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The 38M™ Aerostat: A New System for Surveillance

John A. Krausman*
TCOM, L.P., Columbia, MD, 21046

A requirement has been established to lift an electronics payload of approximately 1,000 lb to an altitude of about 3,000 ft above sea level, using a relocatable mooring system. Existing helium-filled tethered aerostat systems were either too small or, in the case of large aerostats, not relocatable. As a result, the TCOM 38M™ aerostat system was developed as a self-contained, rapidly deployable, unmanned lighter-than-air system to provide midrange altitude capability while utilizing a mooring system mounted on a ground-transportable trailer. The mooring system uses a safe and proven 3-point concept with closehaul and nose line winches. The high strength tether contains conductors for power and fiber optics for data. The characteristics of this system are presented along with altitude and payload capability charts.

I. Introduction

THE 38M™ aerostat system provides a stable platform for payloads operating in what is referred to as the mid range altitudes. The 17M™ and 32M® provide for low altitudes, and the 71M® operates much higher at altitudes in the 15,000 ft range. The 38M™ system is well suited to carry a variety of payloads for numerous mission profiles.

II. System Characteristics

The aerostat flexible structure is an aerodynamically shaped nonrigid structure that uses helium as the lifting gas. It is designed to operate in 50 knot winds and to survive in 70 knot steady winds while airborne or moored. The hull is 125 feet long and 39 feet maximum diameter with a volume of 90,000 cubic feet. The empennage uses fins in an inverted “Y” configuration. An internal air filled ballonet maintains the internal pressure during ascent and descent and a system of blowers and valves is used with the air ballonet to automatically maintain hull pressure. The rigging lines spread the load forces from the tether to the flexible structure material. A large detachable fabric windscreen is attached to the aerostat underside to provide environmental protection to the sensors and payload. The moored 38M™ system is shown in Fig. 1, the aerostat during launch is shown in Fig. 2, and the aerostat in flight is shown in Fig. 3.

Aerostat avionics include a power distribution and pressure control unit that operates entirely automatically, a telemetry unit, a rapid deflation device that operates automatically in case of aerostat breakaway, and batteries that allow the aerostat to be safely recovered with full telemetry in the event of power failure to the aerostat. The aerostat carries a lightning pole at the nose and another on the vertical fin to provide a preferred path for lightning to discharge to ground via lightning cables and the protective braid in the tether.

The system can be set up and made operational in 8 to 10 hours using a crew of eight persons, while launch or recovery of the aerostat requires a crew of four. Typical flight duration capability is 14 days, followed by a short moored period for addition of helium to the aerostat.

Payloads may range from 500 to 1,500 lbs, and available power to the payload is about 5.5 kVA at 400 Hz. Possible payloads include radar surveillance, passive electronics and communications surveillance, electro-optical/infrared camera surveillance, and communications relay/networking.

* Senior Engineer, Systems Engineering Department, AIAA Associate Fellow.

III. Mooring System

The mooring system uses a safe and proven three point launch and recovery concept with nose line and port and starboard closehaul line winches. When deployed, the trailer uses outriggers for added stability and the mooring system boom pivots on the trailer to relieve wind loads on the aerostat. The main winch inhaul and outhaul rate is 100 to 175 feet per minute using a capstan type winch feeding tether to a tether storage drum via an automatic level wind device. All winches are hydraulic using power from electrically driven hydraulic power units. Total weight of the mooring system and trailer is approximately 60,000 pounds, and the mooring system can be configured for air transport on a large aircraft such as a C5A or C17. A standard truck tractor is used to transport the trailer to any desired location. The 38M™ mooring system is shown in Fig. 4.

