

The cost of refurbishing the interiors of narrowbody aircraft varies widely. There are many interior items to consider, and the majority of maintenance is done on an on-condition basis, and is at the discretion of the operator. This makes the timing costs of interior refurbishment hard to predict.

The costs of narrowbody interior refurbishment

Narrowbodies' interiors are typically refurbished every six to eight years. The workscope varies from simply upholstering seats to a complete reconstruction of the cabin. Planning the interior refurbishment or refitting of narrowbodies is more straightforward than for long-haul aircraft, especially with the trend towards maximising seat capacity and minimising galleys, lavatories and other space-consuming 'monuments'.

Trying to nail down the cost of interior refurbishments or upgrades is difficult. Even if the raw materials and physical interior components all had one standard price, and even if man-hours (MH) consumed and labour rates were the same everywhere, the picture would still be far from clear. This is because certification and aircraft downtime are only two of a number of other 'hidden' issues that can affect the total outlay for an operator or asset manager.

Planning ahead

The project commences with the layout of passenger accommodations (LOPA) plan of the existing cabin configuration. There should also be a blank one, so that the operator can sketch in its desired arrangements. Once the new cabin has been defined on the LOPA, a detailed specification should be drawn up that defines everything needed for the refurbishment and aircraft customisation.

The next phase is to compile a shortlist of the maintenance and repair organisations (MRO) where the work could be performed. "The MRO's geographical location will be important," advises Phil Seymour, managing director of IBA management consultants. "The aircraft should not be too far away, since this would make it harder to monitor the

job and maintenance capability or to take advantage of the downtime to perform scheduled inspections on the aircraft and its engines, and attend to recent airworthiness directives (ADs) and service bulletins (SBs)."

The specification should be circulated among the shortlisted MROs, vendors and other providers, who will then provide an estimate of how much the project should cost, and within a specified deadline. "Always do your homework early," advises Stacy Mattson, vice president of technical and product support at International Aero Interiors, in Burlington WA. "The earlier that vendors are involved, the better off everyone will be, and the more chance they will have of saving you money. For example, airlines tell us they need a cabin in 60 days. Well that is no use, because many components can take 45 days just to procure. Depending on the scope of the modification, we may need a couple of weeks to gather data, perform our research and build the bill of materials, just to be able to offer a rough order of magnitude (ROM) quote."

It is vital to avoid wasted expense further down the line. To this end, it would be worthwhile to visit the bidders' facilities to conduct first-hand inspections. Questions to ask include:

- What is the general appearance of the facility? Is there an on-site Federal Aviation Administration (FAA) designated engineering representative (DER) or European Aviation Safety Agency (EASA) approved engineering capability with supplemental type certificates (STCs) to support anticipated major aircraft modifications and for aircraft weight/balance changes?

- Does the facility have its own design and styling capability, or will an independent designer have to be hired?

- Is the shop equipped with computer aided design (CAD) capability

enabling stylists to quickly generate possible cabin configurations, with pre-scanned examples of chosen colours and fabrics?

- Does the facility have an avionics & in-flight entertainment (IFE) capability, including passenger satellite communications where appropriate?

- Is the completion vendor/MRO also qualified to perform maintenance and inspection services and aircraft repainting, so that operators may make the most productive use of downtime for the refurbishment?

- What is the overall quality of the shop's work for a typical completed interior? Are there gaps between panels?

- Are panels and fixtures properly aligned? Does everything function properly?

- Is the MRO familiar with the latest technology for producing the lightest possible interior for your aircraft type?

- What is the shop's track record in turning out jobs within the budgeted outfitting weight allowance?

- Are there sufficient staff to meet the project's timetable? Is there a lot of turnover, or have the same experienced hands been retained over the years?

- What is the shop's record in meeting delivery schedules?

- What is the warranty policy and how positive has overall customer satisfaction been?

- How well does the shop support its work post delivery?

- Do refurbishments include a cabin noise-attenuation treatment (especially if planning a 'bare-bones' refurbishment)?

After inspecting the facilities and actual examples of refurbishments, making a final decision is often very difficult and involves balancing quality, convenience and track records against price. Once an MRO has been selected, the interior has been designed and styled, and fabrics have been chosen, the



specification will be rewritten and frozen as part of the work contract.

