

ARCHIVED REPORT

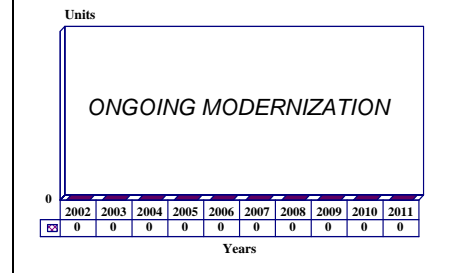
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Transall C-160 Series - Archived 2/2003

Outlook

- C-160 production ended in 1985
- A number of C-160 modification efforts are planned

10 Year Unit Production Forecast
2002-2011



Orientation

Description. Twin-turboprop medium tactical transport. Accommodates up to 93 ground troops, 62 to 88 paratroops, or 63 casualties on stretchers plus four medical attendants.

Sponsor. Defense ministries of France and Germany.

Contractors. Arbeitsgemeinschaft Transall, a joint venture that consisted initially of Messerschmitt-Bolkow-Blohm GmbH, Hamburg, Federal Republic of Germany; Aerospatiale, Paris, France; and VFW-Fokker GmbH, Bremen, Federal Republic of Germany.

Status. First series production ended in 1972; second series production was completed in 1985.

Total Produced. Series One: 178 aircraft, including three prototypes and six pre-series aircraft. Series Two: 35 aircraft.

Application. Transport, tanker, communications relay, and ELINT/ESM.

Price Range. \$7.0 million in 1970 dollars for basic aircraft configured for cargo operations.

Technical Data

(C-160 Series Two)

Design Features. Cantilever high-wing monoplane. All-metal ailerons and hydraulically operated double-slotted flaps. Airbrakes inboard and spoilers outboard, and forward of flaps on each wing. Semi-monocoque fuselage of circular base section, flattened at the bottom.

Upswept rear fuselage with cargo door on underside. Tricycle-type landing gear. Two pairs of main wheels mounted in tandem, retracting into fairing on each side of fuselage. The wheels may be partially retracted to lower fuselage for cargo loading.

Dimensions

Overall length	32.40 m	106.30 ft
Overall height	11.65 m	38.22 ft
Wingspan	40.0 m	131.23 ft
Cargo hold dimensions (inc. ramp)		
Length	17.21 m	56.46 ft

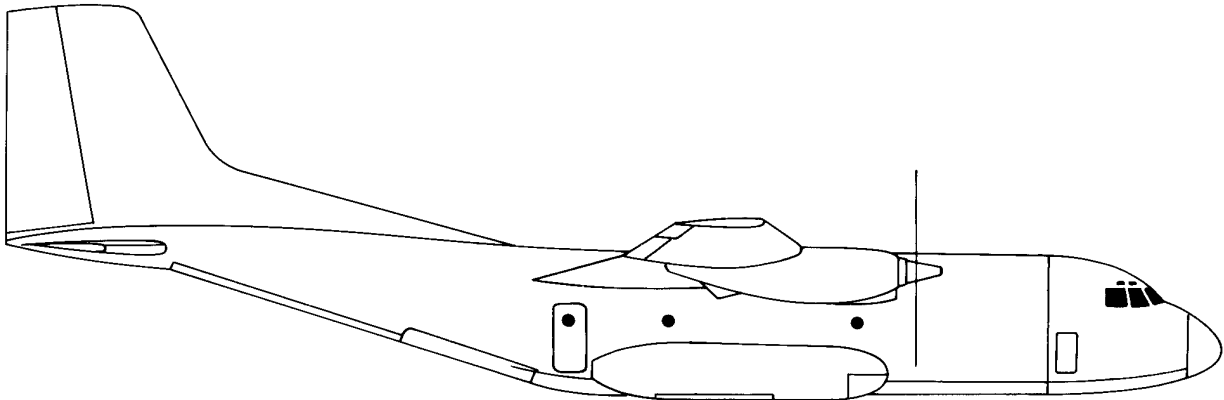
Metric

US

32.40 m	106.30 ft
11.65 m	38.22 ft
40.0 m	131.23 ft
17.21 m	56.46 ft

	<u>Metric</u>	<u>US</u>
Max useful height	2.98 m	9.78 ft
Useful width	3.15 m	10.33 ft
Usable volume	140 cu m	4,944 cu ft
Weight		
Min operating weight empty	28,000 kg	61,730 lb
Max payload	16,000 kg	35,275 lb
Max TOW	51,000 kg	112,435 lb
Max landing weight	47,000 kg	103,615 lb
Performance^(a)		
Max level speed at 4,875 meters	513 kmph	277 kt
Service ceiling at 45,000 kg AUW	8,230 m	27,000 ft
Max ferry range with center-section wing tank	8,858 km	4,780 nm
Propulsion		
Two Rolls-Royce/Snecma Tyne Mk 22 turboprops		
Thrust (each)	4,549 kW	6,100 ehp

^(a)At maximum TOW, unless noted otherwise.



TRANSALL C-160

Source: Forecast International

Variants/Upgrades

C-160A. Pre-series aircraft: three for French Air Force; three for West German Air Force.

