

767 family modification programmes

The most prominent modification programmes available for the 767 are a flightdeck upgrade and several passenger-to-freighter modifications. A large number of aircraft are expected to be converted to freighters over the next 10 to 15 years.

Flightdeck upgrade

Innovation Solutions and Support (IS&S) has developed a flightdeck upgrade retrofit for the 767 and 757. This replaces the original enhanced attitude direction indicator (EADI) and enhanced horizontal situation indicator (EHSI) for each pilot with four new flatpanel displays. It also removes several analogue standby instruments.

The main purpose of this flightdeck upgrade is to remove instruments as well as the avionic line replaceable units (LRUs) that support them. It also reduces maintenance costs and takes out about 200lbs of weight from the aircraft.

The modification also standardises the latest formats available in the industry for the primary flight display and navigation displays. The upgrade also provides a solid foundation for developing the flightdeck to use an electronic flight bag (EFB), the main objective of which is to give the aircraft a paperless flightdeck. The documents in the EFB can be displayed on the new displays in the flightdeck.

The modification recently gained supplemental type certificate (STC) approval from the Federal Aviation Administration (FAA). Installation takes three or four days and costs a total of \$250,000-275,000. IS&S is now working to get approval from Europe's Joint Airworthiness Authority (JAA). The first aircraft to be modified was a 767-200 for Airborne Express (ABX), and more of its aircraft are being modified.

Avionic upgrades

There are several avionic upgrades with which all aircraft types must comply when registered and operating in certain parts of the world. Some of these modifications are already mandatory, while others will become so. Airlines operating in some parts of the world will not be affected by these modifications, however.

The first of these modifications includes 8.33 KHz radio spacing, which

has been mandatory since October 1999 throughout Europe, and is required to cope with the amount of airspace congestion there. This means that all affected aircraft will have been modified.

The second modification relates to the traffic collision avoidance system (TCAS) and Mode S air traffic control transponder. The Mode S transponder is mandatory for aircraft equipped with TCAS, and also where a regulatory authority requires a Mode S transponder to be fitted.

TCAS has been mandatory for all aircraft in the US since 1993, and in Europe since 2000. TCAS and Mode S equipment was not installed on the early production 767s. The 767 production incorporated this equipment in the 1989 to 1991 timeframe. All 767s delivered now have the equipment installed.

The third main modification, which is required worldwide, is the installation of enhanced ground proximity warning systems (EGPWS) or terrain awareness systems (TAWS). The FAA mandated that EGPWS/TAWS be installed on all new production aircraft from March 2002, and that aircraft already built should be modified by March 2005.

The JAA required installation of EGPWS/TAWS on new aircraft from October 2001, and that previously built aircraft be modified by January 2005.

The International Civil Aviation Organisation (ICAO) stipulated that the equipment should be installed on new production aircraft registered outside the US and Europe from January 2001, and on previously built aircraft by 2003.

Boeing started installing EGPWS/TAWS equipment on new production aircraft from May 1998.

Reduced vertical separation minima (RVSM) is a requirement for aircraft operating in Europe and the Atlantic Ocean area. RVSM only requires a calibration of pitot tubes to ensure accuracy of altimeter readings.

Basic area navigation (B-RNAV) is a European requirement for navigation accuracy to ensure that the aircraft does not deviate more than five miles from a

planned track more than 5% of the time. The 767 meets this requirement because it is fitted with a flight management system (FMS) as standard. Precision area navigation (P-RNAV) is required in a few areas, for better accuracy of navigation. It requires a flat screen on the flightdeck, as well as the navigation database installed in the flight management computer to be P-RNAV compliant.

Freighter conversion

The 767-200 has now reached an age where its market values are sufficiently low to justify conversion to freighter. The total costs of aircraft purchase, conversion to freighter, additional maintenance and interest accrued are therefore low enough for a lessor to make a financial return from leasing the converted aircraft to a freight carrier at market lease rates. The bulk of the total cost incurred by a lessor is accounted for by the purchase cost of the used passenger aircraft. The drop in values of used 767-200s in recent years to a sufficiently low level has been a trigger for the first freighter conversions.

The values of 767-300s are still too high, but they are declining and are expected to reach a low enough level to trigger conversion of some of the oldest aircraft in the next few years.

There are two passenger-to-freighter modification programmes for the 767-200 that allow the conventional loading of maindeck freight containers on the aircraft. These are offered by Bedek Aviation and Aeronavali.

There is also the Airborne Express freighter modification which avoids the use of a conventional freight door, and instead utilises a system of passing specialised containers for carrying express packages through the original passenger door. A batch of 767-200s that have been converted for ABX are in operation with this system.

