

Air and Space this Week

Item of the Week

THE DASH-80

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World War II required capable long-distance cargo planes to support far-flung military operations, and both Douglas and Boeing were big players in producing them. After the War, both companies, and others, realized that a civilian version of wartime cargo aircraft could be very profitable. In the early 1950's, jet propulsion's advantages over piston and turbo-prop engines showed first military planners, then commercial companies, that jet aircraft were the true future for commercial aviation. Some of the existing airframe designs were robust enough to be used as a basis for new jet designs, others weren't and were discontinued.

Boeing invested heavily in designing and building aircraft that could support the needs of changing military aviation in the early 1950's. The B-29 was a fine airplane, but Korea showed it to be too slow for upcoming needs. Boeing designers went to work, and the first B-52 prototype flew in April, 1952.

Jet engines used much more fuel than piston engines; the B-52 and other jet bombers of the future would require tankers capable of refueling bombers in flight. Long-range military operations would require more airlift support than the C-46 and C-47 cargo planes could provide. Even second-generation cargo aircraft like Boeing's C-97, built from the design of the B-29 and B-50 bombers, would not be sufficient for future needs.

BOEING ROLLS THE DICE

Boeing aircraft designers went to work on a jet-powered cargo aircraft even before the B-52 contract was secured. The company invested heavily in their endeavor (\$16M), designing and building a prototype airframe and engines that could be turned into a tanker or straight cargo aircraft. The effort was enormous; the design went through a total of 80 variations before the prototype was built (at least that's what the marketing department said).

The general idea was to start with the B-29 airframe, add a second deck, and then use the more-powerful B-50 engines (Pratt & Whitney 4360s). Almost 1000 of the resulting C-97 Stratofreighters was built. The basic design was successful, resulting in the [C-97 cargo plane](#) that served through the Vietnam War and were used for SAC command planes. But the design of its engines had reached diminishing returns; a jet version was needed, and pronto.

The Boeing program for a jet cargo/tanker began on May 20, 1952. The C-47 design was used as a base. The 35° swept wings of the B-47 and B-52 were added, along with advanced ailerons

and four Pratt & Whitney JT3 engines, each producing 10,000 pounds of thrust. The aircraft no longer had a close resemblance to a C-47, but they stuck with a designation of Model 367-80 for security reasons. It was referred to as the “Dash-80” for short.

Boeing was not the only aircraft company that was trying to develop jet cargo/tanker aircraft.

THE DASH-80’S FIRST FLIGHT

The first flight of the *Dash-80* was made 69 years ago this week, on July 15, 1954, the 34th anniversary of the Boeing’s founding. The Air Force was greatly impressed by its 3500-mile range and freight capacity. They asked for a few minor modifications, including a widening of the cabin by one foot, and then ordered 29 airplanes, which they designated as the KC-135A., to be used for aerial refueling. The aircraft was so successful that 732 would be built, and after two rounds of engine upgrades, it is ***still in service today.***

[One of the perks I enjoyed when I was on the faculty of the University of North Dakota, where we taught at both Minot and Grand Forks Air Force Bases, was that I got to fly on a KC-135 training mission. We didn’t have a full load of fuel, and the plane’s performance was amazing (this was after its first round of engine upgrade, and its thrust to weight ratio when empty was impressive, indeed). Two B-52s were assigned to our flight. Our refueling boom operator was undergoing a check flight that day, and I could watch over his shoulder. It was amazing to see an aircraft as large as the B-52 so close that I could recognize its pilots on the street later if I saw them. The boomer was a young kid, but a very, very talented operator. The old-timer checking him out was grudgingly impressed, then spent most of the rest of the flight showing him some tips and bending his ear with yarns, some of which might have been true.]

ENTER TEX JOHNSTON

Boeing had a winner on its hands, but it needed to demonstrate its excellence to the burgeoning airline industry. Everyone had heard that Boeing had an amazing jet, but hearing and seeing for oneself are two different things. One of the concerns of the day was the airframe: Was it strong enough to handle the weight of cargo and the power of its engines? Another concern was the stability of such a large, powerful, aircraft.