“The next step in the process is to meet with the completion MRO’s engineers and stylists for the formal design of the new interior,” says Seymour. “Since you already have a good idea of what you want, these consultations could be wrapped up in a couple of days.”

He points out that the chosen MRO should ideally have lots of experience with the operator’s own aircraft type, so it will probably have already developed several standardised cabin configurations that suit its needs, without having to ‘redesign the wheel’. It should also offer several options for galleys, cabinets and lavatories. For each of these amenities and arrangements, the MRO facility will already have earned an STC. Importantly, by choosing seating configurations or accessories which are already certified and, in some cases, even pre-built and stocked in the MRO’s inventories, the client can save time and money over a completely customised cabin. The client may even choose to apply company colours to the interiors, so matching fabrics and sidewall treatments can be chosen quickly, thereby avoiding additional disruption arising from stringent fire-blocking tests (for each new material) in accordance with the regulatory authorities. Above all, IBA advises of the need to avoid changes after the work has begun, which are often expensive and cause delays.

Another consideration is the effect of an aircraft’s ‘newness’ on market availability of materials. “While there is usually plenty of available material for older aircraft, for the newer models, however, one may have to rely on the

original equipment manufacturer (OEM),” says Mattson. “For the 737-800 there is not a lot of surplus material on the market. A customer recently asked me for a 737NG fleet modification, wanting to have parts in hand by June, but because they were for new generation (NG) aircraft, the market simply did not have enough available material.”

The project can either go well, and to budget and schedule, or not. Below are two hypothetical scenarios, one with a positive outcome, and the other a negative one.

The first scenario involves a 737-800 going through a heavy C check. Before rolling out it was completely repainted after having been totally stripped. The fore and aft galleys, toilets, stowage boxes and coat closets were overhauled and refurbished. All the decorative laminates covering the bulkheads, galleys and toilets were replaced. Passenger seats, cabin attendant seats, and cockpit seats were also removed, overhauled and reinstalled with new seat covers. Most of the carpet was removed and washed, and badly worn areas were replaced with brand new ex-stock. The ceiling panels were removed and painted. The cabin hat racks were refurbished, and 52 window outer panes and 25 window inner panes were replaced. The average labour cost for this check is \$850,000, while the direct material cost is \$1.75 million. The total cost of labour and materials is \$2.6 million. It is estimated that by carrying out this check together with the cabin refurbishment, the airline saved \$500,000, and reduced the downtime from a potential high of eight weeks to six weeks. This prevented the loss of a further \$200,000 in lease payments.

Refurbishing narrowbody interiors requires careful planning so as to minimise delays. It is advised that airlines and lessors visit and inspect potential refurbishment facilities to verify that they have suitably qualified staff and the appropriate facilities, equipment and expertise.

In the second scenario a 737-800 was not scheduled for any check other than a complete cabin refurbishment. All the vendors had promised their delivery dates, and the MRO was ready to carry out the refurbishment. The aircraft was ferried to the MRO facility, and the stripping of the cabin began immediately in anticipation of the new cabin materials being ready as promised. Unfortunately a vendor could not keep to its promised delivery date, and the galleys failed to materialise. When the aircraft finally rolled out of the hangar with its new cabin, three months had elapsed. The invoiced cost of this cabin refurbishment became virtually meaningless considering the aircraft had lost so much operational revenue. In addition, for each extra day a 737-800 spends on the ground it costs the lessee about \$10,000 in lost lease rentals.

Leased aircraft

Interior refurbishment or reconfiguration can often become the subject of disagreement between the operator and leasing company for leased aircraft. The main issue of contention is often the scope of responsibility and cost liability for either party prior to the aircraft transferring to a new operator. While maintenance reserves are usually taken for base checks, which are mainly based on the maintenance planning document (MPD), they do not usually include the interior fittings. Indeed, the only time the MPD relates to the interior is when items are removed to allow airframe structural inspections to take place. For example, the MPD does not dictate whether sidewall panels need to be checked for cracks, since this is part of the airline’s own bespoke programme for the interior. So while an aircraft could technically be fresh from a D-check, as per the MPD, it does not necessarily mean that the interior is ‘fresh’, unless that has specifically been defined in the lease document.

