GNSS, TRANSPONDER MODE S SSR CAPABLE OF ADS-B OUT, AND ADS-B OUT EQUIPMENT CARRIAGE FOR IFR OPERATIONS

Release Date: 19 MAY 2014

The GCAA has recently conducted a review of CAR PART III, and IV to consider the following improvements for enhancing UAE ATM capabilities:

1. The UAE PBN Implementation Plan, and the UAE ATM Strategic Plan 2012-2030 (under finalisation) recognise that the future ATM within the UAE FIR requires PBN at an Advanced RNP or better capability and system interoperabilities to meet anticipated traffic levels.

2. ICAO MID Region has developed a surveillance strategy for the implementation of ADS-B which includes a time line for implementation of 2017.

Note: The UAE PBN Implementation Plan can be viewed on the GCAA Website at the following link: http://www.gcaa.gov.ae/en/pages/forms.aspx, under “Safety Affairs > General > Performance Based Navigation”.

The review has concluded that there is a need for new requirements to be introduced to ensure carriage of GNSS, Transponder Mode S SSR, and ADS-B Out equipment for aircraft operating flight in UAE IFR for transition to satellite based aircraft CNS technology in support of the future ATM system for the UAE. It is important to highlight that the European Commission laying down similar requirements for European airspace with similar compliance timeframes.

The aircraft avionics equipage is to facilitate:

1. Satellite based navigation for aircraft operating under the IFR to replace navigation by reference to ground-based navigation aids:
   a. The GNSS is the single navigation system meeting the RNP 1 criteria within the UAE FIR. The use of GNSS will ensure compliance with the UAE PBN Implementation plan, the UAE ATM Strategic Plan and the Concept of Operations contained in the UAE Airspace study. It also obviates the need for the UAE Air Navigation Service Providers to replace a number of the existing ground-based navigations aids mostly VHF Omni Range [VOR] equipment installations. In addition, advanced aircraft navigation applications such as Required Navigation Performance (RNP) navigation, User Preferred Routes, Flexi-Tracks and Area Navigation based Standard Instrument Departures and Standard Terminal Approach Routes are available using the GNSS.
   b. In the short term, the contingency means of providing alternative navigation for aircraft unable to meet GNSS capabilities is the provision of track keeping compliance monitoring by ATC Surveillance services.

2. Mode S and ADS-B based electronic surveillance of aircraft for the purposes of Air Traffic
Management (ATM):
a. ADS-B provides ATC with ‘radar-like’ surveillance without the cost or the technical limitations of SSR. En-route surveillance using ADS-B was introduced by the en-route ANSP in 2006. A network of duplicated ADS-B ground stations provide continuous surveillance coverage over an area larger than the UAE FIR above altitude 2000 ft. The ADS-B stations provide cooperative surveillance, i.e. they can only detect signals from ADS-B OUT equipped aircraft. ADS-B provides the opportunity for significantly improved efficiency and safety wherever it is deployed for electronic surveillance by ATC. Aircraft avionics equipment for ADS-B consists of a Mode S transponder with ADS-B OUT capability incorporated, with a connection to a compatible GNSS receiver to input the aircraft position source data (latitude and longitude of aircraft position, position accuracy and integrity parameters).

Under the patronage of the NASAC, a thorough assessment has been conducted to ensure that the following key performance areas are addressed:

1. Access and equity;
2. Capacity;
3. Cost effectiveness;
4. Efficiency;
5. Environment;
6. Flexibility;
7. Global interoperability;
8. Participation by the ATM community;
9. Predictability;
10. Safety; and

This notice is published to announce to the public this amendment and to entitle all concerned parties to:

1. Review the attached proposed regulation versus their current and future aircraft fleet configurations and performances; and
2. Submit their comments online through the GCAA website within 45 days from the date of this NPA.

Comments must be submitted through the GCAA Website – E-Publication – Notice of Proposed Amendment, using the Action of “Submit NPA Feedback Request.”

Comments and Responses may be viewed in the Comments Response Document CRD pertaining to this NPA on the GCAA website.
Below is a list of the publications which will be affected upon entry into force of the proposed amendment:

1. PART IV - CAR-OPS-1 Operators

1.1. GNSS

CAR–OPS 1.653 IFR operations – Flight and navigational instruments and associated equipment

(a) An operator shall not operate after 07 December 2017 an aircraft, operating under IFR or within controlled airspace, with an individual Certificate of airworthiness first issued before 08 January 2015 unless it is equipped with GNSS equipment having the capabilities set out in AMC1 to CAR-OPS 1.653(a) and (b).

(b) An operator shall not operate an aircraft, operating under IFR or within controlled airspace, with an individual Certificate of airworthiness first issued on or after 08 January 2015 unless it is equipped with GNSS equipment having the capabilities set out in AMC1 to CAR-OPS 1.653(a) and (b).

AMC1 to CAR-OPS 1.653(a) and (b):

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<tr>
<th>Mandatory Minimum Navigation System (TSO Certified Equipment)</th>
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<td>TSO-C 145 or –C 146 or –C196 (or later version) GNSS;</td>
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<td>or</td>
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Note1: TSO-C 145 or –C 146 or –C 196 (or later versions) GNSS are recommended as this standard of GNSS equipment may be required to meet later navigation and ADS-B approvals.

Note 2: The above represents minimum equipage requirements. Some operations under the PBN may require more than one GNSS unit to be fitted.

CAR-OPS 1.243 Operations in areas with specified navigation performance requirements

(See AC OPS 1.243)

(a) An operator shall ensure that an aeroplane operated in areas, or through portions of airspace, or on routes where navigation performance requirements have been specified, is certified according to these regulations, and, if required that the Authority has granted the relevant operational approval. (See CAR–OPS 1.865 Communication and Navigation equipment for operations under IFR or within controlled airspace, or under VFR over routes not navigated by reference to visual landmarks, CAR–OPS 1.870 Additional navigation equipment for operations in MNPS airspace, CAR–OPS 1.872 Equipment for operation in defined airspace with RVSM, CAR–OPS 1.653 IFR operations – Flight and navigational instruments and associated equipment).

