. A nautical mile represents around 6,080 feet and is 800 feet more than the statute mile.)

[5] Douglas Aircraft had been given a contract on 19 April 1941 to check if the Allison 3420 engine could be used in bombardment type aircraft—clearly a closely related project. Douglas had also been working for several years on the XB-19—just recently flown and the largest aircraft ever built in the United States. The Air Corps planned to use the XB-19 as a flying laboratory to gather information that would help the design and construction of future giant aircraft.

[6] The Glenn Martin Company had been engaged in a new bomber (the XB-33, under contract since June 1941), before becoming involved in the Northrop "flying wing" program. In addition, by 1943 the company had been approached by the Navy for participation in a new production project.

still a tall order—a minimum overall range of 10,000 miles, and an effective combat radius of 4,000 miles with a 10,000-pound bombload.[7] This was about 4 times the combat radius of the Boeing B–17, the AAF's newest and best bomber. The conferees further specified that the future intercontinental bomber should have a cruising speed between 240 and 300 miles per hour, and a 40,000-foot service ceiling (5,000 feet less than originally requested).

Contractor Selection — 3 October 1941

After a review of preliminary data from Boeing, Consolidated, and Douglas, the Materiel Division of the Air Corps suggested prompt action on the Consolidated study, which covered several long-range bomber designs, both 4- and 6-engine pusher and pusher-tractor types.[8] This endorsement of Consolidated was in no way a rejection of either Boeing or Douglas services.[9] Yet, it proved to be a turning point in the intercontinental bomber program.

Development Decision — 16 October 1941

The decision was made by Maj. Gen. Henry H. Arnold, Chief of the new Army Air Forces, on the recommendation of Brig. Gen. George C. Kenney, Commanding Officer of the Air Corps Experimental Division and

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[7] Although the word "range" is often qualified, in this context it indicates how far an aircraft can fly under given operating conditions from the moment of takeoff to the time when its fuel supply is exhausted, as in "the aircraft's range was 7,000 miles, enough to fly nonstop from San Francisco to London." The "combat radius" is the radius of action for any given airplane on a combat mission with a specified load and flight plan. The "radius of action" differs from "range" in that the aircraft is always considered to return to the point at which it takes off. It is like the radius of a circle, and represents the maximum distance at which a given airplane can operate, under given conditions, from the center of the circle and still return to the center. This distance, under combat conditions, is considerably less than one-half the distance that the aircraft can fly under noncombat conditions.

[8] Consolidated, after specializing for many years in seagoing aircraft, reentered the landplane field early in 1940, with development of the B–24 Liberator. Keenly aware of the Air Corps's interest in large bombers with extended ranges, the company at this time had begun work on a number of design possibilities.

[9] Douglas Aircraft stated in late 1941 that it did not desire to undertake an "out-and-out 10,000-mile airplane project." It proposed instead the development of Model 423, a 6,000-mile bomber, which was rejected. As for Boeing, the AAF believed as late as April 1942 that the company was "overly conservative" and had not yet "really tackled the [long-range] airplane design with the necessary degree of enthusiasm." Two Boeing bomber designs (Models 384 and 385) submitted in September were never developed.

Engineering School at Wright Field, Ohio. General Kenney's recommendation rested on a detailed proposal (drawings and bid were submitted by Consolidated on 6 October), which asked for $15 million plus a fixed-fee of $800,000 for research and development, mockup, tooling, and production of 2 experimental long-range bombers (Model 35). Delivery of the first airplane would be 30 months after approval of the contract; that of the second, 6 months later. Consolidated also stipulated that the project could not be "entangled with red tape" and constantly changing directives.

Initial Contract Date — 15 November 1941

The initial contract (W535 ac-22352) of 15 November 1941 met Consolidated's terms. On 22 November, 7 days after the contract's approval, Wright Field Engineering Division concluded that the 6-engine rather than the 4-engine design should be adopted. This posed no problem, since it had been one of the options offered by Consolidated. On 10 December,[10] Model 35 was redesignated Model 36 to avoid confusion with the Northrop "flying wing," by then known as the B-35. There was yet no sign of the difficulties soon to come.

Mockup Inspection — 20 July 1942

After more than 6 months had been spent in refining the chosen design, exerting every effort to control weight, reduce drag, and eliminate the various developmental kinks of a new airplane, the B-36 mockup was inspected. Controversy generated by the inspection nearly caused cancellation of the experimental program. The Mockup Committee wanted to reduce firepower and crew to make the B-36 meet its 10,000-mile range requirement. But some members argued that such changes would render the airplane tactically useless and in fact superfluous, since the Experimental Engineering Division already had a "flying laboratory" (XB-19). If these reductions were necessary, the AAF should stop the project and channel the manpower into more productive bomber programs. The Mockup Committee eventually agreed to delete "less necessary" items of equipment from the aircraft. This reduced weight and saved the future B-36—at least temporarily.

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[10] Three days after the Japanese attack on Pearl Harbor. The United States declared war on Japan on 8 December 1941; on the 11th, Germany and Italy declared war on the United States. The U.S. war declaration was made on the same date.

Development Slippage 1942–1943

A month after inspection of the B-36 mockup, Consolidated suggested shifting the XB-36 project from San Diego, California, to its new government-leased plant in Fort Worth, Texas. Even though the move was completed in September 1942, less than 30 days after being approved by the AAF, development was set back several months. Innumerable problems remained to be solved, but Consolidated asked the AAF to place a contract for a production quantity of the new aircraft. The contractor claimed that 2 years could be pared from the development cycle if preliminary work on production B-36s started without waiting for completion of the experimental planes. Consolidated's request was ill-timed. Military setbacks during 1942, especially in the Pacific, plus the fact that even under the best circumstances the B-36 could not soon become operational, prevented the AAF from diverting scarce resources for its production.

Another Consolidated request in the summer of 1942 fared somewhat better. The AAF agreed to development of a cargo configuration of the XB-36, provided that 1 of the 2 experimental bombers was produced at least 3 months ahead of the cargo plane (referred to as the XC-99). Consolidated actually wanted the XC-99 to test the engines, landing gear, and flight characteristics of the forthcoming XB-36s. The contractor also believed the XC-99 could be ready to fly much sooner than either of the 2 XB-36s because armament and other military gear would be left out. The AAF conditions were accepted, however, and a $4.6 million contract was approved by year's end.[11]

Production Go-Ahead 19 June 1943

While engineers kept on wrestling with weight increases and various developmental troubles,[12] war problems suddenly boosted the importance of the B-36. Military setbacks that had hampered the program in 1942 assumed a new dimension in the spring of 1943 as China appeared near collapse. The

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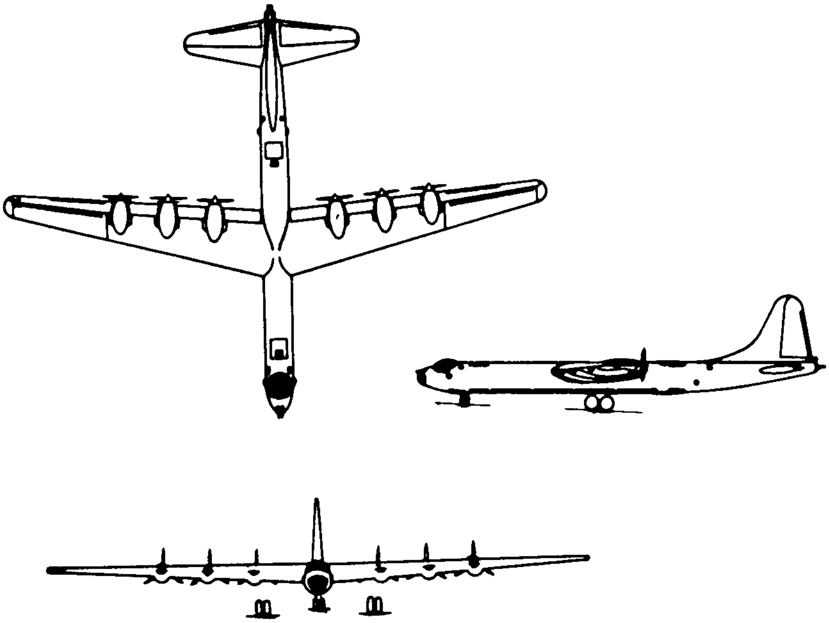
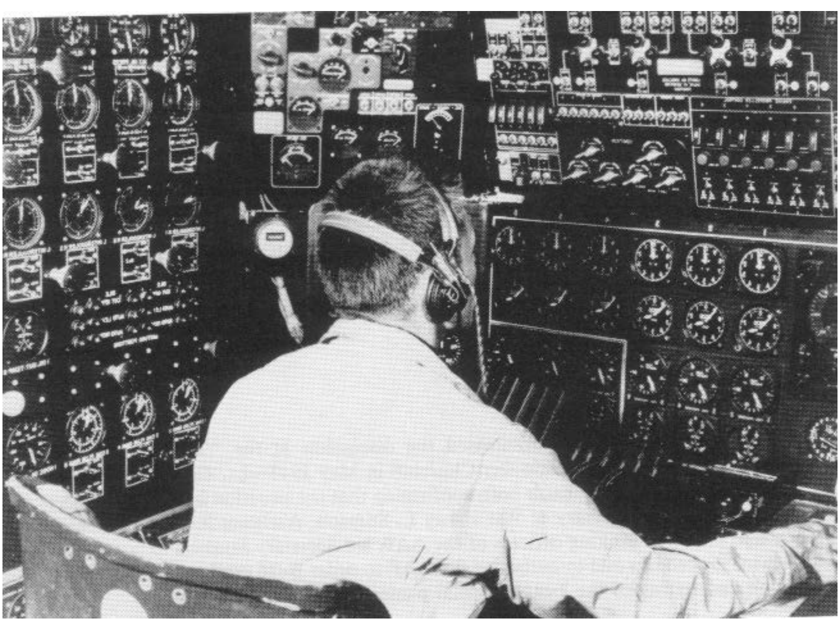
[11] The proposed C-99 could have carried 400 fully equipped troops or more than 100,000 pounds of cargo, but only a single XC-99 was built. It was delivered in 1949 and remained in the inventory until 1957.

[12] The B-36's twin tail was to be deleted in favor of a single vertical one. This would decrease weight by 3,850 pounds, stabilize direction, and lower drag. The modification was approved on 10 October 1943, when the initial development contract (W535 ac-22352) was amended by Change Order No. 7. This change order (previous ones were insignificant) also allowed the contractor a 120-day delay in delivery. So at best the AAF would not get its first XB-36 until September 1944.





A flight engineer at his station in the CONVAIR XB-36.

B-17 and the B-24 had insufficient range to operate over the vast distances of the Pacific. The Boeing B-29 was in the early stage of production, but was experiencing more problems than usual.[13] The parallel development of the Convair B-32 (Consolidated until mid-March), generally considered by AAF as an "insurance plane," in case the B-29 failed, did not progress as well as hoped for. The B-32 seemed much less promising than the B-29, on which higher priorities had been concentrated. Moreover, even if production delays could be overcome, neither of these planes could reach Japan, for battles had to be won before the Mariana Islands could become a base for B-29 or B-32 operations. Speeding up B-36 development might provide a way, possibly the only one, for attacking the Japanese homeland and at least would immediately bolster Chinese morale.[14] Therefore, on 19 June General Arnold[15] directed procurement of 100 B-36s. The order, however, would be cut back or canceled in the event of excessive production difficulties. The AAF letter of intent for 100 B-36s was signed by Convair on 23 July.

New Setbacks — 1943-1944

In spite of its elevated status, the B-36 program made scant progress. Essential wind tunnel tests of the new design were postponed until the spring of 1944, because other projects had retained higher priorities and no alternate testing facilities were available. Meanwhile, besides usual engineering difficulties, Convair was greatly concerned over the growing weight of the Pratt & Whitney X-Wasp engine selected for the experimental B-36. In Convair's opinion, tying the XB-36 to a single engine design was a mistake. Yet, further study of the Lycoming BX liquid-cooled engine (noted for lower fuel consumption) had been discontinued on the belief that development of the BX engine would demand manpower, materiel, and facilities that could not be spared. The AAF also insisted that development of a new engine would only delay "expeditious prosecution"of the B-36 design. In any case,

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[13] Appendix I, pp 482, 484.

[14] The war in the Pacific dominated the discussion at the "Trident" conference of President Roosevelt and Prime Minister Churchill in May 1943—Lt. Gen. Joseph W. Stilwell and Maj. Gen. Claire L. Chennault both confirming that the situation in China was desperate. Ensuing talks between Secretary of War Henry L. Stimson, Assistant Secretary of War Robert P. Patterson, and high-ranking officers of the AAF, led Secretary Stimson to waive customary procurement procedures and to authorize the AAF to order B-36 production without awaiting completion and testing of the 2 experimental planes then under contract.

[15] General Arnold became Commanding General of the AAF in March 1942 and was promoted to 4-star general 1 year later.

before much of anything could be done, the B-36 was relegated to a secondary position. This time, the Convair B-32 had to come first.[16]

Definitive Production Contract 19 August 1944

The letter of intent of 23 July 1943,[17] supplemented by Letter Contract W33-038 ac-7 on 23 August 1943, gave way 1 year later to a definitive contract. This $160 million contract (including a $6 million fixed fee and the cost of all spare parts and engineering data) continued to cover the production of 100 B-36s, but no longer carried any priority rating. Delivery schedules, however, were unchanged. The first B-36 was due in August 1945; the last, in October 1946.[18]

Program Reappraisal 1945

With victory in sight,[19] war contracts were scrutinized for cancellation or drastic cutback. Aircraft production was actually cut by 30 percent on 25 May, a reduction of 17,000 planes over an 18-month period. The review left the B-36 contract untouched. There was no question that a long-range bomber was needed. The proof was in the terrible price paid in lives and materiel to win advanced bases in the Pacific. The atomic bomb, unlikely to remain an American monopoly, was another strategic justification. Inasmuch as U.S. retaliation would have to be quick, there would be no time for conquering faraway bases. And, realistically, a long-range bomber could be the best war deterrent for the immediate future. From the economic standpoint, the B-36 also looked good. It out-performed the B-29 and the

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[16] The military situation in the Pacific improved materially by mid-1944. The Marianas campaign neared its successful conclusion, and the forthcoming use of bases on Saipan, Tinian, and Guam urgently called for medium-range bombers. Production troubles with the B-29 were almost solved, and it was now left to Convair to accelerate the B-32 program. B-36 work would continue, but only as a safety measure.

[17] The U.S. Government was not liable should a letter of intent be canceled. This was not so for the more often-used letter contract which obligated funds.

[18] Not surprisingly, these delivery dates were subsequently changed, as was the $160 million contract— increased by $61 million on 26 August 1946, when Change Order No. 10 was approved.

[19] The German surrender was officially ratified in Berlin on 8 May 1945; Japan surrendered unconditionally on 14 August, but the Japanese Emperor did not sign the Potsdam requirements for surrender until 2 September.

B-35 "flying wing" for long-range missions and was cheaper by half to operate than the B-29 in terms of cost per ton per mile. On 6 August 1945, General Arnold approved the Air Staff recommendation to keep the B-36 production contract intact.[20]

Unrelenting Problems 1945-1946

While the fate of the B-36 program vacillated with changing wartime priorities, the aircraft's development remained painfully slow. By 1945 Convair still worried over the weight of the R-4360-25 engine—Pratt & Whitney's third version of the original X-Wasp. Adding nose guns required extensive rearrangement of the forward crew compartment. A mockup of the new nose section had been approved in late 1944 and would become a prototype nose for the second XB-36. Yet, the radio and radar equipment in the new nose would augment gross weight by at least 3,500 pounds—more, if the antenna of the AN/APQ-7 radar could not be installed in the leading edge of the wing. This and the 2,304-pound increase for the 6 new engines could present a serious problem. Nor was it easy to select wheels for the aircraft's landing gear. The rationale for dual main wheels was simplified maintenance without a need for special tools. The single-wheel type had other merits. These arguments ended in mid-1945 when Maj. Gen. Edward M. Powers, Assistant Chief of Air Staff for Materiel, Maintenance, and Distribution, recommended that a new landing gear be devised to distribute the aircraft weight more evenly, thus reducing the need for specially built runways.[21]

Meanwhile, faulty workmanship and use of substandard materials were discovered in the experimental B-36. AAF inspectors also noted the dearth of qualified workers at the beginning of the project and the failure of the airfoil contour of the aircraft wing to conform to specifications. In fairness to Convair, substituting materials was a generally accepted practice in urgently awaited experimental planes. As for other discrepancies, the contractor was not altogether to blame but promised to correct them promptly. Progress was made, but labor strikes at the Fort Worth plant in

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[20] Lt. Gen. Hoyt S. Vandenberg, then Assistant Chief of Air Staff for Operations, Commitments, and Requirements, advocated formation of 4 "Very Heavy" groups equipped with B-36s to constitute an "effective, mobile task force for our postwar air force." General Vandenberg's recommendation was embodied in the AAF's postwar 70-group program. This program remained a constant, though unreachable goal until the start of the Korean War.

[21] The four-wheel truck-type gear eventually adopted was 1,500 pounds lighter than the one previously considered. It also enabled the B-36 to use any airfield suitable for the B-29.

October 1945 and in February 1946, a normal part of postwar adjustment, delayed the program for several months. On 25 March General Powers indicated that the structural limitations of the forthcoming XB–36 might make it useless, other than as a test vehicle for the initial flight.

First Flight — 8 August 1946

In spite of every effort, the all-metal, semimonocoque XB–36 did not fly until almost 6 years after signature of the development contract. The initial 37-minute flight of 8 August was deemed successful, but the wing flap actuating system and the aircraft's overall performance fell below the original expectations. Besides its known structural limitations, the XB–36 had an already obsolete single-wheel landing gear, carried only a minimum of components, and lacked the nose armament designed for the second XB–36. Still, a beginning had been made. After being grounded in late 1946 for modification, the XB–36 was test-flown for 160 hours by pilots of the Air Materiel Command (AMC).[22] The plane was then sent to the contractor for further testing,[23] and the United States Air Force (USAF)[24] retrieved it in mid–1948. As predicted by General Powers, the experimental B–36 had limited operational value and was used by the Strategic Air Command (SAC)[25] for training.

Third Program Review — December 1946

On 12 December 1946, General Kenney, who had been promoted to 4-star general in March 1945 and headed SAC since April 1946, suggested reducing the procurement contract for 100 B–36s to a few service-test

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[22] The lineage of AMC reflected the many reorganizations following the establishment on 17 July 1944 as the AAF Materiel and Services Command (Temporary), the parent organization. On 31 August 1944, the Materiel and Services Command (Temporary) became the AAF Air Technical Service Command, which became the Air Technical Service Command on 1 July 1945. AMC was created on 9 March 1946, and on 1 April 1961, it became Air Force Logistics Command.

[23] Convair pilots made 53 test flights with the XB–36 (Serial Number 42–13570), logging a total of 117 flying hours.

[24] The United States Air Force was established on 26 July 1947, when the National Security Act of 1947 became law. It began functioning as a separate service, coequal with Army and Navy, on 18 September 1947.

[25] The Strategic Air Command was established by the Army Air Forces on 21 March 1946.

aircraft. After studying available performance estimates on the B-36, the SAC Commander believed it to be inferior to the forthcoming B-50,[26] a Boeing development of the famed B-29. The B-50 and the B-36 were to become the only 2-piston-powered bombers produced in the postwar era of jet bombers. Among the B-36 shortcomings cited by General Kenney were a useful range of only 6,500 miles, insufficient speed, and lack of protection for the bomber's gasoline load. Neither the Air Staff nor Lt. Gen. Nathan F. Twining, Air Materiel Command Commanding General, agreed with General Kenney.

General Twining said that the B-36 could not be judged from the XB-36, which had just entered testing. All new airplanes encountered developmental problems, as exemplified by the B-17 and other successful aircraft. Moreover, many improvements could soon be expected, and the B-36 was the only suitable aircraft far enough along to serve as an interim long-range atomic carrier until the B-52 arrived.[27] Gen. Carl Spaatz, the AAF's new Commander, wholly agreed with General Twining. Thus once more, the B-36 contract was retained in full.

Engine and Other Improvements December 1946–July 1947

Even though the B-36 program seemed to undergo one crisis after another, engineers kept on forging ahead. By mid-1947 Convair was confident that the 4-wheel landing gear would be ready for the first B-36 production model (B-36A). And while this B-36A and 21 others would retain the R-4360-25 engine of the XB-36, conversion of this engine had been approved in December 1946. The new water-injection R-4360-41 engine with its 3,500 horsepower (500 more than the -25 engine) would allow ensuing productions (B-36Bs) to take off within a shorter runway distance. It would also yield slightly better performance at both high and cruising speeds. Nevertheless, more improvements appeared in order. Hence, an even more powerful version of the R-4360 engine, fitted with a variable

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[26] Known as the B-29D in July 1945, when 200 were ordered. This number was almost immediately reduced to 60. The future B-29D was redesignated B-50 in December because the many design changes resulted in a nearly new airplane. Except for the B-36, the B-50 was the only piston-powered bomber produced in the postwar era of jet bombers.

[27] General Twining also argued that the normal desire for the best could be deceiving. Keeping pace with the speed of technological advances was a tricky business. The Boeing B-52, then in the design stage, would probably become a better plane than the B-36, but a promising development could not be abandoned every time a better one appeared on the horizon.

discharge turbine (VDT), was under development.[28] Convair claimed that the VDT engine (also proposed for the B-50) would give the B-36 a top speed of 410 miles per hour, a 45,000-foot service ceiling, and a 10,000-mile range with a 10,000-pound bombload. To offset the cost of adapting the VDT engine to the B-36, Convair suggested financing the airframe modification for 1 prototype B-36 with the VDT engine by slashing 3 B-36s from the current procurement contract. This was approved by the Commanding General, AAF, in July 1947. Although Convair hoped additional VDT-equipped B-36s (B-36Cs) would be ordered if the prototype proved successful, a decision on this matter was deferred.

Fourth B-36 Reappraisal — August 1947

The creation of an independent Air Force obviously meant more authority and greater responsibility in the choice of basic weapon systems. General Vandenberg, Deputy Chief of Air Staff,[29] therefore wasted no time in forming the USAF Aircraft and Weapons Board. Through this forum, senior officers would recommend the weapons that would best support long-range plans for the Air Force's development and gradual buildup. The board first met on 19 August and, because of the advent of the atomic bomb, the role of strategic bombing and the means of accomplishing such missions took precedence. The B-36 was the only bomber that could launch an immediate atomic counterattack without first acquiring overseas bases. Although vulnerable to enemy fighters because of its fairly low speed, the B-36 did offer an important advantage: its great range would promote the crew's chances of completing their mission. On the other hand, future supplies of atomic bombs were expected to be sparse. Hence, plans had to cover the possible use of conventional bombs.[30]

The board members differed on how to solve these complex problems. Some considered the B-36 obsolete and favored buying fast jet bombers—an obvious gamble since these would have insufficient range and would not be available for years. Others wanted to increase the B-36's speed with the new

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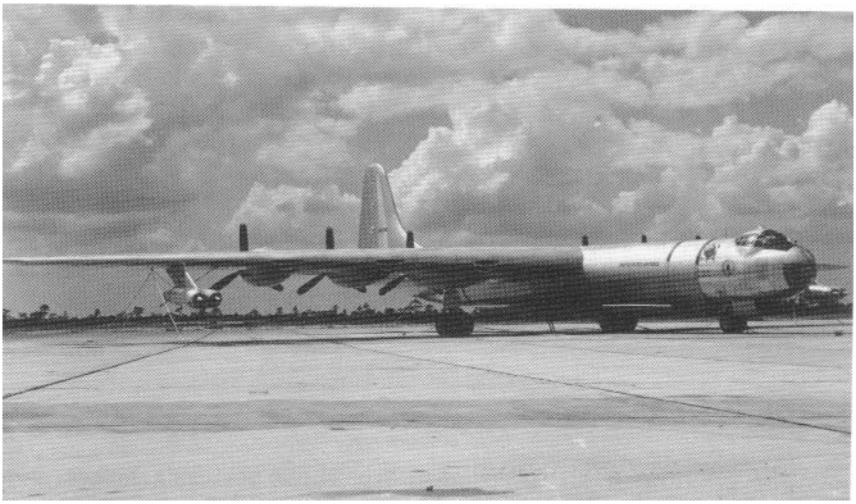
[28] Convair also offered in February 1947 to install 8 Curtiss-Wright T-35 gas turbine engines in one B-36. The installation was expected to cost less than $1.5 million and to be completed by April 1948. The proposal was turned down. The T-35 engine was too far in the future for the B-36, and the Curtiss-Wright delivery estimates were overly optimistic.

[29] General Vandenberg became Vice Chief of Staff of the United States Air Force, with 4-star rank, on 1 October 1947.

[30] Large stocks of wartime B-29s were still in the inventory for economic reasons, although the Superfortress's range was inadequate without overseas bases.



B-36 Peacemaker at Eglin AFB, Florida, September 1950.

VDT engine and also use it as an all-purpose bomber. Still others preferred the B-50, because it was faster than the B-36 and could attain even greater range and speed with the addition of VDT engines. After prolonged discussion, a consensus emerged to retain the B-36 as a special purpose bomber. This special purpose B-36 would eventually be replaced by the B-52,[31] if the latter proved satisfactory and no better means for delivering the atomic bomb came on the scene. Since the endorsed B-36 would be for specialized use, there were several reasons for not installing the VDT engine in a prototype B-36. No additional B-36 procurement would be needed. And even though the promised improvements were tempting, any retrofit with VDT engines would delay completion of the 100 B-36s on order and run up costs. General Spaatz[32] promptly approved the board's recommendations and the VDT-equipped B-36 prototype was canceled on 22 August.

Unsolved Dilemma — 1947

Concern with weapon selection left many problems unanswered. Limited B-36 procurement was one solution; finding some use for the

[31] At best not to be expected before 1953.

[32] In September 1947 General Spaatz was appointed by President Truman as the first Chief of Staff of the new United States Air Force.

government-owned Fort Worth plant, soon to be idle, was another problem. The Air Force could not stand by as Convair's dejected B-36 work force sought and probably secured more stable employment before completion of the B-36 program.[33] There were further complications. Funds had been appropriated during the war for the 100 B-36s, but any amount unspent by the end of June 1948 would have to be reappropriated by a Congress that might be of a different mind. Production speedup was one solution. If Convair turned out 6 aircraft every month, the hundredth B-36 would be delivered in January 1949. This would leave but 7 months of production (July 1948-January 1949) for which new funds would have to be provided. Chiefly because of shortages of government-furnished equipment, accelerating production proved impossible.[34] This was just as well since it would have hastened the end of the Fort Worth activities. But the monthly production rate of 4 B-36s, as later endorsed, carried another pitfall—post-

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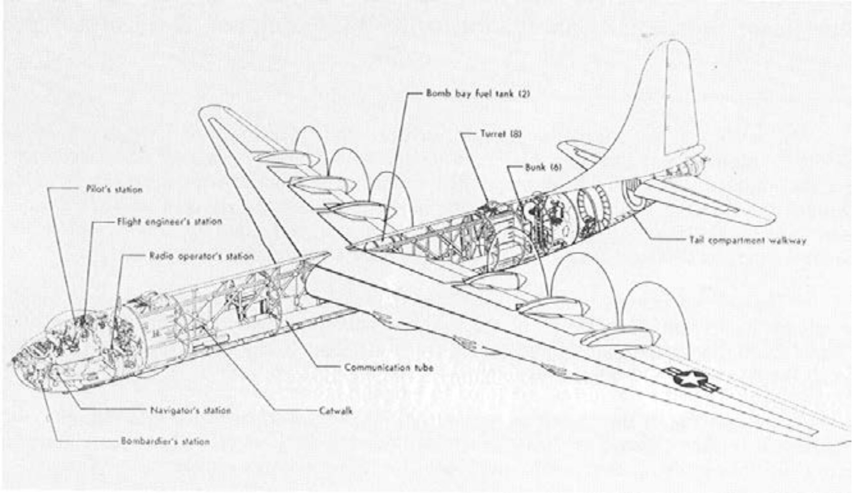
[33] In mid-1948 the Air Force convinced Northrop that production of the future RB-49 (a development of the experimental YB-49 "flying wing") should be sub-contracted to Convair. To begin with, this would keep the Fort Worth plant in operation upon completion of the B-36 program. Of perhaps greater import, this cooperation would blend Northrop's engineering skill and Convair's experience in quantity production of large aircraft. Cancellation of the RB-49 project in January 1949 wiped out all this planning, although Northrop received a go-ahead from Air Materiel Command for completion of a YRB-49 prototype, which was extensively flight-tested.

[34] Production was also slipping (and more delay later occurred) because of defective propellers, landing gear door problems, corroded hinges, unsatisfactory magnesium castings, deficiencies in turret installations, and occasional malfunctions of the constant speed drive. Meanwhile, the government was spending $150,000 a day to keep the plant operating.



poning delivery of the last B-36 to November 1949. This would extend by 10 months the production time for which Convair would have to plan with no assurance that money would ever be available to complete the program.[35] Aware of the contractor's predicament, the Air Force in late December 1947 promised to request a reappropriation of B-36 funds when Congress reconvened in early 1948.

First B-36A Delivery — 30 August 1947

This B-36A and the next 12 productions were known for a while as YB-36As. All, save the first one, eventually reverted to the B-36A designation (some even before leaving the production line). The exception was earmarked for static tests.[36] This decision had been made in mid-1946, after a convincing argument by General Twining. The general admitted that much might be known about a given structure, but deemed it wise to static test one to destruction.[37] He said, "Experience has shown that we would have been unable to use our bombers efficiently had we not had this policy in effect in the past. The B-17, originally designed for a gross weight of 37,000 pounds, fought the war flying universally at 64,000 pounds. This could never have been done without accurate knowledge of the strength of the component parts."

Contractor New Proposal — 4 September 1947

The post-World War II years spelled trouble for the aircraft industry. Competition was fierce, and no contractors could afford to forego any significant prospects. Cancellation ofthe VDT-equipped B-36 prototype,

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[35] Convair was responsible for payment of work under subcontracts. Payments incurred before the expiration of a prime contract (30 June 1948 in the B-36's case) could be recovered, but the contractor's capital would remain tied up during the long drawn-out process of going through the Court of Claims. The other alternative (and one the Air Force certainly did not want) was for Convair to throttle down the flow of supplies, trim plant operations, and lay off workers until the financial future of the B-36 program was straightened out.

[36] Hence, the plane could dispense with various items of still hard-to-get or highly unreliable equipment. Completion of the true productions was another story. Delivery of a second B-36 slipped another 8 months, and the last B-36A (of 22 finally produced) did not reach the Air Force until September 1948.

[37] Static testing is the testing of an aircraft, missile, or other device in a stationary or hold-down position, either to verify structural design criteria, structural integrity, and the effects of limit loads, or to measure the thrust of a rocket engine or motor.

therefore, did not deter Convair from reopening the project a few weeks later. The contractor this time proposed to offset the cost of installing VDT engines in the last 34 of the 100 B–36s under contract by simply reducing the contract's total to 95. No extra money would have to be found, other than enough to cover necessary government-furnished equipment. Convair further offered to produce the new B–36s (B–36Cs) without delaying the current contract by more than 6 months (November 1949–May 1950). The possibility of retrofitting the remaining B–36A and B–36B aircraft was suggested, inasmuch as both types were much nearer completion. Afforded immediate attention, the Convair proposal of September 1947 was approved on 5 December, except for retrofitting the 61 B–36s, which could be dealt with later. SAC alone totally disagreed, having lost faith in the B–36 as a long-range bomber. As a whole, SAC officials generally believed the relatively slow aircraft could better serve in such tasks as sea-search and reconnaissance. For these purposes, General Kenney emphasized, the extra speed promised by the VDT engines was of no real importance. As it turned out, mating the VDT engine with the B–36 failed completely.[38] The project died in early 1948, but not without repercussion.

First Flight (YB–36) — 4 December 1947

This plane (Serial No. 42–13571), the second of the 2 experimental B–36s ordered by the AAF, had been chosen as the production prototype on 7 April 1945.[39] It was equipped with few components, but featured the many configuration changes so far approved.[40] Convair was expected to retain the YB–36 for 6 to 12 months to test its configuration and identify future production line changes. During its third flight on 19 December 1947, the YB–36 reached an altitude of more than 40,000 feet—a rewarding event at the time. Nevertheless, it stayed with Convair much longer than anticipated and was not accepted by the Air Force until 31 May 1949. The aircraft reached SAC in October, but was returned to Convair 1 year later (October

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[38] There was nothing wrong with the engine itself (it was the basic R–4360 used in other B–36s), nor with the variable turbine that boosted the engine power. The problem stemmed from the cooling requirements (generated by the aircraft's high-operating altitude), which degraded the engine's rated performance.

[39] Following approval of Change Order No. 11 to the initial contract of November 1941. This order also relegated complete performance tests to the second B–36A production (temporarily designated YB–36A and due to be fully equipped).

[40] Included were new landing gear, bubble canopy (for better vision), reversible pitch props, nose guns, and redesigned forward crew compartment.

1950) to be fitted for reconnaissance. The YB-36's operational life ended after 2,050 flying hours.[41] In the spring of 1957, it was placed in the Air Force Museum at Wright-Patterson AFB, Ohio.

Fifth Near-Cancellation April–June 1948

When it became obvious that a faster B-36 (equipped with VDT engines and due to be known as the B-36C) could not be obtained, the Air Force once more thought of canceling the entire B-36 program. Yet, various factors had to be considered. Twenty-two of the basic and relatively slow B-36s were nearly completed, and a great deal of money had already been spent on the controversial program. The Air Force, therefore, decided to postpone any decisions. It instructed the Air Materiel Command to waive the modification of several shop-completed B-36s that had been awaiting adjustments, and to expedite their delivery. This would allow Convair to speed up the aircraft's flight test program, as consistently recommended by the Air Force. In addition, new yardsticks were established to compare the basic B-36's performance with that of other bombers under similar conditions. The new yardsticks measured the 4 most important and interdependent characteristics of any given bomber— speed, range, altitude, and load capacity.

Test results, although not spectacular, favored the basic B-36. They showed that the slow B-36 surpassed the B-50 in cruising speed at long range, had a higher altitude, larger load capacity, and a far greater combat radius than the B-50 or B-54—a B-50 variant then being considered, but canceled in 1949. It now seemed that the B-36 might become a much better plane than had been expected. If so, any hasty reduction of the contract might wreck the program just as it was about to pay off. The beginning of the Russian blockade of West Berlin on 18 June 1948 spared the Air Force further indecision. On the 25th, Air Force Secretary W. Stuart Symington and other top USAF officials, deeply concerned by the Soviets' aggressiveness, unanimously agreed to stay with the B-36.[42] The proposed VDT-

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[41] Thirty-six Convair test flights accounted for 97½ hours; Air Force pilots flew the remainder.

[42] The Berlin blockade of June 1948 came at the time the administration decided to give high priority to building an atomic deterrent force. The crisis increased the decision's urgency, and the concurrent cancellation of any important military program would have been psychologically unsound. Finally, the B-36 was the only intercontinental bomber available, and its shortcomings, whatever they were, were not that obvious. These facts undoubtedly prompted General Kenney to join in the decision, even though a month before he had still recommended that the B-36 production be halted.

equipped B-36C (34 of them) would revert to the B-36B configuration, assuring the Air Force of getting 95[43] of the 100 B-36s under contract since June 1943.

Initial Delivery — 18 June 1948

This B-36A, officially accepted by the Air Force in May 1948, was delivered on 18 June to the Air Force Proving Ground Command[44] to undergo extensive testing. It was a true production aircraft, whereas the first B-36A (accepted in August 1947 and permanently designated as the YB-36A) had few components, was stripped of its engines, and never went past static testing.

Enters Service — 26 June 1948

SAC's 7th Bomb Wing at Carswell AFB, Texas, received the first 5 B-36As.[45] These and ensuing B-36A deliveries were unarmed and were used mainly for training and crew conversion. They did not join the operational forces until converted to the reconnaissance configuration.

Total B-36As Accepted — 22

Included in this total was the first B-36A (YB-36A) that had been earmarked for static tests.

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[43] There could be no B-36Cs, but the 5-aircraft reduction remained necessary to meet the price rise and to pay for the ill-fated VDT engine installation.

[44] At Eglin AFB, Fla.

[45] By that time, the very heavy bomber designation, previously applied to the B-36, had been dropped. The change dated back to 18 September 1947 (the same day the United States Air Force started functioning as a separate service), when all USAF bombers had been reclassified into 3 categories. In effect, range, rather than weight, had become the primary classification factor. Hence, bombers with an operating radius of more than 2,500 miles were categorized as heavy; those with an operating radius between 1,000 and 2,500 miles were medium bombers, and all those with operating radius of less than 1,000 miles were designated as light bombers. Under these provisions, the B-36 and B-52 became heavy bombers; the B-29, B-50, B-47, and B-58, medium bombers; and the B-45, B-57, and B-66, light bombers.

Acceptance Rates 1947–1949

The Air Force accepted the first B-36A (YB-36A) in August 1947 and 20 other B-36s in 1948—1 in May, 5 in June, 5 in July, 4 in August, and 5 in September. The twenty-second and last B-36A was accepted in February 1949.

End of Production September 1948

Five months before the last acceptance.

Flyaway Cost Per Production Aircraft $2.5 million

This prorated figure reflected the original contract cost for 100 B-36s, as amended on 26 August 1946. It did not include the post-production cost of reconfiguring each B-36A for reconnaissance.

Subsequent Model Series B-36B

Other Configurations RB-36E

All RB-36Es were converted B-36As. The YB-36, first flown 4 December 1947, was fitted for reconnaissance in lieu of the YB-36A, bringing the RB-36E total to 22. During the reconfiguration, the B-36A's 6 R-4360-25 engines were replaced by 6 R-4360-41s—the more powerful engines already installed in the B-36Bs. Equipped with cameras like the K-17C, K-22A, K-38, and K-40, the RB-36E also received some of the B-36B's more advanced electronics. The E-model featured equipment vital to its intrinsic missions—all-purpose strategic reconnaissance, day-and-night mapping and charting, as well as bomb damage assessment. Its normal crew was 22, which included 5 gunners to man the 16 M-24A1 20-millimeter guns.

Phaseout 1950–1951

Convair began adapting the B-36A to the reconnaissance configuration in early 1950. The B-36A's phaseout was fairly fast, the Air Force taking delivery of the last RB-36E in July 1951.

Milestones — 30 June 1948

A B-36A dropped 72,000 pounds of bombs during a test flight on 30 June, demonstrating the aircraft's vast capacity.

B-36B

Previous Model Series — B-36A

New Features

In the B-36B, R-4360-41 engines with fluid injection supplanted the B-36A's R-4360-25s. The B-36B also offered better and more electronics equipment, including the AN/APQ-24 bombing-navigation radar (substituted for the B-36A's APG-23A). The B-36B could carry 86,000 pounds of bombs (a 14,000-pound increase). Of greater importance, it could carry atomic bombs weighing perhaps as much as 43,000 pounds.[46] Eighteen of the B-36Bs could handle remote-controlled VB-13 "Tarzon" bombs (2 per bomber).

First Flight — 8 July 1948

The plane, flown by Convair, performed well—far better than expected. Several later tests by Convair and AMC pilots showed more rewarding results. On 5 December 1948, a long-range mission of 4,275 miles was flown at high altitude. Save for climb and descent, an average cruising speed of 303 miles per hour was maintained during the entire 14-hour flight at 40,000 feet. This was surpassed during a similar mission on 12 December, when the average speed rose to 319 miles per hour. Then on 29 January 1949, a B-36B dropped two 43,000-pound bombs on a practice target, the first from 35,000 and the second from 40,000 feet.

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[46] The bombs were 364 inches long and had a diameter of some 54 inches. To carry these bombs internally, bomb bays needed to be rearranged. Although approved in 1945 as the "Grand Slam Installation," this modification did not reach the production line until all B-36As had been built. There were good reasons for the delay. When B-36 production first started, the high secrecy given to the atomic bomb kept the necessary engineering specifications from reaching the contractor. The Air Force at the time did not know how many atomic bombs were available, and lacked other data on which to base firm carrier requirements. The B-36As could have been retrofitted to carry the crucial weapons, but the modifications appeared senseless since these early bombers were highly deficient.

Enters Operational Service — November 1948

The B-36Bs joined the B-36As of SAC's 7th Bomb Group at Carswell AFB in November 1948. On 7-8 December, one of these new B-36s flew a nonstop, round-trip, simulated bombing mission from Carswell to Hawaii. On the way back, the aircraft's 10,000-pound bombload was dumped a short distance from Hawaii. The distance flown in 35½ hours exceeded 8,000 miles.[47] Yet, because many "bugs" had to beworked out, the B-36 did not become truly operational until several years later. In 1951, many B-36s were available and, if called upon, were capable of accomplishing their long-range, high-altitude bombing mission, with either conventional or special weapons. However, the aircraft were in a constant state of flux, either being reconfigured or awaiting modification. In reality, full operational capability was not achieved before 1952.

Additional Procurement — 1949

The Air Force possessed 59 groups in the fall of 1948, when the B-36 was just entering the SAC inventory. The soundness of the postwar 70-group objective had been confirmed,[48] and a 66-group force seemed possible within a near future. Hence President Truman's decision to hold the 1949 defense budget to a ceiling of $11 billion had been a drastic blow.[49] The job of rebuilding the Air Force had to be done all over again, and this time from the opposite direction. The problem was no longer how to procure additional airplanes for 70 groups, but how to whittle current forces to 48 groups with the least possible harm to national security. Canceling the aircraft already on order, with minimum loss to the government, was the other difficult task facing the Air Force in early 1949. The B-36 actually gained from the crisis. The Air Force canceled the purchase of various bombers,

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[47] A B-50, another of SAC's newly assigned bombers, made the flight over a much longer route of 9,870 miles in 41 hours and 40 minutes, receiving 3 inflight refuelings from KB-29 tankers.

[48] A Civilian Air Policy Commission (headed by Thomas K. Finletter) was established by the President in 1947. At the same time, a Joint Congressional Aviation Policy Board was formed. Both thoroughly investigated the weaknesses of the Air Force as it began functioning as a separate service. The 2 reports (published on 1 January and 1 March 1948 respectively) recommended orderly but prompt expansion of the forces towards a minimum goal of 70 groups.

[49] The $14 billion budget was to be parceled almost equally among the 3 military services. This prompted Secretary Symington to compare it to throwing a piece of meat into a lion's den and letting the animals fight over it—a remark fully justified by later events.

fighters, and transports in mid-January. At the time, however, it endorsed the urgent procurement of additional B-36s,[50] as recommended by Gen. Curtis E. LeMay, SAC's Commanding General since October 1948. A second augmentation of the program was approved in the spring, when RB-54s were canceled in favor of still more B/RB-36s, as again recommended by General LeMay.[51] The President authorized the recertification and release of funds for the first increase on 8 April; for the second, on 4 May.

Sixth and Last Near-Cancellation 1949

Curtailment of the defense budget brought interservice disagreements to a boil. The Air Force and the Navy had long recognized that whichever service possessed the atomic mission would eventually receive a larger share of the budget. Thus, they had grown more and more wary of each other's strategic programs. Meanwhile, the B-36 atomic carrier had been the target of much criticism, even though few people had seen it—let alone flown it.[52] In early 1949, the B-36's censure grew ominous and could not be brushed aside. An anonymous document began making the rounds in press, congressional, and aircraft-industry circles charging that corruption had entered into the selection, and that the aircraft's performance did not live up to Air Force claims. In August, a second unsigned paper accused the Air Force of having greatly exaggerated the importance of strategic air warfare. The charges of corruption and favoritism were investigated by the Armed

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[50] The Air Force proposed to spend $172 million (of some $270 million released by the cancellation of other aircraft) to buy 39 additional B-36s and to improve or reconfigure those already under contract. This was in line with General LeMay's testimony before the Board of Senior Officers hastily convened on 29 December 1948 by General Vandenberg, who had replaced General Spaatz as Chief of Staff of the Air Force on 30 April 1948. General LeMay insisted that the safest course called for an increase of 2 groups of B-36 heavy bombers (at the expense of 2 medium bomb groups), plus 1 strategic reconnaissance group of B-36s (in lieu of RB-49s).

[51] General LeMay was sure that the B-36 could do everything as well as, and in most cases better than, the B-54. The big B-36 required more parking apron space, but this was not a serious problem. Its maintenance so far had been surprisingly easy. Therefore, it was not impossible to raise the 18-aircraft authorization of every B/RB-36 group to the 30-aircraft level of each medium bomb group. This would slash personnel costs and boost SAC's offensive power. A larger B-36 fleet, General LeMay asserted, together with the approved stepped-up production of Boeing's forthcoming B-47, was the best strategic way to face the near future.

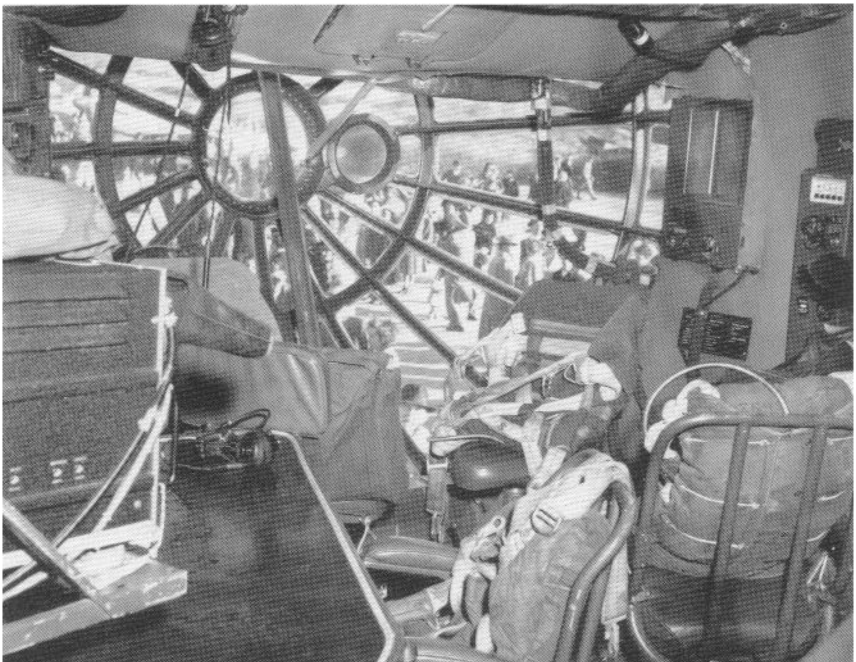
[52] The B-36 had been accused of being as slow as the ancient B-24 and far more vulnerable. Some critics claimed that under the most favorable conditions it would take up to 12 hours to ready the aircraft for flight. Others, with obvious relish, wrote that the connecting tunnel between the B-36's pressurized cabins was too small for a fat sergeant.

Services Committee of the House of Representatives and quickly proven false. On 25 August the investigation closed, after completely clearing the Air Force. However, hearings on the B-36 resumed in October. Briefly stated, the committee had to decide, at least for the time being, whether the nation should rely on massive retaliation with intercontinental bombers in case of attack, or depend upon the Navy's fleet and air arm to defend the North American continent. Even though there were doubts about the B-36's ability to evade fighters, the Air Force emerged triumphantly from the October debates. Yet, the argument between the 2 services over roles and missions was far from settled.[53]

Initial Deficiencies 1949-1950

In contrast to the B-36As, the B-36Bs were equipped from the start

[53] August 1949 amendments to the National Security Act of 1947 had enlarged and strengthened the Office of the Secretary of Defense and severely weakened the authority of the service secretaries. Interservice rivalry nevertheless persisted.



The front section of a B-36, which accommodated the navigator, bombadier, radar operator, and nose gunner.

with remote retraction turrets and 20-millimeter guns. Unfortunately, this was no asset. The B-36Bs in their original configuration would be long gone before either the turrets or guns worked properly.[54] Also, the R-4360-41 engines of the B-36Bs demanded extra fuel tanks. Even though the new bomb-bay tanks were supposedly self-sealing, their leaks lasted throughout the B-36B's short life.

Other Problems 1949–1950

Many of the B-36B's initial troubles resembled those of any other new aircraft. Minor adjustments were needed and— as so often the case—parts shortages were acute. Although the Air Force frowned on cannibalization as never affording a lasting solution, stripping parts from one B-36 to keep another flying became fairly common. Shortages of equipment, such as empennage stands, dollies, jacks, and related items, hampered maintenance. Because there was no money for new equipment, maintenance crews utilized as well as they could some of the tools used for the old B-29s. Personnel turnover further hampered progress. All these problems persisted through 1950.

Post-Production Conversions 1950–1951

Even though the B-36's performance since mid-1948 kept on exceeding early expectations, the aircraft's relatively slow speed continued to cause concern. Tests had shown that altitude was very important in protecting a bomber.[55] Nonetheless, a bomber putting on a burst of speed over a target

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[54] The B-36's defensive armament system, furnished by the government, was designed and built by General Electric according to Air Materiel Command specifications. At first, obvious gun and turret defects postponed the system's installation. Then, lack of ammunition, also government-furnished, delayed testing until mid-1949. And, obviously, the guns had to be air-fired before remaining deficiencies could be found and corrected. As the Eighth Air Force Commander bluntly put it in February 1950: "There is no use driving a B-36 around carrying a lot of guns that don't work."

[55] Locating, intercepting, and shooting down a bomber flying at 40,000 feet was not easy, even if the bomber's speed was no faster than that of the B-36B with its 3,500-horsepower engines. General Kenney had long been disenchanted with the B-36, but admitted in an October 1948 interview, "How are you going to shoot down a bomber at night flying at 40,000 feet with a solid overcast?" Most likely, General Kenney's words could be challenged. During World War II, the Luftwaffe had caused heavy attrition of the Royal Air Force's Bomber Command over the night sky in Europe. On the other hand, it should be noted that General Kenney's interview was conducted on the eve of the Armed Services Committee investigation of the B-36. The Air Force could hardly belittle an aircraft which had acquired a symbolic dimension in the Air Force's and Navy's dispute over the atomic mission.

or while under attack increased its chances of survival. This could have been achieved with the substitution of VDT engines, had this project not failed. A step-up in speed could also be gained, Convair insisted, by mounting 2 General Electric turbojet engines under each of the B–36's wings. These engines could be cut in to boost the power of the B–36's regular ones. Using the proven twin jets already selected for the future B–47 would trim development and testing, while raising the B–36's top speed over the target from 376 to 435 miles per hour. Unlike the extensive changes needed to install the VDT engines, only minor modifications of the aircraft would be required to mount wing nacelles. In fact, Convair was confident that a prototype B–36 with jet-assist engines would be ready to fly less than 4 months after Air Force approval.

The Air Force did not question the merits of the jet pod installation proposed by Convair as early as October 1948. Approval was delayed because of the budgetary restrictions looming in December 1948 and the decision a month before to convert some B–36s for reconnaissance. A prototype B–36 with jet pods was not authorized until 14 January 1949—far too late to allow changes on the B–36B assembly line. Hence, B–36Bs that had barely become operational had to leave the inventory to be equipped with jet pods. But the modification was simple, and most of them soon rejoined the SAC forces as B–36Ds. Eight of the aircraft were also brought up to the reconnaissance configuration, becoming RB–36Ds.

Total B–36Bs Accepted — 62

Convair actually built 73 B–36Bs, but the Air Force directed modification of 11 prior to formal acceptance. Four of the 11 appeared on USAF rolls as B–36Ds, and 7 as RB–36Ds.[56]

Acceptance Rates

The Air Force accepted 31 B–36Bs in fiscal year (FY) 1949; 30 in FY 50, and a last one in September 1950 (FY 51).

End of Production — September 1950

With delivery of the sixty-second B–36B.

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[56] Convair kept on listing the planes as B–36Bs. Consequently, the Convair B/RB–36D production totals never did match the USAF B/RB–36D acceptances. These discrepancies resulted from different accounting methods and proved of no real importance.

Flyaway Cost Per Production Aircraft **$2.5 million**

As in the B-36A's case, this was a prorated figure based on the estimated procurement costs of 100 B-36s. The price the Air Force paid to bring the B-36B to the B-36D configuration as well as other post-production modification expenses were not included.

Subsequent Model Series **B-36D**

Phaseout **1951**

The B-36B phaseout was fast, almost as quick as that of the B-36A. Twenty-five B-36Bs were already undergoing conversion during the first half of 1951.

B-36D

Previous Model Series — B-36B

New Features

The B-36D featured 2 pairs of J47-GE-19 turbojets (in pods, beneath the wings) to assist the basic 6 R-4360-41 engines; K-3A bombing and navigation system (in lieu of B-36B's APG-24 radar)[57] to allow a single crew member to act as radar operator and bombardier; AN/APG-32 radar (instead of APG-3) to control the tail turret; and higher takeoff and landing weights (370,000 and 357,000 pounds, respectively).[58] The aircraft was fitted with snap-action bomb-bay doors, as opposed to the sliding type of the preceding B-36As and Bs. The new bomb-bay doors opened and closed in 2 seconds.

First Flight (YB-36D) — 26 March 1949

Flown even sooner than Convair expected, the prototype B-36D was a converted B-36B. It differed notably from ensuing B-36Ds by carrying in its pods 4 Allison J35 jet-assist engines, in place of the later standard J47-GE-19s.

First Flight (Production Aircraft) — 11 July 1949

The first true B-36D flew on 11 July 1949, but the Air Force did not accept any of these aircraft for another year.

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[57] The K-1—not the K-3A—at first equipped most B-36Ds (new productions as well as converted B-36Bs). This K-1 system was little more than a refined APQ-24. It likewise had its share of problems, chief among them the random failure of vacuum tubes. In fact, soon after the B-36s entered the inventory, more than 25 percent of their aborts were due to radar deficiencies.

[58] Forty thousand more takeoff pounds than the B-36B and a 29,000-pound landing weight increase.

Enters Operational Service 1950

The first B-36Ds accepted by the Air Force in August 1950 went to Eglin AFB for testing, but SAC received some of the new productions much later. By December, the command's operational bombers included 38 B-36s—several B-36Ds and about 24 B-36Bs (soon to be brought up to the D configuration). The aircraft equipped units of the Eighth Air Force's 7th Bombardment Wing.

Overseas Deployments 1951

Except for the sole B-36 simulated bombing mission to Hawaii in December 1948, no B-36s were flown overseas before 1951. Then on 16 January, 6 B-36Ds went to the United Kingdom, landing at Lakenheath Royal Air Force Station, having staged through Limestone AFB, Maine. The flight returned to Carswell on 20 January. A similar flight was made to French Morocco on 3 December, when 6 B-36s of the 11th Bombardment Wing touched down at Sidi Slimane, having flown nonstop from Carswell.

Remaining Deficiencies 1951

Despite 2 years of engineering test flights and high priority modifications, many of the problems in early productions remained unsolved.[59] Undoubtedly, progress was being made through gradual changes and carefully devised fixes. The aircraft were nearly combat ready by 1951, but far from perfect. In October, for example, the B-36's gunnery system remained operationally unsuitable. In fact, SAC viewed the "gunnery and defensive armament as the weakest link in the present B-36 capability."

Operational Improvements 1952–1953

Improved containers and better sealants reduced fuel tank leakages.

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[59] An early major B-36 problem was the recurring leaks in the aircraft's fuel system. The unreliable electrical system and the dangerous flight conditions that could result were also of deep concern through the end of 1949. Engine troubles were still frequent in 1950, compounded by the fact that an engine malfunctioning at a given altitude could check out in perfect order on the ground. Hence, the Air Force on 15 September approved a SAC request for "immediate procurement and installation of airborne ignition analyzers together with necessary spares and supporting equipment for all B-36, B-50, and C-124 type aircraft assigned to this command."

Changes in the electrical system had pared fire hazards during ground refueling operations. Landing gear and bulkhead failures were almost totally corrected. Nevertheless, the Air Force was not satisfied. In April 1952 it ordered a series of gunnery missions for both B-36 and RB-36 aircraft. Known as Far Away, this test was completed in July. It showed that malfunction of the B-36's defensive armament system was due in part to poor maintenance and gunnery crew errors.[60] This prompted Test Fire, a field service exercise begun in September by a RB-36 squadron of the 28th Strategic Reconnaissance Wing. Test Fire ended in December, having attained its main purpose of helping to standardize maintenance and operational procedures.

As anticipated by the Air Force, Test Fire also confirmed the overall conclusion of Fire Away that the B-36's defensive armament was nearly as bad as ever. Various pieces of equipment needed to be redesigned and the fire-control system was barely adequate. In light of this, Hitmore was launched in early 1953. This third project pooled the efforts of the Air Force, General Electric, and Convair (the prime contractor). It required the modification of 6 B-36s to further assess the actual airborne accuracy of the fire-control system. In addition, these planes made separate test flights to gauge the operational efficiency of the gunnery system. The Hitmore results proved encouraging. By mid-year no critical problems had been uncovered. The B-36's defensive armament could be made to work well, after numerous but minor modifications.

Special Modifications — 1954

Several B-36Ds received the special modifications initially applied to a number of the B-36Js (sixth and last of the B-36 model series). Approved in February 1954, the modification contract extended over 11 months. The first modified B-36D, flown in June by Convair, was returned to the Air Force the same month. The modified B-36Ds were identified as Featherweight B-36D-111s. Like other featherweight B-36s, they were to be used for high-altitude operations. Hence, they had been stripped of all armament except the tail turret. Convair had also removed all non-essential flying and crew comfort equipment from the modified planes. To shed even more

[60] The problem of caring for new and highly sophisticated equipment came as no surprise to the Air Force. In early 1949, the Sperry Company had opened a school to train personnel in proper maintenance of the K radar system. SAC, however, was reluctant to let its few trained radar men attend the 8-month course, and it was just as hard to recruit qualified students.

weight, the Featherweights carried a 13-man crew, 2 fewer than the standard B-36D.

Total B-36Ds Accepted 26

Just 26 B-36Ds came off the production lines,[61] but modification of most of the B-36Bs accepted by the Air Force gave SAC a sizeable B-36D contingent.

Acceptance Rates

Except for 1 B-36D received in fiscal year 1952 (August 1951), all B-36Ds were accepted by the Air Force in FY 51—5 in August 1950, 5 in September, 1 in October, 2 in November, 1 in December, 3 in January 1951, 6 in March, and 2 in April.

End of Production June 1951

Production ended in June and the Air Force accepted its twenty-sixth B-36D in August.

Flyaway Cost Per Production Aircraft $4.1 million

Airframe, $2,530,112; engines (installed), $589,899; propellers, $184,218; electronics, $55,974; ordnance, $30,241; armament, $747,681.

Subsequent Model Series B-36F

Other Configurations RB-36D, GRB-36D, and RB-36D-111

Phaseout 1956-1957

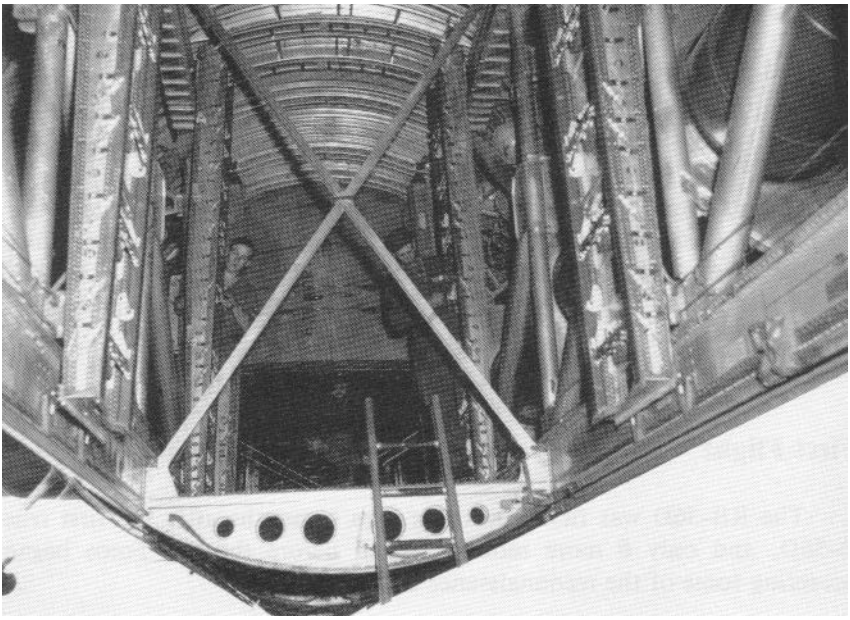
In December 1956, SAC's operational inventory counted 250 B/RB-36s of

[61] Including 4 planes accounted for by Convair as B-36Bs.

one kind or another. Only 11 B-36Ds remained, after some 6 years of service. It was merely a matter of months before the last of the Ds would be gone.

Milestones 1953

In August and September, B-36s of the 92d Heavy Bomb Wing completed the first mass flight to the Far East, visiting bases in Japan, Okinawa, and Guam. Nicknamed Operation Big Stick, this 3-day exercise came shortly after the end of hostilities in Korea and demonstrated U.S. determination to try every means possible to keep peace in the Far East. On 15 and 16 October, the 92d Heavy Bomb Wing left Fairchild AFB, Washington,[62] bound for Andersen AFB in Guam and 90 days of training. This was the first time an entire B-36 wing was deployed to an overseas base.



Two airmen at work on a portion of a B-36 bomb bay.

[62] Fairchild's severe winter climate adversely affected the 92d Wing's combat readiness. The B-36Ds were still prone to fuel cell leaks, and their usual staging from Fairchild to even colder areas made matters worse. The wing had not yet been able to trade its Ds for either Hs or Js that promised better fuel cell sealant.

RB-36D

New Features

The RB-36D carried cameras (similar to those on the RB-36Es) and electronics, as required by the aircraft's principal missions—all-purpose strategic reconnaissance, day and night mapping, charting, and bomb damage assessment. The RB-36D carried a crew of 22; the B-36D, a crew of 15.

Basic Development 1949

Development of the RB-36D coincided with that of the jet pod-equipped B-36B—later identified as the B-36D. As in the bomber's case, General LeMay strongly influenced the procurement decision that soon followed.[63] He had commanded the B-29 strikes against Japan in World War II, and one of his first actions upon taking charge of the Strategic Air Command was to insist on a quick supply of strategic reconnaissance planes. Speedy conversion of the B-36As and delivery of the RB-36Es ahead of the RB-36Ds attested to the urgency of the SAC Commander's request.

First Flight 18 December 1949

The RB-36D was first flown less than 6 months after the first true B-36D, and only 6 more months passed before the Air Force began accepting some of the reconnaissance aircraft.

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[63] Only 3 strategic reconnaissance candidates remained in November 1948, when the Board of Senior Officers met to review the Air Force's needs for long-range reconnaissance aircraft. The jet pod-equipped B-36 emerged as the board's first choice. The B-47 was second, as also favored by the SAC Commander. The B-54, officially canceled within several months, was third and last. The RB-49, once a strong contender, was not even discussed. Its fate had been sealed during the summer, when problems had arisen in testing the B-49—Northrop's latest tactical configuration of the unconventional B-35 "flying wing."Moreover, development of the RB-49 would have been time-consuming and expensive, 2 commodities the Air Force could not afford.

Enters Operational Service — June 1951

Due to severe materiel shortages, the new RB-36Ds did not become operationally ready until nearly half a year after delivery to SAC.

Problems and Improvements — 1951-1953

Being virtually alike, the B/RB-36Ds shared the same problems and received similar improvements.

Special Modifications — 1954

As in the B-36D's case, some RB-36Ds were changed to the featherweight configuration. These RB-36D-111s retained a large crew, 19 instead of 22. The Convair modification contract extended from February 1954 to the following November. The first modified RB-36D-111 was flown in August, and returned to the Air Force in the same month.

Total RB-36Ds Accepted — 24

The Air Force carried these 24 aircraft as RB-36D productions. In contrast, 8 of them initially appeared on the contractors' records as B-36Bs.[64]

Acceptance Rates

The Air Force took delivery of 3 RB-36Ds in June 1950. It accepted the other 21 in FY 51—between July 1950 and May 1951. The Air Force never acquired more than 3 RB-36Ds in 1 month.

End of Production — May 1951

Delivery of the 24th RB-36D spelled the end of this aircraft's production.

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[64] The fine line between Convair and USAF ledgers was of no consequence—it did not affect costs nor the aircraft's operational capability.

Flyaway Cost Per Production Aircraft

The RB-36D carried the $4.1 million price tag of the B-36D.

Subsequent Model Series — B-36F

Other Configurations — GRB-36D-111/RF-84F

The GRB-36D/RF-84 combination, better known as the FICON (*fi*ghter *con*veyor) or carrier-parasite program, came into being in the early fifties. The RB-36s were becoming more and more vulnerable, and no new form of defense was readily available. The Air Force therefore looked to the past for solutions. As a result, it planned in 1951 to put a parasite RF-84 in the RB-36's bomb bay.[65] The parasite plane would be released about 800 or 1,000 miles from the target and within a relatively safe area. The pilot of the RF-84 would continue on to the target, obtain high- or low-level photography as desired, then return to the mother aircraft. An alternate FICON mission would be long-range, high-speed bombing. No real problems arose, but it took longer than thought to bring the FICON project to fruition.