Seattle, the home of Boeing, also held a major Gold Cup hydroplane race every year that attracted a lot of enthusiasts. The 1955 event, held on Lake Washington, would be Boeing’s great opportunity to show off the *Dash-80*. Boeing invited a lot of airline executives to the event to witness a fly-by of the Dash 80, flown by test pilot Alvin “Tex” Johnston. His penchant for wearing cowboy boots and a Stetson had on the flight line made his nickname a natural. Tex also recognized the need to demonstrate the new plane effectively...

Tex, like so many of his generation, had fallen in love with aviation at an early age. When he was 11, a barnstormer landed near his family’s farm, and Tex wrangled a ride. He was so smitten he took money from his newspaper route, bought a wrecked glider, fixed it up, and got his dad to tow it behind the family car. Tex would get the glider aloft, then cut loose and

practice landing in the adjacent field. He was 15 years old. After high school, he trained to be an aircraft mechanic, and after that, he joined Inman's Flying Circus, working as both mechanic and pilot. He would become a civilian instructor for the U.S. Army Air Corps Civilian Flight Training Program in 1939, and spent WWII in the USAAC Ferry Command, based in Dallas. The War was a year old when Tex was offered a job with Bell Aircraft as a test pilot, working on the P-39 Airacobra, the P-63 Kingcobra, and the XP-59 [Airacomet](#).

After WWII, Tex convinced Larry Bell to take two surplus Airacobras and modify them for air racing, to promote Bell aircraft. Tex's flight test boss, Jack Woolams, would fly *Cobra 1*, and Tex would fly *Cobra 2* in the upcoming National Air Race. The day before the race, Woolams was killed when his canopy failed, but Tex knew that Jack would have wanted him to race, so he did. Tex's crew worked all night to make *Cobra 2's* canopy stronger and other safety-related modifications, and Tex won, setting a race speed record in the process. His victory and speed record would win him the prestigious Thompson Trophy for 1946.

Tex helped Bell design the rocket-propelled *X-1* aircraft. He flew it to Mach 0.72 on May 22, 1947, then worked with the design team to modify the *X-1's* trim controls, which did not operate correctly at high speed. Later that year, Chuck Yeager broke the "sound barrier" in that particular aircraft, now in the collection of the National Air and Space Museum.

Tex continued his flight test career by switching over to Boeing in July, 1948. He flew the B-47 Stratojet and piloted the first flight of the Boeing B-52 prototype.

With accomplishments like these, there was no doubting Tex's skill and daring. He was the perfect choice for the demonstration of the *Dash-80*. A good thing, for Boeing was very heavily-invested in the future of the *Dash-80*, and there was only the one prototype. A LOT was on the line.

THE BIG DAY FOR BOEING

August 7, 1955, dawned bright and clear. The hydroplane races were going well, and Boeing's CEO, Bill Allen, was delighted to have so many airline people attending aboard his personal yacht.

The *Dash-80* approached the race course, and to the astonishment of all present, Tex put Boeing's huge prototype into a barrel-roll as he flew by, pull up into a tight chandelle to reverse course, and do a second barrel-roll coming back!

Bill Allen had no idea that Tex would perform such radical maneuvers with Boeing's big investment. After the initial shock (and likely a quick change of linen), Allen received rave reviews from his guests. Any doubt about the *Dash-80's* airframe and its airworthiness had instantly vanished, but Allen was still very upset.

Tex was summoned into Allen's office the very next day. Allen intended to call him on the carpet, asking pointedly (and likely more graphically than generally-reported) what Tex thought he was doing with Boeing's only prototype. Tex looked him in the eye and said, "I was selling airplanes." Allen could take no adverse action, but he was very angry and refused to discuss

the barrel roll for years. At his retirement dinner years later, he was presented with a famous photo taken from one of the *Dash-80*'s windows while upside-down. No record is left of his reaction, likely adverse, but when he left the retirement dinner, he left the photo behind.

Let's review. Tex had confidence enough in the *Dash-80* and Boeing to put his very life on the line to prove the plane's value. Bill Allen, not so much.

