Subject: **Lights for Hot Air Airship VFR Flights at Night** (Subpart F – Equipment)

Status: Consultation

Requirement reference:

- ICAO Annex 2 and Annex 6
- ICAO Doc. 9760, Volume 2
- EC 1702/2003 (and amendments)
- EASA Type Certification Procedure (TCP)
- EASA MB 02/04, MB Decision n° 7-2004
- LFHLLS [1]
- CAP 494, BCAR Part 31 [2]
- CS 31HA (draft February 2003) [3]
- CS-23 [4] (CS-VLA [5])
- CS-27 [6] (CS-VLR [7])
- ETSO-C30c [8] (SAE AS8037) [9]
- ETSO-C96a [10] (SAE AS8017) [11]

Introductory note

Hereby presented Special Conditions have been classified as important SC and as such shall be subject to public consultation, in accordance with EASA Management Board decision EASA MB 02/04, MB Decision n° 7-2004 products certification procedure, 30 March 2004, Article 3 (2.) of which states:

"2. Deviations from the applicable airworthiness codes, environmental protection certification specifications and/or acceptable means of compliance with Part 21, as well as important special conditions and equivalent safety findings, shall be submitted to the panel of experts and be subject to a public consultation of at least 3 weeks, except if they have been previously agreed and published in the Official Publication of the Agency. The final decision shall be published in the Official Publication of the Agency."

Statement of Issue

EASA received an application for the airworthiness certification of light installation on hot air airships for VFR flights at night. The applicable codes LFHLLS, BCAR 31 Supplement 1 and CS 31HA (CG9 draft Feb. 2003) provide no requirements for the design and installation of such lights. The purpose of this Special Condition (SC) is to define the certification basis for light installation on hot air airships for VFR flights at night. It should be noted, that "Night VFR" flying is currently subject to national regulations which might require additional equipment depending on the category of the airspace used for the flight. Therefore national regulations might pose additional requirements (e.g. NAV).

Background

The legal origin of the vast majority of airworthiness requirements can be traced back to ICAO documents. This accounts also for exterior and interior lights for aeroplanes and helicopters. The relevant ICAO sources are ICAO Annex 2, 6 and Doc. 9760, Volume 2.

ICAO documents do not address the specific properties of airships, simply because they do not comprise them. Therefore it is technically and economically reasonable to adapt the existing rules for light aeroplanes and light helicopters to hot air airships, to make most advantage of already existing equipment and experience. However, whilst large airships usually install standard aeroplane equipment, hot air airships are much more sensitive to complex installations resulting in additional weight and

[1] LFHLLS – Airworthiness Requirements for Hot Air Airships, issued 13 November 1997, Germany (Lufttüchtigkeitsforderungen für Heißluft-Luftschiffe)
[2] CAP 494, BCAR Part 31 - CAP 494, British Civil Airworthiness Requirements, Part 31 - Manned Free Balloons, Supplement 1 Small Hot Air Airships (Not exceeding 4250 cubic metres capacity), remark: equivalent to BCAR Working Draft Paper 696
[3] CS 31HA – Certification Specifications for Hot Air Airships, issued February 2003, JAA Core Group 9, Lighter-than-Air subgroup
[4] CS-23 - Certification Specifications for Normal, Utility, Aerobatic, and Commuter Category Aeroplanes, Amendment 2, 9 September 2010
[5] CS-VLA - Certification Specifications for Very Light Aeroplanes, Amendment 1, 5 March 2009
[6] CS-27 - Certification Specifications for Small Rotorcraft CS 27, Amendment 2, 17 November 2008
[7] CS-VLR - Certification Specifications for Very Light Rotorcraft, Amendment 1, 17 November 2008
[8] ETSO-C30c – European Technical Standard Order, Subject: Aircraft Position Lights, 24 October 2003
[9] AS8037 – SAE Aerospace Standard, Minimum Performance Standard for Aircraft Position Lights, SAE AS 8037, Rev. A
[10] ETSO-C96a – European Technical Standard Order, Subject: Anticollision Light Systems, 24 October 2003
[11] AS8017 – SAE Aerospace Standard, Minimum Performance Standard for Anticollision Light Sytems, SAE AS 8017, Rev. B

costs.