Flown in January 1952, the FICON composite prototype comprised a modified, standard RB-36D and a straight-wing Republic F-84E Thunderjet. Extensive flight tests soon demonstrated the FICON concept was practical. The parasite's straight wings posed no great difficulties. Sweeping down the tail of a forthcoming F-84 prototype (YF-84F) would enable it to fit in the RB-36 bomb bay. Elimination of the YF-84F's tail flutter by using faired bomb-bay doors removed the last stumbling block.

Contracts awarded Convair and Republic in the fall of 1953 called for modifying 10 RB-36Ds and 25 RF-84Fs, respectively. This was far below the

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[65] A carrier-parasite combination had been tried before for somewhat different purposes. It had long been known that heavily laden bombers could not cope with interceptors. Studies undertaken in 1944 to afford some protection to the then yet-to-be flown B-36 envisioned a pilotless, remote control, fast fighter that could be carried to the battle area in one of the bomb bays of the huge long-range bomber. However, this was given up in favor of a pilot-operated fighter that would be more maneuverable in facing repeated attacks. The tiny, folding-wing XF-85 Goblin which ensued was developed by the McDonnell Aircraft Corporation in late 1945 and first flown in August 1948. Because no B-36s were readily available, it was test-dropped from a B-29. The project, however, never went past the experimental stage. The Goblin production was abandoned for a number of technical and financial reasons, but danger was the primary obstacle. The Air Force believed the odds of retrieving a fighter in the midst of a raging battle were poor. Moreover, if the bomber was shot down before the fighter was launched, both crews would be lost. Finally, if the bomber was destroyed after the launching, the short-range Goblin would also be doomed.

number of aircraft SAC had in mind—30 RB-36s and 75 RF-84s. Still, modification of only 35 was to take time. To begin with, the carrier RB-36Ds turned out to be featherweight configurations of the big reconnaissance bomber, and none of these were available before 1954. Furthermore, the reconfigured planes had to be modified to carry the additional mechanisms for stowing, aerial servicing, releasing and retrieving the F-84F parasites.[66] Specifically, this meant that each carrier was equipped with a straight beam extended down from the bottom of the airframe. Each modified parasite featured a retractable probe, mounted on the forward top fuselage section to ease hook-up. Actually, the technical operation of FICON was simple. Carriers and parasites could fly out of different bases. The parasite could be picked up in midair enroute to the target area, or by ground hook-up prior to takeoff. Night operations were also possible. The first GRB-36D-111 carrier was delivered in February 1955, 6 months ahead of the first parasite RF-84F (subsequently identified as the RF-84K). The FICON B-36s served with SAC's 99th Heavy Strategic Reconnaissance Wing.

Phaseout 1956–1957

The RB-36D followed the B-36D's phaseout pattern. That of the FICON aircraft was much the same.[67]

[66] The FICON carriers retained all their ferret electronic countermeasures components, which were relocated aft of the bomb bays. New APX-29 rendezvous equipment was added.

[67] By mid-1957, SAC's strategic and reconnaissance fighters, the RF-84Ks included, were on their way out.

B-36F

Previous Model Series B-36D

New Features

The only telling difference between the B-36F and the preceding B-36D lay in the substitution of more powerful engines—R-4360-53s in lieu of R-4360-41 engines.

First Flight (YB-36F) 18 November 1950

The prototype B-36F and B-36F production models were equipped from the start with six 3,800-horsepower R-4360-53 engines. Each generated 300 more horsepower than a B-36D engine, but still failed to bring the B-36F's performance up to par.[68]

Enters Operational Service 1951

The Air Force accepted a first B-36F in March 1951 and a few more in the months that followed. No B-36Fs reached SAC until August.

Operational Problems 1951-1952

The B-36F's R-4360-53 piston engines were not wholly satisfactory because of excessive torque pressure as well as ground air cooling and

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[68] Production plans early in 1951 projected a normal growth in the B-36 employment through use of even more powerful engines. Adoption of the Pratt & Whitney R-4360-57 reciprocating engines would stretch the combat radius of a B-36 with a 10,000-pound bomb load from 3,360 to 4,200 nautical miles. It would also jump the bomber's average speed from 186 to 300 knots. These plans were dropped in August 1952, when the Air Force decided that no more B-36s would be built other than those now in production. The announcement coincided with USAF statement that Boeing's all-jet, 8-engine B-52 would replace the B-36 heavy bomber, and that Boeing had been awarded a letter contract to build 70 of the new bombers.

combustion problems. Pratt & Whitney, Convair, and the Air Materiel Command joined forces to solve these deficiencies quickly.

Post-Production Modifications 1954

As in the case of other B-36 model series, a number of the new B-36Fs were brought up to the configuration introduced by the Featherweight B-36J-111. Approval of the Convair modification contract in February 1954 was followed by delivery of the first B-36F-111 in May. The B-36F featherweight modifications were completed in December, on schedule.

Total B-36Fs Accepted 34

Among the 34 B-36Fs bought by the Air Force was the B-36F prototype, later completed as a true production model.

Acceptance Rates

The Air Force took delivery of the first 4 B-36Fs toward the end of fiscal year 1951—1 in March 1951, 1 in May, and 2 in June. The other 30 B-36Fs were accepted in FY 52—2 in July 1951, 5 in August, 4 in September, 8 in October, 6 in November, 4 in December, and 1 in January 1952.

End of Production October 1951

The Air Force did not get its last B-36Fs until several months after production was over.

Flyaway Cost Per Production Aircraft $4.1 million

The B-36F carried the price tag of the B-36D. Airframe, engines, electronics, all cost the same.

Subsequent Model Series B-36H

Other Configurations RB-36F and YB-60

RB-36F: The Air Force ordered and took delivery of 24 long-range reconnaissance versions of the B-36F. The first 4 RB-36Fs were accepted in fiscal year 1951 (all in May); the 20 others in FY 52 (between August and December 1951). Cost records listed both the B-36F and the RB-36F at $4.1 million each.

YB-60: This B-36 configuration never went past testing. First known as the YB-36G, this apparent successor to the B-36F, was redesignated YB-60 in mid-1951 because it so obviously differed from the B-36. At the same time, Convair's plans to bring existing B-36s to the G configuration were given up. The swept-wing, pure-jet YB-60, with its new needle-nose radome and new type of auxiliary power system, soon found itself competing with the future B-52. Both used the same jet engines (Pratt & Whitney J57-P-3s), but in comparison the YB-60's performance test results proved disappointing, and the program was canceled in January 1953. The cost of building and testing the 2 B-60 prototypes (accepted in the fall of 1951) ran around $15 million.

Phaseout 1958-1959

In mid-1958, 46 RB-36s remained in the active inventory. SAC identified 19 of them as RB-36Fs. No B-36Fs were listed, although USAF rolls still reflected 32 B-36s. Total phaseout was imminent in any case.

Items of Special Interest 1954-1955

On 16 June 1954, SAC's 4 RB-36-equipped heavy strategic reconnaissance wings were given a primary mission of bombing. They did limited reconnaissance as a secondary mission. Then on 1 October 1955, the RB-36 reconnaissance wings were redesignated heavy bombardment wings, while retaining a latent reconnaissance capability.

B-36H

Previous Model Series — B-36F

New Features

The B-36H had a rearranged crew compartment and additional twin tail radomes to store the components of the AN/APG-41A radar.[69]

First Flight (YB-36H) — November 1950

The B-36H and B-36F prototypes were first flown at almost the same time. Yet, B-36H deliveries did not start until December 1951, when the Air Force already had most of its 34 B-36Fs. The B-36H's marked improvement over the F accounted for the delay between production. The Air Force bought 156 B/RB-36Hs—more than double the production total of any other B-36.

Enters Operational Service — 1952

Once underway the production flow of B/RB-36Hs was steady, averaging 8 aircraft per month during 1952, and 6 monthly between January and September 1953.

Operational Problems — 1952

By 1952, engineering on the B-36 was little more than correction of rather minor deficiencies showing up in service. The B-36H (like the B-36F) had 6 R-4360-53 engines, but the early troubles of these new engines were virtually under control. Other problems arose, however. During a few months in 1952, all B-36s were restricted to an altitude of 25,000 feet after

[69] The AN/APG-41A was far superior to the AN/APG-32 gun-laying radar employed by the preceding B-36Ds and B-36Fs.

an RB-36 accident at 33,000 feet was traced to a faulty bulkhead. This restriction remained in effect until all deficient bulkheads were discovered and replaced.

The B-36's original propeller blades carried flight restrictions that hampered performance. A new blade, made by a special flash-welding process, could be used freely except for landing and takeoff. This blade weighed an extra 20 pounds, but its greater efficiency promised to compensate for the loss in aircraft range. A batch of 1,175 was ordered for prompt installation.

Grounding 1952

In March, defective landing gears caused a series of accidents. After 2 crashes, the Air Force grounded all B-36s except the first 152. This meant that almost all of the last half of B/RB-36F productions and some 30 B/RB-36Hs already accepted by the Air Force could not be flown. Investigations from the start had blamed the aircraft's landing gear pivot shaft. Since a heavier bar could be devised and serve until a permanent alteration could be made, the grounding orders were soon lifted.

Post-Production Modifications 1954

Some B-36Hs and B-36H reconnaissance versions were reconfigured by Convair in 1954. They were returned to SAC in the same year as B/RB-36H-111s, having undergone the same stripping and overall modification as other featherweight B/RB-36s. No troubles were met with during the fulfillment of the B/RB-36H or other featherweight modification contracts. The crew of each aircraft so modified was cut. For high-altitude operations, B-36s carried only a crew of 13 (a decrease of 2); RB-36s, a crew of 19 (a decrease of 3).

Total B-36Hs Accepted 83

Acceptance Rates

The Air Force accepted 32 B-36Hs in fiscal year 1952—7 in December 1951, 5 in January 1952, 3 in February, 5 in March, and 4 in each of the next 3 months. It received 43 B-36Hs in FY 53—4 in July 1952, 4 in August, 7 in September, 3 in October, 4 in November, 2 in December, 4 in January 1953, and 3 during each of the next 5 months. The last 8 B-36Hs were accepted in FY 54—3 in July 1953, 3 in August, and 2 in September.

End of Production July 1953

All B-36Hs, including the last one built, had been accepted by the end of September.

Flyaway Cost Per Production Aircraft $4.1 million

In round figures, the B-36H and B-36F prices were alike. In reality, the B-36H cost an additional $11,321. Airframe costs were much lower, but the price of the engines showed a steep increase. Armament, electronics, and propeller cost also had gone up. The new costs were: airframe, $2,077,785; engines (installed), $874,526; propellers, $214,186; electronics, $80,272; ordnance, $30,241; armament, $872,436.

Subsequent Model Series B-36J

Other Configurations RB-36H and B-36H (Tanker)

RB-36H: The Air Force bought 73 long-range reconnaissance versions of the B-36H. Twenty-three were accepted in FY 52 (all during the first 6 months of 1952); 42 others in FY 53 (between July 1952 and June 1953). The last 8 were delivered in FY 54 (3 in July 1953, 3 in August, and 2 in September). The RB-36H price matched that of the B-36H and did not include the featherweight modification costs of 1954.

B-36H (Tanker): Searching for a tanker that could refuel jet aircraft at higher altitudes and higher speeds, SAC in early 1952 became interested in a readily convertible B-36 bomber-tanker. The Air Force therefore asked Convair to equip one B-36 with a probe and drogue refueling system. The modification contract was approved in February 1952 and the work was completed in May. Testing, postponed to the end of the month because of the late delivery of one B-47 receiver aircraft, was satisfactory enough. Yet, no other tests took place until January 1953, after a new and vastly

The NB-36H—modified to be a test bed for a nuclear reactor.

improved British-made probe and drogue refueling system was installed.[70] The converted B-36H tanker subsequently flown could refuel one or more receiver aircraft. The 9-crewmember tanker could be returned to its standard bomber configuration in some 12 hours. But the B-36's bomber commitments never really allowed SAC to exploit these features.

Phaseout 1956–1959

Conversion of SAC's heavy bomb wings to B-52 aircraft began in June 1956, with the B-36H-equipped 42d Wing at Loring AFB, Maine.[71] Nonetheless, like the final B-36Js, the much-improved B-36Hs were among the last to go.

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[70] The British had developed refueling techniques to the point where they were actually in use on commercial airplanes, and the Air Staff in late 1947 had already begun to consider adapting the British technique to combat aircraft refueling. This would allow short-range but relatively speedy bombers of the B-50 type to get to a distant and heavily defended target with the atomic bomb—a task allocated to the B-36, but especially hazardous due to that long-range bomber's slow speed.

[71] The 93d Bomb Wing at Castle AFB, Calif., fully equipped with B-52s in April 1956, had been a B-47 outfit prior to conversion.

Other Uses 1952-1955

One B-36 was modified by Convair in 1952 to carry guided air missiles (GAMs), specifically the GAM-63 Rascal,[72] under development by the Bell Aircraft Corporation since 1946. A mockup inspection of the B-36/Rascal prototype disclosed no major obstacles, and 11 other B-36s were programmed to be modified as director aircraft (DB-36s) for the new missiles.[73] Several factors soon dictated changes in USAF plans. The principal ones were ongoing Rascal difficulties, imposition of new technical requirements, and reorientation of the program to achieve the best aircraft/missile operational combination. Although testing with the DB-36 would go on for awhile, the Air Staff decided in mid-1955 that it definitely wanted the B-47, not the B-36,[74] to carry the Bell rocket-powered GAM-63. Time lessened the decision's importance, the Rascal program being canceled in November 1958.[75]

1955-1957

One B-36H (Serial No. 51-5712) never reached SAC. The Air Force reserved it for special tests that might lead to the design of the world's first atomic-powered plane. The future nuclear-propelled B-36 (temporarily labeled the X-6) did not materialize. Even so, the modified and redesignated B-36H (NB-36H) saw extensive duty as a nuclear-reactor test bed. Forty-seven test flights were made, yielding valuable data on the effects of radiation upon airframe and components. The NB-36H had undergone various modifications prior to testing. The most important one added a crew compartment to the fuselage nose section. This shielded all crew members from radioactive rays, when the nuclear reactor in the aft bomb bay operated. Composed of lead and rubber, this compartment completely surrounded the crew. Only the pilot and copilot could see out through the

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[72] The name Rascal derived from the guidance system used during the missile's dive on the target. This system was called a *Ra*dar *Sca*nning *L*ink, and the word Rascal was formed by combining the underlined letters of the 3 words.

[73] Such aircraft as the B-29, B-50, B-47, and even the B-52 were considered or modified as Rascal carriers, either for experimental or operational use.

[74] Most of the DB-36 modification contract was canceled. Convair completed only 3 aircraft and reimbursed $1.6 million to the Air Force.

[75] At a top speed of Mach 2.95, the Rascal could carry a 3,000-pound nuclear warhead 90 nautical miles. Still, it remained unreliable and was overtaken by technological progress.

foot-thick, leaded-glass windshield. A closed-circuit television system enabled the crew to see the reactor as well as other parts of the aircraft.

Milestones 6 April 1955

A B–36 launched a guided missile with an atomic warhead from 42,000 feet. The explosion took place 6 miles above Yucca Flat, Nevada. It was the highest known altitude of any nuclear blast at the time.

B-36J

Previous Model Series — B-36H

New Features

The B-36J had 2 additional tanks, 1 on the outer panel of each wing, allowing an extra fuel load of 2,770 gallons. It also had a much stronger landing gear, permitting a gross takeoff weight of 410,000 pounds.[76]

First Flight (YB-36J) — July 1953

The prototype flight was swiftly followed by the September flight of the first B-36J production model. The latter was immediately accepted by the Air Force.

Enter Operational Service

SAC received its full contingent of B-36Js in less than a year.

Production Modifications — 1954

The last 14 B-36Js entered the operational inventory as lightweight B-36J-111s. In contrast to other B-36 featherweights (modified after production), Convair made all necessary changes before completing the aircraft. This delayed delivery for a month (too short to disrupt SAC's plans) and saved more than $100,000.

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[76] This had long been a SAC goal. The Air Force and Convair as early as 1952 discussed how to increase the takeoff weight of available B-36s without compromising safety—USAF engineers arguing that the structural integrity of some of the aircraft's new components was unknown. Takeoff weight was raised to 370,000 pounds in June 1952. But still cautious, the Air Force's authorization covered only B-36s that already had somewhat stronger landing gears.

Operational Problems 1953–1958

SAC had no critical problems with the B-36Js. For that matter, the entire B-36 fleet showed improvement, largely because of Project SAM-SAC. This program, initiated in 1953, required the cyclic reconditioning of all operational B-36s (215 as of September 1954) and constantly tied-up 25 aircraft in depots. Yet, the intensive maintenance paid off for both the older B-36s and the latest and final B-36Js. In the same vein, the crew-to-aircraft ratio (too low for many years) began to improve as the number of combat-ready crews grew steadily.

Other Improvements 1953–1958

The B-36 was certain to be entirely outmoded by mid-1955.[77] Until then, however, it remained SAC's primary atomic bomb carrier and perhaps the Nation's major deterrent to Soviet aggression. Meanwhile, the Air Force found ways to keep enhancing its effectiveness. Ever resourceful, the service set up the Quick Engine Change Program, which combined an engine and accessories in a power package that could be field-installed in no time. Applied to other aircraft as well, the change program for B-36s ran from 1953 until September 1957. Another ingenious and long-lasting project was Big-Kel (devised by the San Antonio Air Materiel Area at Kelly AFB, Texas), which replenished the flyaway kits of B-36 spares utilized in SAC wing rotation overseas.

Planning Changes 1957–1958

Defense funds cutbacks in fiscal year 1958 compelled the Air Force to alter plans for every USAF program at every echelon. SAC did not escape the crisis. The B-52 procurement was stretched out and the B-36 service-life extended. Although the worldwide flying hours of the 2 bombers were reduced, these changes were fraught with complications. To begin with, phasing out the giant B-36s was a large undertaking. Because it could "find no other use for them," the Air Force had ordered the $1 billion fleet

[77] Phaseout of the B-36 was settled before 1953. All kinds of technological advances called for it. Withdrawing B-36s from the inventory would also make it possible to do away with the strategic fighters that were to accompany the cumbersome bombers on most of their missions.

scrapped.[78] Still, the B-36s were to remain first-line strategic bombers up to their final day. As a rule, B-36s flew from their last operation straight to the Arizona storage base for reclamation and destruction.[79] The shortage of B-52s forced the withdrawal of B-36s from several reclamation contracts. By then, the Air Force had made it a practice to support the B-36s still in service with components from out-of-service planes. Moreover, to conserve the most in money and manpower, only required items were saved and unneeded reclamations were avoided. Hence, the reactivated B-36s obviously posed problems.

Total B-36Js Accepted 33

Acceptance Rates

The Air Force accepted 28 B-36Js in fiscal year 1954—2 in September 1953 and 2 in October, 3 each month from November 1953 through March 1954, none in April, 4 in May, and 5 in June. Five more B-36Js were accepted in FY 55—4 in July 1954 and 1 in August.

End of Production August 1954

The Air Force received the last B-36J on 10 August and delivered it 4 days later to the 42d Heavy Bomb Wing at Loring AFB.

Flyaway Cost Per Production Aircraft $3.6 million

The B-36J cost half a million dollars less than the preceding

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[78] The scrapping of the first 200 B-36s was due to yield a return of $93.5 million, but the Air Force recouped much more. Various configurations of the B-36's basic R-4360 engines equipped other USAF aircraft (KC-97s, B-50s, C-119s, and C-124s) and $22,000 worth of parts (mainly, crankshafts and cylinders) was removed from each B-36 engine. This was no small savings because 4,000 engines (1,200 of the early R-4360-41s and 2,800 of the more powerful -53s) became surplus as a result of the B-36 phaseout.

[79] B-36s began arriving at Davis-Monthan in February 1956. Reclamation and destruction were handled by the Mar-Pak Corporation, Painesville, Ohio. Mar-Pak had reclaimed 161 B-36s by December 1957 and processed the last B-36 in April 1959.

B-36H—airframe, $1,969,271; engines (installed), $639,651; propellers, $214,186; electronics, $77,691; ordnance, $32,036; armament, $707,379.

Subsequent Model Series — None

Other Configurations — None

Phaseout — 1958-1959

In December 1958, only 22 B-36s (all B-36Js) remained in the operational inventory. Symbol of global airpower during the early days of the United States Air Force, the B-36 Peacemaker neared its end. On 12 February 1959, the last of SAC's giant bombers and the final B-36J built by Convair left Biggs AFB, Texas, where it had seen duty with the 95th Heavy Bomb Wing. The plane (Serial No. 52-2827) was flown to Amon Carter Field in Fort Worth and put on display as a permanent memorial.

Milestones — 12 February 1959

Retirement of the last B-36 marked the beginning of a new era—SAC's becoming an all-jet bomber force on that day.

Program Recap

The Air Force accepted a grand total of 385 B-36s (prototype, test, and reconnaissance aircraft among them). As recorded by the Comptroller of the Air Force, the program consisted of 1 XB-36, 1 YB-36, 22 B-36As, 62 B-36Bs, 26 B-36Ds, 34 B-36Fs, 83 B-36Hs, 33 B-36Js, 24 RB-36Ds, 24 RB-36Fs, 73 RB-36Hs, and 2 swept-wing, all-jet B-36 prototypes (known for a while as YB-36Gs but redesignated and flown as YB-60s). Be that as it may, these listings were far afield from most operational counts. Modifications and reconfigurations sharply altered the B-36 program. The Air Force accepted only 26 true B-36D productions, but conversion of the B-36Bs gave SAC another 50 B-36Ds. Similarly, the B-36A reconfiguration gave the reconnaissance forces 22 RB-36Es, not reflected in production data. Pinning a price on the B-36 was not so involved. Some true productions, like the B-36Hs, ran as high as $4.15 million, but early B-36s were far cheaper. The Air Force estimated the entire program (research, development, prototypes, and production) at $1.4 billion. Prorated, this came to $3.6 million per aircraft. Omitted from every unit cost, however, were the expenses incurred for all engineering changes and modifications, added on after approval of a basic contract.

TECHNICAL AND BASIC MISSION PERFORMANCE DATA

B/RB-36 AIRCRAFT

Manufacturer (Airframe)	Consolidated Vultee Aircraft Corp. Fort Worth, Tex.
(Engines)	The Pratt & Whitney Aircraft Division of United Aircraft Corporation, East Hartford 8, Conn., and The General Electric Co., Schenectady, N.Y.
Nomenclature	Strategic Heavy Bomber and Reconnaissance Aircraft.
Popular Name	Peacemaker

	B-36A	B-36B	RB-36E	B-36D	B-36D-111	B-36F	B-36H	B-36J	B-36J-111
Length/Span (ft)	162.1/230	162.1/230	162.1/230	162.1/230	162.1/230	162.1/230	162.1/230	162.1/230	162.1/230
Wing Area (sq ft)	4,772	4,772	4,772	4,772	4,772	4,772	4,772	4,772	4,772
Weights (lb)									
Empty	135,020	140,640	164,238	161,371	161,264	167,646	168,487	171,035	166,165
Combat	212,800	227,700	238,300	250,300	244,400	254,300	253,900	266,100	262,500
Max Takeoff[a]	311,000	328,000	370,000	370,000	370,000	370,000	370,000	410,000	410,000
Engine: Number, Rated Power per Engine & Designation	(6) 3,000-hp R-4360-25	(6) 3,500-hp R-4360-41	(6) 3,500-hp R-4360-41 & (4) 5,010-lb st J47-GE-19	(6) 3,500-hp R-4360-41 & (5) 5,010-lb st J47-GE-19	(6) 3,500-hp R-4360-41 & (5) 5,010-lb st J47-GE-19	(6) 3,800-hp R-4360-53 & (4) 5,010-lb st J47-GE-19	(6) 3,800-hp R-4360-53 & (4) 5,010-lb st J47-GE-19	(6) 3,800-hp R-4360-53 & (4) 5,010-lb st J47-GE-19	(6) 3,800-hp R-4360-53 & (4) 5,010-lb st J47-GE-19
Takeoff Ground Run (ft)									
at Sea Level	6,000	6,030	4,400	4,400	4,400	3,990	3,990	5,290	5,290
Over 50-ft Obstacle	8,000	8,520	5,685	5,685	5,685	5,110	5,110	6,820	6,820
Rate of Climb (fpm) at Sea Level	502	500	970	960	970	920	920	720	780
Combat Rate of Climb (fpm) at Sea Level	1,447	1,510	2,140	2,210	2,330	2,060	2,060	1,920	1,995

Service Ceiling (ft) (100 fpm Rate of Climb to Altitude)	—	28,500	32,200	33,100	33,400	33,000	33,000	27,400	28,500
Combat Ceiling (ft) (500 fpm Rate of Climb, Max Power, to Altitude)	—	38,800	40,000	40,700	41,300	40,900	40,800	39,900	39,500
Average Cruise Speed (kn)	189	176	190	193	192	204	203	198	197
Max Speed at Optimum Altitude (kn/ft)	300/31,600	331/34,500	348/36,500	353/36,200	363/37,300	363/37,100	361/36,700	357/36,400	363/37,500
Combat Radius (nm)	3,370	3,740	3,057	3,065	3,260	2,807	2,705	2,955	3,465
Total Mission Time (hr)	35.6	42.43	31.7	31.5	33.7	26.7	26.4	29.4	34.6
Armament	16 20-mm guns	16 20-mm guns	16 20-mm M24A1 guns	16 20-mm M24A1 guns	16 20-mm M24A1 guns	16 20-mm M24A1 guns	16 20-mm M24A1 guns	16 20-mm M24A1 guns	2 20-mm M24A1 guns
Crew	15	15	22	15	13	15	15	15	13
Max Bombload[b] (lb)	72,000	72,000	None[c]	72,000	72,000	72,000	72,000	72,000	72,000

Abbreviations

fpm = feet per minute
hp = horsepower
kn = knots
max = maximum
mm = millimeter
nm = nautical miles
st = static thrust

[a] Limited by the strength of the aircraft's main landing gear. The maximum takeoff gross weight of a number of B-36Bs was restricted to 278,000 pounds. B-36s with higher takeoff weights (370,000 pounds or more) were equipped with stronger landing gears (modified after production) or new landing gears (installed on the production line).

[b] The basic mission bombload was 10,000 pounds. Bombloads could be made of various combinations—WW II box fins, interim conical fins, and so-called new series. Except for the B-36As, all B-36s could carry bombloads of 86,000 pounds (e.g., two 43,000-lb bombs), when their gross weight did not exceed 357,500 pounds.

[c] Like other B-36s in the reconnaissance configuration, the RB-36E was equipped with 23 cameras (mostly K-22As, K-17Cs, and K-38s) and carried 80 T-86 photo flashes.

Basic Mission Note

All basic mission performance data were based on maximum power, except as otherwise indicated.

Combat Radius Formula:

B–36A—Not applicable, since this model was used mainly for training and crew transition.

B–36B—Warmed up, took off, climbed on course with normal power to 10,000 feet, cruised at long-range speeds at altitudes for best range (10,000 feet minimum). Climbed to arrive at 25,000 feet, 30 minutes prior to target. Cruised long-range speeds for 15 minutes, conducted 15-minute normal-power bomb-run, dropped bombs, conducted 5-minute evasive action plus 10-minute escape at normal power. Returned to base at altitudes for best range using long-range cruise-climb technique. Range-free allowances included 10-minute normal-power fuel consumption for warm-up and take-off, 5-minute evasive action at normal-power fuel consumption, and 5 percent initial fuel for landing and endurance reserves.

B–36D—Warmed up, took off, and climbed on course to 5,000 feet at normal power; cruised out at long-range speeds to point of cruise-climb operation. Began climb to combat altitude, using long-range climb powers, to arrive at cruise ceiling 500 nautical miles from target. Cruised at long-range speeds at combat altitude, using best engine (reciprocating-jet) combinations; 15 minutes from target, conducted 10-minute engine normal-power bomb-run, dropped bombs, and conducted 2-minute evasive action and 8-minute escape from target at normal power. After leaving target area, cruised back at long-range speeds, using best engine combinations, until 500 nautical miles from target. Descended to optimum cruise altitude and cruise-climbed back to base. Range-free allowances included 10-minute normal-power fuel consumption for reciprocating engines and 5-minute normal-power fuel consumption for jet engines for starting and take-off, 2-minute normal-power fuel consumption at combat altitude for evasive action, 30-minute fuel consumption for long-range speeds at sea level (reciprocating engines only), plus 5 percent of initial fuel load for landing and endurance reserves.

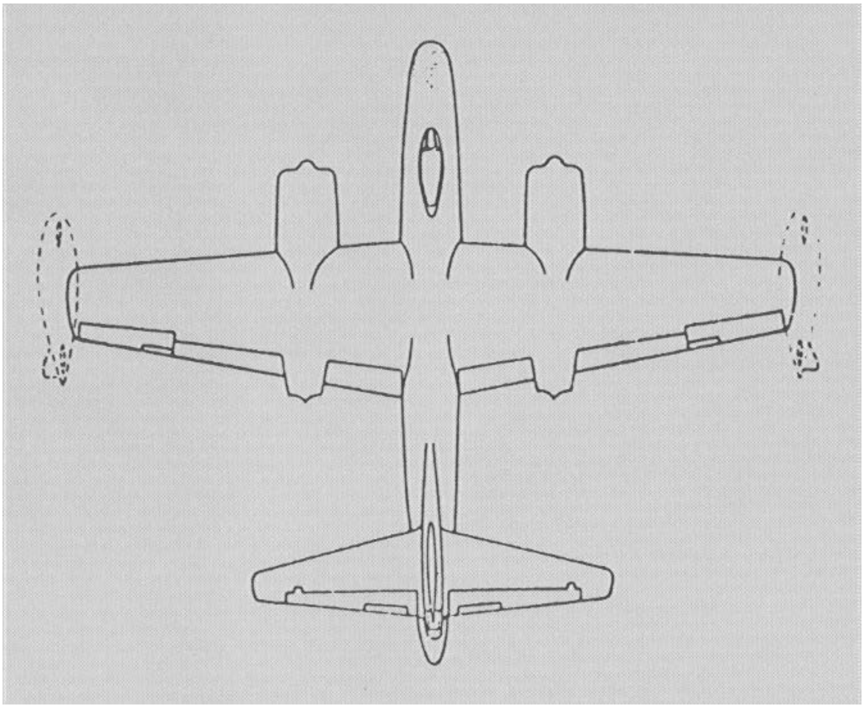
B–36D–111—Same as B–36D.

B-36F, B-36H, B-36J, and B-36J-111—Same as B-36D and B-36D-111, except also dropped chaff.

RB-36E—Same as B-36D and B-36D-111, except "conducted 10-engine normal-power photo-run" (instead of bomb-run), and "dropped flash bombs" (instead of bombs).

B-45 Tornado

North American Aviation, Incorporated



B-45 Tornado
North American

Manufacturer's Model 130

Overview

In 1943, aware of Nazi Germany's advances in the field of jet propulsion, the Army Air Forces (AAF) asked the General Electric Company to devise a more powerful engine than its prospective axial turboprop. This was a tall order, but it eventually brought about the production of the J35 and J47 turbojets. In 1944, 1 year after the jet engine requirements were established, the War Department requested the aircraft industry to submit proposals for various jet bombers, with gross weights ranging from 80,000 to more than 200,000 pounds. This was another challenge, and only 4 contractors answered the call.

Pressed for time, the AAF in 1946 decided to skip the usual contractor competition, review the designs, and choose among the proposed aircraft that could be obtained first. The multi-jet engine B-45, larger and more conventional than its immediate competitor, won the round, with the understanding that if a less readily available bomber was to prove superior enough to supplant it (which the Boeing XB-47 did), that aircraft would also be purchased.

Testing of the XB-45 prompted pre-production changes. North American Aviation, Incorporated, redesigned the nose panel, increased the aircraft's stabilizer area, and lengthened the tailplane by nearly 7 feet. In August 1948, 22 of the 90 B-45s, ordered less than 2 years before, reached the newly independent Air Force. However, the B-45's increased weight, excessive takeoff distance, and numerous structural and mechanical defects generated scant enthusiasm.

Meanwhile, the B-47's future production had become certain, and in mid-1948 the Air Staff actually began to question the B-45's intrinsic value as well as its potential use. Soon afterwards, as President Truman's budgetary axe slashed Air Force expenditures, the programmed production of B-45s was reduced to a grand total of 142, a decrease of 51 aircraft.

Although continuously plagued by engine problems, component malfunctions, lack of spare parts, and numerous minor flaws, the B-45 regained importance. Like all bombers produced after the end of World War II, the B-45 was designed to carry both conventional and atomic bombs. In mid-1950, when U.S. military commitments to the Korean War reemphasized the vulnerability of the North Atlantic Treaty Organization forces in Europe to Soviet attack, the Air Force made an important decision. Since the U.S. planned to produce large quantities of small atomic and thermonuclear weapons in the near future, the use of such weapons, heretofore a prerogative of the strategic forces, would be expanded to the tactical forces, particularly in Europe.

The program that ensued, under the code name of Backbreaker, entailed difficult aircraft modifications because several distinct atomic bomb types were involved and large amounts of new electronics support equipment had to be fitted in place of the standard components. In addition, the 40 B-45s allocated to the Backbreaker program also had to be equipped with a new defensive system and extra fuel tanks. Despite the magnitude of the modification project, plus recurring engine problems, atomic-capable B-45s began reaching the United Kingdom in May 1952, and deployment of the 40 aircraft was completed in mid-June, barely 30 days behind the Air Staff deadline.

All told, and in spite of its many valuable secondary functions, the B-45 did not achieve great glory. The entire contingent, Backbreaker and reconnaissance models included, was phased out by 1959. Yet, the B-45 retained a place in aviation history as the Air Force's first jet bomber and as the first atomic carrier of the tactical forces.

Basic Development — 1944

Like the trouble-plagued but eventually successful and long-lasting B-47, the B-45 officially originated in 1944, when the War Department called for bids and proposals on an entire family of jet bombers, with gross weights ranging from 80,000 to more than 200,000 pounds. These were ambitious requirements considering the kind of airplanes being planned at the time in the United States and elsewhere. Yet, the emergence of unrealistic requirements was a common practice that would endure for decades.[1]

[1] From experience, government officials most likely rationalized that inflating the requirements was the only way to get at least the minimum acceptable. Late in 1948, engineers

Unofficially, the roots of both the B–45 and B–47 aircraft could be traced to 1943, when the Army Air Forces, aware of Nazi Germany's advances in the field of jet propulsion, asked the General Electric Company to design something better than the TG–100 axial-flow turboprop engine that was being developed for the Consolidated-Vultee's 2 experimental P–81 escort fighters (the mass production of which did not materialize). The AAF's demands were met with General Electric's development of the 4,000-pound-thrust TG–180 and the TG–190 engines,[2] of which various models were to power subsequent bomber and fighter aircraft. For its part, North American began to attempt satisfying the AAF's requirements for a jet bomber with a design for an easy-to-build airframe, conventional in concept and straightforward in its aerodynamic form. Model 130, as the design was labelled in early 1944, was a mid-wing monoplane with dihedral tailplane and a retractable landing gear. North American planned to propel its new bomber with 4 jet units, grouped in horizontal pairs, 1 pair on each side of the fuselage outboard of the tailplane.

Initial Procurement — September 1944

The AAF initiated the procurement of the future B–45 with Letter Contract AC–5126. This document, issued on 8 September 1944, called for the development and testing of 3 experimental B–45s,[3] all of which were to be based on North American design 130. In time, as production of the

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of the Air Materiel Command began to point out the pitfalls of this practice. But their concern did not prevail. In 1952, many in the Air Staff also recommended caution and their efforts achieved some degree of success. Nevertheless, as the "weapon system concept" gained momentum, it became evident that the Air Force believed increasingly that mission objectives had to come first and that technology could be made to satisfy such objectives. (For details, see B–58, p 354 and pp 373-374).

[2] The TG–180, eventually built in large quantities by the Allison Division of the General Motors Corporation, became the J35; the TG–190, continuously produced by the General Electric Company, became the J47.

[3] The basic terminology of military aircraft underwent little change throughout the years. For the United States Air Force (as well as the preceding Army Air Forces), an experimental aircraft is a vehicle in a developmental or experimental stage, which is not established as a standard vehicle for service use. The experimental aircraft may be built to try out an idea, or to try for certain capabilities or characteristics. It may embody a new principle or a new application of an old principle. The status of such aircraft is indicated by the prefix, or classification letter X. In contrast, the prototype aircraft is a preproduction vehicle procured for evaluation and test of a specific design. The prototype status is indicated by the letter Y. This prefix symbol is acquired by the first complete and working aircraft made of a given model or model series, intended to serve as the pattern or guide for subsequently produced members of the same class.

aircraft appeared probable, North American altered the overall configuration of 1 of its 3 XB–45s. The selected vehicle was actually completed as a tactical model and, although seldom referred to as YB–45, assumed the role of a standard prototype.

Production Decision — 2 August 1946

The AAF originally intended to schedule a formal competition between the various contractors working on projects to satisfy the War Department's requirements of 1944. In 1946, since the early production of a jet bomber seemed highly desirable, the AAF decided to forgo the planned competition. Instead, available designs would be reviewed to determine which model could be obtained first. Four contractors were involved: North American, working on the XB–45; the Boeing Airplane Company, engrossed in the development of the swept-wing, 6-jet XB–47; the Consolidated Vultee Aircraft Corporation (Convair), engaged in the XB–46; and the Glenn L. Martin Company, builder of the XB–48.[4] But while the XB–45 and XB–46 were nearing completion and flights of these aircraft were scheduled for 1947, the XB–47 and XB–48 in 1946 were still in the early stages of development, and 2 years might elapse before the end of their fabrication and initial flight testing. Pressed for time, the AAF opted to appraise the XB–45 and XB–46 immediately and to postpone consideration of the XB–47 and XB–48 until they flew. Then, if either the XB–47 or the XB–48 proved superior enough to supplant the new bomber being produced (which the XB–47 did) that aircraft would be bought.[5] On 2 August 1946, the AAF

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[4] The military characteristics, issued by the AAF on 17 November 1944 (see B–47, pp 101–102) and embodied by the 4 projects, were specific but not restrictive. The B–45 and B–47 aircraft, the only 2 programs that went beyond the experimental stage, stemmed from the same requirements but ended having very little in common. Both were ordered as "medium" bombers, but in contrast to the B–47, which retained its medium bomber designation, the B–45 became a light bomber. The fact that the B–45, weighing 47,000 pounds and having a combat radius of 764 nautical miles, was finally listed as "light" also showed how swiftly concepts changed. Five years before, the World War II B–17G Flying Fortress, which weighed 37,672 pounds and had a combat radius of 873 nautical miles, was considered "heavy."

[5] The AAF anticipated that the B–47's performance characteristics would exceed those of the B–45, but realistically believed that the swept-wing, underslung engine nacelles, bicycle-type landing gear, and other experimental features of the Boeing design would require an extended period of development. The XB–48, although more conventional than the XB–47, featured a 3-engine installation in each wing and would incorporate the bicycle-type landing gear of the B–47. The XB–48 might prove to be superior to the XB–45, but any potential production of the Martin design remained several years away.

endorsed the immediate production of the B-45.[6] Several factors accounted for the selection. First, the AAF concluded that the XB-46's projected performance most likely would be inferior to that of the XB-45. Second, the XB-46's fuselage was not configured to hold all required radar equipment. Finally, since the XB-45's design only departed slightly from proven configurations, it was the most logical choice prior to testing of the experimental model. The AAF's decision of 2 August prompted within 1 week the negotiation and signature of Contract AC-15569, which called for an initial lot of 96 B-45As (North American Model N-147), plus a flying static test version of the experimental type (NA Model N-130). The cost of the contract was $73.9 million.

First Flight (XB-45) 17 March 1947

On 17 March 1947, the first of the 3 experimental B-45s made its initial flight. The 1-hour flight, from Muroc Army Airfield, California, was conducted under stringent speed restrictions because the aircraft's landing gear doors did not close properly when the landing gear was retracted. This problem could have been avoided by installing new and available landing gear uplocks, but this time-consuming installation was postponed.[7] Nevertheless, the XB-45's demonstration was impressive. No large multi-engine jet bomber had ever been flown before.[8] And, of primary importance from the manufacturer's standpoint, even though a B-45 production order had already been secured, the XB-45 flight preceded that of the still potentially competitive XB-46.

Initial Testing March 1947-August 1948

The Air Materiel Command planned an extensive test program for the

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[6] The decision did not specifically spell the end of the XB-46, but it was a poor omen. Already reduced to only 1 plane, the experimental B-46 program actually lingered until August 1947, when the AAF terminated the whole venture.

[7] As soon as World War II ended, most manufacturers had to compete fiercely for the few, limited orders. This was reason enough for North American not to delay the XB-45's flight.

[8] Douglas's experimental twin-jet B-43, an outgrowth of the company's XB-42 Mixmaster, flew almost 1 year before the XB-45, but the XB-43 was very small and the 2 could not be compared. In the same vein, 2 German developments appearing in 1944 presented no true challenge. One of them, the Arado Ar-234, introduced by the Luftwaffe as a jet-bomber, was so tiny that it rightly belonged to the fighter category. The Junkers Ju 287 only flew as a prototype designed to test a radical wing, Germany's nearing collapse presumably preventing completion of the aircraft.

3 experimental airplanes developed by North American; each of the 3 was to be instrumented for a specialized phase of the program.[9] The testing, however, was marred at the start by an accident that killed 2 of North American's crack test pilots and destroyed their aircraft. This accident was attributed to an engine explosion, but other contributing factors later came to light. These accounted for most of the changes specified in the B-45's production articles. Meanwhile, flight testing of the remaining XB-45s went on. Air Force pilots did not participate extensively in the initial tests. They flew only about 19 hours, while the contractor logged more than 165 flight hours on the 2 surviving aircraft. This total was accumulated in 131 flights, conducted before the Air Force took delivery of the planes. The Air Force accepted 1 XB-45 on 30 July 1948; the other, on 31 August. The acceptances were conditional because the pressurization systems of both planes did not function.

Other Experimental Testing — 1948-1950

After North American fixed the pressurization of the XB-45 cabins, additional tests were undertaken. Air Force pilots flew a total of 181 hours in 1 XB-45 between August 1948 and June 1949, when an accident damaged the aircraft beyond economical repair. The remaining XB-45, although constructed to serve as a prototype, had limited testing value due to an initial shortage of government-furnished equipment. Still, the Air Force put another 82 hours of flying time on the plane. A USAF flight test crew delivered the airplane to Wright-Patterson AFB, Ohio, where equipment was installed for bombing tests at Muroc AFB, California. Unfortunately, the YB-45 proved to be an unsatisfactory test vehicle because it required excessive maintenance. Only 1 mission was accomplished between 3 August and 18 November 1949, and that mission was to evaluate the long-awaited components. The airplane was used for high-speed parachute drops after November 1949, but on 15 May 1950, it was transferred to the Air Training Command to serve as a ground trainer.

Pre-Production Changes — 1947-1948

As might be expected, the crash of an XB-45 precipitated a thorough

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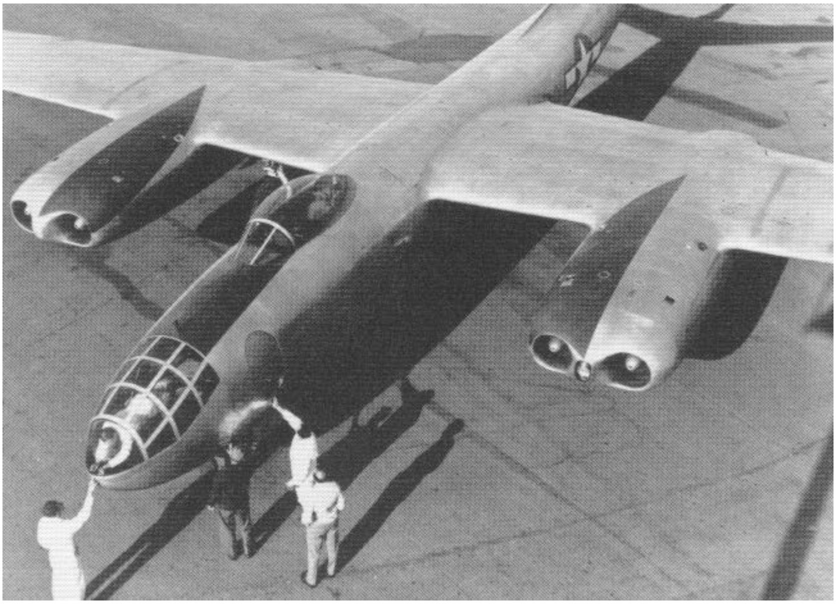
[9] In the late fifties, the various testing phases to which all aircraft were submitted were supplanted by testing categories. However, the changes affected the testing program's terminology more than its scope. (For specific information, see B-52, pp 224-225).

Close-up of 2 of the 4 jet engines that powered the XB-45.



An XB-45 undergoes a taxi test at Muroc Army Airfield, California.

investigation. As suspected, special wind tunnel tests confirmed that the aircraft's insufficient stabilizing area had contributed directly to the accident. The lack of ejection seats, moreover, had practically eliminated the pilot and co-pilot's chances for survival. As a result, 2 ejection seats were installed in the other experimental planes, while an advanced ejection system was being devised for the forthcoming production aircraft. In addition, future B-45s would be equipped with wind deflectors, placed in front of the escape doors from which the other 2 crew members (bombardier-navigator and tail gunner) would have to bail out in case of an emergency. North American also altered the structural configuration of the production vehicle. Most noticeable was a redesign of the nose panel. Finally, the aircraft's stabilizer area was increased, and the tailplane was lengthened from 36 to almost 43 feet.

B–45A

Manufacturer's Model NA–147

New Features

The B–45A differed from the experimental B–45s in featuring improved ejection-type seats for the pilot and co-pilot and safer emergency escape hatches for the bombardier-navigator and tail gunner. Communication equipment, emergency flight controls, and instruments, installed at the co-pilot's station, also were new. Other improvements included the E–4 automatic pilot, a bombing-navigation radar, and A–1 fire-control system, all of which were provided as standard equipment. Some of the B–45As were equipped with the AN/APQ-24[10] bombing-navigation radar system and such sophisticated electronic countermeasures components as the AN/APT–5; other B–45As only provided for the easy retrofit of this equipment. The first B–45As featured versions of the Allison-built J35 jet engines (in most cases, 4 J35–A–11s), but later aircraft were fitted from the start with the higher-thrust jets developed by the General Electric Company, either 2 J47–GE–7s or 2 J47–GE–13s, and 2 J47–GE–9s or 2 J47–E–15s.

First Flight (Production Aircraft) — February 1948

The initial production model of the XB–45 flew in February 1948, less than a year after the first flight of the experimental aircraft.

First Production Deliveries — April 1948

The Air Force began taking delivery of the initial batch of B–45As, 22 of them, in April 1948. These aircraft were identified as B–45A–1s to distinguish them from the subsequent 74 B–45As, known as B–45A–5s. Among other improvements, the B–45A–5s were equipped with more powerful

[10] The AN/APQ-24 bombing-navigation radar system made its operational debut with the Convair B–36B.

J47 engines. As soon as possible, the Air Force assigned 2 B-45A-1s to an accelerated service test program, which was already progressing well by mid-July. Under this program, each of the 2 planes accumulated 150 hours of rigorous testing under day and night operating conditions—test results actually accounting for some of the improvements featured by the B-45A-5s. Three additional B-45A-1s were deployed to Muroc AFB[11] to serve as transition trainers in support of the accelerated service test program. In effect, most of the early B-45As were relegated to the training task and became known as TB-45A-1s. In later years, however, priorities were to dictate that a few TB-45s be brought up to the combat configuration.

Unexpected Problems 1948

From the start, the introduction of the B-45 was hindered by a misunderstanding about the number of USAF pilots who were to be "checked out" in the aircraft at Muroc AFB by personnel of North American Aviation. In June 1948, delays in production made matters worse for the 47th Bombardment Wing, which was earmarked as first recipient of the new multi-jet bombers. Late in the year, the pioneer wing's training problems were aggravated by shortages of several months' standing in ground handling equipment and special maintenance tools. Structural or mechanical defects in a number of the few available B-45s did not help.

Program Uncertainty Mid-1948

Although available records do not disclose any serious consideration of canceling the entire B-45 production, the program apparently ran into

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[11]Among the base's predecessors was the Materiel Command Flight Test Base (ca 1942), which was redesignated Muroc Flight Test Base in 1944. In 1946, the Muroc Flight Test Base on the north end of Muroc Dry Lake and the Bombing and Gunnery Crew Training Base on the south end of the dry lake were merged into a single flight test center at Muroc Army Airfield under the jurisdiction of the Air Materiel Command. Muroc Army Airfield was redesignated Muroc AFB in February 1948 and became Edwards AFB 1 year later in honor of Captain Glen W. Edwards, a USAF pilot killed on 5 June 1948 while testing a prototype jet bomber of the Northrop Aviation's unconventional B-49 "flying wing." Officially dedicated on 27 January 1950, Edwards AFB remained under the Air Materiel Command until April 1951, when the Air Research and Development Command, established as a new major air command in January 1950, assumed jurisdiction. The Air Research and Development Command activated the Air Force Flight Test Center at Edwards AFB on 25 June 1951. The installations, as well as the research and development functions previously assigned to Air Materiel Command, were retained by Air Research and Development Command until 1961, when the newly formed Air Force Systems Command took over.

trouble even before any of the aircraft became truly operational.[12] As early as June 1948, at a meeting held in the office of General Hoyt S. Vandenberg, Air Force Chief of Staff since 30 April, doubts were expressed as to the B-45's value and its future utilization. It was decided (a decision evidently later rescinded) that no contract beyond the current one would be let, that production would go on as planned up to the 119th article, and that the funds already made available for a new contract would be used for another purpose.[13] One group would be equipped with the operational type, the initial 90 aircraft; the remaining aircraft would be placed in storage to cover the group's eventual losses. At the time, officials of the Tactical Air Command (TAC) were asked whether or not they liked the Northrop B-49 prototype, which had an empty weight of 88,000 pounds, almost twice that of the B-45. Shortly afterward, Gen. Muir S. Fairchild, USAF Vice Chief of Staff since 27 May, asked the Aircraft and Weapons Board[14] to determine if

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[12] Some B-45 records were destroyed; others provided a surprising amount of conflicting information. Throughout the years, Air Force historians in attempting to answer certain B-45 queries could only point out that early systems were acquired in many different ways and that variances in methods of documentation complicated matters. For instance, the date on which the B-45 reached an initial operational capability (IOC) could not be ascertained. Other historical data such as the B-45's first production delivery, total USAF testing hours, and the identification of the XB-45 initially destroyed, remained unclear. North American Aviation provided its testing hour total, but the figures did not agree with those obtained from Air Force sources. The most striking examples of the inadequacy of old records undoubtedly pertained to test data—not only on the B-45 bomber, but on other early aircraft as well. This was understandable to some degree because Air Force tests were accomplished at numerous bases and for a great variety of purposes. In any case, all dates and information supplied on the B-45 are based upon documentary evidence. Bits and pieces included in the B-45 coverage are provided in the belief that they may be significant to users.

[13] Obviously, the quantity of B-45s first ordered had been increased, but the contract amendment's date as well as other details are no longer known. A second contract (AC-18000) had been issued in February 1947, either on the 7th or 17th day of that month. This contract dealt with another version of the B-45 (see p 88), but the information also is sketchy. Reportedly, a third contract (W33-038 AC-21702) came into being in June 1948, when the Air Force as a whole showed scant enthusiasm for the aircraft, only to be canceled on an unknown later date.

[14] The Aircraft and Weapons Board was established in August 1947. It made recommendations on problems submitted by the Air Staff and the commands. Composed of the Deputy Chiefs of Staff and major air commanders, the board proved too cumbersome and in December 1948 was replaced by the USAF Board of Senior Officers which included the Vice Chief of Staff, Deputy Chief of Staff for Operations, Deputy Chief of Staff for Materiel, and the Commanding General, Air Materiel Command. The dormant Aircraft and Weapons Board was discontinued in the fall of 1949. However, the establishment of the Air Council in April 1951 was accompanied by the formation of 4 additional boards: the Force Estimates Board; Budget Advisory Board; Military Construction Board; and a new USAF Aircraft and Weapons Board which replaced the Senior Officers Board. The reactivated Aircraft and Weapons Board lasted for over a decade. (For details, see Herman Wolk, *Planning and Organizing the Postwar Air Force*).

the weight of the various types of aircraft earmarked for or already in production could be reduced. Several conferences ensued, special attention being devoted to the B–45, with some board members suggesting that elimination of the co-pilot position, of the AB/ARC–18 liaison set installed in that position, and of the B–45's tail bumper would take 700 pounds off the aircraft's empty weight. There were other suggestions, some of them equally haphazard. Col. William W. Momyer,[15] who represented TAC at these conferences, discovered that the Air Staff labored under the false impression that TAC did not consider the B–45 suitable for bombardment operations, a conclusion probably based upon previous studies by the command on the aircraft's excessive take-off distances. In the early fall of 1948, by which time 190 B–45s were tentatively scheduled for production, the program's future still remained uncertain. Headquarters USAF wanted to know if TAC needed a reconnaissance aircraft, and if so would a reconfigured B–45 be satisfactory? If this should be the case, all B–45s would be converted to the reconnaissance role. TAC's answers came promptly. Indeed the command needed a new reconnaissance aircraft, but a reconnaissance version of the B–45 would not fulfill its requirements. TAC believed the Air Force would accrue more benefits by equipping 2 groups with the B–45 in order to determine the tactics and limitations of jet bombers. The merits of TAC's recommendations became academic, as budgetary restrictions and other unexpected developments altered all planning.

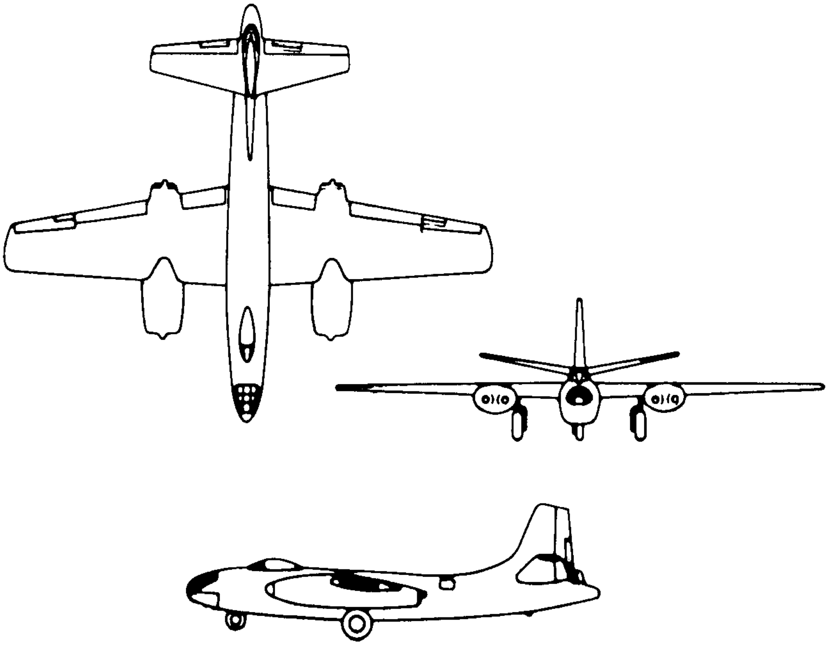
Enters Operational Service — November 1948

B–45A–5s began reaching squadrons of TAC's 47th Bombardment Wing at Barksdale AFB, Louisiana, in the fall of 1948. Despite slippages, 96 B–45As were completed by March 1950. Unfortunately, during the intervening months financial problems had already begun to take their toll on the B–45 program.

Program Reduction — 1948–1949

The budgetary axe that slashed the fiscal year 1949 defense expenditures did not leave the B–45 program unscathed. According to plans, 5 light bomb

[15] Twenty years later, immediately after serving in Southeast Asia as Deputy Commander for Air Operations, Military Assistance Command, Vietnam, and simultaneously as Commander, Seventh Air Force, General Momyer, now a full general, assumed command of Tactical Air Command.



The B-45A, first flown in February 1948.

groups and 3 light tactical reconnaissance squadrons were included in the Air Force's goal of 70 groups.[16] The reduced Air Force program dictated by continued financial restrictions and, more specifically, by President Truman's budget for fiscal year 1950 brought into focus the Air Force's dilemma. The shrunken B-45 program called for only 1 light bomb group and 1 night tactical reconnaissance squadron, which meant that the procurement of the aircraft had to be scaled-down or that a substantial number of the aircraft would have to be placed in storage upon acceptance from the factory. Neither solution was attractive, but the Aircraft and Weapons Board quickly decided to cancel 51 of the 190 aircraft on order. Over $100 million would be released for crucial programs, and sufficient B-45s would be left to equip 1 light bomb group, 1 tactical reconnaissance squadron, plus a much-needed high-speed tow target squadron. Moreover, there would still be extra B-45s to take care of attrition throughout the aircraft's first-line life.[17]

Other Planning Changes 1948–1949

Five light bomb groups were included in the 70-group force planned by the Air Force. In reprogramming available forces to meet the 48-group composition and deployment imposed by current funding limitations, only 1 light bomb group was authorized. This group, the Air Force tentatively decided, would be allocated to the Far East Air Forces (FEAF) and would be equipped with B-45s. Specifically, the Air Force intended to inactivate Barksdale's 47th Group and to replace the B-26s of FEAF's 3d Light Bomb Group, at Yokota Air Base in Japan, with the B-45s of the defunct group. Maintenance personnel of the 47th also would be transferred to Yokota so that FEAF would benefit from the B-45 "know how" gained by the aircraft's first recipient. But even logical and simple plans could go astray. Available and in-coming B-45s could not carry sufficient fuel to fly to Hawaii, and equipping the aircraft with additional fuel tanks, a probable

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[16] See B-36, pp 25-26.

[17] The first-line life of an aircraft cannot be predetermined, only predicted. As a rule, an aircraft remains "first-line" as long as it is "operational," "modern," and "capable of being used to perform critical and essential Air Force missions." Conversely, an aircraft becomes "second line," when its limitations for combat or other military use have been formally recognized. However, second-line aircraft may be called for first-line duty under certain circumstances—in emergency, and in services for which first-line aircraft are not available.

feature of future B-45 models, was at the time impossible.[18] Of course, it might have been practical to move the B-45s to Japan by sea. If a minimum of 10 feet could have been removed from each of the aircraft's wings, a rather impractical expedient, 3 B-45s could be deck-loaded on a Liberty or Victory ship, for a transport fee of approximately $4,000 per aircraft. The use of other sea transports might also have proved possible, but further investigation came to a halt. Early in 1949, the Deputy Chief of Staff for Materiel stated that the overseas deployment of B-45s was out of the question for the time being as well as the immediate future. To begin with, the B-45s were not truly operational. They had no fire-control or bombing equipment, and a suitable bomb sight was yet to be developed for the aircraft. Structural weaknesses, such as cracked forgings, had been uncovered in some of the few B-45s already available. And until corrected, such deficiencies certainly precluded any deployment abroad. Still another impediment arose. As reported by Air Materiel Command (AMC), the new J47 engine due to equip most of the B-45s suffered from serious problems. The engine had to be inspected thoroughly after 7½ hours of flying time; if found still serviceable, it could only be flown an additional 7½ hours before requiring a complete overhaul. Lack of money prevented the purchase of sufficient spare engines to ensure that, if deployed overseas, the B-45s could be kept flying. AMC anticipated difficulties, even for those aircraft that remained in the U.S., not far from the depots where the engines had to be inspected and overhauled. By mid-year, the home-based B-45s were expected to need 900 spare engines, none of which would be available. The shortage was compounded by the fact that F-86 requirements for J47s had first priority.[19] Little relief could be expected, AMC concluded, until jet engines could be used for almost 100 hours between overhauls. At best, this meant that no jet aircraft could be stationed out of the country for another year.

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[18] B-45A-1s, equipped with J35 engines, had a ferry range of 2,120 miles and a take-off weight of 86,341 pounds that included 5,800 gallons of internal fuel. Almost half of the fuel was contained in two 1,200-gallon bomb-bay tanks and no additional fuel space was available. Incoming B-45-5s, equipped with J47 engines, had a similar take-off weight and a negligible range increase of 30 nautical miles. Obviously, General Fairchild's interest in weight reduction retained its validity, but there were no simple solutions. Ferry ranges were computed on the basis that the aircraft's wing tip tanks and bomb-bay tanks were retained when empty. If an increase of the weight figure was desired by a using agency, a reliable rule of thumb up to 1,000 pounds, Air Materiel Command engineers pointed out, was that every extra pound of weight induced a range decrease of 0.025 nautical miles. A corresponding small increase in range could be achieved by weight reduction.

[19] The 1-engine F-86 Sabres, also produced by North American, began entering operational service in 1949, but did not go overseas before December 1950.

Deficiencies and Malfunctions 1949–1950

Difficulties encountered by B–45 units, while impairing further the training of jet pilots, posed serious operational problems. The B–45's flaws varied in importance, but were numerous. High speeds affected the Gyrosyn compass[20] and the E–4 automatic pilot, when the aircraft's bomb-bay doors were open. The emergency brake, which was tied to the B–45's main hydraulic system, was unreliable. Because of poorly designed bomb racks, the bomb shackles became unhooked during certain maneuvers. The B–45's airspeed indicator was inaccurate, and the aircraft's fuel pressure gauges were both difficult to read and erratic. Another safety hazard derived from the engines which, when first started, often caught fire because the aspirator system worked improperly. The temperature gauge of the aircraft's tail pipe, moreover, was so poorly calibrated that it could not indicate the temperatures experienced at high altitudes.

Special problems, with many ramifications, stemmed from the B–45's AN/APQ–24 bombing-navigation radar system, and the fact that hardly any B–45s had already received such equipment did not minimize present or future difficulties. Malfunctions of the pressurization pump limited the altitude at which the APQ–24's receiver and transmitter component could operate. The modulator component of the system was not pressurized at all and likewise limited the APQ–24's utility. In addition, the faulty position of the radar antenna affected the coverage of targets as soon as the APQ–24 had to operate at an altitude of 40,000 feet. In fact, the radar system's overall location left a great deal to be desired, a shortcoming shared by several other components. When utilizing the APQ–24, the B–45 observer had to manipulate 2 mileage control dials, placed to his right and about 1 foot behind his back, while observing the radar scope directly in front of him. The layout of the B–45's radar system was not any better from a maintenance standpoint. The Air Force still lacked sufficient qualified personnel for maintenance and repair, and it took 8 hours just to remove and replace the APQ–24's modulator, one of the system's numerous troublesome links. Contributing to the dismal maintenance situation were shortages of spare parts, special tools, and ground handling equipment as well as engine hoists, power units, and aero stands.

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[20] The trade name for a compass that consisted of a directional gyro synchronized with the horizontal component of the earth's magnetic field by means of a flux gate—the flux gate detecting the direction of the lines of force and transmitting the information electrically to a procession device.

Decision on Nuclear Capability 1950

Prior to 1949, the Air Force did not consider seriously the tactical employment of atomic weapons apart from their use for strategic air warfare. The most important reason was the AAF and Air Force's allegiance to the primacy of strategic air warfare per se.[21] Another factor was the belief that atomic weapons, because of their great cost and the scarcity of fissionable material, would remain relatively few in number. When the

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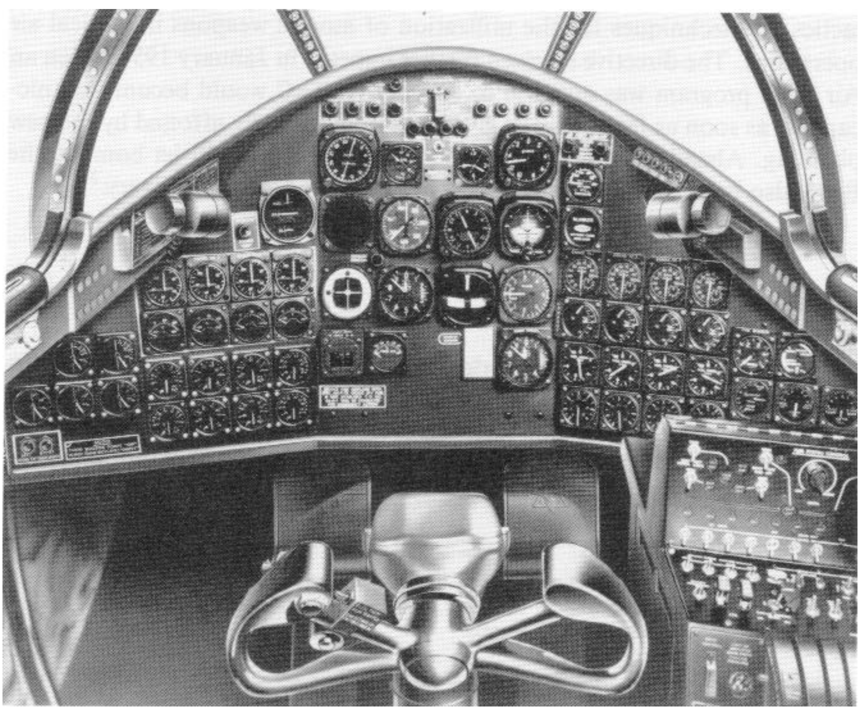
[21] After the German surrender, AAF leaders declared their long-held theory of strategic bombing had been proved— that massive bombing of selected vital targets in a nation's interior could cripple its war-making capabilities and seriously weaken the people's will to resist. Critics argued that strategic bombing had failed to achieve its objectives, that its cost was excessive, and that tactical air power had made the greater contribution to Allied victory. Despite the controversy, it soon became obvious that Boeing's spectacular B-17 Flying Fortresses and subsequent B-29 Superfortresses had a greater impact on U.S. policy than the best known World War II fighters.



