Push-Pull Aircrafts

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Adam A500

A500

Adam A500 during flight test at the Mojave Spaceport

Role	civil utility aircraft
Manufacturer	Adam Aircraft Industries
First flight	July 11, 2002
Status	Production completed
Number built	7
Developed into	Adam A700

M-309 on display at Wings Over the Rockies Museum(May 2007).

Adam A500 during flight test at the Mojave Spaceport

Adam A500

M-309 CarbonAero technology demonstrator at Mojave

The **Adam A500** is a six-seat civil utility aircraft that was produced by Adam Aircraft Industries. The aircraft is of pod-and-boom, push-pull configuration with its two Continental TSIO-550-E piston engines mounted to provide centerline thrust.

Adam Aircraft ceased operations on 11 February 2008, and filed for Chapter 7 bankruptcy on 19 February 2008, having delivered seven A500s.

In April 2008 Adam Aircraft was purchased from bankruptcy by AAI Acquisition Inc. At the time of purchase this new company indicated that they would pursue certification of the A700 jet as a priority and that the A500 would not be produced due to the continuing poor market for piston-engined aircraft. AAI went out of business in April 2009 without producing any aircraft.

In July 2009 there was an indication that a new buyer, Triton America and Thomas Hsueh were interested in purchasing the A500 design and returning the aircraft to production.

M-309

The A500 was developed from the **M-309 CarbonAero** technology demonstrator designed by Burt Rutan and built by Scaled Composites at the Mojave Airport. The "309" designation refers to this being Rutan's 309th aircraft design. The 309 first flew in March 2000, but the aircraft has since been gutted and was used as a static display outside the

Adam Aircraft Industries headquarters. In 2006 the 309 was loaned to the Wings Over the Rockies Air and Space Museum and is now on display outside.

Description

Compared to conventional twin-engine installations, the centerline thrust arrangement reduces drag and maximizes the controllability of the aircraft should one engine malfunction or fail. This engine configuration was used by the similar Cessna Skymaster. The A500 airframe is largely built of carbon epoxy skins composite materials with Nomex honeycomb core. Other features include cabin pressurization.

The prototype A500 first flew on July 11, 2002 and was FAA certified in May 2005.

A500 payload issues

In evaluation flights conducted in 2007 the A500 was noted as being over the projected empty weight by 1,260 lb (570 kg) or 30%.

The initial design empty weight publicized in 2003 was 4,200 lb (1,910 kg), while the actual empty weight of the serial number 7 A500 was 5,460 lb (2,480 kg). Initial gross weight was to be 6,300 lb (2,860 kg), which was increased to 7,000 lb (3,180 kg). This resulted in a change of useful load from a forecast 2,100 to 1,540 lb (950 to 700 kg).

With the 230 US gal (870 l) fuel tanks full, the available payload for crew, passengers and baggage is 160 lb (73 kg), down from a projected 720 lb (327 kg). This means that the A500 cannot carry full fuel and one standard weight adult male or female pilot.

Adam Aircraft had intended to address the lack of useful load by demonstrating that the current 30 US gal (110 l) of unusable fuel is actually 10 US gal (40 l). This would have increased the useful load by 120 lb (50 kg) and allowed a full fuel crew weight of 280 lb (127 kg).

Support and aircraft type club formation

The five A500s in private service have run into problems obtaining parts and at least one was reported as grounded due to parts issues in August 2008.

The aircraft owners organized an aircraft type club, the *A500 Owners Association*, with the goal of convincing the new owners of the design at that time, AAI Acquisitions to provide parts support for the existing aircraft.

AAI's head of customer support, Jan D'Angelo, responded in August 2008, saying:

> “ There's no economic model that justifies setting up a support team to support just five planes in the field. There's no critical mass to make it economically ”

viable.

A600 Turboprop Derivative

Discussion of an A600 Turboprop derivative aircraft led to the development of preliminary performance specifications, cost models, and even a small show model. Variations were conceived that retained a single turboprop engine on the nose as well as variations with a single turboprop engine on the tail. The show model was made for the variation with a single Pratt & Whitney Canada PT6A pusher engine mounted on the aft fuselage.

The A600 concept made little economic sense, due to the price of a single PT6A 500 hp engine being equal to the price of two Williams International FJ33 engines at the time.

Specifications (A500)

General characteristics

- **Crew:** one
- **Capacity:** five passengers
- **Length:** 37 ft 6 in (11.43 m)
- **Wingspan:** 44 ft 0 in (13.41 m)
- **Height:** 9 ft 7 in (2.92 m)
- **Airfoil:** NASA LS(1)-0417
- **Empty weight:** 5,350 lb (2,427 kg)
- **Gross weight:** 7,000 lb (3,175 kg)
- **Fuel capacity:** 230 gal (872 litres)
- **Powerplant:** 2 × Teledyne Continental TSIO-550E , 350 hp (260 kW) each

Performance

- **Maximum speed:** 225 kn (259 mph; 417 km/h)
- **Cruise speed:** 220 kn (250 mph; 410 km/h)
- **Stall speed:** 75 kn (86 mph; 139 km/h) in landing configuration with gear and flaps down
- **Range:** 892 nmi (1,026 mi; 1,652 km) at 75% power
- **Ferry range:** 1,286 nmi (1,480 mi; 2,382 km) at 45% power
- **Service ceiling:** 25,000 ft (7,600 m) maximum certified ceiling, 14900 feet on one engine

Chapter- 2

Canaero Toucan and Caproni Ca.4

Canaero Toucan

Toucan

Role	Ultralight aircraft
National origin	Canada
Manufacturer	Canaero Dynamics Aircraft
Designed by	Peter Corley
First flight	September 1983
Introduction	January 1986
Primary user	private owners

The **Canaero Toucan** is a Canadian high-wing, two seats in tandem, twin engine push-pull configuration, twin-boom ultralight kit aircraft that was produced from 1983 to the late 1980s by Canaero Dynamics Aircraft of Rexdale, Ontario.

The Toucan greatly resembles an ultralight Cessna Skymaster.

Development

The Toucan design work started in January 1983 and was completed in April of the same year, with the first flight of the prototype in September 1983. Construction of the first pre-production aircraft was started in July 1985 with the first production aircraft flying in January 1986.

Four prototypes/pre-production aircraft were completed, which were followed by a run of twelve Toucans, all completed by June 1986. A second batch of 25 aircraft were planned to have been completed by November 1986 as well.

The Toucan design features a strut-braced high wing built from aluminum covered with aircraft fabric. The wing's leading edge is of "D" cell construction and has fiberglass wing tips. Flight controls are conventional three-axis with full-span flaperons and twin rudders. The fuselage is constructed from welded 4130 steel tube. When originally delivered an airframe parachute was standard.

The landing gear is of tricycle gear configuration with the main gear legs of sprung steel and brakes are standard equipment. Wheel pants, skis and pontoons were optional.

The original engines were 28 hp (21 kW) Rotax 277s with 35 hp (26 kW) Rotax 377 engines as optional, although some aircraft have been modified with larger engines.

Operational history

In Canada Toucans are registered as basic ultralights which prohibits passenger-carrying. Both seats can only be occupied by a student and instructor or two licensed pilots.

In November 2009 there were still five Toucans registered in Canada.

Specifications (Toucan T-IV)

General characteristics

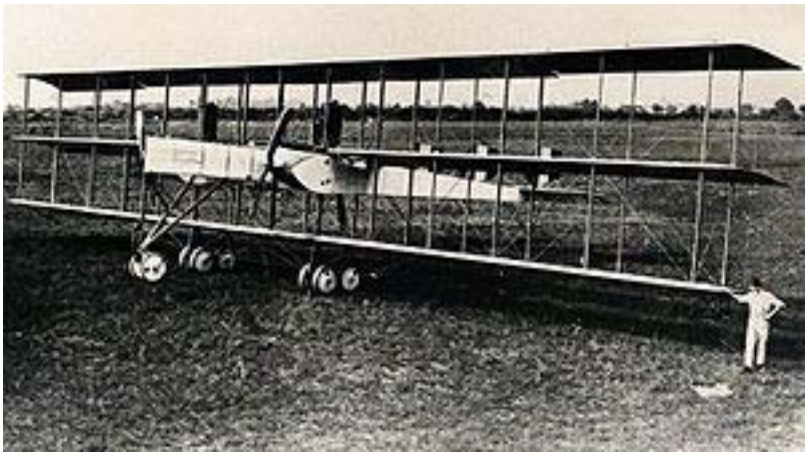
- **Crew:** one
- **Capacity:** one passenger
- **Length:** 18 ft 11.75 in (5.7848 m)
- **Wingspan:** 38 ft 6 in (11.73 m)
- **Height:** 9 ft 4 in (2.84 m)
- **Wing area:** 182 sq ft (16.9 m^2)
- **Empty weight:** 393 lb (178 kg)
- **Gross weight:** 900 lb (408 kg)
- **Powerplant:** 2 × Rotax 277 single cylinder two-stroke aircraft engine, 28 hp (21 kW) each

Performance

- **Maximum speed:** 75 mph (121 km/h; 65 kn)
- **Cruise speed:** 65 mph (56 kn; 105 km/h)
- **Stall speed:** 24 mph (21 kn; 39 km/h)
- **Range:** 170 mi (148 nmi; 274 km)
- **Service ceiling:** 10,000 ft (3,048 m)
- **G limits:** +6/-3
- **Rate of climb:** 1,150 ft/min (5.8 m/s) solo, 165 lb pilot
- **Wing loading:** 4.95 lb/sq ft (24.2 kg/m²)

Caproni Ca.4

Ca.4



Caproni Ca.40 heavy bomber prototype

Role	Heavy bomber; later variants included airliners
Manufacturer	Caproni
First flight	1917
Introduced	1918
Primary users	Italian Army United Kingdom (Royal Naval Air Service) United States
Number built	44 to 53

The **Caproni Ca.4** was an Italian heavy bomber of the World War I era.

Development

After designing the successful Ca.3, Gianni Caproni of the Caproni works designed a much bigger aircraft. It shared the unusual layout of the Caproni Ca.3, being a twin-boom aircraft with one pusher engine at the rear of a central nacelle and two tractor engines in front of twin booms, making a push-pull configuration. The twin booms carried a single elevator and three fins. The main landing gear was fixed and consisted of two sets of four wheels each. The most distinguishing feature of the new plane was, that it was built in a rare triplane layout, instead of the more common biplane.

The huge new bomber was accepted the Italian Army under a military designation **Ca.4**, but it was produced in several variants, differing in factory designations.

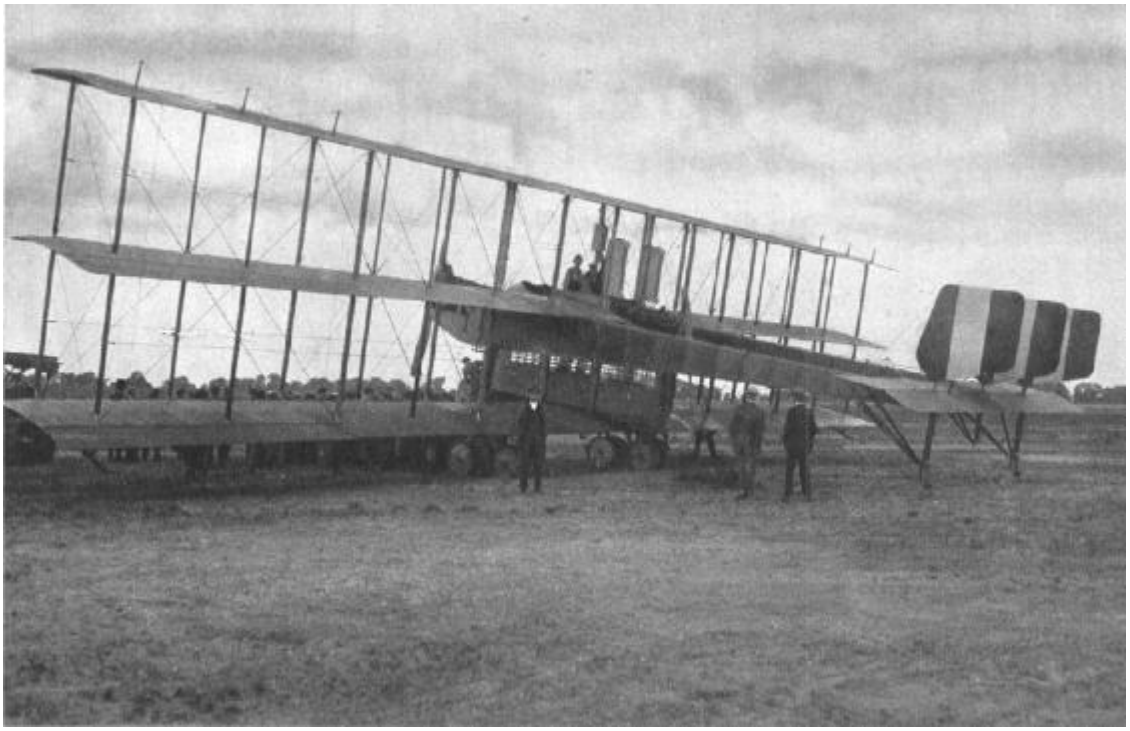
Description

The Ca.4 was a three-engine, twin-boom triplane of a wooden construction with a fabric-covered frame. The open center nacelle was attached to the undersurface of the center wing. It contained the pusher engine, pilot, and forward gunner. At least one variation of the center nacelle seated the crew in a two-seat tandem format with the forward position a gunner/pilot and the rear position the pilot. Others used a forward gunner with side by side pilot positions to the rear of the gunner. Two rear gunners were positioned one in each boom behind the center wing. An engineer or second pilot could also be accommodated there.

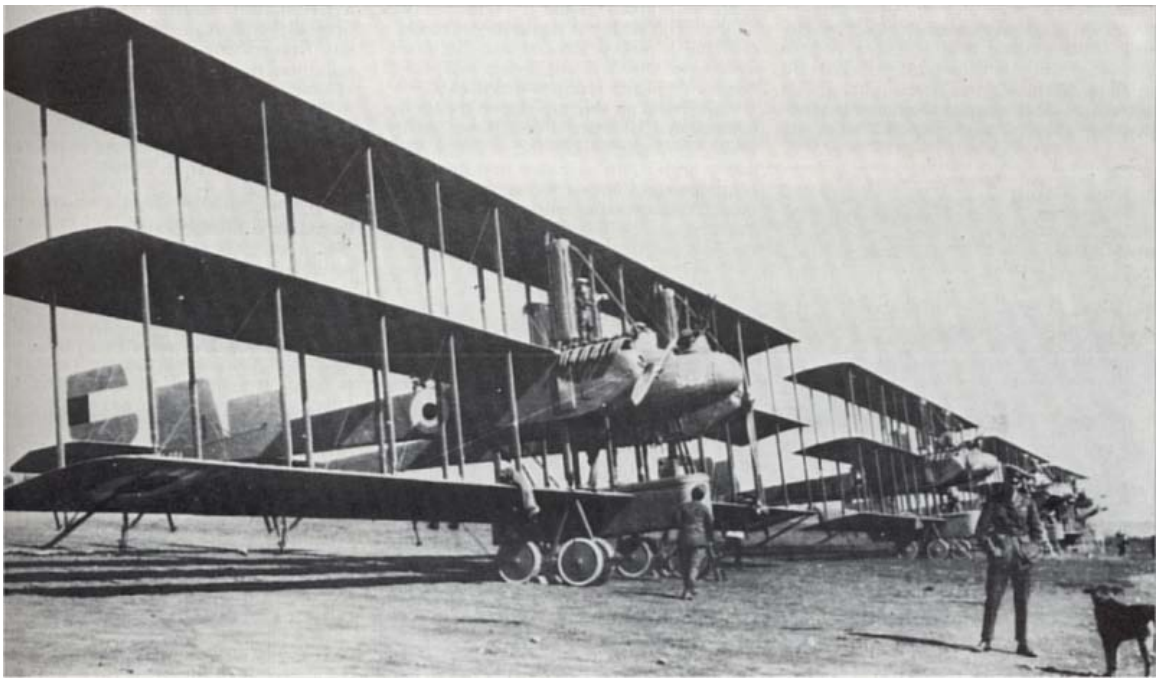
Armament consisted of four (but up to eight) Revelli 6.5 mm or 7.7 mm machine guns in front ring mounting and two boom ring mountings. Bombs were suspended in a bomb bay, which was a long and narrow container fixed to a lower wing. Photographs show at least four different arrangements with regard to the bombing nacelle.

- 1. No nacelle - presumably not a combat configuration.
- 2. A tall, narrow nacelle that housed approximately 12 internal bombs vertically and another 18–20 strapped to the outside.
- 3. A shorter nacelle that may be the lower half of the tall nacelle but with no external bombs.
- 4. No nacelle but with a single long bomb/torpedo slung under the bottom wing.

Variants



The Ca.48 airliner



The Ca.52 (Caproni Ca.42) - second production series of Ca.4-Ca.40 family - Aircraft of N°227 Squadron Royal Naval Air Service

Note: during the war, all these aircraft were designated Ca.4 by the Italian Army. At the time, Caproni referred to the various designs by the total power of their engines. After the war, Caproni devised a new designation scheme for their own design—these are used below.