During the 1990s the CAA UK approved two installations into hot air airships (AAN 27525 and 25590). According to UK legislation these had to be based on the Air Navigation Order and BCAR Section Q.

However, with the technical progress of light emitting diodes, lightweight electronic control hardware and electrical power sources new system installation concept became available. This Special Condition shall address the current level of technology. The proposed special condition is based on a number of properties specific to hot air airships which need to be kept in mind for the discussion:

- They consist of flexible textile structures without rigid parts (except gondola);
- The internal pressure may vary and result in changing stiffness and geometry of envelope and empennage;
- Frequent burner bursts illuminate the envelope from inside;
- The flying altitude above ground is typically far less than 1 500 ft;
- The flight endurance is typically 1·5 hours and therefore a hot air airship is unlikely to fly far from its take-off/landing site;
- Their speed is very slow. V_{max} is less then 35 km/h (≈19 kts, <10 m/s)

With respect to its speed it is therefore reasonable to assume that the hot air airship is an almost static obstacle in the airspace in comparison to the forward speed of an aeroplane or a helicopter. At maximum forward speed a hot air airship is still considerably slower than the stalling speed of a Cessna 172 or the transition speed of a helicopter. To detect the airship and identify it as an obstacle is therefore much more important than estimating its trajectory.

The Special Condition was compiled from parts of ICAO Annexes 2 and 6 (incl. Doc. 9760), CS 23 and CS 27 (CS-VLA and CS VLR) which were considered being appropriate for hot air airships.

This ensures the maximum extent of compatibility with internationally accepted rules while taking account of the specific hot air airship characteristics.

Proposed Special Conditions

The following requirements shall be applied to lights for hot air airships. The nomenclature of e.g. "XCS 31HA.1383" serves as a placeholder for a future CS 31HA.

Subpart F

LIGHTS

XCS 31HA.1381 Instrument lights (Sources: CS 27.1381; ICAO Annex 6, 6.10 d))

All instruments, equipment and controls that are essential for the safe operation of the airship and that are used by the crew must be illuminated. The illumination must:

(a) Make each instrument, switch and other device for which it is provided easily readable; and

(b) If instrument lights are installed for illumination;

(1) Their direct rays are shielded from the pilot's eye; and

(2) No objectionable reflections are visible to the pilot.

XCS 31HA.1383 Landing lights (Sources: ICAO Annex 6, 6.10 c); CS 27.1383; CS 23.1383)

(a) There must be a least one landing light.

(b) A landing light must be designed and installed so that:

(1) No dangerous glare is visible to the pilot;

(2) The pilot is not seriously affected by halation;

(3) It provides enough light for night operation;

(4) It does not cause a fire hazard in any configuration.

(c) At least one separate switch must be provided, as applicable

(1) For each separately installed landing light;

(2) For each group of landing lights installed at a common location.

XCS 31HA.1385 Position light system installation
(Sources: CS 23.1385; ICAO Doc. 9760, Vol. 2, Chapter 5)

(a) General. Each part of each position light system must meet the applicable requirements and each system as a whole must meet the requirements of XCS 31HA.1387 to XCS 31HA.1397.

(b) Left and right position lights. Left and right position lights must consist of a red and a green light spaced laterally as far apart as practicable and installed on the airship such that, with the airship

in the normal flying position, the red light is on the left side and the green light is on the right side.

(c) Rear position light. The rear position light must be a white light mounted as far astern as practicable.

(d) Light covers and colour filters. - as in 3.4 of SAE S8037.