The cockpit of the B-45 Tornado, specially designed so the pilot could view all indicators at a glance.

development and large quantity production of small nuclear weapons became probable, the Air Force earmarked such weapons again for strategic use, especially as warheads for proposed guided missiles. Nevertheless, the Weapons Systems Evaluation Group conducted a study on the use of the atomic bomb on tactical targets, after evaluating the effect of the bomb on such targets as troops, aircraft, and ships massed for offensive operations, as well as naval bases, airfields, naval task forces, and heavily fortified positions. Concluded in November 1949, the study found nuclear bombs to be effective on all targets. Although informal in nature, the Weapon Systems Evaluation Group's study was noted by the Air Staff. Yet no action was taken until mid-1950, when the outbreak of the Korean War underlined the weakness of the North Atlantic Treaty Organization forces, should the Russians decide to seize the opportunity to attack in Europe. From then on events moved promptly. The lion's share of the atomic responsibilities, including the retardation mission that normally would fall under the tactical sphere of activities, was retained by the Strategic Air Command (SAC),[22] but the use of atomic or thermonuclear weapons would become Air Force-wide. On 14 November 1950, the Air Staff directed TAC[23] to develop tactics and techniques for the utilization of atomic weapons in tactical air operations. The directive received further impetus in January 1951, when an Air Staff program was outlined to ensure that TAC would become atomic-capable as soon as feasible. The B–45 was tremendously affected by the new planning. Already established as the Air Force's first multi-jet bomber, the B–45 also became the first light bomber fitted for atomic delivery.[24]

Immediate Setback 1950

Ordered in the wake of World War II as a SAC medium bomber, the B–45 was designed to carry the A-bomb.[25] But the secrecy surrounding the production of the first atomic weapons created difficulties for which neither the contractor nor the AAF could be blamed. Because of faulty informa-

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[22] The retardation mission consisted of bombing operations to slow or stop the advances of ground forces. The latter rightly belonged to the fleeting target category, and SAC did not retain the retardation mission permanently.

[23] TAC, part of the Continental Air Command since December 1948, regained major command status on 1 December 1950.

[24] The deterrent impact of the B–45 remained unknown. Moreover, the aircraft represented but a tiny segment of the Air Force's early atomic armada.

[25] For details, see B–47, pp 111–112.

tion, the B-45 from the start could not have been used as an atomic carrier without significant internal modifications, the principal obstacle being a large spar extending laterally across the aircraft's bomb bay. However, the problem had become moot quickly, the small, short-range B-45 being reclassified as a light bomber in September 1947 and reallocated to TAC.[26] Ironically, the decision to extend the use of atomic weaponry to all combat forces meant that most of the B-45s acquired by TAC would no longer remain under the command's direct control. It also meant that TAC, now due to develop tactical operational techniques with the new weaponry, would have to do so with too few aircraft. In the meantime, the Air Force faced other problems. While the post-World War II achievements in the atomic field had been spectacular, and safer and lighter atomic bombs entered the stockpile much sooner than expected, intensive secrecy again had accompanied the new developments. Hence, as in the case of the old atomic bomb, the B-45 would be unable to carry any of the new weapons without first undergoing extensive modification.

Special Modifications — 1950-1952

The special modification program, spurred by the Air Force's decision of mid-1950, was not allowed to linger. In December 1950, 5 months after tentatively earmarking 60 B-45s for atomic duty,[27] the Air Staff directed AMC to modify a first lot of 9 aircraft to carry the small bombs for which designs were then available. This initial project would allow suitability tests by the Special Weapons Command,[28] and give TAC at least a few test aircraft to undertake its new tasks. As a beginning, 5 of the 9 aircraft would be equipped with the scarce AN/APQ-24 system; the remaining 4, with the AN/APN-3 Shoran navigation and bombing system, plus the visual M9C Norden bomb sight. North American would bring the 9 light bombers to the required special weapons configuration for a total cost of $512,000. In mid-1951, the program for operational use of the B-45 in potential atomic operations was established. The aircraft in this program were nicknamed

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[26] See B-36, p 21.

[27] Enough for 3 squadrons of 16 aircraft each, plus 12 attrition aircraft. This total, reduced to 40 aircraft in mid-1951, was re-increased in mid-1952, when 15 other B-45s were added to the special modification program.

[28] A separate command of short duration. Established in December 1949, the Special Weapons Command was redesignated Air Force Special Weapons Center and assigned to Air Research and Development Command in April 1952, losing major command status at that time.

Backbreaker and included, in addition to the B-45 light bombers, 100 of the many F-84 fighter-bombers built by the Republic Aviation Corporation.[29] Moreover, the program was accorded a priority second only to a concurrent and closely related modification program involving various SAC bombers. In the early fall of 1951, the program received further impetus. The Air Staff confirmed that modified B-45s, equipment, and allied support had to be supplied to enable units of the 47th Bombardment Wing in the United Kingdom to achieve an operational atomic capability by 1 April 1952. In addition to the first lot of 9 aircraft, the program would count 32 B-45s, the latter aircraft's modification cost being set at $4 million.[30] The Air Staff wanted 16 of the planes to be ready by 15 February 1952; the remainder, by 1 April. These were ambitious plans. Remodeling the B-45 aircraft to the Backbreaker configurations was an extensive operation. Equipment had to be installed in the aircraft for carrying 3 distinct bomb types, and this necessitated some structural modifications to the bomb bay.[31] Then too, a large amount of advanced electronics support equipment had to be added, in place of the standard equipment. Also, the aircraft had to be fitted with a new defensive system and extra fuel tanks. North American and the Air Materiel Command's San Bernardino Air Materiel Area, in San Bernardino, California, shared modification responsibilities for the B-45 Backbreaker program. In early 1952, the 9 B-45s, already brought to a limited Backbreaker configuration by AMC and North American, were sent by TAC to San Bernardino for completion of the modifications. Complete reconfiguration of the other 32 B-45As also took place at the San Bernardino Air Materiel Area during the first 3 months of 1952, with North American furnishing all necessary kits. That the work was done without significant delay was noteworthy, for all parties had to overcome serious difficulties. Much of the electronic and support components required for the Backbreaker configuration, being new and of advanced designs, were in very short supply. The requirement for the AN/APQ-24 radar was in direct competition with a SAC special program. Also, the few available AN/APQ-24 sets had to be adapted to the special weapons configuration. Shoran sets, as well, were not readily available, and a quantity had to be diverted from Far East Air Forces' and TAC's B-26 programs. There were other challenges. Some of the new equipment could not be installed before

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29 The aircraft were modified F-84Es, identified as F-84Gs.

30 One B-45A was destroyed by fire in February 1952 and not replaced, thus reducing the total from 41 to 40. Of the $4 million allocated to the project, some of the funds came from other Tactical Air Command projects which had to be canceled.

31 Special cradles were provided for the 3 types of bombs; and special hoisting equipment was required for loading each type of bomb on the Backbreaker B-45.

connecting parts were manufactured. In addition, some needed components simply did not exist. For example, the bomb scoring device, which consisted of a series of switches and relays, was actually manufactured at San Bernardino. The Air Materiel Area also made parts for the A-6 chaff dispenser, including a removable chute for easier maintenance. In the same vein, a special fuel flow totalizer was produced by North American, which likewise manufactured special tie-in equipment for the AN/APG-30 radar and the rest of the Backbreaker B-45's tail defense system. Finally, the Fletcher Aviation Corporation of Pasadena, California, produced the extra fuel tanks, while AMC's Middletown Air Materiel Area in Middletown, Ohio, built the special slings that had to be used to carry some of the new bombs.

Overseas Deployment 1952

Atomic-capable B-45As began reaching the United Kingdom on 1 May 1952, and deployment of the 40 aircraft was completed on 12 June. This

Tornadoes of the 47th Bombardment Group, Langley AFB, are prepared for deployment to the United Kingdom, July 1952.

schedule fell about 30 days behind the Air Staff deadline, but was a remarkable achievement considering the project's magnitude. Not only had the Backbreaker modifications proven exacting, but the Air Force had to cope with various engine problems. As reported by the General Electric Company field representatives servicing the 47th Bombardment Group throughout most of 1951 the J47s powering the Backbreaker aircraft shared some of the flaws of the aircraft's initial engines. Turbine buckets of the new J47s ruptured like those of the Allison J35s. Tail cones fractured just as easily when the J47s functioned improperly. Oil leaks appeared, which meant that the engines had to be removed for repairs and test runs. The Air Force did not expect any new engine to be problem-free from the start, but the urgency surrounding the Backbreaker program made these difficulties more significant. Besides, TAC had to take care of many other tasks. The B–45 deployment called for a somewhat more integrated atomic weapons support system than that used by SAC. TAC had immediately envisioned a concept that actually emphasized the mobility, flexibility, and speed characteristic of tactical air operations. While the TAC concept and the demands it necessarily entailed were not all approved, the Air Staff had endorsed the salient points of the command's proposal. As a result, after being activated on 31 August 1951, the 1st Tactical Support Squadron moved to Europe in the spring of 1952. Once overseas, the support squadron was attached to the 47th Bombardment Wing,[32] now a Third Air Force unit of the United States Air Forces in Europe. Like the Backbreaker modification program, the logistic organization and supply system devised by TAC had required much work. Still the system soon was accused of being unwieldy, wasteful of personnel, and unsuited to the support of delivery operations from widely dispersed bases. Modified during the ensuing year, TAC's revised atomic weapons support system was expected to allow greater dispersion in weapon storage and to provide the flexibility essential for varied theater requirements.

New Modifications and Retrofit — 1952–1953

In July 1952, the Air Force decided to increase the number of atomic B–45 aircraft by 15. The endorsed configuration was to be that of the Backbreaker aircraft, plus improvements. In short, some electronic changes were needed, the Backbreaker aircraft's tail defense system had to be upgraded, and the fuel flow totalizer, which had been required for the first

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[32] TAC's 47th Wing was at Langley AFB, Virginia, in early 1952. The B–45 overseas deployment prompted the wing's relocation to Royal Air Force Station Sculthorpe, England.

40 Backbreaker B-45s but had not been installed because of production delays, was to be added. Another important change, perhaps the most important, called for relocation of the supports required by a specific type of atomic bomb. The supports had to be moved into the forward bay to allow the installation of a 1,200-gallon fuel tank in the rear bay, since theextra fuel would give the aircraft a range increase of almost 300 nautical miles.

In September 1952, after conferring with North American, the Air Force decided on the improved Backbreaker configuration and established a program for procurement and installation of the necessary kits. The Air Force allocated $2.2 million for modification of the 15 additional B-45s, and $3 million for retrofit of the first 40 Backbreaker aircraft. Logically, the San Bernardino Air Materiel Area was to take care of the new modifications and would also provide all necessary kits for the Backbreaker retrofit, which would be done in the field. Although less involved than the original Backbreaker modifications, the new program slipped. During the second half of 1952 the Air Materiel Command was in the process of decentralizing responsibilities from its headquarters to the various air materiel areas. Hence, delays occurred in processing engineering data and purchase requests which, in turn, retarded kit preparation and delivery by North American.

Contractual problems, too, occurred at North American, as the contractor was no longer tooled for the B-45 and was working to capacity on other products. As a result, kit deliveries did not start until July 1953, pushing installation back 4 months. In September 1953, the Air Force added 3 B-45s to the modification program, but as 2 of the original aircraft had been deleted and 1 had crashed, the total still remained at 15. Because no more B-45As were available, 3 of the subsequent models in the B-45 series were modified, postponing the program's completion to March 1954.

Remaining Shortcomings 1953-1954

While the Backbreaker modifications and retrofit enabled the B-45s to handle several types of small atomic bombs, the modified aircraft were not fitted to deliver the special atomic bombs needed for the retardation mission.[34] In 1953, because of the increasing availability of atomic weapons, the Air Force thought of relieving SAC from the retardation responsibility. However, the matter again was dropped, since no tactical aircraft would be able to satisfy the retardation requirements until the Douglas B/RB-66s

[34] The retardation mission covered the slowing down of enemy troop movements or lines of supply by air interdiction, in this case, tactical bombing.

Subsequent Model Series — B/RB-45C

Other Configurations — B-45B and TB-45A

B-45B—A basic B-45 offering new radar and fire-control systems. This projected variant did not reach production.

TB-45A—Some of the early B-45As, bare of most components and equipped with Allison engines until re-fitted with more powerful J47s, were used to teach pilots the tricky new skill of jet flying. Occasionally referred to as TB-45As, a few of them were brought up to the Backbreaker configuration.

Phaseout — 1958

In January 1958, less than 50 B-45s remained in the Air Force's operational inventory. These multi-jet bombers, the first ever assigned to a combat unit, belonged to the 47th Bomb Wing (Tactical) which, 10 years before, had also been the first to fly them. However, the wing's conversion to Douglas-built B-66s was underway, spelling the B-45's end. By July 1958, the obsolescent B-45s had left Sculthorpe Air Station for other bases in Europe and North Africa, where they were briefly used for fire fighting training. Late in the summer of 1958, a few B-45s stood under the hot Spanish sun at Moron Air Base, where they were to be junked and sold for scrap.

Other Uses

One B-45A, designated JB-45A,[37] served as an engine test bed for a

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costs subsequent to approval of basic contract. As was often the case, the Air Force endorsed this price formula because of fluctuations of costs and cost arrangements during the production period of the entire program.

[37] The classification letter J, like the classification letters X and Y (see p 63) symbolizes the special status of a vehicle, be it an aircraft, a ship, or a missile. The letter or prefix symbol J shows that the vehicle is assigned to a special test program. This program may be conducted in-house, or may require a formal loan contract usually referred to as bailment contract. In either case, whatever modifications are made to accommodate testing are temporary. Upon test completion, the vehicle is returned to its original configuration, or returned to standard operational configuration. The same status prefix symbols, or classification letters, are used by all services of the Department of Defense.

entered the TAC inventory, a prospect several years away.[35] Other possibilities were entertained in 1953 and 1954. Quantum technological jumps made it likely that small thermonuclear weapons would be obtainable sooner than anticipated. Since modified B–45s and a whole family of fighter-bombers could now carry some of the small atomic bombs, modified B–45s and other aircraft presumably could also be made to deliver, within their range limitations, thermonuclear weapons of similar weight and dimensions. Such possibilities, as sound as they later proved to be, in the B–45's case did not go past the theoretical stage.

End of Production — March 1950

The B–45A production ended in March 1950, when the Air Force took delivery of the last aircraft.

Total B–45As Accepted — 96

The Air Force accepted its 96 B–45As over a period of 24 months, the first deliveries being made in April 1948.

Flyaway Cost Per Production Aircraft — $1.1 million

The $73.9 million procurement contract of 1946 provided for 96 B–45As, which would put the aircraft's unit cost below $800,000. However, the basic cost of each B–45A was finally set at $1,080,603—airframe, $682,915; engines (installed), $189,741; electronics, $81,907; ordnance, $552; armament (and others), $125,488. The same price tag was assigned to every model of the B/RB–45.[36]

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[35] Although the A3D, from which the B/RB–66 derived, served well in the tactical role for the Navy, the Air Force bought it without illusions, knowing the Douglas aircraft could not become the tactical bomber truly needed by the Tactical Air Command (TAC). Similarly, the B–57 was ordered for TAC in 1951 as an interim recourse. The Martin B–57, a night intruder bomber primarily, was first earmarked for atomic operations only because the number of B–45s was limited. And as with other post-World War II planes, the alternate use of reconnaissance models of the B–57 and B–66 as atomic bombers also was being planned. In any case, not only did production of the B–57 and B–66 slip but the 2 programs proved troublesome, which hardly lessened TAC's predicament.

[36] The B/RB–45's identical unit price represented an average reached regardless of contractor or fiscal year procurement and did not reflect engineering change and modification

Westinghouse development. The B–45 light bomber was also tentatively earmarked for a special duty. Believing that utilization rather than aircraft design and construction determined whether a plane was a tactical or a strategic tool, TAC thought the B–45 might be used for close air support operations. There were good reasons for the command's investigation. Sufficient close support of ground forces could not be mustered from the tactical units available in early 1950. Moreover, the bombardment classification of an aircraft in no way obviated the aircraft's potential close air support role. Still, the project was killed in infancy. To begin with, the B–45 was not rugged enough to accomplish the necessary ground attack maneuvers. In addition, modification costs to equip the aircraft properly would be quite high. Finally, the extra equipment would compromise the B–45's capability for level bombing.

B/RB-45C

Manufacturer's Model NA-153

Previous Model Series B-45A

New Features

Few new features separated the B-45C from the B-45A. The B-45C was equipped for air refueling[38] and fitted from the start with wing tip tanks.[39] The RB-45C also looked like the B-45A, except for a small bump on the tip of the aircraft's nose, where a forward oblique camera was enclosed. The RB-45C in addition featured a water injection system for increased take-off thrust that utilized two 214-gallon droppable tanks suspended beneath the nacelles by means of assisted take-off suspension hooks. If preferable, the RB-45C could make use of 2 droppable assisted take-off rockets located on the underside of the nacelles. The RB-45C included sweeping internal changes. Five stations were provided, and these stations could mount 10 different types of cameras. However, the crew could not move to the aft camera compartment when the RB-45C was flying; in-flight access to the bomb bays was possible, but only if the bomb bays were empty, the bomb-bay doors were closed, and the pressurized compartments were depressurized.

Basic Development 1947 and 1949

North American began working on the B-45C design on 22 September 1947, 2 months after the AAF had endorsed the aircraft's production.

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[38] The air refueling arrangement consisted of a boom receptacle located on the top of the fuselage, about midway, and of a single-point refueling receptacle on the left side aft of the bomb bays.

[39] The B-45C was often flown with 1,200-gallon wing tip tanks; when full, each fuel tank weighed some 7,500 pounds.

Design of the RB-45C was initiated in January 1949, when the entire B-45 program was significantly reduced.[40]

Production Decision 1947 and 1949

The Air Force decided to buy a sizable fleet of B-45Cs on 3 July 1947 and signed the necessary document (Contract AC-18000) in October of the same year. But after only 10 B-45Cs were completed, numerous change orders were issued that drastically altered the October contract. Procurement was limited to the 10 B-45Cs already built, plus 33 airframes that were to be modified on the production lines to serve as photo-mapping and reconnaissance aircraft.[41] As it turned out, the RB-45C order marked the end of the B-45 production run.

First Flights 1949 and 1950

The B-45C first flew on 3 May 1949; the RB-45C in April 1950.

Enters Operational Service 1950-1951

The Air Force started taking delivery of the B-45C in May 1949 and of the RB-45C in June 1950. Even though a few of the aircraft were deployed overseas in late 1950, no B/RB-45C unit reached an initial operational capability (IOC) before 1951. The RB-45Cs were earmarked for SAC, primarily. The command's inventory reached a peak of 38 aircraft in 1951, some B-45s being included in this total. However, no B/RB-45 aircraft remained on the SAC rolls in 1953. Yet, this did not spell the RB-45's end.

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[40] The additional production of 2 B-45Cs and 49 RB-45Cs (Manufacturer's Model NA-162), under contract since 17 June 1948, was canceled either in late 1948 or early 1949. Although money was a factor, the Air Force's belief that a reconnaissance version of the B-47 would be superior to the best RB-45 nailed the cancellation.

[41] Lt. Gen. Curtis E. LeMay replaced Gen. George C. Kenney as Commander of the Strategic Air Command on 19 October 1948. SAC's new Commanding General had commanded the B-29 strikes against Japan during World War II and lost no time in re-emphasizing to Air Force officials at the highest level the importance of reconnaissance. In fact, every bomber produced after World War II had a genuine reconnaissance counterpart, or could be used for reconnissance. In the latter case, it might take but a few hours to prepare a given aircraft for the reconnaissance role, or to bring back the reconnaissance bomber to its original configuration. Sometimes the 2 versions of 1 aircraft were assigned to the same unit.

Like the B-45As, the aircraft served other Air Force commands for several more years.

War Commitments 1950–1951

The B/RB-45s were not officially committed to the Korean War,[42] but 3 TAC B/RB-45s reached the Far East in the fall of 1950. The small detachment, TAC personnel and civilian technical representatives included, departed for Japan in late September for the express purpose of measuring the reconnaissance capability of a configuration which had not yet been given the most telling of all tests, that of actual combat. Arrival of the RB-45s was well timed, as the RB-29s of the 91st Strategic Reconnaissance Squadron were no longer able to perform with impunity the special missions ordered by Far East Air Forces or the targeting and bomb-damage assessment photography desired by its Bomber Command. Eager to maintain its reconnaissance capability in the face of the Soviet-built MiG jets, Bomber Command on 31 January 1951 took control of the RB-45 detachment and attached it to the 91st Squadron. The RB-45 crews managed to outrun and outmaneuver the MiGs for several months. Yet, on 9 April 1951, 1 of the too few RB-45s barely escaped a numerically far superior enemy. In the ensuing months, while the RB-29s were no longer allowed to enter northwestern Korea, even with escort, the RB-45s could still go into the MiG-infested area if they had jet fighter escort. However, after another harrowing experience on 9 November 1951, the RB-45s also were restricted by Far East Air Forces from entering the sensitive areas of northwestern Korea in daylight. In January 1952, the 91st Squadron was directed to convert to night operations, but testing soon showed that the squadron's RB-45s could not be used for night photography because the aircraft buffeted too badly when its forward bomb bay was opened to drop flash bombs. In any case, deficiencies confirmed soon after the RB-45s had reached Japan,[43] plus the many commitments levied on the 33 aircraft, had foretold the eventual end of the RB-45's Korean experience.

End of Production 1950 and 1951

Production of the B-45C was completed on 13 April 1950, that of the RB-45C in October 1951, when the last aircraft were delivered.

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[42] The B/RB-45s were not shown on the Air Force listing of aircraft which participated in any fashion in the 3-year conflict.

[43] The 91st Strategic Reconnaissance Squadron thought the RB-45s were so unsafe for ditching that a Japan-based rescue plane held a station orbit over the Sea of Japan each time these planes crossed to Korea.

Total B/RB-45Cs Accepted 43

The Air Force accepted 10 B-45Cs and 33 RB-45Cs between May 1949 and October 1951.

Flyaway Cost Per Production Aircraft $1.1 million

The Air Force prorated the basic cost of the entire program. Consequently, the B/RB-45Cs carried the price tag of the B-45As.

Subsequent Model Series None

Other Configurations TB-45s

Some B-45s, after undergoing in-production modifications, assumed a training role usually assigned to elderly, surplus aircraft. This unusual project took shape early in 1949, when Secretary of the Air Force W. Stuart Symington informed Secretary of Defense James V. Forrestal that future technological trends in aircraft and weapons development called for various types of special training. Even though the procurement of aircraft had been cut, in line with President Truman's fiscal policy, steps had to be taken to keep improving the striking power of the Air Force within the approved 48-group structure. Hence, Mr. Symington recommended and Mr. Forrestal approved the conversion of 16 B-45Cs for tow target duty in order to teach anti-aircraft gunners high-speed, high-altitude firing. The B-45C conversion project, accomplished by North American, was allocated $1.6 million. Broken down, this meant that the modification of each aircraft cost about $80,000 and that $20,000 covered the spare components required by every plane. Targets and reels were supplied from current Air Force stocks. But as Mr. Symington had pointed out, there was no exact troop basis for the computation of tow target requirements. The 16 TB-45Cs proved insufficient for antiaircraft gunnery practice, so a few early B-45As were also converted as tow target airplanes. Unfortunately, the low thrust of the Allison J35 engines of the first B-45As prevented the additional conversions from performing well, and the TB-45A association with the tow target program was of short duration.

Phaseout 1958

The B/RB-45C phaseout followed the B-45A pattern. In mid-1959, only 1 RB-45C remained in the Air Force inventory.

Other Uses — JB-45C and DB-45s

In early 1950, the Air Force considered using some B-45s as aerial tankers for F-84s carrying special weapons. TAC wanted to know in particular the speed at which refueling, by means of the probe and drogue system, could best be accomplished. The command also asked how much extra fuel could be carried by the B-45, taking into consideration the weight of refueling gear and tanks. Although no actions were taken following these investigations, the Air Force determined that Republic F-84s could operate with a B-45 "Mother" aircraft as a "cell." The most serious handicap would be the necessity for lights during night formation. Without lights, night formation could be conducted with reasonable safety only under bright moonlight. It was also determined that, as a tanker, 1 B-45 aircraft could service 4 planes as well as 2, with the exception that the fuel available for each fighter would be proportionally reduced.

JB-45C. One B-45C, designated JB-45C after its temporary reconfiguration, served as engine test bed for Pratt & Whitney J57 and J75 engines.

DB-45. One B-45C and another unspecified B-45 model, designated DB-45s after conversion, were used as director aircraft in connection with the development of guided weapons.

Milestones — 1950 and 1952

The first air-to-air refueling of a jet aircraft was accomplished in 1950,

The RB-45C (left) was the first jet aircraft to be refueled in the air in this country. The tanker (right) is a KB-29A. 1950.

with a SAC RB-45C and a Boeing KB-29B tanker. On 29 July 1952, a 91st Strategic Reconnaissance Wing RB-45C (Serial Number 48-042), a SAC aircraft commanded by Maj. Louis H. Carrington, made the first nonstop, trans-Pacific flight from Elmendorf AFB, Alaska, to Yokota AB, Japan. This flight, made possible by 2 KB-29 inflight refuelings, earned Major Carrington and his 2-man crew the Mackay Trophy for 1952.

Program Recap

The Air Force accepted a grand total of 142 B-45s—XB-45s and reconnaissance versions included. Precisely, the B-45 program counted 3 experimental airplanes (one of which completed as preproduction article and sometimes referred to as prototype), 96 B-45As (some of them singled out as B-45A-5s because of in-production improvements), 10 B-45Cs, and 33 RB-45Cs. The entire small contingent (51 aircraft less than originally ordered) was produced by North American Aviation, Incorporated, of Inglewood, California, with most of the aircraft actually being built in a former Douglas facility at Long Beach, California.

TECHNICAL AND BASIC MISSION PERFORMANCE DATA

B/RB-45 AIRCRAFT

Manufacturer (Airframe)	North American Aviation, Inc., Inglewood, Calif.
Manufacturer (Engines)	The General Electric Co., Schenectady, N.Y.
Nomenclature	Light Tactical Bomber and Day or Night Photo-reconnaissance Aircraft.
Popular Name	Tornado

	B-45A	B-45A (Backbreaker)	B-45C	RB-45C
Length/Span (ft)	75.3/89	75.3/89	75.3/89	75.9/89
Wing Area (sq ft)	1,175	1,175	1,175	1,175
Weights (lb)				
Empty	45,694	47,022	48,969	50,687
Combat	58,548	67,820	73,715	73,200
Takeoff[a]	91,775	92,745	112,965	110,721
Engine: Number, Rated Power per Engine & Designation	(2) 5,500-lb st J47-GE-7 or -13 & (2) 5,000-lb st J47-GE-9 or -15	(2) 5,500-lb st J47-GE-7 or -13 & (2) 5,000-lb st J47-GE-9 or -15	(2) 5,000-lb st J47-GE-7 or -13 & (2) 5,000-lb st J47-GE-9 or -15	(2) 5,000-lb st J47-GE-7 or -13 & (2) 5,000-lb st J47-GE-9 or -15
Takeoff Ground Run (ft)				
at Sea Level	3,400	4,950	6,900	6,100
Over 50-ft Obstacle	4,930	7,570	8,960	8,070
Rate of Climb (fpm) at Sea Level	4,050	2,950	2,500	2,700
Combat Rate of Climb (fpm) at Sea Level	5,950	4,300	4,550	1,020

Service Ceiling (ft) at Combat Weight (100 fpm Rate of Climb, to Altitude)	46,400	1,700	41,250	41,500
Combat Ceiling (ft) (500 fpm Rate of Climb, Max Power, to Altitude)	32,800	8,000	37,550	37,800
Average Cruise Speed (kn)	408	401	405	404
Maximum Speed at Optimum Altitude (kn/ft)	496/3,500	492/Sea Level	498/Sea Level	495/4,000
Basic Speed at Altitude (kn/ft)	438/35,000	434/35,000	436/35,000	436/35,000
Combat Radius (nm)	463	764	876	916
Total Mission Time (hr)	2.4	3.9	4.47	4.6
Armament	2 .50-cal machine guns in tail turret	2 .50-cal M3 guns in tail turret	2 .50-cal machine guns in tail turret	2 M-7 .50-cal machine guns in tail turret
Crew	4	4	4	4
Maximum Bombload (lb)**	22,000 (1 Grand Slam) (1 12,000-lb Tall Boy) (2 4,000-lb general purpose bombs) (4 2,000-lb gp; 14 1,000-lb gp; 27 500-lb gp; & 16[b] 500-lb gp)	22,000 (1 Grand Slam) (27 100-lb M38A2 special bombs)	22,000 (1 Grand Slam) (1 12,000-lb Tall Boy) (2 4,000-lb general purpose bombs) (4 2,000-lb gp; 14 1,000-lb gp; 27 500-lb gp; &16[b] 500-lb gp)	25 M-122 Photo Flash, 188-lb each; Cameras, in various stations, 12 (3 K-17Cs, 1 K-38, 1 K-37, 1 T-11, 1 S-7A, 1 K-22, 2 K-37s, 2 K-38s)

[a] Limited by space.
[b] Loading allowed for 1 bomb-bay tank.

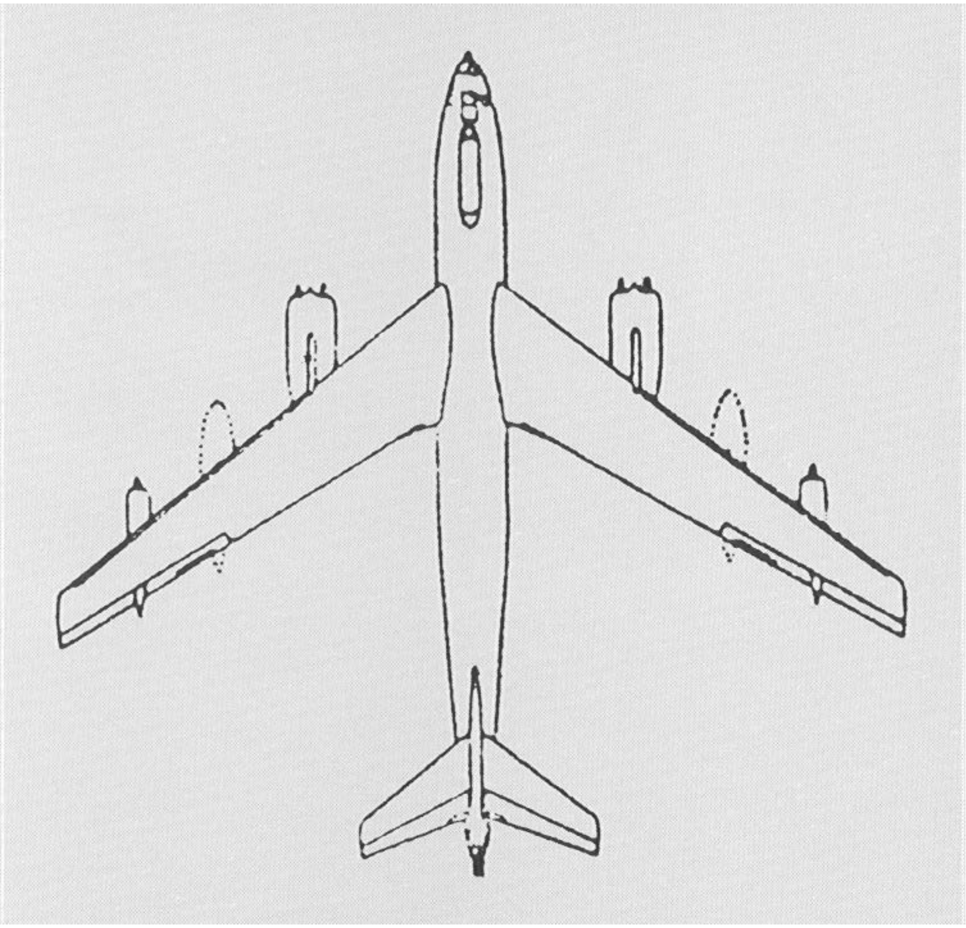
Abbreviations

cal	= caliber	kn	= knots
fpm	= feet per minute	nm	= nautical miles
gp	= general purpose	st	= static thrust

Basic Mission Note

All basic mission's performance data is based on maximum power. B–45 Backbreaker and B/RB–45C's combat radius formula: took off and climbed on course at maximum power to cruise ceiling, the latter being defined as that altitude at which the aircraft had the performance potential of making a 300-foot-per-minute rate of climb using normal thrust at momentary weight. Cruised at long-range power at cruise ceiling; 15 minutes prior to target, power was increased to normal power and bomb run was made to target. Dropped bombs, conducted 2-minute evasive action followed by an 8-minute normal power run out from target. Continued flight to base at long-range speeds at cruise ceiling. Under nacelle tanks and droppable bombing tanks were dropped when empty.

B-47 Stratojet
Boeing
Airplane Company



B–47 Stratojet
Boeing

Manufacturer's Model 450

Weapon System 100A

Overview

The B–47's production was spurred in 1944 by the War Department's demand for jet bombers. In contrast to the B–45, and other concurrent proposals, the B–47 design, as finally approved, included radically new features. Foremost were the aircraft's thin swept wings which, coupled with 6 externally mounted jet engines, promised a startling, high-speed bomber, probably capable of carrying out effective operations for the foreseeable future despite an enemy's fighter air defense. Undoubtedly, the B–47 lived up to expectations. More than 2,000 production models were bought, and some B–47 versions, true production models or post-production reconfigurations, remained in the operational inventory for nearly 2 decades. Yet few aircraft programs witnessed as much development, production, and post-production turbulence as the B–47 did. To begin with, there were arguments about cost and plant location and after 1947, complaints by Boeing that the newly independent Air Force had laid additional requirements that changed the concept of the overall program. Also, the secrecy which shrouded the development of atomic weapons, long after the atomic attacks on Japan, increased the difficulty of preparing the B–47 to handle every new type of special weapon—a problem shared by the B–36 and B–45. Ensuing events only compounded the initial disarray.

As it had for the B–36, the Truman Administration's stringent financial restrictions worked in favor of the B–47. Pressed for money, the Air Force decided to buy more B–47s instead of purchasing additional B–50s or future B–54s, since neither one of those rather expensive bombers had any growth potential. Hence, even though the B-47 was yet to fly, the initial production order of 1948 was increased in mid-1949. The subsequent Korean War, rising world tensions, and mounting urgency to build an atomic deterrent force raised the tempo of the B-47 program. In December 1950, the Air Force foresaw a monthly production of 150 B-47s, but still recommended changes, making it almost impossible to settle on an acceptable type. Other factors made matters worse.

The B-47 was the first USAF bomber to receive a weapon system designation, a move prompted by the Air Force recognition that the rising complexity of weapons no longer permitted the isolated and compartmented development of equipment and components which, when put together in a structural shell, formed an aircraft or missile. However, this was as far as the B-47 benefited from the new developmental philosophy. The Boeing airframe was built without adequate consideration for its many crucial components. In turn, the components, subcontracted or furnished by the government, were behind schedule and when provided, did not match the sophistication of the high-performance B-47.

In 1951 alone, the Air Force took delivery of 204 B-47Bs, none of which were suitable for combat. The aircraft's canopy was unsafe; the B-47B had no ejection seats (a deficiency shared by 200 successive B-47s); the bombing and navigation system was unreliable; a new tail defense system was needed; and the jet engines were creating unique development problems such as fuel boil-off at high altitudes, which reduced the aircraft's range—already shorter than anticipated. In sum, the hasty production of an aircraft as revolutionary as the B-47 proved to be costly, generating extensive, unavoidable modification projects like Baby Grand, Turn Around, High Noon, and Ebb Tide. Yet once accomplished, the B-47 modifications worked.

Finally deployed overseas in mid-1953, the B-47s totally replaced the obsolete, atomic-carrier B-50s by the end of 1955, when new B-47 production models were delivered that could carry larger fuel loads and thus had greater range. After the B-47 demonstrated that it was rugged enough for low-altitude bombing, some of the aircraft were again modified to satisfy a new set of requirements levied in 1955. These modifications also worked, and in 1957, the Air Force publicly demonstrated its new low-altitude, strategic bombing tactics, an achievement marking the beginning of an era in aeronautics.

Despite its convoluted start, the B-47 program proved successful. The aircraft served in various roles and was involved in many experimental projects, some connected to the development of more sophisticated atomic weapons, like Brass Ring, or with the development of air refueling or other endeavors of great significance to the Air Force. Strategic Air Command's last B-47s went into storage in early 1966, while a few converted B-47 bombers and reconnaissance models kept on paying their way for several more years, remaining on the Air Force rolls until the end of the 1960s.

Basic Development 1943

Development of the B-47 can be traced back to June 1943, when an informal Army Air Forces (AAF) request led several aircraft manufacturers to begin design studies of multi-jet aircraft that could be used for fast photographic reconnaissance or medium bomber missions.[1] General Electric's successful development of an axial flow jet engine, easier to install in wing nacelles than previous jet types, came at the same time. This undoubtedly was important. Boeing and several other companies quickly included the new engine in their planning. But more crucial to the aircraft's development was Boeing's use at war's end of captured German research data on the design of swept-back wings. This led in 1947 to the sensational XB-47.

Design Competition 1944

The informal requirements of 1943 became official on 17 November 1944. The AAF issued military characteristics for a jet-propelled medium bomber with a range of 3,500 miles, a service ceiling of 45,000 feet, an average speed of 450 miles per hour, and a top speed of 550. Besides the Boeing Airplane Company of Seattle, Washington, the other firms—North American Aviation, Incorporated, Convair, and the Glenn L. Martin Company—entered the design competition prompted by these requirements. The Boeing entry (Model 432), designated the XB-47 by the AAF, was a straight-wing design resembling a B-29 with much thinner wings and carrying 4 of the new General Electric axial flow jet engines. To overcome problems experienced with the engine pod-nacelles of a previous design, Boeing had buried the new engines inside the fuselage of Model 432. All

[1] Requirements had to be readied and money had to be found before a formal announcement could be made. Yet the procedure followed in June 1943 was not unusual and could only benefit the AAF. In this case, it might also have had the distinct advantage of keeping Boeing engineers busy and preventing them from drifting to Navy projects upon completion of their work on the development of a long-range bomber. The AAF already knew that Convair had pretty well clinched the long-range bomber program (a B-36 production order had just been issued) and that the concurrent procurement of a similar bomber was out of the question. (Boeing did not receive a study-contract for its "long-range" XB-52 until mid-1946.)

designs submitted by the other companies featured wing nacelles for housing the jet engines.[2]

Letter Contract — 1 February 1945

This letter contract authorized Boeing to spend up to $150,000 (against an estimated $1.5 million set aside for development) in a Phase I (wind tunnel) study of Model 432, Boeing's first entry in the recently opened medium bomber competition. The model nevertheless was rejected on the grounds that the location of the engines could be unsafe. The AAF actually thought that Boeing engineers should do more research in the basic jet problems associated with high-speed bombers. To achieve superiority in the air would require a new concept superior to any of the current bomber designs. Early in September, Boeing revised the original configuration of Model 432 and proposed its first swept-wing bomber design. Labeled Model 448 (the AAF designation remained XB-47), the new aircraft featured a thin wing swept back and 2 more engines—a total of 6 engines. The AAF liked the wing configuration of Model 448, but still insisted that housing engines inside a fuselage created a fire-hazard. Besides, externally mounted engines were easier to maintain and replace, which could add years to the service life of an aircraft. Boeing's hasty return to the drawing board resulted in Model 450, which carried 6 jet engines hung under the wings in pods—2 pairs in strut-mounted inboard nacelles and single units attached directly under the wing, at a distance of 8 feet from the wing tip. The AAF promptly approved Model 450 in October 1945.

Development Decision — December 1945

In December, a technical instruction authorized contractual negotiations for the development of 2 experimental aircraft. The AAF endorsed Boeing's proposal to build and test 2 flyable XB-47's for $9,357,800, counting the $1.5 million that had been set aside for development of the straight wing design (Model 432) initially submitted by Boeing. The proposed planes would be bare of any tactical equipment, but necessary space would be provided. The subsequent discovery that more equipment space was needed and that some structural changes had to be made raised

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[2] Letter contracts for development and mockups of the 3 designs were awarded in the fall of 1944, resulting in the North American XB-45, Convair XB-46, and Martin XB-48. Of these, only the North American XB-45 went into production.

Boeing's original quotation to $9,441,407. This figure also was approved, after the Wright Field price control experts concluded that the XB-47's cost of $95 per airframe-pound was reasonable and considerably lower than the corresponding costs of the XB-45 and XB-48 bombers. Nonetheless, the letter contract of February 1945 was not officially amended until 17 April 1946 (after completion of the XB-47 mockup).

Mockup Inspection — April 1946

The XB-47 mockup was completed, inspected, and approved in the spring of 1946. Army Air Forces personnel attending the XB-47 mockup seemed impressed. Just the same, the Mockup Committee suggested major changes in the nose compartment, pilot and co-pilot seating, and landing gear arrangement. The Chief of the AAF Requirements Division cautioned that any additional weight would cut down the speed of the XB-47, thus defeating the purpose for which the plane was designed.

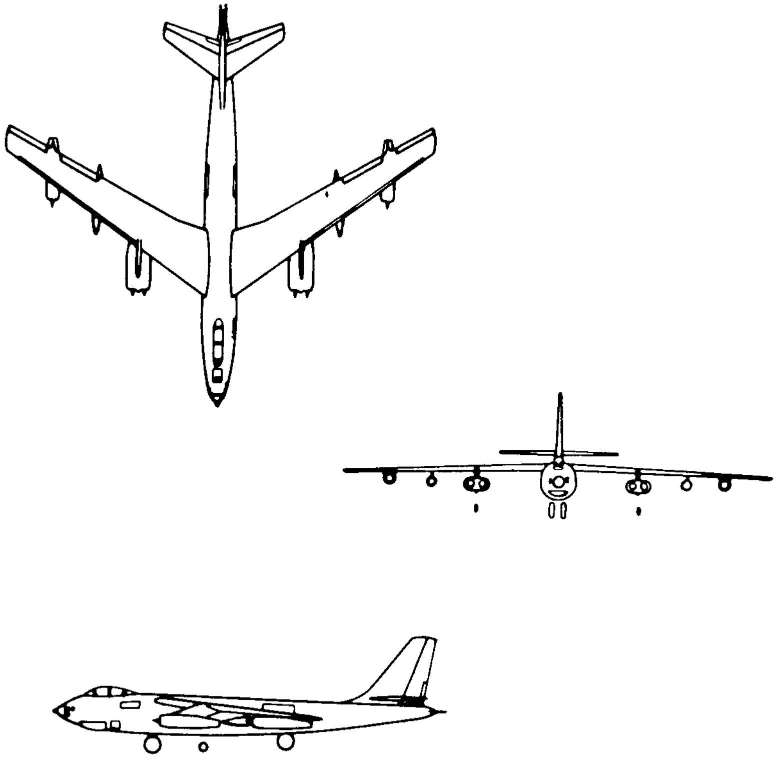
Development Slippage — April 1946–September 1947

Even though the XB-47 mockup had been well received, development of the experimental plane took longer than expected. Actual work began in June 1946, but progress was hampered by problems with the aircraft landing gear,[3] control surfaces, as well as bottlenecks in power plant installations. The initial lack of overtime pay for the Boeing personnel did not help. All told, a 6-month slippage occurred.

Definitive Development Contract — 10 July 1947

It took a year and a half to complete the contractual negotiations initiated by the technical instruction of December 1945. The definitive fixed-price contract (W33-038 ac-8429) of July 1947 called for 2 stripped XB-47s, spare parts, mockups of the completed airplane and fuselage, wing tunnel tests, and research data at a total cost of almost $9.7 million—about $25,000 more than the cost of the amended letter contract of April 1946,

[3] The XB-47's thin swept wing eliminated any possibility of suspending a landing gear or retracting one into it. The problem was solved, however, with the installation of a tandem gear, fairly similar to the type previously tested on a Martin B-26. The new arrangement had an additional advantage: reducing the XB-47's weight by 1,500 pounds.



First large American jet featuring swept wings—the XB-47.

which the fixed-price contract superseded. Moreover, the AAF estimated that post-test flight changes most likely would raise the aggregate cost of the contract to more than $10.5 million—a prediction that did materialize. By February 1950, numerous change orders had brought total costs near the $12 million mark.

XB-47 Roll-out — 12 September 1947

The first XB-47 rolled out of the Seattle factory in the same month that the United States Air Force was established. The plane was even more startling than the spectacular B-17 Flying Fortress had been 12 years before. The swept wing had already been used experimentally by the Bell Aircraft Corporation on 2 modified P-63 Kingcobras and by North American on the XP-86, first flown in October 1947, but this was the first time the design appeared on a large American jet.

First Flight (XB-47) — 17 December 1947

The experimental B-47 was flown from Seattle to nearby Moses Lake AFB, Washington, to begin a series of extensive flight tests. Bad weather delayed the flight until 17 December—44 years to the day after the Wright brothers' first manned flight at Kitty Hawk, North Carolina.

Testing — 1948-1954

The Air Force flew the first XB-47 (Serial No. 46-065) for about 83 hours, including nearly 38 hours of Phase II flight tests that were accomplished between 8 July and 15 August 1948. The contractor tested the XB-47 during most of the aircraft's 6 years of life, accumulating more than 330 hours of test flights in the process. In 1954, having been stripped of wings and engines, the experimental B-47 was cut in 2 and exhibited at Palm Beach AFB, Florida.

Appraisal — 1948

The Boeing pilots that first flew the XB-47 liked it. After completion of the first phase of testing, a Boeing pilot remarked, "The plane still is doing much better than anyone had a right to expect. We're still exploring one thing at a time, but every door we've kicked open so far has had good things inside." Just the same, the XB-47's overall performance proved disappointing. Its maximum altitude was 2,500 feet below the 40,000-foot ceiling proposed by Boeing and 7,500 feet lower than originally required by the AAF. Its speed was also slower than expected. In fact, in mid-1949 the XB-47 exchanged its six J35-GE-7/9 engines for the larger 5,200-pound thrust J47-GE-3s that equipped the second XB-47 from the start.

Acceptances 1948

The Air Force accepted the first XB-47 conditionally (minus certain equipment to be installed later by Boeing) on 29 November 1948. The second XB-47, first flown in mid-1948, was accepted the following month, under the same conditions. The Air Force took delivery of the experimental planes in December 1948, but lent them to the contractor in subsequent years. Like its predecessor, the second XB-47 was extensively tested. Boeing logged almost 100 hours of test flights; the Air Force, over 237.

B-47A

Manufacturer's Model 450-10-9

Production Decision — September 1948

The Air Force began to plan for the procurement of B-47 productions in December 1947—at about the same time the experimental version first flew—and planning in the following months centered on the production of 54 B-47s (13 B-47As and 41 B-47Bs). A serious misunderstanding arose during the ensuing negotiations. The Air Force assumed $35 million would pay for 10 aircraft and enough tooling for the production of an additional 44. Boeing thought tooling and plant expenses to build 54 B-47s would reach $31 million, without counting the actual cost of each plane. In any case, when Boeing received an official production go-ahead in September 1948, it was only authorized to proceed with the engineering, planning, tool design, procurement of tool materials, and placing of subcontracts for 10 B-47s, in an amount not to exceed $35 million. Moreover, production would not take place in Seattle, as Boeing wished, but at a government-owned plant in Wichita, Kansas—a shift that accounted in part for the slippage that later occurred.

Production Letter Contract — 22 November 1948

This letter contract (W33-038 ac-22413) covered a first order of 10 B-47As for $28 million and the future procurement of 3 additional B-47As and 41 B-47Bs, at a cost still to be negotiated. In keeping with routine procurement practices, the letter contract of November 1948 was amended more than once. First, the 3 additional B-47As were canceled; then on 28 February 1949, the number of B-47Bs on order was raised from 41 to 55.[4]

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[4] The Air Force had interrupted Boeing's testing earlier in the month and flown the first XB-47 to Andrews AFB, Maryland, where it was shown to members of the House Armed Services Committee. The 3-hour flight from Moses Lake AFB, Washington, on 8 February 1949 averaged 602.2 miles per hour over a 2,289-mile course and set an unofficial transcontinental speed record. Evidently, the XB-47 was capable of reaching great speeds, but the Air Force still considered its combat speed too slow.

The Air Force also ordered the design and construction of a ground test rig for the prototype jet-assisted take-off system that it believed future B-47s would need.

Program Reappraisal 1949

As in the case of the B-36, President Truman's decision in late 1948 to hold down defense expenditures worked in favor of the B-47. Pressed for money, the Air Force had to evaluate carefully its limited options. It finally decided to buy more B-47s, an aircraft that General LeMay, also a strong supporter of the B-36, much preferred to the B-50 or future B-54 (almost immediately canceled). The B-47 program increase was reflected in a June 1949 amendment of the basic production letter contract of November 1948. This noteworthy amendment (No. 8) authorized the expenditure or obligation of about $60 million (twice the original amount) for the purchase of 15 B-47s (10 B-47As, plus 5 B-47Bs) and follow-on procurement of 97 B-47Bs (not yet priced). Amendment No. 8 also covered the modification of the 2 XB-47s for use as partial prototypes of production aircraft. Production deliveries were scheduled for the period April 1950 through December 1951.

Definitive Production Contract 14 November 1949

It took months of hard bargaining to arrive at a fair price for the B-47Bs covered by the letter contract of November 1948, as amended in June 1949. The definitive $208.7 million contract (W33-038 ac-22413) of November 1949 was actually a compromise. The Air Force settled for 87 B-47Bs (15 less than planned during the preceding June), and Boeing's fixed fee was reduced. The contract still required that the B-47B be developed according to the new specifications that had been issued in September 1948. These called for single-point refueling (through 1 opening), tactical type assisted take-off (ATO) installation, external fuel tanks, increased gross weight (202,000 pounds after in-flight refueling), the K-2 bombing and navigational system (also earmarked for the B-47A), and an unmanned radar-controlled tail turret—all of which would require some redesign of the wing, body and landing gear. Delivery schedules, however, remained unaltered. The 10 B-47As were due between April and November 1950; the 87 B-47Bs, between December 1950 and December 1951.

First Flight 25 June 1950

Even though deliveries had been scheduled to start in March 1950, Boeing did not fly the first B-47A until 25 June. It took another year to deliver all 10 B-47As on order to the Air Force.

Testing[5] 1950-1951

Continued flight testing of the B-47A and of the first XB-47 revealed that neither plane was safe, mainly because both were underpowered. Also, critical braking problems occurred following refused takeoffs, and after gross weight landings on wet runways. In addition, after refused landings, go-arounds were hazardous owing to the jet engines' poor acceleration. The answer lay in equipping B-47 productions with higher thrust engines and drogue parachutes that would act as in-flight air brakes. But these remedies were not yet available. Modifications of subsequent B-47As yielded sufficient improvements, but not without considerable delay. Yet none of the changes recommended by a March 1950 USAF engineering inspection reached any of the B-47As.[6]

Enters Service May 1951

The B-47A entered service at MacDill AFB, Florida, with the 306th Bombardment Wing, Medium. The 306th had been told to prepare for the combat crew training of its own aircrews well in advance of the receipt of its first new plane, also that the 306th aircrews in turn would train the crews of other future B-47 wings. The arrangement, considered temporary since late 1950 when the B-47 program was almost doubled, lasted through December 1951. The Air Training Command then took over most of the training task, which in time proved even more complex than anticipated.

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[5] Runways of adequate length were available at Wichita, Kansas. Hence in line with the change of production location, testing was shifted from Seattle in the fall of 1949. Moses Lake AFB was transferred to the Continental Air Command at about the same time.

[6] Many factors accounted for the production slippage that plagued the B-47 program from the start. The XB-47's flight to Andrews in February 1947 set back Boeing tests for several weeks. Relocation from Seattle to Wichita took time. Modification of the second XB-47 in August 1950 and allocation of the aircraft to Operation Greenhouse (a Pacific atomic test scheduled for 1951) was another testing handicap. Still, Boeing claimed that the principal reason for the B-47A production delay was that the concept of both the B-47A configuration and the overall B-47 program had been changed by the Air Force in September 1948 (when the production decision was made). The Air Force, on the other hand, pointed out that the requirements of 1948 barely affected the B-47As. Also, the engineering changes requested in March 1950 were to be made on a "no delay" basis on the B-47Bs and had no bearing on the B-47As.

Subsequent Model Series

B-47B

Other Uses

1951-1952

None of the B-47As saw operational duty. Never considered as true production aircraft, the B-47As were unarmed and at first practically bare of components; upon delivery, only 4 of the 10 were equipped with the K-2 Bombing-Navigational System. One of their few advantages probably lay in their crew ejection seats, a controversial feature deleted from the first B-47B lots.[7] In addition to their training role, the B-47As were used in extensive tests. Some stayed with the Air Proving Ground Command. Two were designated to try out the A-2 and A-5 fire-control systems.

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[7] Boeing had problems from the start with B-47 ejection seat equipment. Canopy ejection technology in the early planes was reconsidered after an XB-47 accident in which the pilot was killed. Boeing then proposed an additional escape hatch and bail-out spoiler (much like the one eventually featured by the B-47B).

B-47B

Manufacturer's Model 450-11-10

Previous Model Series B-47A

New Features

The B-47B differed from the B-47A in many ways. It carried J47-GE-23 engines (6 of them) and solid fuel rockets for assisted take-off. It had a Nesa[8] glass windshield with rain repellant (in lieu of impractical windshield wipers); hydraulic boost on all control surfaces; a spoiler door (at the aircraft's main entrance) to ease in-flight escape, plus a single-point ground and air-to-air refueling receptacle. Finally, it featured a 2-gun tail turret controlled by radar sight; a B-4 fire-control system; K-4A bombing-navigational system; AN/APS-54 warning radar, and many other improved electronic components, including AN/APT-5A electronic countermeasure devices.

Initial Design September 1948

Design of the B-47B started 5 years after Boeing began work on a multi-jet aircraft for photoreconnaissance and bombing missions with conventional weapons. The informal photographic reconnaissance requirements of 1943 were dropped the following year, when the need for a new medium bomber was clearly established. But by the time Boeing received a production go-ahead, circumstances had changed. The Air Force now wanted its new jet bomber to carry atomic weapons as well as conventional bombs.[9] In

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[8] Trade name of glass coated with a transparent chemical conductor of electricity. Nesa glass, therefore, was easily kept free of ice.

[9] The mounting urgency to build an atomic deterrent force despite the lack of funds posed grave problems in the fall of 1948. While the B-36 program was no longer in jeopardy, other programs had to be canceled or drastically reduced. Faced with far-reaching decisions, the Air Force opted for the faster production of a more versatile and atomic-capable B-47. This approach was not new. Back in 1946, the AAF had decided that all new planes capable of

addition, the photo-reconnaissance requirements of several years past were revitalized.

Developmental Problems **1948–1952**

Deficiencies identified in the XB–47 and subsequent B–47As complicated the B–47B's development. It was one matter to devise fixes for a handful of B–47As, but far more difficult and time-consuming to come up with definite production line modifications. In any case, there were other deep-seated problems that later became obvious. The B–47 was the first USAF bomber to receive a weapon system designation, which meant in theory that all systems to equip and maintain the plane were designed exclusively for the B–47. In effect, however, the Boeing airframe was developed without adequate consideration for such crucial components as engines and bombing systems. Then, too, rising world tensions and the outbreak of the Korean War led to the hasty production of the B–47, before quality and performance were assured. Even though the B–47B was yet to be flown, the Air Force as early as December 1950 foresaw 149 aircraft per month coming off the assembly line. As in World War II, new contractors were selected to pool production.[10] This haste in the long run hampered both development and production. By August 1950, the Air Force had recommended some 2,000 changes, making it almost impossible to settle on an acceptable production type. Meanwhile, Boeing had begun to step up production. By mid-1951, B–47Bs were flowing in ever-increasing numbers from the Wichita line but had to await the modifications and equipment that would make them suitable for combat.[11]

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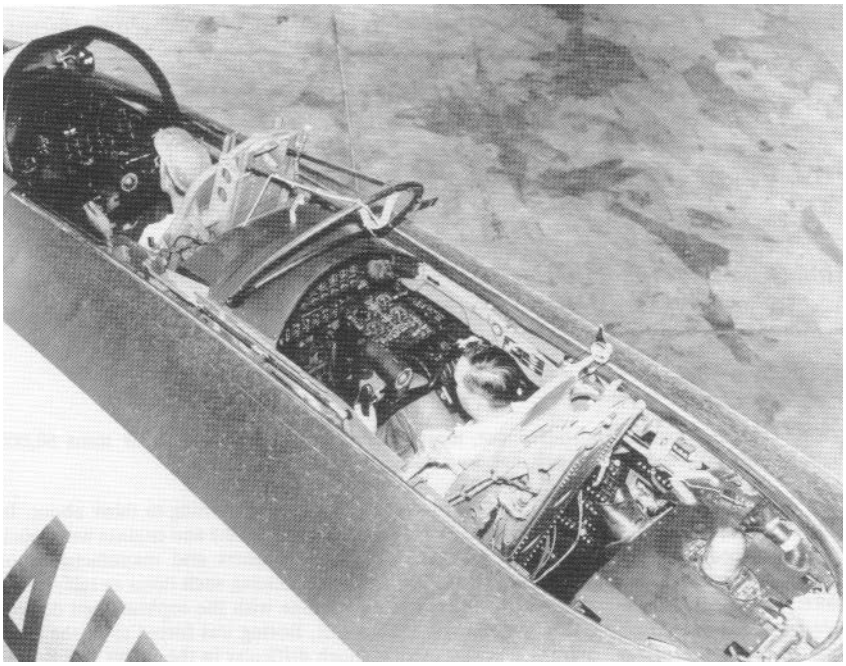
carrying bombs as heavy as the atomic bomb should be able to carry the A-bomb itself. Yet, long after the atomic attacks against Japan, the secrecy shrouding the bomb persisted. As in the B–36's case, this would be of no help to B–47 development.

[10] Douglas Aircraft Co., was awarded a production letter contract in December 1950; Lockheed Aircraft Corp., soon afterwards. This would allow production to start without awaiting the definitive contracts that were signed in October 1952. The Air Force's determination to solve unexpected B–47B problems promptly changed this planning. As a result, neither the Douglas plant at Tulsa, Okla., nor the Lockheed facilities at Marietta, Ga., started production before 1953.

[11] Despite an overall production slippage of nearly a full year, components subcontracted by Boeing as well as government-furnished equipment and parts were still behind schedule. General LeMay was adamant in pointing out that failure to develop component systems in phase with production of the new bomber was an indication of bankruptcy in USAF procurement policy. The SAC Commander also thought that the USAF Armament Laboratory was not capable of satisfying the Air Force's needs.

A Stratojet on a jet-assisted take-off, Wright-Patterson AFB, Ohio.



Front and rear cockpits of a B–47, canopy removed.

By mid-1952, the B-47 development was still under way. Requirements kept expanding, special mission modifications were requested, and the Air Force again considered various redesigns of the aircraft's propulsion system.

Testing 1948–1954

In view of the B-47's sweeping new features, it was envisioned from the start that development and testing would be involved as well as lengthy.[12] The XB-47's early flight tests quickly confirmed this expectation. Hence, the Air Force on 7 April 1950 endorsed an unusual operational suitability test, known as Project WIBAC (Wichita Boeing Aircraft Company). This meant that before the B-47 could be delivered to SAC's operational units, the aircraft and its equipment would be thoroughly tested at Wichita by Air Proving Ground Command and SAC personnel.[13] Besides, WIBAC promised to provide statistics on parts consumption, parts failures, and engine life. Guiding data on service testing, maintenance procedures, base facilities, and training needs were also part of the deal. The ambitious WIBAC task soon proved overwhelming. While no B-47Bs had reached WIBAC by mid-1951, the project was already in trouble. In August, WIBAC requested review of the whole B-47 program—production, allocation, requirements, and operational deficiencies.

First Flight (Production Aircraft) February 1951

The Air Force accepted this plane in March and 87 similar productions within a year.[14] Testing by WIBAC in late July 1951 verified that the new B-47Bs could not possibly meet the Strategic Air Command's require-

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[12] The development and test phase, mostly completed in mid-1953 (after some 50,000 flight-test hours), exceeded the original time estimate by almost 4 years.

[13] Early WIBAC appraisals of the B-47 gave the Air Force something to think about. In mid-1951, SAC observers liked the airplane, but noted that the airframe and engines were much more advanced than the component systems. Moreover, designers and manufacturers of component parts, as well as the numerous subcontractors producing such items as relays, fuel selector valves, booster pumps, and the like, were not in tune with the sophisticated designs necessary for such a high-performance aircraft. As a result, Boeing was forced to fit the B-47 with the same type of equipment that had caused so much difficulty in the B-29s and B-50s.

[14] The 88 planes, like the B-47As, featured 6 J47-GE-11 engines until re-fitted with the more powerful J47-GE-23s that equipped subsequent B-47Bs.

ments.[15] In September, USAF test pilots pointed out that the plane's weight gain, from 125,000 to 202,000 pounds, had badly affected its flying qualities, making it unstable at high altitude and generally hard to maneuver.

Modification Planning — October 1951

The impasse reported by WIBAC led to a conference in October 1951, attended by many top Air Force generals. Most conferees seemed to believe that WIBAC, and more specifically the office of the B-47 project officer, had been given an impossible job. Opinions differed, however, on how some of the difficulties encountered could have been avoided or at least reduced. Maj. Gen. Bryan L. Boatner, Commanding General of the Air Proving Ground, thought better results could have been secured had Air Research and Development Command and Air Materiel Command (AMC) contributed technical personnel and stationed them permanently at WIBAC as Strategic Air Command (SAC) and Air Proving Ground did. Lt. Gen. Earle E. Partridge, who headed the research and development command, commented that the concentration of all B-47 tests at Wichita had been a mistake. Generals Partridge and Boatner agreed that the B-47 was a very complicated piece of equipment and that the production problems were the greatest ever experienced. Then, General Twining (Vice Chief of Staff since October 1950) said that the B-47 problem fell to the Air Staff and that it would be solved. To this end, a so-called refinement program was set to begin in early 1952 at the USAF Grand Central Plant in Tucson, Arizona. The minimum modifications to make the B-47 combat ready were lined up, SAC alone suggesting close to 50. Maj. Gen. Thomas S. Power, SAC's Vice Commander, pointed out that his command was more familiar than most with the bomber's deficiencies. He announced that an engineering operational program in the 306th Wing would get under way in early 1952. This program, General Power stated, should help significantly in speeding up progress.

Additional Procurement — 1951-1952

Advanced procurement plans were finalized in November 1951—on the heels of the October conference—by a definitive contract for 445 additional

[15] The first SAC B-47B (Serial No. 50-008) was flown on 23 October 1951 from Wichita to MacDill by Col. Michael N. W. McCoy, Commander of the 306th Wing. Even though the plane was not combat ready, a beginning had been made and this was celebrated on 19 November, when the aircraft was named "The Real McCoy." Six more B-47Bs programmed for the 306th during that month were refused because of serious deficiencies, but a total of 12 were accepted before the end of the year.

productions. This number was reduced to 395 in March 1952, after more realistic production schedules were endorsed.[16] Nonetheless, new procurement soon followed. Fifty-two RB-47s and 510 B-47Bs were ordered in June 1952, and 3 other production contracts were issued during the year—1 in September called for 540 B-47Bs; 1 in October, for 70 RB-47s; and 1 in December, for another 193 B-47Bs. As it turned out, the Air Force reduced the number of B/RB-47s (1,760 aircraft) ordered in 1952, and most of these aircraft came off the production line as B-47Es.

Basic Safety Deficiencies 1951–1952

Explosive decompression tests in 1951 proved the B-47's original canopy unsafe for high altitude combat operations. A sectionalized canopy was the answer, but would not be available for some time. Another major problem was the lack of ejection seats in the B-47B. SAC long believed that ejection-type seats were the safest method of egress from high-speed aircraft. Boeing studies on the subject had shown it would be impossible to get out of an uncontrolled B-47 without ejection seats. Escaping under controlled flight conditions would even be hazardous without them. Although the 10 B-47As had ejection seats, these were operationally marginal. Therefore, in the interest of saving weight—at least until the B-47 reached a 4,000-nautical mile range—a group of senior officers (including some from SAC) had decided to dispense with the seats. SAC's ensuing objections were to no avail, but its request in mid-1950 for reinstatement of the seats was finally approved. Still it became obvious in December 1951 that ejection seats would not be incorporated in production for quite a while.[17] As many as 400 B-47s would not have any, and this was far more than SAC had been

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[16] As the B-47 bomb bay was designed to carry atomic bombs, no additional framework installation was required. Bomb racks, sway braces, hoists, and other equipment items were attached from the start to the airframe, specifically to the bomb-bay fuel tank floor. Just the same, production and operational difficulties with the aircraft itself prompted a further cutback in the B-47B's atomic capability in April 1952. The Air Force decided at the time that the first 89 B-47Bs would not be required to carry any atomic bombs, and that the next 80 aircraft would only be expected to handle 2 specific types of bombs. While some of this early planning changed, a directive that all subsequent B-47Bs would be able to carry low-density atomic bombs could not be satisified. Despite all efforts, the high-speed B-47s proved unable to release subject bombs at altitudes below 30,000 feet.