AMC1 to CAR-OPS 1.243: GNSS equipage shall be in compliance with the Advanced RNP Navigation requirements of ICAO document 9613 Performance Based Navigation Manual, certified in accordance
with UAE CAAP 52 and the UAE PBN handbook.

1.2. SSR Transponder

CAR-OPS 1.866 - Transponder equipment

b) An operator shall ensure that:
   i. aircraft operating flights under IFR or within controlled airspace (with an individual certificate of airworthiness first issued on or after 8 January 2015 are equipped with secondary surveillance radar transponders having the capabilities set out in Part 1 of AMC1 to CAR-OPS 1.866;
   ii. aircraft with a maximum certified take-off mass exceeding 5 700 kg or having a maximum cruising true airspeed capability greater than 250 knots, operating flights under IFR or within controlled airspace with an individual certificate of airworthiness first issued on or after 8 January 2015 are equipped with secondary surveillance radar transponders having, in addition to the capabilities set out in Part 1 of AMC1 to CAR-OPS 1.866, the capabilities set out in Part 2 of AMC1 to CAR-OPS 1.866;
   iii. fixed wing aircraft with a maximum certified take-off mass exceeding 5 700 kg or having a maximum cruising true airspeed capability greater than 250 knots, operating flights under IFR or within controlled airspace, with an individual certificate of airworthiness first issued on or after 8 January 2015 are equipped with secondary surveillance radar transponders having, in addition to the capabilities set out in Part 1 of AMC1 to CAR-OPS 1.866, the capabilities set out in Part 2 and 3 of AMC1 to CAR-OPS 1.866.

c) An operator shall ensure that by 7 December 2017 at the latest:
   i. aircraft operating flights under IFR or within controlled airspace, with an individual certificate of airworthiness first issued before 8 January 2015, are equipped with secondary surveillance radar transponders having the capabilities set out in Part 1 of AMC1 to CAR-OPS 1.866;
   ii. aircraft with a maximum certified take-off mass exceeding 5 700 kg or having a maximum cruising true airspeed capability greater than 250 knots, operating flights under IFR or within controlled airspace with an individual certificate of airworthiness first issued before 8 January 2015 are equipped with secondary surveillance radar transponders having, in addition to the capabilities set out in Part 1 of AMC1 to CAR-OPS 1.866, the capabilities set out in Part 2 of AMC1 to CAR-OPS 1.866;
   iii. fixed wing aircraft with a maximum certified take-off mass exceeding 5 700 kg or having a maximum cruising true airspeed capability greater than 250 knots, operating flights under IFR or within controlled airspace, with an individual certificate of airworthiness first issued before 8 January 2015 are equipped with secondary surveillance radar transponders having, in addition to the capabilities set out in Part 1 of AMC1 to CAR-OPS 1.866, the capabilities set out in Part 2 and 3 of AMC1 to CAR-OPS 1.866.

d) An operator shall ensure that aircraft equipped in accordance with paragraphs b) and c) and having a maximum certified take-off mass exceeding 5 700 kg or having a maximum cruising true airspeed capability greater than 250 knots operate with antenna diversity as prescribed in paragraph 3.1.2.10.4 of Annex 10 to the Chicago Convention, Volume IV, Fourth Edition including all amendments up to No 85.

AMC1 to CAR-OPS 1.866

Part 1: Secondary surveillance radar transponder capabilities referred to the Mandate document
1. The minimum capability for the secondary surveillance transponder shall be Mode S Level 2 certified in accordance with paragraphs 2.1.5.1.2, 2.1.5.1.7 and 3.1.2.10 of Annex 10 to the Chicago Convention, Volume IV, Fourth Edition including all amendments up to No 85.

2. Each implemented transponder register shall be compliant with the corresponding section of ICAO document 9871 (2nd edition).

3. The following data items shall be made available to the transponder and be transmitted by the transponder via the Mode S protocol and in accordance with the formats specified in ICAO document 9871 (2nd edition):

   (a) 24-bit ICAO aircraft address;
   (b) Mode A code;
   (c) pressure altitude;
   (d) flight status (on the ground or airborne);
   (e) data link capability report;
       — airborne collision avoidance system (ACAS) capability,
       — Mode S specific services capability,
       — aircraft identification capability,
       — squitter capability,
       — surveillance identifier capability,
       — common usage Ground Initiated Comms.-B (GICB) capability report (indication of change),
       — Mode S subnetwork version number;
   (f) common usage GICB capability report;
   (g) aircraft identification;
   (h) special position indication (SPI);
   (i) emergency status (general emergency, no communications, unlawful interference) including the use of specific Mode A codes to indicate different emergency states;
   (j) ACAS active resolution advisories when the aircraft is equipped with Traffic alert and collision avoidance system II (TCAS II).

4. Other data items may be made available to the transponder.

5. The data items referred to in point 4 shall only be transmitted by the transponder via the Mode S protocol if the aircraft and equipment certification process covers the transmission of these data items via the Mode S protocol.

6. The continuity of transponder functionality supporting the Mode S protocol shall be equal to or less than 2.10^-4 per flight hour (i.e. mean time between failure equal to or greater than 5 000 flight hours).

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**Part 2: Secondary surveillance radar transponder capabilities referred to the Mandate document**

1. The minimum capability for the secondary surveillance transponder shall be Mode S Level 2 certified in accordance with paragraphs 2.1.5.1.2, 2.1.5.1.6, 2.1.5.1.7 and 3.1.2.10 of Annex 10 to the Chicago Convention, Volume IV, Fourth Edition including all amendments up to No 85.

