

CargoLifter airships

Peter Lobner, 11 August 2019

Background

CargoLifter AG was founded in September 1996 in Wiesbaden, Germany, with the objective of offering a logistics service based on the point-to-point transportation of heavy and oversized loads using lighter-than-air (LTA) technology in airships of their own design.

An abandoned former Soviet military airbase in Brand-Briesen, south of Berlin, was selected as the site to build their production and operation center, including a giant airship hangar measuring 360 m (1,180 ft) long x 220 m (720 ft) wide x 106 m (348 ft) high. This hangar is the largest freestanding building in the world.

Two different types of Cargolifter airships were planned: the CL75 “Aircrane” transportation balloon and the much larger CL160 semi-rigid airship. The CargoLifter CL160 was much larger than the Hindenburg zeppelin built in the 1930s.

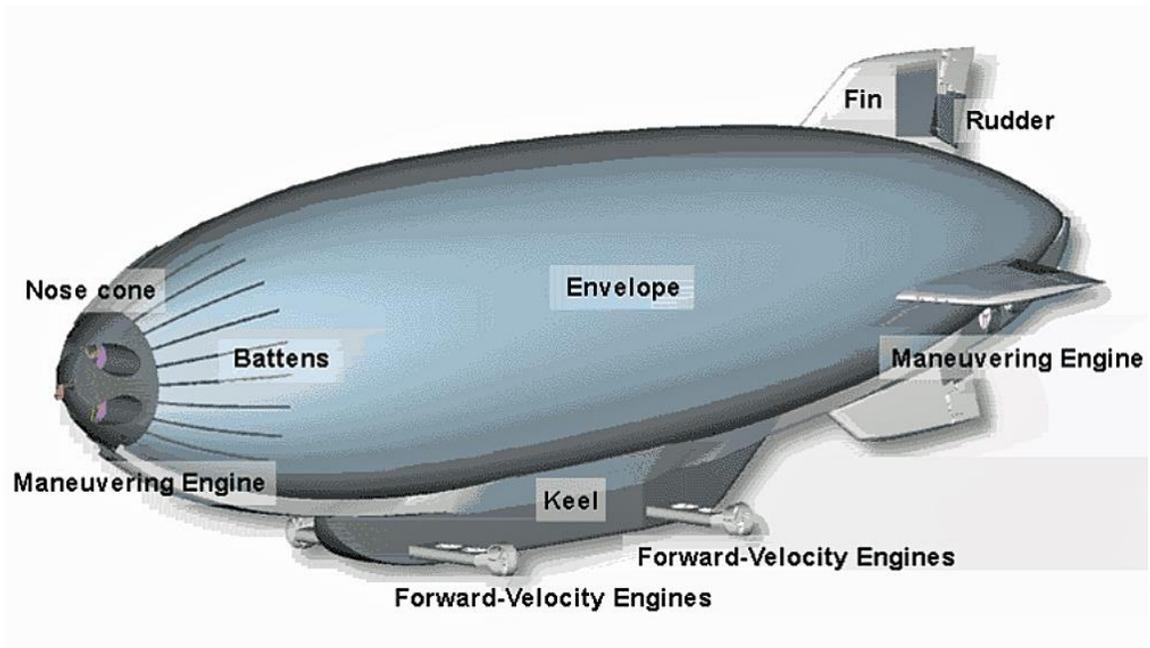
Airship	Envelope length (m)	Envelope length (ft)	Envelope width (m)	Envelope width (ft)	Envelope volume (m3)	Envelope volume (ft3)
CargoLifter CL160	260	853	65	213	550,000	19,423,067
Hindenburg LZ-129	245	804	41.2	135	200,000	7,062,000

Cargolifter AG planned to build up to 50 CL160 airships and 10 CL75 transportation balloons by 2015 and establish the global infrastructure that could support this fleet of airships.

Unfortunately, Cargolifter AG became insolvent and failed in mid-2002, after their giant hangar in Brand-Briesen was completed, but before their first CL160 airship was built.

