

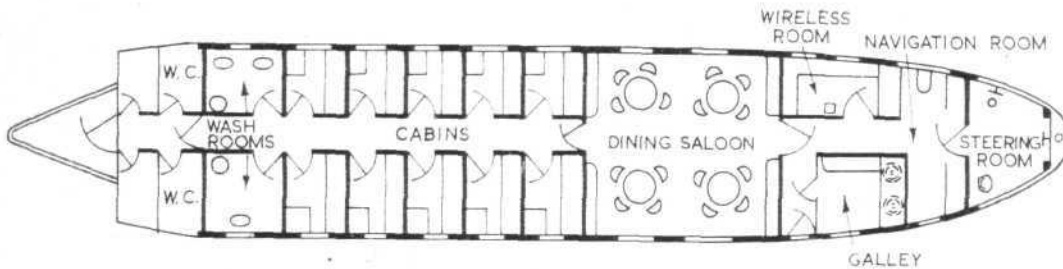
In these pictures, from left to right, are seen the "Bodensee," "Graf Zeppelin" and "Hindenburg." In the centre photograph, taken at Cardington in April 1930, when "Graf Zeppelin" visited England, the British ship R100 is seen at her mooring mast in the distance; she measured 709ft against the German ship's 757ft

Regularity of operation was good for the period but punctuality was poor: fluctuations in block time of up to 12 hours were not uncommon on the Atlantic services.

On the basis of such a limited operational record it is difficult to reach any firm conclusion on the true practicability of the rigid airship as a scheduled vehicle. However, of about 160 rigid (three-quarters of them Zeppelins) built, and almost all for military or experimental purposes, about 20 per cent were destroyed in accidents. It is true that some of these accidents, including that to the *Hindenburg*, would not have happened if non-inflammable helium had been used instead of hydrogen but, on the other hand, all three of the American rigid built came to untimely ends, although they were filled with helium. In spite of the unique career of the *Graf Zeppelin*, which with comparatively few narrow escapes from disaster flew far more hours than any other rigid, in the light of modern knowledge of the extent and strength of

senders; so, if the above figures are correct, the airship appears to have been just about capable of covering its cost of fivepence per seat-mile at 100 per cent load factor during its last season of operation, for which 18 round trips were planned.

The validity of the above cost figures is difficult to assess, but it is interesting that in 1928 Eckener had estimated that the economic single fare for the *Graf Zeppelin* on the North Atlantic route would be £600, and that this fare was charged on the early North Atlantic proving flights, being equivalent to a revenue rate of about 3s per passenger-mile. (A transatlantic fare of £400 was later charged on this airship.) If we assume that Eckener was working on an average load factor of 65 per cent—and he is hardly likely to have taken anything lower than this—the above revenue rate implies a total operating cost of about 2s per seat-mile, or nearly three times the figure claimed for the same aircraft six years later. Different assumptions in the writing-off of the aircraft and ground



Passenger accommodation and flight-deck layout of "Graf Zeppelin." All of it was contained in the forward car, visible from the ground

vertical currents in the atmosphere it is doubtful whether the rigid airship could have achieved acceptable safety standards in world-wide scheduled operation.

Some indication of the economic characteristics of the rigid airship as a scheduled vehicle in the early and mid-1930s is provided by figures given by Dr. Hugo Eckener of the Zeppelin company to the American Federal Aviation Commission in 1934. He stated that the total operating costs of the *Graf Zeppelin* on the South American service were 15 shillings per aircraft-mile. As that airship had accommodation for 20 passengers, this was equivalent (if the aircraft is regarded as a purely passenger-carrying vehicle) to a seat-mile cost of about ninepence in contemporary money values. Eckener also estimated in 1934 that the total operating cost of the *Hindenburg* on the same route would be 27s per aircraft-mile. With accommodation for 50 passengers, this would be equivalent to a seat-mile cost of 6½ pence.

In 1938 Eckener claimed that an airship like the *Hindenburg* making 15 round trips a year on the North Atlantic route (50 per cent more than were made in 1936) would have a total operating cost of about 21s per aircraft-mile, equivalent to rather more than threepence per seat-mile with accommodation for 75 passengers. In actual fact, the Transatlantic single fare charged on the *Hindenburg* was £80—equivalent to a revenue rate of nearly fivepence per passenger-mile—and, at this fare, the airship is said to have covered 80 per cent of its cost of operation during 1936. During the 1936-37 winter, however, the passenger accommodation on the *Hindenburg* was extended to take a total of 72 pas-

facilities may account for part of the discrepancy, but such calculations as can now be made suggest that Eckener's 1934 and 1938 figures were—probably intentionally—optimistic and that a more realistic estimate of the operating costs of a 1928 20-passenger rigid airship of 3,700,000 cu ft capacity, such as the *Graf Zeppelin*, over non-stop stage lengths of up to about 5,000 miles would be about 1s per seat-mile (at mid-1930s money values).

For a 1936 50-passenger airship of 7,000,000 cu ft capacity, such as the *Hindenburg*, making ten transatlantic round trips a year total costs (in the same money values) were probably more like eightpence per seat-mile. This was about the operating cost over very much shorter stages (up to about 500 miles) of, for example, the 1936 24-passenger Short Empire flying-boat and about double those of the 1935 21-passenger Douglas DC-3 landplane on 500-mile stages. The above airship costs were achieved with hydrogen as the lifting agent. Substitution of non-inflammable helium, of nearly ten per cent less lifting capacity would probably have increased these costs between 50 and 100 per cent, although the Zeppelin company was working on methods of mitigating this effect in the years immediately preceding the War.

In the event, the *Hindenburg* disaster marked the end of the rigid airship and the Second World War sealed its fate. By the time the war was over the long-range aeroplane had so developed and was in such widespread use on the long-haul air routes of the world that the much slower and, by comparison, operationally unproven rigid airship—even filled with helium, had no chance of revival.

Passengers in "Hindenburg" could look down from a promenade deck



Lighter-than-air luxury: the writing room of "Hindenburg"