BOEING 707

The *Dash-80* had a number of innovations that would find a home in commercial aviation. For example, Boeing used the same engine-mounting type that they pioneered with the B-47, encasing the jet engines separately in a nacelle suspended from the aircraft wing on a pylon. The nacelles could be opened up to service the engine without removing it from the aircraft, and engines mounted that way would be safer in a crash situation. Another innovation came from Boeing's desire to operate the *Dash-80* from non-military airports, which typically had runways shorter than the military airports that served the jets of the day. Some big military aircraft also were equipped with parachutes to help them slow down after landing, a tactic impractical for a busy civilian airport. So Boeing engineers came up with the thrust reverser, a mechanism that redirected engine thrust forward to help slow the aircraft. Thrust reversers are still in common use today.

There were still a few bugs to be worked out of the *Dash-80* design before it could enter commercial service. Perhaps the worst was the *Dash-80*'s landing gear. It was a new version of the tricycle set-up used by most large aircraft, except perhaps the DC-3. During a series of taxi tests run the day before the roll-out was scheduled, the left main landing gear collapsed. It was designed to break-away from the plane in a crash situation, without damaging the wing or fuel tanks, but it *collapsed*. Not good. Engineers quickly patched the *Dash-80*'s dings and beefed up the main landing gear. A month later, Tex had been testing the brakes with a series of fast taxiing and hard stops, then taking off for high altitude, to see how the brake mechanism handled the temperature changes involved. The heating was sufficient to boil the hydraulic fluid in the brake lines, which were equipped with sensors that would close off the lines in case the line broke, so that all the hydraulic fluid would not be lost. The valves closed properly, depriving Tex of brakes when he landed. He had no choice but to swerve the *Dash-80* off the runway into what he hoped was a softer median that would provide sufficient slowing action. His tactic worked well, until the nose gear was sheared off when it hit an unseen concrete block in the taller grass. It took three days to fix the nose gear, and re-design the check valves and sensors to prevent a repeat.

Large aircraft of the day were prone to skids on runways (the value of grooved pavement in preventing hydroplaning would be invented by NASA in the coming decades, saving many lives). The *Dash-80* was equipped with a new kind of anti-skid brake pads, and Tex took it on a few test ground runs to try them out. They worked fine, without fading, even though they got rather hot during the tests. Tex then took off, and left the gear down for 15 minutes to cool the brakes. It wasn't enough; when Tex retracted the gear, a series of bangs soon followed,

accompanied by a lot of acrid smoke and the smell of burning rubber. Tex quickly lowered the gear, letting the air stream blow out his burning tires. Braking upon landing wasn't a problem for this particular flight; half of the *Dash-80*'s ten tires were flat!

Another problem to be solved before starting commercial production involved the new-fangled thrust reversers. During a test involving a series of landings, a hydraulic line to one of the engine thrust reversers broke, spewing hydraulic fluid onto the hot brakes below. The resulting blaze brought out the fire crew as Tex and company abandoned ship. But the repair was easy, and the long-term solution was to use a less-flammable hydraulic fluid in all of the *Dash-80*'s hydraulics.

The final problem requiring solution prior to commercial construction was more serious than those mentioned above. Tex and the two other test pilots for the *Dash-80* knew that the design of the plane's tail needed some work. Under some circumstances, the tail would suffer "flutter," and under some circumstances, there was a mild tendency for the aircraft to suffer from a "Dutch roll." [Remember the opening sequence to *The Six Million Dollar Man* TV show? Steve Austin's plane was wobbling on its roll axis prior to its crash – a perfect example of a Dutch roll. The aircraft was actually the *M2-F2* lifting body, piloted by Bruce Peterson; more on that [here](#).]

Tex did the barrel rolls anyway. Oh, and by the way, he had rolled the aircraft a few times before the Big Day, so his confidence was backed by experience.

Fixing the tail's problems was more complex than fixing brakes and landing gear. It required making the tail fin larger (more like the B-52's), rearranging the fin's internal structure, and adding an electronic yaw dampener and a hydraulically-boosted rudder mechanism. After that, the *Dash-80* design was good to go.

I suspect that one of the reasons that Tex was willing to roll the aircraft so publicly was that he wanted to counter in advance any rumor by Boeing's competition that the *Dash-80* had stability problems, and was therefore unsafe for commercial traffic (after all, if the three test pilots knew there was a problem with the tail, they probably weren't the only ones to know about it).