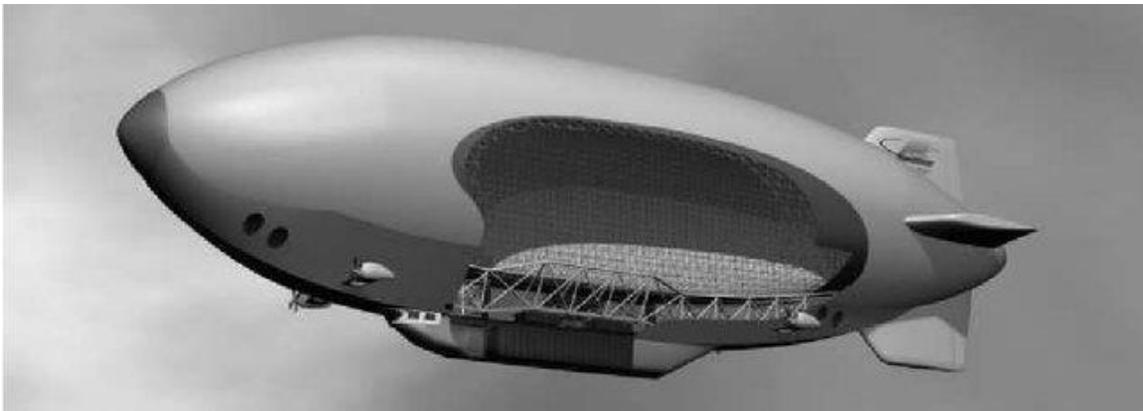
The CargoLifter CL160 airship

The semi-rigid CL160 airship had a long structural keel under the envelope to support all heavy loads and distribute those loads into the airship's envelope.



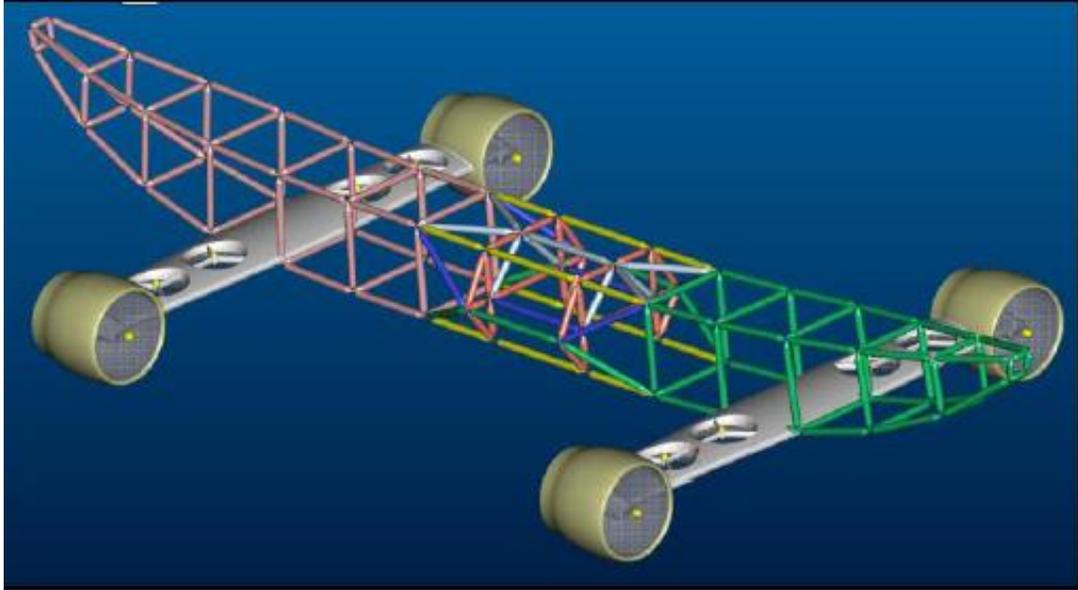
CL160 general arrangement drawing.