There is currently one freighter modification for the 767-300 offered by Bedek Aviation, but Boeing should start to offer its modification in a few years.

PAYLOAD CHARACTERISTICS 767-200/-200ER CONVERTED FREIGHTERS

Aircraft type	Aeronavali 767-200	Aeronavali 767-200ER	Bedek 767-200ER
MZFW-lbs	258,000	266,000	258,000/266,000
OEW-lbs	164,600	164,600	164,400
Gross structural payload-lbs	93,400	101,400	93,600/101,600
Type maindeck containers	88" X 125" X 96"	88" X 125" X 96"	88" X 125" X 96"
Number maindeck containers	20	20	19
Unit volume maindeck containers-cu ft	494	494	494
Unit tare weight maindeck containers-lbs	240	240	240
Total volume maindeck containers-cu ft	9,880	9,880	9,386
Total tare weight maindeck containers-lbs	4,800	4,800	4,560
Type lowerdeck containers	LD-2	LD-2	LD-2
Number lowerdeck containers	22	22	22
Unit volume lowerdeck containers-cu ft	124	124	124
Unit tare weight lowerdeck containers-lbs	203	203	203
Total volume lowerdeck containers-cu ft	2,728	2,728	2,728
Total tare weight lowerdeck containers-lb	4,466	4,466	4,466
Total volume all containers-cu ft	12,608	12,608	12,114
Total tare weight all containers-lbs	9,266	9,266	9,026
Net structural payload-lbs	84,134	92,134	84,574
Maximum packing density-lbs/cu ft	6.67	7.31	7.64

767-200

The first issue to be considered for 767-200 passenger-to-freighter modifications is that there are 16 different maximum take-off weight (MTOW) variants of the 767-200/-200ER. These range from 282,000lbs to 315,000lbs for the -200 models and from 335,000lbs to 395,000lbs for the -200ERs.

Few freight carriers are likely to be interested in the 767-200, and most will require the -200ER's long-range capability. The majority of 767-200ERs still in active service have MTOWs of 351,000lbs to 395,000lbs.

Besides there being several different MTOW versions, there are also several wing numbers, each with its own limit on MTOW. While it is possible to get an MTOW upgrade kit from Boeing for an aircraft, the wing number will limit the possible higher MTOW. There are also several landing gear specifications and engine types.

The centre wingbox fuel tank can also be activated using a Boeing service bulletin, giving the aircraft the capability of the -200ER variant.

The -200 and -200ER share the same fuselage tube, and can carry the same number and type of freight containers and pallets. While the -200ER does have longer range performance, range is only extended when carrying less than a full payload on the converted freighters. The -200ER thus has a limited advantage.

Aeronavali

Alenia Aeronavali has the exclusive licence agreement with Boeing for the 767-200 passenger-to-freighter modification. Boeing will finalise the engineering package with Aeronavali, and Boeing will apply for the amended type design (ATD) certificate. Aeronavali will be responsible for the sales and marketing of the modification, as well as carrying it out. The modification will be available from June 2007.

The Aeronavali modification programme's main feature is the installation of a 134-inch wide by 103-inch tall maindeck freight door. Following conversion the -200 has a maximum zero fuel weight (MZFW) of 258,000lbs and an operating empty weight (OEW) of 164,600lbs without any containers or pallets loaded. This gives the aircraft a maximum structural payload of 93,400lbs (*see table, this page*).

The 767-200ER has an MZFW of 266,000lbs and the same OEW as the -200. This gives the aircraft a maximum structural payload of 101,400lbs (*see table, this page*).

Aeronavali will offer various operational weight increases, as well as avionics upgrades. Aeronavali can offer an upgrade of MZFW to 266,000lbs for both passenger and freighter-modified aircraft. Any aircraft that Aeronavali modifies to freighter will have a provision

to upgrade MZFW to 266,000lbs.

Aeronavali also offers a free maximum landing weight upgrade to 283,000lbs and an MZFW upgrade to 258,000lbs.

The 767-200 and -200ER have identical maindeck space for freight containers, and also have several options for container loading configurations. The one that provides the highest freight capacity is the use of 18 88-inch wide by 125-inch long by 96-inch tall containers loaded in nine pairs side by side, plus one of these containers at either end of the maindeck. These 20 containers each have an internal volume of 494 cubic feet, providing a total maindeck containerised volume of 9,880 cubic feet (*see table, this page*).

Each of these containers has a tare weight of 240lbs and so the full complement has a tare weight of 4,800lbs (*see table, this page*).

The 767-200's lower deck can accommodate 22 LD-2 containers by loading five pairs side by side in the forward section of the lowerdeck, and 12 in the aft section of the deck. This is unchanged from the original passenger aircraft's capacity. Each container has an internal volume of 124 cubic feet and tare weight of 203lbs. The full set of lower deck containers has a freight volume of 2,728 cubic feet and tare weight of 4,466lbs (*see table, this page*).

