

# NASA / Douglas - Deltoid VTOL hybrid lifting body airship

Peter Lobner, 27 February 2025

## 1. Introduction

In 1975, NASA sponsored a study named *Feasibility of Modern Airships – Phase I*, with Goodyear Aerospace Corp. and Boeing Vertol Company as contractors performing studies of civilian roles for lighter-than-air (LTA) craft. The following six categories of airships were considered in the NASA study:

- Fully buoyant, conventional
  - Rigid airships
  - Non-rigid airships
- Partially buoyant, vertical takeoff and landing (VTOL), hybrid
  - Lifting body concepts
  - Combined / integrated concepts
- Partially buoyant, short takeoff and landing (STOL), hybrid
  - Lifting body concepts
  - Auxiliary wing concepts

Airship designs selected to represent each of the six categories were evaluated on three different mission profiles, short-range, transcontinental and intercontinental, with the airship sized for two different payloads, 50 and 100 tons (45.4 and 90.7 metric tons).

The candidates in the partially-buoyant VTOL category of hybrid lifting body airships were the Boeing Vertol Deltoid and Helipsoid, the NASA / Douglas Deltoid, and the Goodyear Dynastat.



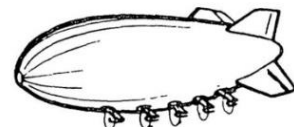
Boeing Deltoid



NASA/Douglas Deltoid



Boeing Helipsoid



Goodyear Dynastat

Source: Adapted from NASA CR-137691, Vol. I (1975)

The particular mission profiles are summarized in the following table.

PARAMETER \ MISSION	SHORT RANGE	TRANSCONTINENTAL	INTERCONTINENTAL
RANGE (STILL AIR)	300 NM (556 km)	2,000 NM (3,704 km)	5,000 NM (9,260 km)
CRUISE ALTITUDE	2,000 ft ISA (610 m ISA)	13,000 ft ISA (3,962 m ISA)	2,000 ft ISA (610 m ISA)
CRUISE SPEED*	50, 100, 200 kt (25.7, 51.4, 102.9 m/s)	50, 100, 200 kt (25.7, 51.4, 102.9 m/s)	50, 100, 200 kt (25.7, 51.4, 102.9 m/s)
RESERVES	50 NM (93 km) DIVERSION & 10% INITIAL FUEL	250 NM (463 km) DIVERSION & 10% INITIAL FUEL	250 NM (463 km) DIVERSION & 10% INITIAL FUEL
DESIRED PAYLOAD	50-100 TONS	50-100 TONS	100 TONS
DESIGN ALTITUDE (FOR HULLS, PROP/ ROTORS AND ENGINE SIZING)	5,000 ft ISA (1,524 m ISA)	15,000 ft ISA 4,572 m ISA	5,000 ft ISA (1,524 m ISA)
*CRUISE SPEED AT CRUISE ALTITUDE			

Source: NASA CR-137691, Vol. I (1975)

The Phase I initial screening led to the selection of the Boeing Vertol Helipsoid to represent the category of partially-buoyant VTOL hybrid lifting body airships. The NASA / Douglas Deltoid was not considered further in the NASA feasibility study. Its interesting design features are summarized in this article.

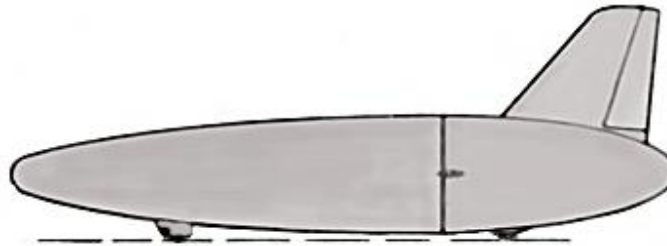
## 2. The NASA / Douglas Deltoid hybrid lifting body airship concept

This deltoid-shaped hybrid airship concept was developed by a team of NASA-Langley researchers and L. L. Douglas of Boeing Vertol, based loosely on a series of heavier-than-air lifting body research aircraft developed and flight tested by NASA and the U.S. Air Force.



(L to R) USAF X-24A, NASA M2F3 & NASA HL-10 lifting body research aircraft.  
Source: USAF, Air Force Test Center

The NASA / Douglas Deltoid hybrid airship had a broad delta planform with a elliptical longitudinal cross-section with a thickness ratio of about 17%.



*Elevation view of the NASA / Douglas Deltoid hybrid lifting body airship.  
Source: Adapted from NASA CR-137691, Vol. I (1975)*