2. Each implemented transponder register shall be compliant with the corresponding section of ICAO document 9871 (2nd edition).
3. The following data items shall be made available to the transponder and be transmitted by the transponder via Version 2 of the extended squitter (ES) ADS-B protocol in accordance with the formats specified in ICAO document 9871 (2nd edition):

(a) 24-bit ICAO aircraft address;
(b) aircraft identification;
(c) Mode A code;
(d) special position indication (SPI) using the same source as for the same parameter specified in Part A;
(e) emergency status (general emergency, no communications, unlawful interference) using the same source as for the same parameter specified in Part A;
(f) ADS-B version number (equal to 2);
(g) ADS-B emitter category;
(h) geodetic horizontal position in accordance with the world geodetic system revision 1984 (WGS84) latitude and longitude, both while airborne or on the ground;
(i) geodetic horizontal position quality indicators (corresponding to the integrity containment bound (NIC), 95 % navigation accuracy category for position (NAC p ), source integrity level (SIL) and system design assurance level (SDA));
(j) pressure altitude using the same source as for the same parameter specified in Part A;
(k) geometric altitude in accordance with the world geodetic system revision 1984 (WGS84), provided in addition and encoded as a difference to pressure altitude;
(l) geometric vertical accuracy (GVA);
(m) velocity over ground, both while airborne (east/west and north/south airborne velocity over ground) or on the ground (surface heading/ground track and movement);
(n) velocity quality indicator corresponding to navigation accuracy category for velocity (NAC v );
(o) coded aircraft length and width;
(p) global navigation satellite system (GNSS) antenna offset;
(q) vertical rate: barometric vertical rate using the same source as for the same parameter specified in the data item in point 2 (g) of Part C when the aircraft is required and capable to transmit this data item via the Mode S protocol, or Global Navigation Satellite System (GNSS) vertical rate;
(r) mode control panel/flight control unit (MCP/FCU) selected altitude using the same source as for the same parameter specified in Part C when the aircraft is required and capable to transmit this data item via the Mode S protocol;EN L 305/44 Official Journal of the European Union 23.11.2011
(s) barometric pressure setting (minus 800 hectoPascals) using the same source as for the same parameter specified in Part C when the aircraft is required and capable to transmit this data item via the Mode S protocol;
(t) ACAS active resolution advisories when the aircraft is equipped with TCAS II using the same source as for the same parameter specified in Part A.

4. Surveillance data items (the data items in point 3(h), (k) and (m)) and their quality indicator data items (the data items in point 3(i), (l) and (n)) shall be provided to the transponders on the same physical interface.
5. The data source connected to the transponder and providing the data items in point 3(h) and (i) shall meet the following data integrity requirements:

(a) horizontal position (data item in point 3(h)) source integrity level (SIL, expressed with respect to NIC) shall be equal to or less than 10^-7 per flight-hour;

(b) horizontal position (data item in point 3(h)) integrity time to alert (leading to a change of the NIC quality indicator), if on-board monitoring is required to meet the horizontal position source integrity level, shall be equal to or less than 10 seconds.

6. The primary data source providing the data items in point 3(h) and (i) shall be at least compatible with GNSS receivers that perform receiver autonomous integrity monitoring (RAIM) and fault detection and exclusion (FDE), along with the output of corresponding measurement status information, as well as integrity containment bound and 95 % accuracy bound indications.

7. The system integrity level of the data sources providing the data items in point 3(f), (g), (k) to (p) shall be equal to or less than 10^-5 per flight-hour.

8. The quality indicator information (NIC, NACp, SIL, SDA, NACv and GVA) (the data items in point 3(i), (l) and (n)) shall express the actual performance of the selected data source as valid at the time of applicability of the measurement of the data items in point 3(h), (k) and (m)).

9. With respect to the processing of the data items in point 3(a) to (t), the transponder system integrity level for the extended squitter ADS-B protocol, including any interconnecting avionics to the transponder, shall be equal to or less than 10^-5 per flight-hour.

10. The total latency of the horizontal position data (the data items in point 3(h) and (i)) shall be equal to or less than 1.5 second in 95 % of all transmissions.

11. The uncompensated latency of the horizontal position data (data item in point 3(h)) shall be equal to or less than 0.6 second in 95 % of the cases and shall be equal to or less than 1.0 second in 99.9 % of all transmissions.

12. The total latency of the ground speed data items (the data items in point 3(m) and (n)) shall be equal to or less than 1.5 second in 95 % of all transmissions.

13. If the transponder is set to use a Mode A conspicuity code of 1000 then the broadcast of Mode A code information via the extended squitter ADS-B protocol shall be inhibited.

14. Other data items may be made available to the transponder.

15. Except for military reserved formats, the data items referred to in point 14 shall only be transmitted by the transponder via the extended squitter ADS-B protocol if the aircraft and equipment certification process covers the transmission of these data items via the extended squitter ADS-B protocol.

16. The continuity of transponder functionality supporting the ADS-B protocol shall be equal to or less than 2. 10^-4 per flight hour (i.e. mean time between failure equal to or greater than 5 000 flight hours).

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**Part 3: Secondary surveillance radar transponder additional surveillance data capability referred to the Mandate Document**

1. Each transponder register that is implemented shall be compliant with the corresponding section of ICAO document 9871 (2nd edition).

2. The following data items shall be made available to the transponder and be transmitted by the transponder as requested by the ground-based surveillance chain, via the Mode S protocol and in accordance with the formats specified in ICAO document 9871 (2nd edition):
(a) MCP/FCU selected altitude;
(b) roll angle;
(c) true track angle;
(d) ground speed;
(e) magnetic heading;
(f) indicated airspeed (IAS) or mach number;
(g) vertical rate (barometric or baro-inertial);
(h) barometric pressure setting (minus 800 hectoPascals);
(i) track angle rate or true airspeed if track angle rate is not available.

3. Other data items may be made available to the transponder.

4. The data items referred to in point 3 shall only be transmitted by the transponder via the Mode S protocol if the aircraft and equipment certification process covers the transmission of these data items via the Mode S protocol.

1.3. ADS-B Out

CAR–OPS 1.867 – ADS-B OUT capability for operations under IFR or within controlled airspace

a) An operator shall not operate, after 07 December 2017, an aircraft, operating flights under IFR or within controlled airspace, with an individual Certificate of airworthiness first issued before 08 January 2015 unless it is ADS-B OUT capable as per the specifications set out in AMC1 to CAR-OPS 1.867(a) and (b).

b) An operator shall not operate an aircraft, operating flights under IFR or within controlled airspace, with an individual Certificate of airworthiness first issued on or after 08 January 2015 unless it is ADS-B OUT capable as per the specifications set out in AMC1 to CAR-OPS 1.867(a) and (b).

c) An operator shall not operate flights under IFR or within controlled airspace an aircraft ADS-B OUT equipped in accordance with paragraph a) or b) unless ADS-B OUT capability is serviceable.