- **Ca.40** - single prototype.
- **Ca.41** - production variant, essentially similar to the prototype and powered by 3 Fiat A.12 inline engines of 210 kW (280 hp). A few Ca.41s were powered by 186 kW (250 hp) Isotta-Fraschini engines instead. These were referred to internally by Caproni as the **Caproni 750 hp**. Forty-one built.
- **Ca.42** - powered by Liberty 298 kW (400 hp) inline engines and known internally as the Caproni 1,200 hp. Twelve built.
- **Ca.43** - single example of a floatplane variant.
- **Ca.48** - Airliners converted from Ca.42s after World War I; the Ca.48 first flew in 1919. The double-deck passenger cabin mounted between the booms seated a total of 23 passengers who entered via the nose nacelle; 16 of them sat in the lower cabin on long benches alongside its walls with large windows providing them with good views, and the other seven passengers sat on an upper deck, as did the pilots. The Ca.48 was powered by three 298-kilowatt (400-horsepower) Liberty L-12 engines. Although it is unlikely that the Ca.48 ever entered airline service, a Ca.48 did visit the First Aviation Exhibition Amsterdam of August–September 1919, where it was very popular with visitors, among whom was Prince Hendrick (1876–1934), Prince Consort of the Netherlands (1901–1934).
- **Ca.51** - single example of a considerably enlarged design with biplane tail and tail barbette. Three × 522 kW (700 hp) Fiat A.14 engines.
- **Ca.52** - Ca.42s built for the RNAS. Six built.
- **Ca.58** - Ca.48s re-engined with Fiat A.14 or Isotta-Fraschini V.6.
- **Ca.59** - as for the Ca.58, but this designation used for customers outside Italy.

Production figures differ in publications. The most likely number is 38 of all Ca.4 variants (other quoted figures are: 38 of Ca.40 and Ca.41 and 6 Ca.42 or 32 Ca.42 and 21 of other variants). Numerous publications incorrectly refer to all variants as the Ca.42.

Service history

Ca.4s were tested by the Italian Air Force in 1917 and began operations in 1918. They were used for attacking targets in Austro-Hungary. In April 1918, 6 Ca.42s were used by the British RNAS (No. 227 Sqn). At least three CA.42s were sent to the USA for evaluation. After the war, the Ca. 4 was replaced in Italy by the Ca.36.

Despite its unstable and fragile appearance, the Ca.4 was well-designed. Its size, without regards to its height, was not any larger than that of other foreign heavy bombers. With Liberty engines, it had a fast speed, similar to other heavy bombers, while its bomb load had one of the largest capacities of that era, surpassed only by that of the Imperial German: Zeppelin-Staaken R.VI. If it had been flown with other engines, its performance would have suffered.

Operators

- Italy : *Corpo Aeronautico Militare*
- UK
- USA

Specifications

Ca.42

General characteristics

- **Crew:** 4 (pilot, co-pilot, front gunner, and rear gunner/mechanic)
- **Length:** 13.10 m (42 ft 11 in)
- **Wingspan:** 29.90 m (98 ft 1 in)
- **Height:** 6.30 m (20 ft 8 in)
- **Wing area:** 200 m² (2,150 ft²)
- **Empty weight:** 6,709 kg (14,791 lb)
- **Max takeoff weight:** 7,500 kg (16,535 lb)
- **Powerplant:** 3× Isotta Fraschini, 201 kW (270 hp) each

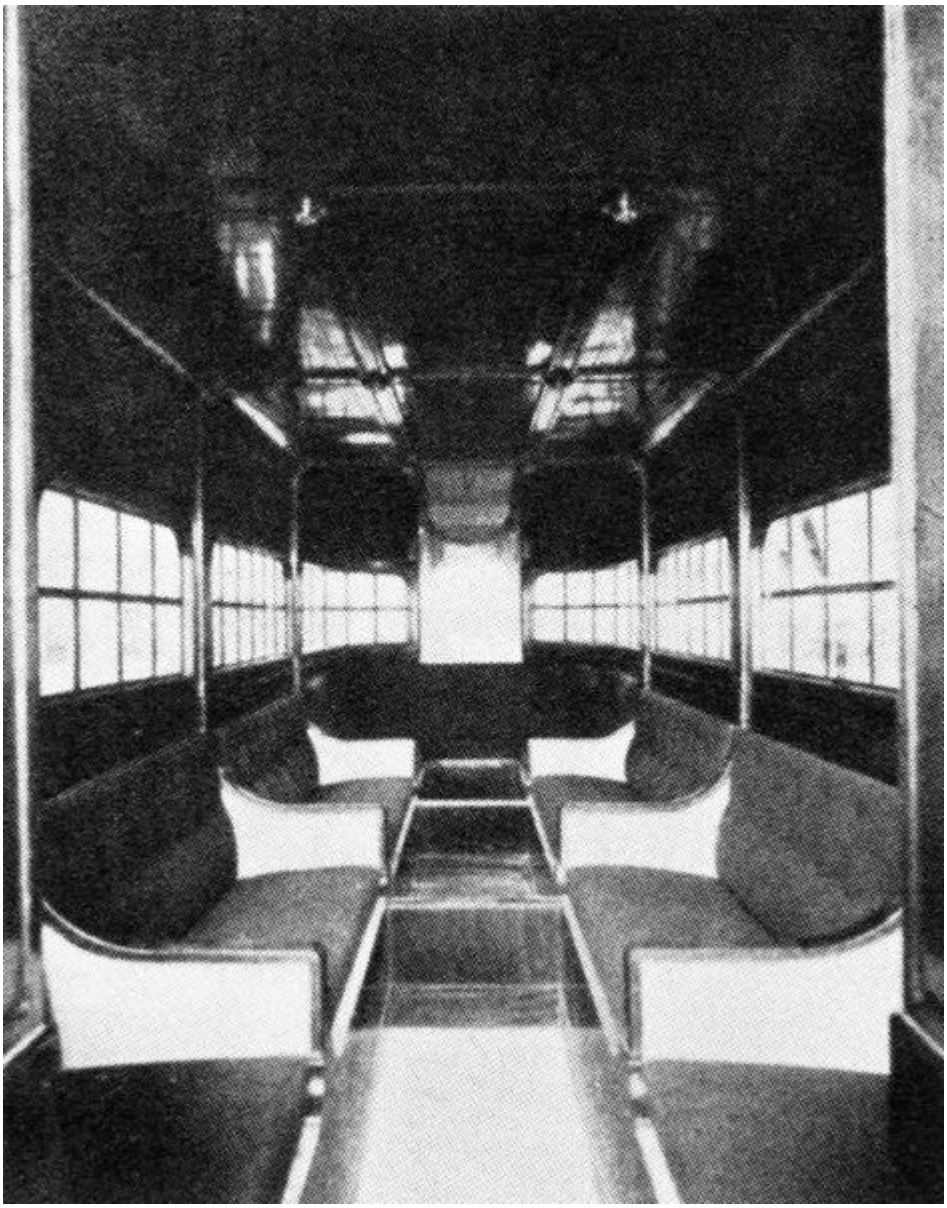
Performance

- **Maximum speed:** 140 km/h (76 kn, 87 mph)
- **Range:** 700 km (378 nmi, 438 mi)
- **Service ceiling:** 3,000 m (9,800 ft)
- **Rate of climb:** 125 m/min (410 ft/min)

Armament

- 4 × 6.5 mm FIAT-Revelli machine guns, two in forward mounting and one in each of two rearward positions.
- 1,450 kg (3,200 lb) of bombs

Ca.48



Interior of lower main passenger cabin of Ca.48 airliner, which accommodated 17 of the 23 passengers.

General characteristics

- **Crew:** 2 (pilot, co-pilot)
- **Capacity:** 23 passengers
- **Length:** 13.20 m (43 ft 3.7 in)
- **Wingspan:** 29.90 m (98 ft 1 in)
- **Height:** 6.30 m (20 ft 8 in)
- **Wing area:** 200 m² (2,150 ft²)

- **Empty weight:** 4,000kg (8,818 lb)
- **Max takeoff weight:** 7,200 kg (15,873 lb)
- **Powerplant:** 3× Liberty L-12, 298 kW (400 hp) each

Performance

- **Maximum speed:** 140 km/h (76 kn, 87 mph)

Chapter- 3

Cessna O-2 Skymaster

O-2 Skymaster

An O-2 Skymaster

Role	Observation aircraft
Manufacturer	Cessna
First flight	January 1967
Primary users	United States Air Force Vietnam Air Force Royal Thai Navy
Number built	532
Developed from	Cessna Skymaster

The **O-2 Skymaster** (also known as the "Oscar Deuce" or "The Duck") is a military version of the Cessna 337 Super Skymaster utilized as an observation and forward air control (FAC) aircraft. The United States Air Force commissioned Cessna to build a military variant to replace the O-1 Bird Dog in 1966.

Design and development

As with the civilian version, the Skymaster was a low cost twin-engine piston powered aircraft, with one engine in the nose of the aircraft and a second engine in the rear of the fuselage. The push-pull configuration meant a simpler single-engine operating procedure due to centerline thrust compared to the common low-wing mounting of most twin engine light planes, and also allowed for a high wing, providing clear observation below and behind the aircraft. During the Vietnam War, the Skymaster was intended to be replaced in the forward air control (FAC) mission by the OV-10 Bronco, but the O-2A maintained a night mission role after the OV-10's introduction due to the OV-10's high level of cockpit illumination, rendering night reconnaissance impractical. The O-2 was phased out completely after additional OV-10 night upgrades.

The first O-2 flew in January 1967 and the plane went into production shortly thereafter, with the USAF taking delivery in March 1967. A total of 532 O-2s were built in two variants for the USAF by 1970. The O-2A served as a FAC aircraft with the 20th Tactical Air Support Squadron, while the O-2B was equipped with loudspeakers and a leaflet dispenser for use in the psychological operations (PSYOPS) role. Several USAF O-2 aircraft were later transferred to and operated by the former VNAF South Vietnamese Air Force.

Following the Vietnam War, the O-2 continued to operate with both U.S. Air Force and Air National Guard units well into the late 1980s. Six former USAF O-2A airframes were also transferred to the U.S. Navy in 1983 for use as "range controllers" with Attack Squadron 122 (VA-122), the Pacific Fleet Replacement Squadron for the A-7 Corsair II at Naval Air Station Lemoore, California. These same aircraft were later transferred to Strike Fighter Squadron 125 (VFA-125), the F/A-18 Hornet FRS at NAS Lemoore, in 1986 for use in the same range control role.

The six Navy O-2A's remained in this role until September 1990, when they were replaced by T-34C Turbo Mentor aircraft transferred from the Naval Air Training Command. Four of the Navy O-2A aircraft were retired and two of these became civil registered in October 1991. These two aircraft were flown in U.S. airshows performing a "Viet Nam Warbird COIN/FAC" routine during the 1990s. The routine debuted at the "Wings Over Houston" (Texas) airshow in October 1991.

Of the six USN aircraft mentioned above, two were transferred to the U.S. Army in late 1990. O-2As had originally entered the U.S. Army's inventory in 1967 from USAF stocks and were augmented by the 1990 aircraft transfer from the U.S. Navy. Several disassembled USAF O-2s remain in storage at Davis-Monthan AFB, Arizona. Two O-2As were used at Laguna Army Airfield, Arizona as part of testing programs carried out by the Yuma Proving Ground. These were retired in October 2010 and sent to a museum.

Operational history

USAF O-2 *Skymaster* in flight

A total of 178 USAF O-2 Skymasters were lost in the Vietnam War, to all causes.

Civilian use

CAL FIRE

In the mid 1970s, the California Department of Forestry and Fire Protection, or CAL FIRE, found that the contractor-owned air attack aircraft, mostly single-engine Cessna 182s and Cessna 210s, did not provide the airspeed and safety needed for the department's new air tanker program. In 1974, Senior Air Operations Officer, Cotton Mason, inspected 40 USAF O-2s at Davis-Monthan Air Force Base. The best 20 were selected and shipped to Fresno, California. These aircraft had been FAC aircraft in Vietnam and were shipped back to the United States in containers, and were disassembled and on pallets when they arrived at Fresno. A crew of California Conservation Corps (CCC) members under the supervision of a CDF Battalion Chief who was an FAA Certificated Mechanic with Inspection Authorization (IA), reassembled the aircraft. They were placed in service in 1976, and successfully served CALFIRE for more than 20 years, until replaced by a fleet of OV-10 Broncos.

Variants

An O-2B Skymaster dropping leaflets over Vietnam

O-2A

Version designed for use in forward air control missions, features ordnance hard points underneath the wings to hold rockets, gun pods or flares. 513 were delivered.

O-2B

Version designed for psychological warfare, and was equipped with loudspeakers and a leaflet dispenser, but otherwise carried no weapons. Thirty-one former civil 337s were converted to O-2Bs.

Operators

Cessna 337 Skymaster on the ground in New Jersey, 2008

Botswana

- Botswana Air Force - Nine O-2A delivered 1993.

Chile

- Chilean Navy - 10 O-2A, six operated, two to Navy Aero Club, two used for spares.

Colombia

- Colombian Air Force

Costa Rica

- Civil Guard Air Section - Three O-2A.

Dominican Republic

- Dominican Air Force - Five O-2A (retired)

El Salvador

- Salvadoran Air Force - 18 O-2A and two O-2B, delivered starting 1981. Eight O-2A and one O-2B remain in service.

Haiti

- Haitian Air Force - Eight (in service 1975-98) Reportedly six of these are Model 337s, and only two O-2As.

Côte d'Ivoire

- National Armed Forces of Côte d'Ivoire - One O-2A delivered 1993.

Namibia

- Namibian Air Force - Six O-2A.

Solomon Islands

- Solomon Islands Government - Two O-2A.

South Korea

- Republic of Korea Air Force - at least 14 O-2A.

South Vietnam

- Vietnam Air Force - at least 35.

Thailand

- Royal Thai Navy - between 11 and 40 aircraft.

Trinidad and Tobago

- Trinidad and Tobago Defence Force

United States

- United States Air Force - between 11 and 40 aircraft
- United States Navy
- United States Army
- California Department of Forestry & Fire Protection

Zimbabwe

- Zimbabwe Air Force - Two O-2A delivered 1994-1995.

Specifications (O-2)

General characteristics

- **Crew:** 2 - pilot and observer
- **Length:** 29.75 ft (9.07 m)
- **Wingspan:** 38.17 ft (11.63 m)
- **Height:** 9.17 ft (2.79 m)
- **Wing area:** 202.5 ft² (18.8 m²)
- **Empty weight:** 2,848 lb (1,292 kg)
- **Loaded weight:** 5,400 lb (2,448 kg)
- **Powerplant:** 2× Continental IO-360C six-cylinder flat engines, 210 hp (157 kW) each

Performance

- **Maximum speed:** 200 mph (322 km/h)
- **Range:** 1,325 mi (2,132 km) combat
- **Service ceiling:** 18,000 ft (5,490 m)
- **Rate of climb:** 1,180 ft/min (6 m/s)

Aircraft on display

- O-2A, AF Ser. No. 67-21331, National Museum of the United States Air Force, Wright-Patterson AFB, Ohio
- O-2A, AF Ser. No. 67-21368, Air Commando Park, Hurlburt Field, Florida
- O-2A, AF Ser. No. 68-10962, Main Gate, Shaw AFB, South Carolina
- O-2A, AF Ser. No. 68-6864, Air Force Armament Museum, Eglin AFB, Florida
- O-2A, AF Ser. No. 67-21376, 105th Airlift Wing area, Stewart Air National Guard Base, New York
- O-2A, AF Ser. No. 68-11164, USAF History and Traditions Museum, Lackland AFB, Texas
- O-2A, AF Ser. No. 68-6865, Kelly Field Heritage Museum, Lackland AFB/Kelly Field Annex (formerly Kelly AFB), Texas
- O-2A, AF Ser. No. 67-21326, Dyess Linear Air Park, Dyess AFB, Texas
- O-2A, AF Ser. No. 67-21395, Air Mobility Command Museum, Dover AFB, Delaware
- O-2A, AF Ser. No. 68-10848, Travis Air Force Museum, Travis AFB, California
- O-2A, AF Ser. No. 67-21380, Museum of Aviation, Robins AFB, Georgia
- O-2A, AF Ser. No. 68-6871, Grissom Air Museum, Grissom Air Reserve Base (formerly Grissom AFB), Indiana
- O-2A, AF Ser. No. 68-11160, 182nd Airlift Wing complex, Peoria Air National Guard Base, General Wayne A. Downing Peoria International Airport, Illinois
- O-2A, AF Ser. No. 68-6901, Pima Air and Space Museum (adjacent to Davis-Monthan AFB), Tucson, Arizona
- O-2A, AF Ser. No. 67-21413, Castle Air Museum (former Castle AFB), Atwater, California
- O-2A, AF Ser. No. 67-21411 , Chanute Display Center, Rantoul National Aviation Center (former Chanute AFB), Illinois
- O-2A, AF Ser. No. 67-21330, Valiant Air Command Warbird Museum, Space Coast Regional Airport, Titusville, Florida
- O-2B, AF Ser. No. 67-21465, March Field Air Museum, March Air Reserve Base (formerly March AFB), California

Chapter- 4

Aeronix Airelle and Bristol Braemar

Aeronix Airelle

Airelle	
Role	Kit-built ultralight
National origin	France
Manufacturer	Aeronix sarl, La Chapelle-Vendômoise
First flight	February 2002
Status	Out of production
Number built	5

The **Aeronix Airelle** is a tandem wing ultralight with twin engines in push-pull configuration, that was designed and built in France at the start of the millennium. Intended to be homebuilt from kits, a few prototypes were constructed but development ended when the company went into receivership in 2006.