[17] Providing satisfactory ejection seats for the B-47's 3-man crew entailed the relocation of important pieces of equipment. Air Material Command estimated this might require as many as 26,000 engineering manhours. In addition, much more was involved to ensure crew safety. In fact, high-speed testing of the approved seats (upward for pilot and co-pilot; downward for the navigator) was still going on in December 1952.

prepared to accept. Since retrofit of the aircraft then seemed economically impossible, the only alternative was to settle for the next best means of egress. To begin with, this called for development of a redesigned dinghy.[18]

Other First Shortcomings 1951-1952

The K-2 bombing and navigation system, like the early K-1 of many B-36s, was unreliable and hard to maintain.[19] By mid-1952 the K-2 had been made to work somehow, but still needed improvement even after additional modifications had brought about its redesignation as the K-4. The Emerson A-2 tail defense system, earmarked for the B-47,[20] was canceled before the end of the year in favor of the General Electric A-5. The decision, based on Project WIBAC's recommendation, proved sound but posed an immediate problem. No A-5 fire-control systems were available and none were to be expected much before 1953. In the meantime, it was mandatory for SAC that a makeshift system be devised. Retrofit of early B-47s with a 2-gun turret and an N-6 optical sight was the chosen solution. This would at least give the aircraft some kind of defense. Although contrary to plans, the extra modification was included in the refinement program that had been endorsed during the conference of October 1951. Not surprisingly, further pioneer difficulties were

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18 It was difficult to maneuver from the crew positions to the escape hatch with the present dinghy attached to the parachute harness. Yet, in an emergency, there seldom was time to attach the raft after leaving one's seat.

19 The 1,600-pound K-2 counted 41 major components, totaling some 370 vacuum tubes and close to 20,000 separate parts. Since the B-47 was compact, the K-2 equipment had been scattered throughout the aircraft. Many of the system's parts were outside of the plane's pressurized area. Hence, no inflight maintenance was possible and high abort rates were to be expected. Maintenance on the ground was nearly as difficult. Pre-flight checking took too long—8 hours, compared to 1 hour for checking almost the same system on the B-36.

20 Development of the system could be traced back to 1946, when the XB-47 was first reviewed by the AMC's armament laboratory—the same laboratory General LeMay still took to task in 1951. Engineers believed that the Emerson-built tail turret, referred to as the A-1 fire-control system and intended for the North American B-45, could be fitted into the B-47 without altering the turret's basic mechanism. With Boeing's concurrence, the Air Force in June 1948 asked Emerson to design for the B-47 a turret gunner cab similar to that of the B-45, but providing sufficient comfort for missions of long duration. The project quickly became so complicated that it was given up. A remote controlled system that would be operated by one of the flight crew members appeared more feasible. This gave way to the A-2 fire-control system, a system eliminating the need for a tail gunner. This A-2 was due to provide accurate defensive fire for protection of the B-47 and to perform, although not simultaneously, both search and track. The A-2, after being fitted into the tail of a B-29, was successfully tested under Project Hornet. Moreover, in theory, the A-2 was superior to the APG-32 built by the General Electric Company for the B-36. In practice, however, while major APG-32 problems could be solved, the A-2's basic suitability for the B-47 remained too questionable to warrant its retention.

encountered. One was fuel boil off and fuel purging, found more critical in jet bombers. The B-47 was designed for maximum speed and range at a high altitude, and the sooner it reached that altitude, the better. Yet, at high altitudes fuel boil and loss of fuel occurred, reducing the aircraft's range which, in any case, remained far shorter than required in early 1944. Development of JP-4 fuel, after numerous experiments, appeared to solve much of the problem, but production quantities would not be available until January 1952. Again, purging fuel tanks required the use of dry ice, which would be difficult to purchase in areas where the B-47s were expected to operate, especially when the aircraft would be operating overseas. Development of portable dry ice manufacturing equipment was a partial answer. A new exhaust gas purging system, being devised by AMC, would be more dependable and less hazardous. It would require no additional maintenance and provide greater and longer protection for more fuel volume than the dry ice system. This was all for the best but, as with every new system, the AMC development would take time.

Slippage Impact 1951-1952

There were extenuating circumstances for the topsy-turvy B-47 program. As Maj. Gen. Albert Boyd, the Wright Air Development Center's Commander, explained in 1952:

> There is a limit to what we can do, or for that matter, what anyone can do, toward developing a radically new airplane in record time, and we, no more than anyone else, are capable of pulling a rabbit out of our hats or cranking out a new aircraft that meets all the desires of the operating activities.

Yet, the impact of the B-47 slippage was serious from the start. To prepare for, operate, and maintain a weapon system as revolutionary as the B-47 presented a tremendous challenge.

SAC confronted numerous problems,[21] some of them crucial. To begin

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[21] Bases had to be prepared for the B-47, particularly by lengthening runways. Since the aircraft's range did not meet requirements, air refueling was a necessity. This complicated matters. Extra troop housing, maintenance facilities, equipment and supply were needed to support B-47 squadrons and their accompanying KC-97 tankers. Training problems came to the fore. Even the first 90 B-47s, finally earmarked for Air Training Command, were fitted with receptacles to teach both B-47 and KC-97 trainees the ticklish air-refueling mating of a fast jet and a slow tanker. Briefly stated, the all-jet B-47, with its crew of 3, played havoc with SAC personnel policies. Large numbers of people became excess, whereas hundreds of others were needed to fill specialties peculiar to jet aircraft. All kinds of mechanics and supervisors had to be retrained for the B-47. Moreover, SAC and other USAF commands never had used pilot-observers. Since the B-47 demanded quadruple-rated aircrewmen, ATC had to turn pilots into proficient navigators, bombardiers, and radar operators.

with, the production delay meant that conversion plans had to be shuffled many times over.[22] Then, slippage of the refinement program, which now appeared unavoidable, would further dilute the command's readiness. Each month lost forced SAC to be ready to fight with even more outmoded B-29s and B-50s. To make it worse, everyone knew that when at long last available, the modified B-47Bs would give SAC only a basic combat aircraft and that considerable modifications were still to come.

Refinement Program 1952-1953

The program, due to begin in January 1952, involved the modification of 310 B-47Bs.[23] SAC expected its first modified planes in July and a monthly input of 75 by year's end. This was optimistic. As predicted by AMC, the Grand Central Depot of Tucson could not possibly handle such a workload without greatly expanding facilities and manpower. This would take time and money, and neither could really be spared. The Air Force found a way out of its new dilemma. Boeing agreed to modify 90 of the aircraft (for about $10 million) and Douglas was also asked to help.[24] The original modification schedule nevertheless slipped. First, it proved difficult to assemble the necessary modification kits. Then, there were not enough kits. In September 1952, SAC's few B-47s were grounded because of serious fuel cell leakages. This again slowed the refinement program, since it obviously required an extra inspection of the aircraft being modified.

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[22] SAC was told in 1949 to get ready for the early conversion of certain units to B-47 aircraft. It learned in September that 108 B-47s would be forthcoming during the years 1950 and 1951. In the spring of 1950, when, as some put it, if the Air Force was in the "jam," it was because of the B-47, SAC refused to get into further trouble programming for conversions too far in advance of aircraft delivery dates. The command chose to go ahead with the 306th and 305th conversions, but to postpone deciding which other wings would convert to B-47s and in what order. Meanwhile, SAC had inherited a new problem. After both air and ground crew training had been rushed, SAC wondered how to keep crew proficiency when it had no planes to fly or to look after. Of small consolation, no such overages existed in the K system and armament category where, besides technical factors, personnel training lagged for lack of tools, test equipment, and parts.

[23] Instead of 400, the first 90 aircraft went to Air Training Command as they were. The command later received 90 other B-47s. These planes had been through the refinement program, but their modification did not include the addition of the interim B-4 fire-control system that was fitted in every B-47 modified for SAC.

[24] Douglas agreed to modify 8 aircraft per month in Tulsa. Boeing promised to fix the planes in Tucson, but saturation of the existing facilities changed this planning. To keep its commitment, Boeing shifted the work to Wichita. The contractor was actually able to modify 40 of the planes directly on the assembly line.

Yet, despite its shaky start, the program fulfilled its requirements. SAC received its first batch of modified B-47s in October—a 3-month slippage that was to prove of slight importance. The last modified B-47s flowed from the Douglas modification center in October 1953.

Enters Operational Service — Fall of 1952

As a beginning, SAC received 8 modified B-47Bs in October 1952, 23 in November, 34 in December, and 13 in January 1953. The aircraft immediately went to the 306th and 305th Wings.

Production Improvement — 1952–1953

Back in late 1951, mechanical failures and a myriad of minor obstacles had caused the B-47 production to slip again. Yet, in the face of persistent shortages of contractor-furnished equipment and government-furnished parts, production took a turn for the better in the spring of 1952. The improvement soon gained momentum. By mid-1953, production was running smoothly and Boeing was rolling out new configurations (B/RB-47Es). Just getting started, Douglas, Tulsa, had already built 10 B-47Bs; Lockheed, Marietta, 7. In addition, two projects were in progress since January 1953. The first and most important one was Baby Grand. It was conducted by Boeing and would add the A-5 fire-control system in 54 new B-47s (units 400–454). The other, Field Goal, was in the hands of Douglas. It would improve 86 (units 1–86) of the 90 unmodified B-47s, first allocated to Air Training Command.

Standardization Decision — April 1953

Even though all modifications covered by the refinement program were incorporated into the production line of the 410st and subsequent B-47's, much remained to be done. Despite the Baby Grand modification, these aircraft, as well as the modified B-47Bs, did not meet the Air Force's expectations. There were other problems. In the hope of improving performance quickly, complex engineering changes had been introduced into the production line at approximately every fifth aircraft. This had essentially resulted in making the aircraft's maintenance far more difficult and its logistical support almost nightmarish. A standardization conference was held at Wichita in April 1953. There, Boeing's 731st B-47 production, a

B-47E referred to as WIBAC Unit 731, was established as the SAC standardization bomber.[25] In the same month, Headquarters USAF approved Turn Around, an AMC modification plan that would bring 114 new B-47s (units 617-730) to the 731st configuration. The Turn Around plan was clever. The Air Force would conditionally accept the 114 aircraft, but leave them at the Boeing plant for modification. The same procedure could be followed on other occasions. In this first case, it would save more than $7 million by eliminating the costly process of bringing back 114 aircraft for modernization after delivery. Turn Around, however, did not address the problem presented by in-service B-47s. This was to be covered by High Noon, a major modification and IRAN (inspect and repair as necessary) maintenance program, approved before the end of May.

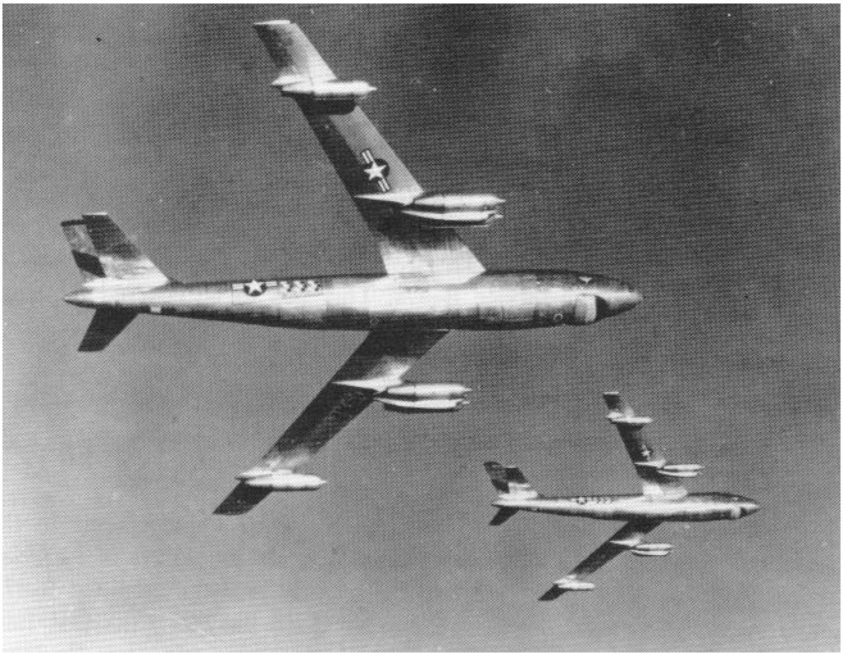
Overseas Deployment — June 1953

SAC was always the first to seek further B-47 improvement. In the meantime, however, the command intended to make ample use of its newly assigned planes. After testing exhaustively in early 1953 the modified B-47B under simulated combat conditions, SAC decided the 306th (its first fully equipped wing) was ready for a 90-day rotational training mission to England. The 306th's deployment originated at MacDill and involved equal flights of 15 B-47s on 3, 4, and 5 June. Establishing a precedent that would be followed many times in the future, the B-47s staged through Limestone AFB, Maine, where they remained overnight before going on the next day. They landed at Fairford Royal Air Force Station on the 4th, 5th, and 6th of June. The 306th Air Refueling Squadron's KC-97s,[26] crammed with support personnel and equipment, deployed on the same dates as the B-47s.[27] They stopped overnight

[25] In June the Air Council reaffirmed the April decision and officially endorsed Boeing's WIBAC Unit 731 as the "improved combat configuration." It took the other 2 contractors little more than a year to follow suit. Douglas Unit 125, delivered in September 1954, and Lockheed Unit 128, delivered 1 month before, were the same as WIBAC Unit 731.

[26] MacDill's 306th Air Refueling Squadron was the first unit to begin equipping with the KC-97 tanker. Its first aircraft, a KC-97E, was delivered on 14 July 1951. Outfitted with a flying boom and loaded with fuel tanks, the 4-engine, propeller-driven KC-97 could fly fast enough to match the minimum speed of the B-47. It transformed the B-47 into an intercontinental bomber. Each KC-97 squadron was authorized 20 aircraft.

[27] As far as SAC was concerned, proper support of the B-47s was of prime importance. In this regard, past production slippage had alleviated anticipated problems. Lagging supply programs had been able to pull abreast, and in some cases exceed wing requirements. For instance, the 306th had on hand nearly 90 percent of its equipment items by the end of 1951. Later, Snowtime, a project conceived by SAC, minimized supply difficulties. Snowtime required storage in only 1 depot (Rome, Griffiss AFB, N.Y.) of parts and equipment that would



Two B-47Bs, equipped with 6 J47-GE-23 engines.

at Ernest Harmon AFB, Newfoundland, and then flew on to Mildenhall Royal Air Force Station. Maintaining 1 or more bomb wings in the United Kingdom was nothing new. B-29 and B-50 wings had been rotating there since 1948. Just the same, the 306th rotational deployment was a milestone. Although a handful of specially modified B-45s had arrived in England in 1952, the move of the 306th there was the first routine deployment of a fully operational jet bomber wing. Moreover, the policy of maintaining at least 1 B-47 wing in England at all times would continue until early 1958.[28]

Aircraft Retrofit 1953-1957

Although modified B-47Bs were indispensable either at home or overseas, the Air Force did not lose sight of its April 1953 standardization

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be needed at B-47 bases at the time of conversion. Sea Weed, a similar project for the overseas B-47 bases, after a tough debut, also helped.

[28] Once started, the deployments were uninterrupted. When the 306th's 90-day rotation was over, the 305th was ready. By the time the 305th's tour was nearing its end, the 22d Bomb Wing had completed the transition to B-47s and was poised for departure.

decision. Yet, SAC operational priorities made it necessary to adjust the High Noon program that was due to modernize the bulk of the early airplanes. As finally approved in June 1953, 165 (units 235-399) of SAC's 289 modified B-47s would first go to High Noon.[29] To the maximum extent possible, the rest of the early planes, including those remaining in SAC's inventory, would also be brought to the 731st configuration. This would be done under Ebb Tide,[30] now organized as High Noon's second phase, but would not affect the AMC's 2-year IRAN maintenance program that had been attached to High Noon from the start.

The High Noon contract was assigned to Boeing. The choice was logical since the first 399 B-47s had all been assembled by Boeing from Boeing parts. Moreover, AMC was confident Boeing could do the work better, faster and cheaper than anyone else. High Noon was essentially a retrofit kit installation. Nevertheless, it was a complicated task, calling for removal, rebuilding, and reinstallation of many component-systems, as well as major revisions of the aircraft nose and cockpit. B-47s earmarked for High Noon began arriving at WIBAC in June 1954, and 36 of them had entered the modification line by February 1955. The first renovated B-47 emerged from its "face lifting" operation on 2 March. It featured ejection seats for all crew members, a bombing-navigation system with improved reliability,[31] water-alcohol injection for thrust augmentation, an expanded rack for rocket-bottle take-off assist units, a modified bomb bay that could house the single-sling, high-density, thermonuclear bomb as well as more general purpose bombs, a reinforced landing gear for increased take-off weight (202,000 pounds), the A-5 fire-control system (in place of the B-4), the AN/ARC-21 long range-liaison radio,[32] and better electronic countermeasures equipment. There were no major problems during the High Noon modification of SAC's 165 B-47Bs. The Boeing contract met its early 1956 completion date and was immediately replaced by Ebb Tide, which also took

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[29] High Noon was the code name assigned to the major modification and maintenance program, approved in May 1953.

[30] Ebb Tide was another code name, the use of which, like that of High Noon, simplified matters when dealing with a complicated standardization project of exceptional scope.

[31] This was still the K system, but it had become more dependable as a result of Reliable, a separate modification project that had also simplified its installation and maintenance.

[32] The problem of obtaining a satisfactory high frequency radio dated back to 1950 and remained of great concern to General LeMay in 1954. Because the AN/ARC-21 long-range liaison radio was not available and its production continued to slip, 13 SAC wings used the Collins 18S-4. The command, however, did not relish having more aircraft fitted with this interim equipment. Fortunately, Project Big Eva, an accelerated test of the AN/ARC/21, concluded in February 1955 that the set perfomed creditably and would not require new maintenance skills.

place in Wichita. Ebb Tide addressed itself to the first 324 B-47s built by Boeing.[33] Of these, 66, selected from units 135-234, would undergo the same transformation as the High Noon planes and return to SAC in the configuration of WIBAC Unit 731. Another 108 of the early productions, out of units 1-134, would be modernized for Air Training Command.[34] In the process, they would exchange their J47-23 engines for the more powerful J47-25s of the other B-47Bs. Finally, 30 planes would be brought to the High Noon standard and be converted to director aircraft (DB-47Bs) for the forthcoming Rascal missiles.[35]

Total B-47Bs Accepted — 397

Ten of these aircraft were built by Douglas, 8 by Lockheed, and all others by Boeing.

Acceptance Rates

The Air Force accepted 2 B-47Bs in fiscal year 1951 (1 each in April and May 1951); 204 in FY 52; 190 in FY 53, and a last one in FY 54 (July 1953).

End of Production — June 1953

The Air Force took delivery of the plane the following month.

Flyaway Cost per Production Aircraft — $2.44 million

Airframe, $1,767,094; engines (installed), $283,082; electronics, $43,835; ordnance, $5,336; armament, $350,109.

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[33] The program did not cover all the aircraft. Only specific lots, or about two-thirds of the 324 planes, went to Ebb Tide.

[34] The Air Training Command planes, subsequently known as TB-47s, closely resembled SAC's B-47s, but they carried no defensive armament or electronic countermeasures equipment. They could not be air-refueled and could not drop bombs. Also, take-off and range were unimproved.

[35] The DB-47Bs would carry the missiles to within 90 nautical miles of the target before launching and guiding them.

Subsequent Model Series — B-47E

Other Configurations — RB-47B and YRB-47B

Design of the RB-47B was started in March 1951. Based on experience, the aircraft's first flight was expected 2 years later. The Air Force at the time also figured that delivery of the new reconnaissance planes could well begin in mid-1953. Yet, in March 1952, the many problems associated with the bomber configuration implied that the reconnaissance B-47 the Air Force had in mind was a long way off. In fact, it was decided shortly before October 1952 that the plane would feature the scarce A-5 fire-control system and the still experimental J47-GE-25 engines. The aircraft, therefore, most likely would not be completed until 1954 and when available, it would have little in common with the basic B-47B. Closely resembling the new E-model, it would come to be known as the RB-47E.

While this marked the production demise of the RB-47B (which never appeared on the Air Force's financial accounts), so-called RB-47Bs and YRB-47Bs came into being to fill SAC's reconnaissance vacuum of the early fifties. These planes, however, were nothing more than converted B-47Bs, equipped with special reconnaissance pods.[36] The Boeing-developed, 8-camera pod could easily be installed in the forward bomb bay, but only provided daylight photographic coverage. The 91st Strategic Reconnaissance Wing (Medium) received its first YRB-47 in April 1953; the 26th, 3 months later. Most of the 90 converted reconnaissance planes were subsequently used as crew trainers for operational RB-47Es.

Phaseout — 1957

In effect, the B-47Bs ceased to exist in 1957. By then, most of these aircraft had been brought up to the 731st's configuration or, as in the TB-47's case, sufficiently transformed to acquire new designation.

Other Uses — DB-47A and QB-47B

As General Boyd later pointed out, multiple demands were pinned on the B-47 from the start. Because it was the fastest bomber, the Air Force

[36] The RB-47Bs were pre-1953 conversions carrying, in principle, a dual bomber-reconnaissance mission. The YRB-47Bs were later conversions, more specifically intended for training.

called on it for Brass Ring,[37] a project concerning the delivery of thermonuclear weapons by unmanned aircraft. The Brass Ring project, spurred around 1949, was immersed in secrecy and of such importance that it was designated as "Special" by the highest authorities. Yet, Brass Ring was handicapped even before it began. In the late forties, technology was taking giant steps, but these steps went in many highly complex and expensive directions. Meanwhile, there was just a trickle of cooperation between the Atomic Energy Commission, which was building the atomic bombs, and the Air Force, which had to carry them. Early in 1950, as the Air Force looked for better ways to deliver the A-bomb, the forthcoming thermonuclear device (the hydrogen, or H-bomb) changed future carrier requirements. At first glance, it appeared that only a guided missile could handle the new weapon.[38] However, the time element—2½ years for a completely operational system—ruled out all missiles the Air Force had under development. The sole alternative seemed to be an aircraft that could assume the guise of a drone or missile. There were not many planes which could meet the required criteria. The aircraft had to be inexpensive, dependable, hardly vulnerable to enemy counter-actions, easily stabilized for automatic control, and quickly available. Only 3 candidates, the B-36, B-47, and B-49,[39] satisfied the basic load and range requirements. Of those, the B-47 was the best despite its high cost. The big B-36 was even more expensive and much too slow. The single point in favor of the B-49, should it ever reach production, was that its high-altitude performance would decrease its vulnerability. Hence, there was little dissension over selection of the B-47 as the H-bomb's first carrier. The Air Force made up its mind quickly.[40] It decided early in 1950 that 1 of the 10 B-47As (finally expected in by 1951) would be returned to Boeing and be converted into a director aircraft (DB-47A). Boeing also agreed on 27 September to modify 2 future B-47Bs

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[37] This name was not officially adopted until April 1951.

[38] The H-bomb was expected to produce a lethal area so great that, were it released in a normal manner, the carrier would not survive the explosive effects.

[39] The prototype B-49 represented Northrop's effort to establish a tactical use for a turbojet-powered version of its experimental B-35 "flying wing." The Air Force halted testing of the YB-49 in February 1950 and of its reconnaissance counterpart 2 years later.

[40] The Air Force, nevertheless, made it clear that any B-47 alterations had to be viewed as just one phase of a much larger program. In short, all delivery methods of possible merit had to be weighed. There were good reasons for such reservations. Lt. Gen. Kenneth B. Wolfe, Air Force Deputy Chief of Staff for Materiel, was not alone in believing that a piloted aircraft should be able to drop the new weapon and withdraw in comparative safety. As far as the B-47 was concerned, General Wolfe insisted, thrust could be added to increase the aircraft's turning speed. Moreover, there should be some way to slow down the H-bomb's rate of fall to enhance the carrier's margin of safety. Time soon proved the wisdom of these arguments.

to missile carrier (MB-47) or drone (QB-47) configurations.[41] Still, the project remained full of uncertainties. The Brass Ring MB-47 might become a true missile and dive towards its target. It might also be equipped with a mechanism to trigger the bomb free, as in a normal bombing run, while another gadget would ensure the missile's self-destruction shortly after the bomb release. Little information was available regarding the weight and size of the future H-bomb. All the Air Force knew was its new "emergency" carrier would have to cover more than 4,000 nautical miles with a load that would have to be dropped within a narrow radius of the target. So most likely, the Brass Ring MB-47 would have to be air-refueled several times. In any case, it would be manned until the last refueling operation. The crew would then bail out over friendly territory and the deserted MB-47 would go on towards its targets through automatic control by air director, stellar tracker, and auto-navigation. The scheme was sound, but getting a fully automatic, non-jammable guidance and bombing system to deliver the new weapon with accuracy would not be easy. It became obvious by 1952 that neither the North American nor Sperry guidance systems could be ready for the Brass Ring operational date, even though the latter had been slipped to July 1954.[42] The problem was so serious that the Air Force had begun to envision a director aircraft "mothering" a B-47 drone all the way to the target. Although the director-drone version could be made to work without a complex autonavigator,[43] it presented other difficulties. To begin with, B-47Bs would have to be modified as directors, since the DB-47A's range was too short for a full-scale Brass Ring mission with an unmanned H-bomb carrier. By mid-1952, however, Brass Ring was in far deeper trouble. General Wolfe's predictions had come true: Brass Ring was not the only way to

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[41] In accordance with the terms of the contractual agreement, Boeing subcontracted 3 major items to other companies. Under these arrangements, North American Aviation, Inc., (involved in an autonavigation development that had been started by the Hughes Aircraft Company) became responsible for the principal guidance system for Brass Ring. The Sperry Gyroscope Company was to supply the automatic flight control system; the Collins Radio Company, guidance equipment. If needed, the Sperry autonavigator—the alternate to North American's—would be supplied as government-furnished equipment.

[42] Continued development of North American's autonavigator was canceled in mid-1952, after costing the government some $850,000. Sperry's work was stopped, as part of Brass Ring, but allowed to resume for a different project. There was ample justification for the decision. In 1953, no other autonavigator had reached as advanced a stage as Sperry's. Also, $2.3 million had already been spent, and not much more was needed to get a finished product.

[43] The lack of a satisfactory autonavigator precluded testing of the original Brass Ring setup. The director-drone combination fared better. The first flight of the carrier, utilizing remote flight control and stabilization equipment, was made on 7 May 1952. By 30 June, both the B-47 drone aircraft and its director, with but part of the required equipment, had flown several test runs with rewarding results.

handle the new thermonuclear device.[44] For instance, testing had shown that a B-36 could deliver a parachute-equipped H-bomb about as accurately as a conventional bomb. Moreover, whether a B-36 or B-47 carried out the operation, the degree of safety would be more than adequate.[45] Against this background, Brass Ring's advantages faded. The acquisition of friendly bases in Europe, Asia, and Africa diminished the importance of range. Availability, a primary Brass Ring plus, also lost merit since the program was slipping. Forecast costs, swelling from $4.9 million in 1950 to $10.3 million in 1952, sealed Brass Ring's fate. The program was officially canceled on 1 April 1953. Despite an appeal by the Wright Air Development Center,[46] the Air Staff's decision stood firm.

DB-47B

The Air Force early in 1952 definitely considered using some bomber types to carry, launch, and guide air-to-surface missiles.[47] This would allow the destruction of enemy targets miles away from the carrier's utmost range. Most importantly, it would prevent the exposure of bombers and crews to hostile ground fire. The Bell Aircraft Corporation's Rascal (GAM-63) was the chosen missile. It was a 20,000-pounder (including an atomic warhead of some 3,000 pounds), with a range of 100 nautical miles. Under development since 1949,[48] the Rascal was earmarked for the Convair B-36, for the B-60

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[44] Various delivery methods were investigated several months before the first full-scale thermonuclear explosion of November 1952. (The explosion took place at Eniwetok, an atoll of the Marshall Islands, designated by the Atomic Energy in 1947 Commission as permanent mid-Pacific proving ground for atomic weapons.)

[45] B-36s became the first bombers capable of handling thermonuclear weapons. Necessary modifications were accomplished under the code names of SAM-SAC and Featherweight. B-47s were modified soon afterwards as part of High Noon. Thermonuclear-capable B-47s could easily be reconverted in the field to carry the initial atomic weapons.

[46] The Wright Air Development Center was convinced that the $5.9 million spent on Brass Ring was worthwhile. As an emergency carrier of the thermonuclear bomb, the Brass Ring role might be eroded, but the program had many ramifications. The director-drone technique remained a crucial element of strategic air power. An additional $2.5 million would have provided 2 B-47 carriers, 1 B-47A director (with their associated equipment), plus engineering and hardware for 3 B-47B directors.

[47] This separate project came up shortly before Brass Ring took a turn for the worse. The Air Force had already learned much from the ill-fated program and this knowledge quickly served many other developmental endeavors.

[48] The Rascal's origin actually went back to 1 April 1946, when the AAF fathered Project MX-776, which called for a subsonic air-to-surface pilotless parasite bomber carrying a substantial warhead over a distance of 300 miles. After 18 months of study, Bell concluded that

(a jet-powered version of the B-36, built and flown but never placed in production), and for the Boeing B-47 and B-52. In March 1952, the candidate list was reduced to the B-36 and B-47, with the latter's modification assigned first priority. In spite of SAC's dislike of the Air Staff decision, Boeing before year's end was given a letter contract covering the modification of 2 B-47Bs into prototype Rascal carriers. In addition, following testing of the YDB-47s, 17 B-47Bs were to be converted to the DB-47B configuration finally approved. Not prone to give up easily, SAC began to urge that it be allowed to substitute B-50s for the B-47s. In the fall of 1953, after its latest appeal was turned down, SAC again pointed out that equipping the B-47 with the Rascal degraded the aircraft's performance, enough to make the combination of doubtful value. Moreover, it probably would never work well, since guidance of the missile added more complex electronic circuits to the already electronically complicated B-47. Then, too, modification costs (nearing $1 million per B-47 carrier) seemed out of line in view of the missile's current stage of development. Finally, SAC considered it unwise to commit strike aircraft and to train personnel before the Rascal problems were resolved and the missile's worth proved.[49]

The command did not win its case, but recurring Rascal slippages were to work in its favor. After completion of 1 mockup and 2 DB-47 prototypes, the letter contract of 1952 stayed in limbo until March 1955. The definitive contract then signed gave Boeing $3.7 million for completion of the work originally scheduled, bringing the conversion cost of each plane slightly below SAC's first estimate. In June 1955, the Air Force decided the B-47 alone would carry the rocket-powered Rascal, and the B-36 modification contract was canceled. Thirty B-47Bs, earmarked for Ebb Tide, now would also be converted and would emerge from Ebb Tide as DB-47s. Yet, despite a successful first Rascal launch from a YDB-47E carrier in July of the same year, the entire project seemed to falter. Technical problems continued to plague the GAM-63 missile (System 112L), and money was short. The Air Staff informed the Air Materiel Command in early 1956 that production

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a rocket power plant was not feasible for a 300-mile missile of the size contemplated. Even though the range requirement was pared to 100 nautical miles, other problems quickly surfaced, spurring development of a test vehicle that would be similar, but much smaller and cheaper than originally specified. This became the Shrike, a missile of canard configuration that was powered by 2 liquid rocket motors. The Shrike eventually boasted a cruising speed of Mach 2 and a range of some 50 nautical miles. First fired on 12 December 1951, it contributed much to the development of the Rascal, which was initially flight tested at Holloman AFB, N. M., on 30 September 1952. The 2 missiles, however, soon parted company.

[49] SAC's misgivings were not solely confined to the B-47. The command surmised that of all the B-36s, the H might not be the one best suited to carry the Rascal. As in the past, SAC insisted that the B-52s be kept out of the Rascal program. On this point, the command succeeded.

requirements for DB-47Es would be limited to 2 airplanes—Boeing Units 928 and 929. In May 1957, it was announced that the operational inventory would get 1 instead of 2 DB-47/GAM-63 squadrons. This was still too much, SAC reiterated, because the Rascal would be outmoded by improved Soviet defenses by the time it became operational. Nonetheless, at year's end, crews of the command's 321st Bomb Wing were engaged in Rascal training. Meanwhile, other factors, including persisting fund shortages, seemed to justify SAC's steadfast opinion. Rascal facilities at Pinecastle AFB, Florida, from where the wing's 445th Bombing Squadron would operate, were yet to be built early in 1958. In August, a review of the last 6 months of Rascal testing revealed a gloomy picture. Out of 64 scheduled launches, only 1 was a complete success, more than half were canceled, and most of the others were failures. The Air Staff officially ended the Rascal program on 29 November 1958,[50] after finally agreeing that ensuing savings could be put to better use.

KB-47G and KB-47F

Early in 1953, 2 47Bs were converted for trials with the British-developed probe and drogue refueling system. The resulting tanker was designated KB-47G; the receiving aircraft, KB-47F. The first air refueling between jet-powered aircraft occurred in September. Despite this success, the project remained just an experiment. From the inception of the B-47 program, SAC had recognized the necessity of developing in-flight refueling for the new but fairly short-ranged plane. The command nevertheless insisted that it made more sense to use cargo aircraft as tankers than to convert expensive and critically needed strike B-47s for this role. SAC also realized the drawbacks of using cargo aircraft. The propeller-driven KC-97 picked for the task could not climb to the B-47's best altitude. This forced the bomber down to the tanker's level, wasting both time and fuel. The B-47 had a tendency to stall at slow speed, a problem which persisted for several years. To keep the bomber from stalling during refueling, the slower KC-97 at times had to begin a shallow dive to gain momentum—a nerve-racking procedure when the 2 aircraft were linked by the refueling boom. The experiment of 1953 was revived in mid-1956, not on SAC's behalf but because the KB-50s of the Tactical Air Command lacked both the altitude and speed to air-refuel new tactical fighters of the Century series. The Air Force on 23 July authorized development of a KB-47 2-drogue prototype tanker and also tried to equip the basic B-50 tanker with 2 auxiliary jet

[50] AMC was directed on 18 November to dispose of the 78 experimental and 58 production Rascals accepted by the Air Force.

engines. The KB-50 modification soon exceeded expectations. For that matter, work on the new KB-47 prototype also went well, except for one problem—money. By October, Boeing's initial estimate of the KB-47's price had doubled, reaching $2.7 million in April 1957. The cost was too high for a tanker never meant to be more than an interim solution. After making sure than not even Air Research and Development Command had a special need for a 2-drogue KB-47, the Air Force stopped work on the unfinished prototype and canceled the entire program on 11 July 1957.

XB-47D

Design of the XB-47D was initiated in February 1951, and 2 months later Boeing received a contract for the conversion of 2 B-47Bs. The Air Force pinned some hopes on gaining a high speed, long-range turboprop jet bomber from the project, but this was not its primary goal. The XB-47D was essentially developed to test a jet engine-prop combination and to provide data on the installation of turboprops in swept-wing aircraft.

The XB-47D closely resembled a B-47B, retaining the outboard J47-GE-23 jet engines, while a single Curtiss-Wright YT49-W-1 engine,[51] a turboprop version of the J65 Sapphire, occupied each of the inboard nacelles (in place of the paired J-47s). A successful technical inspection in January 1952 made it seem likely that an early 1953 first flight was possible. This, however, did not materialize. To begin with the Curtiss-Wright prototype engine, with its 4-bladed propellers 15 feet in diameter, failed to pass the 50-hour qualification run. The Air Force then estimated that it would take another year before testing could resume. Continuing troubles with the engine-prop combination and shortages of government-furnished equipment delayed further progress. The first XB-47D was not flown until 26 August 1955; the second, not until 15 February 1956. Even though both aircraft accumulated a good many flying hours, no prototypes were ordered. Having served its basic purposes, the program never went beyond the experimental stage.

YB-47C

The B-47C, normally due to follow the B-47B, did not reach production. In contrast to the XB-47D, this plane was definitely intended to answer

[51] The prototype T-49 was a 1-spool engine; the final article, designated T-47, a 2-spool system.

SAC's requirement for an "ultimate" B-47—a bomber and reconnaissance plane having a combat radius of over 2,000 miles without air refueling. The Air Force hoped that the B-47B (Boeing's 88th production) set aside for the experiment would be ready for flight testing in late 1951. When the thrust of the selected new engines (Allison-built J35s) proved insufficient, more powerful ones had to be found. It was finally decided that the new version, now known as the YB-56, would be powered by 4 Allison J71-A-5 turbojets (still in the prototype stage). The Air Force also considered replacing some of the steel and aluminum in the airframe with titanium and magnesium (lighter materials, just as strong, but far more expensive), and of stripping the plane of its normal bombload in favor of reconnaissance equipment for a future RB-56A. The YB-56 reverted to its YB-47C designation as yet another engine later came into consideration. This final effort signaled the aircraft's doom because the engine in question was the Pratt and Whitney YJ57, yet to be available and already earmarked for the B-52. Because the prototype still lacked suitable engines and its cost could top $8.7 million, the Air Force stopped further work in December 1952. Cancellation of the YB-47C marked the end of the proposed YB-47Z—an improved version of the YB-47C, featuring side-by-side pilot seating and space for a fourth crewman. The projected RB-56As also fell by the wayside.

A specially modified Stratojet—the XB-47D—was used to test the Curtiss-Wright YT49 turboprop engine.

B-47E

Manufacturer's Model 450-157-35

Previous Model Series B-47B

New Features

Boeing's 400th production included crew ejection seats in a revised nose section, more powerful J47-GE-25 engines,[52] and the General Electric A-5 fire-control system. This configuration, first classified as an Air Force standard, was designated B-47E. A modified landing gear allowing heavier takeoff weight appeared on the 521st and subsequent B-47Es. This configuration was labeled B-47E-II. A far stronger landing gear was incorporated in the 862d B-47 production. This last configuration of the B-47E model series was identified as the B-47E-IV. The armament of all B-47Es was changed to two 20-mm cannons, and the 18-unit internal jet-assisted take off system of early B-47Es was soon replaced by a jettisonable rack containing 33 units, each with a 1,000-pound thrust. Increasingly more efficient components equipped the B-47E and B-47E-II aircraft. Still, many later acquired the improved MA-7A bombing radar, AN/APS-54 warning radar, AN/APG-32 gun-laying radar, and other highly sophisticated electronic devices first carried by the B-47E-IV.[53] The under surfaces and lower portion of the fuselage of most B-47Es were painted a glossy white to reflect the heat from nuclear blasts.[54]

First Flight (Production Aircraft) 30 January 1953

The Air Force accepted this plane in February and took delivery of 127 similar productions before mid-year.

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[52] Already refitted in several B-47Bs.

[53] In later years, a number of B-47E-IV bombers featured the improved MD-4 fire-control system instead of the A-5.

[54] This reflective paint was applied retroactively to some B-47Bs.

Enters Operational Service — April 1953

The B–47E first went to SAC's 303d Medium Bomb Wing, at Davis-Monthan AFB. The 22d Wing at March AFB, California, upon transfer of its early B–47Bs to Air Training Command, would be next to receive the B–47E. The new planes fell far below the improved combat configuration (WIBAC Unit 731) endorsed by the Air Force in the same month. Yet, strides were being made. Besides the added safety of ejection seats, the B–47E from the start featured an approach chute to increase drag, a brake chute to decrease landing roll, and an antiskid braking device. The discarded B–4 fire-control system could at best spray fire in the general direction of an enemy, but the new A–5 could automatically detect pursuing aircraft, track them by means of radar, and correct the firing of its two 20-mm cannons.

Program Change — September 1953

Early in 1953, just as the B–47 program was being revitalized, it seemed new and much bigger problems were on the way. President Eisenhower's defense and fiscal policies did affect the Air Force's development and procurement plans. In September, the 143-wing program was reduced to an interim 120 wings. As anticipated, the B–47 did not emerge from the crisis unscathed. Yet, all things considered, it fared well. Peak procurement, once expected to reach almost 2,200,[55] was cut by 140. But a further reduction of 200 aircraft, considered in October, was avoided. Instead the Air Force instituted a 20-month stretchout of production, pending full-scale rolling of the B–52 lines. In contrast to the B–36 program—so often on the verge of collapse—no significant attempt was ever made to cancel the B–47 production.

Force Conversion — 1953–1956

The production improvement, achieved with the B–47B in 1953, did not falter. Once underway, B–47E deliveries stayed on schedule. By December, SAC had 8 B–47 Medium Bomb Wings; 1 other wing was partially equipped; 5 more had no B–47s assigned, but were scheduled to receive the

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[55] Ten contracts—7 negotiated and 3 pending—had projected total B–47 procurement to be 2,190. Naturally, as design prime contractor, Boeing had the major portion of the business—4 contracts versus Douglas's 1 and Lockheed's 2. The 3 companies similarly farmed out 50 percent of the B–47 parts to various subcontractors scattered throughout the country.

new aircraft. In December 1954,[56] three months after total retirement of the B-29 bombers, the inventory counted 17 fully equipped B-47 wings. Marking the beginning of an all-jet medium bomb force in SAC, the last propeller-driven bombers (B-50s of the 97th Wing) were phased out in July 1955. Six months later, 22 medium bomb wings had received their B-47 contingents, and another 5 wings were getting ready for the new bombers. Conversion of the SAC forces did not necessarily mean that the B-47s were totally free of problems. Nevertheless, it only took until December 1956[57] for SAC to accumulate 27 combat-ready B-47 wings, a phenomenonal increase from 12 wings in July of the same year.

Flying training 1953–1956

In addition to materiel failures and component shortages, training problems limited the combat readiness of SAC's B-47 wings. Some argued that the B-47—be it the earliest B-47A or the latest B-47E—was not inherently hard to fly. Others more realistically emphasized that the flying techniques for the new jet aircraft differed vastly from those for conventional bombers. By 1954, the B-47 had the lowest major accident rate per 100,000 flying hours of any jet aircraft. Still, 55 percent of the B-47 accidents were traced to human error—43 percent to pilots, and 12 percent to maintenance crews. First the size of the crew was unusually small for this type of aircraft—3 men performing the functions of pilot, copilot/gunner, and bombardier/navigator. And although the 10 or 12 crewmembers of a B-29 worked with 130 instruments, the B-47's 3-man crew confronted more than 300 gauges, dials, switches, levers, and the like. Moreover, as a true expert noted, the B-47 was relatively difficult to land and terribly unforgiving of mistakes or inattention. Although often admired, respected, cursed, or even feared, the B-47 was almost never loved.[58] Even so, training progressed. In June 1954, Boeing indoctrination teams began keeping crews up to date on the B-47's limitations and stresses, and teaching techniques that would assure maximum performance under safe conditions. This new program was received with such enthusiasm that it was promptly expanded.

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[56] The 3 contractors achieved monthly peak production in 1954—Boeing rolled out 29 planes in September; Douglas, 11 in March, and Lockheed, 13 in May.

[57] SAC at the time had 1,204 combat-ready B-47 crews and 1,306 B-47 aircraft assigned.

[58] These observations were made in 1975 by Brig. Gen. Earl C. Peck, Chief of the Office of Air Force History. He knew the B-47 well, having achieved the unusual tour-de-force of saving his B-47 on take-off despite the crucial loss of one of the plane's 6 engines. Promoted to 2-star rank in 1976, General Peck became SAC's Deputy Chief of Staff for Operations in April 1977.

The radar-controlled tail turret of the B-47E featured twin 20-mm cannon.

A Boeing B-47E, with its reconfigured nose section.

Heavyweight Modifications 1955-1959

The Air Force received its first B-47E-IV in February 1955. The reinforced landing gear of this "heavyweight" production and subsequent ones permitted heavier take-off weights, a significant achievement in the Air Force's quest for range extension.[59] The B-47E-IV had a take-off weight of 230,000 pounds—precisely 28,000 pounds more than previously permissible. Since the additional weight was largely allotted to fuel load, the B-47E-IV had a combat radius of 2,050 nautical miles. This was almost twice the distance demonstrated 5 years before by the initial B-47s and about 300 nautical miles farther than earlier B-47Es, already equipped with somewhat stronger landing gears.[60] The Air Force decided in March 1955 that in the next 4 years all active B-47s would be brought up to the heavyweight configuration. The modifications consisted of changing the aft landing gear and adding an emergency elevator boost system to ensure safe flights in spite of the increased weight. The forthcoming post-production changes were priced at $9.2 million, but the Air Force deemed them well worth the cost.

New Operational Requirements 1955-1956

About the time the much improved heavyweight B-47E-IV entered the inventory, more requirements were levied on the aircraft. Early in 1955,[61] after initial escape-maneuver tests had convinced SAC that the B-47 might be rugged enough for low-level bombing, the command requested a

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[59] This had been a tricky undertaking from the start. Normally, range extension meant weight reduction. Yet, back in 1952, while some engineers tried to reduce the aircraft's weight, others needed to add equipment to improve mission performance. The solution at the time appeared to rest on better engines and lighter airframe materials, as proposed for the B-47C. When this did not succeed, SAC suggested modification of the B-47's tandem landing gear.

[60] The B-47E-II, the first range-extended B-47, reached the Air Force in August 1953, after being also brought up to the improved combat configuration that had been endorsed earlier in the year. After flight-testing the stability of the modified plane, the Air Force flew it to find out if still higher gross weight take-offs could be possible. This paved the way for the heavyweight B-47E-IV.

[61] The year started auspiciously. The B-47E-IV was available, and the first B-47 for thermonuclear weapons had been delivered in January. Although the production-line modification of the aircraft had been made without awaiting the results of a concurrent flight test, the Air Force was not overly concerned. Most of the essential equipment had been installed on the aircraft, and only minor changes would be needed to ready it for combat. Justifying the Air Force's confidence, more than 1,100 B-47s could handle the new thermonuclear bombs by the end of April 1956.

further immediate check. There were many potential benefits. High-speed B–47s, flying at low-level, would be less vulnerable—more difficult for enemy radars to track and less likely to be intercepted by fighter aircraft, ground fire, or surface-to-air missiles. Increasingly sophisticated enemy defenses would be double-tasked, facing both high- and low-level attacks. The Air Staff swiftly endorsed SAC's request, but testing came to an abrupt halt after the loss of a low-flying B–47 over Bermuda. Low-level flight tests were not resumed until Boeing and the Air Research and Development Command assured Air Proving Ground Command that the B–47's structural integrity was not in doubt. In June a 6,000-pound dummy bomb was successfully released during a 2.6G-pullup from level flight, and an 8,850-pound practice bomb was properly dropped from a 2.5G-pullup in another flight. In both instances, release took place during the early portion of an Immelmann turn and the low-altitude bombing system functioned respectably.[62] In December 1955, SAC asked that 150 B–47s be modified by Boeing for low-level flight. This was authorized in May 1956.[63] At the time, however, the Air Staff reserved approval of the same modification for other B–47s, even though SAC pointed out that AMC might do the work as part of the aircraft's IRAN program.

Special Training 1955–1959

The B–47's low-level flying task entailed special training requirements. These had been anticipated by SAC in Hairclipper, a training program begun in December 1955. Adverse weather, excessive maintenance requirements due to low-level flying, and personnel losses to other training programs combined to hamper progress. Unexpected and serious LABS deficiencies in the low-altitude bombing systems, as well as several accidents in December

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[62] Development of the low-altitude bombing system dated back to 1952, and the low-level bombing tactic was not new. SAC's fighter-bomber pilots had been trained to fly at low-level and the command's F–84s had been modified for this purpose. But this did not really create a precedent. One could hardly compare the 200,000-pound (design loaded weight) B–47 with aircraft of the F–84 type. The B–47's thin wings covered a span of more than 116 feet. Empty, the B–47E weighed almost 80,000 pounds. In contrast, the F–84 had a wing span of about 36 feet and its empty weight was under 12,000 pounds.

[63] One year later, the Air Force made public its revolutionary strategic bombing tactic. Use of the B–47 for "toss bombing" was revealed at Eglin AFB in May 1957, during aerial firepower demonstrations before a joint civilian orientation group. (In a toss-bombing attack, the plane entered the run at low altitude, pulled up sharply into a half loop with a half roll on top, and released the weapon at a predetermined point in the climb. The bomb continued upward in a high arc, falling on the target at a considerable distance from its point of release. Meanwhile, the maneuver allowed the airplane to reverse its direction and gave it more time to speed away from the target.)

1957, were the final blows. General Power, SAC's Commander in Chief since 1 July 1957,[64] officially discontinued Hairclipper on 5 March 1958. Yet, demise of the training program did not signify the end of low-level flying. Pop Up, a related training program that took advantage of concurrent advances in weapons developments, fared better.[65] Interrupted in April 1958, when fatigue cracks in the wing structure of some B–47s led to severe flying restrictions, Pop Up resumed in September after the aircraft had been thoroughly checked. Going strong in 1959, this program had practically reached its training goal by year's end.

Structural Modifications 1958–1959

The discovery of fatigue cracks in the B–47's wings and a rash of new flying accidents in early 1958 triggered an immense inspection and repair program. Nicknamed Milk Bottle and started in May 1958, the program involved all 3 manufacturers, although AMC manpower and facilities carried the largest load. More likely to suffer fatigue because of extensive low-level flying training, B–47s of the 306th and 22d Bomb Wings were the first to enter the Milk Bottle program—receiving an interim fix in advance of the permanent repair being devised by Boeing. The interim fix called for a major inspection of suspect areas. After dissassembly to reveal the affected structures, each bolt hole was reamed oversized. A boroscope and dye penetrant were used to locate possible cracks. If any were found, the holes were reamed again. The same kind of procedure was used on the milk bottle fittings. B–47s with no further problems—457 of them—were returned to service after receiving the interim fix, which generally required about 1,700 manhours per bomber. Optimistically, as it turned out, Boeing estimated these planes would last about 400 hours before requiring further modifications. The so-called "ultimate" or permanent Milk Bottle repairs were far more involved, leading to no less than 9 technical orders. Briefly stated, the repairs covered primarily the splice that joined outer and inner wing panels; the area where the lower wing skin met the fuselage and, finally, the milk bottle pin (for which the program was named) and surrounding forging located on the forward part of the fuselage, near the navigator's escape hatch. The entire endeavor proved time consuming as well as expensive—

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[64] General Power succeeded General LeMay, who became Air Force Vice Chief of Staff in July 1957.

[65] The Pop Up tactic also put much less stress on the B–47's flexible wings than low-altitude toss-bombing. In the Pop Up maneuver, the aircraft swept in at low-level, pulled up to high altitude, released its weapon, then dove steeply to escape enemy radars.

fund obligations reaching $15 million by mid-year. But there were results. By the end of July, 1,230 B-47s had been through Milk Bottle, and 895 of them had already been returned to operational units. Considering its magnitude, Milk Bottle proceeded remarkably well, with most of the fleet modified by October. When the program ended in June 1959, only a few of the interim-repaired aircraft still needed work, which could be done during the regular inspect-and-repair-as-necessary cycle. While Milk Bottle did not solve all problems, it put safety back into the workhorse B-47, an aircraft badly needed at the time.

Unsolved Problems 1958-1959

The engineering fixes devised by Boeing for Milk Bottle showed that it was possible to identify the parts in an aircraft that were most likely to fail, but left many questions unanswered. No one could explain why primary structures in the B-47 were affected by maneuvers that the aircraft was designed to perform. General Power saw no use in turning to other aircraft unless SAC was assured they would survive low-level flying. General Power insisted that despite Boeing's evaluation of the B-47's structural life since 1956, not enough was known about aircraft service span. General LeMay agreed that weapon system producers had to give the Air Force more information on operation and its effect on metal fatigue. In addition, the Air Force and aircraft industry needed to combine their efforts. They had to expand existing programs to collect statistical maneuver-loads data, to conduct cyclic testing, and to develop better instrumentation and analytical techniques.[66] The knowledge to be gained, General LeMay thought, together with judicious application of engineering skills and maintenance funds would prevent the early retirement of aircraft, an extremely expensive alternative.[67] Yet, in any aircraft's life cycle, there was a point beyond which further repair became uneconomical. Perhaps, General LeMay noted, all that could be done to keep the aged B-47 combat ready was to correct anticipated problems.

Final Assessment 1958-1959

Devising the Milk Bottle repairs was just a beginning. While the repairs

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[66] Wright Air Development Center was already considering the B-47's fatigue problem in May 1958 and was flight-testing a Douglas B-66 light bomber to learn more about low-altitude turbulence. Moreover, closely related projects were either in being or soon to start.

[67] Some 15 years later, low-flying B-52s continued to attest to the concept's value.

were underway, Boeing had to develop a broad structural-integrity program to determine the modification's impact on the B-47's service life. Moreover, any other potential problem areas had to be uncovered. The collapse of Boeing's cyclic test aircraft in August 1958 revealed for instance that the B-47's upper longerons—the beams running lengthwise along the fuselage—were susceptible to fatigue when the aircraft approached 2,000 hours of flying time.[68] Similar cyclic tests by Douglas and the National Aeronautics and Space Administration (NASA) did not disclose any serious deficiency until December, when NASA ceased testing after a fracture appeared near one of the B-47's wing stations. Boeing tests continued until January 1959, without duplicating NASA's discovery. But when Douglas stopped in February, after almost 10,000 test hours, its B-47 had also developed a 20-inch crack. If the cyclic testing of the late fifties truly simulated flight conditions, NASA and Douglas's findings were relatively important, since SAC's B-47s had never been individually tagged for 10,000 flying hours. In any event, there were gaps in other crucial research. The low-altitude flying program, using oscillograph recorders to track the stresses and strains of lower levels on the B-47, was far from complete. Still a decision had to be made without delay, if only to justify the purchase of other aircraft. In mid-1959, the Air Force cautiously assigned the B-47 a life expectancy of 3,300 hours.[69]

Other Setbacks 1959-1960

SAC initially wanted 1,000 B-47s modified for low-level flying. This meant fitting the aircraft with absolute altimeters, terrain clearance devices,[70] and doppler radars—the type of new equipment that would require extensive testing and lots of money. In 1959, it became evident that the B-47 would survive the Milk Bottle crisis only to face other severe problems. Because of development testing slippages and the money-saving phaseout of some B-47 wings, SAC scaled down its low-altitude requirements by half. The command did stress, however, the urgency of modifying the 500 B-47s now earmarked for low-level flying. SAC again pointed out

[68] This led to further inspections, the identification of 11 B-47s with defective longerons, and the Air Material Command's eventual modification of all the aircrafts' support beams.

[69] Implied was the requirement for regular rigid inspections. In addition, the Wright Air Development Center admitted that this figure was based on technical consideration only. It could change, because service life did not reflect economic or operational factors.

[70] The kind SAC needed to fly low at night or during periods of reduced visibility did not even exist in 1956.

that the aircraft lacked missile penetration aids and was marginally suited for high altitude strikes. Against improved enemy defenses, the B-47 would be obsolete in 1963 if not properly equipped for low-level flight. The Air Staff did not question SAC's justifications, but fund shortages dictated harsh decisions. Hence, in lieu of 500, only 350 B-47s would be modified for low-level flying, and the aircraft would receive simpler and much less costly equipment than asked for by SAC.[71] Obviously, the end of the B-47 was in sight.

Total B-47Es Accepted — 1,341

Boeing built 691 of the 1,341 B-47Es; Douglas, 264; and Lockheed, 386.

Acceptance Rates — 1953-1957

The Air Force accepted 128 B-47Es in FY 53, 405 in FY 54, 408 in FY 55, 280 in FY 56, and 120 in FY 57.

Flyaway Cost Per Production Aircraft — $1.9 million

Airframe, $1,293,420; engines (installed), $262,805; electronics, $53,733; ordnance, $6,298; armament, $253,411.

Average Cost Per Flying Hour — $794.00

Average Maintenance Cost Per Flying Hour — $361.00

End of Production — 1957

The final B-47E (Serial No. 53-6244) was delivered on 18 February to

[71] The Air Force had canceled in late 1958 the B-47's use of the GAM-72 Quail, a short-range decoy missile, mainly because of dollar limitations. Procurement of the GAM-67 Crossbow had already been dropped, and modification of the B-47 to protect it from infrared missiles was abandoned in mid-1959.

the 100th Bomb Wing at Pease AFB, New Hampshire. The famous "Bloody Hundreth" of World War II was the 29th and last SAC wing to be equipped with B-47s.[72]

Subsequent Model Series — RB-47E

Other Configurations — EB-47E, EB-47L, ETB-47E QB-47E and WB-47E

EB-47Es—Several B-47Es were fitted with additional electronic countermeasures equipment, primarily jammers. These EB-47Es, sometimes referred to as E-47Es, normally called for a crew of 5; otherwise, they were identical to the B-47E bombers which they were expected to accompany.[73] The EB-47Es fulfilled many different tasks. Some of the aircraft carried a special electronic countermeasures equipment rack in the bomb bay. Known as Blue Cradle EB-47Es, they only required a 3-man crew.

EB-47Ls—A number of B-47Es received communications relay equipment to allow them to serve as airborne relay stations for command post aircraft and ground communications systems. The EB-47Ls, requiring a 3-man crew, were replaced in the mid-sixties by more modern aircraft.

ETB-47E—After 1959 some B-47Es were used for training. As in the TB-47B's case, the converted ETB-47E featured a fourth crew seat for the instructor.

QB-47E—In this configuration, all armament items and non-essential equipment were removed from the B/RB-47E. Unmanned and radio-controlled, the aircraft served as missile targets. These QB-47Es were considered as nonexpendable, because of their $1.9 million unit cost, and the guided missiles used against them were programmed to make near misses. A few 3-crew QB-47Es featured telemetric and scoring devices.

WB-47E—Converted B-47Es featured nose-mounted cameras that recorded cloud formations. WB-47Es also differed from the B-47Es by carrying air-sampling and data-recording equipment in place of nuclear weapons.

Adaptation of the B-47 bomber to the weather role dated back to 1956.

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[72] One of these wings, the 93d, had converted to B-52s in 1955.

[73] The prefix letter "E" is assigned to any aircraft equipped with special electronics for employment in a variety of related roles, such as electronic countermeasures or airborne early warning radar.

It followed General Precision Laboratories' successful modification of a SAC B-47B—a project prompted by Congress as a result of the disastrous 1954 hurricane season. The Air Weather Service of the Military Air Transport Service[74] used the modified B-47B to penetrate hurricanes and to perform other weather duties. In November 1958, the aircraft also began to help checking the accuracy of the weather satellite Tiros II. The WB-47B logged 126.5 hours of flying time before retirement in 1963, when more efficient WB-47Es became available. The weather service received the first of 34 WB-47Es on 20 March 1963. These former B-47Es, no longer needed by SAC, were modified by Lockheed at its Marietta plant. The WB-47Es began to be replaced by WC-130 and WC-135 aircraft in 1965, but total phaseout took another 3 years. The last WB-47E—the final operational B-47 in the Air Force's inventory—was delivered to Davis-Monthan AFB on 31 October 1969.

Phaseout 1957-1966

Delivery of the last B-47E coincided with the beginning of the aircraft's phaseout. Both occurred in 1957, shortly after the 93d Bomb Wing started exchanging its B-47s for more modern B-52s. The Air Force, nevertheless, expected the B-47 to be around for many years. The aircraft's accelerated retirement, as directed by President John F. Kennedy in March 1961, was delayed on 28 July by the onset of the Berlin crisis of 1961-1962. In the following years, B-47s were gradually committed to the Davis-Monthan storage facility, but it took Fast Fly, a project initiated in October 1965, to hasten the demise of the elderly plane.[75] SAC's last 2 B-47s went to storage on 11 February 1966.[76]

Item of Special Interest December 1956

Spurred by the Suez crisis of 1956, SAC demonstrated its potential ability to launch a large striking force on short notice. Within a 2-week period in early December, more than 1,000 B-47s flew nonstop, simulated

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[74] The Military Air Transport Service was established on 1 June 1948. It became the Military Airlift Command on 1 January 1966.

[75] SAC's last KC-97s were retired on 21 December 1965.

[76] Some RB-47s remained with the 55th Strategic Reconnaissance Wing, but not for long. However, several B-47 conversions saw many more years of duty.

combat missions, averaging 8,000 miles each (a total of 8 million miles) over the American continent and Arctic regions. Commenting on the spectacular mass flights, General Twining, Air Force's Chief of Staff since 30 June 1953, said the operation showed that the ability to deliver nuclear bombs had clearly taken the profit out of war.[77]

Record Flights 1957–1959

25 January 1957—A B-47 flew 4,700 miles from March AFB, California, to Hanscom Field, Massachusetts, in 3 hours and 47 minutes, averaging 710 miles per hour.

14 August 1957—A 321st Bomb Wing B-47 under the command of Brig. Gen. James V. Edmundson, SAC Deputy of Operations, made a record nonstop flight from Andersen AFB, Guam, to Sidi Slimane Air Base, French Morocco, a distance of 11,450 miles in 22 hours and 50 minutes. The flight required 4 refuelings by KC-97 tankers.

30 November 1959—A B-47, assigned to the Wright Air Development Center, broke previous time-and-distance records by staying aloft 3 days, 8 hours and 36 minutes and covering 39,000 miles.

Other Uses

1954—The Air Force set aside 17 B-47Es, already equipped with the necessary alternators, to test the new MA-2 bombing system earmarked for the forthcoming B-52s. The decision's purpose was 2-fold. To begin with, it would speed up testing of the MA-2. Of equal importance, the relatively large number of aircraft involved would allow the training of a cadre of MA-2 technicians. And this, in turn, would provide skilled personnel for SAC's B-52 units much sooner than otherwise possible.

1968-on—As SAC's EB-47Es neared retirement, the United States Navy acquired 2 of the planes and Douglas began modifying them in mid-1968. In addition to their Blue Cradle equipment, these 2 EB-47Es

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[77] The United States exploded its first "droppable" hydrogen bomb in the Marshall Islands on 1 March 1954. A second U.S. thermonuclear device was successfully tested on the 20th. The tests (part of Operation Castle, an Atomic Energy Commission endeavor) confirmed that it was possible to make light-weight, high-yield thermonuclear weapons. This technical advance obviously would make aerial bombing easier. (It also had an immediate impact on the Convair surface-to-surface Atlas missile. The Atlas's restrictive performance characteristics were loosened to the point where only the "state of the art" bound the missile's continued development.)

received more passive and active electronic systems. Long-range external wing tanks were replaced with a variety of pods filled with electronic countermeasures gear. More chaff dispensers were also added. The modified EB-47Es were redesignated SMS-2 and SMS-3 as they became part of the Navy's Surface Missile System, where they were expected to be used for almost 10 years to sharpen the electronic countermeasures skills of the Fleet. The 2 were due to be retired in the late seventies and to join some other 20 B-47s on display around the country.

RB-47E

Manufacturer's Model 450-158-36

Weapon System 100L

New Features

The RB-47E differed outwardly from the B-47E in that its nose was 34 inches longer. An air-conditioned compartment in the aircraft's redesigned nose housed cameras and other sensitive equipment. Included were an optical viewfinder, photocell-operated shutters actuated by flash lighting for night photography, and intervalometers for photographs of large areas at regularly spaced intervals. The RB-47E had no bombing equipment, but the 20-millimeter tail armament and A-5 fire-control system of the B-47E were retained. A photographer/navigator replaced the bombardier in the aircraft's 3-man crew. The RB-47E also featured the internal jet-assisted take-off system of the earliest B-47Es.

First Flight (Production Aircraft) — 3 July 1953

The RB-47E flew sooner than expected. Nonetheless, the problems and delays anticipated by the Air Force in March 1952 (when many B-47Bs were modified for reconnaissance) did occur. It took almost another 2 years for the RB-47E to become a real asset.

Initial Shortcoming — 1953–1955

An initial RB-47E was assigned to an operational unit in November 1953. This plane featured an interim camera control system that was also due to equip temporarily the next 134 RB-47Es. The sophisticated Universal Camera Control System,[78] designed by the Air Force's Photographic

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[78] The Universal Camera Control System provided for the simultaneous automatic operation of cameras. It also controlled shutter speeds, aperture settings, and image compensation according to ground speed, light, and altitude preset data.

Reconnaissance Laboratory, already tested on the RB-47B, and earmarked for the entire RB-47E contingent, would first appear on the 136th RB-47E. Problems with the interim camera control system soon altered the USAF plans. Because of the system's repeated failures, the Air Proving Ground Command recommended early in 1954 that further operational suitability tests of the available RB-47Es be canceled. No meaningful testing could be conducted, Air Proving Ground Command stated, without a RB-47E equipped with the universal system. This fell in line with General LeMay's thinking. The SAC Commander had already advised Maj. Gen. Clarence S. Irvine, AMC Deputy Commander for Production, that the day-and-night photo capability of the reconnaissance B-47E was unsatisfactory, be it at low or high altitude. General Irvine was quick to point out that minor improvements had been made to the interim camera control system. He willingly admitted, however, that the RB-47E's problems would not be entirely solved prior to the October delivery of the first Universal Camera Control System-equipped RB-47E production. Further discussion of the matter ended in May 1954, when the Air Staff decided that the first 135 RB-47Es would receive a simplified camera control system. This seemed to indicate that the aircraft would not undergo retrofit as originally planned and that SAC would be saddled with 2 RB-47E configurations. Although the Air Staff reversed its decision later in the month, this did not mean that all difficulties were over. Shortages of government-furnished equipment, chiefly of Universal Camera Control Systems, continued to hinder the program. The Air Force nearly reached its production total of RB-47Es by mid-1955, but many of the aircraft were not fully equipped. Yet phaseout of the 91st Strategic Reconnaissance Wing—recipient of the earliest RB-47Es—was only 2 years away.