GM1 to CAR-OPS 1.867(a): If, after 08 January 2015, such aircraft is ADS-B OUT capable prior to 07 December 2017, then CAR-OPS 1.867(b) becomes applicable from 08 January 2015.

AMC1 to CAR-OPS 1.867(a) and (b): the ADS-B capability should be demonstrated against Certification Specifications - Airborne Communications, Navigation and Surveillance (CS-ACNS) contained in Annex I to ED Annex I to ED Decision 2013/031 or equivalent accepted by the GCAA.

1.4. ADS-B In

CAR–OPS 1.868 – ADS-B IN capability

An operator shall not operate an aircraft with the ADS-B IN capability operative unless approved by the GCAA.
2. PART IV - CAR-OPS-3 Operators

2.1. GNSS

CAR–OPS 3.653 IFR operations – Flight and navigational instruments and associated equipment

(a) An operator shall not operate after 07 December 2017 a helicopter, operating under IFR or within controlled airspace, with an individual Certificate of airworthiness first issued before 08 January 2015 unless it is equipped with GNSS equipment having the capabilities set out in AMC1 to CAR-OPS 3.653(a) and (b).

(b) An operator shall not operate a helicopter, operating under IFR or within controlled airspace, with an individual Certificate of airworthiness first issued on or after 08 January 2015 unless it is equipped with GNSS equipment having the capabilities set out in AMC1 to CAR-OPS 3.653(a) and (b).

AMC1 to CAR-OPS 3.653(a) and (b):

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Note1: TSO-C 145 or –C 146 or –C 196 (or later versions) GNSS are recommended as this standard of GNSS equipment may be required to meet later navigation and ADS-B approvals.

Note 2: The above represents minimum equipage requirements. Some operations under the PBN may require more than one GNSS unit to be fitted.

CAR-OPS 3.243 Operations in areas with specific navigation performance requirements

(See IEM OPS 3.243)
(a) An operator shall not operate a helicopter in defined areas, or a defined portion of specified airspace, based on Regional Air Navigation Agreements where minimum navigation performance specifications are prescribed unless approved to do so by the Authority (RNP/RNAV Approval). (See also CAR-OPS 3.865(c)(2), CAR–OPS 3.653 IFR operations – Flight and navigational instruments and associated equipment)

AMC1 to CAR-OPS 3.243 GNSS equipage shall be in compliance with the Advanced RNP Navigation requirements of ICAO document 9613 Performance Based Navigation Manual, certified in accordance with UAE CAAP 52 and the UAE PBN handbook.

2.2. SSR Transponder

CAR-OPS 3.866 - Transponder equipment
b) An operator shall ensure that:
   iv. helicopter operating flights under IFR or within controlled airspace with an individual certificate of airworthiness first issued on or after 8 January 2015 are equipped with secondary surveillance radar transponders having the capabilities set out in Part 1 of AMC1 to CAR-OPS 3.866;
   v. helicopter with a maximum certified take-off mass exceeding 5 700 kg or having a maximum cruising true airspeed capability greater than 250 knots, operating flights under IFR or within controlled airspace with an individual certificate of airworthiness first issued on or after 8 January 2015 are equipped with secondary surveillance radar transponders having, in addition to the capabilities set out in Part 1 of AMC1 to CAR-OPS 3.866, the capabilities set out in Part 2 of AMC1 to CAR-OPS 3.866;

c) An operator shall ensure that by 7 December 2017 at the latest:
   iv. helicopter operating flights under IFR or within controlled airspace, with an individual certificate of airworthiness first issued before 8 January 2015, are equipped with secondary surveillance radar transponders having the capabilities set out in Part 1 of AMC1 to CAR-OPS 3.866;
   v. helicopter with a maximum certified take-off mass exceeding 5 700 kg or having a maximum cruising true airspeed capability greater than 250 knots, operating flights under IFR or within controlled airspace with an individual certificate of airworthiness first issued before 8 January 2015 are equipped with secondary surveillance radar transponders having, in addition to the capabilities set out in Part 1 of AMC1 to CAR-OPS 3.866, the capabilities set out in Part 2 of AMC1 to CAR-OPS 3.866;

d) An operator shall ensure that helicopter equipped in accordance with paragraphs b) and c) and having a maximum certified take-off mass exceeding 5 700 kg or having a maximum cruising true airspeed capability greater than 250 knots operate with antenna diversity as prescribed in paragraph 3.1.2.10.4 of Annex 10 to the Chicago Convention, Volume IV, Fourth Edition including all amendments up to No 85.

AMC1 to CAR-OPS 3.866

Part 1: Secondary surveillance radar transponder capabilities referred to the Mandate document

1. The minimum capability for the secondary surveillance transponder shall be Mode S Level 2 certified in accordance with paragraphs 2.1.5.1.2, 2.1.5.1.7 and 3.1.2.10 of Annex 10 to the Chicago Convention, Volume IV, Fourth Edition including all amendments up to No 85.

2. Each implemented transponder register shall be compliant with the corresponding section of ICAO document 9871 (2nd edition).

3. The following data items shall be made available to the transponder and be transmitted by the transponder via the Mode S protocol and in accordance with the formats specified in ICAO document 9871 (2nd edition):
   (a) 24-bit ICAO aircraft address;
   (b) Mode A code;
   (c) pressure altitude;
   (d) flight status (on the ground or airborne);
   (e) data link capability report;
   — airborne collision avoidance system (ACAS) capability,
   — Mode S specific services capability,
   — aircraft identification capability,
— squitter capability,
— surveillance identifier capability,
— common usage Ground Initiated Comms.-B (GICB) capability report (indication of change),
— Mode S subnetwork version number;

(f) common usage GICB capability report;
(g) aircraft identification;
(h) special position indication (SPI);
(i) emergency status (general emergency, no communications, unlawful interference) including the use of specific Mode A codes to indicate different emergency states;
(j) ACAS active resolution advisories when the aircraft is equipped with Traffic alert and collision avoidance system II (TCAS II).

