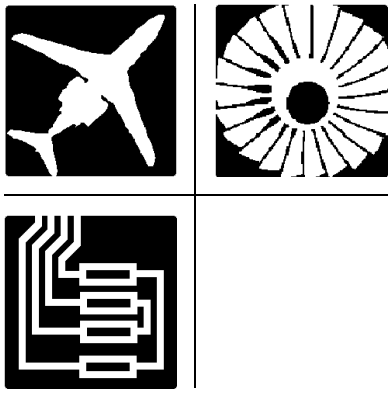
Transall C-160 Series

Outlook

- French/German/Turkish C-160s to remain in service until replaced by Airbus A400M
- Redelivery of upgraded French C-160G Gabriel SIGINT aircraft completed in 2011
- France committed $141 million in C-160 upgrades as a stopgap for the delayed A400M arrival

Note: Icons indicate area(s) of current and potential retrofit/modernization activity



Orientation

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

Current 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 million in 1970 U.S. dollars.

C-160F Transall

Source: French MoD

Transall C-160 Series

Contractors

Prime

Airbus Group, (formerly European Aeronautic Defence and Space (EADS))	http://www.airbus-group.com, Mendelweg 30, Leiden, 2333 CS Netherlands, Tel: + 31 71 52 456 00, Fax: + 31 71 52 328 07, Prime

Comprehensive information on Contractors can be found in Forecast International's "International Contractors" series. For a detailed description, go to www.forecastinternational.com (see Products & Services/Governments & Industries) or call + 1 (203) 426-0800.

Contractors are invited to submit updated information to Editor, International Contractors, Forecast International, 22 Commerce Road, Newtown, CT 06470, USA; rich.pettibone@forecast1.com

Technical Data

(C-160 Series Two)

	Metric	U.S.
Dimensions		
Overall length	32.40 m	106.30 ft
Overall height	11.65 m	38.22 ft
Wingspan	40 m	131.23 ft
Cargo hold dimensions (incl. ramp)		
Length	17.21 m	56.46 ft
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 T-O weight	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 T-O weight, unless otherwise indicated.

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, and 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 that it had received. The 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 the second-series aircraft were fitted with hose-reel-and-drogue-type in-flight refueling equipment to allow operation as tankers, and five others incorporated provisions for this equipment. Four others were 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.

Variants

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-160G Gabriel. French Air Force SIGINT aircraft.

C-160R. Model renovated with new avionics.

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 side-looking airborne radar (SLAR), forward-looking infrared (FLIR), and electronic warfare systems. Search radar can be replaced by a retractable ventral radar for 360° scan.

C-160AAA. Proposed airborne early warning variant equipped with radomes, 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 were operated 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 4-meter fuel receiver boom mounted above and behind the flight deck.

Milestones

Month	Year	Major Development
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 AF
	1982	Four additional second-series aircraft authorized for French AF
	1985	Production completed
Apr	2014	Turkey receives first A400M replacement

Worldwide Distribution/Inventories

Country	Operator	Designation	Quantity	Average Age
FRANCE	France Air Force	C-160G	2	30.00
FRANCE	France Air Force	C-160R	50	37.00
GERMANY	Germany Air Force	C-160D	77	44.50

Transall C-160 Series

Country	Operator	Designation	Quantity	Average Age
INDONESIA	Manunggal Air	C-160NG	1	29.00
INDONESIA	Manunggal Air	C-160P	3	32.00
TURKEY	Turkey Air Force	C-160D	17	47.00

Identified Retrofit & Modernization Contractors

Propulsion

Rolls-Royce Defence Aerospace	http://www.rolls-royce.com/defence/, PO Box 3, Filton, BS12 7QE Bristol, United Kingdom, Tel: + 44 117 97 91234, Fax: + 44 117 97 98005 (Marketing Engine Upgrades)
Snecma	http://www.snecma.com, 10, allée du Brévent, CE1420 Courcouronnes, Evry, 91019 France, Tel: + 33 1 69 87 09 00, Fax: + 33 1 69 87 09 02 (Marketing Engine Upgrades)

Electronics

Le Service Industriel de l'Aeronautique (SIAe)	http://www.defense.gouv.fr/air, 5 bis, Avenue de la Porte-de-Sevres, Paris, 75015 France, Tel: + 33 1 45 52 81 02, Fax: + 33 1 45 52 65 15 (Midlife Update; C-160G Gabriel SIGINT Upgrade)
Thales Airborne Systems	http://www.thalesgroup.com/aerospace, Centre Charles Nungesser, 2, ave Gay-Lussac, Elancourt, 78851 France, Tel: + 33 1 34 81 60 00, Fax: + 33 1 30 66 79 66 (Midlife Update; C-160G Gabriel SIGINT Upgrade)
Thales Avionics SA	http://www.thalesgroup.com/aerospace/, 25 Rue Jules Védrines, Valence, 26027 France, Tel: + 33 4 75 79 85 11, Fax: + 33 4 75 49 36 20 (TopOwl Helmet-Mounted Display)

Opportunities

With relatively few C-160s in the worldwide inventory, programs for these aircraft tend to be limited to the fleets of specific nations and funded to meet specific needs. These programs generally run the planned course, with few, if any, additional aircraft modified.