Design and development

Design of the Airelle began in 1999 and a one third scale model flew the following October. The full scale Airelle was formally introduced with a mock-up at the Paris air show held at le Bourget in June 2003, though its first flight was made in February 2002.

Its layout was very unusual, both in that it had a tandem pair of wings and that its twin engines were in push-pull configuration. The rear wing had the greater span and chord, and was swept (at 30°) and tapered, with outward-leaning fins and rudders at its tips.

rather as in traditional lifting canard aircraft. However, the unswept, straight tapered foreplane had a much greater fore/rear wing span ratio (about 80%) than most of this type, for example 66% for the World War II Miles Libellula. The whole trailing edge of each rear wing, which had a dihedral of 2°, was occupied by a combination of outboard mass balanced ailerons and inboard plain flaps. The foreplane had full span elevators and slightly turned down tips. The wings, like the rest of the Airelle's structure, were largely carbon fibre. The fins had inward turned tips. The Airelle's rudders had several modes of operation: used together they controlled yaw, as normal; they could be split on one side only, as spoilers; or both faces could separate to act as airbrakes.

The Airelle's fuselage was short, with the centrally hinged, forward opening, transparent cabin doors between the wings and engines. Both two and four seat variants were planned. A glass cockpit and a control system without rudder bars was fitted. The fuselage was deeper aft, carrying the rear wing higher than the foreplane. The prototype Airelles were powered by 30 kW (40 hp) Zazottera flat four engines, though Hirth F2ES engines of the same power were planned for production aircraft and a projected VLA version was intended to take engines of up 75 kW (100 hp). The Airelle had a tricycle undercarriage with sprung, composite main legs mounted on the fuselage.

Operational history

After the Paris Air Show of 2003, Aeronix concentrated on promoting and delivering kits of the ultralight version, with deliveries starting that year. By June, 7 had been sold. By 2005 at least 5 had been built and the third prototype, with the French experimental registration *F-WATC* flew at that year's Paris show. By that time the, first two Airelles were in store at the Aeronix factory, the second prototype having been damaged in an engine fire during testing. The fifth Airelle was prepared for a Pole to Pole publicity flight, equipped with non-standard instrumentation. Gary Purdom, the company test pilot, was to fly the aircraft; but before it could be done Aeronix went into receivership in February 2006.

Specifications (Ultralight prototype)

General characteristics

- **Capacity:** 2
- **Length:** 5.88 m (19 ft 3 in)
- **Wingspan:** 9.46 m (31 ft 0 in)
- **Height:** 3.015 m (9 ft 10.7 in)
- **Wing area:** 15.00 m^2 (161.5 sq ft)
- **Empty weight:** 295 kg (650 lb)
- **Max takeoff weight:** 472.5 kg (1,042 lb)
- **Fuel capacity:** 60 L (13.2 Imp gal, 15.9 US gal)
- **Powerplant:** 2 × Zanzoterra flat twin, 30 kW (40 hp) each
- **Propellers:** 3-bladed ground adjustable pitch, from Duc, Arplast or Ecoprop, 1.60 m (5 ft 3 in) diameter

Performance

- **Maximum speed:** 230 km/h (140 mph; 120 kn)
- **Cruising speed:** 200 km/h (120 mph; 110 kn)
- **Stall speed:** 58 km/h (36 mph; 31 kn)
- **Never exceed speed:** 290 km/h (180 mph; 160 kn)
- **Range:** 700 km (435 mi; 378 nmi)
- **Rate of climb:** 10 m/s (2,000 ft/min)

Bristol Braemar

Bristol Types 24 and 25 Braemar

Role	Heavy bomber
Manufacturer	Bristol Aeroplane Company
Designed by	Frank Barnwell
First flight	1918-08-13
Number built	2
Developed into	Bristol Pullman

The **Bristol Braemar** was a British heavy bomber aircraft developed at the end of the First World War for the Royal Air Force. Only two prototypes were constructed.

Development

The prototype Braemar was developed in response to the establishment of the Independent Air Force in October 1917, as a bomber capable of the long-range bombing of Berlin if necessary. A large triplane, it had internal stowage for up to six 250 lb (110 kg) bombs.

The initial design featured a unique engine installation with a central engine room housing all four engines. The engines were to be geared in pairs and power taken from the engines to the four propellers by power shafts. This design was abandoned early in development, and both the completed Braemars had a conventional engine installation, with the engines in inline tandem pairs, driving pusher and tractor propellers. However, the engine-room design was resurrected later in the Braemar's development life, for the proposed steam-powered Tramp.

The first prototype Braemar flew on 13 August 1917, with four Siddeley Puma engines of 230 hp (170 kW) each. The prototype showed generally good performance with a top

speed of 106 mph (171 km/h), but there were complaints from the test pilots about the view from the cockpit and the controls, and so the next aircraft produced was an improved version designated Braemar Mk.II. The Mk.II had considerably more power, in its four Liberty L-12 engines of 400 hp (300 kW), which gave it an improved speed of 125 mph (201 km/h).

The Braemar never entered service with the RAF, and the two prototypes were the only Braemars built. The Braemar design was subsequently developed as the Pullman passenger aircraft.

Specifications (Braemar Mk.II)

General characteristics

- **Crew:** 6 - two pilots, wireless operator, engineer and two gunners
- **Length:** 51 ft 6 in (15.73 m)
- **Wingspan:** 81 ft 8 in (24.89 m)
- **Height:** 20 ft (6.10 m)
- **Wing area:** 1,905 ft² (177 m²)
- **Empty weight:** 10,650 lb (4,840 kg)
- **Loaded weight:** 18,000 lb (8,170 kg)
- **Powerplant:** 4× Liberty L-12 inline engine, 400 hp (300 kW) each

Performance

- **Maximum speed:** 109 kn (125 mph, 200 km/h) at sea level
- **Range:** more than 1,000 mi ()
- **Service ceiling:** 17,000 ft (5,100 m)
- **Wing loading:** 9.45 lb/ft² (46.2 kg/m²)
- **Power/mass:** 0.08 hp/lb (150 W/kg)

Armament

- **Guns:** 2 × 0.303 in (7.7 mm) machine guns
- **Bombs:** 1,500 lb (680 kg)

Chapter- 5

Bristol Pullman and AD Seaplane Type 1000

Bristol Pullman

Bristol Types 26 and 33 Pullman

Role	Passenger aircraft
Manufacturer	Bristol Aeroplane Company
Designed by	Frank Barnwell
First flight	May 1920
Status	Prototype
Primary user	Royal Air Force
Number built	1
Developed from	Bristol Braemar
Developed into	Bristol Tramp

The **Bristol Pullman** was a British prototype passenger aircraft developed from the Braemar triplane heavy bomber.

Design and development

The first **Pullman** was actually built as the third **Braemar**, and first flew early in May 1920. It was shown at the International Aero Show at Olympia in July of that year, where its great size and interior fittings were much admired. The Pullman was one of the earliest British aircraft to have a fully-enclosed crew cabin, and this feature was disliked by service pilots, who often carried fireman's axes with them to enable them to escape in an emergency.

Operational history

Ultimately the Pullman was not accepted for squadron use by the Royal Air Force, nor was it selected for use by any civil operator. The prototype was the sole example of the type constructed or configured.

Operators

United Kingdom

- Royal Air Force

Specifications

General characteristics

- **Crew:** 2
- **Capacity:** 14
- **Length:** 52 ft (15.88 m)
- **Wingspan:** 81 ft 8 in (24.89 m)
- **Height:** 20 ft (6.10 m)
- **Wing area:** 1,905 ft² (177 m²)
- **Empty weight:** 11,000 lb (5,000 kg)
- **Loaded weight:** 17,750 lb (8,070 kg)
- **Powerplant:** 4× Liberty L-12 inline engine, 400 hp (300 kW) each

Performance

- **Maximum speed:** 135 mph (216 km/h)
- **Range:** more than 1,000 mi ()
- **Service ceiling:** 15,000 ft (4,500 m)

AD Seaplane Type 1000

AD Seaplane Type 1000

Role	Torpedo bomber bomber
Manufacturer	J. Samuel White
Designed by	Harris Booth
First flight	1916
Primary user	Royal Naval Air Service

Number built 1

The **AD Seaplane Type 1000** also known as the **Admiralty Type 1000** and the **AD.1** (from Air Department) was a British seaplane of the First World War designed to attack German warships. When it first flew, it was the largest British aircraft yet to take to the air.

Development

The design of the AD.1 was by Harris Booth of the Admiralty's Air Department just prior to World War I. It was the world's first aircraft designed from scratch as a torpedo bomber, one of the three planned versions of the plane. The other two were a bomber and a plane armed with a recoilless Davis 12-pounder gun (approximately 76 mm calibre).

The aircraft was a float-equipped biplane of pod-and-boom design, with engines mounted at the front of both booms, as well as at the rear of the crew pod. Development began in 1915; it was completed and flown for the first time during the summer of 1916. It was found that the Davis gun would project a blast rearwards so the weapon was changed for a conventional 12-pounder "Naval Landing Gun" though in practice a gun was never installed in the AD.1.

Initially the plane was to use Sunbeam Nubian engines, but this was delayed and Hispano-Suiza selected instead, though eventually the Sunbeam Nubian IIs of 150 hp were delivered in 1917.

Service

Seven aircraft were ordered from J. Samuel White, but when the first one delivered was tested, it was found that its weight was higher than expected, its performance was unexpectedly poor and its undercarriage was not robust enough.

Based on these findings, the contract for the remaining six aircraft was cancelled.

The sole example is known to have survived until 1916, probably at the Royal Naval Air Service's Seaplane Experimental Station, Felixstowe base.

Specifications (AD Seaplane Type 1000)

General characteristics

- **Crew:** 5
- **Length:** 64 ft 3 in (19.6 m)
- **Wingspan:** 115 ft (35.1 m)
- **Height:** ()
- **Empty weight:** 22,352 lb (10,160 kg)

- **Max takeoff weight:** 27,900 lb (12,700 kg)
- **Powerplant:** 3× Hispano-Suiza rotary engines, 100 hp (75 kW) each

Performance

- **Maximum speed:** 73 knots (84 mph, 135 km/h)
- **Range:** 481 nm (553 mi, 885 km)
- **Service ceiling:** 4,900 ft (1,500 m)

Armament

- One 12 pdr gun or two 14 in, 810 lb (360 mm, 367 kg) torpedoes

Chapter- 6

Cessna Skymaster

336 Skymaster
337 Super Skymaster

A Cessna 337 Super Skymaster.

Role	Personal use and air taxi aircraft
Manufacturer	Cessna Reims Aviation
First flight	1961
Status	Active service
Primary user	Private individuals and organizations
Produced	1963-1982
Number built	2,993
Variants	O-2 Skymaster Conroy Stolifter Spectrum SA-550

Part of the contract fleet of **Cessna 337 Skymasters** on firefighting detection duty with the Ontario Ministry of Natural Resources at Dryden, Ontario, 1996.

The **Cessna Skymaster** is a United States twin-engine civil utility aircraft built in a push-pull configuration. Its engines are mounted in the nose and rear of its pod-style fuselage. Twin booms extend aft of the wings to the vertical stabilizers, with the rear engine between them. The horizontal stabilizer is aft of the pusher propeller, mounted between and connecting the two booms. The combined tractor and pusher engines produce 'centerline' thrust and a unique sound.

Development

The first Skymaster, model **336**, had fixed landing gear and first flew on February 28, 1961. It went into production in May 1963, and 195 were produced through mid 1964.

In February 1965 Cessna introduced the model **337 Super Skymaster**. The model was larger, and had more powerful engines, retractable landing gear, and a dorsal air scoop for the rear engine ("Super" was subsequently dropped from the name). In 1966 the turbocharged **T337** was introduced, and in 1973 the pressurized **P337G** entered production.

Cessna built 2993 Skymasters of all variants, including 513 military O-2 versions. Production in America ended in 1982 but continued with Reims in France with the **FTB337** STOL and the military **FTMA** ***Milirole***. Production totalled 94 units.

Design

The Skymaster handles differently from a conventional twin-engine aircraft, primarily in that it will not yaw into the dead engine if one engine fails. Without the issue of differential thrust inherent to conventional (engine-on-wing) twins, engine failure on takeoff will not produce yaw from the runway direction. With no one-engine-out minimum controllable speed(Vmc), in-flight control at any flying speed with an engine inoperative is not as critical as it is with engines on the wing with the associated leverage. Nevertheless, the Skymaster requires a multi-engine-rating, although many countries issue a special "centerline thrust rating" for Skymaster and other like-configurated aircraft.

Ground handling requires certain attention and procedures. The rear engine tends to overheat and can quit while taxiing on very hot days. There have been accidents when pilots, unaware of the shutdown, have attempted take-off on the nose engine alone, even though the single-engine take-off roll exceeded the particular runway length. FAA Airworthiness Directive 77-08-05 prohibits single engine take-offs and requires the installation of a placard with words that say "DO NOT INITIATE SINGLE ENGINE TAKEOFF".

The Skymaster produces a unique sound: a combination sound of its rear propeller slicing through turbulent air from the front prop and over the airframe, while its nose propeller addresses undisturbed air.

Operational history

From 1976 until the middle 1990s, the California Department of Forestry and Fire Protection used O-2 variants of the 337 Skymaster as tactical aircraft during firefighting operations. These were replaced with North American OV-10 Broncos, starting in 1993.

Brothers to the Rescue

From 1991 until 2001 the Cuban exile group *Hermanos al Rescate* (Brothers to the Rescue) used Skymasters, among other aircraft, to fly search and rescue missions over the Florida Straits looking for rafters attempting to cross the Straits to defect from Cuba and, when they found them, dropped life-saving supplies to them. Rescues were coordinated with the US Coast Guard, who worked closely with the group. They chose Skymasters because their high wing offered better visibility of the waters below, they were reliable and easy to fly for long-duration missions (averaging 7 hours), and they added a margin of safety with twin engine centerline thrust. In 1996, two of the Brothers to the Rescue Skymasters were shot down by the Cuban Air Force (FAC) over international waters. Both aircraft were downed by a MiG-29, while a second jet fighter, a MiG-23 orbited nearby.

Variants

Cessna

- **327 Baby Skymaster** - reduced scale four-seat version of the 337, with cantilever wings replacing the 336/337strut-braced configuration. It first flew in December 1967. One prototype was built before the project was cancelled in 1968 due to lack of commercial interest in the design. The prototype was delivered to NASA to serve as a full-scale model for wind tunnel testing. It was used in a joint Langley Research Center and Cessna project on noise reduction and the use of ducted versus free propellers.
- **336 Skymaster** - production version powered by two 195 hp (145 kW) Continental IO-360-A engines, 195 built.
- **337 Super Skymaster** - 336; retractable undercarriage, redesigned nose cowling and new rear engine intake, and greater wing angle of incidence, powered by two 210 hp (160 kW) Continental IO-360-C engines, 239 built.
- **337A Super Skymaster** - 337; minor detail changes, 255 built.
- **337B Super Skymaster** - 337A; increased take-off gross weight, optional belly cargo pack, 230 built.
- **T337B (1967) Turbo Super Skymaster** - 337B; two Continental turbocharged fuel injected 210 hp (160 kW) engines which boosted service ceiling to 33,000 feet (10,000 m), cruise speed to 233 mph (375 km/h), and range to 1,640 miles (2,640 km)
- **337C Super Skymaster** - 337B; new instrument panel and increased take-off gross-weight, 223 built.
- **337D Super Skymaster** - 337C; minor detail changes, 215 built.
- **337E Super Skymaster** - 337D; cambered wingtips and minor changes, 100 built.
- **337F Super Skymaster** - 337E; increased take-off gross weight, 114 built.
- **337G Super Skymaster** - 337F; split airstair entry door, smaller rear side windows, improved flaps, larger front propeller, powered by Continental IO-360-G engines, 352 built.
- **P337G Super Skymaster** - 337G; pressurized cabin and turbocharged engines, 292 built.
- **337H Skymaster** - 337G; minor changes and optional turbocharged engines, 136 built.
- **P337H Pressurized Skymaster** - T337G; minor changes, 64 built.
- **337M** - US military version designated O-2 Skymaster in service, 513 built.

Cessna Skymaster O-2

- **O-2A** - US military designation of the 337M Forward air control, observation aircraft for the US Air Force. 501 delivered to the USAF and 12 to the Imperial Iranian Air Force
- **O-2B**: Psychological warfare version for the US Air Force (31 former civil aircraft were converted to O-2B).
- **O-2TT**: Twin turboprop-powered version of the O-2.
- **Summit Sentry O2-337** : Military version.
- **Lynx**: Armed military version for the Rhodesian Air Force.
- **T337H-SP**

Reims Cessna

- **F337E Super Skymaster**, 24 built.
- **F337F Super Skymaster**, 31 built.
- **F337G Super Skymaster**, 29 built.
- **FT337G Super Skymaster**, 22 built.
- **F337H Super Skymaster**, 1 built.
- **FP337H Pressurized Skymaster**, 1 built.
- **FTB337G Milirole**; military F337G with Sierra Industries Robertson STOL modifications and underwing hardpoints, 61 built.
- **Lynx** : Rhodesian designation for 21 FTB337Gs delivered to the Rhodesian Air Force.