End of Production — August 1955

The Air Force took delivery of the 4 last RB-47Es in August 1955.

Total RB-47Es Accepted — 255

Acceptance Rates

The Air Force accepted 97 RB-47Es in FY 54, 139 in FY 55, and 19 in FY 56.

Flyaway Cost Per Production Aircraft $2.05 Million

Airframe, $1,409,441; engines (installed), $258,159; electronics, $49,163; ordnance, $6,303; armament and special equipment, $333,847.

Average Cost Per Flying Hour $794.00

Average Maintenance Cost per Flying Hour $361.00

Subsequent Model Series RB-47H

Other Configurations RB-47K

On 5 November 1954, the Air Force officially agreed that 15 of SAC's RB-47Es would be fitted with special equipment for both weather and photo-reconnaissance operations at low and high altitudes. These new configurations, featuring high-resolution and side-looking radars, were designated RB-47Ks.[79] The first RB-47K was delivered in December 1955, as scheduled. In essence, the aircraft was an airborne weather information gathering system. SAC wanted the RB-47K to sense, compile, record, and make inflight radio transmissions of weather data. All these tasks were to be done automatically. The RB-47K was also expected to determine the size of clouds as well as to wind speed and direction. This was a large order, and severe equipment problems remained after mid-1956, when the 55th Strategic Reconnaissance Wing reached an initial operational capability. The 55th Wing's 15 RB-47Ks were flown all over the world to provide weather data for SAC and to sample fallouts from foreign nuclear blasts. They were phased out in the early sixties, when some of the last and more efficient B-47Es were modified to assume the weather role.

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[79] USAF delivery ledgers did not list the RB-47Ks because the 15 aircraft were conditionally accepted as RB-47Es, but Boeing accomplished the complex modification before the aircraft left the Wichita plant. This saved time and money. The entire work was done in 5 months and cost less than $5 million.

Phaseout 1957–1967

The RB-47E phaseout followed the B-47E's pattern, and the first RB-47E (Serial No. 51-5272) was sent to storage at Davis-Monthan AFB on 14 October 1957. Nevertheless, a number of reconnaissance B-47s (mostly RB-47Hs) kept on serving SAC for another decade.

RB-47H

Manufacturer's Model 450-172-51

Previous Model Series RB-47E

New Features

A separate pressurized compartment in the area formerly occupied by the short bomb bay housed the aircraft's new electronic reconnaissance and electronic countermeasures equipment as well as 3 operators—bringing the RB-47H's crew to a total of 6.

Basic Development June 1951

General requirements for electronic countermeasures were established in mid-1951. A detailed configuration was made firm in 1952 because, as Lt. Gen. Laurence C. Craigie, Deputy Chief of Staff for Development, put it, "losses to the potential enemy air defense system would be very high," unless the B-47 possessed the capability to counter them. As initially set up, the Air Force's electronic countermeasures program reflected postwar technological advancements as well as state-of-the-art limits. Five phases were planned. Phases I through IV would provide successively more effective self-protection equipment, such as transmitters and chaff for jamming enemy signals. Phase V would install a 2-man pod in the B-47's bomb bay for escort protection. This beginning, as modest as it might seem, would not come easily. Yet, the urgency was great. On 29 December 1952, General Twining, Air Force Vice Chief of Staff, wrote Boeing's President, William M. Allen, to urge that "the necessary engineering leading to an effective capability be accomplished as speedily as possible." SAC, nonetheless, kept on believing that procuring the desired B-47, specially equipped for electronic countermeasures would take several years. In any case, other requirements needed to be addressed.[80]

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[80] As previously indicated, most of these requirements were fulfilled between 1953 and 1955. As of 1956, 978 B-47s incorporated basic electronic countermeasures devices. Others carried so-called Phase 2, Phase 3, or Phase 4 equipment. Twelve reconnaissance RB-47s featured the removable Phase V, 2-man capsule, initially requested.

On 25 June 1953, General Power, SAC's Vice Commander, stressed that the command actually needed more advanced technology than promised by Phase V. In short, a so-called Phase VII electronic reconnaissance apparatus had to be permanently installed in a number of B-47s in place of the planned 2-man pod. These electronic B-47s would ferret out enemy radar defenses and would replace the RB-50s, RB-36s, and modified B-29s which lacked the speed to do such work.

Program Changes 1953–1955

As requested by SAC, the RB-47H program was amended. The RB-47H's initial 2-man pod was replaced by a permanent pressurized compartment that enclosed equipment and 3 additional crew members—then referred to as electronic countermeasures observers. In 1955, the number of aircraft in the program was brought to 35—a 5-aircraft increase.

Enters Operational Service 1955–1956

The first RB-47H reached the 55th Strategic Reconnaissance Wing, Forbes AFB, Kansas, on 9 August 1955, after considerable slippage due to production difficulties. Although most of the RB-47Hs had been received by the end of 1956, the 55th Wing still had problems. Besides its operational commitments, the 55th was responsible for "organizing and training a force capable of immediate and sustained strategic electronic reconnaissance and air-to-air refueling on short notice in any part of the world, utilizing the latest technical knowledge, equipment, and techniques." Combat crew training was delayed from the start by the aircraft's late deliveries. Faulty engines in the first available RB-47Hs and the fuel leaks of subsequent aircraft likewise hampered training. Excessive noise in the aircraft's pressurized compartment did not help either. By the end of 1956, many of these problems had been ironed out, but none of the RB-47Hs was fully and effectively equipped.

Post-Production Modifications 1956–1957

The absence of an automatic electronic direction finder was the RB-47H's most crucial deficiency. Two pioneer productions of the required direction finder finally became available in December 1956. Each was immediately installed by Douglas (at the company's Tulsa plant), and the 2 newly equipped RB-47Hs reached the 55th Wing in January 1957. As could be expected, the many relatively untested components in these direction finders caused more problems. Their seriousness resulted in the establishment of a joint military and civilian committee to assist testing and operation.[81] Additional direction finders were received in March and the RB-47H's first modification program began. Basically, it called for the installation of 1 automatic electronic direction finder in each RB-47H. Numerous related adjustments were necessary, however. Just the same, the work was done promptly, on base, by Douglas personnel.

Total RB-47Hs Accepted — 35

Boeing built the 35 planes.

Acceptance Rates — 1956-1957

The Air Force accepted 30 RB-47Hs in FY 56 and 5 more during the following fiscal year—the last 2 in January 1957.

Flyaway Cost Per Production Aircraft[82] — $2.1 million

Airframe, $1,588,723; engines (installed), $273,449; electronics, $54,877; ordnance, $8,271; armament, $201,597.

Average Cost Per Flying Hour — $794.00

Average Maintenance Cost Per Flying Hour — $389.00

[81] Members of this committee included representatives from the Boeing Aircraft Company, the Federal Telecommunications Laboratory, the Strategic Air Command, the Wright Air Development Center, and the Oklahoma Air Materiel Area. Within a month, the committee's work led to the selection of proper test equipment, the development of appropriate maintenance procedures, and the design and manufacture of an oscilloscope calibration instrument to reduce maintenance time.

[82] As noted earlier, the flyaway cost of any production aircraft never included the engineering and modification cost incurred after approval of a basic contract.

End of Production 1957

The Air Force took delivery of its last 2 RB-47Hs in January.

Major Retrofit 1960-1962

Although the RB-47H's post-production modifications of 1957 were satisfactory and the aircraft was practically unique, SAC had to keep pace with incessant technological advances. New requirements and the development of more sophisticated equipment soon required a reconfiguration of the RB-47H's special compartment. A mockup inspection in September 1959 was followed in August 1960 by the first flight of a refitted RB-47H. The plane, besides its 6 radar sets, carried some of the most modern electronics. The RB-47H prototype of 1960 was put together by Boeing, but other RB-47Hs were retrofitted in Tulsa by Douglas. The first reconfigured aircraft was returned to the 55th Wing in November 1961.[83]

Subsequent Model Series None

Other Configurations EB-47H/ERB-47H

The EB-47H, for a time designated ERB-47H, was an RB-47H that carried special electronic "ferret" equipment. As such, the 3 planes so modified by Boeing before the end of 1957 were able to detect, locate, record, and analyze electromagnetic radiations.

Phaseout 29 December 1967

On 29 December, SAC's last B-47 type aircraft, an RB-47H (Serial No. 53-4296) of the 55th Wing, was flown to Davis-Monthan AFB for storage. Completion of the RB-47H phaseout came exactly 20 years after the initial flight of the experimental B-47.

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[83] Seventeen months before, an RB-47H flying over the Bering Sea had been shot down by Soviet fighters. This RB-47H loss closely followed the U-2 incident of May 1960.

Program Recap

The Air Force accepted a grand total of 2,041 B–47s (including the first 2 experimental planes and the prototype of a never-produced configuration). Specifically, the B–47 program comprised 2 XB–47s, 10 B–47As (mostly used for testing), 397 B–47Bs, 1 YB–47C, 1,341 B–47Es, 255 RB–47Es, and 35 RB–47Hs. All other B–47s in the Air Force's opertional inventory, be they weather reconnaissance aircraft (WB–47Es), ETB–47E combat crew trainer, QB–47 drones, or others, were acquired through post-production reconfigurations.

TECHNICAL AND BASIC MISSION PERFORMANCE DATA

B/RB-47 AIRCRAFT

Manufacturer (Airframe)	Boeing Airplane Co., Seattle, Wash.; Douglas Aircraft Co., Tulsa, Okla.; Lockheed Aircraft Corp., Marietta, Ga.
(Engines)	The General Electric Co., Schenectady, N.Y.
Nomenclature	Strategic Medium Bomber and Reconnaissance Aircraft
Popular Name	Stratojet

	B-47A	B-47B	B-47E-IV	RB-47H
Length/Span	106.8/116	106.8/116	107.116	108.7/116.3
Wing Area (sq ft)	1,428	1,428	1,428	1,428
Weights (lb)				
Empty	73,240	78,102	79,074	89,230[a]
Combat	106,060	122,650	133,030	139,000[a]
Takeoff[b]	157,000	185,000	230,000	195,133
Engine: Number, Rated Power per Engine & Designation	(6) 5,200-lb st J47-GE-11	(6) 5,910-lb st J47-GE-23	(6) 7,200-lb st J47-GE-25 or 25A	(6) 7,200-lb st J47-GE-25
Takeoff Ground Run (ft)				
At Sea Level	6,000	9,100	10,400	7,800
At Sea Level with Assisted Take-Off	Not Applicable	7,200	7,350	
Over 50-ft Obstacle	7,210	10,650	12,000	9,300
Over 50-ft Obstacle with Assisted Take-Off	Not Applicable	8,650	8,800	
Rate of Climb (fpm) at Sea Level	3,375	2,560	1,850	2,500
Combat Rate of Climb (fpm) at Sea Level	6,200 (mil power)	4,775 (max power)	4,350 (max power)	3,700
Service Ceiling (ft) (100 fpm Rate of Climb to Altitude)	38,100	33,900	29,500	31,500
Combat Ceiling (ft) (500 fpm Rate of Climb to Altitude	44,300	40,800	39,300	37,600
Average Cruise Speed (kn)	424	433	435	424
Max Speed at Optimum Altitude (kn/ft)	521/8,800	528/16,300	528/16,300	516/15,000
Combat Radius (nm)	1,350	1,704	2,050	1,520
Total Mission Time (hr)	6.45	8.27	9.42	6.4
Armament	None	2.50-cal guns	2 20-mm M24A1 guns	2 20-mm M24A1 guns
Crew	3	3	3	6
Max Bombload[c] (lb)	22,000	25,000	25,000	845[d]

Abbreviations		
cal	=	caliber
fpm	=	feet per minute
kn	=	knots
max	=	maximum
mil	=	military
mm	=	millimeter
nm	=	nautical miles
st	=	static thrust

[a] Pod and strut included.

[b] Limited by the strength of the aircraft's landing gear.

[c] Bombloads could be made of various combinations—World War II box fins, interim conical fins, and so-called new series. The B–47B was also capable of carrying one 25,000-pound general-purpose bomb.

[d] Instead of bombs, the RB–47H carried cameras and 845 pounds of chaff.

BASIC MISSION NOTE

All basic mission performance data based on maximum power, except as otherwise indicated.

Combat Radius Formula:

B–47A—Not applicable, since this model was used mostly for testing.

RB–47H—Not available.

B–47B—Took off and climbed on course to optimum cruise altitude at normal power. Cruised out at long-range speeds, increasing altitude with decreasing airplane weight. Climbed to reach cruise ceiling 15 minutes from target. Ran-in to target at normal power, dropped bombs, conducted 2-minute evasive action and 8-minute escape from target at normal power. Cruised back to home base at long-range speeds, increasing altitude with decreasing airplane weight. Range-free allowances included 5-minute normal-power fuel consumption for starting engines and take-off, 2-minute normal-power fuel consumption at combat altitude for evasive action, and 30 minutes of maximum endurance (4 engines) fuel consumption at sea level plus 5 percent of initial fuel load for landing reserve.

B–47E–IV—Took off and climbed on course to initial cruising altitude. Cruised at long-range speeds and altitudes, dropping external tanks when empty. Climbed to cruise ceiling and conducted a 15-minute level-flight bomb run at normal-rated thrust. Dropped bombload and chaff and conducted a 2-minute evasive action and 8-minute escape at normal-rated thrust. Returned to base at long-range speeds and altitudes. Range-free allowances were: fuel for 5 minutes at normal-rated thrust at sea level for take-off allowance, 2 minutes at normal-rated thrust at combat altitude for evasive action, and 30 minutes at maximum endurance airspeeds at sea level plus 5 percent of initial fuel loads for landing reserve.

B-50 Superfortress

Boeing
Airplane Company

B-50 Superfortress
Boeing

Manufacturer's Model 345-2

Overview

The B-50's development was approved in 1944, when the aircraft was known as the B-29D. Still in the midst of war, the Army Air Forces (AAF) wanted a significantly improved B-29 that could carry heavy loads of conventional weapons faster and farther. As World War II ended, the production of thousands of B-29s was canceled. The B-29D survived, but its purpose was changed. Redesignated as the B-50 in December 1945, the improved bomber was now earmarked for the atomic role. The decision was prompted by the uncertain fate of Convair B-36, the first long-range, heavy bomber produced as an atomic carrier. Of course, some of the B-29s that had been modified to carry the atomic bomb remained available, and surplus B-29s were being reconfigured for the atomic task. Just the same, the B-29s of war vintage were nearly obsolete. Hence, they would have to be replaced by a more efficient, atomic-capable bomber pending availability of the intercontinental B-36 or of another bomber truly suitable for the delivery of atomic weaponry.

While the short-range B-50 was immediately recognized as a stopgap measure, the magnitude of the aircraft's development problems proved unexpected. The B-50's first difficulties stemmed from its bomb bay which, like that of the B-29, was too small to house the new bomb and its required components. The fast development of special weapons created more complications, since the individual components of every single type of bomb had to be relocated within the bomb bay's narrow confines.

In keeping with the usual vicissitudes accompanying the development of any new or improved aircraft, the B-50 soon exhibited engine malfunctions. Then, cracking of the metal skin on the trailing edge of the wings and flaps dictated extensive modifications. And while these problems were being resolved, new requirements were levied on the aircraft. In 1949, as the proposed RB-36 remained a long way off, and because of the older RB-29's deficiencies in speed, range, and altitude, some B-50s had to be fitted for the reconnaissance role. To make matters worse, fuel tank overflows, leaking fuel check valves, failures of the engine turbo-chargers, generator defects, and the like continued to plague every B-50 version.

Meanwhile, contrary to plans, most B-50s came off the production lines without the receiver end of the new air-to-air refueling system being developed by Boeing. Additional, and successful, modifications therefore ensued. Nevertheless, the Strategic Air Command (SAC) had no illusions. The B-50, along with the B-36 (first delivered in June 1948), would be obsolete in 1951. That the B-50 did not start leaving the SAC inventory before 1953 was due to the production problems and many modifications of its replacement: the subsonic B-47.

Basic Development 1939

As an outgrowth of the B-29, the B-50 can be traced back to July 1939, when Boeing Airplance Company introduced Model 334A, the B-29's first direct ancestor.[1] Specifically, however, the B-50 bomber stemmed from a B-29 conversion, initiated in 1944.[2]

Initial Procurement February 1940

Requirements for the B-29 Superfortress, from which the B-29D (later known as the B-50) derived, were issued in February 1940, when the Army Air Corps asked the aircraft industry to submit designs for a "Hemisphere Defense Weapon." Boeing Model 345 (a further development of Model 334A) was adjudged best of all proposals for bombers with very-long-range

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[1] Model 334A was actually started in March 1938, when the Army Air Corps asked Boeing to design a pressurized version of its B-17 Flying Fortress. Development of the new pressurized model with tricycle undercarriage was hampered by the Army's lack of money in pre-war years. But Boeing, being aware of the Air Corps' interest, went ahead with the project and managed, still without government funds, to build a mockup of the more refined Model 334A.

[2] The single Boeing Model Number 345 was used for all production versions of the B-29, which in 1942 was the heaviest aeroplane in the world to go into production. The B-29B was the highest designation assigned to a production B-29 model. The B-29C designation was intended for a B-29, earmarked to test new developments of the R-3350 engines, but the project did not materialize. All higher designations identified the purposes of the basic aircraft's various reconfigurations.

characteristics, and the company was authorized in September 1940 to produce the first very heavy bomber to incorporate pressure-cabin installations and other radical changes in design and armament. Development of an improved version of the famed B–29 began in 1944, as a so-called Phase II evolution of the basic design. No specific requirements ensued, but the main intent was to equip the improved bomber with the new Pratt & Whitney R–4360 Wasps and to do away with existing and often troublesome versions of the Curtiss-Wright R–3350 radial engines. The B–29A assigned to the Phase II development project, once reconfigured with the new Wasp engines, was flown by Boeing as the YB–44 prototype. The AAF approved within a few months a production version of the YB–44, which was then designated as the B–29D, and ordered 200 production models of the improved bomber in July 1945.

Procurement Reduction — December 1945

Japan's surrender on 14 August, 3 months after the defeat of Nazi Germany, prompted the cancellation of military procurement. In the process, the 200 B–29Ds on order since July 1945 were reduced to 60 in December of the same year.

New Designation — December 1945

The B–29D became the B–50 in December 1945. Officially, the aircraft's new designation was justified by the changes separating the B–29D from its predecessors. However, according to Peter M. Bowers, a well-known authority on Boeing aircraft, "the redesignation was an outright military ruse to win appropriations for the procurement of an aeroplane that by its designation appeared to be merely a later version of an existing model that was being canceled wholesale, with many existing examples being put into dead storage."[3]

In any case, the former B–29D featured many changes. The redesignated aircraft, built with a stronger but lighter grade of aluminum, had larger flaps, a higher vertical tail (that could be folded down to ease storage in standard size hangars), a hydraulic rudder boost, nose wheel steering, a more efficient undercarriage retracting mechanism, and a new electrical

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[3] Restoration of peace, as precarious as it already appeared to be, prevented the production of nearly 5,000 B–29s (still on order in September 1945), and thousands of operational B–29s became surplus—at least, temporarily.

device to remove the ice from the pilot's windows. The new aircraft's wings and empennage also could be thermally de-iced. Finally, the 4 higher-thrust Pratt & Whitney R-4360 engines that replaced the standard B-29's R-3350s gave a power increase of 59 percent, and electrically controlled, reversible-pitch propellers allowed the use of engine power as an aid to braking on short or wet runways. There was also some rearrangement of the crew. Yet, no matter what designation, there was no doubt that the piston-powered B-29D/B-50 would seem antiquated in the post-war era of jet bombers.[4]

Program Change 1945–1947

The AAF began to plan for an atomic strike force in the first few months of peace that followed the end of World War II. It ordered that 19 additional B-29s be reconfigured as atomic carriers in July 1946,[5] six months after the improved B-29D had become the B-50. Most likely, the AAF already planned that the redesignated bombers would first supplement the reconfigured B-29s and then replace them until a better atomic carrier became available. But the AAF at the time was not in a particularly strong position to press for what it believed to be essential.[6] Hence, the true purpose of the B-50 program did not become official until the spring of 1947.

Production Decision 24 May 1947

The decision to produce the B-50A, first model of the B-50 series, was confirmed on 24 May 1947, nearly 2 years after the aircraft's initial procurement had been authorized.

Procurement Data 1946–1949

Official records revealed that 60 B-29s were authorized for procurement

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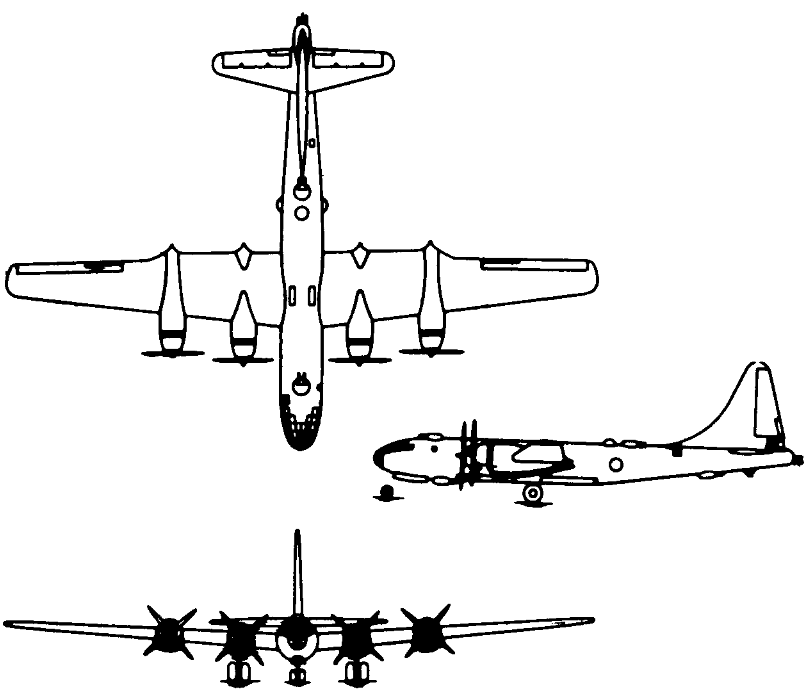
[4] See B-36, pp 11-12.

[5] Modification of the B-29 aircraft to carry the first atomic bombs began early in 1944. Less than half of the 46 modified B-29s remained operational by November 1946. Unlike the first modifications, which were handmade, improvement of the additional B-29s would consist essentially of a standard installation.

[6] The AAF was still subordinate to the War Department prior to its recognition as a separate department within the National Military Establishment in September 1947.

The Boeing B-50, an improved version of the B-29 adapted to carry atomic weapons.



in fiscal year (FY) 1946; 73 B-50s in FY 47; 82 in FY 48, and 132 in FY 49. Production of the last B-50 type, a trainer, as decided on 4 May 1951, did not entail any new procurement, only the amendment of an order previously increased for a different model. This order involved an extra 24 aircraft, the quantity eventually built in the trainer configuration. Procurement logs did not reflect such transactions, but the lack of specific procurement data, contract identifications, exact dates, and the like was not unusual.[7] The aircraft's historical documentation in the immediate post-World War II period often proved meager. In the B-50's case, however, the paucity of details was most likely due to the secrecy which shrouded the project from the start. Nevertheless, the B-50 program's production total was accurately recorded. This total reached 370 aircraft, including the first 60 planes ordered as B-29Ds, but excluding 1 prototype, taken out of the FY 47 procurement order, built in 1949, and paid for with development funds.

Testing 1947-1957

Officially, there were no experimental or prototype B-50s. In actuality, 7 of the 79 B-50As produced by Boeing were allocated to testing.[8] The first B-50A, Serial No. 46-002, initially flew on 25 June 1947, was accepted by the Air Force on 16 October and delivered on the 31st. The airplane was salvaged at Eglin AFB, Florida, on 12 July 1957, after being finally used to verify a stellar monitoring inertial bombing system. Little remains known of the first aircraft's use during the interim 10 years. It was flown a grand total of 769 hours, of which Boeing logged 324 hours and 13 minutes in 176 flights. The aircraft was also lent to the Bell Aircraft Corporation, which flew it 69 times for a total of 199 hours. The test aircraft then stayed with the A. C. Spark Plug Company of Detroit, Michigan, for almost 2 years, from 26 February 1954 to January 1956. During this time, more than 156 hours were accumulated in 43 flights. Air Force pilots flew the remaining 89 hours, and available reports revealed that Air Materiel Command (AMC) made 4 flights of about 6 hours at the Boeing plant before the aircraft's delivery in October 1947. The first B-50A accepted by the Air Force was reclassified as an EB-50A in March 1949, a classification assigned to any aircraft being modified for the electronic countermeasures role or other related purposes. The aircraft retained this classification until January 1956, when it became

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[7] See B-45, p 71.

[8] Numerous other B-50s underwent many tests, but in contrast to the 7 aircraft specifically earmarked for testing, they eventually became part of the operational forces.

known as a JB-50A, indicating that the aircraft was then used for the testing of special instrumentation.

The second B-50A, Serial No. 46-003, accepted by the Air Force also in October, followed its predecessor's path. It was designated EB-50A in November 1947, 1 month after being formally accepted, sent back to Boeing in October 1949, returned to the Air Force on 15 February 1950, and again lent to Boeing in June of the same year. The second EB-50A continued to be tested at the Boeing plant until January 1952, but was retained by the Air Force from then on. The rest of the airplane's operational life was given over to testing, by both Air Research and Development Command and AMC. Most of this was done at Aberdeen, Maryland, where the aircraft was involved in a fatal crash on 24 November 1952. Available records indicate that Air Force pilots only flew the plane 59 times.[9] Five of the other B-50As, earmarked for testing from the start, were obviously used to devise the special modifications required by the upgraded and highly classified atomic program. Basic testing data, therefore was also highly classified and strictly disseminated. An extra and vastly improved B-50A[10] was entirely confined to testing in order to develop the canceled B-54.

Production Slippage — 1947–1948

The AAF thought that some B-50s would be available in September 1947, and that 36 of the aircraft would be immediately delivered to the Air Materiel Command for atomic modification. It was also believed the programmed modifications would be easier to accomplish than the latest performed on the B-29s, because part of the work would have already been done in production. These estimates proved wrong. Slow delivery of the B-50 postponed the beginning of the modification program to 1 February 1948, and the time spent modifying each B-50 jumped from an estimated 3,500 to some 6,000 manhours. In retrospect, however, there seems to have been scant ground for criticism. The B-50 modification program, together with that of the B-29, promised all along to be complex. As it turned out, the project became far more involved than anticipated.

Special Modifications — 1948–1949

As an improved version of the B-29, the modifications of the B-50 were

[9] This figure was obtained from test reports on record at the Air Force Flight Test Center and the Federal Records Center at St. Louis, Mo.

[10] Air Force ledgers excluded the plane from the B-50A total. This was the aircraft that was logged as a prototype and paid for with development funds.

of necessity closely interlaced with those performed on the basic aircraft. For the same reason, aware that the B-50's performance would be only slightly better than that of the B-29, the Air Staff by late 1949 had ceased to contemplate large-scale production of the plane.[11] The B-50 was to be a stopgap, to be used until an aircraft more suitable for the delivery of atomic weapons became available. Its extended operational life in this role was dictated by circumstances, not by choice. Therefore, additional, unanticipated modifications became necessary and proved costly.

As directed by the Joint Chiefs of Staff in January 1948—when the B-36 program appeared once again on the verge of collapse[12] and only 3 B-50s had been delivered—the large-scale atomic project to improve SAC's operating capability called for numerous separate projects. Modification of bombers to carry new atomic bombs was the primary requirement, but other required changes were important. The bombers needed a greater range, which meant that they would have to be modified for in-flight refueling and tankers would be needed. In addition, the bombers would have to fly in the worst climate, which also meant that most of them would have to be winterized. Finally, the Joint Chiefs' project required that several bombers be fitted with electronics that could withstand the cold weather of the arctic, and that other significant modifications be made to various types of aircraft in order to make sure that the atomic carriers would be given the best chances of survival.[13]

Inevitably, estimates of modification costs proved highly unrealistic. To make matters worse, the many extra modifications directed by the Joint Chiefs of Staff took place when money was particularly scarce.[14] For example, in August 1948 lack of funds nearly stopped the B-50 modifications being done at the Boeing-Wichita Plant. Moreover, as time went by

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[11] The Strategic Air Command at the time was increasingly concerned by the long-term problem of developing an atomic carrier of great effectiveness. The command had already admitted that the B-50 (along with the B-36) would become obsolescent after 1951, and that no practical means existed to extend the B-50's life (as well as that of the B-29) beyond 1955. The initial production slippage, various deficiencies, and limited speed of the subsonic B-47, due to supplant the B-50, were serious. SAC's predicament was compounded by the arguments clouding the development of the B-52, which the command believed was the aircraft best suited not only to take over the B-36's task but also to assume most facets of the overall atomic mission.

[12] See B-36, pp 20-21.

[13] There were delays, but these goals were reached. Reactivated B-29s were modified as refueling tankers; reactivated B-29s and incoming B-50s were modified for reconnaissance; F-80 and F-84 escorts were prepared to provide the required protection, and new C-97 transports were bought to support the bombers.

[14] See B-36, pp 25-26.

and a variety of more sophisticated bombs entered the stockpile, the program's complexity grew and new modifications were needed. Obviously, overall costs also rose.

Meanwhile, three-fourths of the additional bombers earmarked by the Joint Chiefs to carry new atomic bombs had received the necessary primary modifications by 15 December 1948. In addition, except for 15 B-50As, all modified bombers had received new standard electronics. Every one of the 72 B-50As involved in the project had been winterized; 57 of them had been fitted for air refueling, and 15 had been given arctic electronics. Production difficulties, program changes, and funding uncertainties delayed some of the modifications. But, save for a few minor exceptions, the Air Force met the Joint Chiefs' extended completion deadline of 15 February 1949.[15]

As usual, modification of the B-50As and of other aircraft connected with the project was split into 2 phases. The contractor, Boeing in the B-50's case, installed all items that became an integral part of the bomber, while removable parts were furnished as "kits" to Strategic Air Command units which then completed the installation.[16]

Enters Operational Service 1948-1949

B-50A deliveries to SAC's 43d Bombardment Wing, at Davis-Monthan AFB, Arizona, began in June 1948,[17] and by the end of the year 34 B-50As were on hand. Nevertheless, a true initial operational capability was not gained until 1949. Problems of all sorts contributed to the delay. In June 1948, the 43d Wing had only 25 percent of the parts required for the new aircraft, and most of the available parts consisted of bolts, nuts, and gaskets. Even though about 25 percent of the B-50A parts were interchangeable with B-29 parts, and some others could be manufactured locally, the wing considered its parts shortages intolerable. Expedients, such as pilot pickup of parts either from the factory or from AMC depots, would "not be feasible with a large number of aircraft." In addition, since only 60 percent

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[15] Besides the B-50As, B-29s, B-36s, F-80s, and C-97s were included in the first modification package directed by the Joint Chiefs of Staff. The overall cost was high. It took $35.5 million to rejuvenate, modify, or adapt a grand total of 227 aircraft.

[16] Certain classified portions of the bombers' new configurations were assembled by the Sacramento Air Materiel Area of the Air Materiel Command into special kits, designated "X" kits. These kits also were installed in the field by personnel of the Strategic Air Command.

[17] A single B-50A (Serial #46-017) reached the 43d Wing on 20 February 1948. The plane was flown from Seattle, Washington, by a 43d Wing crew, who had been checked out in the B-50 aircraft at Eglin Field, Fla.

of all special tools and equipment had reached the wing, much time and many manhours were lost in getting any work done. In late 1948, the overall situation was getting worse.

Other Early Problems 1948–1949

Because of its atomic bombing mission, the 43d Bombardment Wing was accorded various prerogatives: war-strength manning was one of them.[18] The percentage of effective manning was 97.8 percent for officers and airmen by the end of 1948. In addition, the wing's personnel overages could not be used to fill lower priority requirements which ensured that, once the wing acquired its full complement of aircraft and was brought to complete war strength, such personnel would take over the additional assignments. Meanwhile, however, the wing was particularly short of electronics, air control, and photo interpretation officers. Among the airmen, there were shortages of airplane electrical mechanics, airplane and engine electrical accessories repairmen, and camera technicians.

As early as February 1948, 3 Boeing representatives had come to Davis-Monthan and organized classes to teach personnel how to service in-coming B–50As. Operation of a B–50 Mobile Training Unit had actually started in March—regular squadron maintenance slowing down appreciably in the months that followed because of the time maintenance crews had to devote to learning how to take care of the new aircraft. Also, in keeping with the global concept of the upgraded atomic forces, the maintenance of aircraft operating in extreme cold weather had received major attention from the start. Much time was therefore spent preparing and sometimes slightly modifying the aircraft before they left the United States for less clement environments. Also time-consuming was the training of personnel this preparation entailed.

As extensive as these preparations were, the rotation of B–50 bombers overseas, initiated in November with the deployment of 5 aircraft, disclosed unsuspected problems. Once in Alaska, 1 of the B–50As crashed, the other 4 being grounded until the cause of the crash was determined. Although no definite conclusions were reached, the congealing of oil in the small-sized tubing of the aircraft's manifold pressure regulator appeared to be the correct assumption, and modified regulators, successfully tested by AMC,

[18] The same privilege was given to the 509th Bombardment Wing, entirely equipped with B–29s, but remained meaningless throughout the forties, because the Air Force did not have any extra personnel resources. Hence, the 509th had to function with a limited peacetime manning until additional qualified manpower could be provided.

were installed in all B–50s. Also, in keeping with the usual vicissitudes accompanying the introduction of any new aircraft, the B–50As soon exhibited engine malfunctions. In addition, faulty constant speed drive alternators significantly increased the heavy workload of maintenance crews. But progress was made, and the B–50A's performance steadily improved during 1949.

Special Training 1948–1950

Although generally satisfied with the B–50A's initial improvements, SAC knew that forthcoming modifications, program changes, and the reconfigurations usually dictated by such changes, would create new difficulties. These problems could become insurmountable if skilled personnel remained at a premium. The command, therefore, in early 1948 began to plan an extensive cross-training program.[19] As established, the program required that all bombardiers be trained as radar operators, while all radar operators were to master the difficult bombardment skill. Moreover, all pilots were to be trained as loran operators; all navigators, as radar operators; all co-pilots, as flight engineers; all flight engineers, as crew chiefs, and all crew chiefs, as assistant flight engineers.

"Precision bombing" also occupied a place in the overall training program outlined by the Strategic Air Command. In the late forties, because of the limited supply of atomic bombs, "precision bombing" was scrutinized by the highest Air Force authorities. In July 1948, as the SAC training program was just beginning to take shape, the Air Staff underlined the importance of "precision bombing" by pointing out that ". . . each bomb must be employed as though we had a rifle with but one (1) cartridge per man and very few men, thereby placing all the emphasis on the single 'shot' where decisive results will be dependent upon the accuracy with which these few 'shots' are placed." Even though the supply of bombs increased as time passed, the Air Force continued to emphasize bombing accuracy.

Old and New Deficiencies 1948–1950

In November 1948, as a few B–50As were already available and an all out effort was being made to upgrade SAC's atomic striking power, Lt. Gen.

[19] The cross-training program included many pre–World War II practices, some of which were poorly received by SAC's rated personnel. Hence, as finally established, the program proved to be of short duration.

Curtis E. LeMay, in charge of the command since October, took a dim view of the overall program.[20] "I am shocked," he wrote to Gen. Hoyt S. Vandenberg,[21] "by the deficiencies of air bases and forward airfields earmarked for the new forces . . . . as we are responsible for dropping the atomic bomb, I maintain that to be unable to dispatch aircraft into and out of these fields at night during marginal weather is ridiculous." Most places, General LeMay pointed out, were without even elementary operational facilities such as suitable control towers, radio aids, night lighting, crash and fire fighting equipment, and the like. In short, regardless of the severe shortages of funds, a minimum of construction money had to be found, and this project was to receive top priority until more permanent improvements could be made. Closely related to the necessary upgrading of the special bases was the development of standardized procedures to prevent the disaster of an accidental atomic detonation. The SAC Commander's demands could not all be satisfied with dispatch, but progress was made in all cases. And of primary importance, the achievements realized did sustain the test of time.[22]

Meanwhile, as base facilities were being improved and strict safety procedures were devised, new problems began to plague the B-50As. At the end of 1949, the planes were prohibited from flying above 20,000 feet, because of turbosupercharger deficiencies. Then, cracking of the metal skin on the trailing edge of the wings and flaps dictated unexpected modifications. Later on, failure of the rudder hinge bearing caused the temporary grounding of every B-50A. To complicate matters, while these problems were being worked out, new requirements were levied on the aircraft.

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[20] In the process, SAC's new Commander did not overlook some of the cross-training program's weaknesses. While retaining several of the pre-war practices, General LeMay focused his attention on the morale problem within SAC and made training more realistic and worthwhile. In order to familiarize personnel with operating conditions outside the United States, SAC units were deployed on a rotational schedule for limited periods of time to selected oversea bases. Accuracy of high altitude bombing was substantially improved. Combat crew proficiency was raised through the system of "lead-crew" training which had proved so successful during World War II. In 1949, a lead-crew school was established at Walker AFB, New Mexico. Being a lead-crew member enhanced promotion chances and, in later years, became the basis for immediate advancement to higher rank.

[21] General Vandenberg succeeded Gen. Carl Spaatz as USAF Chief of Staff on 30 April 1948.

[22] SAC's nuclear safety record, based on procedures promoted by General LeMay, remained remarkably good in view of the difficulties associated with any type of atomic operations. Nevertheless, accidents occurred. One, in January 1966, when 2 aircraft collided and crashed near Palomares, Spain, generated a great deal of adverse publicity. (See B-52, p 279).

Additional Modifications 1949–1953

Despite its substantial cost—$35.5 million—the modification ordered by the Joint Chiefs of Staff in January 1948 turned out to be a mere preamble. Growing international tension heightened the urgency of the whole endeavor. Hence, on 16 October 1948, the Air Staff directed a new round of special modifications for 1949.[23] Once again, the Air Materiel Command was instructed to give the highest priority to the project, a priority that even the outbreak of the Korean War would not affect.

Even though the entire modification project was carefully outlined, changes occurred. At first, 15 B–50As that did not have air refueling capability were to be fitted with receivers and other necessary equipment. A directive in early 1949 changed this in favor of equipping these 15, plus 5 more B–50A atomic carriers, for a reconnaissance role. As foreseen, this was about the extent of the B–50A's involvement in the second portion of the atomic project. Additional modifications were reserved for subsequent versions of the B–50As and for different aircraft—mostly B–29s, but also some C–97 transports, and new B–36Bs. Later on, however, as the B–47 program faltered, new requirements arose that directly affected the B–50As.

In January 1952, Sacramento area teams began working on the B–50As to allow 50 of them to carry 2 new types of atomic bombs, and Boeing undertook the preparation of the necessary kits. But the B–47's shortcomings created workloads of staggering proportions for both the Air Force and the contractor. For example, 180 additional B–29s left from World War II had to be reactivated and modified for the atomic task.[24] Although Boeing

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[23] The Air Staff passed on its requirements to the Air Materiel Command, which also dealt with the various contractors, but the highest governmental levels were again involved. In fact, in fiscal year 1949 the President personally approved the release of $35 million (the sum had nothing to do with the $35.5 million previously spent and was added to the only $2 million so far available) to carry the Joint Chiefs of Staff's atomic modification project one step farther. Nevertheless, the Air Force was not a mere agent; its responsibilities kept on growing as the complexities of the modifications increased. The Air Force's task acquired a new dimension in mid-1948, when its resources were needed for the Berlin airlift, which was thus in direct competition with the crucial atomic project.

[24] The Air Materiel Area assigned the work of reconditioning and rehabilitating the 180 B–29s to the Grand Central Aircraft Company of Tucson, Arizona. This sudden modernization program proved difficult. The bomb-bay doors of the reactivated aircraft had to be modified to the B–50's pneumatic type. Bombsights, radars (AN/APQ-7s, AN/APQ-13s or -23s, according to availability), and other components had to be added even though, when reconfigured, the 180 B–29s would still be inferior to other B–29 atomic carriers. Upon completion of the contracted modifications, the aircraft went back to AMC, which was still responsible for the installation of all kits. To speed matters, 2 air materiel areas (Sacramento and Oklahoma City) became involved, but new problems arose, Boeing bearing the brunt of most of them. Under the pressures of World War II, the Bell Aircraft Corporation, the Glenn L. Martin Company, and other contractors besides Boeing, each had been involved in the

was placed on a 24-hour day, 7-day week schedule to supply B-50A and B-29 kits, established deadlines could not be met. The modifications to the B-50As, due to be completed in May, slipped several months. Still, the last B-50A, a straggler, was finished before November 1952.

End of Production — January 1949

Production of the B-50A ended in January 1949 with delivery of the last 3 aircraft.

Total B-50As Accepted — 79

The Air Force accepted a total of 79 B-50As within a 16-month period.

Acceptance Rates

The Air Force accepted 30 B-50As in FY 48 (starting in October 1947 and ending in June 1948), and 49 B-50As in FY 49 (from July 1948 through January 1949).

Flyaway Cost Per Production Aircraft — $1.14 million

The B-50A's unit cost was set at $1,144,296—airframe, $684,894; engines (installed), $193,503; propellers, $65,496; electronics, $71,369; ordnance, $5,524; armament (and others), $123,060. Except for the program's last model, the TB-50H, every B/RB-50 version was assigned the same price tag.[25]

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fabrication of the aircraft. The 180 B-29s therefore differed from each other in various respects, which meant that special kits had to be developed to fit every configuration. Boeing's difficulties snowballed as each kind of kit required separate prototyping and separate engineering approval. In the long run, slippages in kit deliveries postponed completion of the new B-29 project to the fall of 1953, a 6-month delay.

[25] The identical unit price of most B-50s represented an average reached regardless of contractor or fiscal year procurement. This average unit cost did not include the engineering change and modification costs incurred after approval of a basic contract. The Air Force often endorsed such price formulae because of the fluctuations of costs and cost arrangements during the production period of many programs, aircraft, missiles, and other weapon systems alike.

Subsequent Model Series B/RB-50B

Other Configurations TB-50A

As indicated by the prefix letter T, the TB-50As were B-50As that had been modified as bombing-navigation trainers. Eleven B-50As, equipped with the hose-type inflight refueling system, underwent such conversion, and were primarily used for training crews of the B-36, even though this aircraft could not be refueled in the air. Like most B-50s, the redesignated TB-50As, after undergoing further modifications,[26] ended their service life as KB-50J tankers.

Phaseout 1954-1964

The B-50As began phasing out of SAC in mid-1954, when the 93d Bombardment Wing started receiving eagerly awaited B-47s. But retirement from SAC did not mean that the B-50A's operational life was over. Under one designation or another, many of the B-50 aircraft remained in the Air Force's active inventory for about another decade.[27]

Milestones 2 March 1949

On 2 March, Lucky Lady II,[28] a B-50A (Serial No. 46-010) of the 43d Bomb Group, completed the first nonstop round-the-world flight, having covered 23,452 miles in 94 hours and 1 minute. Carswell AFB, Texas, was the point of departure and return. Lucky Lady II was refueled 4 times in the air (over the Azores, Saudi Arabia, the Philippines, and Hawaii) by KB-29 tankers of the 43d Air Refueling Squadron.[29] For this flight, the B-50A crew

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[26] A difficult modification since the aircraft had to be stripped of all armament (tail guns excepted), and large single tanks had to be installed in the bomb bay.

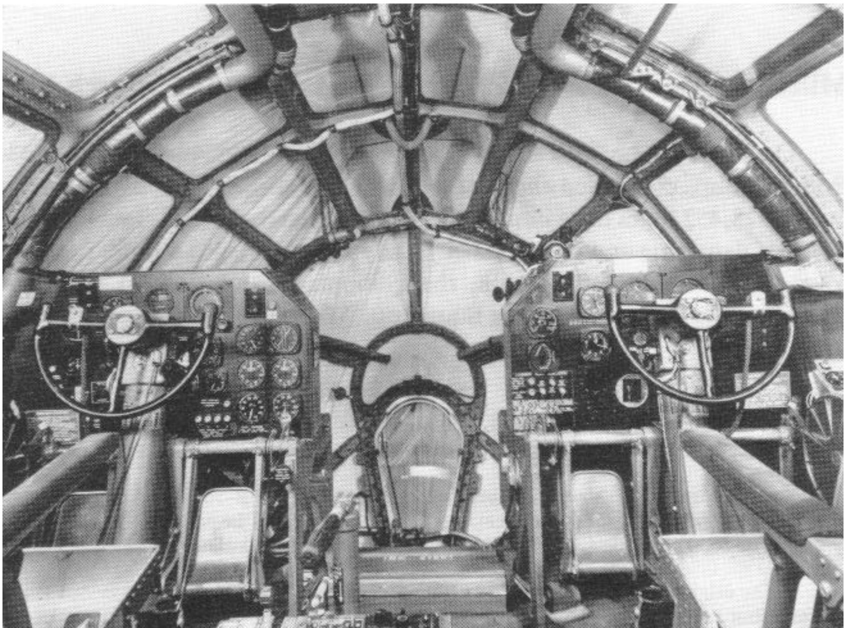
[27] Available records showed that once released by SAC, 134 B-50s were modified for the tanker role. Some of these aircraft remained in the operational inventory until 1964; other B-50s, after reconfiguration, served the Air Weather Service until almost the end of 1965.

[28] The original Lucky Lady was a wartime B-29, which participated the previous year in a similar but unsuccessful round-the-world flight.

[29] The 43d and 509th Air Refueling Squadrons were the first air refueling units in the United States Air Force. Beginning in late 1948, the 2 squadrons were equipped with World War

of 14, commanded by Capt. James Gallagher, received numerous awards and decorations. Foremost among these were the Mackay Trophy, given annually by the National Aeronautic Association for the outstanding flight of the year, and the Air Age Trophy, an Air Force Association award given each year in recognition of the air age. The Air Age Trophy was later renamed the Hoyt S. Vandenberg Trophy in honor of the second U.S. Air Force Chief of Staff.

II B-29s that had been modified to carry and dispense fuel in the air through the use of trailing hoses and grapnel hooks, a refueling system developed by the British. These modified B-29s were known as KB-29M tankers.



Pilot and co-pilot stations in a Boeing B-50.

B/RB-50B

Manufacturer's Model 345-2

Previous Model Series B-50A

New Features

An increase in gross weight, from 168,480 to 170,400 pounds, a new type of fuel cell, and a few minor improvements were the basic differences between the B-50B and the preceding B-50A. The B-50B, however, was immediately reconfigured for the reconnaissance role. In this capacity, the RB-50B featured 4 camera stations (numbering a total of 9 cameras), weather reconnaissance instruments, and extra crew members housed in a capsule that was located in the aircraft's rear bomb bay. In addition, the RB-50B carried fittings for two 700-U.S. gallon underwing fuel tanks.

Planning Changes 1948-1949

The Air Force had planned to use its next lot of 45 B-50s as atomic carriers. It also expected that the forthcoming aircraft, identified as B-50Bs, would be capable of carrying both the Mark 3 and Mark 4 bombs.[30] However, neither plans nor expectations materialized. Indeed, besides the 45 non-atomic capable B-50Bs, 35 subsequent B-50 models would also fail to incorporate from the start the B-50A's initial post-production improvements. Meanwhile, the older RB-29's deficiencies in speed, range, and altitude prompted the Air Force to endorse the immediate reconfiguration of its 45 new B-50Bs. The decision did not reflect the Air Force's preferences. Ideally, reconnaissance aircraft should be superior in performance to the bomber type dependent upon their information. But limited funds had not permitted the development of such a specialized aircraft, and the proposed

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[30] The 81st B-50 was to be the starting point for the necessary production line modifications. (The first 79 B-50s were B-50As; the 80th B-50 was set aside and used as a prototype.)

RB-36B remained a long way off. Acquisition of the RB-50B, therefore, appeared to be the best as well as the only alternative. Although all 45 aircraft were re-fitted for the reconnaissance role, the Air Force's financial ledgers kept on carrying the planes as B-50Bs.

First Flight — January 1949

The first B-50B, initially flown early in January 1949, was accepted by the Air Force on the 18th. Within a short period, 14 B-50Bs were delivered to SAC, the first of the 14 being received by the command on 31 January. This aircraft (Serial No. 47-119) was immediately sent to the Boeing Wichita plant for modification as reconnaissance aircraft, marking the beginning of the B-50B fleet's reconfiguration.

Reconfiguration Task — 1949-1951

Adapting the B-50B to the reconnaissance role became a fairly involved project for a number of reasons. At first, the Air Force thought of exempting 15 B-50Bs from the proposed modifications. Then, because of new requirements, the Air Force decided to reconfigure all the B-50Bs and further, to fit them for a variety of reconnaissance purposes. Eventually, 3 different types of reconnaissance B-50Bs came into being. Although identified from the start as RB-50Es, RB-50Fs, and RB-50Gs, the reconfigured B-50Bs were not formally redesignated until 16 April 1951.

The RB-50E, first of the 3 types, was returned from the Wichita plant in May 1950. The Air Force acquired 14 RB-50Es, all of them in just a few months. Earmarked for photographic reconnaissance and observation missions, the RB-50E normally required a crew of 10. According to the type of mission being flown, the left-side gunner served as weather observer, or as in-flight refueling operator. When at this station, at altitudes above 10,000 feet, the left gunner had to use oxygen and wear heated clothing. As in the case of the original B-29,[31] compartments for the other crew members were pressurized and featured heating and ventilating equipment. The RB-50E's defensive armament, like that of other B-50 models, also dated back to the B-29. The only difference was that the number of .50 caliber machine guns had been increased from 10 to 13, all of which were still housed in 5

[31] The B-29 was the first military aircraft in the world to have pressurized compartments for all members of the crew, including the tail gunner.

electrically operated turrets. The turrets were controlled remotely from the sighting stations.

The RB-50F, the second reconfigured version, was returned from Wichita in July 1950. The Air Force received 14 RB-50Fs, Boeing completing the required modifications in January 1951. The RB-50F closely resembled the RB-50E, but was equipped with the Shoran[32] radar system for the specific purpose of conducting mapping, charting, and geodetic surveys. However, the Shoran radar prevented the RB-50F from making use of its defensive armament, which was identical to that of the RB-50E. To give the weapon system additional versatility, the Shoran radar and associated components were housed in removable kits. Deletion of the kits and a simple adjustment restored the RB-50F's defensive power. Therefore, if needed, the 2 aircraft types could be used for the same basic reconnaissance missions.

The RB-50G, the third and last reconnaissance version derived from the B-50B, entered SAC's inventory between June and October 1951. The 15 reconfigured aircraft (Manufacturer's Model 345-30-25) differed significantly from the RB-50E and RB-50F. Electronic reconnaissance was the principal mission of the RB-50G. The aircraft featured 6 electronic countermeasures stations, an addition which had necessitated a number of internal structural changes. Some external modifications had also been necessary to accommodate the radomes and antennae of the aircraft's new radar equipment. Finally, during the reconfiguration process, the 16-crew member RB-50G had been fitted with the improved nose of the B-50D, the production model which actually followed the B-50B. In contrast to the RB-50F, the RB-50G could use its defensive armament while operating its new radars and electronic countermeasures equipment.

Other Modifications 1949–1950

Reconfiguration of the RB-50s did not necessarily eliminate some of the B-model's flaws. As a result, several modifications were accomplished either before, during, or after the basic aircraft had been adapted to the reconnaissance role. Problems of various importance were identified,[33]

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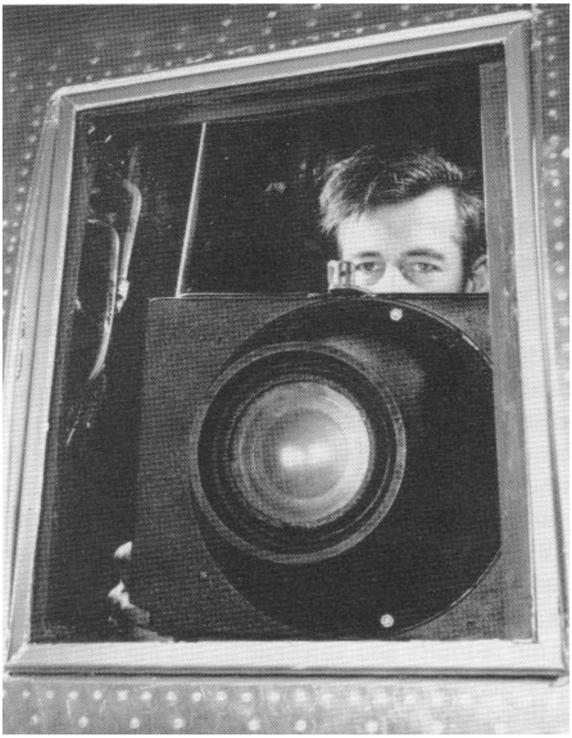
[32] Shoran was originally developed as a *Sho*rt *Ra*nge *N*avigational aid to bombing to enable a bomber to strike its target when the target was not visible from the aircraft. This method, first applied in a primitive fashion during World War II, proved very effective within certain limitations. These parameters were primarily the restricted range of the electronic signal from aircraft to ground and return, and later on the frequent lack of a single geodetic survey control system in the region containing the Shoran ground station sites and the targets.

[33] All of the B/RB-50B shortcomings were retained by the subsequent B-50D, and the same corrective measures were applied to this later model.



Looking in a port of a reconfigured RB-50B, one could see the lens cone of a hand-operated reconnaissance camera. This aircraft featured 9 such camera stations.

some of them as soon as the aircraft reentered the Boeing plant. Leaks from fuel cells were an unexpected dilemma—probably attributable to the aircraft's thin, light-weight fuel cells.[34] The B-50A, equipped with heavy-weight fuel cells, had not encountered such difficulties. While AMC wrestled with the problem, interim measures were taken, including the tightening of cell interconnect bolts and replacement of defective tanks. In October, instead of improving, the fuel cell problem became worse, "a considerable increase in fuel tanks leaks [being] attributed to the arrival of cool weather." By year's end, AMC decided to replace the defective cells of the B-50B and all subsequent B-50s with a new type of fuel cell, as soon as it became available.[35] Meanwhile, there were other problems. Like the previous B-50As, the new aircraft experienced fuel tank overflows, leaks in

[34] The main fuel cells in the B-50 were located within the wing. Looking forward from the pilot's position there were as many as 17 cells to the left and the same number to his right. On most models only 11 cells were utilized in the right wing and 11 in the left wing.

[35] The B-50D deliveries were actually stopped, pending availability of the new fuel cells.

fuel check valves, failures of the engine turbochargers, warped turbos and warped turbo bucket wheels, generator defects, and the like. In addition, since all B-50 airframes were basically alike, the B/RB-50s shared the B-50A's trailing wing problems. This was not a new experience. Several years before, cracks had also appeared in the metal skin at both forward and trailing edge of the upper side of the B-29's wing assembly. In all cases, stress beyond metal strength had been the most probable cause.[36] The permanent solution, finally endorsed in 1949, was to use heavier metal in the fabrication of future wing flaps. This was a simple enough solution, but not quickly implemented.

Program Reduction 1949

Cancellation of the B-50 program was not seriously considered before the aircraft entered the inventory in substantial numbers, but the program was drastically altered in 1949. An early B-50A, set aside to serve as prototype for the model due to follow the B-50B, did not fare well. Initially known as the YB-50C, this aircraft was expected to feature a longer fuselage, a single bomb bay, larger wings, and 4 new R-4360-43 turbo-compound engines.[37] The YB-50C's take-off weight was tentatively set at 207,000 pounds, a significant 50,000-pound increase over the weight of most B-50 models. By November 1948, the B-50C mockup had been completed, inspection of the prototype was scheduled for May 1949, and 43 production aircraft (14 B-50C and 29 RB-50Cs) were already on order. In late 1948, because of the many changes embodied in its design, the future B-50C became the B-54, the original quantity of aircraft under contract remaining unchanged.[38] The new designation, however, did not help the aircraft's prospects.

President Truman's curtailment of the fiscal year 1949 defense budget forced the Air Force to make some difficult adjustments. While the B-54's high price was known, the cost effectiveness of the aircraft was not clear. Yet for good reasons, neither Secretary of the Air Force W. Stuart Symington nor General Vandenberg wished to give up the new aircraft. No B-54s had been produced, but work was underway by the manufacturer and sub-

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[36] Responsible for 2 recent B-50A accidents.

[37] The Pratt & Whitney development was usually referred to as the VDT (variable discharge turbine) engine (for details, see B-36, pp 14-15 and p 19).

[38] In addition, the next two annual procurement programs provided for 43 and 58 other B/RB-54s, respectively.

contractors. Therefore, the program's cancellation would entail some financial loss and disturb the industry. On the other hand, certain facts could not be overlooked. Whether known as B-50C or B-54, the aircraft had no growth potential; its design represented Boeing's effort to extract the last ounce of performance out of the final development of the basic B-29. Actually, the B-54 configuration provided an undesirable outrigger landing gear requiring wider taxiways than existed at operating bases; jet engines could not be added without designing entirely new wings; and the new K-1 bombing system could not be installed without sacrificing a belly turret or without a drastic alteration of the aircraft's fuselage. Finally, and of great importance, General LeMay[39] wanted no part of the B-54.

On 21 February 1949, while appearing before the Board of Senior Officers,[40] General LeMay again strongly reiterated that the B-54 program should be canceled in favor of additional B-36s, since development of the B-36 with jet pods indicated superior performance in speed, altitude, and range. Pending quantity production of the B-52, the SAC Commander stated, the B-36 provided the best capability to carry out his command's primary mission, a mission vital to national security.

Although Secretary Symington and General Vandenberg did not question General LeMay's expertise, both remained reluctant to terminate the procurement of the B-54. The crux of the problem was that canceling the B-54s and getting more B-36s would alter the medium/heavy bomber group-combination, included in the program recently approved by the Joint Chiefs of Staff. As an alternative, Secretary Symington then suggested substituting less costly B-50s for the B-54s. But the SAC Commander quickly pointed out that the substitution, even if acceptable on the basis of economy, would still be a very bad solution. Instead, General LeMay testified, if all programmed B-54s could not be replaced by B-36s, the best course of action would be to secure extra B-47s, as soon as possible. After weighing and balancing all factors involved, the Board of Senior Officers concluded that production of the B-47 should be accelerated and additional B-36s bought. The board's recommendations were approved by Mr. Symington and General Vandenberg in April 1949, marking the end of the B-54 program.

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[39] General LeMay was promoted to full general on 29 October 1951.

[40] The board's members, convened to review the composition of the 48-Group Program imposed by President Truman's budgetary restrictions, included Gen. Muir S. Fairchild, Vice Chief of Staff, Gen. Joseph T. McNarney, Commanding General of the Air Materiel Command, Lt. Gen. H. A. Craig, Deputy Chief of Staff for Materiel, and Lt. Gen. Lauris Norstad, Deputy Chief of Staff for Plans and Operations.

End of Production 1949

The B-50B production ended in April 1949, with the delivery of 7 aircraft.

Total B-50Bs Accepted 45

The Air Force accepted its 45 B-50Bs within a period of 4 months. All but 1 of the 45 aircraft became RB-50s.

Acceptance Rates

The Air Force accepted 9 B-50Bs in January 1949, 14 in February, 15 in March, and the last 7 in April.

Flyaway Cost Per Production Aircraft 1.14 Million

Like the B-50A, the B-50B's unit cost was averaged at $1,144,296. This amount did not include reconfiguration costs, estimated in September 1948 at $217,000 per aircraft.

Subsequent Model Series B-50D

Other Configurations EB-50B

One of the first B-50Bs accepted by the Air Force was immediately returned to Boeing, where it was flown experimentally with a track-type nose and main landing gear. As indicated by its "E" designation, the aircraft was also equipped with various electronic devices, while on loan from the Air Force.

Phaseout 1954

The RB-50s began leaving SAC's operational inventory in 1954, when modern but still troublesome RB-47s finally became available. SAC had 40 RB-50s in 1951, a peak total reduced to 12 in 1954 and 1955, with the last aircraft leaving the command in December 1956. However, in contrast to the B–50A, phaseout from SAC did not signify the end of the RB–50's primary role. In 1954, although reassigned from the command, several RB–50s, their Shoran equipment greatly improved,[41] still performed photo-mapping missions; in 1957, a few RB–50Es and RB–50Gs continued to be utilized by the Air Force Security Service. However, these were exceptional cases, and the RB–50's primary career came to a close before the end of the decade.

[41] The initial Shoran had been refined and had become known as the Hiran, an abbreviation for *Hi*gh Precision Sho*ran*.

B–50D

Manufacturer's Model 345–9–6

Previous Model Series **B–50B**

New Features

Externally, the B–50D differed from the B–50A and B–50B only in that it had an all-plastic nose and provisions for droppable wing tanks. Otherwise, the B–50D bomber greatly resembled the B–50A.[42] A different type of equipment for in-flight refueling, larger fuel capacity, more efficient radar, fewer crew members (10 instead of 11, and sometimes only 8), plus other minor improvements completed the list of changes separating the 2 bombers.

First Flight **May 1949**

Initially flown in May 1949, the first B–50D was accepted by the Air Force on 14 June. Deliveries to SAC began 10 days later, with the arrival of 1 B–50D (Serial No. 47–167).

Enters Operational Service **Mid–1949**

The B–50Ds entered operational service with SAC in mid-1949, but within 3 months the new planes presented so many major maintenance problems that the command decided to refuse further deliveries and to return those B–50Ds presently assigned whenever possible to the Air Materiel Command. Some 50 B–50Ds were involved, most of which were grounded for extended periods of time during the remainder of 1949 and the first 6 months of 1950, because their main fuel cells, inverters, turbosuper-

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[42] The B–50D's actual predecessor was the B–50B. In practice, since the B–50B was immediately reconfigured for the reconnaissance role, the 2 aircraft could not be compared.

chargers, alternators, generators, and even wing trailing edges carried flaws of one kind or another. As was usually the case, these problems were resolved, but the solution took time, a commodity the Air Force could then ill afford.

Other Initial Shortcomings 1949–1950

Disappointingly, most B–50Ds came out of production without the "receiver-end" of the new flying boom air-to-air refueling system then being developed by Boeing. Yet, adoption of a refueling system had been planned all along.[43] The experimental refueling program, approved by the end of 1947, provided for modification of a prototype tanker and bomber-receiver which, once satisfactorily tested, would be rushed to SAC for the training of crews. Refueling in the air had been carried out as early as 1923, but only the Flight Refueling, Ltd., a British company formed in the 1930s, was manufacturing the necessary equipment. The Air Force in March 1948 had given Flight Refueling a contract to supply 40 complete sets of tanker-bomber refueling equipment, together with technical assistance by British engineers, necessary tools, and installation drawings.[44] The Air Force was willing to pay a high price—in excess of $1.2 million—for a temporary solution to the air refueling problem. Despite the British system's merits and potential for improvement, the Air Force expected that it would soon be supplanted by the Boeing type, which primarily consisted of substituting a mechanical boom for the hose of the British contraption. Boeing's progress however was slower than anticipated. As a result, neither the "receiver-end" nor the feeding apparatus of the new equipment could possibly be installed during the production of a majority of

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[43] The Air Force was well aware that the Strategic Air Command's entire atomic capability would rest in the short-range B–29 and B–50 medium bombers until the intercontinental B–36 entered the inventory. This meant, for a few years at least, dependence on carefully selected overseas bases. It also underlined the urgency of the air refueling program. And even though the B–36 was finally considered fully operational in 1951, the number of available aircraft was often limited since the new intercontinental bombers were constantly involved in some of the special atomic project's many modifications. In any case, be it in support of atomic, conventional, or other Air Force missions, air refueling remained a vital capability and top Air Force priority.

[44] The first installation of the British system, employing hose connections and gravity feed, was completed in May 1948. Flight-testing prompted a few modifications, but by September 24 B–29s had been modified, 12 as tankers and 12 as receiver aircraft, and were delivered to SAC. The British hose system permitted the transfer of 2,600 gallons of fuel at a rate of 90 to 100 gallons per minute, thus increasing the receiver aircraft's combat radius by perhaps as much as 40 percent. Still unsatisfied, the Air Materiel Command was already working on the development of a force feed technique to increase the flow of fuel to 200 gallons per minute.

A Strategic Air Command crew was briefed before a mission in a B–50D bomber.

the B–50Ds.[45] This led to several retrofits. The most urgent one entailed giving the aircraft the necessary receivers, since the B–50Ds would serve as atomic carriers until replaced by the B–47s.