Figure 1. 38M™ Aerostat Moored

Figure 2. 38M™ Aerostat Launch

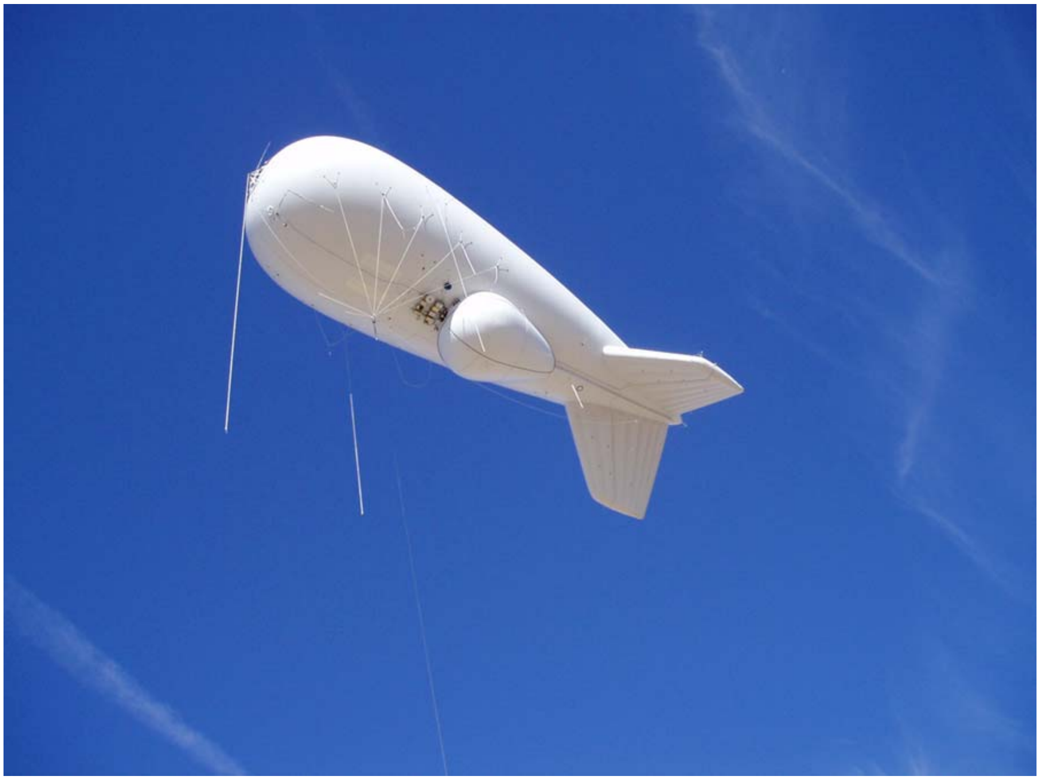

Figure 3. 38M™ Aerostat In Flight

Figure 4. 38M™ Mooring System

IV. Tether

The high strength tether contains conductors for power and fiber optics for data. The optical fibers are used to transmit payload data and telemetered aerostat data between the aerostat and the ground processing station. Surrounding the power conductors and optical fibers are the Kevlar® strength member layers. The outer layers consist of a lightning protection conductor braid and a polymer outer jacket to provide protection to the core from the environment. The weight of the tether is approximately 200 pounds per thousand feet with a diameter of approximately 5/8 inch.

V. Altitude Performance

The 38M™ Aerostat system is capable of midrange aerostat performance. At 80 deg F, the altitudes achieved are in the 3,000 to 4,500 ft range, as shown in Fig 5. Performance with higher ground pad altitudes are then plotted on the chart, as shown in Fig 6. Note that higher pad altitudes result in lower above-ground performance.

These charts show the optimum altitude achieved for the aerostat system, which balances the need for lift with the expansion of the helium. Calculation of the optimum altitude and lift is explained in detail in a previous publication[1]. Temperatures shown are seasonal temperatures and do not represent daily fluctuations. Altitudes obtainable with the current mooring system are limited to 4,000 ft above ground level based on the amount of tether which can be wrapped on the storage drum. Minor modifications to the mooring system would provide sufficient length of tether for the aerostat to reach 5,000 ft above ground level.