Source: https://www.slideshare.net/1st_TSG_Airborne/cl160-Ita



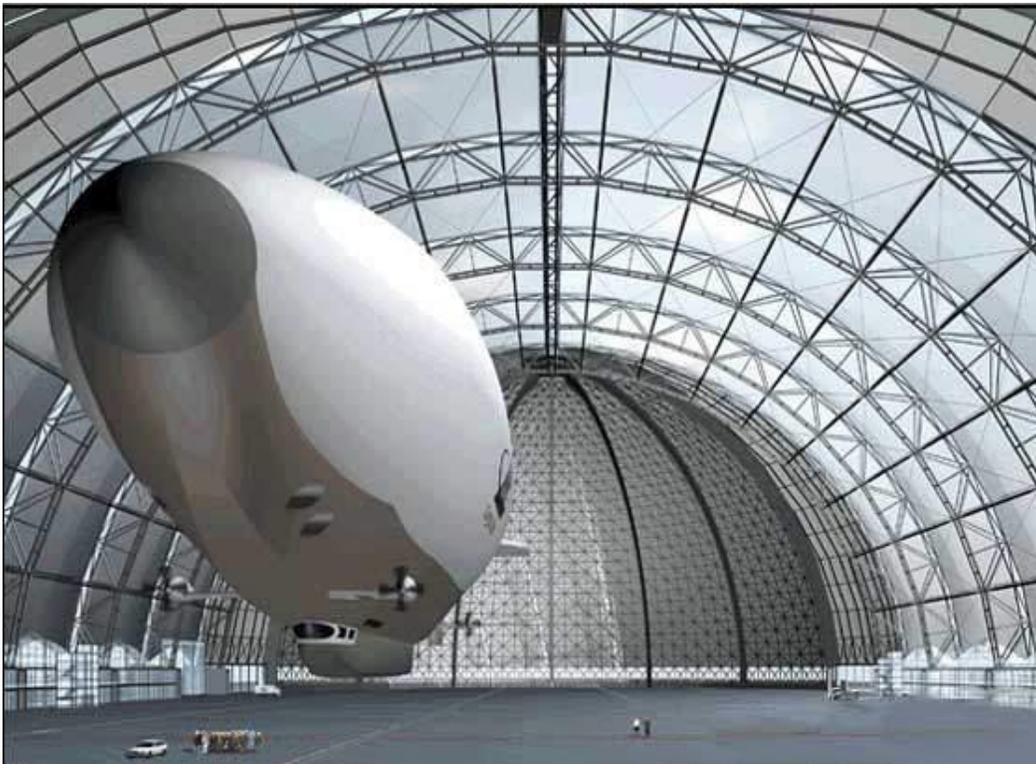
CL160 cutaway drawing showing the keel structure.

Source: Carl Schweizerhof / Wilhelm Rust, "Finite element load limit analysis of thin-walled structures....." July 2002



*CAD rendering of the CL-160 keel structure.
Source: NASA Ames Research Center, June 2016*

You can appreciate the scale of the CargoLifter hanger at Brand-Briesen in the following graphic, which shows a single CL160 airship inside the hanger.



CargoLifter CL160 in hanger. Source: Aerospace Technology

The CL160 would have been capable of carrying very large and heavy payloads; and capable of making an in-flight load exchange (drop off or pick up cargo) while hovering over its destination. The CL160's lift gas (helium) would have fully supported the weight of the airship and its cargo, thereby enabling vertical takeoff and landing (VTOL) and hovering.

Executing a load exchange from a hovering CL160 airship

Among the challenges in making an in-flight load exchange from a hovering airship are station keeping over the destination, and managing the balance between lift and mass while massive cargo items are being added to, or removed from, the airship. As described on the Aviation Technology website (<https://www.aerospace-technology.com/projects/cargolifter/>) the CL160 would have performed an in-flight delivery of cargo as follows

