Hangzhou Gauss Inflatable Tech Co., Ltd – unmanned blimps & aerostats

Peter Lobner, 19 June 2023

1. Introduction

Hangzhou Gauss Inflatable Tech Co., Ltd. was established in 1999 with an initial business focus on producing large inflatable military decoys of aircraft and vehicles. Their current products line now

includes a variety of unmanned, lighter-than-air (LTA) free-flying conventional blimps and a hybrid airship, tethered aerostats and tethered balloons. In addition, the firm manufactures a range of inflatable terrestrial structures, such as large hangars, maintenance shelters, field hospitals, air domes, tents and recreational facilities.

The Gauss website is here: https://www.gausstechnology.com

This article addresses only the Gauss LTA vehicles designed for outdoor operation:

- Unmanned 20-m hybrid airship
- Unmanned 20-m to 30-m conventional blimps
- Small remote-controlled conventional blimps (8-m to 13-m)
- Tethered aerostat systems (12-m to 22-m)
- Skystar ellipsoidal tethered aerostat systems (4-m to 6-m)

2. Unmanned 20-m hybrid airship

Description of the airship

In 2018, Gauss designed, built and flew a custom, lightweight, 20-m (65.6 ft), unmanned, non-rigid, three-lobed airship at the Computing Conference 2018 in Hangzhou, China. This airship had a general arrangement that closely resembles the much larger, manned Lockheed-Martin P791 hybrid airship that flew in 2006 as part of the U.S. Defense Advanced Research Projects Agency's (DARPA's) Project WALRUS.

Gauss claims that, in the absence of wind, the airship can take off and land vertically and hover in the air, without the need for a dedicated take-off and landing site. Although the Gauss specifications indicate that the airship was designed for remotely-controlled free flight, it only flew as a tethered airship at the Computing Conference 2018 in Hangzhou. It was not demonstrated in free flight.

General characteristics of Gauss 20-m unmanned hybrid airship

Parameter	Gauss 20-m hybrid airship CCA-C20-1
Length	20 m (65.6 ft)
Width, max	5.5 m (18.0 ft)
Envelope volume	180 m^3 (6,357 ft^3)
Weight, takeoff	160 kg (353 lb)
Weight, payload	15 to 25 kg (33 to 55 lb)
Power sources	• Single cylinder, two-stroke engine • 36 V, 7 AH battery
Propulsion	• 2 x flank-mounted, thrust vectoring, 2-bladed propellers (up/down vectoring) • 2 x stern-mounted, thrust vectoring, 2-bladed propellers (left/right vectoring)
Speed, max	85 kph (52.8 mph)
Altitude, best operational	10 to 150 m (33 to 492 ft)
Turning radius, min.	10 m (33 ft)
RC control range	1 km (0.62 miles); 15 km (9.3 miles) range can be supplied
Endurance	3 hours

Compiled from data published on the Gauss website, March 2023

Gauss hybrid airship flying tethered.
Source: Alibaba Group (2018)

Lifting off from the landing pad at the Hangzhou conference venue.
Source: techtalkthai.com (Sep 2018)

One of two flank thrust-vectoring propeller.
Source: Alibaba Group (2018)

Stern thrust-vectoring propellers.
Source: The Morning Context (May 2022)

The four landing feet on the Gauss hybrid airship, which look like the Air Cushion Landing System (ACLS) pads on the Lockheed Martin P791, are removable and apparently non-functional.

Tethered above the Hangzhou conference venue, without the landing "feet".
Source, both photos: Semtech videos (Sep 2018)

20 m "Alibaba Cloud" unmanned hybrid airship at the Computing Conference 2018 in Hangzhou, China. Source: Alibaba Group (2018)

The Alibaba application

Founded in 2009, Alibaba Cloud was created out of the Alibaba Group's need to operate its core e-commerce business at a massive scale. The Alibaba Cloud forms the digital backbone of the group.

At the Computing Conference 2018, the Gauss hybrid airship was used to carry equipment aloft and serve as an airborne communications node in Alibaba's LoRa (a proprietary radio communication technique) Internet-of-Things (IoT) network, which was demonstrated at the conference. Alibaba reported:

> "At the Computing Conference 2018 in Hangzhou, an airship hovered over the conference serving as a LoRaWAN gateway for Internet of Things (IoT) services on the ground. …. At the core of the service, Link WAN, an IoT network management platform, was mounted to the airship to enable gateway management and fast device access to the cloud."

> "Signals can be sent or received beyond a 30-km (18.6 mile) radius, stretching from 40 km (24.8 miles) above the ground to 20 m (65 ft) below the ground."