If an aircraft was brand new on delivery to its first lessee, the return conditions state that the interior is returned in ‘as good as new’ condition, unless there is a pricing and rental adjustment to reflect a reasonable rather than new condition upon lease-return.

Typically, an aircraft coming off-lease,

especially from a low-cost carrier (LCC), will require new seats, carpets, and sidewall panels, due to the inherent wear-and-tear of high-frequency operations. IBA estimates a budget of \$2,000 per passenger seat, with a new triple-seat assembly costing \$6,000. Another major cost area relates to the certification status of the parts. "Much of the equipment coming out of airlines like Varig, which used its own seats, galleys and lavatories manufactured in Brazil, are of no use for FAA and EASA jurisdictions," says Seymour. "So even for 737s and A320s, we have seen some lessors having to spend \$400,000-\$500,000 simply on addressing and managing the mis-match between an aircraft in a return condition and what it needs to go back on lease."

Harald Schween, manager of transition & documentation services at Lufthansa Technik, makes the point that a particularly problematic clause in most leasing contracts merely states that the aircraft's cabin upon lease return has to comply with 'international airline standards' regarding appearance and technical condition. "This is problematic and controversial because the lessor's interpretation of this clause is often very different to the lessee's."

Indeed, topics of conflict often centre on the identification by the lessor of 'wear and tear' issues, such as stains,

cracks and dirt. A common bone of contention arises when some of the sidewall panels are replaced, thus showing up adjacent ones as slightly darker or more worn. In such cases it has been known for the lessor to demand the replacement of all panels so that they are all exactly the same shade, even though the 'darker' ones were not broken at all.

"Any modification to a fabric or covering requires a new 'burn certificate,' which is the responsibility of the lessee, and without which the aircraft is technically not airworthy and will not be accepted back by the lessors," continues Schween. "Furthermore, if the lessee is unable to provide the valid certificate, the lessee may need to change the material and/or re-conduct a burn test in a testing lab, which could result in a major additional cost to the operator."

Cabin cost and logistics

Mattson points out that when costing overhead bins, which are a seemingly straightforward component category, there can also be nasty surprises. "Bins in the constant cross-section of the cabin are made in larger quantities than those at either ends of the fuselage, which tapers. Of course, the more that are made, the cheaper they are, and vice-versa. Now when you go to the OEM, for example, a

bin for the constant section can cost \$18,000, but if you want one from the non-constant section, it is \$32,000, even though it is a smaller bin. Moreover, there must be 50 different part numbers for the same-sized bin, simply because it has different variations, including: a first aid kit; a fire extinguisher; magazine racks; provisions for a curtain header; and has several choices for the attachment points."

Much also depends on overall worldwide demand for a particular aircraft type. "There is such high demand for A320s and 737NGs that the lessee receiving an aircraft previously used by another airline will not want to delay delivery, and they are in short supply," observes Seymour. "In contrast, when the industry is in a trough, operators looking to lease aircraft have a wide selection of aircraft to choose from. They can put a lot of pressure on the seller and insist that the equipment must be replaced with new, or better than it is now."

Seymour points out that LCCs, in particular, are increasingly installing as many seats as possible to maximise revenue, even to the extent of having only two lavatories on board instead of three, which in itself can save up to \$2 million per aircraft. However, there are no easy provisions for reinstalling the third lavatory, and a subsequent operator must

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also consider that the lead time on obtaining a new one can typically be 120-180 days. Interestingly, some airlines now do not even include pull-down window blinds and seat-back pockets, and are probably saving themselves \$250,000 as a result. There are also weight savings.

“The scope of the majority of the modifications to the 737-300s in recent times has been to remove first class and make it all coach. We are also seeing 737-800s increasing capacity, by taking out aft galleys,” says Mattson. “When you take out a monument there are knock-on effects to the ceilings, bins, sidewalls, sidewall support extrusions, lighting, air-conditioning, the passenger service units, and quite a large number of other items and systems. This is where a lot of the costs come from.”

Indeed, by increasing seat pitch and spacing, the new seats may not line up with the overhead PSUs & lights, in which case the pitch of the PSUs must be changed with infill panels to match the positions of the new seats. This can also affect the layout of safety equipment in the cabin, not to mention the overall weight and balance of the aircraft itself. Delays may thus result because the OEM (Airbus or Boeing) and the certification authorities may have to be consulted. The resulting wait for revised paperwork could therefore become a serious bottleneck. To add to the potential problems, secondary damage, especially to sidewall panels, usually occurs somewhere in the cabin whenever a seat configuration changes.