C-160D. West German Air Force version. Total of 110 completed. First flown in November 1967.

C-160F. French Air Force version. Total of 50 produced. First flown in April 1967.

C-160Z. Designation of the South African Air Force version. Nine produced. First flown in February 1969.

C-160S. Proposed maritime surveillance version, with search radar and low-altitude navigation system.

C-160SE. Proposed electronic surveillance version, with SLAR, FLIR, and electronic warfare systems. Search radar can be replaced by a retractable ventral radar for 360-degree scan.

C-160AAA. Proposed airborne early warning variant, equipped with radome nose and tail.

C-160 Second Series (C-160NG). Similar to initial C-160s, with upgraded avionics, strengthened wing, and optional additional fuel tank in center section. Total of 35 produced. Ten aircraft fitted with hose-reel-and-drogue-type equipment for tanker operations; five

others have provisions for carrying this equipment. Four more aircraft operate as Astarte communications relay aircraft in support of French nuclear forces. Two other units were produced as Gabriel ESM/ELINT

aircraft. Six more were built and exported to Indonesia. All French second series aircraft are equipped with a four-meter fuel receiver boom mounted above and behind the flight deck.

Program Review

Background. Messerschmitt-Bolkow-Blohm (MBB), Aerospatiale, and VFW-Fokker formed Transall (Transporter Allianz) in January 1959. Together they produced the Transall C-160 to meet German and French requirements for a medium transport. These requirements included troop, paratroop, freight, casualty, and vehicle transportation. VFW-Fokker was the overall production manager and was responsible for design and manufacture of the main fuselage and the horizontal tail unit. MBB was responsible for the front and rear sections of the fuselage, while Aerospatiale produced the outer wing section and powerplant assemblies. Messier (of France) and Liebherr (of West Germany) shared production of landing-gear units.

The French Air Force placed an order in 1977 for 25 additional C-160s beyond the 50 Series One C-160Fs it had purchased. This number was increased to 29 in 1982. These second-series aircraft were produced by MBB and Aerospatiale (50/50 responsibility). The chief improvements were upgraded avionics and a reinforced wing. Ten of these second-series aircraft were fitted with hose-reel-and-drogue-type in-flight refueling equipment to allow operation as tankers, while five others incorporated provisions for this equipment. Four others are operated as communications relay aircraft in support of French nuclear forces. A further six production aircraft were delivered to the Indonesian government. These were operated by Pelita Air Service. Production of the second series ended in 1985.

German Service-Life Extension Program. The German Air Force C-160 fleet has been undergoing a service-life and operational capability extension program since the late 1980s. The program is being conducted in three phases. The first two phases of the program covered strengthening of the wing box and were completed by Daimler-Benz Aerospace Airbus. The third phase, also performed by the company (which has been absorbed by EADS), covered strengthening of the rest of the airframe.

The C-160 was originally designed for about 5,000 flights, based on an average of 1.2 flight hours per flight. With the structural strengthening, the aircraft's service life will be extended to at least 12,000 flight operations. The entire upgrade program includes avionics upgrades described later in this report. The

upgrade should keep the German C-160s in service until the year 2010.

French Service-Life Extension Program. The French Air Force has begun a program to extend the service life of 73 of its C-160s. Under the program, EADS is to extend the service life to 22,500 hours from 20,000 hours.

Tyne Upgrades. Snecma and Rolls-Royce market an engine upgrade, called Tyne Plus, for the Tyne 22 and Tyne 21 powerplants that power the C-160 transport and the Atlantic maritime patrol aircraft, respectively. The two companies have discussed the possible upgrade with the French and German defense ministries. Snecma has also been discussing the upgrade with the South African Air Force.

The Tyne Plus upgrade would provide increased power and range and reduce maintenance costs. The power increase would be approximately 500 shp, resulting in improved payload/range capabilities for the C-160. The upgrade would also provide faster climb, increased cruise speed, and decreased fuel burn. Also, the difficult-to-use water/methanol injection system (which is also a source of corrosion) would be removed.

A feasibility study, estimated to cost £1.0 million (\$1.4 million), would focus on the impact of the proposed changes to the engine, and would cover engine-cycle changes, the gearbox, thermodynamics, and aerodynamics. If the program receives an official go-ahead, flight trials could begin in two-and-one-half to three years.

Among the benefits of the Tyne Plus upgrade is an increase in aircraft speed that would allow French Air Force C-160NGs to refuel fighter aircraft. Ten of the French C-160NGs are equipped for tanker operations, however, this refueling capability is not often utilized because of the slower speed of the C-160NGs. A speed increase would permit the C-160NGs to refuel fighters such as the Dassault Mirage 2000.

The German Air Force recently decided to upgrade the Tyne engines on 86 C-160s. The upgrades will be performed by EADS. Few details are currently available on this effort, including whether or not it is related to the Tyne Plus program.

German Avionics Upgrade Program. As described above, German Air Force C-160s are undergoing an avionics upgrade to help keep these aircraft in service until the year 2010. The avionics upgrade involves two efforts: (1) incorporation of an autonomous navigation system (ANS) and flight-control and flight-management systems, and (2) retrofit of individual avionics components.