Conversions/modifications

- **Conroy Stolifter** - an extensive single-turboprop engine STOL cargo plane conversion of the Skymaster. Front engine was replaced with a Garrett AiResearch TPE-331 turboprop; rear engine was deleted, and its space filled with an extended cargo pod.
- **AVE Mizar** - flying car, created by Advanced Vehicle Engineers, was an attachment of Skymaster wings, tail, and rear engine to a Ford Pinto outfitted with aircraft controls and instruments.
- **Summit Sentry** - Summit Aviation re-manufactured existing used 337 airframes into the militarized **O2-337** which includes four wing-mounted NATO standard pylons capable of carrying 350 lb (159 kg) each for 7.62 mm and 12.7 mm gun pods, rocket launchers, bombs, markers and flares. The aircraft was marketed for the target identification and marking, reconnaissance, helicopter escort and aerial photography roles. Examples were sold to the Haitian Air Force Honduras, Nicaragua, Senegal and the Thai Navy. The variant was still in production in 1987.
- **Spectrum SA-550** - built by Spectrum Aircraft Corporation of Van Nuys, California, it was an extensive single-turboprop engine conversion of a Reims FTB337G constructed in the mid 1980s. They removed the nose engine, lengthened the nose, and replaced the rear engine with a turboprop.

Military operators

 Bangladesh
- Bangladesh Army

 Burkina Faso

 Chad

 Chile
- Chilean Air Force

 Colombia

 Costa Rica

 Ecuador

 El Salvador

 Equatorial Guinea

 Guinea-Bissau

 Haiti
- Haitian Air Force

 Iran
- Imperial Iranian Air Force

 Jamaica

 Mexico

 Nicaragua
- 8 x 0-2A
- 1 x 0-2B

 Niger
- Military of Niger

Paraguay
    Paraguayan Air Force: 1 x 337RG
Peru
Portugal
    Portuguese Air Force (32 x FTB-337G) - Purchased in 1973 to replace the force's aging Dornier Do 27 fleet, which had been used intensively in the Portuguese Colonial War. The first 337 deliveries did not arrive until December 1974 - after the end of the war. The last Skymaster in service with the Portuguese Air Force was retired on July 25, 2007.
Rhodesia
    Rhodesian Air Force
South Africa
    South African Air Force
South Korea
    Republic of Korea Air Force
Sri Lanka
    Sri Lanka Air Force
Swaziland
    Military of Swaziland
Thailand
    Royal Thai Navy
Togo
    Togo Air Force
Trinidad and Tobago
United States
    United States Air Force
Zimbabwe
    Air Force of Zimbabwe

Specifications (337D)

General characteristics

- **Crew:** 1
- **Capacity:** 5 passengers
- **Length:** 29 ft 9 in (9.07 m)
- **Wingspan:** 38 ft 0 in (11.58 m)
- **Height:** 9 ft 4 in (2.84 m)
- **Wing area:** 201 ft² (18.7 m²)
- **Empty weight:** 2,655 lb (1,204 kg)
- **Max takeoff weight:** 4,400 lb (2,000 kg)
- **Powerplant:** 2× Continental IO-360-C piston engine, 210 hp (157 kW) each

Performance

- **Maximum speed:** 200 mph (174 kn, 320 km/h)

- **Range:** 764 mi (664 nmi, 1,220 km)
- **Service ceiling:** 19,500 ft (5,944 m)
- **Rate of climb:** 1,200 ft/min (6.1 m/s)

Chapter- 7

Dornier Do 18

Do 18

Role	Flying boat
Manufacturer	Dornier
First flight	15 March 1935
Primary users	Luftwaffe Lufthansa
Number built	170

The **Dornier Do 18** was a development of the Do 16 flying boat. It was developed for the *Luftwaffe* , but *Lufthansa* got 5 aircraft and used these for tests between the Azores and the North American continent in 1936 and on their mail route over the South Atlantic from 1937 to 1939.
27–29 March 1938 a "Do 18 W" established a seaplane record flying non-stop a straight distance of 8,391 km (5,214 mi) from Start Point, Devon to Caravelas in Brazil.

Design and development

In 1934, the Dornier *Flugzeugwerke* started development of a new twin engined flying boat to replace the Dornier Do J *"Wal"* (Whale) in both military and civil roles. The resultant design, *Do 18* retained the layout of the Wal, with a metal hull fitted with distinctive stabilising sponsons, and powered by two engines above the wing in a push-pull layout, but was aerodynamically and hydrodynamically more efficient. It was planned to be powered by two of the new Junkers Jumo 205 diesel engines. Although heavy, these promised to give much lower fuel consumption than conventional petrol engines of similar power.

The first prototype, the **Do 18a**, registration *D-AHIS* (and named *Monsun* by Lufthansa) flew on 15 March 1935, powered by two of the earlier 410 kW (550 hp) Junkers Jumo 5c diesels as the planned Jumo 205s were not yet available. It was lost on 2 November 1935 over the Baltic during high-speed tests. Three further prototypes followed, two (the Do 18d and Do 18b) being prototype military aircraft, and the Do 18c (later redesignated Do 18 V3), a civil prototype.

The Do 18c was delivered to Lufthansa as a Do 18E civil transport (*D-ABYM Aeolus*), quickly followed by a further two aircraft, (*D-AANE Zyklon* and *D-ARUN Zephir*) with a final Do 18E (*D-AROZ Pampero*) being built in 1938.

A further civil Do 18 was the **Do 18F**, a modified aircraft with longer wingspan and higher weights built for extended-range flights. The sole Do 18F, *D-ANHR*, first flew on 11 June 1937. It was later modified with 656 kW (880 hp) BMW 132N radial engines to test a possible upgrage for the Luftwaffe's aircraft, flying in this from on on 21 November 1939 as the **Do 18L**. It suffered cooling problems, however, and further development of the radial powered Do 18 was abandoned.

Operational history

Civil service

In 1936, Lufthansa started a series of endurance trials, culminating on 10–11 September when *Zephir*, flown by *Flugkapitän* Blankenburg with Lufthansa Director Freiherr von Gablenz as passenger, was launched by catapult from the seaplane tender *Schwabenland* at Horta, Azores, flying the 4,460 km (2,270 mi) to New York in 22 hours 12 minutes. Also on 11 September, *Aeolus* flew from Horta to Hamilton, Bermuda in 18 hours 15 minutes, continuing to New York the next day. For the main leg of the North Atlantic the aircraft needed the help of the catapult on *Schwabenland*. On 22 September *Aeolus* returned to Horta in 17:50 h (3850 km). *Zephir* was catapulted on 28 September at Hamilton. The second Flights to New York followed on 5-6 and 6–7 October and the returnflights this time 17 and 18 October from Sydney, Nova Scotia. The flying boats did not wait for their tender and went on to Lisbon and Travemünde.

In April 1937 D-ARUN *Zephir* and D-ABYM *Aeolus* started their service on the South Atlantic mail route from Bathurst, now Banjul, Gambia to Natal, Brazil (3040 km). Catapult ships were based in Bathurst and Fernando de Noronha to allow the aircraft to cross the Atlantic carrying a full load of mail.

In June they were joined by V6 D-AROZ *Pampero*. *Aeolus* was lost on 30 July 1937, when it had to make an ocean landing due to engine problems and was heavily damaged when *Ostmark* tried to retrieve the plane. *Pampero* (20 August) and *Zephir* (29 January 1938) also had to make ocean landings. *Pampero* was lost at sea nearly without trace on 1 October 1938 with a crew of five.

Lufthansa's fifth aircraft was the only **Do 18F** V7 D-ANNE *Zyklon*, that first took to the skies on 11 June 1937. This was the only Do 18 with a wider span which enable it to stay in the air with one engine out. This was a special demand of *Lufthansa Zyklon* was used over the South Atlantic between September 1937 and March 1939. The Do 18s crossed the South Atlantic 73 times.

Zyklon is not the aircraft, that established the England to Brazil distance record from 27–29 March 1938 as often stated.

The record-aircraft D-ANHR was taken from the military production line and was specially prepared. It was flown as a builder's machine with a Lufthansa crew augmented by the works pilot *Gundermann*. On the way back to the South American station the seaplane tender *Westfalen* took the plane in the English Channel where it was catapulted to Brazil. On the record flight the conditions were not optimal and the plane did not reached Rio de Janeiro as planned.

Military use

In *Luftwaffe* service, it was obsolete by the outbreak of World War II, but - as the only military flying boat - 62 (58 serviceable) in 6 squadrons were in use mainly on North Sea reconnaissance missions. In 1940 some squadrons changed their base to Norway. The vulnerable and underpowered flying boat was soon relegated to training and the air/sea rescue role. In the middle of 1941 only one Squadron was still operational on Do 18. The Blohm & Voss BV 138 had superseded the Dornier.

A Do 18 was the first German aircraft to be shot down by British aircraft during the war, when one of a formation of three was caught over the North Sea by nine Fleet Air Arm Blackburn Skua fighter-bombers of 803 Naval Air Squadron flying from HMS *Ark Royal* on 26 September 1939. The flying boat was able to make an emergency landing but was sunk by the destroyer HMS *Somali*.

Variants

Civil variants

Do 18E
: Initial civil version, powered by 410 kW (550 hp) Jumo 205C-1 engines. Four built.

Do 18F
: Long range civil version V7 D-ANNE *Zyklon*, with extended-span (26.30 m (86 ft 3 in)) wings and increased take-off weight. One built.

Do 18L
: The record-aircraft D-ANHR modified with BMW 132M radials. One converted.

Military variants

- The **Do 18D** 79 built, was the first military version, powered by two 450 kW (600 hp) Jumo 205C engines, armed with one 7.92 mm (0.312 in) MG 15 machine gun in the bow and dorsal positions.
- The **Do 18G** 62 built, was an improved version, powered by two 656 kW (880 hp) Jumo 205D engines, armed with a 13 mm (0.51 in) MG 131 machine gun in the bow, and a 20 mm MG 151 cannon in a power-operated dorsal turret. This version had an altered bow contour and broader sponsons
- The **Do 18H** 22 built (+ conversions ?) was an unarmed dual-control training version.
- The **Do 18N** was a designation for unarmed air-sea search and rescue conversions.

Including the civilian flying boats 170 Dornier Do 18 were built by Dornier in Manzell (48 until March 1939) and Weser-Flugzeugbau in Einswarden and Nordenham (122 until August 1940).

Operators

- Germany
  - *Lufthansa*
  - *Luftwaffe*

Specifications (Do 18D-1)

General characteristics

- **Crew:** 4
- **Length:** 19.23 m (63 ft 1 in)
- **Wingspan:** 23.70 m (77 ft 9 in)
- **Height:** 5.32 m (17 ft 5¾ in)
- **Wing area:** 98.0 m² (1,055 ft²)
- **Empty weight:** 6,680 kg (14727 lb)

- **Max takeoff weight:** 8,500 kg (18,739 lb) (Normal take-off) (Catapult weight: 10,000 kg (22,046 lb)
- **Powerplant:** 2× Junkers 205C-4 six-cylinder, vertically opposed diesel engine, 451 kW (C-engine) (605 hp) (take-off power) each

Performance

- **Maximum speed:** 250 km/h (135 knots, 155 mph) at sea level
- **Cruise speed:** 190 km/h (103 knots, 118 mph) (max endurance cruise)
- **Range:** 3,500 km (1,890 nmi, 2,175 mi)
- **Service ceiling:** 4,350 m (14,270 ft)
- **Climb to 1,000 m (3,300 ft):** 7.5 min

Armament

- **Guns:** 1 × 7.92 mm MG 15 machine gun in each of bow and dorsal positions
- **Bombs:** 2× 50 kg (110 lb) bombs under starboard wing

Chapter- 8

Dornier Do 335

Do 335 *Pfeil*

Role	Fighter-bomber
Manufacturer	Dornier Flugzeugwerke
First flight	October 1943
Introduced	1944
Primary user	*Luftwaffe*
Number built	37

The **Dornier Do 335 *Pfeil*** ("Arrow") was a World War II heavy fighter built by the Dornier company. The two-seater trainer version was also called *Ameisenbär* ("anteater"). The *Pfeil*'s performance was much better than other twin-engine designs due to its unique "push-pull" layout and the much lower drag of the in-line alignment of the two motors. The *Luftwaffe* was desperate to get the design into operational use, but delays in engine deliveries meant only a handful were delivered before the war ended.

Development

The origins of the Do 335 trace back to World War I when Claudius Dornier designed a number of flying boats featuring remotely-driven propellers and later, due to problems with the drive shafts, tandem engines. Tandem engines were used on most of the multi-

engine Dornier flying boats that followed, including the highly successful Do J and the gigantic Do X. The remote propeller drive, intended to eliminate parasitic drag from the engine entirely, was tried in the innovative but unsuccessful Do 14, and elongated drive shafts as later used in the Do 335 saw use in the rear engines of the four-engined, twinned tandem-layout Do 26 flying boat.

There are many advantages to this design over the more traditional system of placing one engine on each wing, the most important being power from two engines with the frontal area (and thus drag) of a single-engine design, allowing for higher performance. It also keeps the weight of the twin powerplants near, or on, the aircraft centerline, increasing the roll rate compared to a traditional twin. In addition, a single engine failure does not lead to asymmetric thrust, and in normal flight there is no net torque so the plane is easy to handle. The choice of a full "four-surface" set of cruciform tail surfaces in the Do 335's design, allowed the ventral vertical fin–rudder assembly to project downwards from the extreme rear of the fuselage, in order to protect the rear propeller from an accidental ground strike on takeoff.

In 1939, Dornier was busy working on the **P.59** high-speed bomber project, which featured the tandem engine layout. In 1940, he commissioned a test aircraft to validate his concept for turning the rear pusher propeller with an engine located far away from it and using a long driveshaft. This aircraft, the Göppingen Gö 9 showed no unforeseen difficulties with this arrangement, but work on the P.59 was stopped in early 1940 when Hermann Göring ordered the cancellation of all projects which would not be completed within a year or so.

In May 1942, Dornier submitted an updated version with a 1,000 kg (2,200 lb) bombload as the **P.231**, in response to a requirement for a single seat high-speed bomber/intruder. P.231 was selected as the winner after beating rival designs from Arado, Junkers, and Blohm & Voss development contract was awarded as the Do 335. In autumn 1942, Dornier was told that the Do 335 was no longer required, and instead a multi-role fighter based on the same general layout would be accepted. This delayed the prototype delivery as it was modified for the new role.

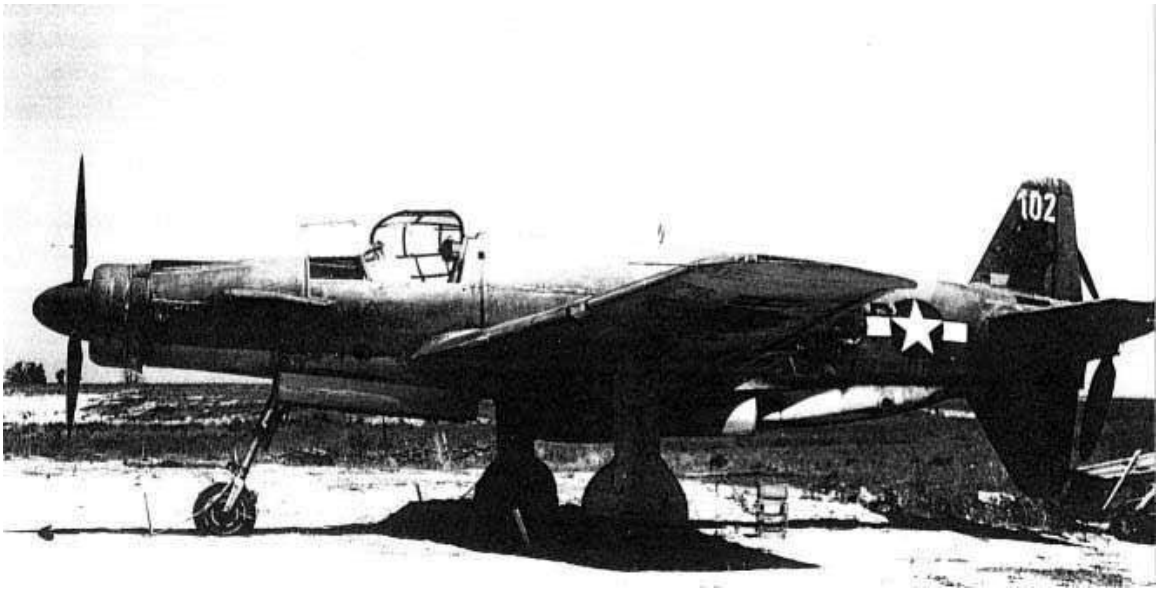
Fitted with DB 603A engines delivering 1,750 PS (1,287 kW, 1,726 hp) at takeoff, the Do 335 V1 first prototype, bearing the *Stammkennzeichen* (factory radio code) of **CP+UA**, flew on 26 October 1943 under the control of *Flugkapitän* Hans Dieterle, a regular Heinkel test pilot and later primary Dornier test pilot. The pilots were surprised at the speed, acceleration, turning circle, and general handling of the type; it was a twin that flew like a single. However, several problems during the initial flight of the Do 335 would continue to plague the aircraft through most of its short history. Issues were found with the weak landing gear and with the gear doors, resulting in them being removed for the remainder of V1 flights. V1 made 27 flights, flown by three different pilots. During these test flights V2 (W.Nr 230002), *Stammkennzeichen* CP+UB was completed and made its first flight on 31 December 1943, again under the control of Dieterle. New to the V2 were upgraded DB603 A-2 engines, and several refinements learned from the test flights of V1 as well as further windtunnel testing. On 20 January 1944, V3 (W.Nr.