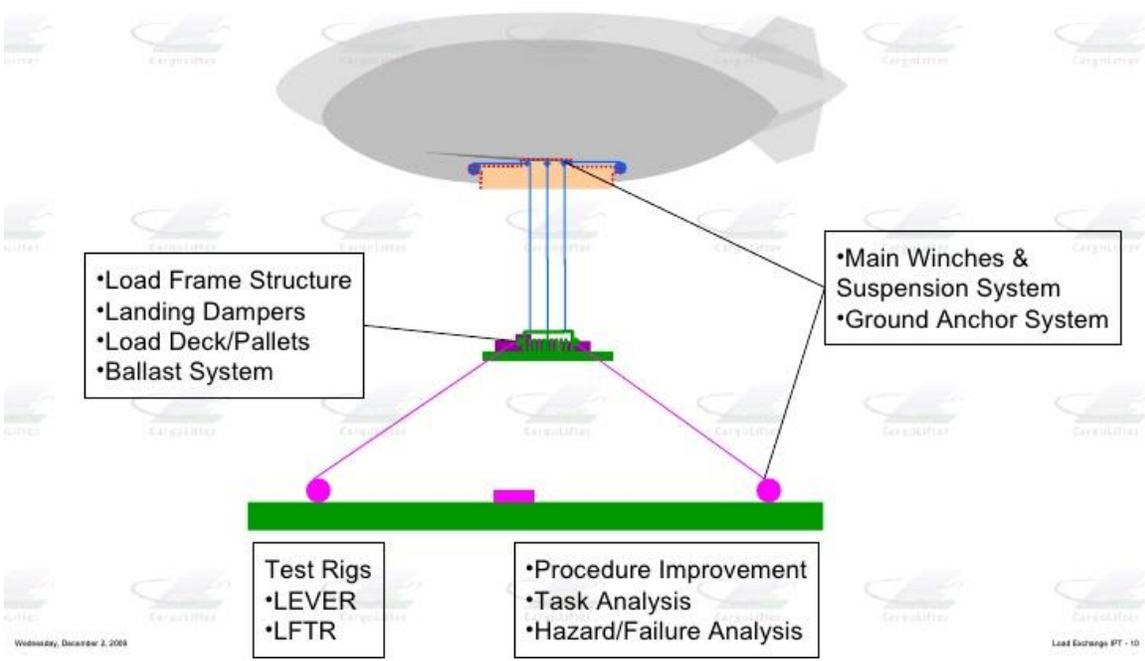
“The airship’s load exchange procedure makes use of a new, specially developed technology, allowing it to load and unload without landing. The airship hovers at about 100 m above the ground and a special loading frame, which is fixed during flight to the keel of the airship, is then rigged with four cable winches to the ground, a procedure which is to assure that the airship’s lifting gear stays exactly above the desired position. Ballast water is then pumped into tanks on the frame and the payload can be unloaded. The anchor lines are released and the frame is pulled back into the payload bay of the airship.”

When the CL160 receives new cargo during a load exchange transaction, the amount of water ballast needed would be reduced. An in-flight load exchange is illustrated in the following graphics.



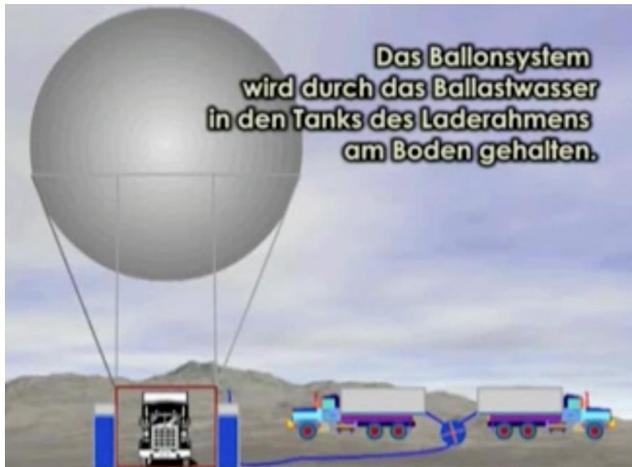
*Load exchange from a hovering CL160.
Source: CargoLift AG*

Load Exchange Work Packages



Load exchange experiments with CL75AC heavy-lift aerostat

The load exchange ballasting process for the CargoLifter CL160 was tested from 2000 – 2002 and demonstrated successfully using the CargoLifter CL 75AC heavy-lift aerostat and a specially designed loading frame that also carried the water ballast when needed.



The balloon system is held on the ground by the combined weight of the cargo and ballast water (blue) in the tanks of the loading frame.



Pumping the ballast water from the loading frame to the tanker trucks makes the balloon system lighter-than-air and it lifts off at a certain point with the cargo.



Pumping the ballast water back into the loading frame upon landing secures the balloon system safely on the ground. The cargo now can be removed from the loading frame. The balloon system remains held to the ground by the weight of the ballast water.

