Breaking the moULD

Felicity Stredder explores the evolution of the ULD from its humble beginnings to the advanced units of today and asks: is there further to go?

Modern, lightweight ULDs have come a long way from the 1960s pallets and profiles

Early days

The ULD as we know it today has not always occupied the critical *rôle* it now plays in loading operations. In fact, before the late sixties and seventies when the first recognisable containers made of weather-proofed cardboard were developed, pallets were used exclusively. Pallets - firstly made of plywood and then of balsa wood sandwiched between thin sheets of aluminium for lightness - were used to consolidate loads, secured to the floor with nets. "The disadvantage of this pallet type," begins Klaus Demtröder, PalNet Managing Director, of the balsa wood offering, "was the daily capacity, as with this bonding procedure you could only make eight a day." As a result of the unsophisticated gluing procedure used to assemble these pallets, the final product was neither quick to manufacture, nor did it boast much structural integrity.

"A common defect was for the balsa wood core to become rotten and require replacement," informs Bob Rogers, Senior Adviser for Nordisk Aviation. It wasn't long before metal pallets, complete with their own restraints and floor fittings, developed – but what of those all-important sides?

Neale Millett, Principal Consultant for Wright Stuff Consulting, picks up the thread. "The first cardboard containers were officially non-structural ULDs and came in two forms: as profiles that were placed on pallets and then restrained with a net and, a little later, as "baggage boxes" that were used in certified holds," he conveys.

Following the advent of these unfixed cardboard, and later fibreglass, shells in the 1960s, back in the early days of B707 and DC8 freighters, the next instalment in the ULD's timeline was a major milestone: the solid structure. Eventually these separate profiles and pallets became united as one fixed unit. "Container bodies were most commonly made of fibreglass, often requiring extensive repair," says Bob Rogers. Next, at long last, we arrive at the iconic all-aluminium structure in approximately 1970, launched into the market in collocation with the unveiling of the jumbo jet. Still they were relatively unsophisticated compared to the ULDs of today. Bob continues, "When aluminium container bodies did make an appearance they were typically made from corrugated aluminium sheets and an average container would weigh double or more what it does today." These units topped the scale at a sizeable 90 kilogrammes before containing any cargo at all.

Commercial roll-out

In all cases, the purpose these units served was to optimise loading productivity, both by maximising capacity and minimising turnaround times. Martin Kraemer, Sales Director at Jettainer, comments, "The idea behind ULDs was to reduce the downtime of an aircraft by pre-loading baggage and freight on to pallets and into containers and then easily load these into the aircraft. In addition, the containers' design facilitated a more efficient use of the available space inside the aircraft belly, which made the transport more secure and freed up more space for additional cargo."

Whilst their commercial roll-out has seen more demanding criteria arise for today's ULDs, cargo operations nonetheless remain entirely reliant on the basic premise: what began life as a box on a pallet.

From cardboard, to fibreglass, to a basic aluminium structure: already the ULD had undergone multiple makeovers before it took on its now familiar face – or its three-letter nickname. The renowned LD3 unit, however, didn't actually arrive on the scene until 1970, in conjunction with the arrival of the B747, the first passenger aircraft to have containerised lower deck cargo compartments. The LD3 was designed and developed by ULD pioneer James 'Jim' Jackson during his 40 years' service with American Airlines – an accolade for which he is now a recognised member of the TIACA Hall of Fame for his contribution to the advancement of the air cargo industry.

Following the introduction of minimum standards and specifications by IATA, these containers were given the label of the Unit Load Device. The ULD, as it was now called, underwent further notable changes over the next 40 years or so as industry demands evolved and requirements changed. Though not as momentous as initial milestones in design, these developments were equally significant in their impact on operations, as they began to target new objectives like cost-efficiency, durability and environmental impact.

Eras of change

Establishing the main drivers in the evolution of the ULD is easy, for they form a pyramid: durability and weight sit at the bottom, with cost balancing delicately on these variables. Ulf Hartmann, Technical Director for Zodiac Aerospace, explains the significant *rôle* that cost has played over the years. “The priority has changed a few times, always depending on the oil price,” he asserts. “When in the 1970s the oil price went up, ULDs had to become lighter. After the oil price became stable again, the focus shifted to robustness/damage resistance.

“Right now, with oil prices low again, the tare weight no longer has the highest priority. Ultimately, cost was the driving factor for both aspects in the end: low weight saves cost due to lower fuel burn and robustness saves cost due to lower repair cost,” he summarises succinctly.