230004),*Stammkennzeichen* CP+UC was completed and flown for its first time by Werner Altrogge. V3 was powered by the new DB603 G-0 engines which could produce 1,900 PS (1,400 kW) at take-off and featured a slightly redesigned canopy which included rear-view mirrors in blisters, one in each of two matching side panels of the main canopy. Following the flights of the V3, in mid January 1944, RLM ordered five more prototypes (V21–V25), to be built as night fighters. By this time more than 60 hours of flight time had been put on the Do 335 and reports showed it be a good handling, but more importantly, very fast aircraft, described by Miltch himself as "...holding its own in speed and altitude with the P-38 and does not suffer from engine reliability issues". Thus the Do 335 was scheduled to begin mass construction, with the initial order of 120 preproduction aircraft to be manufactured by DWF (Dornier-Werke Friedrichshafen) to be completed no later than March 1946. This number included a number of bombers, destroyers (heavy fighters), and several yet to be developed variants. At the same time, DWM (Dornier-Werke München) was scheduled to build over 2000 Do 335s in various models, due for delivery in March 1946 as well.

On 23 May 1944, Hitler, as part of the *Jägernotprogramm* directive, ordered maximum priority to be given to Do 335 production. The main production line was intended to be at Manzel, but a bombing raid in March destroyed the tooling and forced Dornier to set up a new line at Oberpfaffenhofen. The decision was made, along with the rapid shut-down of many other military aircraft development programs, to cancel the Heinkel He 219 night fighter, and use its production facilities for the Do 335 as well. However, Ernst Heinkel managed to delay, and eventually ignore, its implementation.

At least 16 prototype Do 335s were known to have flown (V1–V12, W.Nr 230001-230012 and *Müster*-series prototypes M13–M17, W.Nr 230013-230017) on a number of DB603 engines including the DB603A, A-2, G-0, E and E-1. The first preproduction Do 335 (A-0s) starting with W.Nr 240101, *Stammkennzeichen* VG+PG, were delivered in July 1944. Approximately 22 preproduction aircraft were thought to have been completed and flown before the end of the war, including approximately 11 A-0s converted to A-11s for training purposes.

Flight tests



Do 335 tested in the USA

The first 10 **Do 335 A-0**s were delivered for testing in May. By late 1944, the **Do 335 A-1** was on the production line. This was similar to the A-0 but with the uprated DB 603 E-1 engines and two underwing hardpoints for additional bombs, drop tanks or guns. It was capable of a maximum speed of 763 km/h (474 mph) at 6,500 m (21,300 ft) with MW 50 boost, or 686 km/h (426 mph) without boost, and able to climb to 8,000 m (26,250 ft) in under 15 minutes. Even with one engine out, it could reach about 563 km/h (350 mph).

Delivery commenced in January 1945. When the United States Army overran the Oberpfaffenhofen factory in late April 1945, only 11 Do 335 A-1 single-seat fighter-bombers and two Do 335 A-12 trainers had been completed.

French ace Pierre Clostermann claimed the first Allied combat encounter with a *Pfeil* in April 1945. In his book *The Big Show* (pages 273-274) he describes leading a flight of four Hawker Tempests from No. 3 Squadron RAF over northern Germany, he intercepted a lone Do 335 flying at maximum speed at treetop level. Detecting the British aircraft, the German pilot reversed course to evade. Despite the Tempest's considerable low altitude speed, the RAF fighters were not able to catch up or even get into firing position.

Variants

- **Do 335 A-0** : 10 pre-production aircraft.
- **Do 335 A-1** : Single-seat fighter-bomber aircraft.
- **Do 335 A-2** : Proposed single-seat fighter-bomber aircraft with new weapon aiming systems, later proposed longer wing and updated DB603L engines.
- **Do 335 A-3** : Proposed single-seat reconnaissance aircraft built from A-1 aircraft, later proposed with longer wing.

- **Do 335 A-4** : Proposed single-seat reconnaissance aircraft with smaller cameras than the A-3
- **Do 335 A-5** : Proposed single-seat night fighter aircraft, later night and bad weather fighter with enlarged wing and DB603L engines.
- **Do 335 A-6** : Proposed two seat night fighter aircraft.
- **Do 335 A-7** : Proposed A-6 with longer wing.
- **Do 335 A-8** : Proposed A-4 fitted with longer wing.
- **Do 335 A-9** : Proposed A-4 fitted with longer wing, DB603L engine and pressurized cockpit.
- **Do 335 B-1** : Abandoned in development.
- **Do 335 B-2** : Single-seat destroyer aircraft. Fitted with 2 additional Mk 103 in the wings and two 315 auxiliary fuel tanks.
- **Do 335 B-3** : Proposed updated B-1 but with longer wing.
- **Do 335 B-4** : Proposed update of the B-1 with longer wing, DB603L engine.
- **Do 335 B-12**: Proposed dual seat trainer version for the B-series aircraft.
- **Do 435** : A Do 335 with the redesigned, longer wing. Allied intelligence reports from early May 1945 make a report of a spotted Do 435 at the Dornier factory airfield at Lowenthal.
- **Do 535** : Actually the He 535, once the Dornier P254 design was handed over to Heinkel in October 1944.
- **Do 635** : Proposed long-range reconnaissance version. Also called Junkers Ju 635 or Do 335Z. Mock up only.
- **Do P 256**: Proposed turbojet nightfighter version, with two podded He S011 engines, based on Do 335 airframe. Not built.

Survivors

The only surviving Do 335 (VG+PH) at the Steven F. Udvar-Hazy Center near Washington, DC

Only one Do 335 survives today. The aircraft was the second preproduction Do 335 A-0, designated **A-02**, with construction number (*Werknummer*) 240102, and factory radio code registration, or *Stammkennzeichen*, of VG+PH. The aircraft was assembled at

Dornier's plant in Oberpfaffenhofen (southern Germany) on 16 April 1945. It was captured by Allied forces at the plant on 22 April 1945. The aircraft was test flown from a grass runway at Oberwiesenfeld, near Munich, to Cherbourg, France while escorted by two P-51s. The Do 335 was easily able to out distance the escorting Mustangs and arrived at Cherbourg 45 minutes before the P-51s. VG+PH was one of two Do 335s to be shipped to the United States aboard the Royal Navy escort carrier HMS *Reaper*, along with other captured German aircraft, to be used for testing and evaluation under a USAAF program called "Operation Sea Horse". One Do 335 (registration FE-1012) went to the USAAF and was tested in early 1946 at Freeman Field, Indiana. Its fate is not recorded.

VG+PH went to the Navy for evaluation and was sent to the Test and Evaluation Center, Patuxent River Naval Air Station, Maryland. Following testing from 1945 to 1948, the aircraft languished in outside storage at Naval Air Station Norfolk. In 1961, it was donated to the Smithsonian's National Air Museum, though it remained in deteriorating condition at Norfolk for several more years before being moved the National Air & Space Museum's storage facility in Suitland, Maryland. In October 1974, VG+PH was returned to the Dornier plant in Oberpfaffenhofen, Germany (then building the Alpha Jet) for a complete restoration. In 1975, the aircraft was restored by Dornier employees, many of whom had worked on the airplane originally. They were amazed to find that the explosive charges built into the aircraft to blow off the tail fin and rear propeller in the event of an emergency were still on the aircraft and active 30 years later.

Following restoration the completed Do 335 was displayed at the Hanover, Germany Airshow from 1 May to 9 May 1976. After the air show, the aircraft was lent to the Deutsches Museum in Munich where it was on display, without a swastika on the dorsal vertical tail in accordance with German law, until 1986, when it was shipped back to Silver Hill, Maryland. VG+PH can be seen today in the Steven F. Udvar-Hazy Center of the National Air & Space Museum alongside other unique late-war German aircraft such as the only known example of the Arado Ar 234B-2 *Blitz* jet recon-bomber, and the only surviving Heinkel He 219A *Uhu* (Eagle-Owl) night fighter's fully restored fuselage and tail surfaces is on display as an assembled unit, as the wings and engines/nacelles of the surviving He 219A there are still undergoing restoration as of Oct 2009.

Specifications (Do 335 A-0)

General characteristics

- **Crew:** 1, pilot
- **Length:** 45 ft 5 in (13.85 m)
- **Wingspan:** 45 ft 1 in (13.8 m)
- **Height:** 15 ft (4.55 m)
- **Wing area:** 592 ft² (55 m²)
- **Empty weight:** 11,484 lb (5,210 kg)
- **Max takeoff weight:** 19,500 lb (8,590 kg)

- **Powerplant:** 2× Daimler-Benz DB 603A 12-cylinder inverted engines, 1,287 kW, 1,726 hp (1,750 PS) each

Performance

- **Maximum speed:** 474 mph (765 km/h)
- **Combat radius:** 721 mi (1,160 km (half load))
- **Service ceiling:** 37,400 ft (11,400 m)

Armament

- 1 × 30 mm (1.18 in) MK 103 cannon (as forward engine-mounted *Motorkanone*)
- 2 × 20 mm MG 151 cannons
- Up to 1,000 kg (2,200 lb) bombload

Chapter- 9

Dornier Seastar and Handley Page V/1500

Dornier Seastar

Seastar

Role	Utility amphibian
National origin	Germany/United States
Manufacturer	Dornier Seaplane Company
Designed by	Claudius Dornier
First flight	1985

The **Dornier Seastar** is a turboprop-powered amphibious aircraft built largely of composite materials. Developed by Claudius Dornier of Germany, it first flew in 1985. The design is owned by Claudius Dornier's son, Conrado, who founded Dornier Seawings AG (now Dornier Seaplane Company) to continue work on the project.

Design and development

The Seastar is a parasol wing flying boat, with its two engines mounted in a single nacelle over the wings in a push-pull configuration. In general layout, it strongly resembles Dornier's Do 18 of the 1930s.

The first prototype, a proof-of-concept aircraft using the metal wings from a Dornier Do 28 and with large struts bracing the wing to the sponsons, made its maiden flight from Hamburg on 17 August 1984. The second prototype, representing the definitive design was larger, and featured a new, unbraced composite wing. It first flew from Oberpfaffenhofen on 24 April 1987.

In October 2009, Dornier Seaplane announced that it would launch production of the Seastar.

In May 2010, Dornier announced that it would build the Seastar in St-Jean-sur-Richelieu, about half an hour away from Montreal, Canada.

Variants

Seastar CD-2

Specifications (Seastar CD-2)

The Dornier Seastar on the Wolfgangsee in Austria

General characteristics

- **Crew:** One or two
- **Capacity:** 12 passengers
- **Length:** 12.46 m (40 ft 10½ in)
- **Wingspan:** 15.50 m (50 ft 10¼ in)
- **Height:** 4.60 m (15 ft 1 in)
- **Wing area:** 28.48 m² (306.6 ft²)
- **Empty weight:** 2,400 kg (5,291 lb)
- **Gross weight:** 4,200 kg (9,259 lb)
- **Powerplant:** 2 × Pratt & Whitney Canada PT6A-112, 373 kW (500 hp) each each

Performance

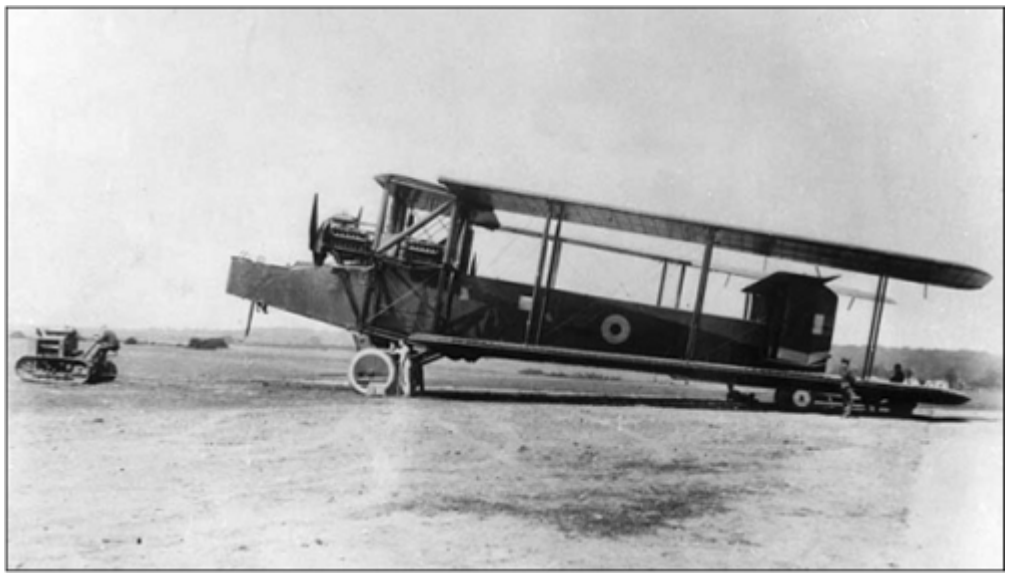
- **Cruising speed:** 341 km/h (212 mph)
- **Stall speed:** 115 km/h (72 mph)
- **Range:** 1,850 km (1,150 miles)
- **Endurance:** 9 hours 12 min
- **Service ceiling:** 8,535 m (28,000 ft)
- **Rate of climb:** 8.0 m/s (1,575 ft/min)
- **Takeoff Distance to 15 m (50 ft):** 410 m (1,345 ft)
- **Landing Distance from 15 m (50 ft) (on land):** 480 m (1,575 ft)

Handley Page V/1500

Handley Page V/1500

Role Heavy Bomber

Manufacturer	Handley Page
Designed by	George Rudolph Volkert
First flight	22 May 1918
Introduction	1918
Primary user	Royal Air Force
Number built	63



Handley Page V/1500 illustrating its folding wing capability

The **Handley Page V/1500** was a British night-flying heavy bomber built by Handley Page towards the end of the First World War. It was a large four-engined biplane, which resembled a larger version of Handley Page's earlier O/100 and O/400 bombers, intended to bomb Berlin from East Anglian airfields. The end of the war stopped the V/1500 being used against Germany, but a single aircraft was used to carry out the first flight from England to India, and later carried out a bombing raid on Kabul during the Third Anglo-Afghan War. It was colloquially known within the fledgling Royal Air Force as the "Super Handley".

Development and design

The V/1500 was produced to meet a British Air Board 1917 requirement for a large night bomber capable of reaching deeper into Germany than the Handley Page O/100 which had recently entered service, carrying a 3,000 lb (1,400 kg) bombload. This implied the ability to bomb Berlin from bases in East Anglia.

While the V/1500 had a similar fuselage to that of the O/100, it had longer-span, four-bay biplane wings and was powered by four 375 hp (280 kW) Rolls-Royce Eagle VIII engines mounted in two nacelles, so two engines were pulling in the conventional manner and two pushing, rather than the two Eagles of the smaller bomber. Construction was of

wood and fabric materials. A relatively novel design feature was the gunner's position at the extreme rear of the fuselage, between the four fins.

Owing to pressure of work at Handley Page's Cricklewood factory, and to ensure security, the first prototype was constructed by Harland and Wolff at Belfast, Northern Ireland, being assembled at Cricklewood and first flying on 22 May 1918. Orders were placed with a number of companies (including Harland and Wolff, Beardmore, Handley Page, Grahame-White and Alliance Aircraft for a total of 210 V/1500s, although only 40 aircraft were completed, with a further 22 produced as spares.

Service

Three aircraft were delivered to No. 166 Squadron at RAF Bircham Newton (Norfolk) during October 1918. The squadron commander did not get clear orders for his mission until November 8, due to debate at high level. A mission was scheduled for that night (bomb Berlin, fly on to Prague as the Austro-Hungarian forces had surrendered by then, refuel, re-arm, bomb Düsseldorf on the way back). No mission was flown - a technical expert insisted that all the engines on one aircraft be changed. The same happened the following day (but with a different aircraft). The three aircraft were about to taxi out after the second set of engine changes when an excited ground crew member ran out to stop them — the Armistice had just been declared.

One of the original batch of aircraft (J1936, *Old Carthusian*) went on to record two significant 'firsts'. On 13 December 1918, the bomber, flown by Major A.C.S. Maclaren and Captain Robert Halley, accompanied by Brigadier General N.D.K. McEwan, made the first ever 'through-flight' from England to India. Taking off from Britain the aircraft flew via Rome, Malta, Cairo, and Baghdad, finally reaching Karachi on 15 January 1919.

The same aircraft played a pivotal role in ending the Third Anglo-Afghan War. On 24 May 1919, flying from Risalpur piloted by Captain Halley and with Lt E. Villiers as observer, the V/1500 reached Kabul in three hours. Of its payload of four 112 lb (51 kg) bombs on improvised bomb racks removed from B.E.2cs and 16 20 lb (10 kg) bombs carried in the fuselage and dropped by hand, four bombs hit the royal palace. Although the bombing did little physical damage, it had a great psychological impact on the citizens - the ladies of the royal harem rushed onto the streets in terror, causing great scandal. A few days later King Amanullah sued for peace, bringing an end to the war after less than one month of hostilities. This could be said to be the first decisive use of strategic bombing..

