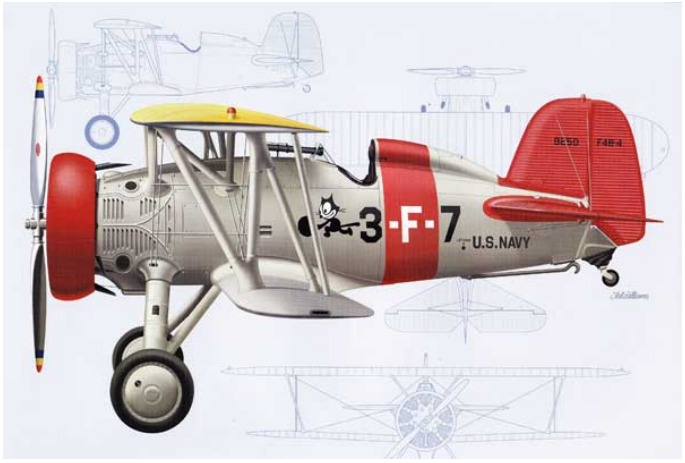
an important lesson learnt . .

Boeing 299

In the summer of 1934 the U.S. Army Air Corps circulated a proposal for a new long-range bomber to replace the B-10. Prospective builders were instructed to have “multi-engined” aircraft ready for a flying competition in October 1935. The candidate aircraft were to be capable of flying at least 1,020 miles and preferably 2,200. It had to be able to carry a 2,000-pound bomb load. Also, it had to be able to reach a speed of at least 200 mph, though 250 mph was considered desirable.



P-12/F4B

Boeing had a reputation for building biplane pursuit aircraft such as the P-12/F4B for the US Army Air Corps and the US Navy and, just a few years later, producing one of the first of the modern airliners, the Model 247. This was a sleek and fast twin engined aircraft, but in response to the US Army Air Corps proposal Boeing designers decided to push the boat out and propose something radically different.
They realized that any design with two engines would offer only marginally better performance over the B-10 it was supposed to replace. Some successful civilian designs at the time (the Fokker and Ford trimotors) incorporated three engines - with one in the nose of the aircraft as well as one under each wing. However, the need for defensive armament and a bombardier in the nose of the aircraft made this option infeasible. Boeing designers therefore wondered if the multi-engined reference in the Air Corps specification could mean four engines. Discreetly, they asked Air Corps officials for an interpretation and were told that a four-engine bomber was indeed acceptable if it met all performance criteria.
Given the competitive nature of the aircraft industry, Boeing engineers worked on what they termed “Model 299” in total secrecy. By late July 1935, the new aircraft was ready for its maiden flight. All went smoothly. When the test pilot, Leslie Tower, was asked how the big airplane handled, he replied dryly: “Just like a little ship, only a little bigger.”

The Model 299 was made of an aluminium alloy. Like other designs of the time, it had enclosed cock-pits, cowled engines, and retractable landing gear. It also had wing flaps for better performance at slow airspeeds, electric trim tabs on its control surfaces for improved handling characteristics, a hydraulically operated constant-speed propeller, and “blister” positions on the fuselage for defensive machine-gun posts.

Boeing model 299 cockpit

fly-off at Wright Field

After a short period of testing at the factory in Seattle, the 299 was readied for delivery to Wright Field, Ohio, for the competition. On Aug. 20, 1935, the 299, powered by four 750 horsepower Pratt & Whitney "Hornet" engines, made the nonstop flight from Seattle to Dayton - 2,100 miles - in nine hours and three minutes. That worked out to an average airspeed of 232 mph, remarkable for the time. This performance, coupled with the 299's size, weight, armament, design, and four-engine safety, created a sensation, and Air Corps officials looked on the aircraft with awe.