The converted 767-200 and -200ER both have a containerised volume of 12,608 cubic feet and tare weight of

PAYLOAD CHARACTERISTICS 767-300 CONVERTED FREIGHTERS

Aircraft type	Boeing 767-300BCF	Boeing 767-300ERBCF	Bedek 767-300ER
MZFW-lbs	278,000	295,000	295,000
OEW-lbs	182,900	184,100	180,700
Gross structural payload-lbs	95,100	110,900	114,300
Type maindeck containers	88" X 125" X 96" Plus A2	88" X 125" X 96" Plus A2	88" X 125" X 96" Plus A2
Number maindeck containers	22/2	22/2	22/2
Unit volume maindeck containers-cu ft	494	494	494
Unit tare weight maindeck containers-lbs	240	240	240
Total volume maindeck containers-cu ft	11,708	11,708	11,708
Total tare weight maindeck containers-lbs	5,280	5,280	5,280
Type lowerdeck containers	LD-2	LD-2	LD-2
Number lowerdeck containers	30	30	30
Unit volume lowerdeck containers-cu ft	124	124	124
Unit tare weight lowerdeck containers-lbs	203	203	203
Total volume lowerdeck containers-cu ft	3,720	3,720	3,720
Total tare weight lowerdeck containers-lb	6,090	6,090	6,090
Total volume all containers-cu ft	15,428	15,428	15,428
Total tare weight all containers-lbs	11,370	11,370	11,370
Net structural payload-lbs	83,730	99,530	102,930
Maximum packing density-lbs/cu ft	5.43	6.45	6.67

9,266lbs (see table, page 18). The 767-200 has a net structural payload of 84,134lbs and the -200ER a net payload of 92,134lbs.

The 767-200, with an MTOW of 320,000lbs, can carry a full payload up to about 2,000nm, while the 767-200ER with an MTOW of 351,000lbs can carry the payload up to about 3,200nm.

Alenia Aeronavali's modification has a list price of \$11.0-11.5 million. This has to be considered in relation to probable used aircraft acquisition costs.

Bedek Aviation

Bedek Aviation has its own supplemental type certificate (STC) for a passenger-to-freighter modification on the 767-200/-200ER. During modification, the aircraft have the option of an MZFW of 258,000lbs or a higher specification of 266,000lbs. The aircraft also have an OEW of 164,400lbs without tare weight. This gives the aircraft a maximum structural payload of 93,600lbs or 101,600lbs, depending on MZFW.

The 767-200 and -200ER have various MTOWs and MZFWs, and Bedek can offer upgrades. These vary according to the size of the upgrade and the individual aircraft being modified, but costs vary from \$200,000 to \$500,000.

The 767-200's maindeck can accommodate 19 88-inch wide by 125-inch containers on its maindeck (see table, page 18). This is one fewer of the

same type of freight containers used by the aircraft converted with the Aeronavali modification. Bedek chose this loading configuration because the additional loading position was limited on weight.

These 19 containers provide a maindeck freight volume of 9,386 cubic feet and have a tare weight of 4,560lbs (see table, page 18).

The lower deck carries the same number of LD-2 containers as described for the Alenia Aeronavali modification, and so have the same freight volume and tare weight.

In total, the aircraft has a total freight volume of 12,114 cubic feet and container tare weight of 9,026lbs. This gives the aircraft a net structural payload of 84,574lbs or 92,574lbs (see table, page 18), depending on MZFW. This is similar to the aircraft converted by Aeronavali.

The 767-200 with an MTOW of 351,000lbs has a range of about 3,000nm when carrying a full structural payload. This aircraft can operate up to about 4,000nm with a gross payload of about 70,000lbs, equal to a net payload of 60,000lbs.

Aircraft with MTOWs lower than 351,000lbs have shorter range performance. These can be upgraded by Bedek during the modification process.

The 767-200ER, with an MTOW of 351,000lbs and fuel capacity of 20,450 US Gallons, can carry a full payload the same distance of 3,000nm as a -200SF, but extends the range to about 5,000nm

for a gross payload of about 55,000lbs. Although the -200ER has a range benefit over the -200 for passenger models, the additional fuel capacity is of no real benefit for freighter-modified aircraft, since range is only extended when carrying payloads of about half the maximum.

The list price for Bedek's modification is less than \$10 million, and includes the cargo loading system but not the weight upgrades.

To date, Bedek has received orders for 37 767-200 conversions, 21 of which have been delivered. Customers include Colombia's Tampa Cargo, Denmark's Star Air, and ABX of the US.