4. Other data items may be made available to the transponder.

5. The data items referred to in point 4 shall only be transmitted by the transponder via the Mode S protocol if the aircraft and equipment certification process covers the transmission of these data items via the Mode S protocol.

6. The continuity of transponder functionality supporting the Mode S protocol shall be equal to or less than 2.10^{-4} per flight hour (i.e. mean time between failure equal to or greater than 5 000 flight hours).

Part 2: Secondary surveillance radar transponder capabilities referred to the Mandate document

1. The minimum capability for the secondary surveillance transponder shall be Mode S Level 2 certified in accordance with paragraphs 2.1.5.1.2, 2.1.5.1.6, 2.1.5.1.7 and 3.1.2.10 of Annex 10 to the Chicago Convention, Volume IV, Fourth Edition including all amendments up to No 85.

2. Each implemented transponder register shall be compliant with the corresponding section of ICAO document 9871 (2nd edition).

3. The following data items shall be made available to the transponder and be transmitted by the transponder via Version 2 of the extended squitter (ES) ADS-B protocol in accordance with the formats specified in ICAO document 9871 (2nd edition):

(a) 24-bit ICAO aircraft address;
(b) aircraft identification;
(c) Mode A code;
(d) special position indication (SPI) using the same source as for the same parameter specified in Part A;
(e) emergency status (general emergency, no communications, unlawful interference) using the same source as for the same parameter specified in Part A;
(f) ADS-B version number (equal to 2);
(g) ADS-B emitter category;
(h) geodetic horizontal position in accordance with the world geodetic system revision 1984 (WGS84) latitude and longitude, both while airborne or on the ground;
(i) geodetic horizontal position quality indicators (corresponding to the integrity containment bound (NIC), 95 % navigation accuracy category for position (NAC p ), source integrity level (SIL) and system design assurance level (SDA));
(j) pressure altitude using the same source as for the same parameter specified in Part A;
(k) geometric altitude in accordance with the world geodetic system revision 1984 (WGS84), provided in addition and encoded as a difference to pressure altitude;
(l) geometric vertical accuracy (GVA);
(m) velocity over ground, both while airborne (east/west and north/south airborne velocity over ground) or on the ground (surface heading/ground track and movement);
(n) velocity quality indicator corresponding to navigation accuracy category for velocity (NACv);
(o) coded aircraft length and width;
(p) global navigation satellite system (GNSS) antenna offset;
(q) vertical rate: barometric vertical rate using the same source as for the same parameter specified in the data item in point 2 (g) of Part C when the aircraft is required and capable to transmit this data item via the Mode S protocol, or Global Navigation Satellite System (GNSS) vertical rate;
(r) mode control panel/flight control unit (MCP/FCU) selected altitude using the same source as for the same parameter specified in Part C when the aircraft is required and capable to transmit this data item via the Mode S protocol;
(s) barometric pressure setting (minus 800 hectoPascals) using the same source as for the same parameter specified in Part C when the aircraft is required and capable to transmit this data item via the Mode S protocol;
(t) ACAS active resolution advisories when the aircraft is equipped with TCAS II using the same source as for the same parameter specified in Part A.

4. Surveillance data items (the data items in point 3(h), (k) and (m)) and their quality indicator data items (the data items in point 3(i), (l) and (n)) shall be provided to the transponders on the same physical interface.

5. The data source connected to the transponder and providing the data items in point 3(h) and (i) shall meet the following data integrity requirements:

(a) horizontal position (data item in point 3(h)) source integrity level (SIL, expressed with respect to NIC) shall be equal to or less than 10^-7 per flight-hour;
(b) horizontal position (data item in point 3(h)) integrity time to alert (leading to a change of the NIC quality indicator), if on-board monitoring is required to meet the horizontal position source integrity level, shall be equal to or less than 10 seconds.

6. The primary data source providing the data items in point 3(h) and (i) shall be at least compatible with GNSS receivers that perform receiver autonomous integrity monitoring (RAIM) and fault detection and exclusion (FDE), along with the output of corresponding measurement status information, as well as integrity containment bound and 95 % accuracy bound indications.

7. The system integrity level of the data sources providing the data items in point 3(f), (g), (k) to (p) shall be equal to or less than 10^-5 per flight-hour.

8. The quality indicator information (NIC, NACp, SIL, SDA, NACv and GVA) (the data items in point 3(i), (l) and (n)) shall express the actual performance of the selected data source as valid at the time of applicability of the measurement of the data items in point 3(h), (k) and (m)).

9. With respect to the processing of the data items in point 3(a) to (t), the transponder system integrity level for the extended squitter ADS-B protocol, including any interconnecting avionics to the transponder, shall be equal to or less than 10^-5 per flight-hour.
10. The total latency of the horizontal position data (the data items in point 3(h) and (i)) shall be equal to or less than 1.5 second in 95% of all transmissions.

11. The uncompensated latency of the horizontal position data (data item in point 3(h)) shall be equal to or less than 0.6 second in 95% of the cases and shall be equal to or less than 1.0 second in 99.9% of all transmissions.

12. The total latency of the ground speed data items (the data items in point 3(m) and (n)) shall be equal to or less than 1.5 second in 95% of all transmissions.

13. If the transponder is set to use a Mode A conspicuity code of 1000 then the broadcast of Mode A code information via the extended squitter ADS-B protocol shall be inhibited.

14. Other data items may be made available to the transponder.

15. Except for military reserved formats, the data items referred to in point 14 shall only be transmitted by the transponder via the extended squitter ADS-B protocol if the aircraft and equipment certification process covers the transmission of these data items via the extended squitter ADS-B protocol.

16. The continuity of transponder functionality supporting the ADS-B protocol shall be equal to or less than $2 \times 10^{-4}$ per flight hour (i.e. mean time between failure equal to or greater than 5,000 flight hours).