Atomic Modifications 1949–1951

As pointed out by the Air Staff in late 1948, the urgency of the second phase of atomic modifications could not be overstated. Many of the additional requirements were specifically addressed to the new B–50Ds. However, the aircraft's participation in the special atomic project started poorly. First, the B–50D deliveries did not begin on time, delaying signifi-

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[45] Slippage of the flying boom air-to-air refueling system altered many plans. Forty of 92 B–29s, earmarked for the tanker role, were to receive the new system but were fitted with the British hose type instead. All 92 aircraft were designated KB–29Ms. A later directive of the large-scale atomic project assigned another 116 B–29s, withdrawn from storage, to the refueling task. This time, the aircraft were fitted with the American system, but Boeing did not start the modification before August 1950 and only completed it in 1951. These aircraft, identified as KB–29Ps, were mainly used to air-refuel the B–50D atomic carriers. Soon afterward, Boeing undertook to bring another 185 reactivated B–29s to the KB–29P configuration.

cantly the aircraft's post-production modifications. Then, in addition to their imperfections and because of a misunderstanding between Boeing and the Air Force, the first B-50Ds delivered to SAC had not been adapted on the production line to carry both the Mark 3 and Mark 4 bombs,[46] a production feature of all subsequent B-50Ds. This serious omission created more work and delays, because Boeing had to prepare special kits[47] to be installed by personnel of the 93d and 509th Bombardment Wings, the new aircraft's first recipients.

Meanwhile, incredibly rapid technological developments were beginning to complicate the exacting atomic project requirements of January 1948. On the surface, converting a bomber aircraft to an atomic weapon carrier appeared simple. The basic components needed were relatively few in number. The installation consisted of a shackle or bomb rack capable of suspending and releasing the bomb, sway braces to hold the bomb in place during flight, and a limited number of pieces of equipment bracketed to the airplane and connected by cable to the bomb mechanism. Included were arming controls, the capsule insertion gear, and the T-boxes[48] that controlled, tested, and monitored the bomb. In addition, a pair of hoists, attached to the bomb-bay frame lifted the bomb into place. Ironically, the "simple" conversion proved difficult for several reasons. First, the B-50 was a development of the B-29, an aircraft never intended to carry an atomic payload. The B-29/B-50 bomb bay was too small to house the required components and new bombs. Procurement and development of the B-50 occurred in an era when in-house secrecy almost totally enshrouded spectacular atomic advances. The rapid development of more efficient bombs created additional problems, since every single new type of bomb required that associated components be relocated within the narrow confines of the B-29 and B-50 bomb bay.

Faced with uninterrupted modification crises, the Air Force in March 1950 issued military characteristics for the development of a so-called "universal system," which could hoist, suspend, and release most types of atomic weapons and be easily fitted in the bomb bay of all atomic carriers.

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[46] The Mark 3 was first available in 1948; the Mark 4, in mid-1949.

[47] These kits, called the "auxiliary bombing system," only were to be installed "when and if needed." This qualification, however, did not reduce SAC's extra workload, since field personnel still had to learn how to install the kits.

[48] The T-boxes housed specialized electronics components used for the monitoring, control, and testing of the circuits and equipment that played a role in the atomic operation. As a rule, a T-box (also popularly known as "Black-box" because of the black-color) denotes any unit, as a bombsight, robot pilot, or piece of electronic equipment that may be put into, or removed from, a radar set, an aircraft, or the like, as a single package. Such units are used for ready maintenance.

After many conferences, the requirements were revised, scaled down, and finally dropped in the B-29 and B-50's cases, again because the bomb bay of those aircraft did not provide the necessary space.[49] In the same year, as the new Mark 4 bombs became plentiful, the Air Force ascertained that these bombs, although more efficient than the preceding Mark 3s,[50] were not very satisfactory. Instead the Air Force believed in the necessity of developing a faster-detonating, lighter, safer, and easier-to-handle bomb. From then on, events moved swiftly, with not one, but several new types of bombs entering the atomic stockpile before 1953.[51]

Acquiring several new types of bombs presented a significant advantage for the Air Force, however, ensuring that the bombs could be handled efficiently was a challenge of great magnitude. Tremendous problems soon emerged. First, it appeared that adapting 1 squadron of B-50Ds (15 aircraft) to carry the most advanced of the new bombs would be impossible without destroying the aircraft's capability to handle other types of atomic bombs.[52] Then, the urgent modification of 180 B-50Ds (and 69 B-29s) to prepare these aircraft for the bomb that immediately followed the Mark 4, acquired top priority. A third new type of bomb, fully available before delivery of the most advanced one, also called for prompt and difficult modifications. Finally, and perhaps fortunately, a fourth new type was eliminated from consideration in the B-29 and B-50 bombers, because the bomb was too long to be fitted in the short bomb bay of these aircraft. Meanwhile, the B-50D's many modifications were further complicated by the on-going installation of an improved bombing-navigation radar system, the AN/APQ-24.[53]

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[49] First installed in the large bomb bay of a B-36 in March 1952, the universal system became a standard feature of the intercontinental bombers. The installation of a fairly similar configuration of the system was seriously contemplated for the B-47, but did not materialize.

[50] The Mark 3s were all phased out by early 1951.

[51] Improved versions of those new bombs became available in 1954 and 1955, by which time better coordination between the Air Force and the Atomic Energy Commission had minimized the physical changes required for aircraft to carry new type bombs. And later on, as thermonuclear weapons came into being, the costly chore of transforming bombers into atomic carriers was eliminated.

[52] In June 1951, the Air Staff endorsed SAC's request to extend the new requirement to 16 B-47Bs and 12 B-36Ds. The Air Staff also directed that if the new bombs could not be carried by the aircraft without hampering their other capabilities, then specifically designed kits would be delivered to SAC, so that the command would be prepared either way. Modification of the 15 B-50Ds, or development of the necessary kits, would retain precedence over any similar work for the B-47s and B-36s.

[53] The B-36B was the first recipient of the new AN/APQ-24 and this radar was not authorized for other B-50 bombers or for the older B-29s, which retained the Norden optical sights. In any case, the APQ-24 also proved to be unsatisfactory because of lack of security, high rate of malfunction, and inadaptability during bad weather.

Completion and Appraisal 1952–1953

Adaptation of the B–50D to the atomic carrier role followed the B–50A's pattern. Boeing worked overtime, extra AMC teams were deployed to the SAC bases, and special care was exercised to make sure that SAC's overall atomic capability was not severely strained by the incessant modifications.[54] For example, only the first 4 aircraft of every B–50D wing were modified to carry the most sophisticated atomic bomb of the period, and the modifications,[55] started in January 1952, were completed in May. Similarly, the adaptation of 180 B–50Ds, to accommodate the Mark 4's immediate successor, was carefully scheduled, 4 groups of 45 aircraft undergoing changes at different times. There were some occasional schedule overlaps and several serious delays. Boeing modification of 80 B–50Ds in late 1951 slipped several months, and another B–50D modification, due to be completed by June 1952, was delayed for lack of the necessary kits. In some instances, however, the bombers' modifications were so successfully organized that the B–50Ds were able to handle a new type of bomb as soon as it became readily available.

In March 1953, several months after new requirements had been formulated, the Mark 4 bombs were removed from the atomic stockpile. By late 1953, just as the modifications prompted by the new requirements were being completed, SAC began to replace some of its B–29 and B–50 bombers with new B–47s. These substitutions had long been planned, although the B–47 deliveries were late. Still, some believed that the long modification lead time had more or less nullified the usefulness of the older B–29 and B–50 aircraft.

Criticism of the atomic modification project was not new. Back in 1951, harrassed AMC personnel complained that the magnitude of the modification task was reaching such proportions that the very existence of the weapons system, through which the atomic bombs were to be employed, was being jeopardized.[56] In June 1951, Maj. P. C. Calhoun, an AMC project officer appearing before the Special Weapons Development Board, expressed the same opinion. "These modifications are necessary," Major Calhoun emphasized, "but if the USAF tactical capability is to be maintained, weapon systems programs must be better planned, better phased,

[54] The same careful timing was extended to the modification of the B–29, B–36, and subsequent B–47 bombers.

[55] As anticipated by the Air Force, the aircraft ended being fitted with a number of permanent parts (so-called Parts A), and special kits were provided.

[56] In addition to the many modification programs, numerous retrofit programs were necessary to add new or improved equipment or to correct deficiencies in installed equipments.

and better executed." In short, the Air Materiel Command as a whole deplored the atomic project's short deadlines, interim solutions, and costly crash programs. Moreover, in continually "butchering" the bombers lay the danger of seriously impairing their operational characteristics. AMC's criticism was valid, but the Air Force had no easy solutions. Counterbalancing these drawbacks, and perhaps too quickly overlooked, the fact remained that the B-29 and B-50 wings comprised a large portion of SAC's atomic arsenal until the end of 1953, when their conversion to B-47s began.

End of Production — 1950

The Air Force acceptance of the last 2 B-50Ds in December 1950 marked the end of the aircraft's production.

Total B-50Ds Accepted — 222

The Air Force accepted its 222 B-50Ds over a period of 19 months.

Acceptance Rates

The Air Force accepted 15 B-50Ds in FY 49, all during the month of June 1949; 160 in FY 50; and 47 in FY 51, starting in July 1950 and ending in December. A peak number of B-50Ds, 29 of them, was accepted in FY 50, during the month of December 1949.

Flyaway Cost Per Production Aircraft — $1.14 Million

The B-50D carried the unit price tag of the B-50A and B-50B. It was set at $1,144,296.

Subsequent Model Series — TB-50H

Other Configurations — DB-50D, KB-50, KB-50J, TB-50D, WB-50D

DB-50D—Early in 1951, 1 B-50 was modified as a director aircraft, identified as DB-50D, and used to launch the Bell rocket-powered GAM-63

Rascal missile.[57] By August, Air Force planning provided for the activation, sometime in 1953, of 2 squadrons of Rascal carriers, one of B–36s and another of B–50Ds, the latter squadron being programmed to operate from oversea bases because of the B–50's limited range. Adaptation of the B–50D to the DB–50D configuration was to begin in June 1952, ahead of the B–36 modification. However, Rascal deficiencies, as well as other considerations, altered these plans. The DB–50D continued flight testing the new missile until 1955, but activation of both the DB–50D and DB–36 squadrons was canceled.

KB–50—The Air Force planned all along that a total of 134 B–50s,[58] made up of B–50As, RB–50s, and B–50Ds, when no longer needed by the SAC atomic forces, would be converted to tankers. The proposed aircraft, referred to as KB–50s, would feature extensively reinforced outer wing panels, as well as the necessary equipment to air refuel simultaneously 3 fighter-type aircraft by the probe and drogue method. The modifications, assigned to the Hayes Aircraft Corporation, also included deletion of the B–50's defensive armament and replacement of the basic aircraft's aft tail section. Although the completion date of the Hayes modifications was tentatively set for December 1957, the project (ordered in the mid-fifties) proceeded so well that it was ended ahead of time. A first KB–50 flew in December 1955 and was accepted by the Air Force in January 1956, the tankers from then on steadily entering the operational inventory of the Tactical Air Command (TAC). By November 1957, TAC's KB–29s, which the KB–50s replaced, had all been phased out. By year's end, all of the command's aerial refueling squadrons had their full complement of KB–50s. TAC had nothing but praise for the new tankers. The KB–50s presented no serious problems, and their reliability was such that the command considered asking for more of them. Extra KB–50s would come "cheap," TAC calculated, if additional numbers of B–50s were merely added on to the Hayes modification line. Nevertheless, the recommendation remained in limbo, which was just as well since the modification line had already been closed and the superior KB–50J was on its way.

KB–50J—The Air Force tentatively endorsed the KB–50J program in mid-1956, because it believed the KB–50s of TAC's aerial tanker fleet no longer had both the speed and altitude to refuel modern jet aircraft effectively.[59] The KB–50J, first flown in April 1957, was still powered by 4

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[57] See B–36, pp 46–47.

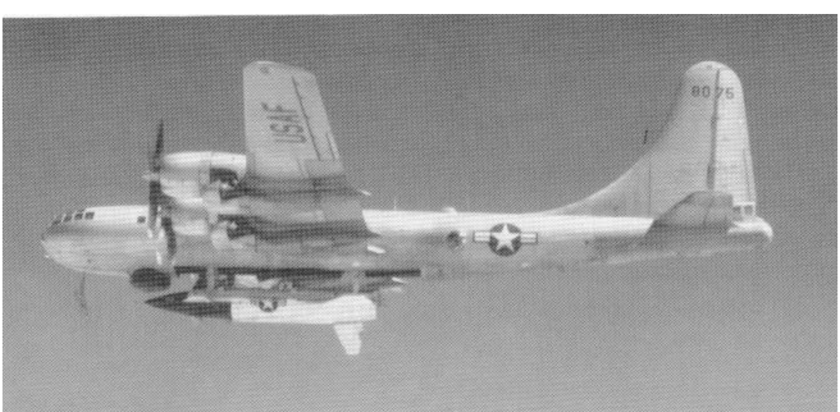
[58] Some records indicated 136 B–50s were involved, a discrepancy probably due to the fact that 2 B–50s, used as prototypes for the forthcoming reconfigurations, were included in the higher total but excluded from the Air Force's operational accounts.

[59] See B–47, pp 130–131.

Pratt & Whitney R-4360-35 piston radial engines, but featured in addition two 5,200-pound thrust General Electric J47-23 turbojet engines that were installed in pods, suspended from pylons at the former locations of the KB-50's auxiliary wing tanks.

Flight testing of the KB-50J, immediately started in April 1957, was completed in December, with rewarding results. The aircraft had made successful hook-ups and transfers of fuel to several types of tactical aircraft at higher altitudes, greater gross weights, and higher airspeeds than possible with the KB-50. The J-model's slightly shorter refueling range was more than compensated by its superior performance. Its jet engines decreased takeoff distance by 30 percent and the time to climb to refueling altitude by 60 percent. Of utmost importance, in contrast to the KB-50, the KB-50J could maintain satisfactory refueling speeds in level flight at altitudes which did not unduly penalize the receiver aircraft. The Air Force, therefore, decided that a great many KB-50s would be brought to the KB-50J configuration. However, only the most modern KB-50s (former B-50Ds) would be eligible for the retrofit. The first such aircraft, withdrawn from Tactical Air Command's 429th Air Refueling Squadron in September 1957, was modified in 4 months' time and returned to the operating forces on 16 January 1958. Reminiscent of the careful procedure applied to the atomic modifications, the KB-50 retrofit was strictly scheduled to make sure that TAC's refueling capability was not seriously impaired. As the Hayes Aircraft Corporation gained more experience, it took 20 fewer days to modify each of the aircraft, and the retrofit project proceeded smoothly.

The Air Force had over 100 KB-50Js by 1959, but its operational requirements had already begun to change. Hence, TAC quickly pointed out that while the KB-50Js were not expected to present major maintenance or



A GAM-63 Rascal missile was attached to a specially modified DB-50D before firing.

supply problems from the start, the retrofitted aircraft should be considered as "interim" refuelers. Tankers were critical to the successful accomplishment of nonstop overseas deployment of the forces, the command insisted, and the often-modified, 12-year-old KB-50J, despite its many merits, was not a high-performance aircraft. In short, TAC wanted to acquire a contingent of the new KC-135, a Boeing tanker assigned to the Strategic Air Command. Still, budget limitations were a problem. Each KC-135 cost about $3.5 million, while the KB-50J's unit price was set at $1.27 million.[60] Although 2 squadrons of KC-135s were eventually programmed to reach TAC in mid-1953, this planning did not materialize. In 1960, the Air Force announced that SAC would get more KC-135s and would serve as the single Air Force manager for tanker support. The decision was to take effect in late 1964 or early 1965. Meanwhile, TAC would retain its KB-50s.

Contrary to anticipation, the elderly KB-50Js began to deteriorate almost as soon as available. In 1959, TAC had to resort to cannibalization to fix some of the retrofitted tankers because tail hose depressor actuators were not readily available. Late in the year, both the Pacific Air Forces and TAC faced more serious difficulties. The inner liner of the KB-50 fuel cells, all of which had been manufactured in 1949 and 1950, began to crack, allowing self-sealing compound to infiltrate the tanker's fuel system. TAC recommended that the defective heavy, self-sealing fuel cells be replaced with new lightweight, bladder-type cells, but the command was overruled by AMC on the grounds that the cost involved could not be amortized over the remaining useful life of the aircraft. In July 1960, Hayes started exchanging all KB-50 fuel cells for new similar ones or for cells that had been removed from B-50s in storage at Davis-Monthan AFB, Arizona. The exchange proved satisfactory, but TAC encountered other problems. Landing gear malfunctions plagued the aircraft, and all sorts of old-age deficiencies began to develop. As a rule, TAC maintenance personnel had to expend every month more than 2,000 manhours of overtime per squadron in order to meet operational commitments, while by-passing certain items vital to the continued KB-50J use. These neglected tasks, including depot overhaul of quick engine change kits, had been expected to sustain the tankers until their scheduled phaseout was completed. The KB-50 inventory was substantially reduced as the aircraft's retirement became closer. In 1964, a few KB-50s saw action in Southeast Asia, but this proved to be the aircraft's last operational commitment.

TB-50D—As in the B-50A's case, 11 B-50Ds were brought up to the

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[60] This figure included the B-50D's basic cost, leaving some $130,000 for the bomber's adaptation to the KB-50 and KB-50J configurations.

trainer configuration, redesignated TB-50Ds, and used for various support duties, including the training of B-36 crews.

WB-50D—Extensive corrosion of the WB-29s prompted the Air Force to decide in 1953 that some B-50Ds, as they became surplus, would be adapted for the weather role and immediately returned to SAC. There these aircraft accomplished "special weather reconnaissance" missions for the 97th Bomb Wing until April 1955, when all WB-50Ds were earmarked for the Air Weather Service.[61] Meanwhile, a much larger reconfiguration program was also approved. In June 1954, the Air Force confirmed that the weather service's WB-29s would be replaced by modified B-50Ds. The modification contract, assigned to the Lockheed Aircraft Corporation, included 78 B-50Ds and specified a completion deadline of November 1955.

Although the new WB-50Ds would represent only be a partial and temporary solution to the range and altitude problems of the deteriorating

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[61] The aircraft's withdrawal from SAC left the command with no special weather reconnaissance capability until the end of the year, when the first RB-47K weather aircraft was delivered.

Two student navigator-bombardier-radar operators aboard a TB-50D trainer aircraft.

WB-29s, the Air Weather Service eagerly awaited the forthcoming aircraft. While deficient in overall performance, the modified planes would feature improved equipment and instrumentation of special importance to the weather mission. The APM-82 Automatic Navigator, for example, was a radar navigation device capable of measuring drift and ground speed under all conditions, except a calm and glassy sea. Also included were the ANQ-7 Temperature Humidity Indicator, the ML-313 Psychometer, improved altimeters, and flight indicators. However, the new equipment proved more difficult to install than anticipated, and Lockheed could not meet established modification schedules. The first modified aircraft, or prototype WB-50D, flew on 20 August 1955, and the first production model was delivered to the Air Weather Service in November, when the whole modification program should have been completed. Still, once available, the WB-50Ds performed far better and for a much longer period of time than expected. Like other modified versions of the B-50Ds, the reconfigured aircraft did not avoid some of the problems caused by their near obsolescence. In 1960, after several fuel cells failed in flight, 28 WB-50Ds were grounded. As in the KB-50's case, most WB-50Ds were subsequently retrofitted with new or surplus fuel cells. The modification was well justified, 40 WB-50Ds remaining in the weather service inventory in March 1963. The aircraft's phaseout began shortly thereafter, but the last WB-50D (Serial No. 49-310) was not retired before the fall of 1965.[62]

Phaseout 1953–1955

Some of SAC's 5 wings of atomic-capable B-50s began to exchange their aircraft for new B-47 medium bombers in the last months of 1953, and once underway the delayed conversion proved fairly steady. SAC still possessed 2 wings of B-50s in early 1955, but not for long. The last B-50D (Serial No. 49-330), assigned to the 97th Bomb Wing, Biggs AFB, Texas, was phased out of the atomic forces on 20 October. However, the B-50D retirement from SAC did not spell the end of the aircraft's active life. Like other B-50s, many reconfigured B-50Ds served the Air Force for another 10 years.

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[62] This aircraft was flown to Davis-Monthan AFB, Ariz., for storage. Later it was displayed at the Smithsonian Institution.

TB-50H

Manufacturer's Model 345-31-26

Previous Model Series — B-50D

New Features

The TB-50H trainer differred significantly from the B-50D, and other models in the series. First, the TB-50H featured 2 astrodomes, which facilitated training by making it possible for crewmen to trade positions during flight. Also, in another departure from combat aircraft, the trainer had no drop tanks, could not be air-refueled, and carried no defensive armament. The TB-50H was designed to teach B-47 crews how to use the K-system of radar navigation and bombing[63] and to train specialized engineers, multi-engine pilots, bombardiers, navigators, and observers. The trainer normally carried a crew of 12, consisting of pilot, co-pilot, engineer, bombardier, navigator instructor, left navigator trainee, right navigator trainee, right scanner, K-system trainee, K-system instructor, radio operator, and left radar trainee. The TB-50H's rear bomb bay was packed with electronic gear, but the aircraft was lighter and therefore slightly faster than the B-50D.[64]

Production Decision — 1951

In the spring of 1951, the Air Force decided to cancel the production of the last 24 B-50Ds, ordering instead an equivalent number of B-50 trainers. The decision, confirmed in April 1951, when the B-50 procurement contract was amended, became official on 4 May. The Air Force at the time also decided that the new trainers, directly developed from the B-50D, would be known as TB-50Hs.

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[63] See B-47, p 117 and p 119.

[64] The TB-50H's basic weight was 82,726 pounds, and its normal take-off weight was 146,756 pounds; the B-50D's corresponding weights were 84,714 and 158,250 pounds, respectively. The TB-50H's maximum speed at the optimum altitude of 31,000 feet was 363 knots, 20 knots faster than the B-50D at 30,000 feet.

First Flight (Production Aircraft) 1952

The first TB-50H was flown in April 1952. Within a few months, several of the aircraft reached the Air Training Command.

Enters Operational Service August 1952

The TB-50Hs entered operational service in August 1952 at Mather AFB, California. They were assigned to the 3536th Observer Training Squadron of Air Training Command's 3535th Observer Training Wing. As intended, the TB-50Hs were used primarily to train B-47 crews. The last of the 24 TB-50Hs arrived at Mather AFB in March 1953.

End of Production 1953

Delivery of one last aircraft in February 1953 marked the end of the TB-50H production, as well as the termination of the entire B-50 program's production run.

Total TB-50Hs Accepted 24

All 24 aircraft were accepted during fiscal year 1953.

Acceptance Rates

The Air Force accepted 2 TB-50Hs in August 1952, 3 in September, 7 in October, 3 in November, 7 in December, and the final 2 aircraft in 1953, one in January and one in February.

Flyaway Cost Per Production Aircraft $1.48 million

The TB-50H's unit cost was recorded at $1,485,571—airframe, $993,100; engines (installed), $203,232; electronics, $68,392; ordnance, $8,790; others (propellers, included), $212,057.[65]

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[65] About $350,000 over the average unit price of other B-50s.

Subsequent Model Series **None**

Other Configurations **KB-50K**

When no longer needed for training, the TB-50Hs were brought up to the KB-50J configuration and identified as KB-50Ks. The KB-50J and KB-50K tankers were identical, except for their origin, which accounted for their different designations. The first KB-50K flew in December 1957, and was accepted by the Air Force in January 1958. All modifications, including the addition of the 2 jet engines, were also accomplished by the Hayes Aircraft Corporation and were completed in less than a year. The KB-50Ks, like most KB-50Js, were assigned to the Tactical Air Command and were still being flown in the early sixties.

Phaseout **June 1955**

The TB-50Hs were phased out of Air Training Command in June 1955, but once reconfigured as KB-50Ks the aircraft served the Air Force for nearly another 10 years.

Program Recap

The Air Force bought 370 B-50 production models and 1 B-50 prototype. Specifically, the B-50 program comprised 79 B-50As, 1 YB-50C (prototype of an improved B-50A), 45 B-50Bs, 222 B-50Ds, and 24 TB-50Hs. Other B-50s, such as the RB-50s, KB-50s, and WB-50s, stemmed from extensive modifications. Such modifications were done either on the production lines after conclusion of the basic contract, or years after the aircraft had been utilized in its intended configuration.

The Air Force added jet engines to a number of B-50s, but others, still only piston-powered and conspicuous in the jet era that followed the end of World War II, remained in the active inventory much longer than expected. For example, some of the B-50As, which were operational in June 1948, continued flying as WB-50s in 1964, acquiring in the process a service life of a quarter of a century.

TECHNICAL AND BASIC MISSION PERFORMANCE DATA

B/RB-50 AND KB-50 AIRCRAFT

Manufacturer (Airframe)	Boeing Airplane Co., Renton, Wash.
Manufacturer (Engine)	The Pratt & Whitney Aircraft Division, United Aircraft Corp., East Hartford, Conn., and The General Electric Co., Schenectady, N.Y.
Nomenclature	Medium Strategic Bomber, Reconnaissance Aircraft, and Flight-Refueling Tanker
Popular Name	Superfortress

	B-50A	B-50D	RB-50G	KB-50
Length/Span (ft)	99.0/141.2	99.0/141.2	99.0/141.2	99.0/141.2
Wing Area (sq ft)	1,720	1,720	1,720	1,720
Weights (lb)				
Empty (basic)	85,155	84,714	88,438	90,270
Combat	120,500	121,850	129,209	107,511
Takeoff (max normal)	158,250[a]	158,250[a]	150,000[a]	173,000[b]
Takeoff (max overload)	168,480[c]	173,000[b]	170,400[c]	Not Applicable
Engine: Number, Rated Power per Engine & Designation	(4) 3,500-lb st R-4360-35 & (1) G.E. Turbo Superch CH-7-B1	(4) 3,500-lb st R-4360-35 & (1) G.E. Turbo Superch CH-7-B1	(4) 3,500-lb st R-4360-35 & (1) G.E. Turbo Superch CH-7-B1	(4) 3,500-lb st R-4360-35 & (1) G.E: Turbo Superch CH-7-B1
Takeoff Ground Run (ft)				
At Sea Level	5,940	6,420	6,150	6,350
Over 50-ft Obstacle	7,425	8,025	7,620	7,940
Rate of Climb (fpm) At Sea Level	675	620	630	608
Combat Max Rate of Climb (fpm) at Sea Level (Max Power)	2,260	2,200	1,680	2,210
Service Ceiling (ft) (100 fpm Rate of Climb to Altitude)	26,550	24,000	23,800	23,250
Service Ceiling (ft) at Combat Weight (100 fpm Rate of Climb to Altitude)	37,300	36,900	37,150	39,800

Combat Ceiling (ft) (500 fpm Rate of Climb, Max Power, to Altitude)	36,000	35,650		
Average Speed (kn)	212	212	227	209
Maximum Speed at Optimum Altitude (kn/ft) Max Power	344/30,000	343/30,000	339/29,700 (Opt)	351/30,600 (334 kn with hoses & drogues extended)
Basic Speed at Altitude (kn/ft) Max Power	337/25,000	337/25,000	333/25,000	287/5,000
Combat Radius (nm)	1,905	2,082	2,116	1,000
Total Mission Time (hr)	17.70	19.53	18.69	10.8
Armament	13 .50-cal machine guns (counting 3 in tail turret)	13 .50-cal machine guns (counting 3 in tail turret)	13 .50-cal Colt-Browning M-3 machine guns (counting 3 in tail turret)	None
Crew	11[d]	8[e]	16[f]	6[g]
Maximum Load (lb)	28,000[h] bombs	28,000[h] bombs	10 Cameras (4 K-38s with 36-in lens, or 2 K-38s with 24-in lens; 1 L-22A or K-17; 1 A-6 Motion Picture; 3 K-17Cs; 1 T-11, 6-in lens).	13,821 gal. of fuel (self-sealing wing tanks

[a] Limited by performance.

[b] Limited by strength.

[c] Limited by space.

[d] Pilot, co-pilot, engineer, navigator-radar operator-bombardier, bombardier-navigator-radar operator, radio-electronic countermeasure operator, left-side gunner, right-side gunner, top gunner, tail gunner, and extra crew member.

[e] Pilot, co-pilot, engineer, radio-electronic countermeasures operator, left-side gunner, right-side gunner, top gunner, and tail gunner.

[f] Pilot, co-pilot, navigator, engineer, nose gunner, top gunner, left-side gunner, right-side gunner-radio operator, radar operator, tail gunner, and 6 electronic countermeasures operators.

[g] Pilot, co-pilot, engineer, radar-navigator, and 2 refueling operators.

[h] 20,000 pounds, internally; 8,000 pounds, externally.

Abbreviations

cal = caliber
fpm = feet per minute
GE = General Electric
kn = knots
max = maximum
min = minimum
nm = nautical miles

Basic Mission Note

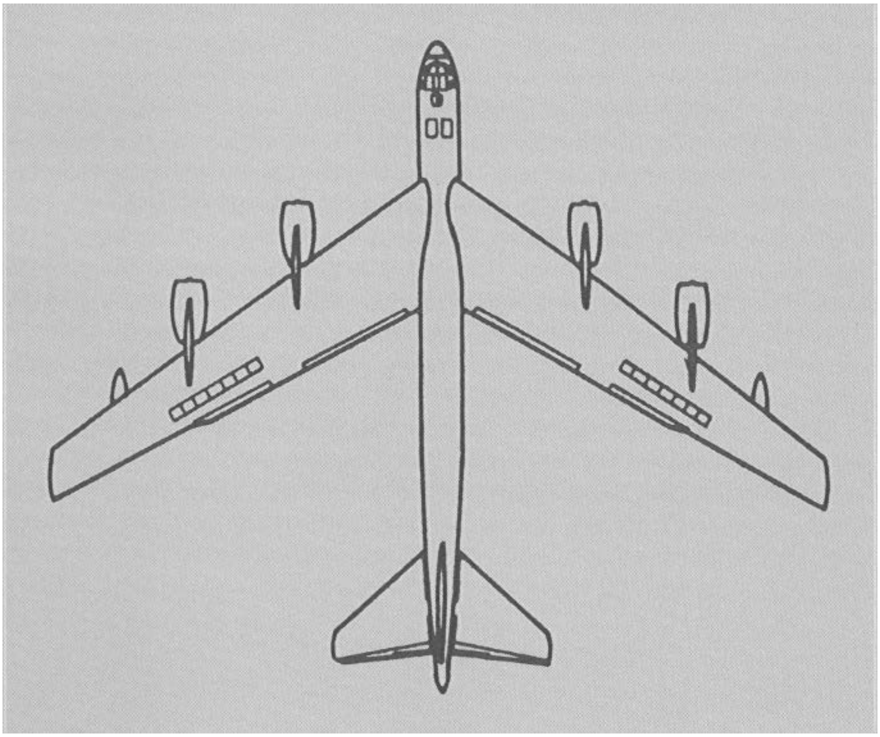
All above basic mission's performance data are based on normal power, except as otherwise noted.

B-50A and B-50D's Combat Radius Formula: Warmed up, took off, climbed on course to 5,000 feet (at normal power), cruised at long-range speeds at altitude for best range but not less than 5,000 feet, climbed on course to reach cruising ceiling 500 nautical miles from target, cruised in level flight to target, conducted 15-minute (normal-power) bomb run, dropped bomb when carried, conducted 2 minutes of evasive action at combat altitude (no distance credit) and an 8-minute run-out from target area (with normal power), cruised at long-range speeds at combat altitude for 50 nautical miles, cruised back to base at long-range speeds at not less than 5,000 feet for best range.

RB-50G's Combat Radius Formula: Took off and climbed on course to 5,000 feet (at normal power), cruised out at long-range speeds. Dropped external and bomb-bay tanks when empty. Climbed to arrive at cruise altitude 500 nautical miles from target. Cruised toward target at long-range speeds, 15 minutes from target conducted normal-power bomb run, conducted 2 minutes of evasive action and 8 minutes of escape from target at normal power. After leaving target area, cruised back at long-range speeds until 500 nautical miles from target, descended to 25,000 feet and cruised back to base at long-range speeds. Climbed to arrive at refuel altitude (cruise ceiling) immediately prior to rendezvous (1 hour at long-range speeds for rendezvous and hook-up, no distance credit), transferred fuel at the rate of 980 gallons per minute while proceeding toward bomber target at normal-rated power, disengaged and returned to base at refueling altitude and long-range speeds. (Mission was planned so that radius at the end of transfer was 1,000 nautical miles.)

B-52 Stratofortress

Boeing
Airplane Company



B–52 Stratofortress
Boeing

Manufacturer's Model 464

Weapon System 101

Overview

Most post-World War II bombers evolved from military requirements issued in the early or mid-forties, but none were produced as initially envisioned. Geopolitical factors accounted for the programs; the military threat, varying in degrees of intensity through the years, never ceased to exist. While these factors justified the development of new weapons, technology dictated their eventual configurations. Strategic concepts fell in between, influenced by circumstances as well as the state-of-the-art. Thus the B–36, earmarked in 1941 as a long-range bomber, capable of bearing heavy loads of conventional bombs, matured as the first long-range atomic carrier. The impact of technology was far more spectacular in the case of the B–52, affecting the development of one of history's most successful weapon systems, and the concepts which spelled the long-lasting bomber's many forms of employment.

As called for in 1945, the B–52 was to have an operating radius of 4,340 nautical miles, a speed of 260 knots at altitude of 43,000 feet, and a bombload capacity of 10,000 pounds. Although jet propulsion had already been adopted for the smaller B–45 and B–47 then under development, the high fuel consumption associated with jet engines ruled against their use in long-range aircraft. But what was true in 1945, no longer applied several years later. After floundering through a series of changing requirements and revised studies, the B–52 project became active in 1948. Air Force officials decided that progress in the development of turbojets should make it possible to equip the new long-range bomber with such engines. The decision, however, was not unanimous. Money was short, B-52 substitutes were proposed, and it took the deteriorating international situation caused by the Korean conflict to ensure production of the jet-powered B-52—the initial procurement contract being signed in February 1951.

While technological improvements received top priority when new weapons were designed, untried technology was a tricky business. Hovering over the B-52 weapon system was the specter of the B-47's initial deficiencies. As a result, the B-52 was designed, built, and developed as an integrated package. Components and parts were thoroughly tested before being installed in the new bomber. Changes were integrated on the production lines, giving birth to new models in the series, a fairly common occurrence. Yet, in contrast to the usual pattern, B-52 testing only suggested improvements, and at no time uncovered serious flaws in any of the aircraft. In fact, Maj. Gen. Albert Boyd, Commander of the Wright Air Development Center, and one of the Air Force's foremost test pilots, said that the B-52's first true production model was the finest airplane yet built.

Initially flown in December 1954, the B-52's performance was truly impressive. The new bomber could reach a speed of 546 knots, twice more than called for in 1945, and could carry a load of 43,000 pounds, an increase of about 30,000 pounds. Still, most of the early B-52s were phased out by 1970, due to Secretary of Defense Robert S. McNamara's mid-sixties decision to decrease the strategic bomber force. However, the later B-52G and H-models, and even some of the earlier B-52Ds, were expected to see unrestricted service into the 1980s.

By mid-1973, the B-52s had already compiled impressive records. Many of the aircraft had played important roles during the Vietnam War. Modified B-52Ds, referred to as Big Belly, dropped aerial mines in the North Vietnamese harbors and river inlets in May 1972. In December of the same year, B-52Ds and B-52Gs began to bomb military targets in the Hanoi and Haiphong areas of North Vietnam, where they encountered the most awesome defenses. Although the B-52s were often used for purposes they had not been intended to fulfill, after decades of hard work they remained one of the Strategic Air Command's best assets.

Basic Development — 1946

Officially, the B-52's development was initiated in June 1946. However, the basic configuration finally approved bore little resemblance to the original Boeing proposal. In reality, the aircraft's genealogical roots reached back to June 1945, when the Army Air Forces (AAF) directed Air Materiel Command (AMC) to formalize military characteristics for new postwar bombers, as prompted by ". . . the need for this country to be capable of carrying out the strategic mission without dependence upon advanced and intermediate bases controlled by other countries . . . ." The timing of the AAF directive of June 1945 was worthy of note. Although total victory in World War II seemed imminent, the directive obviously reflected growing pessimism over the future of international relations and increasing concern with the experimental B-35 and the problem-ridden B-36, both yet to be flown.

Military Characteristics — 23 November 1945

The first in a series of military characteristics for heavy bombardment aircraft was issued in November 1945. This initial document called for a bomber with an operating radius of 5,000 miles (4,340 nautical miles) and a speed of 300 miles per hour (260 knots)[1] at 34,000 feet, carrying a crew of 5, plus an undetermined number of 20-millimeter cannon operators, a 6-man relief crew, as well as a 10,000-pound bombload. Maximum armor protection was another prerequisite.

Request for Proposals — 13 February 1946

A design directive, allowing maximum design latitude, was distributed to the aircraft industry with invitations to bid on the military characteristics of November 1945. Three manufacturers—Boeing Airplane Company, Glenn L. Martin Company, and the Consolidated Vultee Aircraft Corporation—submitted cost quotations and preliminary design data close to requirements.

Letter Contract — 28 June 1946

The AAF concluded that Model 462, the Boeing proposal for a straight-wing aircraft grossing 360,000 pounds[2] and powered by 6 Wright T-35 gas turbine engines with 6 propellers, promised the best performance per dollar cost. The proposed aircraft, with its 3,110-mile radius, fell short

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[1] The range and speed of aircraft were shown in statute miles until the late 1940s; in some cases, until the early 1950s. Afterwards, speed was measured in knots; range, in nautical miles.

[2] Gross weight is the total weight of an airplane fully loaded; take-off weight is the actual gross weight of an airplane at take-off; the main factor limiting an airplane's maximum take-off weight is structural strength.

in range, but experience showed such a deficiency could be alleviated during the course of development. Hence, on 5 June Boeing was informed that it was the competition's winner and in mid-month Model 462, which closely resembled the much lighter B-29, became the XB-52.[3] Because money, never sufficient from the users' point of view, appeared particularly scarce at the time, the letter contract awarded to Boeing on 28 June covered only the initial development (Phase I[4]) of Model 462. Specifically, Letter Contract W-33-03A-ac-15065 asked for a full-scale mockup of the intercontinental XB-52, plus preliminary design engineering, construction of a power plant test rig, gunfire testing, structural testing, and the supplying of engineering data. Boeing could spend not more than $1.7 million on this Phase I work. And while the letter contract allowed the eventual continuation into a second phase, money was not mentioned.

Initial Reappraisal — October 1946

Despite the apparent urgency of the new bomber project, the military characteristics of November 1945 did not prevail long. In October 1946, less than 3 months after Boeing's receipt of a letter contract, discussions began that essentially reflected the AAF's unanimous concern over the "monstrous size" of the proposed XB-52 (Model 462). Maj. Gen. Earle E. Partridge, Assistant Chief of Air Staff for Operations, flatly stated that the XB-52 design failed to meet requirements. Boeing thereupon came up with a different proposal. This was Model 464, a much lighter (230,000 pounds), 4-engine version of the previous 6-engine design. Maj. Gen. Laurence C. Craigie, Chief of the AAF's Engineering Division, recommended adoption of the 4-engine XB-52, but many changes were yet to come. Indicative of the period's difficult times, new and sometimes unrealistic requirements later followed that nearly spelled the program's end.

Program Changes — 1946–1947

In November 1946, General LeMay, then Deputy Chief of Air Staff for Research and Development, while noting that the 230,000-pound XB-52

[3] The next available bomber designation; Martin's Model 234 (a development of the contractor's winning attack design submitted in February 1946 as the XA-45) being already earmarked as the future (and later canceled) B-51 light bomber.

[4] A "phase" was a stage in the planned development of a program considered in respect both to (a) the nature of the tasks undertaken and (b) the timing.

had merits, stressed that besides extra range the future B-52 should have a higher cruising speed, something in the vicinity of 400 miles per hour. Boeing's ensuing suggestion that a 300,000-pound plane (60,000 pounds less than Model 462) might be the answer became academic, or so it seemed. In December, the AAF asked Boeing to provide design studies for a 12,000-mile range, 4-engine general purpose bomber, capable of carrying the atomic bomb. A 400-mile per hour tactical speed was required, and a gross weight of 480,000 pounds was again authorized. Fully aware of the existing limits of technology and because its first turboprop bomber had fallen far short on range, Boeing gave the AAF 2 very-heavy bomber designs—Models 464-16 and 464-17. Both appeared fairly similar and were to be powered by 4 T-35 turboprop engines of higher horsepower than those earmarked for the earlier 464 version. There was a clear difference, however. The special mission 464-16 model would carry only a 10,000-pound bombload; the general purpose 464-17 model, up to 90,000. While perhaps attractive in theory, the AAF categorically rejected the simultaneous development of 2 new bombers because this would be financially reckless. What it really wanted was an aircraft that could either carry many conventional bombs or be stripped for long-range, special missions. After careful evaluation, the AAF opted for Model 464-17.

Revised Military Characteristics — June 1947

The military characteristics of November 1945 were officially superseded in June 1947. The new characteristics called for a heavy bomber offering the improved performances that had been in the definition process for about 8 months. Except for range, the 464-17 XB-52, as proposed, met requirements. Its degree of success, however, would largely depend on the much improved T-35 engine promised by Wright. Moreover, a new problem had begun to surface. The requirements painstakingly established since October 1946 no longer seemed adequate.

New Setbacks — Mid-1947

The latest XB-52 (Model 464-17) appeared satisfactory, but only temporarily. This came as no great surprise. General LeMay long believed that, even if all went well, this XB-52 would be too large and too costly—possibly limiting procurement to 100 aircraft. General Craigie was also highly critical. In his opinion, the new XB-52 would offer little improvement over Convair's B-36G.[5] And, quite likely, the XB-52 would be obsolete before completion. Soon there was talk of scrapping the whole venture, but General LeMay favored caution. The XB-52 project should be given a 6-month "grace" period pending final decision concerning its future. This was in line with the AAF's thinking. Thus, after the shelving of Model 464-17, Boeing continued to search for means to improve the airplane. The company swiftly drew up a series of preliminary configurations (Models 464-23, 464-25, and 464-27), which finally culminated in Model 464-29. Even though the weight remained the same, high speed increased slightly to 455 miles per hour, and the operating radius jumped to 5,000 statute miles. Still, Model 464-29 was not to be the final answer.

Further Reappraisal — July-December 1947

While Boeing was told to continue development of the XB-52, AMC was reminded that no actual construction could be started without express consent of the AAF's Commanding General. The command was also directed to explore every possible means for delivering the atomic bomb. The use of subsonic pilotless aircraft was given priority, but one-way manned flights were not excluded.[6] In late September, the Aircraft and Weapons Board of the now independent United States Air Force convened a Heavy Bombardment Committee to obtain "a fresh evaluation of the long-range bomber program." In other words, committee members were directed "to study methods for aerial delivery and individual and mass atomic attacks against any potential aggressor nation from bases within the continental limits of the United States." The Heavy Bombardment Committee concluded decisively that speed and altitude were the basic qualities required of a bomber due to carry the A-bomb. This was particularly true when the bomber reached the combat zone. Up to that point, the plane could actually cruise at lower altitude. By the same token, the all-important range could well be extended by air refueling in the non-combat theater. The committee ended its work by preparing preliminary military characteristics that essentially asked for a special-purpose bomber (in lieu of a general-purpose weapon) with an 8,000-mile range and a 550-mile-per-hour cruising speed. More changes ensued, but the committee's recommendations had an

[5] See B-36, p 42.

[6] The Air Force pursued some of those early projects. Like Brass Ring, spurred by the advent of the hydrogen bomb, none materialized as originally conceived.

immediate impact. Boeing's latest 450-mile-per-hour XB-52 (Model 464-29), obviously too slow to survive in combat, no longer had a chance.

New Military Characteristics 8 December 1947

The military characteristics of June 1947 were officially superseded on 8 December. The new set, as approved by General Vandenberg, Vice Chief of Staff, General Kenney, Commander of Strategic Air Command (SAC), and Gen. Joseph T. McNarney, who now headed the Air Materiel Command, closely resembled the proposal submitted by the Heavy Bombardment Committee. The most telling difference was that the bomber's required cruising speed was reduced—a change endorsed after studies by the AMC and Rand[7] pointed out that the desired 8,000-mile range could be attained only at a speed not in excess of 500 miles per hour.

Near-Cancellation 1947-1948

With the approval of new characteristics, the question arose within the Air Staff whether the Boeing contract should be amended or canceled in favor of a new design competition. The idea of a new competition was tempting. A better bomber might be obtained by again tapping all the engineering brains in the industry. Also, as previously noted by General LeMay, many companies which had failed to bid on the original project were of a different mind now that a large part of the Air Force production funds appeared slated for the future B-52. The Air Materiel Command did not agree with the Air Staff. AMC claimed that Boeing was the best-qualified heavy bomber contractor, that a new competition would consume much valuable time, and that some $4 million would be wasted if the Boeing development contract was nullified. For good reasons, the AMC arguments failed to convince the Air Staff. First, Boeing already had a large share of the Air Force business, and amending the company's contract might cause political repercussions or a public accusation of favoritism. Secondly, if Boeing was truly the best contractor, it would win the competition handily,

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[7] Rand (for research and development) was the code name applied to numerous studies by the Douglas Aircraft Company—a project initiated by the AAF in 1946. In 1948, a grant from the Ford Foundation brought about a reorganization of the project. It became the Rand Corporation, a non-governmental, nonprofit organization dedicated to research for the welfare and national security of the United States. Research by the corporation was conducted with its own funds or with funds supplied by government agencies. The Rand Corporation is located in Santa Monica, Calif., but maintains offices in Washington, D.C.

and little delay would occur because the company had already worked on the XB-52 preliminary design. Therefore, on 11 December 1947, following verbal approval by Under Secretary of the Air Force Arthur S. Barrows, Lt. Gen. Howard A. Craig, Deputy Chief of Staff for Materiel, directed AMC to cancel the Boeing contract. However, the case was not closed. Before the directive could be executed, Boeing's President, Mr. William M. Allen, protested vigorously to Secretary of the Air Force Stuart Symington that the decision was unsound. The Boeing letter stressed that the proposed cancellation and renewal of XB-52 competition would be "a serious injustice to the contractor . . . and provide a 'second chance' to others who would profit from Boeing's progress." The letter also underlined that the company had passed up other projects after entering the heavy bombardment competition in the spring of 1946. Since then, some of its ablest talent had been dedicated to the project. Finally, the bulk of the other Air Force production contracts held by Boeing would be completed before the B-52 production could begin. In all fairness, the Air Force had to admit that many of Boeing's arguments were valid. Thus, it might be best to avoid any rash decision.

Other Alternatives 1948

In January 1948, Mr. Symington replied to Boeing, giving a keen analysis of the problem facing the Air Force.[8] He considered the heavy bombardment project to be of the greatest importance, and believed the new bomber would play a dominant role in any future war. "For this reason," he emphasized, "the USAF must be assured of the best possible design and configuration. There could be no compromise on this provision." The Secretary said that much scientific progress had been made since the original competition. The technique of air-to-air refueling had been perfected to the point where it should be possible to develop an airplane with the top speed and cruising speed of a medium bomber and with only a slightly higher gross weight. This aircraft should certainly be lighter than previously proposed versions of the XB-52. Another possibility (insufficiently considered, according to the Air Staff) was the flying wing design. Rand studies had noted that this configuration offered definite advantages when applied to long-range, high-speed aircraft. Mr. Symington concluded that, until all avenues had been thoroughly explored, no final decision could be made on the original Boeing contract.

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[8] Concurrent difficulties with the B-36 did not help. This program once again appeared on the verge of collapse—another major decision soon confronting the Secretary.

Go-Ahead Decision March 1948

In February 1948, after acknowledging the merits of the flying wing being tested by the Northrop Corporation, Boeing noted some of the inherent disadvantages of this type of configuration. Foremost were marginal stability and control. Boeing willingly emphasized that research and experiment with the all-wing aircraft should not be discouraged. But the proposed B–52 had more flexibility for radar and armament installation and none of the "flying wing's" problems. Consequently, the conventional aircraft should be given first developmental priority, "so that the Air Force should not be left without an effective bomber." From its own investigation, AMC's Engineering Division contended that the XB–52 development should be continued. The Air Staff also began to favor the XB–52, believing it to have a higher probability of success and to be easier to maintain than any potential version of the "flying wing." Thus, in March 1948, the Secretary of the Air Force informed Boeing that its present contract would be modified to develop a bomber meeting the military characteristics of December 1947, as already or subsequently revised. In April Boeing presented a complete Phase II proposal for the design, development, construction, and testing of 2 XB–52s (Model 464–35). Although estimated to cost about $30 million, this Phase II proposal received the Air Force's endorsement in July.

Additional Revisions 1948

During 1948, several revisions were made to the military characteristics of December 1947. The first occurred in March, 2 months after Boeing submitted for the first time Model 464–35—a bomber having the desired range and speed but weighing only between 285,000 and 300,000 pounds. A second revision specified a 360,000-pound plane, with an average cruising speed of 445 miles per hour and a range of 11,635 miles. A final revision on 15 December defined a 280,000-pound bomber that could carry 10,000 pounds of bombs and 19,875 gallons of fuel for 6,909 miles, at a maximum speed of 513 miles per hour at a 35,000-foot altitude. None of the 3 revisions affected the December 1947 requirements for a 5-man crew and tail armament only. But more changes occurred over time and the B–52s eventually carried a crew of 6, as a rule.

Contractual Arrangements September 1947–November 1948

Boeing's original contract, as initiated by the letter contract of June

1946, was approved on 2 September 1947. By then the contract already reached $4.6 million—$1.7 million for Phase I, the initial development commitment, plus $2.9 million for Phase II, an extension of the Phase I work directed by the existing letter contract. The Phase II funds were provided per supplemental agreement on 13 June 1947. Of necessity, these funds were shuffled around. For a while, the Phase II funds were due to finance the Phase I development of Model 464-17. However, this model's cancellation prompted a second change, the $2.9 million Phase II funds now being earmarked for the Phase II development of yet another configuration—Model 464-35. Meanwhile, as approved by Under Secretary Barrows, an additional $563,766 was allocated on 7 April 1948 for the Phase I development of the same model (464-35), bringing the Phase I investment to a total of $2.3 million. But completion of the Phase II development would prove to be considerably more expensive. In mid-1948, as a result of the revised characteristics of December 1947, the Phase II cost of developing, building, and testing 2 XB-52s (Model 464-35) was estimated at $28.3 million. This did not include $1 million for contractor-selected spare parts or $4.8 million for engineering design improvements and the installation of tactical equipment in the 2 experimental planes. Even spread over several years, the research and development budget could not possibly sustain such expense without jeopardizing other essential projects. Some expedient had to be found. On 17 November 1948, the Air Force approved another supplemental agreement to the definitive contract of September 1947. This time, the agreement shifted $6.8 million of procurement funds to support the first 2 years of the XB-52 development.

Radical Change 1948

In the spring of 1948, after floundering for about 2 years through a series of changing requirements and revised Phase I studies, the XB-52 project finally seemed on its way. Although the Air Force still made it clear that the XB-52 development program must result in the most advanced design possible, Boeing actually prepared to build 2 experimental, turboprop-equipped articles of Model 464-35, its latest bomber proposal. But the plans once again were altered—with more drastic changes yet to come—by recent progress in the development of turbojet engines. The turbojet concept was not new. As early as June 1945, during discussions over the characteristics for strategic bombers, AAF officers had pushed for the development of jet engines suitable for bombers. However, the fuel consumption of jet engines was then so high that this kind of propulsion was discarded in view of the ranges required of the strategic bombers. In 1948 the technological situation was totally different. The Air Force asked Boeing in

May 1948 if it could incorporate jet engines in the proposed XB-52. This resulted in still another XB-52 version (Model 464-40), featuring the Westinghouse J40 engine and a minimum of changes to the turboprop XB-52 under construction. The Air Force received Boeing's preliminary study of its jet-propelled Model 464-40 in late July.

New Controversy 1948

Shortly after Boeing's Model 464-40 was submitted to the Air Force, a new debate arose. In October, General Craig expressed his dislike for the proposal, believing that improvement in heavy bombardment aircraft would come only when the bomber configuration was changed and stating that "unless supersonic propellers become a reality, future aircraft of this class will be powered by turbojet engines, however neither of these developments are sufficiently near at hand that the turboprop step can be eliminated." The Deputy Chief of Staff for Materiel's pessimism proved unwarranted, as Boeing engineers within days of his remarks devised the very solution which led to the development of the remarkable B-52. Still, Boeing did not reap success without toil. On 21 October, after arriving at Wright Field to confer on their XB-52 turboprop aircraft (Model 464-35), Boeing engineering executives were informed by AMC officials that a drastic reappraisal of the XB-52 project seemed in order. In short, AMC wanted a preliminary study of an entirely new airplane which would be powered by Pratt and Whitney Aircraft Division's new J57 turbojet engines. According to popular newspaper accounts, the Boeing representatives retired to a Dayton hotel room over the weekend. Drawing on the experience gained in the B-47 program, they worked around the clock and on Monday morning, 25 October 1948, presented the requested proposal—a 33-page report plus a hand-carved model of their new design—Model 464-49. Perhaps the feat was not as spectacular as it appeared. As exemplified by Model 464-40, Boeing had been considering for quite a while the possible use of jet power plants in bombers far heavier than the B-47. In any case, the Boeing engineers liked Model 464-49, an airplane having 35-degree swept wings, 8 engines slung in pairs on 4 pylons under the wing, and an overall configuration that departed from the B-29 and B-50 for the newer B-47 body style. They were confident that additional range could be gained with "only reasonable increase in weight," and that the new jet engines would provide improved altitude and speed performances. Besides, jet engines would eliminate the many unsolved problems of propeller aerodynamics and control, and probably extend the airplane's operational life. Finally, this jet version of the XB-52 could be available almost as quickly as the turboprop already under development.

Program Reendorsement 1949

The Board of Senior Officers[9] was favorably impressed by most of the operational accomplishments expected of the new 330,000-pound model. When equipped with J57 turbojets (yet to be available), the swept-wing XB–52 promised to reach a top speed of 496 knots (572 miles per hour); to fly 6,947 nautical miles at an average speed of 452 knots (520 miles per hour) without refueling; and to be capable of delivering a 10,000-pound bombload at a comfortable altitude of 45,000 feet. After a final evaluation in January 1949, the board decided to continue development, "with the Boeing Aircraft Company," of the XB–52 as a turbojet in lieu of the turboprop-powered aircraft. This would be done under the same contract, and Boeing was so informed on 26 January. Meanwhile, favorable opinions did not prevail in all quarters. The stringent economy drive directed by President Truman in late 1948 endangered the costly B–52 development program. Concerted attempts were made to equate performance and cost data with present and "soon-to-be" outdated aircraft. In February, the Deputy Chief of Staff for Materiel's Directorate of Research and Development came to the program's rescue. Officials pointed out that the major difference between the B–36 and the proposed B–52 was timing. The B–36 seemed to be the solution to the strategic bombardment problem as it appeared in 1942; the future B–52, as it appeared in 1949. Under existing state-of-the-art limitations, vigorous development of the turbojet B–52 afforded the Air Force its only hope for carrying out the strategic air mission, specifically the delivery of the atomic bomb, should it become necessary over the next 5 years. Surely, the Air Force would be remiss if it failed to develop a successor to the B–36. While the arguments of the Research and Development Directorate were persuasive, a new threat surfaced. In the spring of 1949, the Fairchild Aircraft Corporation forwarded a design proposal for the development of an unconventional strategic bomber.[10] The Board of Senior Officers again reviewed the Boeing airplane's potential growth and agreed to continued development of Model 464–49. However, Fairchild's unconventional design did not disappear, and other contractors soon submitted proposals that further imperiled the new program.

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[9] Established in December 1948, the USAF Board of Senior Officers included the Vice Chief of Staff, the Deputy Chief of Staff for Operations, the Deputy of Staff for Materiel, and the Commanding General, AMC. This board replaced the USAF Aircraft and Weapons Board, which was composed of all Deputy Chiefs of Staff and major air commanders and had proved too cumbersome. The dormant board was discontinued in the fall of 1949.

[10] The Fairchild proposal aircraft, a fuel-carrying wing, indeed appeared revolutionary. It used a railroad flatcar as a launcher. The intent was to provide maximum initial speed and altitude so that the aircraft would conserve fuel and attain sufficient range.

Mockup Inspections 1948–1949

Like the many model configurations considered at one time or another, all mockup inspections scheduled prior to 1948 were canceled. Moreover, the few finally conducted in January 1948 only covered nose sections, where arrangement of the reduced crew presented difficulties. As for Boeing's latest turboprop XB-52 (Model 464-35), although its mockup was essentially complete by October 1948, all work was halted before any formal inspection could be made. Thus, the swept-wing turbojet XB-52 was the first to merit a full-fledged mockup inspection. This was accomplished at the Boeing Seattle plant and lasted from 26 to 29 April 1949. The inspection board of USAF personnel found no special faults with the mockup but noted in its report that the experimental XB-52, with its J40-6 engines, would not match the B-36's 4,000-nautical-mile radius. The board also indicated that expedited development, as well as significant improvement of the J57 turbojet might assure B-52 aircraft of a 4,000-nautical mile combat radius, but this could not be expected before 1954. In any case, the importance of meeting such a requirement had been emphasized to the contractor. The Air Staff approved the board's report on 1 October, with significant reservations. This was obvious when Gen. Muir S. Fairchild, Vice Chief of Staff since 27 May 1948, carefully underlined that the XB-52 mockup report was approved to expedite potential future production, but that such approval "does not include acceptance of any production article not meeting specified range requirements."

Last Near-Cancellation 1949–1950

General Fairchild's "tentative approval" of the XB-52 mockup inspection report was viewed by many as a practical "cancellation of the program as it now exists." Since the J57 engine, in its present developmental stage, would only give the B-52 a combat radius of about 2,700 nautical miles, the bomber would never materialize unless some "mechanical dodge" was devised to extend range. Maj. Gen. Orville R. Cook, the AMC Director of Procurement and Industrial Planning, favored a review of the program and perhaps a revision of the military characteristics and scheduling of another design competition. General LeMay,[11] in command of SAC since October 1948, believed that the solution lay in engine development, that it was unnecessary to accept inferior performance in either speed or range, and

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[11] Promoted to full general on 29 October 1951, General LeMay headed SAC until mid-1957.

that a conference on the B-52 airplane was urgently required. Meanwhile, Boeing kept busy. Accelerated engineering and development tests were conducted to solve problems of aero-elasticity, vibration, and control that resulted from the higher wing sweep, greater speeds, and thinner wing. In November 1949, convinced that inadequate range seriously jeopardized the future of its new bomber (Model 464-49), Boeing offered a heavier B-52 (Model 464-67). This 390,000-pound B-52, Boeing said, would have a radius of 3,785 nautical miles for production aircraft anticipated in 1953 and 4,185 nautical miles for a B-52 in 1957. Increased combat radius could be obtained in time and with additional expenditure of money. Boeing concluded that the heavier XB-52 was as technically advanced in aircraft design as possible. The contractor's efforts to safeguard the B-52 program did not go unnoticed. By year's end, SAC officials generally agreed that the contractor had made appreciable progress toward satisfactory development of the airplane. Soon afterwards, the conference suggested by General LeMay took place. However, the meeting's conferees at Headquarters USAF on 26 January 1950 faced a difficult task. Once more, substitutes were proposed for the B-52. Included were new proposals by the Douglas and Republic Aircraft Companies, Fairchild Aircraft Corporation's unusual design, the swept-wing B-36G (later known as the YB-60), a Rand turboprop airplane, 2 new designs of the B-47, and several missile aircraft. Even though General LeMay took a firm stand in favor of the B-52 as the aircraft which would best meet the requirements of the strategic mission, the conference ended before any decision could be reached. But SAC's Commander-in-Chief was not easily deterred. In February, the Air Staff requested from AMC all performance data and tentative production dates of the various combat vehicles recently considered. In the same month, however, General LeMay asked the Board of Senior Officers to accept Boeing Model 464-67 in lieu of Model 464-49. Approved by the board on 24 March 1950, this change eventually led to the production decision General LeMay so badly wanted.

Production Decision — January 1951

Although there were no more direct attempts to sidetrack the B-52 development once Model 464-67 was endorsed, the future of the production program remained uncertain. Some substitutes seemed to regain momentum, with the swept-wing B-36 and long-range B-47Z coming to the fore. SAC opposed both, believing the new B-36 would have lower cruising and target speeds than a future B-52 and that the 3-man crew B-47Z would retain inherent limitations for intercontinental operations. A comparative study of the B-52 and the advanced B-47, SAC officials stated, showed that the B-52 was superior in performance. The B-52's extra crewmen would materially reduce the serious fatigue problems stemming from long missions. Also, electronic countermeasures equipment could be fitted in the larger B-52, thereby ensuring protection against future surface-to-air and air-to-air guided missiles. In spite of such arguments, the Air Staff had made no definite commitment by the fall of 1950, compelling General LeMay to become directly involved once again. And whereas World War II had prompted production of the B-36, another war helped the B-52. General LeMay was quick to point out that the international situation during the Korean conflict was deteriorating rapidly; that SAC's forward operating bases were becoming more vulnerable to enemy attack; and that increasing as well as modernizing SAC's intercontinental bombardment forces should receive priority consideration. Referring again to the B-52, General LeMay said: "Perhaps even more important is the concurrent requirement for the development of a long-range, high-performance aircraft, such as the RB-52, capable of operating alone over highly defended enemy areas in the performance of the reconnaissance mission." Finally convinced, the Board of Senior Officers concurred that the B-52 would be the production successor to the B-36. Also, since the B-52 was not a radical departure from existing stages of aircraft development, procurement could start before completion of the XB-52 testing. General Vandenberg, Chief of Staff since 30 April 1948, approved the board's recommendations on 9 January 1951; Thomas K. Finletter, the new Secretary of the Air Force, on the 24th.

Initial Production Plans 1951-1952

Letter Contract AF33(038)-21096, signed on 14 February 1951 by Boeing and the Air Force, was the first document authorizing production. It covered long lead time items and the production of 13 B-52As, the first of which was tentatively scheduled for delivery in April 1953. The letter contract of 1951 was finalized on 7 November 1952 by a cost-plus-fixed-fee contract. As originally agreed, Boeing's fixed fee remained set at 6 percent of the contract costs. In the interim, there were changes and many more were to follow. An amendment to the first letter contract provided for 17 reconnaissance pods—detachable capsules to be fitted in the early bombers. In July 1951, the Air Staff directed AMC to acquire 4 more B-52s—presumably to match the number of aircraft to the total of reconnaissance pods ordered. The additional planes were to be paid for, like their predecessors, with fiscal year (FY) 1952 funds, but would come from a second Boeing plant—yet to be selected. The directive, however, was soon rescinded, and in October the Air Staff informed AMC that all B-52 production aircraft would be in a reconnaissance configuration. In September 1952, the Air Force gave Boeing a second letter contract—AF33(600)-22119—that called for 43 RB-52s. But none of these early plans materialized due to technical improvements and budgetary restrictions. Ironically, the Korean War, which first worked in favor of the production program, slowed down progress because the industrial situation was confused following the unexpected outbreak of hostilities. Meanwhile, development of the 2 experimental B-52s gradually moved on.

Development Difficulties 1950-1952

As far as General LeMay was concerned, it was difficult enough to persuade the Air Staff to approve Model 464-67, but even more challenging to avoid the frustrating series of events that had marked the B-47 development. The reconnaissance requirements finally stipulated in early 1951 especially complicated matters. Boeing had known for a long while of the Air Force's reconnaissance ambitions.[12] There was nevertheless considerable disagreement between the Air Staff and SAC. Headquarters USAF thought photography should be the RB-52's main mission and that any equipment compromising this function should be excluded. On the other hand, SAC believed the airplane should have a full complement of electronic reconnaissance (or ferret) equipment for operation at night or in bad weather. Furthermore, only a minimum of cameras should be carried to give "local" photographic coverage when light conditions permitted. At any rate, preliminary designs for an experimental RB-52 were completed by mid-1950, but in August Boeing embarked on another approach. The contractor suggested forsaking the RB-52 because it would be simpler and much cheaper to install in the B-52's bomb bays a multi-purpose pod housing reconnaissance equipment. This multi-purpose pod could be replaced by a photo pod or a ferret pod, as needed. At this point, AMC agreed

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[12] Development of a special, long-range reconnaissance airplane, the so-called X or RX-16, became a topic of primary interest soon after the end of World War II. Yet, by 1949 ideas about the equipment required to accomplish the strategic reconnaissance mission remained in constant flux. There was also increasing concern that the cost of building a specific airplane for reconnaissance would be "staggering to the national economy." The Air Force therefore dropped the RX-16 project. It began instead to consider modifying bomber aircraft for the reconnaissance role. A first step toward this goal, the Air Materiel Command stressed, was to determine the type of data needed, then decide on the equipment best fitted to gather such data. The Air Force nevertheless believed that manned aircraft such as the B-36 and B-52 would be required for reconnaissance duty well into the 1960's. There were concurrent talks about parasite aircraft and guided missiles which most likely would some day perform reconnaissance functions.

that the proposal was sound, but cautioned Boeing that the B-52's bombing capabilities could not be jeopardized to satisfy reconnaissance objectives. In response, SAC proposed in June 1951 a reconnaissance B-52, capable of conversion to the bomber configuration. This could be done, according to SAC, by removing the reconnaissance pod and adding bomb racks in its place. An August conference, attended by representatives from the Air Staff, Air Research and Development Command, SAC, AMC, and the Air Weather Service seemed to settle a controversy that centered essentially on priorities. In short, should the aircraft be primarily a bomber with a secondary reconnaissance role, or vice versa? The conferees voted for a B-52 bomber that could be converted to the reconnaissance configuration and returned to its original configuration, as necessary. This "convertibility," the conferees decided, should allow personnel "at the wing level in the field" to do the transformation in a reasonable time. But the lull in the controversy did not last. As already noted, the Air Staff directed in October 1951 that all aircraft "will be of the RB-52 configuration as there is no requirement for a B-52." The directive was misleading since the aircraft would retain conversion features for bombardment operations. In actuality, the Air Staff's decision was a belated approval of SAC's most recent planning. Just the same, the discussions, delays, and production orders of 1952, along with subsequent deletions, did not as a whole expedite the experimental program.