XCS 31HA.1387 Position light system dihedral angles (Source: CS 27.1387)

(a) Except as provided in subparagraph (e), each position light must, as installed, show unbroken light within the dihedral angles described in this paragraph.

(b) Dihedral angle L (left) is formed by two intersecting vertical planes, the first parallel to the longitudinal axis of the airship, and the other at 110° to the left of the first, as viewed when looking forward along the longitudinal axis.

(c) Dihedral angle R (right) is formed by two intersecting vertical planes, the first parallel to the longitudinal axis of the airship, and the other at 110° to the right of the first, as viewed when looking forward along the longitudinal axis.

(d) Dihedral angle A (aft) is formed by two intersecting vertical planes making angles of 70° to the right and to the left, respectively, to a vertical plane passing through the longitudinal axis, as viewed when looking aft along the longitudinal axis.

(e) If the rear position light, when mounted as far aft as practicable in accordance with XCS 31HA.1385 (c), cannot show unbroken light within dihedral angle A (as defined in subparagraph (d)), a solid angle or angles of obstructed visibility totalling not more than 0.04 steradians is allowable within that dihedral angle, if such solid angle is within a cone whose apex is at the rear position light and whose elements make an angle of 30° with a vertical line passing through the rear position light.

XCS 31HA.1389 Position light distribution and intensities (Source: CS 27.1389)

(a) General. The intensities prescribed in this paragraph must be provided by new equipment with light covers and colour filters in place. Intensities must be determined with the light source operating at a steady value equal to the average luminous output of the source at the normal operating voltage of the power source. The light distribution and intensity of each position light must meet the requirements of subparagraph (b).

(b) Forward and rear position lights. The light distribution and intensities of forward and rear position lights must be expressed in terms of minimum intensities in the horizontal plane, minimum intensities in any vertical plane, and maximum intensities in overlapping beams, within dihedral angles L, R, and A, and must meet the following requirements:

(1) Intensities in the horizontal plane. Each intensity in the horizontal plane (the plane containing the longitudinal axis of the airship and perpendicular to the plane of symmetry of the airship) must equal or exceed the values in XCS 31HA.1391.

(2) Intensities in any vertical plane. Each intensity in any vertical plane (the plane perpendicular to the horizontal plane) must equal or exceed the appropriate value in XCS 31HA.1393, where I is the minimum intensity prescribed in XCS 31HA 27.1391 for the corresponding angles in the horizontal plane.

(3) Intensities in overlaps between adjacent signals. No intensity in any overlap between adjacent signals may exceed the values in XCS 31HA.1395, except that higher intensities in overlaps may be used with main beam intensities substantially greater than the minima specified in XCS 31HA.1391 and XCS 31HA.1393, if the overlap intensities in relation to the main beam intensities do not adversely affect signal clarity. When the peak intensity of the forward position lights is greater than 100 candelas, the maximum overlap intensities between them may exceed the values in XCS 31HA.1395 if the overlap intensity in Area A is not more than 10% of peak position light intensity and the overlap intensity in Area B is not more than 2.5% of peak position light intensity.

XCS 31HA.1391 Minimum intensities in the horizontal plane of forward and rear position lights (Source: CS 27.1391)

Each position light intensity must equal or exceed the applicable values in the following table:

Dihedral angle (light included)	Angle from right or left of longitudinal axis, measured from dead ahead	Intensity [candelas]
L and R (forward red and green)	0° to 10° 10° to 20° 20° to 110°	40 30 5
A (rear white)	110° to 180°	20

XCS 31HA.1393 Minimum intensities in any vertical plane of forward and rear position lights (Source: CS 27.1393)

Each position light intensity must equal or exceed the applicable values in the following table:

Angle above or below the horizontal plane –	Intensity
0	1.00 I
0° to 5°	0.90 I
5° to 10°	0.80 I
10° to 15°	0.70 I
15° to 20°	0.50 I
20° to 30°	0.30 I
30° to 40°	0.10 I
40° to 90°	0.05 I