Part 3: Secondary surveillance radar transponder additional surveillance data capability referred to the Mandate Document

1. Each transponder register that is implemented shall be compliant with the corresponding section of ICAO document 9871 (2nd edition).

2. The following data items shall be made available to the transponder and be transmitted by the transponder as requested by the ground-based surveillance chain, via the Mode S protocol and in accordance with the formats specified in ICAO document 9871 (2nd edition):

   (a) MCP/FCU selected altitude;
   (b) roll angle;
   (c) true track angle;
   (d) ground speed;
   (e) magnetic heading;
   (f) indicated airspeed (IAS) or mach number;
   (g) vertical rate (barometric or baro-inertial);
   (h) barometric pressure setting (minus 800 hectoPascals);
   (i) track angle rate or true airspeed if track angle rate is not available.

3. Other data items may be made available to the transponder.

4. The data items referred to in point 3 shall only be transmitted by the transponder via the Mode S protocol if the aircraft and equipment certification process covers the transmission of these data items via the Mode S protocol.

2.3. ADS-B Out
CAR–OPS 3.867 – ADS-B OUT capability for operations under IFR or within controlled airspace

a) An operator shall not operate, after 07 December 2017, a helicopter, operating flights under IFR or within controlled airspace, with an individual Certificate of airworthiness first issued before 08 January 2015 unless it is ADS-B OUT capable as per the specifications set out in AMC1 to CAR-OPS 3.867(a) and (b).

b) An operator shall not operate a helicopter, operating flights under IFR or within controlled airspace, with an individual Certificate of airworthiness first issued on or after 08 January 2015 unless it is ADS-B OUT capable as per the specifications set out in AMC1 to CAR-OPS 3.867(a) and (b).

c) An operator shall not operate flights under IFR or within controlled airspace a helicopter ADS-B OUT equipped in accordance with paragraph a) or b) unless ADS-B OUT capability is serviceable.

GM1 to CAR-OPS 3.867(a): If, after 08 January 2015, such helicopter is ADS-B OUT capable prior to 07 December 2017, then CAR-OPS 3.867(b) becomes applicable from 08 January 2015.

AMC1 to CAR-OPS 3.867(a) and (b): the ADS-B capability should be demonstrated against Certification Specifications - Airborne Communications, Navigation and Surveillance (CS-ACNS) contained in Annex I to ED Annex I to ED Decision 2013/031 or equivalent accepted by the GCAA.

2.4. ADS-B IN

CAR–OPS 3.868 – ADS-B IN capability

An operator shall not operate a helicopter with the ADS-B IN capability operative unless approved by the GCAA.

2. PART III – CHAPTER 4

4.2.1 Aircraft Equipment

Aircraft shall be equipped with suitable instruments and with navigation equipment appropriate to the route to be flown, in particular:

(a) GNSS equipment:

i. An operator shall not operate after 07 December 2017 an aircraft, operating under IFR or within controlled airspace, with an individual Certificate of airworthiness first issued before 08 January 2015 unless it is equipped with GNSS equipment having the capabilities set out in AMC1 to 4.2.1(a).

ii. An operator shall not operate an aircraft, operating under IFR or within controlled airspace, with an individual Certificate of airworthiness first issued on or after 08 January 2015 unless it is equipped with GNSS equipment having the capabilities set out in AMC1 to 4.2.1(a).

(b) SSR Transponder:

i. An operator shall ensure that:

1. aircraft/helicopter operating flights under IFR or within controlled airspace with an individual certificate of airworthiness first issued on or after 8 January 2015 are equipped with secondary surveillance radar transponders having the
capabilities set out in Part 1 of AMC1 to 4.2.1(b);  
2. aircraft/helicopter with a maximum certified take-off mass exceeding 5 700 kg or having a maximum cruising true airspeed capability greater than 250 knots, operating flights under IFR or within controlled airspace with an individual certificate of airworthiness first issued on or after 8 January 2015 are equipped with secondary surveillance radar transponders having, in addition to the capabilities set out in Part 1 of AMC1 to 4.2.1(b), the capabilities set out in Part 2 of AMC1 to 4.2.1(b);  
3. fixed wing aircraft with a maximum certified take-off mass exceeding 5 700 kg or having a maximum cruising true airspeed capability greater than 250 knots, operating flights under IFR or within controlled airspace, with an individual certificate of airworthiness first issued on or after 8 January 2015 are equipped with secondary surveillance radar transponders having, in addition to the capabilities set out in Part 1 of AMC1 to 4.2.1(b), the capabilities set out in Part 2 and 3 of AMC1 to 4.2.1(b).

ii. An operator shall ensure that by 7 December 2017 at the latest:
   1. aircraft/helicopter operating flights under IFR or within controlled airspace, with an individual certificate of airworthiness first issued before 8 January 2015, are equipped with secondary surveillance radar transponders having the capabilities set out in Part 1 of AMC1 to 4.2.1(b);  
   2. aircraft/helicopter with a maximum certified take-off mass exceeding 5 700 kg or having a maximum cruising true airspeed capability greater than 250 knots, operating flights under IFR or within controlled airspace with an individual certificate of airworthiness first issued before 8 January 2015 are equipped with secondary surveillance radar transponders having, in addition to the capabilities set out in Part 1 of AMC1 to 4.2.1(b), the capabilities set out in Part 2 of AMC1 to 4.2.1(b);  
   3. fixed wing aircraft with a maximum certified take-off mass exceeding 5 700 kg or having a maximum cruising true airspeed capability greater than 250 knots, operating flights under IFR or within controlled airspace, with an individual certificate of airworthiness first issued before 8 January 2015 are equipped with secondary surveillance radar transponders having, in addition to the capabilities set out in Part 1 of AMC1 to 4.2.1(b), the capabilities set out in Part 2 and 3 of AMC1 to 4.2.1(b).  

iii. An operator shall ensure that aircraft/helicopter equipped in accordance with paragraphs (b)(i) and (b)(ii) and having a maximum certified take-off mass exceeding 5 700 kg or having a maximum cruising true airspeed capability greater than 250 knots operate with antenna diversity as prescribed in paragraph 3.1.2.10.4 of Annex 10 to the Chicago Convention, Volume IV, Fourth Edition including all amendments up to No 85.