In 1988, Rockwell-Collins GmbH and Rockwell International Corp's Collins Avionics and Communications Division received a contract from the West German Air Force to develop and integrate the ANS. (Both Rockwell-Collins GmbH and Collins Avionics and Communications Division are now part of the newly spun-off Rockwell Collins Inc.) Equipment supplied by Rockwell Collins includes a mission computer with redundant MIL-STD-1553B multiplex bus control, operator controls and displays, and a flight control interface for the ANS. Rockwell Collins also supplied Global Positioning System (GPS) equipment.

In March 1994, Rockwell Collins received a \$21 million production contract from the German Air Force to integrate FMS-800 flight management systems in German C-160Ds, as well as to install the company's GPS receivers into the aircraft.

As part of the German upgrade, the Honeywell SPZ-4500 automatic flight-control system (AFCS) replaced the C-160D aircraft's original Sperry SP-40 autopilot built under license by SFIM. The C-160Ds were also fitted with an air data sensor package and the Honeywell H423 ring laser gyro inertial navigation system.

EADS performed total system integration for the ANS/AFCS effort. As a result of the upgrade, the aircraft's navigator can be eliminated, reducing the number of flight deck crew members from four to three. In mid-1992, the company completed the initial retrofit of the ANS and flight-management system on a German C-160D.

The ANS/AFCS effort was completed in 2000.

The other portion of the German avionics upgrade involves retrofitting individual components into the C-160. This part of the effort is being performed under the sole responsibility of the German Air Force. The HF communications system on the aircraft is being replaced by the Rockwell Collins ARC-190, and the radio altimeter is being replaced by the Thales AHV-6. Replacement of the existing weather radar by the Honeywell Primus 90B has already been completed. All wiring in the aircraft is being replaced because of corrosion. In addition, a Motorola and Datenfunk SELCAL system is being integrated.

As part of the avionics upgrade program, the British company GEC-Marconi Avionics (now part of BAE Systems) received a £1.0 million (\$1.4 million) contract from the German Air Force in January 1994 to supply its new High Integration Air Data Computer (HIADC). A single computer is being installed in each C-160D aircraft, and linked to the navigation system. This contract was the launch order for GEC-Marconi's new HIADC family.

Topstar 100-2 GPS Receiver. In early 2000, Sextant Avionique (now called Thales Avionics) received an order from the French Air Force to equip 65 C-160s with the company's Topstar 100-2 GPS receiver. Deliveries were scheduled to begin in 2001. The Topstar 100-2 receivers will replace the aircraft's existing GPS systems.

Decoy-Flare Dispensers. In mid-1998, the Danish company Terma Elektronik (now called Terma A/S) was awarded a contract by the German BWB military procurement office to supply two decoy-flare dispensers with magazines for a trial installation in a German Air Force C-160D. The contract includes ensuring the compatibility of software with the existing electronic warfare system and the supply of technical documentation.

Missile Warning Systems. In July 2000, the German Defense Ministry selected the Northrop Grumman AAR-54(V) passive missile-approach warning system for installation on German Air Force C-160s. The initial contract is for a nine-month aircraft integration and test program. An 18-lot option is expected to be exercised upon successful completion of the integration and test program, with an option for five more missile warning systems.

Fire-Alert Systems and Battery-Temperature Monitors. EADS is currently installing fire-alert systems and battery-temperature monitors on the German Air Force fleet of C-160s. Installations are expected to be completed by the end of 2002.

Funding

France and Germany are both currently funding a number of C-160 modification efforts.

Recent Contracts

<u>Contractor</u>	<u>Award (\$ millions)</u>	<u>Date/Description</u>
Sextant Avionique	NA	2/00 - Order from French Air Force for installation of Topstar 100-2 GPS receivers on 65 C-160s.
Northrop Grumman	NA	7/00 - Contract from German Defense Ministry for aircraft integration and test program for AAR-54(V).

Timetable

<u>Month</u>	<u>Year</u>	<u>Major Development</u>
Jan	1959	Transall consortium formed by MBB, VFW-Fokker, and Aerospatiale
Feb	1963	First flight of C-160
Oct	1967	Initial production deliveries
	1977	Second series production of 25 aircraft authorized for French Air Force
	1982	Four additional second series aircraft authorized for French Air Force
	1985	Production completed

Worldwide Distribution

<u>Military Operators</u>	
France Air Force	75
Germany Air Force	88
South Africa Air Force	9 (in storage)
Turkey Air Force	20
<u>Commercial Operators</u>	
Manunggal Air (Indonesia)	6

Forecast Rationale

The German Air Force is continuing an upgrade program that will help keep its C-160 transports in service until 2010. The Luftwaffe has also started a number of other C-160 modification efforts, and it is planning several more. Meanwhile, the French Air Force has begun a service-life extension program for 73 of its C-160s.

The German Air Force is planning further upgrades for its C-160s. These involve surface treatment, integration studies of a radio/data communications system, and a new intercom. The upgrades are to be performed by EADS.

Ten-Year Outlook

No further production of the C-160 is planned. Present upgrade efforts will continue.

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