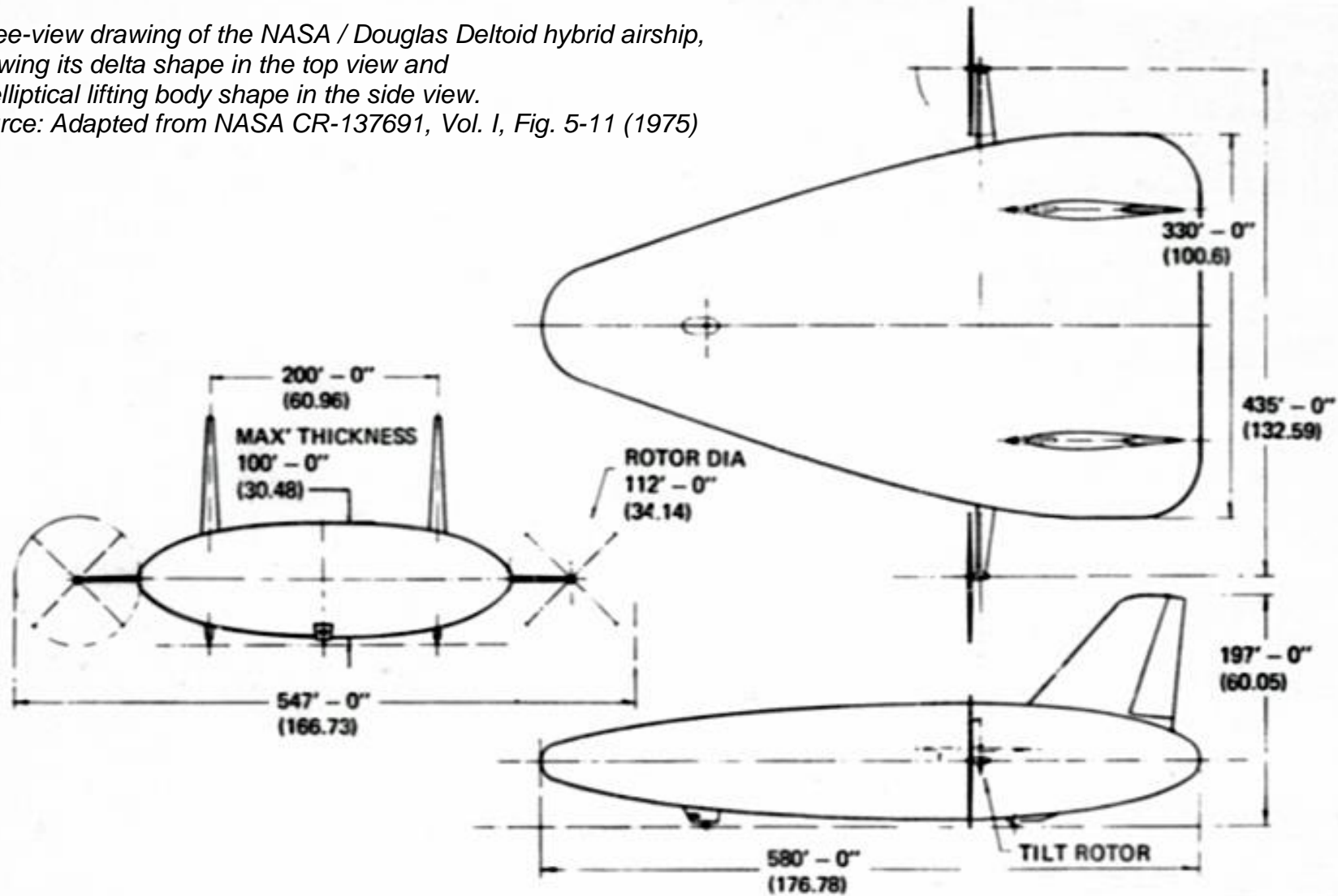
Propulsion and maneuvering control was provided by two flank-mounted, 34.1-m (112-ft) diameter, variable pitch, prop-rotors. Engines were mounted inboard. Depending on the total installed power and buoyancy ratio, a NASA / Douglas Deltoid airship may be either VTOL or STOL.

The crew gondola was tucked under the nose of the airship, with the nose landing gear integrated with the gondola. The two wide track main landing gear were aligned under the tail fins.

### **General characteristics of the NASA / Douglas Deltoid hybrid lifting body airship**

<b>Parameter</b>	<b>NASA / Douglas Deltoid (circa 1975)</b>
Type	Hybrid, deltoid lifting body airship
Length, OA	176.8 m (580 ft)
Width, hull	100.6 m (330 ft)
Width, to prop-rotor axis	132.6 m (435 ft)
Width, OA	166.7 m (547 ft)
Hull thickness, max	30.5 m (100 ft)
Hull thickness ratio	0.173
Spacing between vertical tail fins	61.0 m (200 ft)
Height, OA (to tip of tail)	60.1 m (197 ft)
Buoyancy ratio	Not specified
Propulsion & maneuvering	2 x flank-mounted, 34.1-m (112-ft) diameter, variable pitch, vectoring, prop-rotors
Aerodynamic control surfaces	<ul style="list-style-type: none"> <li>• Twin tail fins with rudders.</li> <li>• No visible horizontal stabilizer.</li> </ul>

Three-view drawing of the NASA / Douglas Deltoid hybrid airship, showing its delta shape in the top view and its elliptical lifting body shape in the side view.  
Source: Adapted from NASA CR-137691, Vol. I, Fig. 5-11 (1975)



### 3. For more information

- “Feasibility Study of Modern Airships – Phase I, Volume I – Summary and Mission Analysis,” NASA CR-137691, Volume I, Fig. 5-11, Boeing Vertol Company, May 1975:  
<https://ntrs.nasa.gov/api/citations/19750024930/downloads/19750024930.pdf>

#### **Other *Modern Airships* articles**

- *Modern Airships - Part 1*: <https://lynceans.org/all-posts/modern-airships-part-1/>
  - Boeing Helipsoid hybrid airship
  - Boeing Deltoid hybrid airship
  - Goodyear Dynalifter hybrid airship
- *Modern Airships - Part 2*: <https://lynceans.org/all-posts/modern-airships-part-2/>
- *Modern Airships - Part 3*: <https://lynceans.org/all-posts/modern-airships-part-3/>