(c) ADS-B OUT:
   i. An operator shall not operate, after 07 December 2017, an aircraft/helicopter, operating flights under IFR or within controlled airspace, with an individual Certificate of airworthiness first issued before 08 January 2015 unless it is ADS-B OUT capable as per the specifications set out in AMC1 to 4.2.1(c).
   ii. An operator shall not operate an aircraft/helicopter, operating flights under IFR or within controlled airspace, with an individual Certificate of airworthiness first issued on or after 08 January 2015 unless it is ADS-B OUT capable as per the specifications set out in AMC1 to 4.2.1(c).
   iii. An operator shall not operate flights under IFR or within controlled airspace an aircraft/helicopter ADS-B OUT equipped as per paragraph (c)(i) and (c)(ii) unless ADS-B Out is serviceable.
GM1 to 4.2.1: These requirements apply even to State aircraft/helicopter defined as “an aircraft/helicopter designed to carry persons or freight” and intending to operate flights in IFR, which requires access to controlled airspace or the published route structures.

GM2 to 4.2.1: These requirements do not apply to:

i. State aircraft other than those specified in GM1 to 4.2.1;

ii. model aircraft;

iii. foot-launched flying machines (including powered paragliders and hang gliders);

iv. captive balloons; kites; parachutes (including parascending parachutes);

v. aircraft, including gliders, with a MTOM of less than 500 kg, and microlights, used for noncommercial purposes, or that are used for local flight instruction in uncontrolled airspace.

AMC1 to 4.2.1(a):

<table>
<thead>
<tr>
<th>Mandatory Minimum Navigation System (TSO Certified Equipment)</th>
</tr>
</thead>
<tbody>
<tr>
<td>TSO-C 145 or –C 146 or –C196 (or later version) GNSS;</td>
</tr>
<tr>
<td>or</td>
</tr>
<tr>
<td>RNP capable aircraft as approved by the GCAA.</td>
</tr>
</tbody>
</table>

Note1: TSO-C 145 or –C 146 or –C 196 (or later versions) GNSS are recommended as this standard of GNSS equipment may be required to meet later navigation and ADS-B approvals.

Note 2: The above represents minimum equipage requirements. Some operations under the PBN may require more than one GNSS unit to be fitted.

AMC1 to 4.2.1(b)

Part 1: Secondary surveillance radar transponder capabilities referred to the Mandate document

1. The minimum capability for the secondary surveillance transponder shall be Mode S Level 2 certified in accordance with paragraphs 2.1.5.1.2, 2.1.5.1.7 and 3.1.2.10 of Annex 10 to the Chicago Convention, Volume IV, Fourth Edition including all amendments up to No 85.

2. Each implemented transponder register shall be compliant with the corresponding section of ICAO document 9871 (2nd edition).

3. The following data items shall be made available to the transponder and be transmitted by the transponder via the Mode S protocol and in accordance with the formats specified in ICAO document 9871 (2nd edition):

   (a) 24-bit ICAO aircraft address;

   (b) Mode A code;

   (c) pressure altitude;

   (d) flight status (on the ground or airborne);
(e) data link capability report;
   — airborne collision avoidance system (ACAS) capability,
   — Mode S specific services capability,
   — aircraft identification capability,
   — squitter capability,
   — surveillance identifier capability,
   — common usage Ground Initiated Comms.-B (GICB) capability report (indication of change),
   — Mode S subnetwork version number;

(f) common usage GICB capability report;

(g) aircraft identification;

(h) special position indication (SPI);

(i) emergency status (general emergency, no communications, unlawful interference)
   including the use of specific Mode A codes to indicate different emergency states;

(j) ACAS active resolution advisories when the aircraft is equipped with Traffic alert and
    collision avoidance system II (TCAS II).

4. Other data items may be made available to the transponder.

5. The data items referred to in point 4 shall only be transmitted by the transponder via the Mode S
   protocol if the aircraft and equipment certification process covers the transmission of these data
   items via the Mode S protocol.

6. The continuity of transponder functionality supporting the Mode S protocol shall be equal to or less
   than 2.10^-4 per flight hour (i.e. mean time between failure equal to or greater than 5 000 flight hours).

Part 2: Secondary surveillance radar transponder capabilities referred to the Mandate document

1. The minimum capability for the secondary surveillance transponder shall be Mode S Level 2
   certified in accordance with paragraphs 2.1.5.1.2, 2.1.5.1.6, 2.1.5.1.7 and 3.1.2.10 of Annex 10 to the
   Chicago Convention, Volume IV, Fourth Edition including all amendments up to No 85.

2. Each implemented transponder register shall be compliant with the corresponding section of ICAO

3. The following data items shall be made available to the transponder and be transmitted by the
   transponder via Version 2 of the extended squitter (ES) ADS-B protocol in accordance with the
   formats specified in ICAO document 9871 (2nd edition):
      (a) 24-bit ICAO aircraft address;
      (b) aircraft identification;
      (c) Mode A code;
      (d) special position indication (SPI) using the same source as for the same parameter specified
          in Part A;
      (e) emergency status (general emergency, no communications, unlawful interference) using
          the same source as for the same parameter specified in Part A;
      (f) ADS-B version number (equal to 2);
      (g) ADS-B emitter category;
(h) geodetic horizontal position in accordance with the world geodetic system revision 1984 (WGS84) latitude and longitude, both while airborne or on the ground;

(i) geodetic horizontal position quality indicators (corresponding to the integrity containment bound (NIC), 95 % navigation accuracy category for position (NAC p ), source integrity level (SIL) and system design assurance level (SDA));

(j) pressure altitude using the same source as for the same parameter specified in Part A;

(k) geometric altitude in accordance with the world geodetic system revision 1984 (WGS84), provided in addition and encoded as a difference to pressure altitude;

(l) geometric vertical accuracy (GVA);

(m) velocity over ground, both while airborne (east/west and north/south airborne velocity over ground) or on the ground (surface heading/ground track and movement);

(n) velocity quality indicator corresponding to navigation accuracy category for velocity (NAC v );

(o) coded aircraft length and width;

(p) global navigation satellite system (GNSS) antenna offset;

(q) vertical rate: barometric vertical rate using the same source as for the same parameter specified in the data item in point 2 (g) of Part C when the aircraft is required and capable to transmit this data item via the Mode S protocol, or Global Navigation Satellite System (GNSS) vertical rate;

(r) mode control panel/flight control unit (MCP/FCU) selected altitude using the same source as for the same parameter specified in Part C when the aircraft is required and capable to transmit this data item via the Mode S protocol;

(s) barometric pressure setting (minus 800 hectoPascals) using the same source as for the same parameter specified in Part C when the aircraft is required and capable to transmit this data item via the Mode S protocol;

(t) ACAS active resolution advisories when the aircraft is equipped with TCAS II using the same source as for the same parameter specified in Part A.