With regards to weight, many pivotal changes have occurred in the timeline to date. Bob Rogers comments on the earliest efforts. “The initial weight reductions came about simply through improved design, resulting from both the arrival of sophisticated Computer Aided Design systems and also from real-life experience of what worked best in the thoroughly unpredictable air cargo operating environment. These savings brought the weight of a typical LD3 down from around 130 kilogrammes to about 75 kilogrammes,” he remarks. According to Ulf Hartmann, the non-welded container design, first introduced by Zodiac Aerospace in 1987, was an early milestone in weight optimisation, allowing a significant weight decrease from 90 kilogrammes to 75 kilogrammes without affecting the structural integrity of the container.

A surge in jet fuel prices in the mid 2000s resulted in the continued drive for weight reduction by airlines, to offset the expense of fuel burn. Aluminium having been optimised to its fullest extent, this triggered the next milestone in ULD development: the arrival of composite materials. “The biggest change eight to ten years ago was switching from aluminium to composite materials which made them significantly lighter, from 70 kilogrammes down to 50 kilogrammes,” explains Ludwig Bertsch, CEO of CHEP Aerospace Solutions. “The average weight of an LD3 today is around 60 kilogrammes - people are reluctant to go for the lightest model as they necessitate more repairs. However, with the average weight composite, you can expect it to be repaired only once a year, compared to 1.7 times a year previously.”

Indeed, replacing traditional aluminium sheets with composite has seen significant further reduction in tare weight that would have been otherwise impossible, but is this option preferable to the traditional aluminium? “It’s a no-brainer with the weight reduction and reparability,” continues Ludwig. “There are still areas where the aluminium container has its right to exist, for example main deck or for valuable shipments, but other than that, 80% of the time there is no reason to use aluminium for the LD3.”

Unsurprisingly, the use of composite material for ULD manufacture has now become a widespread practice.

Problem solved?

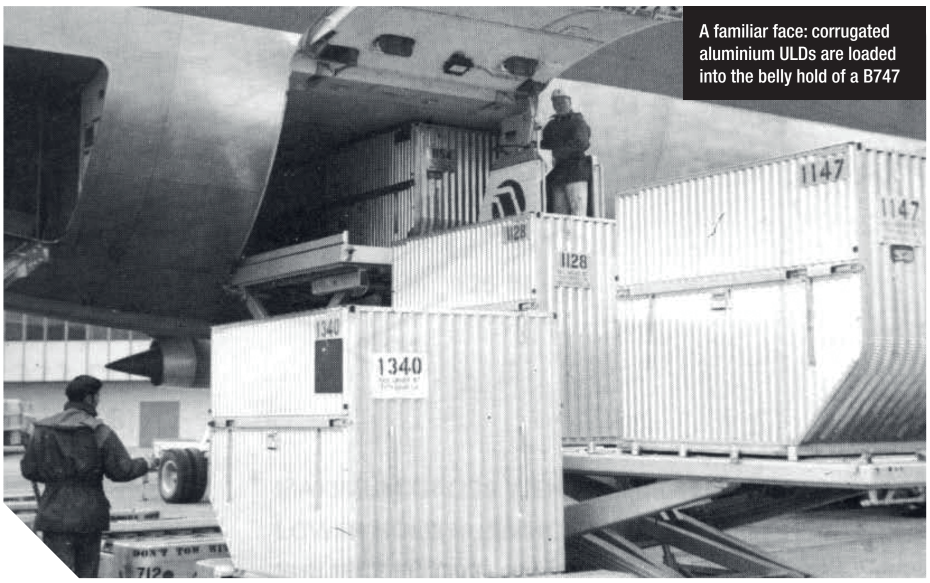
Not exactly. Despite the significantly reduced weight and subsequent cost savings afforded by the composite ULD, new concerns came in tow with this material.

1956: An early pallet carrying a sizeable 5MB hard drive is loaded on to a PanAm DC6

Bob explains: “First of all, most composites are considerably more costly than plain aluminium sheet and secondly, the strength of composites, particularly against the sort of puncture type impacts seen most commonly in the air cargo environment, varies considerably.” Airlines are reluctant to pay higher initial costs or incur higher rates of damage repair costs, he says. “The Holy Grail of the container that can meet all these conflicting requirements remains extremely elusive!”

Unfortunately, damage to ULDs continues to be commonplace, thanks to improper handling by ramp staff, and composite repairs are a costly and specialised affair. “Aluminium can be repaired all over the world, as repair stations are well trained on aluminium, whereas on composite panels, new training needs to be added,” declares Klaus. While the ULD itself may have shed many skins over the years, its developments cannot overcome adverse operating conditions. Ulf Hartmann elaborates: “No significant improvements have been made in the ULD ground handling environment. There still is not enough storage space at airports, ULDs are stored on the ground instead of on racks with rollers, transported with wrong or damaged ground support equipment, permanently handled (or more accurately, mishandled) by forklifts, and so on,” he unhappily relates.