3. Unmanned 20-m to 30-m conventional blimps

Gauss has produced several unmanned conventional blimp designs in the 20-m to 30-m (66 to 98 ft) length range. Their 20-m blimp in the following two photos has a general configuration that is common among many of Gauss' conventional blimps in all size ranges.

Bow quarter view of a Gauss 20-m blimp with cruciform tail.

Gauss 20-m blimp gondola housing the propulsion system with two cantilevered, shrouded, thrust-vectoring propellers (shown vectored up for lift during takeoff). A mission module is attached forward of the gondola. Both are attached via a reinforced rail system along the bottom of the envelope.
Source: Screenshots from Gauss 20-m blimp video (2022)

Gauss reports that the 30-m (98 ft) conventional blimp (HYFTZJY-2.0) shown in the following photo uses a combination of wireless remote control and GPS satellite navigation to provide autonomous flight for some flight segments.

Gauss 30-m blimp (HYFTZJY-2.0). Source: Gauss

Gauss built and flew another 30-m (98 ft) blimp with a novel gondola design with the propeller housed inside a ducted enclosure in the aft portion of the gondola. The propeller slipstream discharged through adjustable horizontal louvers that are used to vector the slipstream airflow up or down to provide vectored thrust. A similar feature is found in the Russian Augur MA-55, RosAeroSystems Au-11, and Aerostatics-01 and -02 small manned blimps.

Gondola configuration showing the enclosed propeller and the thrust vectoring horizontal louvers in the propeller slipstream. Source, both photos: Gauss

Gauss 30-m unmanned blimp with internal propeller. Source: Gauss

General characteristics of Gauss 30-m unmanned blimp with internal propeller

Parameter	Gauss 30-m RC blimp
Length	30 m (98 ft)
Diameter, max	7.5 m (24.6 ft)
Height, overall	10.8 m (35.4 ft)
Envelope volume	956 m^3 (33,761 ft^3)
Weight, gross takeoff	1,050 kg (2,315 lb)
Weight, payload	180 kg (397 ft)
Power sources	Lithium polymer battery
Propulsion	1 x electric motor-driven, 5-blased propeller enclosed in a duct within the gondola. The propeller slipstream discharges thru a duct with movable horizontal louvers to provide vertically-vectored thrust.
Speed, max. cruise	85 kph (52.8 mph)
Turning radius, min.	40 to 60 m (131 to 197 ft)
Endurance	5 hours

Compiled from available data published on the Gauss website, March 2023

4. Small remote-controlled conventional blimps (8-m to 13-m)

Gauss offers an extensive range of small, remotely-controlled (RC) blimps at one meter length increments from 8 to 13 meters (26.2 to 42.7 ft). All have a common design that is generally similar to the larger 20-m (66 ft) blimp described previously, with thrust-vectoring shrouded propellers cantilevered from a small gondola. In addition to forward flight, some models claim vertical takeoff & landing (VTOL), hovering and backup flight capabilities.

Source: Gauss

The blimps have reinforced mounting points or rails along the bottom of the gas envelope where the small gondola and separate mission module(s) are attached and can be positioned longitudinally to establish the desired center-of-gravity of the blimp. Controls are redundant to improve operational reliability and flight safety. Gauss reports control distances up to 3 km (1.9 miles), with an option for longer range on some models.

Gauss notes that, as a class, these small blimps can be configured to carry out a wide variety of missions and are "ideal carriers for still cameras, video HD cameras, infra-red equipment, various measuring equipment, mine detection and all different kinds of remote sensing."

10-m RC blimp (above & right).
Source, both photos: Gauss

13-m RC blimp. Source, both photos: Gauss

Published design and operational parameters for Gauss small blimps are summarized in a following table.

General characteristics of Gauss small outdoor RC blimps (8-m to 13-m)