France has decided to replace its fleet of C-160s with Airbus' new A400M, but delays in that program have left uncertainties in the nation's transport fleet and France has had to look for alternatives. In addition to reallocating $141 million from the A400M purchase to upgrade 10 of its C-160s, the nation has ordered eight Airbus Military CN-235s to help fill its interim transport needs.

Germany and Turkey have run into similar problems in maintaining their C-160 transport fleets while waiting for the arrival of the A400M. As the troubled A400M program has incurred delays – initial deliveries are now planned for 2014 – both have had to look at alternative plans to sustain their transport strength.

Turkey has procured six additional C-130s from Saudi Arabia to defray transport service workload, and in late 2013, received its first A400M. However, the nation did not officially accept the aircraft until April 2014 due to "technical failures." Germany has comparatively newer C-160s and looks as if it will be content to either perform minor upgrades or hang tight until the arrival of the A400M.

The C-160 was designed with a flight life of around 25 years, and even the newest aircraft are now reaching or surpassing that age. Operators are looking to retire their C-160 fleets, and if any aircraft remain in service, they will require significant midlife upgrades.

Even so, three of the C-160's four primary – and only – operators are looking to retire the aircraft, and the remaining operator, Manunggal Air, only operates four. Though the cargo carrier may fund additional upgrades to maintain its fleet, these will be limited by the small fleet size.

AIRFRAME

Life Extension Modification. Should Indonesia's Manunggal Air Service intend to keep flying its fleet of four C-160s, the aircraft will likely need a structural refresh at some point in the future. As cargo aircraft, they won't require as much upkeep as a passenger aircraft, though at some point an overly fatigued airframe becomes an issue of safety rather than comfort.

PROPULSION

Tyne Upgrade. Rolls-Royce and Snecma have marketed an engine upgrade called Tyne Plus for the Tyne 22 and Tyne 21 engines 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.

The Tyne Plus upgrade would provide increased power and range while reducing maintenance costs. The upgrade would result in an increase of 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. In addition, the difficult-to-use water/methanol injection system (which is also a source of corrosion) would be removed.

The German Air Force has decided to upgrade the Tyne engines on its C-160s and chose EADS (now Airbus Group) to perform the upgrades. Few details are currently available on this effort, including whether or not it is related to the aforementioned Tyne Plus program.

The 2011 French defense budget mentioned a renewal of a major contract for engines and propellers. Most likely, this referred to upgrades performed on the Tyne engines. Total expense for work performed or forecast for 2011 was EUR20.8 million ($29.2 million), but this includes other upgrades and minor work such as the midlife update detailed below. Total expense for work performed from 2007 through 2010 was EUR86.0 million ($119.6 million).

ELECTRONICS

Midlife Update. In 2009, due to delays in the A400M program, France reallocated $141 million to upgrade 10 C-160s to keep them in service until an appropriate replacement could be procured.

Thales is the avionics integrator for this project, and, while the program has been sparsely detailed, structural midlife improvements are likely included as well. Because this is only a stopgap effort, the modifications are only designed to extend the C-160's service life and improve capability enough to last through 2018.

With A400 service entry planned for 2014, it is unlikely that many additional C-160s will be upgraded. Some of the midlife update funds may have been allocated to the Tyne upgrade, discussed above.

French C-160G Gabriel SIGINT Upgrade. France operates two C-160G Gabriel SIGINT aircraft. Operated since 1989, the Gabriels were showing their age, and France embarked on an upgrade program in 2002.

The technical renewal for the Gabriels included improvements to the listen and locate capabilities of the radio transmitters, extensions to the detection and analysis capabilities of the radars, renewed programming parameters for the onboard self-protection systems, and various improvements to address IT obsolescence issues.

The ELINT side of the work was carried out by Thales Airborne Systems and the avionics updates were performed by Le Service Industriel de l'Aéronautique (SIAé). It appears that engine overhaul and upgrade was performed as well.

Redelivery of the first upgraded Gabriel was made in 2009, with the second and final in 2011. Program expense was EUR27.1 million ($37.1 million).

TopOwl-H Helmet-Mounted Display System. In November 2007, Thales flight-tested its TopOwl-H helmet-mounted sight and display system on a C-160 for the first time. The system was originally developed for helicopters, and projects a 100 percent overlapped binocular image onto a pilot's visor, enhancing the view of surrounding terrain. Although the system was tested on the C-160, Thales' marketing effort in France appears to be focused on the A400M, which is to replace the older transport. Thales reports orders for more than 1,500 TopOwl systems over the next 10 years.

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FI's Opportunity Outlook

AIRFRAME

			High Confidence				Good Confidence			Less Confidence			
Status		**Thru 2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**	**Total**
Estimated Potential Candidates	**4**	**Life Extension Modification** <> C-160 <> Indonesia											
Planned/In Progress		**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Speculative			**0**	**0**	**0**	**0**	**0**	**0**	**0**	**1**	**2**	**1**	**4**

PROPULSION

			High Confidence				Good Confidence			Less Confidence			
Status		**Thru 2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**	**Total**
Estimated Potential Candidates	**20**	**Tyne Upgrade** <> C-160											
Planned/In Progress		**130**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Speculative			**5**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**5**

ELECTRONICS

			High Confidence				Good Confidence			Less Confidence			
Status		**Thru 2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**	**Total**
Estimated Potential Candidates	**42**	**Midlife Update** <> C-160 <> France <> Air Force											
Planned/In Progress		**10**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Speculative			**5**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**5**