Other Development Problems 1951–1952

Besides the reconnaissance requirements of 1951, various circumstances affected the B-52's development. Early in the year, General LeMay told Boeing that the tandem-seating arrangement featured by the XB-52 mockup was poor. Since it allowed little room for flight instruments, small panel instruments would have to be used, and this had proven unsatisfactory in all types of aircraft. In addition, the tandem arrangment reduced the copilot's role to a flight engineer operating emergency flight controls— obviously limiting his assistance to the pilot. In a plane as important and costly as the B-52, safety was a top priority. General LeMay believed that side-by-side seating of the pilot and copilot would ensure closer coordination between the two, which in some cases might prove vital. The issue of tandem versus side-by-side seating was settled in August. The Air Staff agreed that significant operational advantages would be gained by adopting the side-by-side arrangement. Some slight confusion nevertheless ensued. First, a few of the early B-52 productions would retain the tandem seating configuration; then, only the experimental planes would not be changed. This was decided after Boeing pointed out that the lack of additional facilities made some production delay inevitable. The production time lost could be put to good use, the contractor felt, by incorporating a side-by-side cockpit from the start. This would save SAC the trouble of operating and maintaining 2 B-52 configurations and cut production costs by almost $17 million. There were other protracted discussions. SAC continued to strive for near-perfection, insisting that even greater range was desired to secure better operational flexibility in the dispersal of the B-52 force. Based on earlier experience, SAC also thought that space should be provided in the aircraft to carry the greater bombloads and large missiles anticipated in the future. Finally, there were several arguments about which engines should be used. For instance, SAC asked that an advanced engine, the General Electric X-24A, be made available without delay to permit the B-52 to realize its full potential. But this engine's production was not scheduled until 1957, and no plans were made to phase such an engine into the B-52 program.

First Flight (YB-52) — 15 April 1952

Contrary to usual practices, the prototype B-52 took to the air several months ahead of the experimental B-52.[13] Lagging deliveries of engines[14] and pneumatic systems retarded the XB-52's first flight, but the main delay came from an engineering decision to change the aircraft's rear wing spar—a structural modification directly incorporated in the YB-52. In any case, the prototype's flight also slipped 1 month because General Electric did not deliver the pneumatic systems until 1952. Yet, the YB-52's 15 April flight proved well worth the wait. Taking off from Boeing's Renton Field, Seattle, Washington, the plane flew for 2 hours and 51 minutes before landing at nearby Larson AFB. Enthusiastic reports flowed in from engineers, observers, the pilots and, naturally, from the contractor. Pilots of the escort planes which accompanied the YB-52 on its flight reported that its performance was excellent and commented that its slow approach and landing speed were particularly remarkable. At touchdown, the drag parachute was deployed for testing only, as very little braking was required. Of course, there were a

[13] Boeing's original contract called for 2 XB-52s, bare of certain expensive tactical equipment. In mid-1949, Boeing suggested that such equipment be installed in the second XB-52. The contractor justified the costly installation by pointing out that the resultant airplane could serve as production prototype. The Air Force agreed and the second XB-52 became the YB-52.

[14] The Air Force Power Plant Laboratory insisted from the start that Pratt and Whitney had to supply Boeing with prototypes of the J57-P-3 engines for both the X and YB-52s. It believed that since those engines would equip the B-52s, they should also go into the experimental versions of the plane. This would allow Pratt and Whitney to "debug" the engines during the flight test program, while Boeing was "debugging" the airframe.

few minor problems. One of the quadricycle landing gears retracted improperly, the liquid oxygen system failed (due in part to the crew's unfamiliarity with it), and 1 of the engine oil valves leaked, causing a trail of puffy white smoke rings throughout the flight. A second flight on 20 April was even more successful. Remaining below 15,000-foot altitude because of restrictions on engine operation, the YB-52 attained a speed of 350 miles per hour. The restrictions were anticipated. Pratt and Whitney had encountered difficulty in pushing the experimental J57 through the 50-hour qualification run—succeeding only in August 1951, on the third qualification attempt. Whatever the cause, these early problems were swiftly corrected. By October 1952, the YB-52 had flown some 50 hours and had reached speeds of Mach 0.84 without full power at altitudes above 50,000 feet. The Air Force officially accepted the prototype on 31 March 1953 but let Boeing keep it for further testing. The contractor flight-tested the plane for a total of 738 hours, accumulated in 345 flights.[15] The YB-52 remained on loan to Boeing until January 1958, but the contractor kept it in storage during most of 1957. On 27 January 1958, the aircraft was donated to the Air Force Museum, Wright-Patterson AFB, Ohio.

First Flight (XB-52) — 2 October 1952

Although the experimental B-52 rolled out of the factory on 29 November 1951,[16] it did not fly until almost 1 year later—after significant modifications. The Air Force took possession of the XB-52 on 15 October 1952 (13 days after the aircraft's 2-hour first flight), but did not formally accept it until 1953. Because of its late start, the XB-52 barely participated in the contractor's Phase I testing, flying only 6 flights for a total of 11:15 hours. For the same reason, the Phase II flight test program, which was the Air Force's responsibility, began behind schedule. It was entirely conducted on the XB-52 between 3 November 1952 and 15 March 1953—reflecting an additional slippage of almost 2 months because of inclement weather in the Seattle area. Phase II tests revealed a number of deficiencies. The XB-52's engines surged and might shut down if normal throttle accelerations were

[15] Actually, USAF pilots flew the YB-52 8 times for 27 hours from Edwards AFB, Calif., between 5 June and 18 July 1953. Because the plane was on loan to Boeing, flights and flying hours were included in the contractor's totals.

[16] The XB-52 was moved to the flight test hangar under concealing tarpaulins during the night. According to the press, the great secrecy surrounding the whole event was dictated by the Air Force as a means of testing the effectiveness of its latest security policies. Yet, in view of Boeing's competitors and the many proposals still floating around, one could reasonably assume that the contractor was also eager to keep its new plane out of sight.

attempted at high altitude and low engine inlet temperatures. The brake system could not stop the aircraft within the distances guaranteed by Boeing. The XB-52 tended to pitch up and roll to the right just before stalling. Also, during landing roll, the experimental plane required twice the normal distance to stop. There were also problems with the tires, which tended to blow out when cross winds shoved the aircraft to one side. Completion of the Phase II tests prompted the XB-52's return to Boeing—the aircraft remaining on loan to the contractor for several years. In late March 1953 the plane began to undergo Phase III flight tests, but was soon grounded for major rework and did not resume flying until mid-1954. It nevertheless took part in the overall flight test program, finally accounting for 24 flights and a total of 46 flying hours. Boeing returned the XB-52 to the Air Force in early 1957, and in March the plane was assigned to the Wright Air Development Center at Wright-Patterson, to serve as a test-bed. After 893 hours of flight, 2 J75 engines were installed on the outboard struts, the XB-52 becoming a 6-engine airplane since the 4 inboard J57 engines remained. Modifications to the nacelles and installation of the new engines took time, immobilizing the airplane for almost a year.

Testing Program 1952-1962

Perhaps no aircraft would ever be as thoroughly tested as the B-52, nor did such a long-lasting program often start with so many controversies. The Air Force at first wanted to evaluate the aircraft at Edwards AFB's Flight Test Center. Boeing immediately disagreed, insisting that flying time at Seattle was rarely affected by bad weather and that excessive delays and expenses would occur in correcting defects discovered during testing, if the airplanes were not flown from the Boeing field. The Air Materiel Command somewhat reluctantly sided with Boeing in the belief that B-52 testing at Edwards AFB, under the auspices of the Flight Test Center, might lead to costly post-production modifications—a B-47 episode the Air Force did not care to repeat. The Air Research and Development Command, however, advocated testing the B-52 at the Flight Test Center, since that facility was responsible for the task. Although impressed by the research and development command's logic, AMC pointed out that conducted tests at Edwards would require perhaps an extra $20 million. Air Research and Development Command conceded, "partially as a result of the AMC's uncompromising refusal to provide the necessary additional funds." In 1953, contrary to Boeing's claims, the Seattle weather began to hold back testing. In February, after considering the extended Phase II[17] flying period and the hazards of operating in and to Seattle's metropolitan area, the Air Force directed a change in the test site. Initially, Larson AFB was chosen; subsequently, Fairchild AFB (also in the state of Washington) became the test base, with some of the later tests to be flown from Edwards. Meanwhile, other changes were underway, with more anticipated for the future. To begin with, the testing program acquired several extra B-52s. While the Phase I and II tests were conducted with only the X and YB-52s, the contractor's Phase III testing required 6 B-52s besides the YB-52. In the interim, the Air Force accepted 3 B-52As (the only ones built of 13 ordered) and returned the 3 planes to Boeing for Phase IV testing. Phase IV tests began with the third B-52A production (Serial No. 52-003) on 25 January 1955 and ran through the end of November. These tests had two main purposes. The contractor wanted to spot-check the stability data obtained during the Phase II tests of the reworked XB-52, and to compare the performance of the more powerful J57-P-29 engine against that of the J57-P-1W (first installed in the B-52A). The third B-52A, by itself, accounted for more than 288 hours of Phase IV testing accomplished in 60 flights. As expected, the J57-P-29-equipped B-52A demonstrated superior takeoff and climb performances.

Phase VI functional development testing also took place in 1955, ahead of the Phase V tests, which were delayed because of equipment shortages. The Phase VI tests, conducted at Edwards AFB, started on 3 March and made use of 2 B-52Bs (Serial No 52-005 and 52-006). They ended on 6 September, 2 months earlier than forecast, after 157 flights totaling 984 hours. Phase VI was designed to subject the entire strategic bomber weapon

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[17] The Air Force used the word "phase" to identify definite facets of the testing program. Phase I testing determined contractor compliance and consisted of some 20 hours of flight testing, during which the aircraft was held at about 80 percent of its design limits. Phase II testing was essentially similar to Phase I, but was done by Air Force rather than by contractor pilots. Phase III testing, called contractor development testing, ironed out most of the "bugs" thus far discovered and incorporated most of the modifications suggested by test pilots. In Phase IV, performance and stability testing, the entire performance range was investigated during some 200 hours of flight. Phase V, all-weather testing, as a rule took place at Wright Air Development Center and Eglin AFB. Phase VI tested functional development, using production models. Pilots of the scheduled using agency tested every part of the weapon system. Usually, this phase made use of 3 to 6 aircraft, each of which flew approximately 150 hours. Phase VII, called "operational suitability," was also performed by pilots of the using agencies. Phase VIII, termed unit operational employment testing, was also accomplished by pilots of the using commands, under the supervision of the Air Proving Ground Command. In the late fifties, there were some superficial changes, affecting the testing program's terminology more than its scope. Three categories supplanted the many pre-1960 phases. Categories I and II were essentially similar to Phases I and II; Category III, and its numerous special tests, covered all other former phases. Obviously, testing had to be flexible to serve its purpose. Often, some tests were extended, while others were scheduled out of order. But the testing program's thoroughness remained constant.

system to the demands of an accelerated program (a speed-up of production being actually recommended on 20 June 1955). One of the primary objectives was to determine the system's durability, maintenance manpower requirements, parts consumption, and compatibility of all support equipment. Completion of the Phase VI tests proved that the B-52 (Weapon System 101) was capable of performing its mission. Each B-52 subsystem had been carefully evaluated, with many improvements being requested. This in no way detracted from the B-52's intrinsic excellence, but attested to the importance of such testing during a period of great technological innovation.

Completion of the Phase VI tests, although a basic milestone, did not spell the end of testing. At least 1 of every B-52 model series was extensively tested, with no less than 1,500 Phase II and III test hours programmed for the last one—the B-52H, still being tested in 1962. Final tabulations showed that 13 B-52 productions were used in the overall testing program. Several of these planes were involved in accidents, and 2 were destroyed. But time would vindicate testing costs and efforts.

Research and Development Costs 1952

The research and development work done over some 5 years, plus the price and early testing of the X and YB-52s totalled about $100 million—1.5 percent of the entire program cost. In the early fifties, this was a shocking sum. Yet, the investment soon paid dividends. No major changes appeared until the last 2 models in the series (B-52G and B-52H), and even though the configuration of the early B-52s remained relatively unaltered, they too were to prove invaluable to the strategic force. In retrospect, the Air Force had to admit that money was seldom so well spent.

B-52A

Manufacturer's Model 464-201-0

New Features

The B-52A differed in several major respects from the prototype B-52. It looked more like an older type of bomber because of its enlarged nose that provided side-by-side pilot seating. To accommodate additional equipment, the forward compartment was extended 21 inches. Other improvements consisted of a 4-gun, .50-caliber tail turret, electronic countermeasures equipment, a chaff dispensing system, and J57-P-1W engines. The engines were fitted for water injection, 360 gallons of water being carried in a rear fuselage tank. Although the A-model was capable of "flying boom" flight refueling, its unrefueled range was increased by providing two 1,000-gallon auxiliary fuel tanks supplementing the normal 35,600-gallon fuel load.

Production Slippage — April 1953-June 1954

Restricted to testing, the B-52As were nevertheless considered as the first B-52 productions. While they were also 14 months behind schedule, extenuating circumstances abounded. As early as 1950, Boeing urged AMC to prepare for production, claiming that 1 year in lead time could be gained by securing tooling, materials, and other items without delay. "I can say in all honesty," Boeing's Vice President wrote, "that I believe the $13 million investment would be the cheapest insurance premium our Government ever paid." That the Air Force did not leap into action made sense at the time, since alternative aircraft remained under consideration. Later, when the XB-52 materialized, the aircraft appeared so complicated that even the contractor doubted that a B-29-type of mass production could be applied to the B-52. Comparing the 2 bombers, Boeing's President was quoted as saying, would be like comparing a kiddie-car and a Cadillac. In fact, designing the B-29 had required 153,000 engineering hours; the B-52, 3,000,000. In any case, it would take until August 1952, long after the

YB–52 flew, to get the rival YB–60 out of potential production;[18] several more months for SAC to dispose of the B–47Z competitor,[19] and until mid-1953 for the B–52 program to get truly under way.

Other Delaying Factors 1951–1954

Had the Air Force endorsed Boeing's early request for tooling, it is questionable whether this would have made much difference. Because of the Korean conflict, the tooling industry was unable to meet the demands of the aircraft manufacturers. Another related problem prevailed, however. After World War II, many trained aircraft personnel of necessity migrated to other jobs. These people had to be regrouped and retrained. And, with industry booming nationwide as a result of the Korean War, military procurement began to compete with commercial production. Although Boeing selected subcontractors in the spring of 1951,[20] (immediately following the production letter contract for 13 B–52As), the low priority assigned to the B–52 by the Air Staff was a formidable handicap.[21] Even more serious, according to

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[18] The YB–52 made its first flight on 15 April 1952; the YB–60, on the 18th—Convair flying its modified B–36 only 14 days after receipt of the prototype's eighth engine. The initial scarcity of J57 engines (also used by North American F–100 Super Sabres) presented problems. The worried Boeing contractor was being troublesome and kept on reminding the Air Force that the company had been led to believe that it would receive priority allocations of the new engines—particularly over Convair. The issue, however, did not reach serious proportions. The Air Force lost interest in the YB–60 in August 1952, after the aircraft's performance flaws tarnished its first bright prospects. The B–60 project was officially canceled in January 1953, the 2 experimental planes being scrapped in July 1954.

[19] Boeing B–47Z, also earmarked to receive J57 engines, was the last stumbling block to large-scale B–52 production. SAC won the debate in late 1952, after preparing a convincing new study of the problems at hand. To begin with, the B–47Z had a limited growth potential, but the B–52 was in its comparative infancy. The B–52 could carry more atomic weapons than the B–47Z. The latter, because of its weight limitations, would be less suitable to deliver hydrogen bombs. With almost uncanny vision, the SAC study concluded that it would be a serious mistake not to procure an adequate B–52 force.

[20] Boeing used 2 main criteria for its selection—availability of labor and wartime experience. The major subcontractors eventually picked were the A. O. Smith Co., of Toledo, Ohio, for landing gears; the Kaiser Manufacturing Co., of Richmond, Calif., for profile milling items; the Rohr Aircraft Corporation of Chula Vista, Calif., for drop tanks, power pods, and tail compartments; the Briggs Manufacturing Co., of Detroit, Mich., for rudders, elevators, vertical fin flaps, ailerons, spoilers, and outboard wings; and the A. O. Smith Co., of Rochester, N.Y., for weldments.

[21] At its inception, the program was assigned "S" priority position #63 which was exceedingly low and augured poorly for the successful accomplishment of stated production schedules (1 aircraft per month, at first; 4, later). It was not until September 1952 that the

an Air Force team that analyzed the situation, was "a general inability to adequately plan for the magnitude and complexity of the program." In summary, the protracted B-52 development was caused on one hand by revolutionary changes in aircraft design and propulsion; on the other, by uncertainty within the Air Force as to how far and in what direction it could go in utilizing these changes. As to the early production delays, the program's low priority was an obvious factor. Another cause, the Air Force believed, were defects in the overall organization originally set up by Boeing. Finally, production slipped to allow incorporation of mandatory changes that were identified during the early testing phases of the X and YB-52s.

Program Increase — August 1953

The procurement plans of 1951-1952 underwent many changes. In keeping with almost traditional patterns, the B-52's early production was shaped by deletions, additions, and reconfigurations. The letter contract of February 1951 was amended on 9 June 1952—several months before the definitive contract was signed. Consequently, although 13 B-52As had been initially ordered, only 3 were built. As was usually the case, the second model in the aircraft series bore the brunt of the changes. Against this routine background, important events unfolded. The Air Force, during the first half of 1953, finally endorsed a sizeable B-52 program. Made official in August 1953, the decision called for 282 aircraft—enough to equip 7 SAC wings. Since the Air Force wanted Boeing to deliver the aircraft between October 1956 and December 1958, another plant would be needed. Actually, an additional plant had been approved in mid-1951 and canceled within a few weeks. But this time, the decision stood firm. Harold Talbott, who had succeeded Mr. Finletter as Secretary of the Air Force on 4 February 1953, announced the action on 28 September. Boeing's second facility, established at Wichita, Kansas, eventually surpassed the Seattle plant in B-52 production.

B-52A Roll-Out — 18 March 1954

The Air Force chose to honor its new bomber months before it flew, with a factory roll-out ceremony attended by Gen. Nathan F. Twining, Air Force Chief of Staff since 30 June 1953. Addressing the several thousand

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priority level was raised to #27, but by this time slippages had occurred that were not recoverable.

people assembled at Boeing's Seattle plant, General Twining said: "The long rifle was the great weapon of its day. . . . Today this B-52 is the long rifle of the air age." The very existence of these global jet giants, General Twining stressed, would be a powerful deterrent against attack, for the Stratofortresses were designed to deliver devastating blows deep behind any aggressive frontier.

First Flight (Production Aircraft) — 5 August 1954

The Air Force accepted the initial B-52A (Serial No. 52-001) in June 1954—2 months before the aircraft's first flight—and returned it immediately to Boeing for use in the test program. For the same purpose, the other 2 B-52As were also loaned to Boeing as soon as accepted.

Total B-52As Accepted

The Air Force accepted 3 B-52As—the total built by Boeing. The 10 other B-52As, ordered in early 1951, were completed as B-52Bs.

Acceptance Rates

All 3 B-52As were accepted in 1954, 1 each in June, August, and September.

End of Production — 1954

B-52A production ended in September, with delivery of the third plane.

Flyaway Cost Per Production Aircraft — $28.38 million[22]

Airframe, $26,433,518; engines (installed), $2,848,120; electronics, $50,761; ordnance, $9,193; armament, $47,874.

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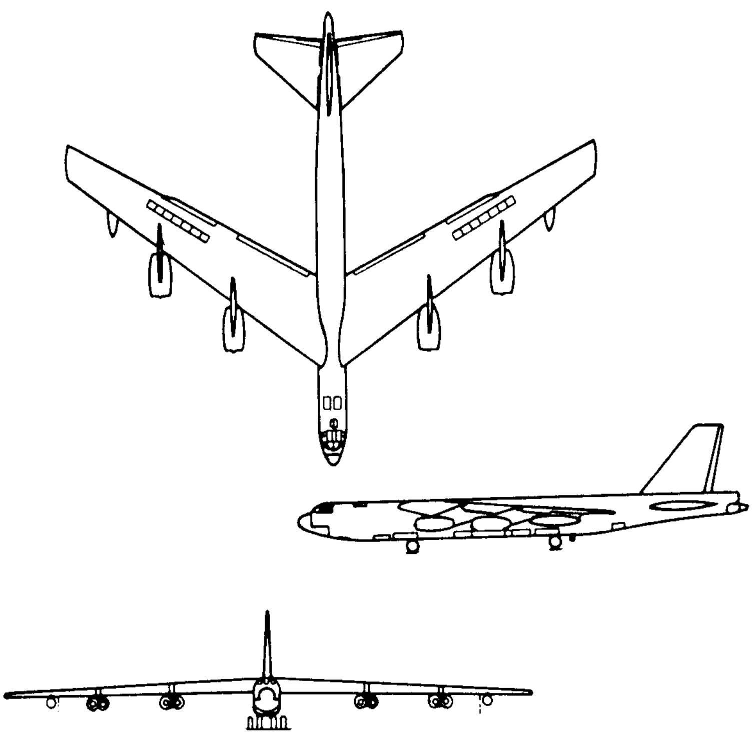
[22] Somewhat cheaper than the X and YB-52s, but not much. Air Force records carried the production B-52As at such seemingly fantastic prices because the aircraft were essentially experimental, with much of the initial tooling and new development costs charged against them.

The first B-52A was "rolled out" of the Boeing Seattle plant in March 1954.



Subsequent Model Series — B-52B

Other Configurations — NB-52A[23]

The last B-52A (Serial No 52-003) was redesignated NB-52A in 1959, after being modified to carry the North American rocket-powered X-15. The origin of the X-15 project dated back to the mid-1950s, when the United States became deeply interested in the space age and manned space flight. The program was a joint venture by the National Advisory Committee for Aeronautics,[24] the Air Force, and the Navy, with the X-15 conceived as a means to obtain technical data on hypersonic aeronautics. As it turned out, the immediate beneficiary of the X-15 flights was the manned space program, and the X-15 established itself as a most successful research aircraft. But the NB-52A's mother ship role, although less spectacular, was important and later a second B-52 became involved. For its part, the B-52A had to undergo extensive as well as permanent modifications by North American and USAF technicians. Specifically, a 6- by 8-foot section was cut out of the B-52's right wing flap to make room for the X-15's wedge tail. A pylon to mate the X-15 to the NB-52 was installed between the bomber's inboard engines and the fuselage. Lines and wires that held the X-15 below the NB-52 passed through this pylon. Large liquid oxygen tanks were placed in the B-52's bomb bays for topping off the X-15's liquid oxygen system prior to separation. A closed circuit television system was added so that the B-52 crew could carefully watch the X-15 and its pilot prior to launch. Finally, there was an elaborate launch control system to make sure that the X-15 was released at precisely the right instant. Captive flights to check out the X-15 and X-15/B-52 combination began at Edwards AFB on 10 March 1959. On 8 June, the first true flight occurred, but the rocket was not lit and the X-15 was flown as a glider. The first rocket-powered flight came in

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[23] The letter N was a prefix used by the Air Force to denote that an airplane (bomber, fighter, and other aircraft alike) was assigned to a special test program and that the aircraft had been so drastically changed that it would be beyond practical or economical limits to bring it back to its original or to standard operational configuration. Besides the familiar X and Y, 3 other so-called classification letters were used as status prefix symbols: namely, the letter G, which denoted an aircraft permanently grounded, utilized for ground instruction and training; J, temporarily reconfigured for special tests; and Z, in planning or predevelopment stage. As of late 1973, all 3 services of the Department of Defense still applied this medium to identify the status of their aircraft.

[24] The National Advisory Committee for Aeronautics, a federal agency established by Congress in 1915, did research for the benefit of commercial and military aviation. The advisory committee was absorbed by the National Aeronautics and Space Administration in the fall of 1958, becoming in the process the organizational core of the newly created agency.

September, with the NB–52A eventually participating in 59 of the 199 X–15 flights conducted before the program's end in 1968.

Phaseout 1960

The B–52A phaseout began in 1960, when the first of the 3 aircraft was retired after being test flown from Edwards AFB at take-off weights up to 415,000 pounds.

B-52B

Manufacturer's Model 464-201-3

New Features

Increased gross weight (420,000 instead of 405,000 pounds), the MA-6A bombing navigation system, and more powerful engines were the main differences between the B-52B and the preceding B-52A. Also, in contrast to the B-52As, some of the B-52Bs could be fitted with "capsule" equipment for reconnaissance duties.[25] In the latter case, the 6-man crew B-52B became an 8-man RB-52B crew.

Configuration Planning February 1951

Boeing started working on the B-52B design in February 1951, concurrent with signature of the first production document.

Design Improvements 1951-1954

Because the aircraft design was derived from the B-47, the B-52B (as well as the fairly similar B-52A) benefited from the start from hard-earned experience. Always hovering over the program was the specter of the B-47's initial deficiencies and delays. Both the contractor and the Air Force seemed determined that the B-52 would not endure such problems. Characteristics of the intensive B-52 development were 670 days of testing in the Boeing wind tunnel, supplemented by 130 days of aerodynamic and aeroelastic testing in other facilities. In essence, Boeing personnel designed, built, and developed the B-52 as a well-knit, integrated packaged system. Parts were thoroughly tested before being installed in the new bomber. Improvements suggested by the YB-52's early flight tests appeared on B-52B production lines. That these changes were few remained worthy of note. Test reports were generally pessimistic, concerning themselves with every aerodynamic

[25] The result of another policy reversal. See pp 235-236.

fault, however serious or minor, suspected or real. In 1953, more often than not, the published account of a B-52 test flight included the unusual statement that "no airplane malfunctions were reported." But the B-52B development was lengthy. Moreover, several B-52Bs, although earmarked for SAC, were diverted to the test program before joining the operational forces. The B-52B's early participation in complex flight tests soon pinpointed desirable production improvements—giving way in turn to new models in the series. Nevertheless, the airplane was considered to be outstanding, and the praise of Maj. Gen. Albert Boyd, the Wright Air Development Center's Commander, would long be remembered. General Boyd, who was also one of the Air Force's foremost test pilots, in May 1954 said that the B-52 was the finest airplane yet built. In a lighter mood, the general told his staff that someone should try to discover how "we accidentally developed an airplane that flies so beautifully."

Procurement Changes 1952-1955

Letter Contract AF33(600)-22119 of September 1952, which called for 43 RB-52Bs, gave way to a definitive contract that was signed on 15 April 1953. In May 1954, an amendment to this contract reduced the number of RB-52Bs by 10 (leaving 33 RB-52Bs on order) and directed construction of the canceled planes in the configuration of the next model series (RB-52C). The May 1954 amendment also added 25 other RB-52Cs on the 15 April 1953 contract. Hence, even though a sizeable B-52 program had been approved in mid-1953, Boeing in May 1954 had only 88 airplanes under contract—3 B-52As, 17 RB-52Bs (per definitive contract AF33(038)-21096 of November 1952), 33 RB-52Bs, and 35 RB-52Cs. Moreover, forthcoming procurement would not affect the current program—the first new order in August actually calling for still another B-52 model. Just the same, the modest program so far endorsed was not immune to further changes. Of significance, from the early procurement standpoint, was an Air Force decision, made official on 7 January 1955, that flatly reversed the Air Staff directive of October 1951. It gave the B-52 first priority as a bomber and once again relegated the aircraft's reconnaissance potential to a secondary role.[26] As a result of the new decision, the 50 RB-52Bs and 35 RB-52Cs

[26] The January 1955 decision coincided with a procurement order for several specialized reconnaissance versions of the Martin B-57 Canberra. These planes would all go to the Strategic Air Command, sometime in early 1956. In the ensuing years, SAC also got a contingent of high-altitude, reconnaissance U-2s, developed by Lockheed and first flown in 1955.

were redesignated B-52Bs and B-52Cs, respectively. Besides, as finally built, 23 of the 50 B-52Bs could not be used for reconnaissance.

Production Slippages 1953-1954

As planned in early 1951, B-52 deliveries were due to start in April 1953. A 15-month slippage soon occurred, because of the Korean War and its many implications. Revised production schedules set up in June 1952 called for the B-52Bs to be delivered between April and December 1954, but additional procurement (finalized in April 1953) extended deliveries to April 1956. Meanwhile, the Air Force accepted 2 B-52Bs in 1954—1 in August and 1 in September. However, scheduled deliveries were suspended for 90 days, while Boeing engineers sought to correct cracking in the landing gear trunnion forgings. This second loss of time was never recouped, the last B-52B reaching the Air Force in August 1956—3 months behind schedule. Yet, once the Air Force decided to go ahead with large-scale procurement, the bulk of the production program went forward with few delays.

First Flight (Production Aircraft) December 1954

Boeing first flew the B-52B in December 1954. Like the B-52A (and subsequent models in the series), the B-52B Stratofortress was impressive. The new aircraft had twice the wingspan and nearly 3 times the wing area of the B-17, and its 8 engines delivered 10 times the power of the B-29. The B-52B's tail fin stood as tall as a 4-story building, while the bomber's length of almost 157 feet spanned over half the length of a football field. The B-52B's wingspan of 185 feet represented a greater distance than that travelled by Orville Wright in his historic first flight at Kitty Hawk, North Carolina.

Enters Operational Service 29 June 1955

SAC assigned its first B-52, a B-52B (Serial No 52-8711) that could be converted for reconnaissance, to the 93d Heavy Bomb Wing, at Castle AFB, California. The 93d, a former medium bomb wing flying late model B-47s, used its new aircraft for crew transition training. SAC had planned from the start that the B-52s would be integrated into B-36 units on a 1-for-1 replacement basis—with retired B-36s being salvaged. Also, units would be converted 1 squadron at a time to facilitate B-52 operations and to prevent problems likely to arise in the assignment of maintenance equipment.

Combat ready on 12 March 1956, the 93d Wing regressed to a nonready status 2 months later, when it was authorized 15 additional B-52s. The wing was again fully operational on 26 June 1957, after crew training had become its primary mission.[27] Most of the B-52Bs produced were assigned to the 93d. A few early B-52Bs were first earmarked for testing, but they too ended with the heavy bomb wing.

Initial Problems 1955

Uncertain B-52 delivery schedules precluded proper budget planning, affecting in turn crew training, maintenance scheduling, and stocking of spare parts. There were shortages of ground support equipment, dual bomb racks, crew kits, electronic countermeasure components and training items. Delayed construction of maintenance facilities, the lack of warehouse space to store flyaway kits, as well as shortages of operational facilties for squadron briefings and other functions were serious handicaps. In addition, the failure of B-52 ramps and taxiways together with runway deterioration interfered with operations. These initial problems, practically resolved at Castle AFB by the end of 1955,[28] were to prove far more severe at many of SAC's future B-52 bases.

Early Deficiencies 1955-1956

Fuel leaks, icing of the fuel system, imperfect water injection pumps, faulty alternators and, above all, deficient bombing and fire-control systems were the main troubles of the early B-52Bs. However, these deficiencies as a whole were not as severe as those usually encountered by a new bomber,

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[27] The Air Training Command had no B-52 school, and SAC's new bombers had to become operational as soon as possible. The best way to solve the problem was for SAC to handle the training of B-52 crews with a combat crew training squadron. This did not create a precedent, the same procedure having been used in SAC's B-36 training program at Carswell AFB, Tex. The 4017th Combat Crew Training Squadron was established at Castle AFB on 8 January 1955, as an integral part of the 93d Wing. When the B-52 training task became too great for 1 squadron, the wing's 3 other squadrons took over flight training, with the 4017th assuming ground instruction and the administrative phase of the program. As a rule, the training program consisted of 5 weeks of intensive ground school and 4 weeks of flight training, totaling between 35 and 50 hours in the air.

[28] Castle AFB's parking ramp and runways were strengthened to handle 450,000-pound loads (the forthcoming B-52C's expected take-off weight). The width of the taxi strips was increased 175 feet. In October 1955, postflight B-52 docks, as well as operations and engineering buildings were under construction. A large hangar had been completed.

and far less distressing than those experienced by the B-47 at the same stage of its career. In any case, most of the B-52B's initial problems were not entirely unexpected. Air Research and Development Command and Air Materiel Command had been insisting for months that the aircraft should be perfected before delivery. Strategic Air Command, in contrast, steadfastly objected to further postponement,[29] believing the aircraft should be accepted and modified at a later date—which they were. SAC's objections to more delay were not inconsistent. General LeMay continued to press for the best weapon system for his force. But after approval of a configuration as nearly perfect as possible, the SAC Commander thought too many immediate improvements, refinements, or additional requirements could well be self-defeating. As late as February 1955, SAC protested against "unneccessary changes;" pointed out that operational units would benefit from "more standardization" in the B-52s; and asked to participate in the coordination of all engineering change proposals. While AMC, which was assigned executive responsibility for the new bomber, did not wish to concede any of its engineering prerogatives, SAC did get its way. Some 170 engineering change proposals suggested for the first 20 B-52s were reduced to 60 by the end of March.

Other Temporary Flaws 1955-1956

In October 1955, Boeing engineers had yet to solve the problem of cabin temperatures. The pilots, sitting high in the nose, were comfortable at a given heating setting. However, observer and navigator, sitting with their feet against the bottom of the fuselage, with the metal sometimes reaching 20 degrees below zero, suffered from the cold—the wearing of winter underwear, heavy clothing, and thick flying boots hardly helping.[30] Conversely, if enough heat was turned on to keep the observer and navigator warm, the pilots became overheated. Pilots also criticized the new bomber's high-frequency communications system. First installed in the B-47, the AN/ARC-21 long-range radio was proving even less reliable in the B-52.

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[29] Most in the Air Force seemed to agree that production should wait until research and development had worked most of the kinks out of any new aircraft. Yet different opinions cluttered the key issue of determining at what point an article was ready for full-scale production. One might conclude that SAC, ill-equipped at the time for its awesome responsibilities, wondered how much caution and time it could reasonably afford.

[30] The problem was compounded by another factor for which the B-52 could not be blamed. The development of personal equipment lagged years behind airframe and engine. Crew MC-1 spacesuits, parachutes, and other paraphernalia were uncomfortable. Crew fatigue from flying the new bomber was often insignificant, compared to that caused by wearing all this survival equipment.

Engine Problems 1955-1956

The J57 engines of the B-52 at first presented a serious problem. The principal difficulty persisting in mid-1955, when the aircraft started reaching SAC, was that none of the various J57s performed adequately with water injection, a process due to augment the engine's thrust at takeoff. The YB-52's J57-P-3 engine had been discarded after many modifications failed to keep it from shutting down at high altitude, regardless of speed. In addition, the power-poor and therefore temporary P-3 could not use water.[31] Equally frustrating were concurrent difficulties with other models of the J57, which left the P-1W as the only fully-qualified engine, even though its performance was substandard. Although fitted for water injection, this model had to be used as a dry engine. For lack of anything better, about one-half of the B-52B fleet was fitted with P-1Ws. The J57-P-9W, slated to succeed the P-1, ran into trouble. It was a lighter engine, incorporating titanium components. Unfortunately, the titanium compressor blades cracked as a result of both forging defects and of substandard metal containing too much hydrogen. A return to steel parts, at a weight penalty of 250 pounds, produced the J57-P-29W[32] and J57-P-29WA engines, which equipped most other B-52Bs. However, by mid-1956 the titanium problems had been solved and the P-19W, a higher-thrust version of the titanium-component P-9W, appeared on the last 5 B-52Bs.

Grounding 1956

The Air Force surmised that the first fatal B-52 accident in February 1956 was caused by a faulty alternator. Twenty B-52Bs, carrying the suspect equipment, were immediately grounded. In addition, the Air Force stopped further B-52 deliveries. In mid-May, after Boeing seemed reasonably convinced that the alternator problem was solved, more aircraft were accepted. However, the alternator problem later resurfaced. The B-52Bs were again temporarily grounded in July, this time because of fuel system

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[31] Even before the B-52 was built engineers recognized that a serious thrust problem would show up during a fully loaded takeoff, particularly on days when runway temperatures approached 100 degrees Fahrenheit. For a while, it seemed jet assisted takeoff units would be needed to provide reserve auxiliary thrust. The Air Force canceled such a project in April 1954, following Pratt and Whitney's successful development of a water injection system that promised to rectify the thrust deficiency. The unexpected difficulties that followed were serious, but not insurmountable.

[32] The rate of water that could be injected in the P-29W engine was only half that of the P-29WA. Subsequent modifications brought the P-29W to the P-29WA's standard.

and hydraulic pack deficiencies. Although this latest grounding did not last long, the 93d Wing's training program suffered. In mid-year, no combat-ready crews were available for the 42d Heavy Bomb Wing's new B-52s.

Support Achievements 1955-1956

The lessons learned during the B-47 conversion program were put to good use in preventing many B-52 maintenance and supply problems. Specialists associated with jet engines, the repair of fuel tanks, and the maintenance of all kinds of systems (bombing, navigation, hydraulics, electrical, and the like), were dispatched to Air Training Command for schooling on B-52 components, their education proving easier than their original transition from propeller-type aircraft to the jet-powered B-47. Other steps were taken to avoid, or at least to minimize, potential difficulties. After 2 years of bickering with SAC, AMC finally consented to establish special holding accounts at various supply depots for ground support equipment. The "Z" accounts, as they were known by 1955, had two distinct advantages. First, they segregated the various equipment needed by the B-52. Secondly they ensured that the 800 or so B-52 line items, which they eventually comprised, would be used exclusively in support of such aircraft. Once the "Z" accounts were established, SAC made certain that all available support items were in place, whether at Castle or elsewhere, prior to the arrival of any B-52. Yet, the Air Staff agreed with SAC that much more would be necessary to thwart other possible support problems of the B-47 type. As a result, in the summer of 1955 the Air Staff asked AMC to study how to speed up the repair of future malfunctions reported by operational units. The Air Staff's request and ensuing discussions between AMC and SAC representatives gave way to Sky Speed, a program organized by AMC's Oklahoma Air Materiel Area. And, before long, Sky Speed set up 1 contractor maintenance team of 50 people at every B-52 base. The Sky Speed teams did not participate, even indirectly, in the important modification projects subsequently done at the Boeing-Wichita plant. Nor did they take over the depot workload of the San Antonio Air Materiel Area, which was responsible for the B-52 inspect and repair as necessary (IRAN) program. However, the teams did reduce the time B-52s spent at the depot by doing much of the work that would ordinarily await the IRAN cycle. The maintenance teams practically kept the aircraft flying, because they immediately corrected noted safety deficiencies, installed fixes, and performed a great many other technical chores. As a rule, it took an average of 1 week for a B-52 to go through a Sky Speed routine checkup, and each B-52 received at least 1 checkup per year.[33]

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[33] By 1958, Sky Speed had reaped such success that a similar program was being devised for SAC's KC-135s.

Post-Production Modifications 1956-1958

Sunflower, a modernization project handled by Boeing, brought 7 early B-52Bs to the configuration of the next model in the series (B-52C). Started in the summer of 1956 at the Wichita plant, the project involved the installation of approximately 150 kits. Sunflower took time to accomplish; the last modified B-52B was not returned to SAC until December 1957. B-52Bs underwent many other modifications. They participated in such projects as Harvest Moon, Blue Band, and Quickclip, all of which were first initiated for the benefit of subsequent B-52 models.

End of Production 1956

The Air Force took delivery of the last B-52B in August.

Total B-52Bs Accepted 50

The Air Force accepted 50 B-52Bs, 27 of which qualified as RB-52Bs.

Acceptance Rates

The Air Force accepted 13 B-52Bs in fiscal year 1955 (the first one in August 1954); 35 in FY 56, and the last 2 in FY 57 (1 each in July and August 1956).

Flyaway Cost Per Production Aircraft $14.43 million

Airframe, $11,328,398; engines (installed), $2,547,472; electronics, $61,198; ordnance, $11,520; armament, $482,284.[34]

Subsequent Model Series B-52C

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[34] Cost breakouts were sometimes undeterminable and occasionally misleading. For instance, contractor-furnished equipment such as electronics might be included in the airframe's cost, instead of being broken out to its proper category. Similarly, the costs of some components and subsystems were often lumped under armament, a category carried on Air Force records as "other, including armament."

Other Configurations

RB-52B and NB-52B

RB-52B—Development of the RB-52B, once briefly referred to as the RX-16,[35] dated back to the early part of 1951. The reconnaissance model featured multi-purpose pods[36] carried in the aircraft's bomb bay. Initially, 17 pods were ordered, solely as flight test articles. The pods were pressurized and equipped with downward ejection seats for the 2-man crew. For search operations, the multi-purpose pod contained 1 radar receiver (AN/APR-14) at the low frequency reconnaissance electronic station, and 2 radar receivers (AN/APR-9) at the high frequency station. Each station had 2 pulse analyzers (AN/APA-11A), with which to process the collected data. The pod also housed 3 panoramic receivers (AN/ARR-88), and all electronic signals were recorded on an AN/ANQ-1A wire recorder. Photographic equipment consisted of 4 K-38 cameras at the multi-camera station, and 1 camera (either a T-11 or K-36) at the vertical camera station. For mapping purposes, the pod had 3 T-11 cartographic cameras. A December 1951 mockup inspection of the multi-purpose pod went well, no major changes being requested. SAC wanted a special electronic reconnaissance (or ferret) pod but this project did not encounter the same success. Work at Boeing progressed smoothly. Air Research and Development Command ascertained that 1 ferret pod-equipped aircraft could gather in a single flight all the electronic reconnaissance data formerly obtained by 3 conventional RB-52s. Nevertheless, the Air Staff canceled the project in December 1952, and a second SAC request in 1954 for a separate ferret pod did not fare any better. By 1955, however, the original multi-purpose pods had become "general purpose capsules," carrying the latest search, analysis, and direction-finding devices. While the more modern capsules might not satisfy all of SAC's requirements, they constituted clever, if temporary, cost-saving expedients. The capsule, which could be winched in and out of the bomb-bay, added only 300 pounds to the weight of the basic aircraft. Finally, the capsule's installation was so simple that it took just 4 hours to convert a B-52 to the reconnaissance configuration. First flown at Seattle on 25 January 1955 (actually, several months ahead of latest schedules), capsule-equipped B-52Bs began reaching SAC's 93d Heavy Bombardment Wing on 29 June. Phaseout of the 27 RB-52Bs followed the B-52B's pattern.

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[35] The X-16 or RX-16 designation, first applied to a post-World War II reconnaissance project, was reserved for the test version of high-altitude aircraft and was never permanently used.

[36] A pod is a compartment or container, often streamlined, attached or incorporated into the outer configuration of an airplane or rocket vehicle. The term is usually qualified. For example, a wing pod is a streamlined nacelle slung beneath an airplane's wing, especially for the installation of a jet engine or engines, while a pod gun was a housing for a machine gun.

NB–52B—After undergoing permanent modifications similar to those made on the last B–52A, the eighth B–52 production was redesignated NB–52B. In this configuration, the new bomber was credited with 140 of the 199 X–15 flights resulting from the NB–52/X–15 combination.[37] The NB–52B also participated in many other important projects, including the lifting body research aircraft program sponsored by the Air Force and the National Aeronautics and Space Administration (NASA). Started in 1966, the program's test flights were still going on in late 1973, with Martin-Marietta's needle-nosed X–24 soon to be tested with the NB–52B. The permanently modified B–52B was also used to test solid rocket boosters for the space shuttle. Moreover, as a mother ship, it was expected to play an active role in the remotely piloted research vehicle program, another joint project of the Air Force and NASA. The NB–52B, like the A-model, carried the price tag of the bomber from which it derived. In each case, however, an additional $2 million was spent to fit the basic aircraft for its many experimental tasks.

Phaseout 1965–1966

In March 1965, SAC began retiring B–52Bs that had reached the end of their structural service life, some of the planes going to the Air Training Command for ground crew training. The first B–52B (Serial No 52–8711), received by SAC 10 years earlier, deserved special treatment. On 29 September, it was donated to the Aerospace Museum at Offutt AFB, Nebraska, for permanent display. The remainder of SAC's 2 B–52B squadrons were earmarked for accelerated phaseout in early 1966, and by the end of June all B–52Bs had been sent to storage at Davis-Monthan AFB, Arizona.

Milestones May 1956

On 21 May, an Air Research and Development Command B–52B, flying at 50,000-foot altitude above the Pacific Ocean, dropped a hydrogen bomb over the Bikini Atoll. It was the first time a B–52 was used as a carrier and drop plane for the powerful thermonuclear weapon.

[37] After being dropped from the wing of the NB–52B mothership, the X–15 flew to altitudes of more than 250,000 feet and reached speeds exceeding Mach 6, with air friction heating its skin to 1,100 degrees Fahrenheit.

Items of Special Interest **November 1956**

On 24 and 25 November, in a spectacular operation called Quick Kick, 4 B–52Bs of the 93d Wing joined 4 B–52Cs of the 42d Bomb Wing for a nonstop flight around the perimeter of North America. The most publicized individual flight was that of a 93d Wing B–52, which originated at Castle AFB and terminated at Baltimore, Maryland, covering some 13,500 nautical miles in 31 hours and 30 minutes. SAC promptly pointed out that the flight would have been impossible without 4 flight refuelings by KC–97 tankers. Also, flying time could have been reduced by 5 or 6 hours with the refueling help of a higher, faster flying all-jet tanker, such as the KC–135 then being developed by Boeing.[38]

January 1957

From 16 to 18 January, in another spectacular operation called Power Flite, 3 B–52Bs of the 93d Bomb Wing made a nonstop, round-the-world flight. With the help of several KC–97 inflight refuelings, the lead plane, Lucky Lady III, and its 2 companions completed the 24,325-mile flight in 45 hours and 19 minutes, less than one-half the time required on the Lucky Lady II flight—the first-ever nonstop round-the-world flight, accomplished in February 1949 by a B–50A that was refueled by KB–29M tankers. The National Aeronautic Association subsequently recognized Operation Power Flite as the outstanding flight of 1957 and named the 93d Wing as recipient of the Mackay Trophy.

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[38] SAC's 93d Air Refueling Squadron at Castle AFB received the command's first all-jet tanker on 28 June 1957. The acquisition of KC–135s meant a great deal to SAC. Mating the new tanker and the B–52 would pay high dividends. It would reduce refueling time and increase safety, the latter remaining a constant goal of the command. Specifically, with a KC–135, the refueling rendezvous could be conducted at the bomber's normal speed and altitude. In contrast, using a KC–97, the B–52 had to slow down and descend to lower altitudes than normal to accomplish the hookup—an exacting exercise.

B-52C

Manufacturer's Model 464-201-6

Previous Model Series B-52B

New Features

Increased gross weight (450,000 instead of 420,000 pounds), larger underwing drop tanks, improved water injection system, and white thermal reflecting paint on the under surfaces were the B-52C's main new features.

Configuration Planning December 1953

As a product of the evolutionary process, the B-52C design did not take shape until December 1953.

First Flight (Production Aircraft) March 1956

Less than 30 months elapsed between design and first flight.

Enters Operational Service 1956

All B-52Cs went to the 42d Bomb Wing at Loring AFB, Maine. The 42d received its first B-52C on 16 June 1956, but did not become combat ready until the end of the year.

Avionics Problems 1956-1957

The B-52 (like the B-47) carried only a tail turret for defensive armament. Providing a suitable fire-control system for the aircraft was particularly important, but proved to be a problem from the start. The A-3 system that equipped the B-52A and a few B-52Bs, was capable of both optical and automatic tracking and search, but because of deficiencies, it was replaced by the MD-5. Installed in most B-52Bs, the MD-5 fire-control system did not live up to expectations. Hence, a theoretically perfected A-3, after reappearing on the last 7 B-52Bs, was fitted in every B-52C. Still unsatisfactory, the A-3 was supplanted by the MD-9 in subsequent B-52 models. The bombing-navigation system was another difficulty of the B-52 program. Moreover, the problem promised to be fairly constant, since any progress was likely to be counteracted by enemy technical developments. The problem of bombing navigation was not new. It had plagued Convair's B-36 and still hampered Boeing's B-47. Actually, the Air Force and various contractors had been wrestling for years with the difficulties associated with accuracy, a primary requirement of any bombing system, multiplied many times in importance by the high cost of nuclear weapons. Simply stated, the bombing-navigation system of the atomic age called for greater instrumental accuracy, increased automatic operation to reduce human error, and immunity from more sophisticated defenses. Two main systems remained under consideration as late as 1953:[39] the K-series bombing-navigation system, which relied essentially on radar and optics, and the MA-2 or Bomb Director for High Speed Aircraft system. The MA-2 combined an optical bombsight, a radar presentation of target, and an automatic computer, together with radar modifications designed for use in high-speed aircraft. The MA-2 appeared ideally suited for both the B-47 and the B-52, but SAC did not believe that the system would be tested sufficiently even by the end of 1955. And while the Strategic Air Command was willing to overlook certain minor deficiencies, it stood firm on the issue that no bombing system that had not been tested or fully approved would be installed in any of its bombers. When the B-52s started reaching the Air Force, neither the K-2 or K-4 bombing-navigation systems of most B-47s, nor the B-36's K-3A had proven satisfactory. For lack of any better system, the K-3A was fitted in some early B-52Bs. However, at altitudes above 35,000 feet, the K-3A became almost useless—loss of definition and poor resolution preventing target identification. The Philco Corporation came to the rescue with a "black box" that increased the K-3A's power output by 50 percent. Yet, this development was merely an expedient, rather than the beginning of a new and improved system. It gave way to the MA-6A bombing-navigation system, a modernized K-3A which was installed in all remaining B-52Bs. Meanwhile, after being rushed through intensified flight tests, the MA-2 kept acting up. In mid-1955, the system still did not perform as well as

[39] The XB-52, YB-52, and B-52As actually came off production without any bombing-navigation system.

expected and its autopilot was particularly deficient. Nevertheless, progress was being made. A vastly improved system, the AN/ASB-15, initially equipped the B-52Cs. However, technical refinements did not cease, and most B-52Cs were retrofitted with the AN/ASQ-48 bombing-navigation system.

Other Problems 1956-1957

In mid-1956, the Air Force and the Thompson Products Company were still working on a permanent fix for the faulty alternators that had been responsible for the fatal crash of a B-52B. A new Thompson model, in use by 1957, was much better but still troublesome. Problems occurred because of defects in the alternator drive's lubricating system, which used grease instead of oil. This was expected to be corrected before the end of the year. Another B-52 malfunction, detected in March 1957, had to do with the trunnion fittings of the main gear. Defective fittings were found in nearly all B-52Cs.

Post-Production Modifications 1958-1962

A special project, Harvest Moon, increased the B-52C's combat potential to that of the next model in the series. Otherwise, as in the B-52B's case, B-52C post-production modifications were parts of large programs that concerned themselves with the overall improvement of the entire B-52 fleet. None of those programs was initiated for the sake of the small contingent of B-52Cs.

End of Production 1956

All B-52Cs were built in 1956, the last 5 reaching the Air Force in December.

Total B-52Cs Accepted 35

The Air Force received 35 B-52Cs, the total finally ordered. All B-52Cs could readily be converted to RB-52Cs.

Acceptance Rates

The Air Force accepted 5 B-52Cs in FY 56; 30 in FY 57. Actually, 1 B-52C was accepted in February 1956; the rest, between June and December.

Flyaway Cost Per Production Aircraft **$7.24 million**

Airframe, $5,359,017; engines (installed), $1,513,220; electronics, $71,397; ordnance, $10,983; armament (and others) $293,346.[40]

Subsequent Model Series **B-52D**

Other Configurations **RB-52C**

The 35 B-52Cs, like some of the B-52Bs, could easily be fitted for reconnaissance. The RB-52Cs were superior to the RB-52Bs, since they were powered from the start by higher-thrust engines—8 J57-P-29Ws. The RB-52Cs also benefited from the other improvements first introduced by the B-52C. Of special importance to the reconnaissance role was the extra fuel carried by the C-model, which significantly extended the aircraft's unrefueled range.

Phaseout **1971**

All B-52Cs were phased out of the active forces in 1971. A B-52C (Serial No 53-402) of the 22d Bomb Wing at March AFB, California, was the last one to be retired. The aircraft reached the storage facility at Davis-Monthan AFB on 29 September, only 3 months later than planned some 5 years before.[41]

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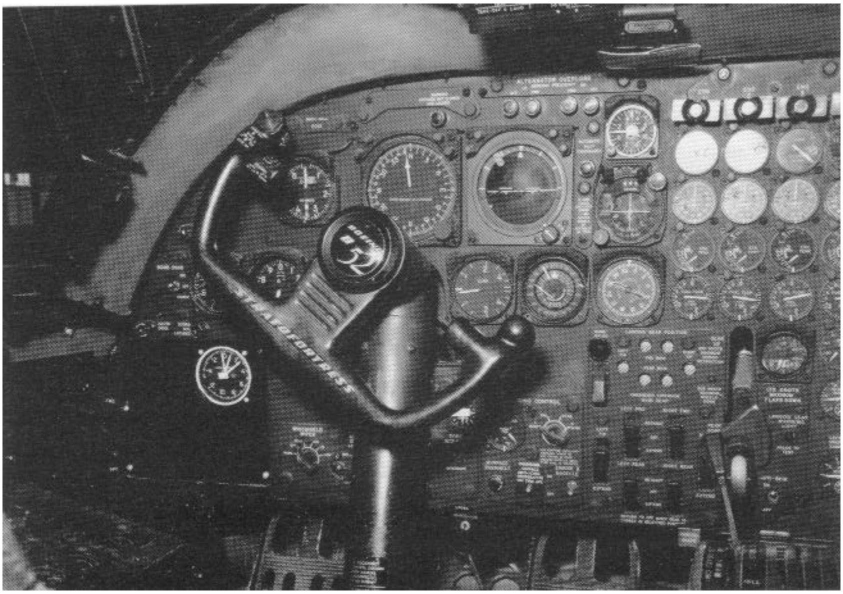
[40] Increased production meant lower unit costs. First beneficiary was the B-52C, acquired at half of the B-52B's price.

[41] In December 1965, a few months after the first B-52Bs started leaving the operational inventory, Robert S. McNamara, Secretary of Defense from 21 January 1961 to 29 February 1968, announced another phaseout program that would further reduce SAC's bomber force. Basically, this program called for the mid-1971 retirement of all Convair B-58s, of the B-52Cs, and of several subsequent B-52 models. Secretary McNamara in December 1965 also stated that 210 General Dynamics FB-111s would be purchased to replace SAC's phased-out bombers. The forthcoming strategic FB-111, closely related to the once highly controversial TFX, was a modified version of the F-111. As such, information on the FB-111 was included in Volume I, *Post-World War II Fighters, 1945-1973*, published by the Office of Air Force History. However, some of the controversies generated by the FB-111 procurement are covered in this volume, in connection with the B-70, AMSA (Advanced Manned Strategic Aircraft), and B-1A projects. See Appendix II, pp 559-593.



View of a B–52 instrument panel.

A Boeing B–52C in flight, its under surfaces coated with white thermal reflective paint.

B–52D

Manufacturer's Model 464–201–7

Previous Model Series **B–52C**

New Features

In contrast to the B–52C, easily convertible to the reconnaissance configuration, the B–52D was equipped exclusively for long-range bombing operations. This was initially the most telling difference between the two. Like some of the B–52Bs, the preceding B–52Cs, and subsequent B–52 models, the B–52Ds could carry the newly developed thermonuclear weapons, all necessary modifications being incorporated on the production lines.

Configuration Planning **December 1953**

As in the case of the B–52C that it so closely resembled, the B–52D's design was initiated in December 1953.

Additional Procurement **1954–1956**

The B–52D marked the beginning of the B–52 large-scale production. It reflected the mid-1953 decision to raise procurement and Secretary Talbott's final endorsement of a second production plant. The B–52D program also benefited from ensuing program increases, and the "D" became the second most-produced B–52 model. The aircraft were ordered under 4 separate contracts. The first, AF33(600)–28223, finalized on 31 August 1954, covered 50 aircraft; the second, AF33(600)–31267, signed on 26 October 1955, involved 51 B–52Ds and 26 B–52Es—the next model in the series. Like preceding B–52s, the new planes were to be built at the Boeing Seattle plant. The other 2 contracts, AF33(600)–26235 and AF33(600)–31155, finalized on 29 November 1954 and 31 January 1956 respectively, totaled 69 B–52Ds and 14 B–52Es—all to come from Boeing's new production facilities in Wichita, Kansas. The 4 contracts, as well as those that covered other B–52Es and subsequent B-52Fs, were of the fixed price type, with redeterminable incentives.[42]

First Flight (Production Aircraft) 4 June 1956

The Air Force accepted the initial B-52D, a Wichita production, in June 1956, on the heels of the aircraft's first flight. The new Seattle-built B-52D, first flown on 28 September, joined the testing program immediately.

Enters Operational Service December 1956

The new B-52Ds did not reach SAC before the fall of 1956. The first few went to the 42d Bomb Wing, at Loring AFB, replacing the wing's initial B-52Cs. Before the end of December, several B-52Ds had also begun to reach another SAC wing, the 93d. However, while the B-52 inventory at the time already counted almost 100 B-52s (40 B-52Bs, 32 B-52Cs, and 25 B-52Ds), combat-ready crews lagged behind, with only 16 in the 42d Wing and 26 in the 93d. But the command did quickly resolve this problem. Less than 2 years later, SAC had 402 combat-ready crews for 380 B-52s.

Operational Problems 1957-1962

B-52Ds encountered the same initial problems as preceding and subsequent models. They were hampered by fuel leaks, icing of the fuel system, and malfunctions of the water injection pumps. After much frustration, the cause of the pump's failure was uncovered. It was simply due to the fact that the water pumps kept operating when the water tanks were empty. The installation of water sensors was the answer. This was done by Sky Speed teams as part of the water injection system's overall improvement program, which was completed by the spring of 1959. Other problems, however, took longer to solve.[43]

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[42] In 1962, when production ended, 16 definitive contracts had been concluded. In addition, the B-52 program was tagged with at least 25 miscellaneous contracts for special studies, special flight tests, the procurement of mobile training units, of flight simulators, and of other related items.

[43] See B-52F, pp 266-267.

Other Problems 1957–1959

As B–52Ds were becoming more plentiful, B–52Es and B–52Fs were also reaching SAC. Concurrently, the command's base facilities kept deteriorating. The eagerly awaited B–52s put stresses on runways that had been designed for the lighter B–47s or the slower B–36s. SAC's problems were further compounded by the large size of the first B–52 wings, generally composed of 45 bombers and 15 or 20 tankers, all situated on 1 overcrowded base.[44] In mid-1958, paving projects started at 9 of 13 bases which, the command pointed out, needed immediate attention. Paving costs alone were estimated at $25 million. Congress also approved $232 million under the fiscal year 1959 military construction program to cover projects programmed by SAC, but an additional $210 million was denied. While few of the requested alert facilities were affected, drastic cuts were made in other SAC construction projects. Strangely enough, the facilities shortage was alleviated somewhat by another problem. In the late fifties, as the Russian missile threat became more pronounced and warning time shrank, SAC bases presented increasingly attractive targets. The only immediate solution was to break up these large concentrations of aircraft and scatter them over more bases.[45] Existing B–52 wings therefore were broken up into 3 equal-size units of 15 aircraft each. Two units would normally be relocated at bases of other commands, which was not an ideal arrangement since runway deficiencies, as well as other difficulties, would be sure to materialize. In essence, after 1958 each dispersed B–52 squadron became a strategic wing, usually accompanied by an air refueling squadron of 10 to 15 aircraft. The same principle would be followed in organizing and equipping the still growing B–52 force.

"Big Four" Modification Package 1959–1963

Concurrent with the increasing Russian missile threat and the beginning of the B–52 dispersal program, a new difficulty came to light. Namely, there was no longer any doubt that the Soviet Union had developed formidable defenses against high altitude bombers. Of some consolation, enemy defenses were known to be far less reliable and potentially successful against low flying aircraft. Undeterred by the fact that its new B–52s had been

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[44] The early and mid-fifties expansion of the bomber force compelled some of the SAC bases to support as many as 90 B–47s and 40 KC–97 tankers.

[45] In the B–47's case, dispersal was a long-range program. It would be accomplished primarily through the phaseout of wings in the late fifties and early sixties.

designed for high-altitude bombing, SAC wasted no time in planning the best way to face its new challenge. To begin with, all B-52s, except for the early B-52Bs, would have to be capable of penetrating enemy defenses at an altitude of 500 feet or lower, in any kind of weather, and without impairing the bomber's inherent high speed at high altitude. Two other necessary steps were to equip all B-52s, modified for low level, with Hound Dog missiles and Quail decoys, so far due to be carried only by the latest B-52s. SAC's fourth requirement was to add an AN/ALQ-27 electronic countermeasure (ECM) system in every modified B-52. This system, the command believed, would allow the B-52 to automatically counter ground-to-air and air-to-air missiles, airborne and ground fire-control systems, as well as the early warning and ground control interception radars of the enemy. Although the requirements outlined by SAC would involve significant modifications and the addition of complex and costly components, they were approved by Headquarters USAF in November 1959. There was an immediate exception, however. The AN/ALQ-27 production was canceled. The command had wanted 572 B-52s fitted with the new AN/ALQ-27, which promised to integrate all ECM functions into one major subsystem, but this modification alone would cost over $1 billion. The Air Staff chose instead a quick reaction capability (QRC)/ECM combination of black boxes that would cost much less. The B-52H (last of the B-52 model series) would feature this equipment from the start, and it would be retrofitted in other B-52s. However, deletion of the AN/ALQ-27 was not to be the program's only setback. Although eventually successful, the "Big Four" low-level modification—also identified as modification 1000—had to overcome numerous difficulties. First was the lack of money. In early 1960, the Air Staff constantly reiterated that a maximum effort was necessary to eliminate complexities and expensive components that promised only incremental improvements. Meanwhile, low-level modification costs had increased from $192 million in November 1959 to $241 million in March 1960. By July, the cost had risen to $265 million. In August, funds were withheld by the Air Staff pending assurance from the Oklahoma City Air Materiel Area that the work would be completed within the $265 million fund ceiling. At the same time, SAC again emphasized that basic requirements should not be compromised just to keep rising costs down. In any case, technical problems also multiplied. At first sight, the low-level modifications appeared straightforward. They called for improvement of the aircraft's bombing-navigation system, modification of the Doppler radar, and the addition of a terrain clearance radar. Low-altitude altimeters also had to be acquired, and each aircraft had to be equipped to carry its newly allocated missiles. The project was actually far more complicated than it seemed, because it covered different B-52 models. In other words, modifications had to be tailored to fit specific configurations. Airframes had to be strengthened, and they also slightly differed from model to model. As a result, low-level modification costs for each B-52C and B-52D aircraft[46] were almost twice as much as for any other B-52. Finally, development of special terrain clearance radars proved more difficult than anticipated. Nevertheless, most low-level modifications were completed by the end of September 1963. Some ECM improvements, due to be accomplished during the aircraft's regular inspect and repair as necessary program, took longer.[47]

Structural Fatigue — 1960-On

The phenomenon of fatigue was yet to be fully understood by 1960, but a great deal had been learned from the B-47's structural problems. For instance, it was well established that takeoffs and landings formed one of the primary sources of fatigue damage. In this case, the B-52, with its wing fuel loads, promised to be especially vulnerable. Moreover, there were other known causes of fatigue: atmospheric gusts, maneuver loads, downwash turbulence from tankers during refueling, taxi, buffet, sonic noise, and stress corrosion. Although flying the B-52 at low level was absolutely necessary, SAC knew there would be a price to pay.

The extent of the damage could not be fully predicted, but gusts at 800 feet were 200 times more frequent than at 30,000 feet. At best, it was believed that low-level maneuvers and gust loads would speed the B-52's structural deterioration by a minimum quotient of 8. Justifying the Air Staff's as well as SAC's opinion, Boeing cyclic testing of a B-52F soon showed that numerous manhours would have to be spent on every B-52F in order to alleviate stress in critical areas of the aircraft. Even though the B-52F contingent was not large, strictly mandatory modifications would total at least $15 million. Meanwhile, following the cyclic tests of a B-52G in early 1960, numerous structural fixes were ordered for the entire B-52 fleet, the B-52Bs included. These modifications, soon carried out as the

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[46] Extra structural modifications accounted for some of the additional expenditure. Another factor was upgrading of the aircraft's initial MA-6A bombing and navigation system, finally replaced in 1964 by the ASQ-48. In any case, the whole project was complex, and modifying the ASQ-38 bombing navigational system of subsequent B-52 models also proved costly.