767-200F build costs

When 767-200s/-200ERs are being converted to freighters, the purchase price, conversion cost, probable maintenance and interest charges all have to be considered.

Market values for 767-200s are now down to about \$3.5 million for the oldest -200s, and down to about \$6.5 million for the oldest -200ERs. Possible maintenance costs relate to component repairs, a C check and an engine shop visit. A high maintenance requirement, however, will be reflected in a lower purchase price.

The cost of modification is \$10-11 million, and if maintenance is in the region of \$3 million then the total cost of



build will be \$16-17 million for a -200 and \$19-20 million for a -200ER. Lessors have to consider this against the probable lease rates the market will bear.

767-300/-300ER

Two freighter modification programmes are being developed for the 767-300/-300ER. These aircraft are still relatively young and are in high demand with passenger carriers. Their market values are therefore still high.

One modification is being developed by Boeing and offered by Boeing Commercial Airplane Services (CAS). The other is being developed by Bedek Aviation.

Boeing CF

The Boeing converted 767-300/-300ER freighter (767-300BCF and 767-300ERBCF) have been designed to have a similar payload to the factory-freighter, the 767-300PF. Boeing will be the modification licence holder and market the modification, and Aeronavali will be the main modification provider for the aircraft. The first modified aircraft will be certified in late 2007.

The converted -300 will have an MZFW of 278,000lbs and a structural payload of 95,100lbs, excluding container tare weight. The converted -300ER will have an MZFW of 295,000lbs and OEW of 184,100lbs, giving a gross structural payload of 110,900lbs (see table, page 19). This is

about 10,000lbs less than the 767-300PF.

The aircraft can accommodate 11 pairs of 88-inch wide by 125-inch long containers on the maindeck, plus two smaller A2 containers at either end of the fuselage. The A2 containers each have an internal freight volume of 420 cubic feet, and the 24 containers provide a total freight volume of 11,708 cubic feet (see table, page 19).

As with the pre-converted passenger variant, the -300 and -300ER can carry 30 LD-2 containers in their lower belly space, eight pairs in the forward section and seven pairs in the aft section. These provide a further 3,720 cubic feet of freight volume and have a tare weight of 6,090lbs (see table, page 19).

Overall, the aircraft have total freight capacity of 15,428 cubic feet and container tare weight of 11,370lbs. This gives the -300 a net structural payload (revenue payload) of 83,730lbs, and the -300ER a revenue payload of 99,530lbs (see table, page 19).

The 767-300BCF will be able to carry a full payload about 2,400nm, while the -300ERBCF will be able to carry a full payload about 3,600nm.

The cost of the modification is not known at this stage, but is expected to be in the region of \$13 million.

Bedek Aviation

Bedek Aviation's modification for the 767-300ER is still under development, and the prototype will be available at the end of 2008.

A small number of 767-200s have been modified to freighter, but the -300ER is expected to have the largest attraction to airlines as a modified freighter. This aircraft will have a gross structural payload of up to 114,000lbs.

Bedek hopes to offer a converted aircraft with an MTOW of 412,000lbs, which is the highest possible for the passenger and -300PF variants. The majority of the passenger-configured -300ERs in operation have MTOWs of 407,000lbs or more. Bedek will include the option of MTOW upgrades with its freighter modification programme.

Following modification to freighter, Bedek expects to have an MZFW of 295,000lbs, equal to the -300ERBCF, and an OEW excluding container tare weight of about 180,700lbs. This will give the aircraft a gross structural payload of about 114,300lbs (see table, page 19). This is higher than the -300ERBCF on account of the lower OEW.

Bedek's main and lower deck configurations will be the same as the -300BCF, so the aircraft will have the same container volume and tare weights. This will give the aircraft a net structural payload (revenue payload) of 102,930lbs (see table, page 19).

This aircraft is expected to have a range of about 3,500nm with a full payload, and is also expected to be able to operate up to about 4,500nm with a net payload of about 81,000lbs freight.

The modification is expected to cost close to the \$10 million list price for the -200 modification.

767-300ERF build costs

The availability of 767-300ERs has reduced over the past two years, pushing up values. Any available aircraft are quickly acquired, and market values are in the \$21-30 million range. The cost of modifying these to freighter will be \$11-13 million, without considering discounts. An additional cost of maintenance of \$2-3 million will take the total to a minimum of \$30 million and more likely close to \$35 million. This has to be considered together with probable market lease rates. These are likely to be in the \$250,000-275,000 region. The current values are therefore too high for most to justify conversion. The values of the aircraft have to be \$10-12 million in most cases.

The availability of 767-300ERs will increase again after two to four years as the first 787s are delivered. This will push values down to a level that will trigger freighter conversions. [AC](#)