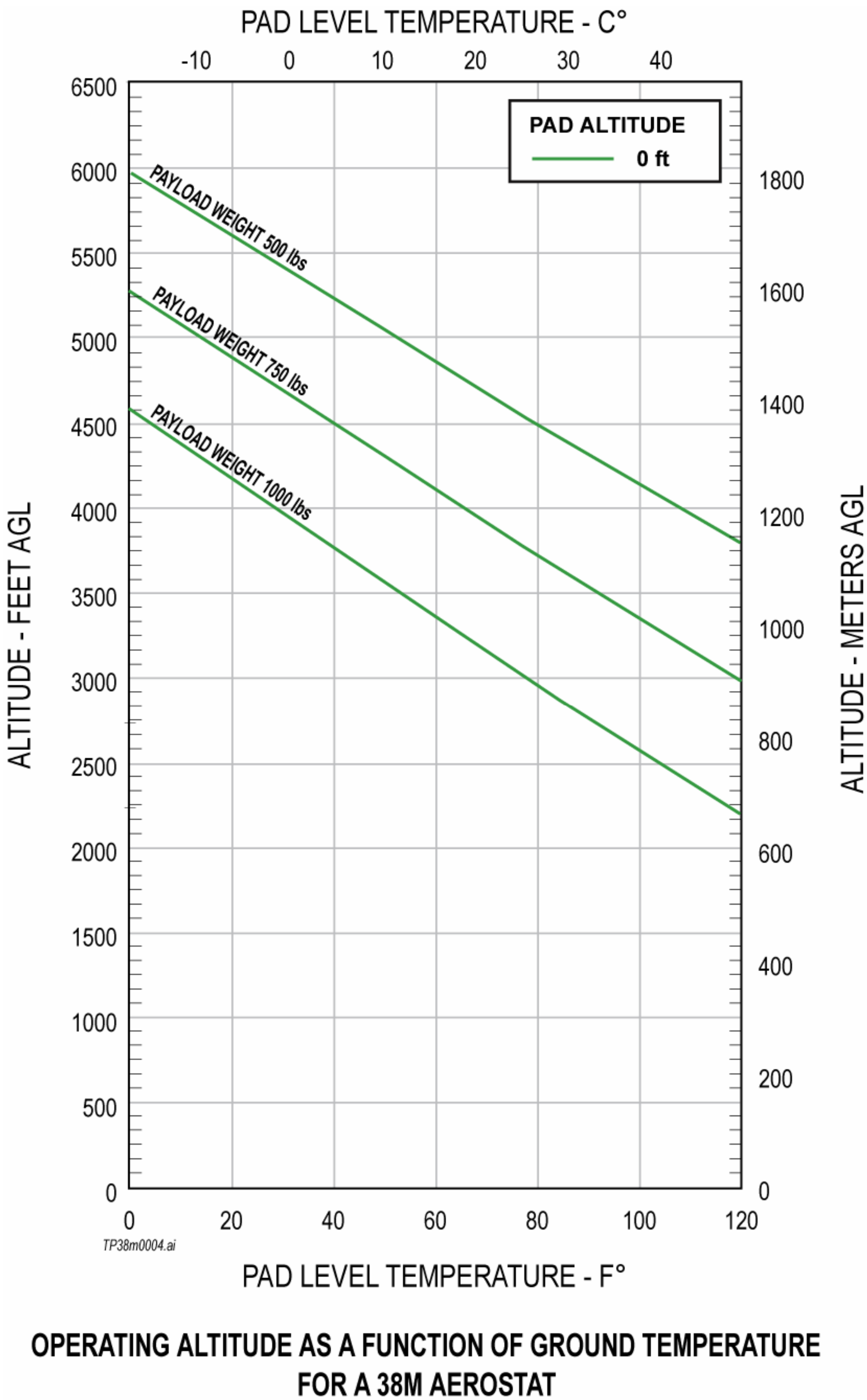

Figure 5. Flight From Sea Level

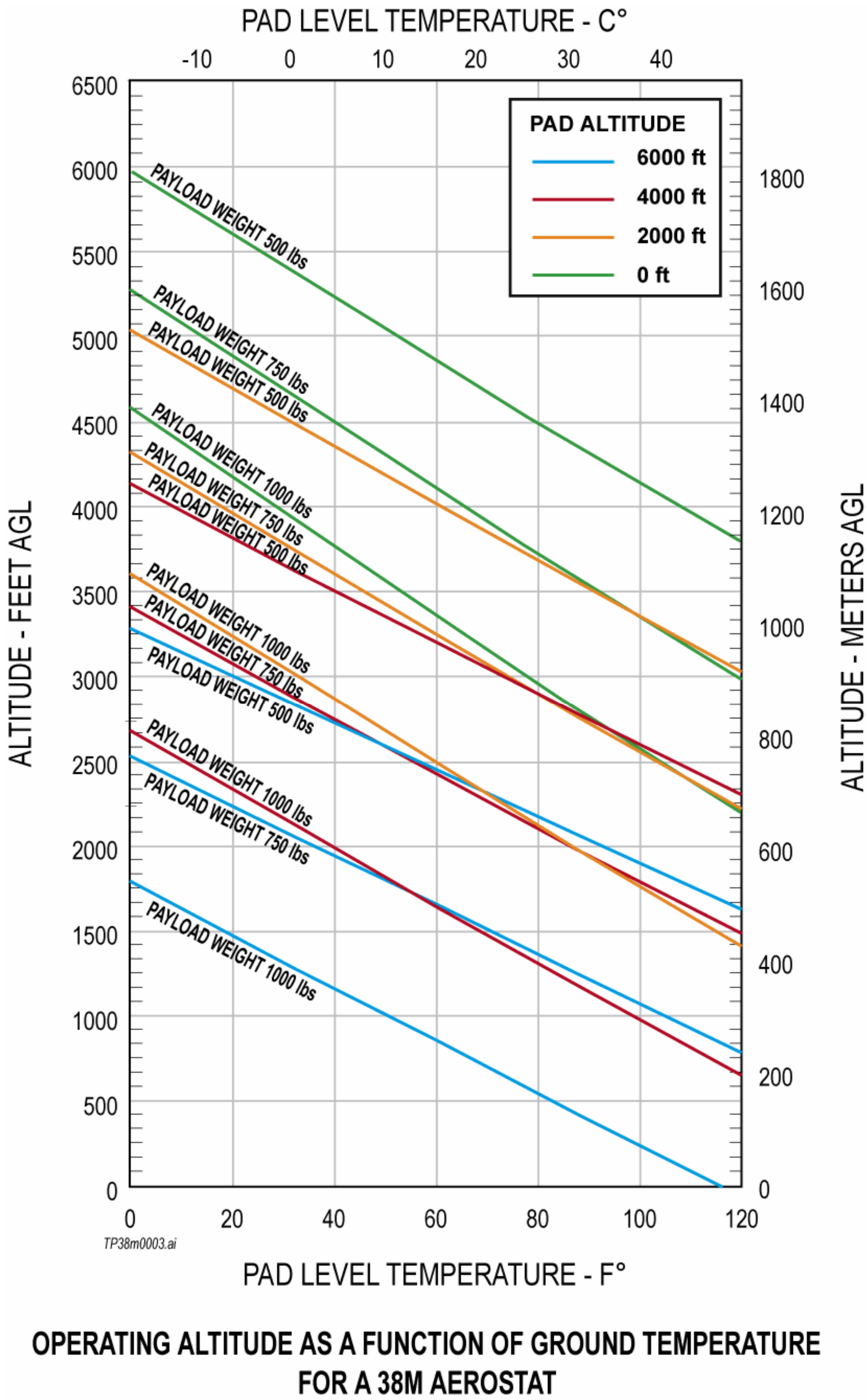

Figure 6. Flight From Various Ground Levels

VI. Conclusion

Following successful tests by the first customer, the 38M™ Aerostat System is now available as a new tethered air vehicle capable of carrying payloads of 500 to 1,500 lbs to altitudes of 3,000 to 4,500 ft. This mid range is situated between the low altitudes of small aerostats and the much higher altitudes of large aerostats. The relocatable mooring system allows easy transportability and setup in remote areas. In addition, the 38M™ system is capable of lifting a variety of payloads for numerous applications.

References

[1]Krausman, J., "Investigation of Various Parameters Affecting Altitude Performance of Tethered Aerostats," *11th AIAA Lighter-Than-Air Systems Technology Conference*, AIAA-95-1625, AIAA, Washington, DC, 1995