In one outdoor test on 7 May 2002, a 55 metric ton German mine-clearing tank was loaded, lifted and discharged from the carriage as water ballast was unloaded and later reloaded in approximately the same time it took to secure the tank in the carriage (several minutes). In this test, the 55 metric tons cargo was exchanged with about 55 cubic meters (1,766 cubic feet, 14,530 US gallons) of water ballast.

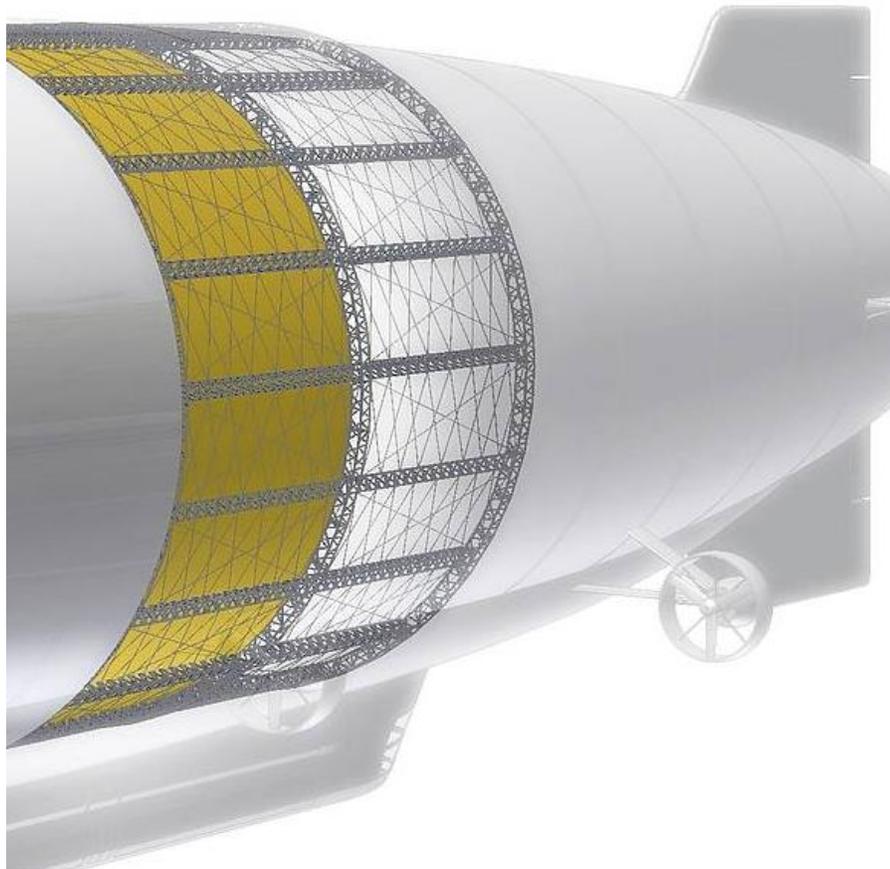
You can watch a short video of this load exchange test and a simple animation of the water ballast transfer process at the following link. The following three graphics are screenshots from this video.

<https://www.youtube.com/watch?v=Iralh-LwcJQ>

CargoLifter Epilogue

Almost two decades after the demise of CargoLifter AG, the CL160 adventure remains as an important milestone in the development of the technology and the business case for modern heavy cargo airships.

The successor firm, CL CargoLifter GmbH & Co. KGaA, was founded in Berlin in 2005. This new entity owns the patents of the former CargoLifter AG and seeks to sell lighter-than-air technology, services and products. They advertise that, “Based on proven and certified components of the AirTruck product range, CargoLifter can develop and build a full-fledged AirShip. Suited for extremely over-sized loads of more than 60 meters and payloads of more than 80 tons, with a flexible load bay for various industrial components. As a rigid airship, it would follow the proven design of the Hindenburg.” Their rigid aerostructure design is shown in the following diagram.



Current rigid aerostructure design.
Source: CL CargoLifter GmbH & Co. KGaA

You'll find more information on the CargoLifter website is here:

<https://www.cargolifter.com/en/company/>

The giant hanger in Brand-Briesen is still in use today, not for aviation, but as the world's largest indoor tropical rainforest and water theme park named Tropical Islands Resort. Here's the link:

<https://www.tropical-islands.de/en/tropical-world/>