1. Introduction

Goodyear Aircraft Corp. became Goodyear Aerospace Corp. (GAC) in 1963 and, over the next 25 years, continued the company’s legacy of developing many different types of airships.

“Dynastat” is a term originated by Goodyear Aerospace in the mid-1960s to define a class of semi-buoyant, semi-rigid, hybrid airships that are identifiable by four or more flank-mounted, large diameter, vectoring prop / rotors that rotate vertically for lift and return to the horizontal position for cruise propulsion. In a Dynastat, the aerostatic lift of the gas envelope carries most or all of the deadweight of the airship. During vertical takeoff and landing (VTOL), dynamic lift from the propellers provides the additional lift and control needed to hover, carry a payload and transition to or from forward flight. In forward flight, aerodynamic lift replaces dynamic lift, allowing the propellers to move to the horizontal position for cruise propulsion. There is no exchange of ballast while passengers and cargo are transferred.

In this article, we’ll look at Goodyear’s design concepts for a two heavy-lift Dynastats, a passenger Dynastat, and a similar airport feeder hybrid airship. None of these hybrid airships were built.

2. The Goodyear Aerospace heavy-lift Dynastats

In the late 1960s, Goodyear Aerospace Corp. developed concepts for very heavy-lift, semi-rigid Dynastats that combined the basic shape of their patented 1957 dynamic lift hybrid airship design with powerful, vectored thrust propulsors. Two concepts are described below.

The first concept is an “intermediate cargo transport” designed for point-to-point transport with VTOL operations at the endpoints. This Dynastat is a very large airship with a length of 730 ft (222.5 m) and a width of 175 ft (53.3 m). It has a design altitude of 10,000 ft (3,048 m). With vectored thrust engines delivering a total of 23,000 hp (17,151 kW), the top speed is 140 knots (161 mph).
With a helium lift gas volume of 10,700,000 cubic feet (302,990 cubic meters), this Dynastat should generate a gross aerostatic lift of 738,300 pounds (334,887 kg). Goodyear projected that this Dynastat had a useful lift of 275,000 pounds (124,738 kg) when taking credit for 125,000 pounds (56,699 kg) of dynamic lift. This translates to a useful lift of 150,000 pounds (68,038 kg) using aerostatic lift alone. That would put the Dynastat’s deadweight at about 588,300 pounds (226,848 kg) and a maximum gross weight of 863,300 pounds (391,586 kg).

For a vertical takeoff at maximum gross weight, 125,000 pounds (56,699 kg) of dynamic lift from propulsors would be required to ascend and transition to forward flight where significant aerodynamic lift will be generated by the airfoil-shaped hull. During the approach to a vertical landing, aerodynamic lift decreases as the heavy airship slows, and propulsive lift must be used to support the gross weight of the airship and control the final descent to the landing site.
The second concept is a “giant transport” designed to carry 800,000 to 1,000,000 pound (400 to 500 tons, 363 to 454 metric tons) payloads over a long range at a cruise speed of 174 knots (200 mph). Vectored thrust propulsors delivering a total of 60,000 hp (44,742 kW) are located along the flanks of the airship hull.

**GIANT TRANSPORT**

*(800,000 - 1,000,000 POUND PAYLOAD)*

**FUEL: CHEMICAL OR NUCLEAR**

*Goodyear concept drawing, circa 1969, for a giant transport Dynastat*

*Source: Report AMCA 70-001, Appendix K*

The giant transport Dynastat has a 20,000,000 cubic foot (566,337 cubic meter) lift gas volume (almost three time that of Hindenburg). With helium lift gas, the giant transport Dynastat would generate an aerostatic lift of 1,380,000 pounds (690 tons, 626 metric tons), which is way more than the deadweight of the airship. Most payloads would be carried in an internal cargo bay. Very large items (i.e., a house or a bridge section) could be carried externally under the airship.

It is not clear how Goodyear planned to manage the airship’s buoyancy while heavy cargo was unloaded or loaded. Some serious ballasting capabilities and powerful vectored thrusters pushing downward would have been needed to hold an empty giant transport Dynastat on the ground after discharging its heavy loads.
3. The Goodyear Aerospace VTOL Dynastat

In 1970, a semi-rigid commercial passenger Dynastat, dubbed the “VTOL Dynastat” was described at the American Helium Society symposium in Washington D.C. This was a short-haul intercity craft designed for relatively quiet VTOL operations in populated areas. Basic design characteristics included:

- 100 x 30 ft (30 x 9 m) passenger cabin for 100 passengers
- 200 – 500 mile (300 – 800 km) range
- Powered by four to six engines driving vectorable prop / rotors for forward and vertical thrust. A rigid structure inside the envelope supported the propulsors on outriggers.
VTOL passenger Dynastat in flight, viewed from the bow. Note all propulsors are vectored up for lift. Source: Nigel Kaley (2003)

VTOL Dynastat at a rooftop landing pad with engines vectored up. Source: Nigel Kaley (2003)
The VTOL Dynastat could be adapted for a range of civil and military missions.