There were other competitors at Wright Field that day. The Martin design was little more than an up- graded B-10. Douglas had modified its highly successful commercial air-liner, the DC-2, and converted it into a bomber, the DB-1. The Martin and Douglas entries were good designs, but Boeing's 299 was in a class by itself. It could carry some five tons of bombs depending on the fuel load, far more than its two-engine competitors, and the 299 carried its load higher, faster, and nearly twice as far. It appeared that the flying competition was over before it had even begun.
Boeing's entry had swept all the evaluations, figuratively flying circles around the competition. Many considered these final evaluations mere formalities - talk was of an order for between 185 and 220 aircraft. Boeing executives were excited - a major sale would save the company.

On Oct. 30, 1935, the Fortress prototype taxied out for take-off. At the controls was the Air Corps' chief test pilot, Major Ployer P. Hill (his first time flying the 299) and Lieutenant Donald Putt (the primary army pilot for the previous evaluation flights).
Also in the cockpit was Boeing test pilot Les "Cowboy" Tower. In the back were Boeing mechanic C.W. Benton, and Pratt and Whitney representative Henry Igo.

The aircraft roared down the run-way and took off. It then climbed very steeply - too steeply. It rose to an altitude of about 300 feet, where it stalled, rolled to the side, crashed back onto the airfield, and exploded.
Putt, Benton and Igo escaped with burns, while Hill and Tower were pulled from the wreckage alive, but later died from their injuries.

Tower, who had been standing behind the pilots as an observer, blamed himself for the accident. Though he did not seem to be seriously injured, he died not long afterward.

Investigators determined that the Fortress had crashed because the elevator and rudder controls were locked - the pilot could not lower the nose, so the aircraft quickly stalled. Ironically, the elevator locks had only been recently installed as a safety feature, to protect the control surfaces from moving about on the ground and being damaged during high winds.
The locking mechanism was controlled from inside the cockpit, but no one remembered to disengage it before take-off. Tower apparently noticed that the control lock was still engaged as the aircraft moved up to stall, but was unable to get to it in time to prevent a crash. More familiar with the 299 than anyone else, this oversight on his part is why he blamed himself for the disaster.
Because the Boeing prototype had crashed, the Corps declared the winner to be the Douglas DB-1—later designated the B-18 Bolo. The crash prompted a new consideration, however, and the realization that modern planes were simply too complex to operate safely, even by two of the best test pilots in the world. Something would have to be done.

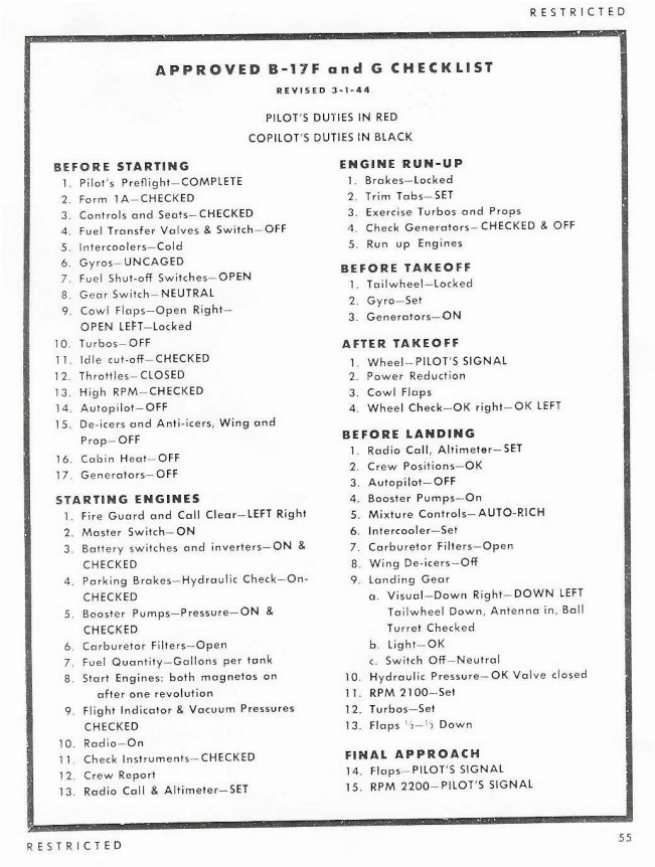
simply too complicated

Just twelve of those Boeing aircraft were delivered to the 2nd Bombardment Group at Langley Field, Virginia, by August, 1937 a far cry from the contract for 220 aircraft Boeing had anticipated.
The 2nd Group's operations were closely watched by Boeing, Congress, and the War Department. Any further accidents or incidents with the Model 299 would end its career. Commanders made this quite clear to all the crews.