The Handley Page V/1500 aircraft *Atlantic* was shipped to Newfoundland in early 1919 to attempt the first non-stop Transatlantic flight. Unfortunately the prize was won by Alcock and Brown in a Vickers Vimy in June 1919. The crew departed for New York but was forced to land in Parrsboro, Nova Scotia on 5 July 1919 where it was repaired over the course of the summer. The *Atlantic* continued to New York on 9 October 1919 carrying with it the first Airmail from Canada to the United States of America.

Final production of the V/1500 totalled 60 aircraft. They were eventually replaced in service by the Vickers Vimy. J1936 ended its life being consumed by termites.

Operators

United Kingdom

- Royal Air Force
  - No. 166 Squadron RAF
  - No. 167 Squadron RAF
  - No. 274 Squadron RAF

Specifications (V/1500)

General characteristics

- **Crew:** Eight or nine
- **Length:** 64 ft 0 in (19.51 m)
- **Wingspan:** 126 ft 0 in (38.41 m)
- **Height:** 23 ft 0 in (7.01 m)
- **Wing area:** 2,800 ft² (260 m²)
- **Empty weight:** 17,600 lb (8,000 kg)
- **Max takeoff weight:** 30,000 lb (14,000 kg)
- **Powerplant:** 4× Rolls-Royce Eagle VIII V-12 water cooled, 375 hp (280 kW) each

Performance

- **Maximum speed:** 99 mph (159 km/h) at sea level
- **Range:** 1,300 mi (2,090 km)
- **Service ceiling:** 11,000 ft (3,350 m)
- **Endurance:** 17 hours
- **Climb to 10,000 ft (3,000 m):** 41 min 25 sec

Armament

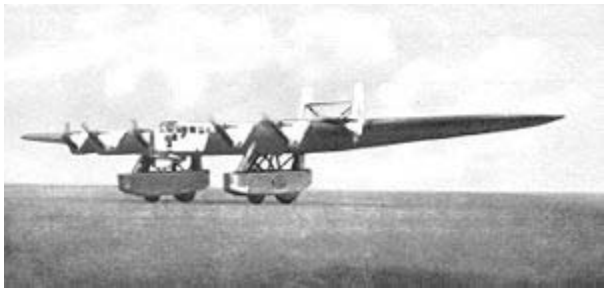
- **Guns:** 3 × .303 in (7.7 mm) Lewis guns each in nose, dorsal and tail positions
- **Bombs:** Up to 7,500 lb (3,400 kg) of bombs (30 × 250 lb/113 kg carried internally)

Chapter- 10

Kalinin K-7 and Latécoère 550

Kalinin K-7

K-7



Role	Heavy bomber
National origin	Soviet Union
First flight	1933
Number built	One

A detailed scale model of a K-7

Kalinin K-7 (Ukrainian: Калінін К-7) was a heavy experimental aircraft designed and tested in the Soviet Union in the early 1930s. K-7 was of unusual configuration with twin booms and large underwing pods housing fixed landing gear and machine gun turrets. In the passenger version, seats were arranged inside the 2.3 meter (7 ft 7 in) thick wings. The airframe was welded from *KhMA* chrome-molybdenum steel. The original design called for six engines in the wing leading edge but when the projected loaded weight was exceeded, two more engines were added to the trailing edges of each wing, one right and one left of the central passenger pod. However V. Nemecek states in his book, *The History of Soviet Aircraft from 1918*, that there was only one further pusher engine added; this agrees with the specification supplied far below.

Designed by World War I Aviator Kostyantyn Kalinin with a wingspan close to that of a B-52 and a much greater wing area, the K-7 was one of the biggest aircraft built before the jet age. It was only one engine short of the B-52 as well, having the curious arrangement of six pulling on the wing leading edge and one pushing at the rear.

The K-7 was built in two years at Kharkiv starting in 1931.

The K-7's very brief first flight showed up instability and serious vibration caused by the airframe resonating with the engine frequency. The solution to this 'flutter' was thought to

be to shorten and strengthen the tail booms, little being known then about the natural frequencies of structures and their response to vibration.

K-7 first flew on 11 August 1933. The aircraft completed seven test flights before a crash due to structural failure of one of the tail booms on November 21, 1933. The accident killed 14 people aboard and one on the ground. Although two more prototypes were ordered in 1933, the project was cancelled in 1935 before they could be completed.

In 1938 Kalinin was executed as an enemy of the state.

Specifications (K-7)

General characteristics

- **Crew:** minimum 11
- **Capacity:** 120 passengers in civilian configuration
- **Length:** 28 m (91 ft 10 in)
- **Wingspan:** 53 m (173 ft 11 in)
- **Height:** ()
- **Wing area:** 454 m² (4,886.8 ft²)
- **Empty weight:** 24,400 kg (53,793 lb)
- **Loaded weight:** 38,000 kg (83,776 lb)
- **Powerplant:** 7× Mikulin AM-34F V-12 piston engines, 560 kW (750 hp) each

Performance

- **Maximum speed:** 225 km/h (121 knots, 140 mph)
- **Service ceiling:** 4,000 m (13,123 ft)
- **Wing loading:** 84 kg/m² (17 lb/ft²)
- **Power/mass:** 103 W/kg (0.06 hp/lb)

Latécoère 550

Latécoère 550

Role	Torpedo bomber
National origin	France
Manufacturer	La societe industrielle d'aviation Latécoère
First flight	29 April 1933
Number built	1

The **Latécoère 550** was a four engined French seaplane, designed in the early 1930s as a bomber/torpedo bomber. Though initial handling problems were partly resolved, the aircraft was deemed too slow and did not go into production.

Design and development

In late 1932 Latécoère received an order from the Commission d'examen des Prototypes et Appareils Nouveaux de l'Aeronautique (CEPANA) for a large four engined floatplane for bomber and torpedo bomber rôles. The resulting aircraft, the Latécoère 550 flew the following year. It was a high wing monoplane with its four Gnôme et Rhône 9 Kdr radial engines mounted on the wings in tandem, tractor-pusher pairs. The tractor motors, neatly cowled, projected well clear of he leading edge; the pusher pair were placed in deep cut-outs in the trailing edge. The cowlings of the latter pair were removed after the first few flights to improve cooling. The wing centre section, between the engines, had an all-metal internal structure and the forward part of the skin was also metal, replaced by fabric further aft. The outer wing sections were slightly tapered on the leading edge only, with elliptical tips; they were entirely fabric covered over a largely wooden structure, though the principal ribs were metal lattices. 6° of dihedral were added after the first tests. Double ailerons of mixed wood and metal construction filled almost all the trailing edges beyond the engine cut-outs.

The fuselage was flat sided and bottomed and only slightly curved on the upper surface. The forward part, from the nose to about midway to the tail was an all steel structure built on four longerons. Further aft, the longerons continued but were now internally braced with spruce struts and fabric covered. The forward part was deeper, ending at the rear with an open position for a ventral gunner. At the nose, where the upper fuselage sides curved inwards to an upper gun turret and a navigator's glazed position below, the lower part ended slightly further aft in an enclosure for the bomb aimer. Pilot and co-pilot sat side by side in a glazed cockpit ahead of the leading edge. Behind them, under the same glazing, sat the engineer and the radio operator. Further aft, at the wing trailing edge, was a dorsal gunner's turret. All crew positions were joined by a corridor.

The Latécoère 550 had its tailplane mounted on top of the fuselage, strut braced from below and bearing twin inboard fins and rudders separately braced to the top of the fuselage. During flight trials, these vertical surfaces evolved in stages from a rather blunt shape, with extensions below the tailplane to a surface with a smoothly curved trailing edge entirely above the tailplane. The rudders were fitted with trim tabs. Because of the inboard rudders, the elevators had three sections.

The 550 was normally equipped with long, single stepped floats. These were mounted below the engines with four vertical spars per side and braced to the fuselage with a further pair running upwards and inwards. Each float also held the inner ends of a pair of lift struts which joined the outer section of the wing at about mid-span. Between engine, float and fuselage the bracing was complicated by further diagonal struts. The floats were replaced for a time with a pair of single wheels, contained in a streamlined structure strong enough to allow attachment of the same struts that connected to the floats. In this

landplane configuration a small steerable tailwheel was added. The split undercarriage allowed the 550 to launch torpedoes and bombs from a longitudinally divided bay beneath the fuselage, with a maximum weapons weight of 1,500 kg (3,100 lbs) and torpedoes carried on the port side.

The first flight was made from Latécoère's marine base at Biscarosse on 29 April 1933 with the 550 in seaplane form. After some modifications to engine cowlings, wings and tail it went to CEPANA at Saint-Raphaël, Var for trials in October 1933 and in November was converted, in less than four hours, into a landplane. It was not well received and described as unfit for purpose: instabilities, high control loads and pitching on contact with the water were amongst the criticisms. After modifications, including the final vertical stabiliser changes, the 550 went back to CEPANA in April 1934 in seaplane form. It seems to have handled better, but by now its maximum speed was seen as low; when the sole 550 was lost in October 1934, its port float struts collapsing on alighting, there was no enthusiasm for further development.

Specifications (seaplane)

General characteristics

- **Crew:** 5
- **Length:** 19.79 m (64 ft 11 in)
- **Wingspan:** 33.97 m (111 ft 5 in)
- **Height:** 5.79 m (19 ft 0 in)
- **Wing area:** 129 m^2 (1,390 sq ft)
- **Empty weight:** 7,264 kg (16,014 lb) up to 7,305 kg depending on equipment
- **Gross weight:** 10,569 kg (23,301 lb)
- **Powerplant:** 4 × Gnôme et Rhône 9 Kdr 9-cylinder radial, 370 kW (500 hp) each at 2,250 rpm

Performance

- **Maximum speed:** 252 km/h (157 mph; 136 kn) at 100 m
- **Combat range:** 1,000 km (621 mi; 540 nmi)
- **Service ceiling:** 6,500 m (21,325 ft) calculated
- **Rate of climb:** 4.10 m/s (807 ft/min) to 4000 m (13,125 ft)

Armament

- 1× 7.7 mm (0.303 in) Lewis machine gun in each of the turrets and in the open ventral position.
- Bombs and torpedoes up to 1,500 kg (3,100 lb) in total in fuselage bay, bombs in starboard side racks and torpedo port side.

Chapter- 11

Moynet Jupiter and Rutan Defiant

Moynet Jupiter

Jupiter

The Moynet 360-6 second prototype Jupiter at Toussus-le-Noble airfield near Paris in June 1971. (Rear propeller is hidden by starboard fin.)

Role	Executive transport
National origin	France
Manufacturer	Engins Matra/Sud-Aviation
Designed by	André Moynet
First flight	17 December 1963
Number built	2

The **Moynet 360 Jupiter** was a small executive transport built in France in the 1960s. It had an unusual twin push-pull configuration, single fuselage configuration. Two prototypes were produced, the second with more power and seating, but no sales resulted.

Design and development

Some civil propeller driven aircraft that have used one or more pairs of engines in push-pull configuration have been flying boats, with engines mounted above the wing and clear of spray. Others have had a pair of engines, one at either end of a pod fuselage with a tail unit mounted on a pair of booms, for example the Cessna Skymaster, the Adam A500 or the Rutan Voyager. The Moynet 360 Jupiter was an example of a push-pull aircraft of a less common configuration, where a single conventional fuselage has an engine at either end; the Dornier Do 335 fighter used the same arrangement. For light civil aircraft, the aim was to combine the performance of a conventional twin-engined aircraft with the ease of handling of a single-engined one.

The Jupiter was an executive transport with between four and seven seats, depending on engine power. It was designed by André Moynet, a member of the National Assembly of France and a former government minister, while also a test-pilot, and built by S.S. Engins Matra (so it is sometimes referred to as the **Matra Moynet Jupiter**), the first prototype flying on 17 December 1963 with the designer and Lucien Tieles at the controls. Its wing had a straight trailing edge, but the centre section had strong taper on the leading edge which continued more weakly outboard. It was of two spar, stressed skin construction, carrying mass balanced ailerons and slotted flaps. The main undercarriage legs, placed at the end of the centre section each carried a single wheel and retracted inwards electrically. A retractable nosewheel completed the landing gear.

One horizontally opposed Lycoming engine was conventionally placed in the nose. Behind it was a standard cabin, though the front seats were further ahead of the leading edge than usual because of the rearward shift of the centre of gravity caused by the rear engine. There were three large windows on each side. For the same reason the rear fuselage was quite short, and it lacked the normal taper, giving it a boxy look, so that the second, pusher Lycoming could be mounted in the extreme tail. This was cooled by air from rectangular intakes on the upper sides of the rear fuselage. The straight edged, tapered tailplane was mounted on the fuselage top above the engine, with small endplate fins carrying balanced rudders. These fins extended above and below the tailplane, with arrow shaped leading edges and straight, swept trailing edges. There was also a long, shallow strake over the rear fuselage. Seen from below, the long span of the tailplane was striking, about 44% of that of the wings; the elevators filled most of the outer part of its trailing edge, avoiding the propeller airstream.

Only two Jupiters were built. The first, designated 360-4 and initially registered as *F-WLKE* had two 200 hp (150 kW) Lycoming IO-360-A1A engines driving two bladed propellers and was configured as a 4-5 seater.

The second prototype was of a more powerful and slightly larger variant designated the model 360-6; it first flew on 25 May 1965. This model had a choice of engines, either 290 hp (216 kW) Lycoming IO-540 six cylinder engines driving constant speed, three bladed propellers, or 310 hp (231 kW) Lycoming TIO-541 engines. The span was increased by 0.37 m (15 in) and length by 0.64 m (25 in). The increased length allowed

seats for 6-7, with two rows of two single seats and a bench seat at the rear that could accommodate 2 or 3. The cabin was sound-proofed and air conditioned and could be pressurised. Access was via a forward starboard side door. There was baggage space behind the cabin with its own external door. The sole 360-6 was registered as *F-WLKY*.

The intention was for Sud-Aviation to produce the 360-6 Jupiter as the **Sud-Aviation M 360-6 Jupiter**. An order was obtained from the French government for some 360-6 pre-production aircraft, but this seems to have been cancelled. Despite sales campaigns in Europe and the U.S.A. no further orders resulted.

The first prototype is now in the reserve collection of the Musée de l'Air et de l'Espace, Le Bourget Airport, Paris museum and the second in the Musée Regional de l'Air, Angers - Loire Airport, France. At le Bourget, the 360-4 bears the normal French registration *F-BLKE* rather than the French prototype style *F-WLKE*.

Variants

M 360-4 Jupiter
: First prototype, 4–5 seats, two 149 kW (200 hp) Lycoming IO-360 engines.

M 360-6
: Second prototype, with stretched fuselage with seven seats and two 216 kW (290 hp) Lycoming IO-540 engines.

M 360-6P
: Proposed pressurised seven-seat version, with Lycoming O-480 engines. Unbuilt.

Sud-Aviation Présidence
: Further enlarged, pressurised version planned by Sud-Aviation.

Specifications (360-6, Lycoming IO-540)

General characteristics

- **Capacity:** 6 or 7 including crew
- **Length:** 8.77 m (28 ft 9 in)
- **Wingspan:** 11.49 m (37 ft 8 in)
- **Height:** 2.46 m (8 ft 1 in)
- **Wing area:** 16.81 m^2 (180.9 sq ft)
- **Empty weight:** 1,338 kg (2,950 lb)
- **Gross weight:** 2,390 kg (5,269 lb)
- **Fuel capacity:** 566 L
- **Powerplant:** 2 × Lycoming IO-540 6-cylinder horizontally opposed air cooled, 216 kW (290 hp) each
- **Propellers:** 3-bladed Hartzell constant speed

Performance

- **Maximum speed:** 363 km/h (226 mph; 196 kn) at sea level. All performance figures estimates at maximum take-off weight.

- **Cruising speed:** 338 km/h (210 mph; 183 kn) at 1,830 m (6,000 ft) on 75% power
- **Range:** 2,060 km (1,280 mi; 1,112 nmi) at 4,500 m(15,000 ft) and 45% power.
- **Rate of climb:** 7.3 m/s (1,440 ft/min) at sea level

Rutan Defiant

The **Rutan Model 40 Defiant** is a four-seat, twin-engine aircraft with the engines in a push-pull configuration. It was designed by well-known aerospace engineer Burt Rutan for the Rutan Aircraft Factory.

Rutan Defiant N57KS.

Rutan Defiant

Development

The prototype Defiant, N78RA, first flew on 30 June 1978. It was intended as a proof-of-concept of a very safe light twin design, requiring little trim change and no pilot action in case of engine failure, and with good single engine performance. A comparison of the Defiant single engine climb rate with a Grumman Cougar showed about 390 vs 280 ft/min at low altitude with both aircraft cleaned up. The prototype is now owned by the Hiller Aviation Museum.

In 1979 the Rutan Aircraft Factory announced they would proceed with certification of a Defiant-based light twin. Adequate financing was not secured for this project, and the design was modified for homebuilt construction as the **Model 74**, with the second aircraft (built by Fred Keller) appearing at Oshkosh 1983. Plans were offered in mid-1984. Nine examples were known to be flying as of mid-1987. Nineteen are registered with the FAA as of 2005.