It is also worth bearing in mind that with the trend today for dual-certification of major interior reconfigurations, additional costs should be budgeted for. “Whereas the FAA uses DERs which are paid in cash by the user per the job, with

an EASA certification I cannot simply present a package to a DER,” explains Mattson. “Instead, I have to turn it over to EASA, which, being just a governing body, will administer it to a national CAA to handle the actual documentation reviewing for the STC. Then, to further complicate matters, each country charges its own rate per hour for the review. And while EASA itself can only charge Euros 99, the UK Civil Aviation Authority (CAA) will charge in Pounds Sterling. An EASA certification and review process can therefore cost more and take a little longer than an FAA one.”

“There is plenty to be considered even if merely refurbishing an aircraft,” adds Mattson. “For instance, you cannot simply assume that your desired decorative material will be available in short order. Many times they are not. For certain materials, like customised carpeting, you may have to buy a whole mill run which can take several weeks. There are some manufacturers which will let you buy in smaller quantities.”

According to Marie-Louise Nordlund, commercial director at Sollentuna Cabin Interiors, SCI, based in Sweden, aircraft cabin carpets are normally not ‘broken’ as such, but become stained and worn. “Carpets can either be cleaned or replaced. On a commercial aircraft, the entire carpet in the aircraft passenger cabin can be replaced, or just the carpet in the aisles and the areas around the doors. An entire carpet change normally only takes place in conjunction with a large C check once a year. An aisle carpet change, however, can take place several times during the year, depending on its condition. For example, a carrier flying in countries with lots of sleet and snow being brought in via passenger shoes, or with very messy drunken passengers, may

It is common practice for airlines to pay lessors reserves for airframe and engine maintenance. There are often disagreements between lessors and lessees over the cost and responsibility of bearing the cost for interior refurbishment. This could be avoided by a facility of reserves for interior refurbishment, which would be small compared to other maintenance items.

experience more frequent carpet change intervals.”

Nordlund says that a carpet can usually be washed four to five times before it needs replacement. “It is important that this task is contracted to professionals, because ordinary cleaning may damage the fire-resistant capabilities in the carpet, thereby destroying it,” stresses Nordlund. “We often perform carpet washes and have tested and certified with several major carpet manufacturers, so that the fire resistance of the carpet is not impaired.”

“The interval for an aisle carpet change on a narrowbody aircraft is normally 1,000-1,500FH, and the labour cost of an aisle carpet replacement is upwards of Euros 550 (\$720). Material or carpet cost on a narrowbody is upwards of Euros 45 (\$60) per square metre, depending on the carpet design, quality and manufacturer. Moreover, for a narrowbody aisle carpet change you need about 25 square metres, depending on floor emergency lighting location. Labour cost for a full carpet change for a narrowbody is Euros 2,500 (\$3,300) and upwards. About 80 square metres are required. Meanwhile, fabric seat covers are frequently sent for dry cleaning, but again depend on the type of passengers flown. After about five dry-cleaning cycles, if not before, the cover needs to be totally replaced. The cost of an economy class basic fabric seat cover is upwards from Euros 130 (\$170) per passenger place, depending on quality, design and volumes purchased. Leather covers are more expensive to buy, but can be more economic over time, although they do require regular maintenance to stay functional. Sidewalls and ceiling panels are normally only replaced in conjunction with C checks or larger checks if needed, and quite often are then only re-laminated, unless broken or torn.”

Michel Pebarthe, aircraft product support director at Air France Industries says that on the Air France A320 fleet, seats, carpets, and the galley surroundings are changed at each C check, which is every 18-20 months. “We replace the seats by standard exchange, putting in place a set which has already been overhauled ‘out of the cycle’. The C check takes only 4-5 days, but to fully overhaul a set of seats can take 15 days to three weeks.”

Changing seat pitches, numbers or overall seating configurations have several knock-on effects, and these are overhead bins, PSUs, safety equipment, lighting, carpeting and air conditioning. This incurs a large cost.