Parameter	8-m blimp	9-m blimp	10-m blimp	11-m blimp	12-m blimp	13-m blimp
Length	8 m (26.2 ft)	9 m (29.5 ft)	10 m (32.8 ft)	11 m (36.1 ft)	12 m (39.4 ft)	13 m (42.7 ft)
Diameter, max		2.1 m (6.9 ft)		2.7 m (8.9 ft)	2.8 m (9.2 ft)	3.2 m (10.5 ft)
Height, overall						3.8 m (12.5 ft)
Envelope volume	20 m^3 (706 ft^3)	27 m^3 (953 ft^3)	34 m^3 (1,201 ft^3)	42 m^3 (1,483 ft^3)	46 m^3 (1,624 ft^3)	55 m^3 (1,942 ft^3)
Material	2-ply nylon	Urethane	2-ply nylon		PVC + TPU composite coated nylon	
Weight, max takeoff		25 kg (55 lb)		46 kg (101 lb)		66 kg (145 lb)
Weight, gondola				22 kg (48.5 lb)		24 kg (52.9 lb)
Weight, envelope				13 kg (28.7 lb)		24 kg (52.9 lb)
Weight, payload	7.6 kg (16.8 lb)	3.4 - 4.5 kg (7.5 – 9.9 lb)	14 kg (30.9 lb)	8 kg (17.6 lb)	16 kg (35.3 lb)	15 kg (33.1 lb)
Power source	Battery	Battery or gasoline engines	12 – 20 Ah lithium polymer battery for main motors, 3Ah for tail motor, 5Ah for systems	High performance lithium polymer battery	Gasoline engine	High performance lithium polymer battery
Propulsion	3.3 kW electric motor drives 2 x 2-bladed thrust vectoring propellers cantilevered from gondola	2 x 2.2 kW electric motors or 2 x 35 cc gas engines drive 2-bladed thrust vectoring propellers cantilevered from gondola	2 x 2.2 kW electric motors drive 2-bladed thrust vectoring propellers cantilevered from gondola + lateral thrust tail propeller	2 x shrouded, thrust vectoring propellers cantilevered from gondola	2 x 2-bladed thrust vectoring shrouded propellers cantilevered from gondola	2 x shrouded, thrust vectoring propellers cantilevered from gondola
Speed, max	40 kph (24.9 mph)	60 kph (37.3 mph)	50 kph (31.1 mph)		90 kph (55.9 mph)	
Wind, max		Level 4			≤ 13m/s (29 mph)	Level 5
Altitude, operating	100 m (328 ft)	50 - 150m (164 - 492 ft)	100m (328 ft)	30 – 150 m (98 – 492 ft)	1,500 m (4,921 ft)	50 – 200 m (164 – 656 ft)
Endurance		1 - 2 hours	2.5 – 4 hours	2.5 hours	1.8 to 2.4 hours	3 hours

Compiled from available data published on the Gauss website, March 2023

5. Tethered aerostats

Gauss currently offers two tethered aerostat systems, with the aerostat sized at 12-meters and 22-meters in length. The complete aerostat system supplied by Gauss Tech consists of the aerostat, the mooring station, the winch and tether cable.

- The load-bearing portion of the tether cable normally is made from Kevlar. The tether also includes a non-load-bearing electric power cable to supply aerostat and mission systems and a fiber optic line for data communications. The tether cable has a copper outer sheath to protect the aerostat from lightning strikes.
- The mooring station is transportable and is designed for use in rugged terrain.
- Aerostat to be configured for a variety of mission using modular payloads, such as: EO/IR (electro-optical / infrared) cameras, surveillance radars, laser target designator, VHF and UHF radio repeaters, and communications intelligence (COMINT) / signal intelligence (SIGINT) receivers.

General characteristics of Gauss tethered aerostat systems

Parameter	12-m tethered aerostat	22-m tethered aerostat
Length	12 m (39.4 ft)	22 m (72.2 ft)
Diameter, max	4.55 m (14.9 ft)	
Envelope volume	130 m^3 (4,591 ft^3)	
Weight, payload	50 kg (110 lb)	190 kg (419 lb)
Available payload power		2 kVA (1.6 kW)
Altitude, max	400 m (1,312 ft)	900 m (2,953 ft)
Wind, max	≤15m/s	
Ground crew		• 6 to assemble / launch / disassemble in about 4 hours • 2 - 3 to operate
Endurance	3 days	14 days

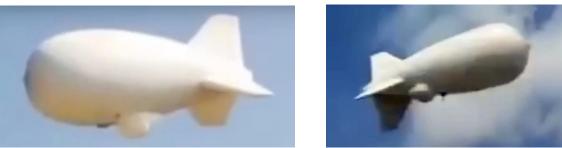*Compiled from available data published on the Gauss website, March 2023*

Gauss' 12-m aerostat is designed to carry a 50 kg (110 lb) payload to altitudes up to 400 m (1,312 ft) on missions lasting up to three days. The gas envelope has an air ballonet to compensate for changes in temperature and altitude while deployed. Outwardly, this aerostat shares several design features with TCOM's 12M aerostat.