the checklist

The pilots sat down and put their heads together. What was needed was some way of making sure that everything was done; that nothing was overlooked. What resulted was a pilot's checklist. Actually, four checklists were developed - take off, flight, before landing, and after landing. The Model 299 was not 'too much airplane for one man to fly', it was simply too complex for any one man's memory. These checklists for the pilot and co-pilot made sure that nothing was forgotten.

With the checklists, careful planning, and rigorous training, the twelve aircraft managed to fly 1.8 million miles without a serious accident. The U.S. Army accepted the Model 299, and eventually ordered 12,731 of the aircraft they numbered the B-17.



RESTRICTED

APPROVED B-17F and G CHECKLIST

REVISED 3-1-44

PILOT'S DUTIES IN RED
COPILOT'S DUTIES IN BLACK

BEFORE STARTING
1. Pilot's Preflight—COMPLETE
2. Form 1A—CHECKED
3. Controls and Seats—CHECKED
4. Fuel Transfer Valves & Switch—OFF
5. Intercoolers—Cold
6. Gyros—UNCAGED
7. Fuel Shut-off Switches—OPEN
8. Gear Switch—NEUTRAL
9. Cowl Flaps—Open Right—OPEN LEFT—Locked
10. Turbos—OFF
11. Idle cut-off—CHECKED
12. Throttles—CLOSED
13. High RPM—CHECKED
14. Autopilot—OFF
15. De-icers and Anti-icers, Wing and Prop—OFF
16. Cabin Heat—OFF
17. Generators—OFF

STARTING ENGINES
1. Fire Guard and Call Clear—LEFT Right
2. Master Switch—ON
3. Battery switches and inverters—ON & CHECKED
4. Parking Brakes—Hydraulic Check—On-CHECKED
5. Booster Pumps—Pressure—ON & CHECKED
6. Carburetor Filters—Open
7. Fuel Quantity—Gallons per tank
8. Start Engines: both magnetos on after one revolution
9. Flight Indicator & Vacuum Pressures CHECKED
10. Radio—On
11. Check Instruments—CHECKED
12. Crew Report
13. Radio Call & Altimeter—SET

ENGINE RUN-UP
1. Brakes—Locked
2. Trim Tabs—SET
3. Exercise Turbos and Props
4. Check Generators—CHECKED & OFF
5. Run up Engines

BEFORE TAKEOFF
1. Tailwheel—Locked
2. Gyro—Set
3. Generators—ON

AFTER TAKEOFF
1. Wheel—PILOT'S SIGNAL
2. Power Reduction
3. Cowl Flaps
4. Wheel Check—OK right—OK LEFT

BEFORE LANDING
1. Radio Call, Altimeter—SET
2. Crew Positions—OK
3. Autopilot—OFF
4. Booster Pumps—On
5. Mixture Controls—AUTO-RICH
6. Intercooler—Set
7. Carburetor Filters—Open
8. Wing De-icers—Off
9. Landing Gear
   a. Visual—Down Right—DOWN LEFT Tailwheel Down, Antenna in, Ball Turret Checked
   b. Light—OK
   c. Switch Off—Neutral
10. Hydraulic Pressure—OK Valve closed
11. RPM 2100—Set
12. Turbos—Set
13. Flaps ½—⅓ Down

FINAL APPROACH
14. Flaps—PILOT'S SIGNAL
15. RPM 2200—PILOT'S SIGNAL

RESTRICTED

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The idea of the pilot's checklist caught on. Other checklists were developed for other crew members. Checklists were developed for other aircraft in the Air Corps inventory.

The idea for this piece came from reading 'The Checklist Manifesto: How to get things right' by Atul Gawande and draws on Wikipedia and various articles on the interweb.