Furthermore, he reckons the cost of an A320 cabin refurbishment, which is highly dependent on airline maintenance policy, is about 40% of the global costs of the 'host' D check visit, of which about 60% are attributed to labour.

"When we perform a D check we remove all of the inside of the aircraft. All the cabin is removed, and all the cabin components are overhauled. Moreover, we have to manage the time to repair and renew the cabin components in 'closed loop' (repaired during the visit and reinstalled on the same aircraft), which is certainly one of the constraints of the general planning," adds Pebarthe.

"Normally, the lower intervals would be used for inspections in the cabin," explains Frank Vetter, deputy manager aircraft cabin systems engineering at Lufthansa Technik. "We have daily checks, weekly checks and then the A-checks at 500FH intervals with our A320s. This is when we mainly perform visual inspections, particularly of the carpet at the entrance area, while seat covers are checked every day. Regular actions are also taken at higher checks, such as the 4C, IL, or D check. We physically remove many of the cabin items for complete refurbishment during these checks. Basically, the lower checks are used for visual inspections and replacements as necessary, and on higher intervals we go in and remove complex items. About half the total heavy check cost is attributed to the interior."

Interestingly, when Lufthansa recently wanted to upgrade its entire narrowbody fleet (A320s and 737s) with new interiors, it organised a special layover of two to three days for each of the 142 aircraft to be processed. "We started upgrading the first aircraft interior at the beginning of February 2006," recalls Andreas Pakszies, director aircraft system engineering, "and by September we had processed 142 aircraft. We basically had four aircraft per week in layover."

Pierre Reville, executive vice president of operations at Sabena technics (TAT Group) reports that most of the time an interior refurbishment is costed on a 'time and material' basis. "This is because it is quite difficult to predict the workscope in advance. The decision whether to change all the curtains, seats and covers, or to



replace carpets cannot be made until the aircraft is available at the MRO. We use a flat rate for all the functional tests, which are required by the Aircraft Maintenance Manual (AMM), because here we know how long we need to test the systems and the overall cabin functionality. If the customer subsequently wants a better cabin appearance, it can decide to increase the work package with more sophisticated checks, although most of the time this is not the case. Carpet replacement tends to be standard at the C check, as is the test for the foam in the cushion. Then sometimes during the C checks we replace all the seat covers and curtains, and repaint the hat racks.

"We have several customers, so the workscope tends to be different every time, depending on the interior work they want included during daily checks, A checks or C checks, and so it can be quite different from one customer to another. Then some operators have IFE while others do not," continues Reville.

The design phase can take several months for a complete cabin reconfiguration. "You need to go back and forth to certify and have it all agreed with the operators. Then there is a long lead time if you want new seats or new galleys, not less than 8-12 months to receive the new material," says Reville. "So if you want to rework your cabin completely it is an 8-12 month project. During this period all your marketing people will have to agree on the version you want. Then there is the design phase, followed by purchasing of IFE, galleys and kitchen zones. The installation itself is actually the easiest part. It can take 2,000-3,000MH to completely reconfigure an A320."

Interior reserves?

"The industry needs to move to having a separate maintenance reserve for aircraft interiors," says Seymour. "Ten to 15 years ago engine maintenance reserves were all-encompassing, but were then split between engine performance restoration and LLPs. In terms of operating lease evolution, the next area to be considered is the aircraft interior, including the cargo compartment and flightdeck as well as the passenger cabin."

A complete carpet change in a 737-800 and A320 costs \$18,000, while refurbishing galleys and monument items costs \$65,000-70,000. Overhauling a full set of seats, which usually occurs during a C check, costs \$135,000-160,000. Window panels cost \$400 each.

"For a typical narrowbody a cabin refurbishment would cost \$400,000," continues Seymour. "This would include seats, carpets plus some sidewall panels and overhead bins, which may need refurbishment. The lavatory and galley modules usually come out at the heavy checks, which is when you should be refurbishing bulkheads and wardrobes and recovering flightdeck seats and cabin attendant seats. You are therefore getting close to the \$650,000-700,000 mark when you include all of these.

"If amortised over 10 years for an A320, it works out at \$5,400 per month over a utilisation of 300FH. This equates to a manageable \$18 per FH, which is about the same reserve for a landing gear." **AC**

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