VTOL Dynastat conducting a ground scanning mission during cruise flight, with engines vectored forward. Source: Nigel Kaley (2003)

Liberian commemorative stamp with a Dynastat. Source: https://www.dreamstime.com/photos-images/postage-stamp-liberia.html
4. Airport feeder airship (Feedliner)

In 1975, the National Aeronautics and Space Administration (NASA) initiated a study called “Feasibility of Modern Airships – Phase I,” and continued with additional Navy sponsorship for Phase II in 1976 – 77. Goodyear Aerospace was a contractor in both phases. In Phase II, Goodyear developed a conceptual design for a civilian airport feeder vehicle (a feedliner), which was a quad-rotor, VTOL, semi-buoyant, ellipsoidal airship capable of transporting passengers or cargo to major hub terminals from distributed suburban and downtown terminals. The distributed terminals would be located on roof-tops of parking garage type facilities.

To enable operations in urban and suburban areas, the airship was subject to a takeoff noise limit of 95 perceived noise decibels (PNdB) at 500 ft (152 meters) from the vehicle centerline.

The airport feeder was a rigid, metal-clad airship design concept, and in that respect, it was different than the semi-rigid VTOL Dynastat described previously.

**Airport feeder airship design & performance characteristics**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Airport feeder airship</th>
</tr>
</thead>
<tbody>
<tr>
<td>Length</td>
<td>238.5 ft (72.7 m)</td>
</tr>
<tr>
<td>Diameter</td>
<td>59.6 ft (18.2 m)</td>
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<tr>
<td>Height, overall</td>
<td>82.5 ft (25.1 m)</td>
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<tr>
<td>Envelope type</td>
<td>Metal clad, with 2 ballonets</td>
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<tr>
<td>Envelope volume</td>
<td>428,500 ft³ (12,135 m³)</td>
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<tr>
<td>Gross weight</td>
<td>67,500 lb (30,618 kg)</td>
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<tr>
<td>$\beta = \text{Static lift / Gross weight}$</td>
<td>0.35</td>
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<tr>
<td>Propulsion</td>
<td>4 x vectorable prop / rotors installed on rigid outriggers between the gondola and the envelope</td>
</tr>
<tr>
<td>Gondola length</td>
<td>96 ft (25.2 m)</td>
</tr>
<tr>
<td>Accommodations</td>
<td>Crew + modular capacity for 80 passengers / cargo</td>
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<tr>
<td>Speed, cruise</td>
<td>130 knots</td>
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<tr>
<td>Altitude, cruise</td>
<td>2,000 ft (610 m)</td>
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<tr>
<td>Range, max</td>
<td>400 n.mi (741 km)</td>
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<tr>
<td>Flight stage length</td>
<td>Range from 15 to 150 n.miles (27.8 km to 278 km), average stage length 40 n. mi (74.1 km)</td>
</tr>
</tbody>
</table>
General arrangement of the Goodyear Feedliner. 
Source: NASA CR-151920 (1976)

Gondola module options for 80 passengers (above) and 40 passengers + cargo (below). Source: NASA CR-151920 (1976)
Approach and transition for rooftop landing with the aid of a winch on a rotating turntable landing pad. Source: NASA CR-151920 (1976)

A rooftop landing site with a rotating turntable to align the airship into the wind. Source: NASA CR-151920 (1976)
Concept for passenger loading / unloading on a rooftop landing pad. 
Source: NASA CR-151920 (1976)

Goodyear airport feeders cycling through a hub terminal. 
Source: 9th AFGL Scientific Balloon Symposium, 1976
Concept for exchanging whole passenger / cargo modules at a hub terminal. The full modules are extracted from one side of the gondola and lowered into the terminal, while replacement modules are raised from the terminal and loaded from the opposite side of the gondola.

Source: NASA CR-151920 (1976)

5. For more information


**Related Modern Airship articles**

• Helistats
• Piasecki – Quad-rotor heavy-lift helistats
• Goodyear Aerospace - Quad-rotor heavy-lift helistats
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