Specifications (Defiant)

General characteristics

- **Crew:** one, pilot
- **Capacity:** 3 passengers
- **Length:** 22.8 ft (6.95 m)
- **Wingspan:** 30 ft 9 in (9.4 m)
- **Height:** 9.33 ft ()
- **Wing area:** 139.4 ft² (12.95 m²)
- **Empty weight:** 1,701 lb (771.5 kg)

- **Loaded weight:** 2,997 lb (1,360 kg)
- **Max takeoff weight:** 2,997 lb (1,360 kg)
- **Powerplant:** 2× Lycoming O-320, 160 hp (119 kW) each

Performance

- **Maximum speed:** 188 kts (216 mph / 342 km/h)
- **Range:** 1,130 miles (1,808 km)
- **Service ceiling:** 18,000 ft (5,485 m)
- **Rate of climb:** 1,600 ft/min (488 m/min)

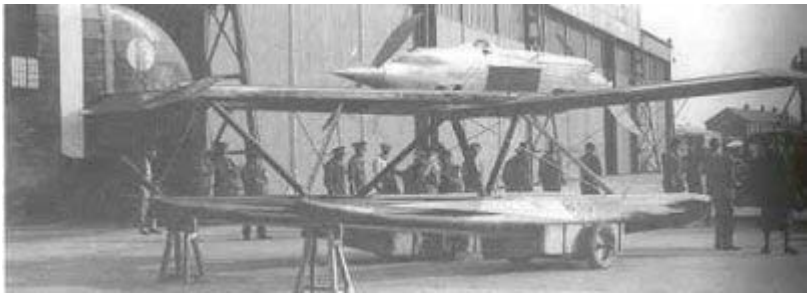
Chapter- 12

Savoia-Marchetti S.65 and Schweizer RU-38 Twin Condor

Savoia-Marchetti S.65

Savoia-Marchetti S.65

Role	Racing seaplane
National origin	Italy
Manufacturer	Savoia-Marchetti
First flight	1929
Number built	1



The **Savoia-Marchetti S.65** was an Italian racing seaplane built for the 1929 Schneider Trophy race.

Design and development

The S.65 was a single-seat twin-engine floatplane of low-wing monoplane configuration with two floats. Its tailplane was supported by two booms and the floats, which extended well toward the rear of the aircraft. Its two 745-kilowatt (1,000-horsepower) Isotta-Fraschini engines were mounted in tandem, each driving a two-bladed propeller, one in the nose in a tractor configuration and the other at the rear of the fuselage in a pusher configuration.

Operational history

The S.65 was excluded from the 1929 race due to mechanical problems, and Italy was instead represented in the race by one Macchi M.52R and two Macchi M.67 seaplanes.

Tomasso Dal Molin of the Italian Schneider Trophy racing team was killed flying the S.65 during training at Lake Garda in northern Italy in 1930.

Operators

- Italy

Schweizer RU-38 Twin Condor

RU-38 Twin Condor

Role	Covert reconnaissance aircraft
National origin	USA
Manufacturer	Schweizer Aircraft Corporation
Designed by	Leslie Schweizer
First flight	31 May 1995
Introduction	May 1997
Status	In production
Primary users	United States Coast Guard United States Department of Justice
Produced	RU-38A 1995-1997 RU-38B 2004-2005
Number built	RU-38A - 2 RU-38B - 3
Developed from	RG-8A

The **Schweizer RU-38 Twin Condor** is a two or three-seat, fixed gear, low wing, twin boom covert reconnaissance aircraft.

RU-38 is the US military designation for the aircraft, indicating *Utility, Reconnaissance*. The Schweizer company model number is **Schweizer SA 2-38A Condor** and, in its three-seat configuration, **Schweizer SA 3-38A Condor**

Based on the Schweizer SGM 2-37 motor glider, a total of five RU-38s were produced between 1995 and 2005. The aircraft remains in production.

Background

The development of the Schweizer SGM 2-37 motor glider for training use at the United States Air Force Academy led to two reconnaissance versions of that design, carrying the company model numbers SA 2-37A and SA 2-37B. In Central Intelligence Agency, US Army and US Coast Guard service these were designated RG-8A and B. The RG-8s were employed in border security and surveillance missions.

In the mid-1990s the Coast Guard decided that the aircraft would be more useful if their capabilities were improved to include night operations by the addition of more mission sensor equipment. Discussions with Schweizer Aircraft resulted in a plan to upgrade two RG-8As and build one new aircraft to provide a total of three.

Development

The RU-38 was intended to fulfill both the low altitude, quiet, over water/hostile terrain reconnaissance role and also the high altitude standoff surveillance role.

The design missions for the RU-23A were:

- Border integrity
- Counter-terrorism surveillance
- Drug enforcement
- Electronic intelligence
- Fishery patrols
- Illegal alien surveillance
- Intelligence collection
- Maritime patrol
- Pollution patrol & environmental monitoring
- Search and Rescue

In converting to the new RU-38A configuration, the conventional RG-8A airframe was greatly modified by:

- Removing the single 235 hp (175 kW) Lycoming O-540-B powerplant
- Installing two Teledyne Continental Motors GIO-550A engines with a 3:2 gear reduction to 2267 operating rpm. The engines are mounted one in the nose and the other in the rear of the fuselage.
- Enlarging the crew compartment
- Improving the engine mufflers
- Increasing the wingspan from 56.5 ft (18.14 m) to 84.13 ft (25.65 m)
- Changing the single tail fin to a twin-boom configuration with two fins
- Greatly enlarged sensor bays
- Improved noise signature reduction
- Tricycle landing gear replacing the conventional landing gear

RU-38A

The resulting aircraft bears little resemblance to the original TG-8. Installation of the twin-boom pods permits the carriage of more sensors. The left-hand pod houses an AN/APN-215(V) color multi-function X-band sea search radar with mapping capabilities. The right-hand pod houses the AN/AAQ-15 forward looking infrared (FLIR) and Low-Light TV enhanced vision systems.

For navigation the RU-38A originally carried both OMEGA and GPS receivers, although the Omega has since been removed with that system's withdrawal from service in 1997. The aircraft also has HF, VHF and UHF radios for voice and encrypted voice communications, plus direction finding. The crew may also use night vision goggles.

The aircraft has no flaps and instead retains the top and bottom surface divebrakes of its sailplane ancestors. Maximum take-off weight of the RU-38A is 5300 lb (2404 kg)

The RU-38A is designed to transit to its operational area with both engines operating. Once in the surveillance area the rear engine would normally be shut down and the aircraft operated in "quiet surveillance mode". The second engine would be available for use in an emergency and for transit back to base.

The first Coast Guard RG-8A was returned to Schweizer for conversion to RU-38A status on 24 January 1994. The initial plan called for the conversion of two RG-8As and then build one new RU-38A.

The first flight of the converted aircraft took place on 31 May 1995. The second USCG RG-8A aircraft that was earmarked for RU-38A upgrade crashed near Puerto Rico in 1996. As a result the program was reduced to provide only two RU-38As to the USCG. The loss of the RG-8A delayed the program for many months and it was not completed until May 1997.

The first RU-38 was tested by the Air Force 445th Flight Test Squadron at Edwards AFB on behalf of the Coast Guard, starting in July 1998. The RU-38A was subject to approximately 100 test flights during the four month test program.

By September 1999 the two converted RU-38As had been delivered to the Coast Guard in Miami, Florida for operational employment. The RU-38As were flown in drug interdiction missions over the Gulf of Mexico and the Caribbean Sea, but the aircraft were reportedly grounded during 2000, due to problems with the aircraft meeting mission requirements or serviceability.

RU-38B

The company further improved the aircraft by replacing the two piston engines with two Rolls Royce Allison 250-B17F turboprop engines which allowed raising the gross weight to 7200 lbs (3265 kg). The new aircraft carries the military designation of RU-38B.

The RU-38B has 140 cubic feet (4.1 cu m) of payload space with a payload weight of 800 lbs (363 kg) available. The payload bays all have large access doors and are located both in the tailbooms and also behind the pilot and co-pilot seats in the fuselage. The latter space can also accommodate a third crew member, if required. Using pallet-mounted sensor packages the aircraft can be quickly changed from one mission to another.

The RU-38B is able to achieve quiet operation while loitering by using a propeller speed as low as 1000 rpm. This is possible because the sailplane-derived wing is efficient and flight at low airspeed can be sustained with low power.

Two RU-38Bs were delivered to the US Department of Justice, one in 2004 and one in 2005.

The RU-38B model is still being actively marketed by Schweizer in 2010.

Certification

Neither the RU-38A or B was certified by the Federal Aviation Administration. Instead all aircraft operate as experimental aircraft in the *Research and Development* category.

Operators

United States

- Schweizer Aircraft - Two RU-38A and one RU-38B
- United States Department of Justice - two RU-38B

Specifications (RU-38B)

General characteristics

- **Crew:** two in side-by-side seating or three, with two pilots in side-by-side seating and one sensor operator in the rear
- **Length:** 35.1 ft (10.7 m)
- **Wingspan:** 84.13 ft (25.65 m)
- **Height:** ()
- **Wing area:** 334.2 ft² (31.06 m²)
- **Airfoil:** Wortmann Fx 61-163
- **Empty weight:** 4265 lb (1934 kg)
- **Loaded weight:** 7200 lb (3265 kg)
- **Useful load:** 2935 lb (1331 kg)
- **Max takeoff weight:** 7200 lb (3265 kg)
- **Powerplant:** 2× Rolls Royce Allison 250-B17F Constant Speed, Full Feather, unknown horsepower () each

Performance

- **Never exceed speed:** 168 knots (312 km/h)
- **Maximum speed:** 168 knots (312 km/h)
- **Cruise speed:** 83 knots (mission speed) (155 km/h)
- **Stall speed:** 62 knots with divebrakes closed (116 km/h)
- **Service ceiling:** 30,000 ft (9230 m)
- **Rate of climb:** ft/min (m/s)
- **Wing loading:** 21.5 lb/ft² (105.1 kg/m²)
- **Power/mass:**

Chapter- 13

Short Singapore

S.19 Singapore

Singapore Mark III, K8565 ‘Q’.

Role	military flying boat
Manufacturer	Short Brothers
Designed by	Short Brothers
First flight	15 June 1934 (III)
Introduced	1935
Primary users	RAF RNZAF
Produced	1934 - 1937
Number built	37

The **Short S. 19 Singapore** was a British multi-engined biplane flying boat built after World War I. The Singapore name first appeared in the mid-1920s, on a one-off, twin-engined, record-breaking aircraft. The design was developed into two four-engined versions; the prototype **Singapore II** and production **Singapore III**. The latter became the Royal Air Force's main long-range maritime patrol flying boat of the 1930s and saw service against the Japanese with the Royal New Zealand Air Force during World War II.

Design and development

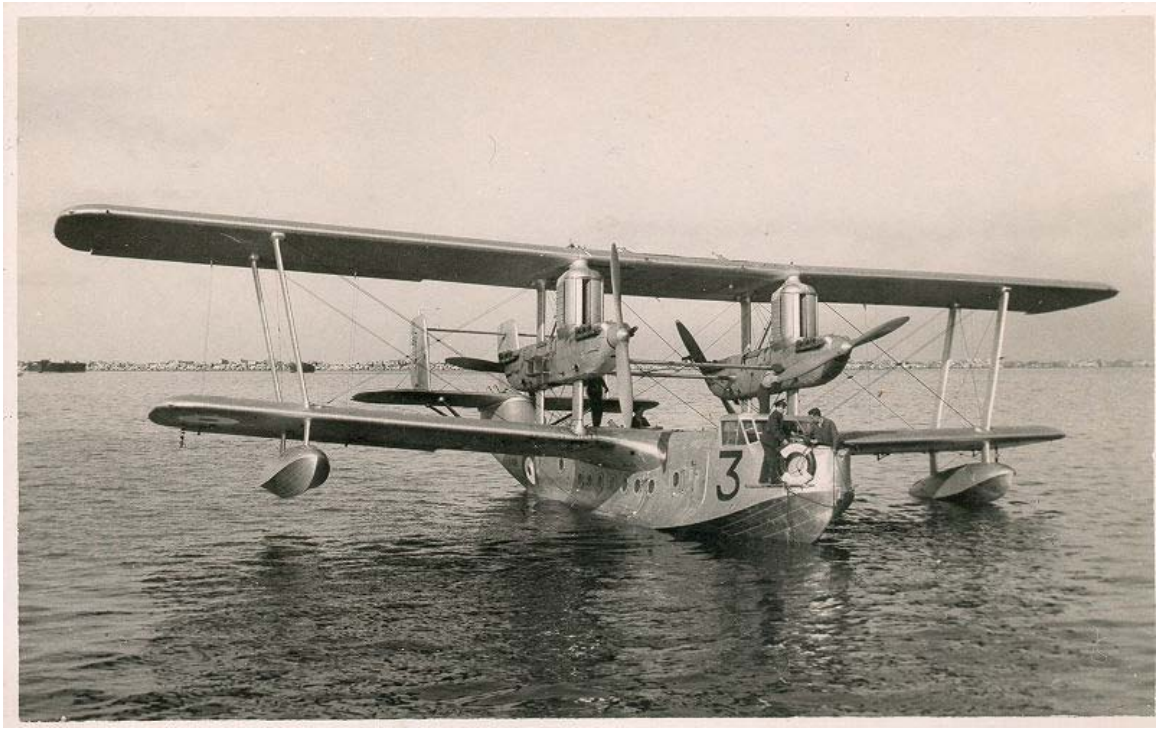
The first large all-metal flying boat called a Singapore was the **Short S.5 Singapore I**. This was a biplane design with single fin and rudder, originally powered by two Rolls-Royce Condor IIIA 650 horsepower (480 kW) engines. One aircraft was built and first flew at Rochester on 17 August 1926, piloted by Shorts' Chief Test Pilot, John Lankester Parker. The type did not enter production, but was used by Sir Alan Cobham for a survey flight around Africa. Registered *G-EBUP*, it left Rochester on 17 November 1927 and arrived at the Cape on 30 March 1928, returning to Rochester on the 4 June 1928. It was displayed at Olympia in July 1929.

The **Short S.12 Singapore II** which followed was a development of the Singapore I with 4 engines, mounted in tractor/pusher pairs (better known as the push-pull configuration). The single example of this aircraft to be built was first flown on 27 March 1930, also by John Lankester Parker.

From the Singapore II came a design with 4 engines and triple fins. In 1933 the British Air Ministry ordered 4 flying boats based upon the Singapore II for trials with squadrons under specification R.3/33. These would be followed by a further production order to specification R.14/34. These aircraft, the **Short S.19 Singapore III**, had all-metal hulls and fabric-covered metal flying surfaces. They were powered by four 675 hp (503 kW) Rolls-Royce Kestrel IX mounted between the wings in two tandem push-pull pairs, similar to the Singapore IIs. The crew of 6 was located in a central cabin and fore, aft and midships open gun positions (Vickers machine gun or Lewis gun). A long range fuel tank could be carried externally on the dorsal hull. The first Singapore III flew on 15 June 1934. Although obsolescent by the time the first aircraft entered service with 210 Squadron in January 1935, the type arrived just in time to benefit from the arms race of the late 1930s and 37 were built. Production terminated in June 1937.

Singapores proved surprisingly tough; after the type was retired by the RNZAF the "Kiwis" attempted to crush one with a bulldozer, only to see the dozer drive the length of the lower wing without making an impression.

Operational history



Short Singapore III flying boat of 230 Squadron at Alexandria, mid 1930s.

230 Squadron was the first squadron equipped with Singapore IIIs. It deployed to Alexandria in 1935. During 1937 the Singapores of 209 Squadron and 210 Squadron moved from Malta to Algeria as part of an international effort to prevent gun running during the Spanish Civil War.

Replacement of the Singapore with the Short Sunderland was well underway by the outbreak of World War II, however 19 survivors saw limited service in secondary theatres, mainly in a training role. The last RAF unit operating the type was No. 205 Squadron RAF in, appropriately enough, Singapore which relinquished its aircraft in October 1941. Four 205 squadron aircraft found their way to No. 5 Squadron RNZAF in Fiji, for use against German raiders. When Japan attacked in December, the New Zealand aircraft found themselves in the front line. They accounted for a Japanese submarine and conducted several air sea rescues before being replaced by Consolidated Catalinas.

Survivors

None are known to have survived.

Variants

Short S.5 Singapore I

> First design aircraft powered by two Rolls-Royce Condor IIIA engines, one aircraft built.

Short S.12 Singapore II
: A development of the Singapore I powered by 4 engines, single example built.

Short S.19 Singapore III
: A development of the Singapore II powered by 4 Rolls-Royce Kestrel IX engines and equipped with triple fins. 37 were built.

Operators

Short Singapore III flying boat of 205 Squadron, in flight below three 'vic' formations of Vickers Vildebeest torpedo bombers of 100 Squadron, both units were based at RAF Seletar.