XCS 31HA.1395 Maximum intensities in overlapping beams of forward and rear position lights (Source: CS 27.1395)

No position light intensity may exceed the applicable values in the following table, except as provided in XCS 31HA.1389(b)(3):

	Maximum intensity	
Overlaps	Area A [candelas]	Area B [candelas]
Green in dihedral angle L	10	1
Red in dihedral angle R	10	1
Green in dihedral angle A	5	1
Red in dihedral angle A	5	1
Rear white in dihedral angle L	5	1
Rear white in dihedral angle R	5	1

Where:

(a) Area A includes all directions in the adjacent dihedral angle that pass through the light source and intersect the common boundary plane at more than 10° but less than 20°; and

(b) Area B includes all directions in the adjacent dihedral angle that pass through the light source and intersect the common boundary plane at more than 20°.

XCS 31HA.1397 Colour specifications (Source: CS 27.1397)

Each position light colour must have the applicable International Commission on Illumination chromaticity coordinates as follows:

(a) Aviation red:
'y' is not greater than 0.335; and 'z' is not greater than 0.002.

(b) Aviation green:
'x' is not greater than 0.440–0.320y; 'x' is not greater than y–0.170; and 'y' is not less than 0.390–0.170x.

(c) Aviation white:
'x' is not less than 0.300 and not greater than 0.540; 'y' is not less than 'x–0.040' or 'y_o–0.010', whichever is the smaller; and 'y' is not greater than 'x + 0.020' nor '0.636–0.400x';

Where 'y_o' is the 'y' coordinate of the Planckian radiator for the value of 'x' considered.

XCS 31HA.1401 Anticollision light system (Source: CS 27.1397; CS 23.1401)

(a) General. If certification for night operation is requested, the airship must have an anti-collision light system that:

(1) Consists of one or more anticollision lights located so that their emitted light will not impair the crew's vision or detract from the conspicuity of the position lights; and

(2) Meets the requirements of subparagraphs (b) to (f).

(b) Field of coverage. The system must consist of enough lights to illuminate the vital areas around the airship, considering the physical configuration and flight characteristics of the airship. The field of coverage must extend in each direction within at least 30° above and 30° below the horizontal plane of the airship, except that there may be solid angles of obstructed visibility totalling not more than 0.5 steradians.

(c) Flashing characteristics. The arrangement of the system, that is, the number of light sources, beam width, speed of rotation, and other characteristics, must give an effective flash frequency of not less than 40, nor more than 100, cycles per minute. The effective flash frequency is the frequency at which the airship's complete anti-collision light system is observed from a distance, and applies to each sector of light including any overlaps that exist when the system consists of more than one light source. In overlaps, flash frequencies may exceed 100, but not 180, cycles per minute.

(d) *Colour*. Each anti-collision light must be either aviation red or aviation white and must meet the applicable requirements of XCS 31HA.1397.

(e) *Light intensity*. The minimum light intensities in any vertical plane, measured with the red filter (if used) and expressed in terms of 'effective' intensities, must meet the requirements of subparagraph (f). The following relation must be assumed:

$$I_e = \frac{\int_{t_1}^{t_2} I(t)\,dt}{0.2 + (t_2 - t_1)}$$

where:

I_e = effective intensity (candelas).

$I(t)$ = instantaneous intensity as a function of time.

$t_2 - t_1$ = flash time interval (seconds).

Normally, the maximum value of effective intensity is obtained when t_2 and t_1 are chosen so that the effective intensity is equal to the instantaneous intensity at t_2 and t_1.

(f) *Minimum effective intensities for anti-collision light.* Each anti-collision light effective intensity must equal or exceed the applicable values in the following table:

Angle above or below the horizontal plane	Effective intensity [candelas]
0° to 5°	150
5° to 10°	90
10° to 20°	30
20° to 30°	15

Conclusion

open

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