4. Surveillance data items (the data items in point 3(h), (k) and (m)) and their quality indicator data items (the data items in point 3(i), (l) and (n)) shall be provided to the transponders on the same physical interface.

5. The data source connected to the transponder and providing the data items in point 3(h) and (i) shall meet the following data integrity requirements:

   (a) horizontal position (data item in point 3(h)) source integrity level (SIL, expressed with respect to NIC) shall be equal to or less than 10^-7 per flight-hour;

   (b) horizontal position (data item in point 3(h)) integrity time to alert (leading to a change of the NIC quality indicator), if on-board monitoring is required to meet the horizontal position source integrity level, shall be equal to or less than 10 seconds.

6. The primary data source providing the data items in point 3(h) and (i) shall be at least compatible with GNSS receivers that perform receiver autonomous integrity monitoring (RAIM) and fault detection and exclusion (FDE), along with the output of corresponding measurement status information, as well as integrity containment bound and 95 % accuracy bound indications.

7. The system integrity level of the data sources providing the data items in point 3(f), (g), (k) to (p) shall be equal to or less than 10^-5 per flight-hour.
8. The quality indicator information (NIC, NACp, SIL, SDA, NACv and GVA) (the data items in point 3(i), (l) and (n)) shall express the actual performance of the selected data source as valid at the time of applicability of the measurement of the data items in point 3(h), (k) and (m)).

9. With respect to the processing of the data items in point 3(a) to (t), the transponder system integrity level for the extended squitter ADS-B protocol, including any interconnecting avionics to the transponder, shall be equal to or less than 10^-5 per flight-hour.

10. The total latency of the horizontal position data (the data items in point 3(h) and (i)) shall be equal to or less than 1.5 second in 95% of all transmissions.

11. The uncompensated latency of the horizontal position data (data item in point 3(h)) shall be equal to or less than 0.6 second in 95% of the cases and shall be equal to or less than 1.0 second in 99.9% of all transmissions.

12. The total latency of the ground speed data items (the data items in point 3(m) and (n)) shall be equal to or less than 1.5 second in 95% of all transmissions.

13. If the transponder is set to use a Mode A conspicuity code of 1000 then the broadcast of Mode A code information via the extended squitter ADS-B protocol shall be inhibited.

14. Other data items may be made available to the transponder.

15. Except for military reserved formats, the data items referred to in point 14 shall only be transmitted by the transponder via the extended squitter ADS-B protocol if the aircraft and equipment certification process covers the transmission of these data items via the extended squitter ADS-B protocol.

16. The continuity of transponder functionality supporting the ADS-B protocol shall be equal to or less than 2.10^-4 per flight hour (i.e. mean time between failure equal to or greater than 5 000 flight hours).

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Part 3: Secondary surveillance radar transponder additional surveillance data capability referred to the Mandate Document

1. Each transponder register that is implemented shall be compliant with the corresponding section of ICAO document 9871 (2nd edition).

2. The following data items shall be made available to the transponder and be transmitted by the transponder as requested by the ground-based surveillance chain, via the Mode S protocol and in accordance with the formats specified in ICAO document 9871 (2nd edition):

   (a) MCP/FCU selected altitude;
   (b) roll angle;
   (c) true track angle;
   (d) ground speed;
   (e) magnetic heading;
   (f) indicated airspeed (IAS) or mach number;
   (g) vertical rate (barometric or baro-inertial);
   (h) barometric pressure setting (minus 800 hectoPascals);
   (i) track angle rate or true airspeed if track angle rate is not available.

3. Other data items may be made available to the transponder.
4. The data items referred to in point 3 shall only be transmitted by the transponder via the Mode S protocol if the aircraft and equipment certification process covers the transmission of these data items via the Mode S protocol.

GM3 to 4.2.1(c): If, after 08 January 2015, such aircraft/helicopter is ADS-B OUT capable prior to 07 December 2017, then 4.2.1(c)(iii) becomes applicable from 08 January 2015.

AMC1 to 4.2.1(c): the ADS-B capability should be demonstrated against Certification Specifications - Airborne Communications, Navigation and Surveillance (CS-ACNS) contained in Annex I to ED Annex I to ED Decision 2013/031 or equivalent accepted by the GCAA.

4.2.2 Aircraft Equipment Exemption
Applicable Air Navigation Service Providers may authorise operations without GNSS, SSR Transponder, or ADS-B out or with equipment unserviceable in accordance with procedure acceptable to the GCAA.

GM1 to 4.2.2: No dispatch with unserviceable equipment shall be approved unless authorised by the State Of Registry.

3. PART III – CHAPTER 6

8.4. No aircraft shall be operated in IFR or controlled areas (as applicable) unless equipped in accordance with PART III – Chapter 4.2.1.

GM1 to 8.4: the exemption provision of Part III Section 4.2.2 applies.

4. PART IV – SPECIAL PURPOSE OPERATIONS – SECTION A

2.5 AIRCRAFT
For use in IFR en route operations and instrument approaches, it must be equipped and maintained for IFR operations, in particular equipped in accordance with PART III – Chapter 4.2.1. However, for instruction in the control and precision maneuvering of an aircraft by reference to instruments, the aircraft may be equipped as provided in the approved course of training.