One last change made the aircraft even more attractive to civilian airline companies. The Air Force had once requested the fuselage be widened slightly, and now the airline companies suggested another small expansion of the fuselage's width – it would allow an additional seat in each row, without making the aircraft much more costly, a big improvement in potential profits!

Boeing made one more demonstration of the capabilities of the *Dash-80* in 1957, setting a trans-continental speed record of 612 MPH, as if it were needed to help against the competition.

The aircraft was put into production as the Boeing 707, and orders would soon come pouring in. The 707 entered commercial service on December 20, 1957. It would dominate the commercial market for years. Boeing would sell 701 B707s and another 154 of its first variant,

the B720. Add in the military versions, and Boeing sold 1010 aircraft. The B707 design and its success led to the production of the many subsequent “7X7” aircraft now in use today.

[I enjoyed watching how visitors reacted to various aircraft and equipment at NASM when I was working. I found that I could often tell a person’s profession or primary interest by noting which objects that gravitated to. For some, it was Apollo artifacts; for mechanics, it was the aircraft engine and tool collection; but for those who had been involved in the management of commercial aviation, they would always make an awe-filled first-stop at the *Dash-80*!]

AFTER THE ROLLS

The *Dash-80* was used as a test bed until 1970. Some of the modifications of that time led to the Boeing 727, and others were used to test the design of wing slats (needed for extra lift at low speeds) and to otherwise explore the lower-speed portion of the *Dash-80*’s flight envelope. Boeing returned the *Dash-80* to its (nearly) original condition, at least externally, then flew it on a re-enactment of its record-setting cross-country flight to D.C., where it was turned over to the Smithsonian National Air and Space Museum.

Tex Johnston’s next Boeing project was Assistant Project Manager for the X-20 Dyna-Soar program, the Air Force’s plan for a manned Space station, that never came to fruition (‘twas tough for a Congressperson to support a “dyna-soar!”). He then became the manager of the Boeing Atlantic Test Center at Cape Canaveral, working on the Minuteman missile system and the Lunar Orbiter program. He left Boeing in 1968, formed his own company, while continuing to work with other companies. One of those was Aero Spacelines, the makers of the “Guppy” line of modified Boeing 377 Stratofortresses, including the *Pregnant Guppy*, built specifically to transport very large but relatively-light rocket components for NASA. His final job was Chief Pilot for Stanley Aviation, where his main effort was on ejection seats and other escape systems.

What a career! Tex was inducted into the National Aviation Hall of Fame in 1993. He was one of the guys with “the Right Stuff,” and his stereotypical Texan mannerisms and maverick courage is said by many to be the inspiration for Stanley Kubrick’s creation of the Slim Pickens’ classic character, Major T.J. “King” Kong, who rode a hydrogen bomb to Armageddon in *Dr. Strangelove*! [What a scene that was! YouTube [here](#).]

CODA

There is an old saying among top pilots that “there are old pilots, and there are bold pilots, but there are no old, bold pilots!” Tex was one of the guys to provide a counter-example to the saying. His boldness was never in doubt, and he lived to be 84, passing on October 9, 1998.

[And Buz, my good friend, you and your SR-71 colleagues are disproving the saying, too!]

REFERENCES

The *Dash-80* is now on prominent display at the Smithsonian National Air and Space Museum's Steven F. Udvar-Hazy Center: https://airandspace.si.edu/collection-objects/boeing-367-80-jet-transport/nasm_A19730272000

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Tex Johnston entry in the National Aviation Hall of Fame:
<https://nationalaviation.org/enshrinee/alvin-tex-johnston>

Boeing's 707/727 webpage: <https://www.boeing.com/history/products/707.page>

Wikipedia: https://en.wikipedia.org/wiki/Boeing_707

Tex rolls the *Dash-80* on YouTube, followed by a Pan Am Boeing 707 Promo film from 1959:
https://www.youtube.com/watch?v=3IV9PZW1N9U&ab_channel=jetdriven

More YouTube views (and I bet you can surf up many others):
https://www.youtube.com/watch?v=AaA7kPfC5Hk&ab_channel=AviationExplorer

Seattle Times story (2/29/1990) about the Roll [here](#).

Info on Bill Allen: Not worth the effort.

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