In order for things to progress down the composite road, therefore, better awareness and safer handling of this specialist equipment is a must. The composite model offers the lightest weight of ULD on the market today, generating a lower fuel burn than its heavier aluminium counterpart, which equates to minimised cost for the airlines and reduced CO_2 emissions; but development has reached something



A familiar face: corrugated aluminium ULDs are loaded into the belly hold of a B747 of a plateau. Until the thorny issue of mishandling is tackled head on, progress on this front is going to be limited.

New concerns

Of late, it seems new objectives have arisen in the redevelopment of the ULD. Having established a functional structure that is both as light as it can be (for now) and durable, the current solution is decreed cost-effective. Subsequently, the focus of improvement has shifted to new areas of concern, not directly linked with cost, like safety and environmental impact.

Bob Rogers offers his perspective: "At the same time as the never-ending efforts to reduce tare weight continue, there are also externally driven initiatives, one interesting one being the development of the explosion proof or hardened ULD, developed in the aftermath of Lockerbie. And more recently, there has been a very considerable interest in developing fire resistant containers that can act as part of an airline's lithium battery risk mitigation process," he reveals. In addition to efforts to enhance the safety of ULDs, the development of specialised Temperature Controlled Containers for the growing carriage of temperature-sensitive cargo has been critical for the advancement of the industry at large.

Technology is also progressing in the area of RFID: another vital component in the ULD's evolution. Ludwig refers to CHEP gaining the IATA innovation award for its CanTrack prototype just last year. This tracking technology, "can inform the user of shock, damage and temperature and protect against theft by sending an alert. In the best case we could be rolling out at the end of this year or early next year," he divulges. "We believe it is going to be one of the biggest disruptive technologies."

Indeed, this breakthrough technology has the potential to solve myriad problems in the transportation of cargo, not least the prominent issue of damage to ULDs, which could help bring down the cost of repairs and increase the ULD's lifespan. Martin Kraemer agrees: "The ability to track ULDs is important, since the item itself is a valuable asset and the fewer ULDs you need in an airline's fleet, the less the costs for running the fleet. With a hundred percent data availability, the ULD's location, whether it is serviceable, whether it is in use or empty – feeding all this into our steering system, that's the future."

Minimising environmental impact is becoming ever more important, too, as airlines' activities are closely monitored by all stakeholders, including the public. "When a ULD has finally reached the end of its life, we recycle both aluminium and composite ones," Martin continues. "The recycling only uses a fraction of the energy used to create new aluminium, making recycling very economical." Between their recyclability and lighter weight, which minimises fuel burn and consequently carbon footprint, environmental concerns are growing in importance.

Jettainer developed the first decision support system to assist with simple tasks for the ULD controller

Further potential?

The ULD has not gone through a series of technological changes over the years; change has been incremental and the basic design criteria, such as dimensions, remain very much fixed.

"ULDs are considered a structural part of the aircraft once on board, so they have to conform to IATA regulations," explains Ludwig. "Strict testing and approval is required before a ULD is allowed on to the aircraft and this is why there are only a handful of ULD companies in operation," he concludes. Drastic change therefore is very limited.

Nonetheless, there is scope for improvement. Aluminium has been used in ULD construction considerably longer than have composites, and when the level of expertise in the two materials equals out, it is likely that this will be reflected in modern developments. "Skills have had to change," agrees Ludwig. "Where welding is used for aluminium, composite repair methods are different and require different tools."

Martin has a few ideas about the future already. "Our expectation is that the next big step in saving weight will come with a surprising new material, which might even derive from a completely different industry. Currently, the container's base is still made of aluminium, thus making up a bulk of the total weight. Manufacturers as well as Jettainer are busy developing a new lightweight pallet, which can then also be used as a base for a container." Klaus Demtröder of PalNet also enthuses about exciting development projects already underway: "My organisation is now working on a composite hybrid container to reduce the weight of an LD3 container. Currently we are staying at 54 kilogrammes," he says.

Bob is practical in his view: "Weight reduction remains possible if, and this is a big *if*, the handling environment of the ULD is improved. There is probably another 15 to 20 kilogrammes of tare weight that could be taken out of standard LD3 containers if they were to be always stored, transported and handled according to the current IATA industry standards."

Thinking outside the box, Ulf suggests that new concepts for passenger handling might lead to a completely new approach in ULD concepts. "So far, a passenger will never have direct access to a ULD. He just drops his bag on a belt and from there it disappears behind the scenes. But who knows what the airport of the future will look like?"

In conclusion

Certainly there is scope for this all-important device to continue to evolve in tandem with the industry. Specialist applications, like temperature control, and stricter requirements, like fire safety regulations, will interact with modern innovations in construction to shape the ULD of the future. **ghi**