New Zealand

- Royal New Zealand Air Force
  - No. 5 Squadron RNZAF (four aircraft transferred from 205 Squadron Royal Air Force from October 1941)

United Kingdom

- Royal Air Force
  - No. 203 Squadron RAF
  - No. 205 Squadron RAF
  - No. 209 Squadron RAF
  - No. 210 Squadron RAF
  - No. 228 Squadron RAF
  - No. 230 Squadron RAF
  - No. 240 Squadron RAF

Specifications (Singapore III to R.14/34)

General characteristics

- **Crew:** 6

- **Length:** 64 ft 2 in (19.56 m)
- **Wingspan:** 90 ft (27.43 m)
- **Height:** 23 ft 7 in (7.19 m)
- **Wing area:** 1,465 sq ft (170.4 m²)
- **Empty weight:** 20,364 lb (9,237)
- **Loaded weight:** 28,160 lb (12,773 kg)
- **Max takeoff weight:** 32,390 lb (14,692 kg)
- **Powerplant:** 4× Rolls-Royce Kestrel VIII/IX piston (pusher/tractor configuration), 675 hp (503 kW) each

Performance

- **Maximum speed:** 136 mph (219 km/h) (at 5,000 ft and normal weight)
- **Cruise speed:** 123 mph (198 km/h)
- **Range:** 1,000 mi (1,610 km)
- **Service ceiling:** 15,000 ft (4,570 m)
- **Rate of climb:** 700 ft/min (3.6 m/s)
- **Endurance:** 6 hours 15 minutes

Armament

- **Guns:** Up to three 0.303 in (7.7 mm) Lewis guns
- **Bombs:** Up to 1,100 pounds (500 kg) of bombs under wings.

Chapter- 14

Thomas-Morse MB-4 and Tupolev ANT 16

Thomas-Morse MB-4

	MB-4
Role	Mail plane
National origin	United States of America
Manufacturer	Thomas-Morse Aircraft
First flight	1920
Number built	at least 2
Developed from	Thomas-Morse MB-3

The **Thomas-Morse MB-4** was a prototype American mailplane of the 1920s. It was of unusual design, being a biplane with two main fuselages housing the crew of two and a central nacelle which carried the aircraft's twin engines in a push-pull configuration. It was a failure, having extremely poor flying characteristics and being described as the "worst thing on wings", and saw no service.

Design and development

The MB-4 was designed to meet a June 1919 specification from the United States Post Office Department for a two- or three-engined mailplane, required to carry 1,500 lb (682 kg) of mail on a single engine. Thomas-Morse chose to use as much as possible of its existing Thomas-Morse MB-3 fighter in order to reduce costs. Two engineless MB-3 fuselages carried the crew and cargo, with the pilot in a cockpit in the nose of the port fuselage and the co-pilot/mechanic in a similar cockpit in the nose of the starboard fuselage, while cargo was carried behind the crew in each fuselage. Two Wright-built 300 hp (224 kW) Hispano-Suiza 8 V8 engines (the normal engine of the MB-3) were

mounted in tandem in a push-pull configuration in a central nacelle between the two main fuselages, with the aircraft's fuel tanks being mounted between the engines.

The MB-4's three-bay biplane wings were all new, with ailerons on the upper wing. It had a conventional tailwheel undercarriage and had two separate tail assemblies, which were standard MB-3 empennages. Dual controls were fitted, with the pilot able to disconnect the co-pilot's controls, but there were no means of communication between the two cockpits.

Operational history

The MB-4 made its maiden flight in February 1920. While the aircraft had reasonable speed for the time, it was otherwise poor, with one fuselage tending to take-off before the other, while the engines caused severe vibration which overloaded the aircraft's structure. It was described as the "worst thing on wings" by Jerome Fried, the general plant superintendent of Thomas-Morse.

One aircraft was tested by the US Post Office, but was not used for mail services, and was scrapped in 1921. At least one MB.4 (and possibly 3) was delivered to the United States Army Air Service where it was stored before being scrapped.

Specifications

General characteristics

- **Crew:** 2
- **Length:** 25 ft 5 in (7.74 m)
- **Wingspan:** 45 ft 6 in (13.87 m)
- **Height:** 11 ft (3.4 m)
- **Wing area:** 645 sq ft (59.9 m^2)
- **Empty weight:** 3,554 lb (1,612 kg)
- **Gross weight:** 5,564 lb (2,524 kg)
- **Powerplant:** 2 × Wright Hispano-Suiza 8 water-cooled V8 engines, 300 hp (220 kW) each

Performance

- **Maximum speed:** 122 mph (196 km/h; 106 kn)
- **Stall speed:** 53 mph (46 kn; 85 km/h)
- **Range:** 600 mi (521 nmi; 966 km)
- **Time to altitude:** 9,000 ft (2,745 m) in 10 min

Tupolev ANT-16

ANT-16 (TB-4)

Role	Heavy bomber
National origin	Soviet Union
Manufacturer	Tupolev
First flight	1933
Status	Retired
Primary user	Soviet Union
Number built	One
Developed from	TB-3
Variants	ANT-20

Tupolev ANT-16 (also known as **TB-4**; Russian: Тяжелый Бомбардировщик - *Heavy Bomber*) was an experimental heavy bomber aircraft designed and tested in the Soviet Union in the early 1930s. Conceptually representing evolution of the TB-3 bomber, ANT-16 was designed under the doctrine that size and payload were more important for a bomber than speed because it would be able to protect itself with defensive armament. The twin 5×1.8×1.8 m (16 ft 5 in × 5 ft 11 in × 5 ft 11 in) bomb bays were the largest in the world at the time and presented many design challenges in order to preserve structural rigidity of the airframe.

The sole prototype first flew on 3 July 1933 with M. M. Gromov at the controls. The test flight program was completed by 29 September 1933 with disappointing results. The two top-mounted engines performed poorly and a significant portion of thrust generated by the wing-mounted powerplants was absorbed by the 2-meter-thick (6 ft 7 in) wing. A proposal to re-equip the aircraft with Mikulin AM-35 engines of 933 kW (1,250 hp) was not implemented.

Specifications (ANT-16)

General characteristics

- **Crew:** Twelve

- **Length:** 32 m (104 ft 12 in)
- **Wingspan:** 54 m (177 ft 2 in)
- **Height:** ()
- **Wing area:** 422 m² (4,542.4 ft²)
- **Empty weight:** 21,400 kg (47,179 lb)
- **Loaded weight:** 33,280 kg (73,370 lb)
- **Powerplant:** 6× Mikulin AM-34 V-12 piston engine, 560 kW (750 hp) each

Performance

- **Maximum speed:** 200 km/h (108 kn, 124 mph)
- **Range:** 1,000 km (540 nmi, 621 mi)
- **Service ceiling:** 2,750 m (9,022 ft)
- **Wing loading:** 79 kg/m² (16 lb/ft²)
- **Power/mass:** 101 W/kg (0.06 hp/lb)
- **Time to altitude:** 34 s to 2,000 m (6,560 ft)

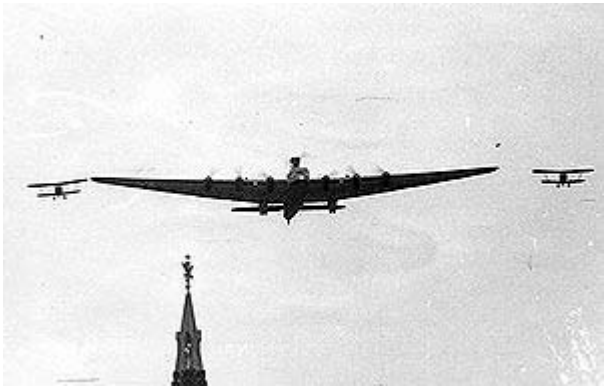
Armament

- **Bombs:** Up to 10,000 kg (22,046 lb) of bombs - 40 × 250 kg (551 lb) or 20 × 500 kg (1,102 lb)

Chapter- 15

Tupolev ANT-20

ANT-20



ANT-20 "Maxim Gorky" propaganda aircraft in the Moscow sky shortly before its crash

Role	Propaganda aircraft/Transport
National origin	Soviet Union
Manufacturer	Tupolev
First flight	1934
Introduction	1934
Retired	1942
Primary user	Soviet Union
Number built	2
Developed from	Tupolev TB-4

The **Tupolev ANT-20** ***Maxim Gorky*** (Russian: Туполев АНТ-20 "Максим Горький") was a Soviet eight-engine aircraft, the largest in the 1930s.

Overview

The ANT-20 was designed by Andrei Tupolev and constructed between July 4, 1933 and April 3, 1934. It was one of two aircraft of its kind ever built by the Soviets. The aircraft was named after Maxim Gorky and dedicated to the 40th anniversary of his literary and public activities.

It was intended for Stalinist propaganda purposes and, therefore, equipped with a powerful radio set called "Voice from the sky" (*"Голос с неба"*, *golos s neba*), printing machinery, radiostations, photographic laboratory, film projector with sound for showing movies in flight, library etc. For the first time in aviation history, this aircraft was equipped with a ladder, which would fold itself and become a part of the floor.

Also, for the first time in aviation history, the aircraft used not only direct current, but alternating current of 120 volts, as well. The aircraft could be disassembled and transported by railroad if needed. The giant aircraft set a number of carrying capacity world records and is also the subject of a 1934 painting by Vasily Kuptsov, in the collection of the Russian Museum at St. Petersburg.

Maxim Gorky *crash*

On May 18, 1935, the *Maxim Gorky* (pilots - I. V. Mikheyev and I. S. Zhurov) and three more planes (Tupolev ANT-14, R-5 and I-5) took off for a demonstration flight over Moscow. The main purpose of the other three planes flying so close was to make evident the difference in size. As a result of a poorly executed loop maneuver (a third such stunt on this flight) around the plane performed by an accompanying I-5 fighter (pilot - Nikolai Blagin), both planes collided and the *Maxim Gorky* crashed into a low-rise residential neighborhood west of present-day Sokol station.

Forty-five people were killed in the crash, including crew members and 33 family members of some of those who had built the aircraft. (While authorities announced that the fatal maneuver was impromptu and reckless, it has been recently suggested that it might have been a planned part of the show.) Also killed was the fighter pilot, Blagin, who was made a scapegoat in the crash and subsequently had his name used eponymously (*Blaginism*) to mean, roughly, a "cocky disregard of authority." However, Blagin was given a state funeral at Novodevichy Cemetery together with ANT-20 victims.

That same year, Warsaw newspapers published an alleged suicide letter by Blagin, with clear anti-communist messages, which modern authors consider to be a fake. The day before the crash, French pilot and writer Antoine de Saint-Exupéry, visiting the Soviet Union for the French newspaper *Paris-Soir*, was the only foreign pilot authorized to board the plane. After the crash Saint-Exupéry mourned the loss of this giant with its 'gangways, the salon, the cabins, the on-board telephone'.

The crash was apparently the inspiration for the Symphony No. 16 by Nikolai Myaskovsky, sketched immediately after the disaster and premiered in Moscow on 24 October 1936. This symphony includes a big funeral march as its slow movement, and the finale is built on Myaskovsky's own song for the Red Air Force, 'The Aeroplanes are Flying'; the work was known during the Soviet era as the 'Aviation Symphony'.

ANT-20bis

Aeroflot's ANT-20bis.

A replacement aircraft, designated **ANT-20bis** had begun production the following year and first flew in 1938. It was largely identical in design but with only six, more powerful engines. This plane, renumbered **PS-124**, served with Aeroflot on transport routes in Russia and Uzbekistan. On December 14, 1942, it too crashed after the pilot allowed a passenger to take his seat momentarily and the passenger apparently disengaged the automatic pilot, sending the ship into a nosedive from an altitude of 500 m (1,500 ft) and killing all 36 on board.

Plans to build a fleet of ANT-20bis aircraft were abandoned in 1939 as Stalin's purges of the aviation industry had resulted in a shortage of qualified engineers.

Operators

Soviet Union

Specifications

General characteristics

- **Crew:** 8
- **Capacity:** 72
- **Length:** 32.90 m (107 ft 11¼ in)
- **Wingspan:** 63.00 m (206 ft 8¼ in)
- **Height:** 10.6 m (34 ft 9¼ in)
- **Wing area:** 488 m² (5,251 ft²)
- **Empty weight:** 28,500 kg (62,700 lb)
- **Loaded weight:** 42,000 kg (92,400 lb)
- **Max takeoff weight:** 53,000 kg (116,600 lb)
- **Powerplant:** 8× Mikulin AM-34FRN V-12 liquid cooled, 671 kW (900 hp) each

Performance

- **Maximum speed:** 220 km/h (119 kn, 137 mph) at sea level
- **Range:** 1,200 km (652 nmi, 750 mi)
- **Service ceiling:** 4,500 m (14,764 ft)

Chapter- 16

Aero Design DG-1, Dornier Do 635 and Dornier Do 214

Aero Design DG-1

The **Aero Design DG-1** (registered *N10E*) is an American racing aircraft designed by David Garber in an attempt to break the world airspeed record for a piston-engined aircraft. It is a single-seat aircraft with two Mazda RX-3 engines installed, one driving a tractor propellor, the other driving a pusher. The fuselage is bullet-shaped and highly streamlined and features a mid-wing and cruciform tail. It first flew on 25 July 1977.

After being displayed at the Sun 'n Fun air museum at Lakeland, Florida for some years, the aircraft was being offered for sale in 2005 with an asking price of $US 125,000.

Specifications

General characteristics

- **Crew:** one, pilot
- **Length:** 20 ft 0 in (6.0 m)
- **Wingspan:** 20 ft 6 in (6.2 m)
- **Height:** ()
- **Powerplant:** 2× Mazda RX3 automotive engines, 330 hp (240 kW) each

Performance

- **Maximum speed:** 390 knots (450 mph, 720 km/h)
- **Range:** 400 nm (460 mi, 740 km)

Dornier Do 635

Dornier Do 635

Role	Fighter-bomber
Manufacturer	Dornier Flugzeugwerke
Designed by	Heinrich Hertel
Introduced	1944
Status	Cancelled
Primary user	*Luftwaffe*
Number built	0
Developed from	Dornier Do 335

The **Dornier Do 635** was a World War II heavy fighter proposed by Dornier. The Do 635 was developed as two Dornier Do 335 fuselages joined by a common center wing section.

Design and developments

In 1944, Junkers helped the Dornier Flugzeugwerke with work on the Do 335 Zwilling or Dornier Do 635. A meeting was arranged between Junkers and Heinkel engineers. After the meeting, they began work on the project 1075 01-21. The prototype was scheduled for test flight in late 1945, the designer-professor Heinrich Hertel having provided a sketch on February 1945. This design consisted of two Do 335 fuselages joined by 2 wings and also having 2 Rb 50 cameras in port fuselage to take aerial photos. Warloads were not formalised, the design only having provision for five 60 kg (130 lb) target marker bombs. The main wheels were common with Ju 352 wheels. It was also intended that two Walter Rocket Assisted Take Off units would be fitted. A variety of radars could have been fitted. In early 1945, a wind-tunnel model was tested, and a cockpits mock-up was constructed. But in February 1945, due to the desperate war situation, the project was cancelled.

At the end of 1944, the Do 635 impressed the Japanese military by its capabilities and design.

Specifications (Do 635 V-1)

General characteristics

- **Crew:** 2 (pilot and navigator)
- **Length:** 18.5 m ()
- **Wingspan:** 27.45 m ()
- **Height:** ()

Performance

- **Maximum speed:** 720 km/h

Armament

None

Dornier Do 214

Do 214

Do 214 model at Dornier's museum in Friedrichshafen

Role	Flying boat, Long range transport
Manufacturer	Dornier
Primary user	Luftwaffe
Number built	0
Variants	Dornier Do 216

The **Dornier Do 214** was a large long-range flying boat developed by Dornier in World War II.

Originally designed as the Do P.93 for passenger transatlantic service from Lisbon to New York, the Do 214 was redesigned as the P.192 for military service in early 1940. In 1941, a full-sized fuselage mockup was constructed in order to evaluate the interior layout. The fuselage was streamlined and of a round cross-section, with the interior consisting of two decks. Wings featuring a small amount of sweep on the leading edge,

with straight trailing edges were shoulder mounted on the fuselage. Eight Daimler-Benz DB 613 24-cylinder double piston engines provided the power, with four tractor engines and four pusher engines. All eight engines provided power to four-blade VDM variable pitch propellers; the front propellers had a 5.00 m (16 ft 5 in) diameter, the rear propellers had a 4.60 m (15 ft 1 in) diameter.

The mammoth eight-engine design was intended for use as a military transport, with a large bow door admitting vehicles and bulky freight to the upper deck. It was also designed for use as a long-range bomber, flying tanker, aerial minelayer and U-boat supply vessel. By 1943, it was realized that long-range flying boats were not needed due to the worsening war situation, and the Do 214 project was canceled.

Specifications (Do 214)

General characteristics

- **Crew:** 12-15
- **Length:** 51.60 m (169 ft 3½ in)
- **Wingspan:** 60.00 m (196 ft 10¼ in)
- **Height:** 14.30 m (46 ft 11 in)
- **Wing area:** 500.00 m² (5,381 ft²)
- **Empty weight:** 76,000 kg (167,551 lb)
- **Loaded weight:** 145,000 kg (319,670 lb)
- **Powerplant:** 8× Daimler-Benz DB 613A 24-cylinder liquid-cooled inline engine, 2,833 kW (3,800 hp) each

Performance

- **Maximum speed:** 490 km/h (304 mph)
- **Cruise speed:** 425 km/h (264 mph)
- **Range:** 6,200 km (3,852 mi)
- **Service ceiling:** 7,000 m (22,965 ft)