[47] The ECM improvements were programmed to take place in several phases. Phase I was an emergency modification that provided the necessary minimum ECM equipment to cope with the enemy's radar and surface-to-air missile threat. Phase II was essentially an ECM retrofit that was included in the "Big Four" package. The components installed during Phase II were either equal to or nearly as sophisticated as those introduced by Phase III. The best available ECM equipment, comparing favorably to the deleted AN/ALQ-27, was fitted in Phase III and also featured in the B-52H. Except for the first 18, all B-52Hs were equipped in production for all-weather and low-level flying.

Hi-Stress Program, initially consisted of 2 phases. The Phase I High Stress fixes were scheduled when the aircraft approached 2,000 flying hours;[48] Phase II, when it was nearing 2,500.[49] The Hi-Stress Program was not to interfere with the "Big Four" modification package; it was not allowed to fall behind schedule and was practically completed by the end of 1962. Concurrently, because of the results of the B–52F cyclic tests, an unanticipated third phase was started. The High Stress Phase III consisted of inspecting and repairing, as necessary, wing cracks in all early B–52s. Sky Speed teams and personnel of the Oklahoma and the San Antonio Air Materiel Areas again took care of most of the work. But these modifications, as thorough as they were, only marked a beginning. In the mid-sixties, the B–52 remained SAC's primary bomber and modifications were necessary to offset structural weaknesses caused by aging.[50] In the early seventies,

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[48] Phase I counted 9 fixes. The main ones consisted of strengthening the fuselage bulkhead and aileron bay area. Other important fixes were the reinforcement of boost pump access panels and wing foot splice plate.

[49] Phase II called for modification of the upper wing panel splice inboard of inboard engine pods, reinforcement of lower wing panel supporting inboard and outboard pods, reinforcement of upper wing surface fuel probe access doors, and strengthening of a bottom portion of the fuselage bulkhead. Some work was to be done also on the upper wing panel splice, 8 feet inboard of the outboard engine pods.

[50] An engineering change proposal (ECP 1128), approved in 1964, was scheduled for completion in June 1966. It called for various structural improvements, including replacement

The D-model was equipped solely for bombing missions.

similar projects would be undertaken either to beef up or to modernize selected models of the elderly B-52s.

Big Belly Modifications — December 1965

Less than 6 months after the B-52s became involved in the Vietnam War (B-52Fs were the first to go), the Air Force initiated a special modification program to allow the B-52Ds to carry more bombs. Referred to as Big Belly, the modification program left the outside of the aircraft intact. Modified B-52Ds could still carry twenty-four 500-pound or 750-pound bombs externally, but the internal changes were significant. Reconfiguration of the B-52D bomb bay allowed the aircraft to carry 84, instead of twenty-seven 500-pound bombs, or 42, instead of twenty-seven 750-pounders, for a maximum bomb load of about 60,000 pounds—22,000 pounds more than the B-52F.

Overseas Deployment — April 1966

B-52Ds of the 28th and 484th Bomb Wings, deployed to Guam in April 1966, immediately began to replace SAC's B-52Fs in the Vietnam conflict. All B-52Ds committed to Southeast Asia had been modified to carry more bombs than the planes they relieved. In the spring of 1967 modified B-52Ds began also to operate out of U Tapao Airfield in Thailand. From there, the aircraft would complete their mission without inflight refueling, which was necessary when operating from Guam. This saved both time and money.

Additional Training — 1968

Because of the war, SAC established on 15 April 1968 a Replacement Training Unit within the 93d Bomb Wing's 4017th Combat Crew Training Squadron at Castle AFB. The unit's purpose was to cross-train every B-52 crew, from the B-52E through the B-52H model, in the operation of B-52D aircraft. After 2 weeks of training, the crews were used to augment the cadre units in Southeast Asia. This spread out combat duties more equitably among the entire B-52 force and provided the crews needed to meet the increased bombing effort.

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of the vertical fin spar and skin. It would enable most of the B-52s to resume unrestricted operations, but was expected to cost $230 million.

Other Structural Modifications 1966–1968

When a single B–52, set aside for static testing, was subjected to final destruction back in February 1955, its wings accepted 97 percent of the ultimate up-bending load before failing—an entirely satisfactory outcome for the configuration tested. However, since that time, the B–52 had flown many hours and far more years than expected. Furthermore, many of the hours accumulated by the 10-year-old bomber had been flown at low-level, which put a great deal of extra stress on an aircraft structure, originally intended for high-altitude bombing. Therefore, the structural modifications, approved in the mid-sixties as a result of engineering change proposal 1243, came as no surprise. Started in December 1966, this modification program ensured selected B–52s of an additional 2,000 hours of service life. All Big Belly B–52Ds, reconfigured with high-density bomb bays, were automatically earmarked for the work. The others were chosen according to a very straightforward formula. Namely, B–52C, D, or F models qualified if they were nearing their flying maximum of unrestricted "E" hours and had not been tabbed for upcoming phaseout.[51] The modification program was completed during the second half of 1968, at a cost of approximately $16 million, after replacing fatigued structural parts in the most critical wing areas of the involved planes.

Special Modifications 1969–1971

Because they had already been fitted to carry heavier bombloads, a number of B–52Ds were earmarked for another round of modifications. The changes this time would allow the aircraft to carry extra aerial mines. As requested by Deputy Secretary of Defense David Packard in December 1968, the project had been thoroughly reviewed, the Air Force concluding that the suggested modification of later B–52 models would be less efficient and more costly—$6.9 million instead of $6.3 million. Although the Air Force's selection was approved by the Office of the Secretary of Defense in mid-1969, the B–52D special modifications were only completed in the fall of 1971.[52] Not too soon, it seemed, for President Richard M. Nixon ordered the mining of North Vietnam's harbors and river inlets on 8 May 1972.

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[51] The "E" hour was an equivalent used to indicate the fatigue damage accrued in the wing structure of all B–52C, B–52D, and B–52F bombers.

[52] It also took time to finalize logistics agreements with the Navy for procurement, modification, storage, and delivery of mines.

Southeast Asian Losses 1966–1973

The Vietnam conflict cost SAC 22 B–52Ds. Surface-to-air missiles and other ground defenses accounted for 12 of the losses. Ten B–52Ds were lost in operational accidents of one kind or another.

End of Production 1957

The B–52D production ended in late 1957, the last 6 productions being accepted by the Air Force in November.

Total B–52Ds Accepted 170

The Air Force accepted 101 B–52Ds from Seattle; 69 from Wichita.

Acceptance Rates

Only 1 B–52D was accepted in FY 56 (June 1956); 92 in FY 57 (between July 1956 and June 1957); and 77 in FY 58 (all in calendar year 1957).

Flyaway Cost Per Production Aircraft $6.58 million

Airframe, $4,654,494; engines (installed), $1,291,415; electronics, $68,613; ordnance, $17,928; armament (and others), $548,353.[53]

Subsequent Model Series B–52E

Other Configurations None

Initial Phaseout 1973–1974

In accordance with Secretary McNamara's mid-sixties decision to cut

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[53] Another price decrease, almost $700,000 below the B–52C's cost.

down the strategic bomber force by mid-1971, SAC inactivated 3 squadrons of B-52D and B-52E aircraft during the early part of 1967. This action, however, did not spell the immediate retirement of the aircraft that had been attached to the inactivated units. Badly needed elsewhere, the Big Belly B-52Ds were immediately used to bolster the resources of the B-52D wings committed to Southeast Asia. The B-52Ds actually outlived 2 subsequent B-52 models. In 1973, a partial retirement of the B-52D fleet was planned. Based on the age and condition of their airframe, 45 B-52Ds were earmarked for phaseout by September 1974.

Operational Status — Mid-1973

In mid-1973, SAC forces still counted about 130 B-52Ds. Some of these aircraft were on their way out—45 by the fall of 1974 and a few others soon afterward. But 80 B-52Ds were expected to see unrestricted service into the 1980s. The Air Force was negotiating a contract with Boeing for the Wichita fabrication of kits and the reworking of wings that would be installed on the 80 B-52Ds, during the aircraft's regular depot maintenance. The cost of extending the B-52D's operational life seemed high, over $200 million for 80 planes, but the Air Force believed it had no alternative.[54] As approved by the Office of the Secretary of Defense on 30 November 1972, the modification, identified as engineering change proposal (ECP) 1581, promised to be extensive. It included redesign and replacement of the lower wing skin, to make it similar to the B-52G wing, and in the process Boeing was to use a more fatigue resistant alloy. The wing center panel was also to be redesigned and replaced. Finally, ECP 1581 called for new upper longerons and some new fuselage side skins. Also, the pressure bulkhead in the B-52D nose would be changed. Already delayed for lack of money, ECP 1581 had been programmed to take at least 2 years.

Record Flights — 26 September 1958

Two B-52Ds of the 28th Bomb Wing, Ellsworth AFB, South Dakota, established world speed records over 2 different routes. One B-52D flew at 560.705 miles per hour for 10,000 kilometers in a closed circuit without payloads; the other, at 597.675 miles per hour for 5,000 kilometers, also in a closed circuit without payloads.

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[54] As explained by Secretary of Defense Elliot L. Richardson to the Senate Armed Services Committee, without the hi-density B-52Ds, the Strategic Air Command's conventional bombing capability would be at the expense of its other missions.

B-52E

Manufacturer's Model 464-259

Previous Model Series — B-52D

New Features

As rolled out of either the Seattle or Wichita plant, the B-52E hardly differed from the B-52D. It was equipped with more reliable electronics, and the more accurate AN/ASQ-38 bombing navigational system replaced the B-52D's final AN/ASQ-48. The relocation of some equipment and a slight redesign of the navigator-bombardier station increased crew comfort and provided better access to instruments and greater maintenance ease. Other dissimilarities between the 2 models grew from post-production modifications.

Configuration Planning — December 1953

As an improved B-52D, the B-52E development dated back to the end of 1953.

Program Increases — 1954-1956

The beginning of large-scale production, the opening of the Wichita plant, and the 7-wing program endorsed in late 1953 did not satisfy General LeMay. The program's long-range increase to 408 aircraft, as approved in March 1954, remained short of his command's requirements. On 20 June 1955, the Air Force Council recommended that the B-52 program be raised to 576 and that production be accelerated. Secretary Talbott approved the council's recommendation, but pointed out that money remained the limiting factor and only 399 aircraft would be produced on an accelerated basis, beginning in mid-1955. The further increase to 576, the Secretary indicated, would depend entirely on the amount of funds obligated in the coming 2 years.[55] In September 1955, on the

[55] On 15 August 1955, Donald A. Quarles replaced Harold Talbott as Secretary of the Air Force.

assumption that money would indeed be forthcoming, SAC began to plan the equipping of 11 bombardment wings, each with 45 B-52s. Five command support B-52s would be added to each wing once every unit had been converted as programmed. In the spring of 1956, the Subcommittee on the Air Force of the Senate Armed Services Committee undertook a review of American airpower. Asked for his opinion, General LeMay again urged that the B-52 production be increased. In December, the President's budget set the B-52 program at 11 wings, and reprogrammed procurement to acquire 53 additional B-52Es, starting in mid-1957, when fiscal year 1958 funds would become available.

Additional Procurement 1955-1956

The B-52E procurement was covered by 4 definitive contracts, funded in fiscal years 1956 and 1957. The first one, AF33(600)-31267, concluded on 26 October 1955, was essentially a B-52D contract to which 26 B-52Es were attached. The second, AF33(600)-32863, signed on 2 July 1956, counted 16 B-52Es and 44 further improved productions (B-52Fs). All such aircraft were to be built in Seattle. The other 2 contracts, AF33(600)-31155 of 10 August 1955 and AF33(600)-32864 of 2 July 1956, also involved other B-52s (either D or F models), but covered 14 and 44 B-52Es, respectively. All would come from the new Wichita plant.

First Flight (Production Aircraft) October 1957

The Seattle-built B-52E was first flown on 3 October 1957, 3 weeks ahead of its Wichita counterpart.

Enters Operational Service December 1957

A few B-52Es began reaching the Strategic Air Command in December 1957.

Initial Operational Problems 1958-1964

Besides sharing the initial deficiencies of other B-52s, the B-52E introduced a new problem. The aircraft's new ASQ-38 bombing-navigation system at first was not as accurate as had been anticipated. It was difficult to maintain, and replacement parts were in short supply. The ASQ-38 problems at first appeared relatively minor, but grew in importance as soon as the B–52E entered the Big Four modification program. Moreover, since the same bombing-navigation system would be installed in all subsequent B–52s, extensive engineering changes were initiated to improve low-level terrain avoidance for the long term. The modifications promised to be time-consuming and costly, and they gave way to a special project, Jolly Well, which exchanged major parts of the ASQ–38 and replaced the terrain computer—another critical component of the overall system. Jolly Well was completed in 1964, after successful modification of the ASQ–38 of 480 B–52s—B–52E, F, G, and H models.

End of Production 1958

The B–52E production ended before mid-1958, the last 3 aircraft being accepted by the Air Force in June.

Total B–52Es Accepted 100

Of the 100 B–52Es accepted by the Air Force, 58 came from Wichita which thus began to assume production leadership over Seattle.

Acceptance Rates

All B–52Es were accepted in FY 58, between October 1957 and June 1958.

Flyaway Cost Per Production Aircraft $5.94 million

Airframe, $3,700,750; engines (installed), $1,256,516; electronics, $54,933; ordnance, $4,626; armament (and others), $931,665.[56]

Average Maintenance Cost Per Flying Hour $925.00

[56] The B–52E cost less than any other B–52. Although production kept on increasing, the price of ensuing models did not go down. On the contrary, in-production structural improvements, better engines, more sophisticated components, and other technological pluses boosted costs.

Subsequent Model Series — B-52F

Other Configurations — NB-52E

The second B-52E built (Serial No. 56-632) was assigned from the start to major test programs. It was used for prototyping landing gears, engines, and other major B-52 sub-systems, test results contributing significantly to the improvements featured by subsequent B-52 models. Also, the B-52E test plane underwent permanent modifications in order to participate in highly specialized development projects. Small swept winglets were attached alongside the nose of the reconfigured bomber—NB-52E. A long probe extended from the nose of the modified plane and the NB-52E wings displayed nearly twice the normal amount of controlling surfaces. In addition, traditional mechanical and hydraulic linkages to move the control surfaces were replaced by electronic and electrical systems. Internally, the NB-52E was loaded with a multitude of special electronic measuring systems. The aircraft was first used to develop an electronic flutter and buffeting suppression system. This would decrease the fatigue and stress of aircrews flying at low level. The N configuration participated in another project, known by the acronym LAMS—Load Alleviation and Mode Stabilization. During the LAMS flights, sensors noted gusts and activated the control surfaces to cut down on fatigue damage to the aircraft. In mid-1973, the NB-52E flew 10 knots (11.5 mph) faster than the speed at which flutter normally would disintegrate the aircraft. This was made possible by the aircraft's winglets (canards), which reduced 30 percent of the vertical and 50 percent of the horizontal vibrations caused by air gusts. The NB-52E's contributions were significant, but its cost was relatively low—$6.02 million. Over the years, barely more than $500,000 had been spent to bring the aircraft to its permanent testing configuration. In 1973 its career was nearing its end; the Air Force planned to retire the NB-52E in mid-1974.

Beginning of Phaseout — 1967–1973

The Secretary of Defense's decision to reduce SAC's bomber fleet by mid-1971 affected the B-52Es more than it did the B-52Ds. While the B-52Ds of units inactivated in 1967 went to other operational wings, excess B-52Es were designated non-operational active aircraft. This meant that the aircraft were stored with operational units, maintained in a serviceable condition, and periodically flown. However, no additional crews or maintenance personnel were authorized for these planes. A few B-52Es were permanently retired in 1967, but only because they had reached the end of their operational life by accumulating a specified number of flying hours under conditions of structural stress. This phaseout pattern was retained in the following years. In mid-1973, the Air Force still carried 48 B-52Es in its inventory, but they were not part of the active operational forces.

B-52F

Manufacturer's Model 464-260

Previous Model Series B-52E

New Features

New J57-43 engines took the place of the B-52E's J57-P-19s or P-29s. Alternators, attached to the left-hand unit of each pair of the J57-P-43W engines replaced the air-driven turbines and alternators in the B-52E's fuselage. The B-52F's only other new feature was a more efficient water injection system.

Configuration Planning November 1954

Continued improvements of the J57 engine series prompted the November 1954 initiation of the B-52F design. Incorporation of the J57-P-43W engines had to entail some changes. A slight modification of the wing structure also had to be planned in order to install 2 additional wing tanks, which would give the B-52F's injection system an increased water capacity—the system's main overall advancement.

Contractual Arrangements 1956

B-52F procurement was accomplished by 2 B-52E contracts—AF33(600)-32863 and AF33(600)-32834. One contract called for 44 Seattle B-52Fs; the other, for 45 B-52Fs from Wichita.

First Flight (Production Aircraft) May 1958

The Seattle-built B-52F first flew on 6 May; the Wichita-built model, on 14 May.

Production Slippages 1958

Whether from Seattle or Wichita, B-52F deliveries lagged a few months behind schedule because authorized overtime for Boeing personnel was curtailed. Fiscal limitations, imposed by the Office of the Secretary of Defense in late 1957,[57] were the cause.

Enters Operational Service 1958

B-52Fs did not start reaching the Strategic Air Command until June 1958. By the end of the month, SAC's 93d Bomb Wing counted 6 B-52Fs.

Initial Problems 1954-1959

Fuel leaks, occurring in the B-52Fs and preceding B-52s, proved difficult to stop. The problem manifested itself from the start. Marman clamps, the flexible fuel couplets interconnecting fuel lines between tanks, broke down on several occasions during the first few weeks of B-52 operation. This caused fuel gushers that obviously created serious flying hazards. Blue Band, a September 1957 project, put new clamps (CF-14s) in all B-52s. Depot assistance field teams did the retrofit well, but Blue Band did not work. The CF-14 aluminum clamps soon showed signs of stress corrosion and were likely to fail after 100 days of service. Highly concerned, the Air Force and Boeing began replacing the aluminum clamps with a Boeing-developed stainless steel strap clamp, the CF-17. Hard Shell, a high-priority retrofit program, put CF-17 clamps in all in-service B-52s. Completed in January 1958, the Hard Shell retrofit was not a fool-proof solution. B-52 operations were again restricted, as several CF-17 clamps ruptured, this time because of deficient latch pins. CF-17A couplings, CF-17 clamps that had been modified to strengthen their latch pins, were used to correct the problem. But neither Boeing nor the Air Force put too much credence on the new modification. This gave way to Quickclip, a new retrofit project started in mid-1958. All B-52s went through Quickclip, which installed a safety strap around the modified clamps. Several cases of broken latch pins were reported before the end of 1958. However, the safety straps prevented the fuel from leaking out, which was Quickclip's whole

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[57] Charles E. Wilson was sworn in as Secretary of Defense on 28 January 1953, and served until 8 October 1957. He was succeeded by Neil H. McElroy, who resigned on 1 December 1959.

purpose. Additional B-52Fs, entering the inventory after the fall of 1958, therefore were also fitted with Quickclip safety straps.

Other Fuel System Problems 1954-1962

Fuel system icing posed another initial and long-lasting B-52 problem which had been shared for several years by other jet aircraft. However, little was known about its cause and effect. A B-52 accident in 1958 brought the problem to a climax, while providing a few definite findings. In many previous crashes, icing of the fuel system had been recognized as a probable cause of accident, but the ice had melted in ensuing fires, leaving no concrete evidence. This time, the Air Force could ascertain that icing of the fuel system strut filters and fuel pump screens had caused the engine to flame out and lose thrust. As a remedial step, B-52s were immediately fitted with filters and screens which promised to be less susceptible to icing. The Air Force in addition initiated new fuel draining procedures and directed use of the driest fuel available. A new fuel booster transfer valve came under development during the same period. The B-52 accident of 1958 also speeded research on fuel additives that would prevent the formation of ice in fuel system components. The Air Force, Boeing, and fuel vendors participated in the intensified research program. Nevertheless, progress was likely to be slow. In the meantime, the only meaningful solution was to put fuel heaters in every B-52 and to do so as quickly as possible. Despite troubles encountered during the thermal shock and vibration tests of the heaters, this retrofit project proceeded according to schedule in late 1959. Concurrently, however, a new problem arose. The fuel additive program, after going on unabated, came to a sudden stop because the additives were damaging the fuel cell's inner coating. But this latest problem was resolved in due time. In October 1962, jet fuel additives had proven so successful in eliminating icing problems that SAC was disconnecting the fuel heaters on its latest B-52s (B-52Hs).

Overall Improvement 1962-1964

The B-52F, after participating in the High Stress and Big Four modification programs, was further improved. Again the improvement covered all B-52s, even the early B-52Bs. It consisted of installing the equipment necessary to detect and locate actual and incipient malfunctions in the bombing-navigation and autopilot systems. This equipment was known as MADREC, an acronym for Malfunction Detection and

Recording.[58] The requirement for MADREC had been established in 1961, and its installation was part of a long-range program. The first stage involved the B-52B, B-52C, and B-52D bombers and was completed by mid-1963. The second stage was directed at the more complicated ASQ-38 bombing-navigation system of the B-52E, B-52F, and subsequent B-52s. In essence, the program was closely associated with the Big Four package. MADREC equipment would play an important role in monitoring the Hound Dog missiles that were carried by almost every B-52, as a result of Big Four. The program neared completion by 1965.

Special Modifications 1964–1965

The revised strategy of the early sixties, calling for a greater non-nuclear retaliatory force, did not leave the B-52 untouched. In June 1964, the Air Staff approved the modification of 28 B-52Fs under a project known as South Bay. Completed in October of the same year, the modification program allowed selected B-52Fs to carry twenty-four 750-pound bombs externally—almost doubling the aircraft's original conventional bombload. In June 1965, as the tempo of activities in Southeast Asia began to escalate, Secretary of Defense McNamara requested that 46 other B-52Fs receive similar modifications. Referred to as Sun Bath, the project this time carried a 1-month deadline. Some problems arose. Multiple ejection racks, beams, kits, and supporting aerospace ground equipment were in short supply. To fulfill its many commitments, Air Force Logistics Command's Oklahoma Air Materiel Area, the project's prime coordinator, had to borrow assets from war reserve materiel and from units of the Tactical Air Command. Just the same, Sun Bath was completed 1 week ahead of schedule.

Southeast Asian Deployments 1965

The first B-52 bombers that entered the war in Southeast Asia were B-52Fs. On 18 June 1965, the initial Arc Light bombing mission was carried out from Guam by 27 B-52Fs of the 7th and 320th Bomb Wings. B-52Fs were the only SAC bombers committed to the Vietnam conflict throughout 1965. Even though all deployed B-52Fs had received ahead of time the

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[58] B-47Es were also due to be fitted with MADREC equipment.

South Bay or Sun Bath modifications to increase their bombload to 38,250 pounds, they were replaced before mid-1966 by modified B–52Ds.

Southeast Asian Losses **1965**

B–52F participation in Southeast Asian operations accounted for the loss of 2 of the planes. The 2 collided in mid-air on 18 June 1965, on their way to the first Arc Light mission.

End of Production **1958**

Production of the B–52F, the last model of the B–52 series built in Seattle, ended in November 1958. The Seattle plant, after manufacturing nearly one-half of the B–52F productions, transferred all B–52 engineering responsibility to Wichita.

Total B–52Fs Accepted **89**

The Air Force accepted 44 B–52Fs from Seattle; 45 from Wichita.

Acceptance Rates

The Air Force accepted 10 B–52Fs in FY 58 (all in June 1958), and 79 in FY 59 (between July 1958 and February 1959).

Flyaway Cost Per Production Aircraft **$6.48 million**

Airframe, $3,772,247; engines (installed), $1,787,191; electronics, $60,111; ordnance, $3,016; armament (and others), $862,839.

Average Maintenance Cost Per Flying Hour **$1,025.00**

Subsequent Model Series **B–52G**

Other Configurations None

Beginning of Phaseout 1971-1973

Although the 93d Bomb Wing retained every one of its B-52Fs, 1971 marked the beginning of the aircraft's phaseout.[59] Retired planes went to Davis-Monthan for storage. In mid-1973, the Air Force still possessed 62 B-52Fs. Thirty-six of these aircraft were in the inactive inventory. Other B-52Fs were used for training.

[59] The Air Force retired a few B-52Fs in 1967. As in the B-52E's case, these planes were retired only because they had exceeded their service life criteria.

B-52G

Manufacturer's Model 464-253

Previous Model Series B-52F

New Features

Besides an increase in gross weight (488,000 instead of 450,000 pounds), major configuration changes characterized the B-52G. A principal distinction was the "wet wing," as it was often called, which contained integral fuel tanks that significantly increased the aircraft's unrefueled range. The B-52G retained the B-52F's new J57-P-43W, but the engine's water injection system was improved in duration by the installation of a single 12,000-gallon tank in the forward fuselage. There were many other changes, some of them quite noticeable. The nose radome was enlarged, the size of the vertical fin reduced, the tail cone modified, and the ailerons eliminated. The B-52G's redesigned wings supported 700-gallon fixed external fuel tanks that replaced the 3,000-gallon auxiliary wing tanks, carried by several preceding B-52 models. While retaining the AN/ASQ-38 bombing navigational system, the B-52G featured the new AN/ASG-15 fire-control system, improved electronic countermeasures technology, a powered stability augmentation system, and emergency ejection seats for the entire crew, including the gunner who was moved to a rearward-facing seat, next to the electronic countermeasures operator.[60] Finally, in addition to its standard bombload, most B-52Gs were in production equipped to carry 2 Hound Dog missiles,[61] 1 on a pylon under each wing between the inboard

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[60] The location of the bombardier and radar navigator was unchanged. They sat forward facing behind and below pilot and co-pilot. Prior to the B-52G, B-52s and their normal crew of 6 only had 5 ejection seats, none for the gunner.

[61] The North American AGM-28 (formerly GAM-77) Hound Dog was an air-to-surface missile powered by a single Pratt & Whitney J52 turbojet. The AGM-28 was equipped with an inertial guidance system and a nuclear warhead. Launched at high altitude and supersonic speed, the AGM-28 could reach a target 500 nautical miles away; at low altitude and subsonic speed, the distance was reduced to 200 nautical miles.

nacelles and the fuselage. Four Quail decoy missiles could also be fitted in the bomb bay.[62]

Basic Development 1955–1956

The B–52G design was officially initiated in June 1956. Yet the roots of the new aircraft can be traced back to January 1955, when Convair's delta-wing B–58 appeared to be heading for trouble. The Air Force's indecision about the future of the costly, high-risk B–58 program meant that the next decade might not bring new bombers to replace or supplement SAC's B–52s. Development of a much more potent version of the original B–52, Air Research and Development Command stated, would prevent a possible technical obsolescence of the strategic force in the 1960s. As envisioned in May 1955, the new aircraft would be a B–52 fuselage with a redesigned wing, J75 engines, and a number of detailed changes. General LeMay at first was unenthusiastic about the proposal, which brought to mind the Lockheed F–84F and its many early production problems.

While conceding that the Boeing bomber should be improved "as much as possible" during production, General LeMay argued that the B–52 production schedule should not be disrupted. Although he came to favor the "super B–52" somewhat later, General LeMay noted that if "true meaningful improvement" was to result, the B–52 production schedule would inevitably be slowed down. As urgent as it seemed, the B–52G design did not start until June 1956. Delays in providing $1.2 million for Boeing to complete the necessary study was a factor; another was the Air Staff's continued concern about the B–58 and resulting procrastination in formally approving the Boeing project.

Development Engineering Inspection 16–18 June 1956

Once the Air Force finally decided to endorse the B–52 model improvement, events moved quickly. In July, the Air Staff shifted $8.8 million to the project, funds which, in any case, had been allocated to support engineering changes. In the same month, Boeing held an initial development engineering

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[62] The McDonnell ADM–20 (formerly GAM–72) Quail was a small delta-wing drone, equipped with 1 General Electric J85 turbojet engine. It had a range of several hundred nautical miles, could match the B–52's performance, and accomplish at least 2 turns and 1 speed change. It contained electronic devices that made it look like a B–52 on enemy radar scopes. The Quail was unique among air-launched missiles in that it was the only decoy missile in the United States Air Force.

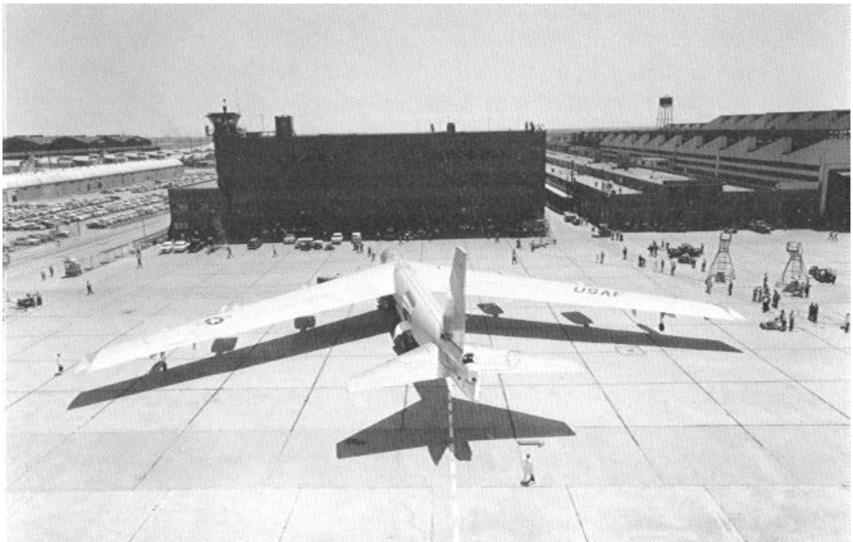
inspection at its Seattle plant. The purpose of the inspection was to determine the new configuration of the crew compartment. While the Air Force found no specific faults with the arrangements set up by Boeing, it pointed out that many questions remained unanswered. On 15 August, the contractor submitted for review a model improvement program that was more comprehensive. The Air Staff approved the revised program on 29 August, but specified that its implementation would be only on a "minimum sustaining basis" until more was known about the B-58 program. Possible forthcoming fiscal limitations were another reason for curtailing program's implementation.

Mockup Inspection — October 1956

The Air Force inspected and approved the crew compartment's mockup for the improved B-52 toward the end of October. The new configuration, based on the so-called "battle-station" concept, placed the defensive crew (the ECM operator and gunner) facing aft on the upper deck, the offensive team (bombing-navigation system operators) facing forward on the lower deck, and the pilot and co-pilot (still sitting side-by-side) facing forward on the flight deck.

Production Slowdown — 1957

The impact of unforeseen events, international as well as domestic, often played havoc with the best plans. In 1955, B-58 problems worked in favor of producing an improved B-52 (B-52G). In April 1956, the Air Force wanted the B-52 production increased to a monthly rate of 20. In December, the President set the B-52 program at 11 wings and procurement was revamped to provide a greater quantity of improved B-52s (B-52Es). Money from the next fiscal year (FY 58) would cover the procurement changes, and faster production would take place as soon as practicable. But the progress was short-lived. In early 1957, Secretary of Defense Wilson made it known that B-52 monthly production rates would be held at 15. There were several compelling reasons for the Secretary's decision. As explained by Secretary of the Air Force Quarles, progress was being made on the B-58 development, and Mr. Wilson had already indicated that the B-58 would not only merit some production effort, but would definitely get it in due time. Moreover, a slower B-52 output might give the Air Force a larger number of further improved models, this time perhaps fewer B-52Es and more B-52Fs. Other factors bearing on the decision were revised intelligence estimates, particularly the latest information on Soviet Bison and Bear bomber production



Roll-out of the first G-model Stratofortress at Boeing's Wichita plant, July 1958.

rates, which seemed to have slowed down. Those, as Mr. Quarles pointed out in Secretary Wilson's words, were "a little different, and it looked like we had more time to do an orderly job." Finally, it was Secretary Wilson's belief that "in many cases we get cheaper production by phasing it out over a longer period of time and getting more expert people to work on it." The Air Force had few grounds for argument, even though SAC pointed out that the endorsed lower production rates would delay its conversion program by almost 1 year. As expected, the decision stood.

Contractual Arrangements 1957–1959

Reflecting the evolutionary production process, preceding B–52s were acquired through contracts that covered a variety of models. As a culmination of this process as well as continued developmental efforts, the B–52G was purchased under different conditions. Three procurement contracts were issued—AF33(600)-35992, funded in FY 57; AF33(600)-34670, in FY 58, and AF33(600)-37481, in FY 59. All 3 contracts involved B–52Gs only. The first one, a cost-plus-incentive fee contract with a sliding percentage of 6 percent, was initiated by letter contract on 29 August 1957 and finalized on 15 May 1958. It purchased 53 aircraft. The second and largest one was a fixed-price-incentive-firm (FPIF) contract for 101 B–52Gs. It was started by a letter contract on 14 June 1957, and also finalized on 15 May 1958.[63] The third and last B-52G contract, begun by letter contract on 5 September 1958, was concluded on 28 April 1959. It was a straightforward fixed-price-incentive (FPI) contract for 39 aircraft.

Enters Operational Service 1959

The B-52G entered service with the 5th Bomb Wing at Travis AFB, California. The wing received its first B-52G (Serial No. 47-6478) on 13 February, one day after SAC's last B-36 bomber was retired and the command became an all-jet bomber force. In May 1959, the 42d Bomb Wing also started getting B-52Gs. By the end of June, 41 of the new bombers had been received by SAC. The early B-52Gs and 13 more could not carry the Hound Dog missiles.[64] A post-production modification, completed in 1962, accomplished necessary alterations and fitted the 54 aircraft with the equipment required to support as well as fire the new weapons.

Special Tests 1960

B-52Gs, of necessity, played an important role in the Category III testing of both the Hound Dog and Quail missiles. A B-52G crew of the 4135th Strategic Wing accomplished the first SAC launch of a Hound Dog on 29 February 1960. On 8 June, a B-52G crew of the same wing repeated the performance with a Quail decoy. By the end of 1961, a respectable supply of the new missiles—225 Hound Dogs and 400 Quails—had already reached the SAC inventory. However, although the new AGM-28 Hound Dogs had become an important part of the B-52's striking power, the missiles were still highly unreliable.[65]

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[63] The May 1958 contract, as initiated in June 1957, evolved from the President's budget of December 1956, which set the B-52 program at 11 wings and a total of 603 aircraft. The last B-52G contract, started by letter contract in September 1958, and the subsequent procurement of B-52Hs (the last model) were not part of the 11-wing program. They could be viewed as added bonuses, prompted by new dissatisfaction with the B-58 program, concurrent fiscal limitations, and the B-58's high price.

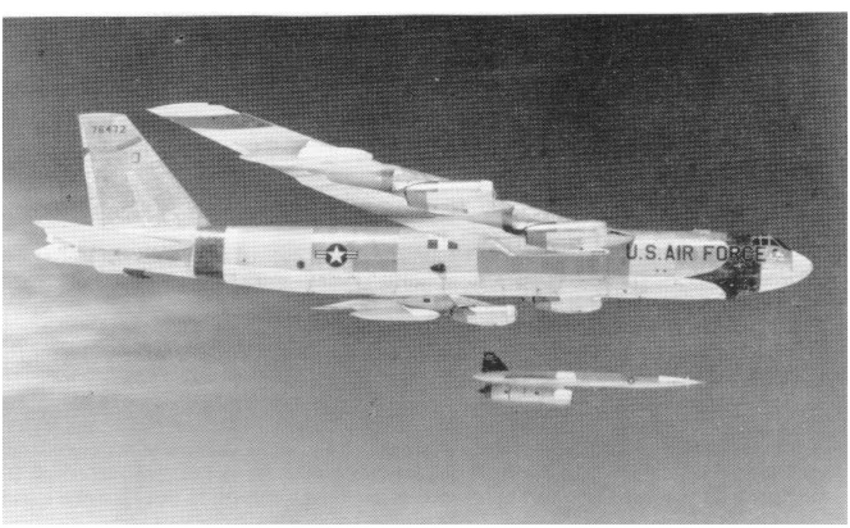
[64] Boeing could not be faulted for the omission. Because of the complexity and high cost of the Big Four modification package, refinement of the many changes under consideration consumed most of 1959. The Air Staff did not decide until the end of that year which B-52 models would be equipped, either in production or through retrofit, to carry the new missiles.

[65] In contrast, the ADM-20 Quail's performance was excellent. In 1963, all Quail decoys were modified for low-level flying. This relatively simple modification added a barometric switch for terrain avoidance and altered the missile's wiring system.

Structural Modifications **1961–1964**

Intensive structural testing, conducted by Boeing and the Air Force in 1960, again confirmed that hard usage shortened the structural life of the B–52 aircraft. The B–52Gs and B–52Hs differed significantly from predecessor models, but design changes incorporated in the new bombers made them even more susceptible to fatigue damage. Briefly stated, the changes had been made to extend the aircraft's range, which essentially meant that while the B–52G and B–52H bombers were lighter than preceding B–52s, their fuel loads had been increased. Moreover, the overall decrease in structural weight had been achieved primarily by using an aluminum alloy in the aircraft's wings. While testing did not question the intrinsic strength of the wing, it pinpointed areas of fatigue. No one could forecast accurately when the wing failures would happen, but low-level flying and the structural strains that occurred during air refueling were expected to speed up fatigue considerably.[66] The anticipated problem appeared serious enough for SAC to impose stringent flying restrictions on the new aircraft, pending approval of necessary modifications. In May 1961, the Air Staff endorsed a $219

[66] It was estimated that under fairly similar circumstances, the operating stress placed on the new wing was approximately 60 percent higher than the stress inflicted on the wing of preceding B–52s.



A GAM–77 Hound Dog missile was launched from under a B–52's wing over Eglin AFB, Florida.

million modification program for all B-52G and B-52H wing structures.[67] The program provided for Boeing to retrofit the modified wings during the airplanes' regular IRAN schedule, except for the last 18 B-52Hs, which would get their modified wings on the Wichita production lines. Started in February 1962, the program was completed by September 1964, as scheduled.

Other Structural Improvements 1964-1972

While ECP 1050 had strengthened the wings of the B-52Gs and B-52Hs by September 1964, as already noted, ECP 1128, a major engineering change proposal approved in the same year for the entire B-52 fleet, had just begun.[68] Concurrently, MADREC, a previously described improvement program that also covered most B-52s, was in progress. In addition, various modifications, addressed to specific B-52 models, were either underway or about to start. In spite of such projects, the Air Force believed that major efforts would still be required in the ensuing years to keep extending the structural life of the critically needed B-52G and B-52H bombers. Hence, the Air Staff in October 1967 approved ECP 1195, an engineering change studied by SAC since 1965. Eventually known as the B-52 Stability Augmentation and Flight Control program, the $69 million modifications installed a number of new devices in the bombers. Necessary kits, contracted for in December 1967, began reaching the Air Force in mid-1969, and their installation required 2 years. Meanwhile, ECP 1185, due to cost about $50 million and actually initiated in May 1966, had started to replace the aircraft's fuselage side skin, crown skin fasteners, and upper longerons. Completion of these latest engineering changes, accomplished as usual during the aircraft's regular IRAN schedule, was expected to ensure the structural safety of the B-52G and B-52H airframes through the 1980s.

Special Modifications 1970-1975

In line with current plants to retain the B-52Gs and B-52Hs for years

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[67] The wing structural improvement program, carried out as ECP 1050, replaced the wing box beam with a modified wing box that used thicker aluminum. It also installed stronger steel taper lock fasteners in lieu of the existing titanium fasteners; it added brackets and clamps to the wing skins, added wing panel stiffeners, and made at least a dozen other changes. Finally, a new protective coating was applied to the interior structure of the wing integral fuel tanks.

[68] Shortly before the beginning of ECP 1128, the Air Force had directed that the tail section of all B-52s be reinforced in order to withstand turbulence during low-level penetration tactics. Started in September 1963, this engineering modification (ECP 1124-2) was due to spread over several years.

to come, the Air Force in 1970 decided to equip these bombers with the Boeing-developed AGM-69A nuclear-tipped short-range attack missile (SRAM).[69] Required modifications and the addition of necessary equipment, such as wing pylons, launch gear, rotary launchers, and new avionics would be accomplished by 2 air materiel areas. Oklahoma City would modify all B-52Gs; San Antonio, all B-52Hs. This long-term, $400 million retrofit program began on 15 October 1971, when 1 B-52G entered the Oklahoma City modification center. In March 1972, a SRAM-equipped B-52G was delivered to the 42d Bomb Wing at Loring AFB, Maine. The 42d became SRAM-operational in August, the first of 19 wings programmed to acquire the versatile missiles.[70] Each modified B-52G and H bomber could carry up to 20 SRAMs, 12 externally and 8 inside the rear of the bomb bay.

Southeast Asian Deployment 1972

As SAC strove to preserve the might of its primary bombers, the war in Southeast Asia continued unabated. Since 1965, when the B-52Fs had first arrived in Southeast Asia, B-52 conventional bombing operations had increased from year to year. The purpose of the bombing was not always the same, the theaters of operation also varied, but the task always grew. B-52Gs did not enter the war before mid-1972; yet, their short-lived participation did not prove easy. On 18 December, as ordered by President Nixon, B-52Gs and the older B-52Ds began to bomb military targets in the Hanoi and Haiphong areas of North Vietnam. The bombing operation, nicknamed Linebacker II, ended on 29 December, after a Christmas pause of 24 hours.[71] In this attack on Haiphong and Hanoi, the B-52s encountered awesome defenses. In 11 days, 15 B-52s were shot down by surface-to-air missiles.

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[69] The 2,300-pound AGM-69A SRAM measured 14 feet in length and 18 inches in diameter. The internally guided, solid-propellant missile could be flown at supersonic or subsonic speeds and set to follow either a high-altitude semi-ballistic trajectory or a low-altitude profile. It could strike targets ahead of the launch aircraft or turn in flight to hit installations to the side or behind the bomber.

[70] SAC's 2 wings of FB-111As would also be equipped with the new missiles, at an estimated cost of $43 million.

[71] SAC B-52s terminated over 8 years of conventional bombing operations in Southeast Asia on 15 August 1973, when all U.S. bombing of targets in Cambodia ceased.

Southeast Asian Losses 1972

SAC lost 7 B-52Gs in Southeast Asia, all of them during 1972.[72] Six of the planes were hit by enemy surface-to-air missiles over North Vietnam, with 4 of them going down around Hanoi and the other 2 crashing in Thailand. The seventh B-52G loss was only indirectly caused by the war. The plane, after taking off from Andersen AFB, Guam, crashed into the ocean, presumably because of materiel failure.

Modernization 1972-On

Ensuring the durability of an airframe was a difficult and costly problem; a worse one, on both counts, was to cope with the enemy's technological developments. In the early seventies, many improvements in electronic countermeasures, initially limited to the Southeast Asia-committed B-52Ds, were extended to the B-52Gs and B-52Hs. These various projects centered essentially on the installation of more efficient jammers to ease the penetration of enemy defenses. One project, Rivet Rambler, was a 2-phase modification accomplished on all B-52Ds by 1971 and specifically directed against the SA-2 radars. In 1973 the Rivet Rambler modification of the B-52G and H bombers was almost completed, but the resulting improvements soon would be nearing obsolescence. Because of the experience gained in Southeast Asia, particularly as a result of the Linebacker II strikes against heavily defended targets, SAC wanted more than ever to equip the B-52Gs and B-52Hs with truly advanced ECM transmitters and jammers. An improved warning system was also needed: one that could detect threats from surface-to-air missiles, anti-aircraft artillery, and airborne interceptors. The Air Staff had already endorsed most of SAC's new requirements. Modification 2525, due to provide more efficient airborne early warning countermeasures, had been approved in June 1971; modification 2519, known as Rivet Ace and due to upgrade the aircraft's

[72] Two B-52Gs had been lost years before in highly publicized accidents. The first occurred on 17 January 1966, when a B-52G collided with a KC-135 tanker during a high-altitude refueling operation and both aircraft crashed near Palomares, Spain. The release of some radioactive material required removal of some 1,400 tons of slightly contaminated soil and vegetation to the the United States for disposal. A lost nuclear weapon, finally located by a U.S. Navy submarine about 5 miles from the shore and approximately 2,500 feet under water, was recovered intact on 7 April. Then, on 22 January 1968, a B-52G with 4 nuclear weapons aboard crashed and burned on the ice of North Star Bay, while attempting an emergency landing at nearby Thule Air Base, Greenland. An extensive clean-up operation to remove all possible traces of radioactive material was completed on 13 September.

radar warning receivers, was approved in December of the same year. However, none of these projects would start before mid-1973, and all were scheduled to take several years. There were many reasons for the implementation delays. Technical difficulties had to be worked out, unexpected requirements were likely to materialize, and new components had to be tested for quality as well as compatibility within any given avionics system. An example was Rivet Ace. Within the span of 2 short years, this fairly unsophisticated modification had become a very ambitious endeavor. In mid-1973, although the transformed modification project was about to start, serious problems remained. Components, due to be added to the aircraft's radar warning receivers, had been tested with success, but the system's new surface-to-air missile detection equipment was still defective. Meanwhile, other projects fared well. B–52s were being modified to carry the SRAM, as scheduled, even though a new modification was being done simultaneously. This additional project would give the aircraft an electro-optical viewing system, which made use of forward-looking infrared and low-light-level television sensors. The new system would make low-level flying much easier, and a B–52H, modified by the San Antonio Air Materiel Area, had already been returned to operational duty by mid-1973. Another improvement considered in mid-1973 consisted of fitting the B–52's bombing and navigation system with automated offset units. Such devices, SAC believed, would ease significantly the synchronized bombing of several targets.

End of Production 1961

B–52G production ended in early 1961. The Air Force accepted the last 2 aircraft in February.

Total B–52Gs Accepted 193

The B–52G was the major production model of the B–52 series. All 193 aircraft were built at the Wichita plant.

Acceptance Rates

Fifty B–52Gs were accepted in FY 59 (between October 1958 and June 1959); 106 in FY 60 (between July 1959 and June 1960); 37 in FY 61 (between July 1960 and February 1961).

Front view of a B-52, showing the television sensors of the new electro-optical viewing system developed to enhance low-level flight.

Flyaway Cost Per Production Aircraft — $7.69 million

Airframe, $5,351,819; engines (installed), $1,427,611; electronics, $66,374; ordnance, $6,809; armament (and others), $840,000.

Average Maintenance Cost Per Flying Hour — $1,025.00

Subsequent Model Series — B-52H

Other Configurations — None

Operational Status — Mid-1973

The Air Force in July 1973 retained 175 of 193 B-52Gs, purchased almost 15 years before. These efficient bombers were undergoing modification, with more changes to come in the future.

Record Flight 1960

On 14 December 1960, a B-52G of the 5th Bomb Wing, Travis AFB, California, completed a world record-breaking flight of 10,078.84 miles without refueling. The flight lasted 19 hours and 44 minutes. The previous closed course record, established in 1947 by a B-29, covered only 8,854 miles.

B-52H

Manufacturer's Model 264-261

Previous Model Series B-52G

New Features

The B-52H did not differ outwardly from the B-52G, except for the shape of its nacelles, slightly altered because of the new engine's larger inlets. Internally, however, there were several important changes. The B-52H featured Pratt and Whitney's 17,000-pound thrust TF-33-P-3 turbofan engines (without water injection system), new engine-driven generators, ECM equipment improved up to the state of the art, and an enhanced fire-control system—the AN/ASG-21. This new system operated a Gatling gun-type of multi-barrel cannon in a remote-controlled tail mounting for rear defense.[73] The AN/ASG-21 also controlled forward-firing penetration rocket launchers. In addition, the B-52H had better cabin arrangements for low-level penetration flights and was equipped to carry the never-to-be GAM-87 Skybolts.[74]

Configuration Planning January 1959

An outgrowth of the B-52G, the B-52H design was initiated in January 1959, 1 month before SAC received its first B-52G. Although no great innovations resulted, some airframe changes had to be made to take care of the new model's special features. The B-52H was due from the start to incorporate the TF-33 turbofan engine, a modified J57 already adopted by

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[73] The Gatling gun, the world's first practical machine gun, dated back to the Civil War. The B-52H's ultra-modern version of this 100-year-old weapon was hydraulically operated and electronically controlled. The 6-barreled gun could spew out a stream of 20-mm shells at the rate of 4,000 rounds per minute.

[74] Instead of Skybolts, the B-52Hs carried decoys and missiles identical to those of the B-52Gs.

commercial jet transports. The new aircraft was also designed to carry 4 Douglas GAM-87A Skybolts, which would be a marked improvement over previous B-52s. Had the Skybolt survived, it would have characterized the B-52H as the first manned bomber capable of serving as a flying platform for launching 2-stage solid propellant ballistic missiles with a range of 1,150 miles, fitted with nuclear warheads.

Final Procurement 1959-1962

Like the B-52Gs, the B-52Hs were bought under individual contracts. Two FPI contracts—AF33(600)-38778, funded in FY 60, and AF33(600)-41961, funded in FY 61—accounted for the entire B-52H lot. The first procurement, initiated by letter contract on 2 February 1959, was finalized the following year, on 6 May 1960. It covered 62 B-52Hs. The second B-52H contract was started by a letter contract on 28 July 1960, but was not finalized until the latter part of 1962. There were good reasons for the delay. This was the end of the B-52 procurement and the contract only purchased 40 more B-52Hs. The Air Force could not be sure this would be enough.[75]

First Flight (Prototype) 10 July 1960

The YB-52H's first flight was entirely successful. Ensuing flight tests showed that the new TF-33 turbofan engines would allow the new plane to surpass the B-52G's range. Take-off would also be improved and require about 500 feet less ground roll than the B-52G.

First Flight (Production Aircraft) 6 March 1961

The Air Force accepted the first B-52H in the same month the plane initially flew, but left it with Boeing for testing. By the end of June 1961, B-52H flight tests had confirmed that the TF-33-P-3 engines were working even better than expected. Moreover, even though the new Emerson ASG-21

[75] These were difficult times. In September 1962, an Air Force recommendation to expand the North American XB-70 program into a full-scale weapon system development was rejected by Secretary of Defense McNamara. In December, President John F. Kennedy confirmed that further development of the Skybolt, an air-to-surface ballistic missile earmarked for the B-52H, was definitely canceled.

fire-control system and the Sunstrand 120 KVA constant speed alternator drive needed perfecting, they both were tactically operable.

Enters Operational Service — Mid-1961

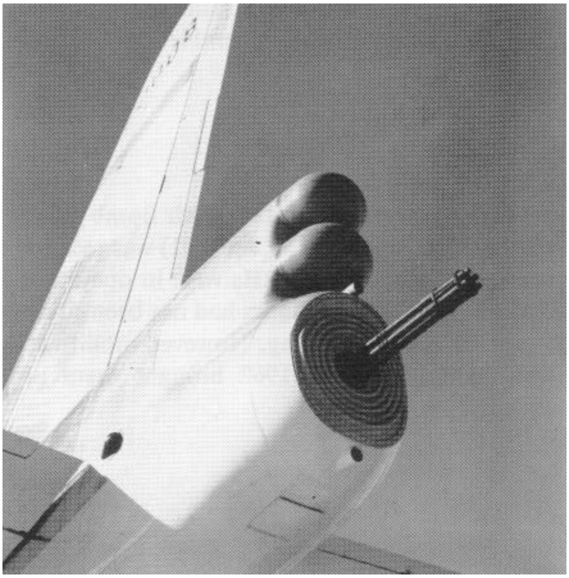
The B-52H entered operational service with the 379th Bomb Wing, at Wurtsmith AFB, Michigan. The first plane (Serial #60-001) was received by the 379th on 9 May. By the end of June, 20 B-52Hs were in operation. In contrast to all other B-52Hs, 18 of those early planes had not been equipped during production for all-weather, low-level flying. However, modifications accomplished between April and September 1962 brought them up to standard.

Engine Problems — 1961–1964

While both the B-52F and B-52G had failed to live up to original range estimates, the B-52H's new TF-33-P-3 turbofan engines gave the aircraft a better range increase than anticipated. Moreover, as indicated by recent B-52H flight tests, some of the new engine's problems appeared to be solved, and remaining malfunctions were being worked out. Yet, despite several engineering fixes, the TF-33 in late 1961 still created difficulties. Throttle creep, hang or slow start, flameout, and uneven throttle alignment were some of the most frequent troubles. In addition, the engine consumed too much oil, turbine blades failed and inlet cases often cracked. By mid-1962, even though most of these early problems had been corrected, Hot Fan, a depot maintenance and overhaul project, was underway. This $15 million modernization effort, involving the accomplishment of 35 technical orders, had 2 essential purposes. The Air Force wanted the TF-33 to be more reliable, and it did not want the engine to fail before 600 hours of operation. Curtailed by the Cuban Missile Crisis of October 1962, when all B-52s stood on alert, Hot Fan was not resumed until January 1963. However, the Oklahoma City Air Materiel Area accelerated its overhaul schedule, and although Hot Fan covered 894 TF-33 engines, the project was practically completed before the end of 1964.

Other Early Difficulties — August 1962

B-52Hs were still being assigned to SAC when a serious and ill-timed problem came to light. In August 1962, again shortly before the Cuban



The ASQ-21 Gatling gun, mounted in the B-52H's tail, provided remote-controlled defense.

A Boeing B-52H, equipped with 4 Douglas GAM Skybolt ballistic missiles.

Missile Crisis, 2 of the B-52Hs at Homestead AFB, Florida, developed cracks where wings and fuselage joined. Boeing and the Air Force focused attention on the taper lock fasteners, which under high stress and in the B-52's operational environment were susceptible to corrosion. They soon determined that the "primary contributing cause for these cracks was the use of taper lock fasteners throughout the forging." In September, Boeing came up with a repair and rework package to take care of the problem. The next month, engineers of Air Force System Command's Aeronautical Systems Division set up requirements to evaluate the impact of stress corrosion on all primary structural materials. Project Straight Pin, the modification package developed by Boeing, was not allowed to linger. Rework centers were immediately established at Moses Lake, Washington; Wichita, Kansas; and at the San Antonio Air Materiel Area's shops. There, maximum interference wing terminal fasteners were replaced with those having extremely low interference, and cracked fitting holes were "cleaned up" by oversize reaming. Although SAC suspended diversion of its airplanes to the modification centers during the Cuban Crisis, Straight Pin was virtually completed by the end of 1962.

Continued Problems 1962–1964

An older stress corrosion problem came to life again in August 1962. Two main landing gear outer cylinders failed on B-52D and B-52F aircraft, the latest in a series of similar incidents with B-52Gs and B-52Hs since the end of 1959. While SAC asked for redesigned cylinders, Air Force engineers noted that a quicker and safer alternative would be to make use of another alloy, one that would be less susceptible to stress corrosion. This gave way to a new study and test program to further investigate current and potential stress corrosion problems. Meanwhile, to prevent other incidents, anti-corrosion coating was applied to all components of the landing gear. Progress was also made to cure most of the B-52H's other early ills. By mid-1962, failure of the aircraft's Sunstrand constant speed drive was becoming a problem of the past. During the same period, a long-standing SAC requirement, only endorsed for the B-52Hs, was finally extended to all B-52s. Started in January 1963 and completed in March of the following year, this retrofit project put 2 cartridge starters in every B-52.[76] The modification was expensive, which accounted for SAC's difficulties in

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[76] The installation of cartridge starters was not simple. The aircraft's electrical system had to be modified to accommodate the new starters and new valves. In addition, duct covers had to be redesigned and nickel cadmium batteries had to be added.

getting it approved for the entire B-52 force, but it was important. Besides giving crews the means to start their engines faster, it would allow dispersed or post-strike B-52s to take off from airfields lacking certain ground support equipment, electrical power carts in particular.

Structural and Other Improvements 1964-On

As already noted, all B-52G structural modifications were extended to the B-52Hs. These aircraft were also included in the many B-52G modernization programs of the early seventies. Like the Gs, the B-52Hs were being equipped to carry the new SRAMs; they were being fitted with electro-optical viewing systems, low-light television cameras, and forward-looking infrared scanners. Finally, they were due to receive better electronics and more sophisticated components to improve both their offensive and defensive systems. A new project, initially triggered by the relatively slow start of the B-52H's TF-33 engines, was also underway. Despite the cartridge starter retrofit that had been accomplished between 1963 and 1964, SAC was still dissatisfied with the time it took for the B-52 to take off. The recently approved Quick Start project, now only concerned with the B-52G and H bombers, would make the ground alert force far less vulnerable to surprise attacks. Quick Start specifically consisted of putting a quick start device on each of the aircraft's 8 engines, thereby ensuring take-off in almost no time.

End of Production 1962

Production ended in the fall of 1962,[77] SAC receiving on 26 October the last B-52H (Serial #61-040). This plane went to the 4137th Strategic Bomb Wing at Minot AFB, North Dakota.

Total B-52Hs Accepted 102

The 102 B-52Hs accepted by the Air Force, like the B-52Gs, were built in Wichita.

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[77] This marked the end of a production run which had begun some 9 years before. Wanting to keep the production door ajar, at least for a while, the Air Force negotiated with Boeing a supplemental agreement to the final B-52H production contract—AF33(600)-41961. Signed on 17 October 1962, this $770,283 agreement ensured that Boeing, the prime contractor, would store the Wichita B-52H tooling until July 1963. Selected B-52 subcontractors, using government-owned facilities, would do the same.

Acceptance Rates

The Air Force accepted 20 B-52Hs in FY 61 (from March through June 1961); 68 in FY 62 (between July 1961 and June 1962); and 14 in FY 63 (the last 5 during October 1962).

Flyaway Cost Per Production Aircraft — $9.28 million

Airframe, $6,076,157; engines (installed), $1,640,373; electronics, $61,020; ordnance, $6,804; armament (and others), $1,501,422.

Average Maintenance Cost Per Flying Hour — $1,182.00

Subsequent Model Series — None

Other Configurations — None

Operational Status — Mid-1973

The Air Force inventory in July 1973 still counted 99 B-52Hs—against an initial contingent of 102. Like the B-52Gs, B-52Hs were undergoing modifications to extend their service-life as well as their efficiency.

Record Flights — January 1962

On 10–11 January, a B-52H of the 4136th Strategic Wing, Minot AFB, North Dakota, completed a record-breaking 12,532.28-mile unrefueled flight from Kadena Air Base, Okinawa, to Torrejon Air Base, Spain. This flight broke the old "distance in a straight line" world record of 11,235.6 miles held by the U.S. Navy's propeller-driven "Truculent Turtle." Weighing 488,000 pounds at takeoff, the B-52H flew at altitudes between 40,000 and 50,000 feet with a top speed of 662 miles per hour on the Kadena-Torrejon flight route.

June 1962

On 7 June, a B-52H of the 19th Bomb Wing, Homestead AFB, Florida, broke the world record for distance in a closed course without landing or refueling. The closed course began and ended at Seymour Johnson AFB, North Carolina, with a validated distance of 11,336.92 miles. The old record of 10,078.84 miles had been held by a B-52G of the 5th Bomb Wing since 1960.

Program Recap

The Air Force bought 744 B–52s—prototype, test, and reconnaissance configurations included. Precisely, the B–52 program counted 1 XB–52, 1 YB–52 (first flown on 15 April 1952, almost 6 months ahead of the experimental B–52), 3 B–52As (restricted to testing), 50 B–52Bs (27 of which could also be used for reconnaissance), 35 B/RB–52Cs, 170 B–52Ds, 100 B–52Es, 89 B–52Fs, 193 B–52Gs, and 102 B–52Hs. Six years of development preceded the beginning of production which, after a slow start around 1953, did not end until October 1962.

TECHNICAL AND BASIC MISSION PERFORMANCE DATA

B-52 AIRCRAFT

Manufacturer (Airframe)	Boeing Airplane Co., Seattle, Wash., and Wichita, Kans.
(Engines)	The Pratt & Whitney Aircraft Division of United Aircraft Corp., East Hartford, Conn.
Nomenclature	Strategic Heavy Bomber
Popular Name	Stratofortress

	B-52B	B-52C/D	B-52E	B-52F	B-52G	B-52H
Length/Span (ft)	156.6/185	156.5/185	156.5/185	156.5/185	157.6/185	156/185
Wing Area (sq ft)	4,000	4,000	4,000	4,000	4,000	4,000
Weights (lb)						
Empty	164,081	177,816	174,782	173,599	168,445	172,740
Combat	272,000	293,100	292,460	291,570	302,634	306,358
Takeoff[a]	420,000	450,000	450,000	450,000	488,000	488,000
Engine: Number, Rated Power per Engine, & Designation	(8) 11,400-lb st (max) J57-P-1WA	(8) 12,100-lb st (max) J57-P-19W	(8) 12,100-lb st (max) J57-P-19W or -29WA	(8) 13,750-lb st (max) J57-P-43W -WA, or -WB	(8) 13,750-lb st (max) J57-P-43WB	(8) 17,000-lb st (max) TF-33-P-3
Takeoff Ground Run (ft)						
at Seat Level[b]	8,200	8,000	8,000	7,000	8,150	7,420
Over 50-ft Obstacle	10,500	10,300	10,300	9,100	10,400	9,580
Rate of Climb (fpm) at Sea Level	2,110	2,225	2,225	2,300	2,150	3,000
Combat Rate of Climb[c] (fpm) at Sea Level	4,760	5,125	5,125	5,600	5,450	6,270
Service Ceiling at Combat Weight (100 fpm Rate of Climb to Altitude)	47,300	46,200	46,200	46,700	47,000	47,700

Combat Ceiling[c] (ft) (500 fpm Rate of Climb to Altitude)	46,550	45,800	45,800	46,000	46,000	46,200
Average Cruise Speed (kn)	453	453	453	453	453	453
Max Speed at Optimum[a c] Altitude (kn/ft)	546/19,800	551/20,200	551/20,200	553/21,000	551/20,800	547/23,800
Combat Radius (nm)	3,110	3,012	3,027	3,163	3,550	4,176
Total Mission Time (hr)	13.50	13.22	13.27	14.03	15.7	17.50
Armament	4 20-mm M24A1s or 4 50-mm M-3s	4 50-mm M-3 guns	4 50-mm M-3 guns	4 .50-cal M-3 guns	4 .50-cal M-3 guns	1 20-mm M-61 gun
Crew	6	6	6	6	6	6
Max Bombload (lb)	43,000[d]	50,000[e]	50,000[e]	50,000[e]	50,000[f]	50,000[f]

Abbreviations

cal = caliber
fpm = feet per minute
kn = knots
max = maximum
nm = nautical miles
st = static thrust

[a] Limited by structure.

[b] Takeoff power, i.e., maximum power of an airplane's engine or engines available for takeoff.

[c] Military power, i.e., maximum power or thrust specified for an engine by the manufacturer or by the Air Force as allowable in flight under specified operating conditions for periods of 30 minutes duration.

[d] Or 1 MK-6 and 2 MK-21 special weapons.

[e] For example, 27 1,000-lb bombs, 4 1,200-lb ADM-20 Quails, and 2 10,000-lb AGM-28 Hound Dog missiles, or MK-28, MK-41, MK-53, and MK-57 special weapons.

[f] For example, 27 1,000-lb bombs, 4 1,200-lb ADM-20 Quails, 2 10,000-lb AGM-28 Hound Dogs or up to 20 2,200-lb AGM-69A SRAM missiles. Bombload could also consist of MK-28, MD-41, MK-53, and MK-57 special weapons.

BASIC MISSION NOTE

All basic mission's performance data are based on maximum power, except as otherwise indicated.

Combat Radius Formula:

B–52B, B–52C, B–52D, and B–52E: Took off and climbed on course to optimum cruise altitude at normal power. Cruised out at long-range speed, increasing altitudes with decreasing weight (external tanks being dropped when empty). Climbed to reach cruise ceiling 15 minutes from target. Ran-in to target at normal power, dropped bombs, conducted 2-minute evasive action and 8-minute escape at normal power. Cruised back to base at long-range speed and optimum altitudes (as an alternate, a 45,000-foot ceiling could be maintained on the return leg with no radius penalty). Range-free allowances included fuel for 5 minutes at normal power for take-off allowance, fuel for 2 minutes at normal power for evasive action, and fuel for 30 minutes maximum endurance at sea level plus 5 per cent of the initial fuel load for landing reserve (the landing reserve range at optimum speed and altitude).

B–52F, B–52G, and B–52H: Took off and climbed on course to optimum cruise altitude at normal power. Cruised out at long-range speed (the long-range speed being maximum speed for 99 percent maximum miles per pound of fuel), increasing altitude with decreasing weight (external tanks being dropped when empty). Climbed to reach cruise ceiling 15 minutes from target. Ran-in to target at normal power, dropped bombs, conducted 2-minute evasive action and 8-minute escape at normal power. Cruised back to home base at long-range speeds, increasing altitude with decreasing airplane weight. Range-free allowances included 5-minute normal-power fuel consumption for starting engines and takeoff, 2-minute normal-power fuel consumption at combat altitude for evasive action, and 30 minutes of maximum endurance (4 engines) fuel consumption at sea level plus 5 percent of initial fuel for landing reserve. The prescribed fuel reserve for the basic mission was equivalent to the following reserve range at best range conditions: B–52F, 810 nautical miles; B–52G, 808 nautical miles (884 nautical miles, Alternate in-Flight); B–52H, 974 nautical miles (1,060 nautical miles, Alternate in-Flight).