Gauss 12-meter aerostat. Source, both photos: Gauss

Gauss' 22-m aerostat is designed to carry a 190 kg (419 lb) payload to altitudes up to 900 m (2,953 ft) on missions lasting up to 14 days. Gauss reports that their 22-m tethered aerostat is designed to "provide around-the-clock airborne persistent surveillance, rapidly & reliably delivering actionable intelligence."

Gauss 22-meter tethered aerostat. Source: Screenshots, Gauss video (2022)

Mobile mooring station for Gauss 22-meter tethered aerostat. Source: Screenshots, Gauss video (2022)

6. Skystar tactical surveillance aerostat systems

Gauss offers three ellipsoidal tethered aerostat systems sized in the 4-m to 6-m size range, as well as custom sizes. These aerostat systems can be configured for a variety of missions that can be performed with a lightweight payload operating at an altitude up to 300 m (about 1,000 ft). Examples of such missions are tactical surveillance (military or police force), target acquisition, traffic monitoring, communications relay, and search and rescue.

The aerostat balloon is packaged in a small trailer with a launch ring. It is easily transportable and rapidly deployable on site with a small ground crew.

The ellipsoidal balloon has an attached sail to stabilize the balloon and establish an upwind / downwind orientation relative to the wind. The tether is unpowered. The mission payload is suspended under the balloon from reinforced points on the envelope and carries its own power source and communications links to a ground station.

The Gauss Skystar tethered aerostat system. Source: Gauss

General characteristics of Gauss Skystar tethered aerostat systems

Parameter	4-m tethered surveillance aerostat	5-m tethered surveillance aerostat	6-m tethered surveillance aerostat
Diameter, max	4 m (13.1 ft)	5 m (16.4 ft)	6 m (19.7 ft)
Envelope volume	23.5 m^3 (830 ft^3)	50 m^3 (1,766 ft^3)	90 m^3 (3,178 ft^3) (est.)
Ideal sphere volume	33.5 m^3 (1,183 ft^3)	65.5 m^3 (2,313 ft^3)	113 m^3 (3,991 ft^3)
Material	Polyurethane membrane & coated rip-stop polyester fabric	Multi-layer envelope	
Helium leak rate, max		0.5% helium loss per day	
Weight, payload	5 – 7 kg (11 – 15.4 lb)	20 kg (44.1 lb)	40 kg (88.2 lb) (est.)
Altitude, operating	244 m (800 ft)		
Altitude, max	300 m (984 ft)	300 m (984 ft)	
Wind, max	Level 3	Level 4	
Endurance	72 hours	7 days	

Compiled from available data published on the Gauss website, March 2023, or estimated (est.)

The basic design of the Gauss Skystar tactical aerostat systems appears to be very similar to the tactical aerostat systems with the same name, Skystar, developed by the Israeli firm RT LTA Systems, Ltd. and in use worldwide.

7. For more information

- "Increasing IoT Network Coverage with Alibaba Cloud Link WAN," Alibaba Cloud, 30 October 2018: https://www.alibabacloud.com/blog/increasing-iot-network-coverage-with-alibaba-cloud-link-wan_594128

Videos

- "2018 Alibaba Yunqi Cloud Computing Conference Highlight," (1.15 min), posted by Alibaba Group, 24 September 2018: https://www.youtube.com/watch?v=6bsEBOtz2Hk
- "22m tethered aerostat," (0.35 min), Hangzhou Gauss Inflatable Tech Co., Ltd., posted by Suki Shen, 29 April 2022: https://www.youtube.com/watch?v=gxQ4ChDdSak&t=11s
- "20m remote control blimp zeppelin," (0.57), Hangzhou Gauss Inflatable Tech Co., Ltd., posted by Suki Shen, 6 July 2022: https://www.youtube.com/watch?v=wV0HLyToURo
- "20m Alibaba remote control blimp zeppelin," (1:07 min), Hangzhou Gauss Inflatable Tech Co., Ltd., posted by Suki Shen, 6 July 2022: https://www.youtube.com/watch?v=lvnQpoZiphA&t=2s
- "Surveillance Balloon," (5.11 min), Hangzhou Gauss Inflatable Tech Co., Ltd., posted by Suki Shen, 26 February 2017: https://www.youtube.com/watch?v=Tk1PGi4HUrY&t=5s

Other *Modern Airships* articles

- *Modern Airships - Part 1*: https://lynceans.org/all-posts/modern-airships-part-1/
- *Modern Airships - Part 2*: https://lynceans.org/all-posts/modern-airships-part-2/
    - RT LTA Systems, Ltd. – Skystar aerostats
- *Modern Airships - Part 3*: https://lynceans.org/all-posts/modern-airships-part-3/