

**SURVEILLANCE AND CONFLICT RESOLUTION SYSTEMS PANEL (SCRSP)
SURVEILLANCE SYSTEMS**

WORKING GROUP-B – Montreal 26th to 30th April 2004

Proposed Annex 10 Volume IV SARPs Changes

Presented by the TSG

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SUMMARY

This paper is all the Annex 10 Volume IV SARPs changes that have been proposed and approved by WG B since SICASP 7.

Reference: WPs: B3-6, B5-10, B5-12, B5-14, B6-03A, B6-04, B6-08A,
B6-23, B6-45.

1. (S2) Insert a new Chapter 2.3 as follows:

2.3 Features for in-flight operations of transponders

2.3.1 Recommendation---Features should be provided to minimise the possibility of disabling the transponder system on an air transport aircraft during an unlawful interference event.

Note: For guidance material see ICAO Doc 9684 section 2.3

2 (S3) Add new paragraph 3.1.1.7.8.1 after paragraph 3.1.1.7.8 as follows:

3.1.1.7.8 *Random triggering rate.* In the absence of valid interrogation signals, Mode A/C transponders shall not generate more than 30 unwanted Mode A or Mode C replies per second as integrated over an interval equivalent to at least 300 random triggers, or 30 seconds, whichever is less. This random triggering rate shall not be exceeded when all possible interfering equipments installed in the same aircraft are operating at maximum interference levels.

3.1.1.7.8.1 *Random triggering rate in the presence of low level in band CW interference.* The total random trigger rate on all Mode A and/or Mode C replies shall not be greater than 10 reply pulse groups or suppressions per second, averaged over a period of 30 seconds, when operated in the presence of non-coherent CW interference at a frequency of 1030 +/- 0.2 MHz. and a signal levels of -60 dBm or less.

3. (S8) Change paragraph 3.1.2.4.1.2.3 as follows:

3.1.2.4.1.2.3 *Mode S interrogation acceptance.*

A Mode S interrogation shall only be accepted if:

- a) the transponder is capable of processing the uplink format (UF) of the interrogation (3.1.2.3.2.1.1);
- b) the address of the interrogation matches one of the addresses as defined in 3.1.2.4.1.2.3.1 implying that parity is established, as defined in 3.1.2.3.3; and

- c) **in the case of an all-call interrogation**, no all-call lockout condition applies, as defined in 3.1.2.6.9; **and**
- d) the transponder is capable of processing the uplinked data **of a long air-air surveillance (ACAS) interrogation (UF-16)** and presenting it at an output interface as prescribed in 3.1.2.10.5.2.2.1.

A Mode S interrogation may be accepted if:

The conditions specified in 3.1.2.4.3 a) and b) are met and the transponder is **not** capable of processing the uplinked data **of a Comm A interrogation (UF=20 and 21)** and presenting it at an output interface as prescribed in 3.1.2.10.5.2.2.1.

4. (S1) Change paragraph 3.1.2.5.3 as follows:

“3.1.2.5.3 *Lockout protocol*. The all-call lockout protocol defined in 3.1.2.6.9 shall be used by the interrogator with respect to an aircraft once the address of that specific aircraft has been acquired by an interrogator **provided that:**

- the interrogator is using an IC code different from zero and;
- the aircraft is located in an area where the interrogator is authorised to use lockout.

Note.1— Following acquisition, a transponder is interrogated by discretely addressed interrogations as prescribed in 3.1.2.6, 3.1.2.7 and 3.1.2.8 and the all-call lockout protocol is used to inhibit replies to further all-call interrogations.

Note 2 Regional IC allocation bodies may define rules limiting the use of selective interrogation and lockout protocol (e.g. No lockout in defined limited area, use of intermittent lockout in defined areas, no lockout of aircraft not yet equipped with SI code capability,...)”

5. (S7) Change paragraph 3.1.2.6.10.1.2 as follows:

3.1.2.6.10.1.2 *Ground report*. The on-the-ground status of the aircraft shall be reported in the FS field and the VS field (3.1.2.8.2.1) and the CA field (3.1.2.5.2.2.1~~3.1.2.8.1.1~~). If a means for automatically indicating the on-the-ground condition (e.g. a weight on wheels or strut switch) is available at the transponder data interface, it shall be used as the basis for the reporting of ~~vertical~~ **on-the-ground** status **except as specified in 3.1.2.6.10.3.1**. If a means for automatically indicating the on-the-ground condition is not available at the transponder data interface (3.1.2.10.5.1.3), the FS and VS codes shall indicate that the aircraft is airborne and the CA field shall indicate that the aircraft is either airborne or on the ground (CA = 6).

6. (S4) Change paragraph 3.1.2.6.10.2.2 as follows:

3.1.2.6.10.2.2.2 *Updating of the data link capability report.* The transponder shall, at intervals not exceeding four seconds, compare the current data link capability status **bits(41-88)** with that last reported and shall, if a difference is noted, initiate a revised data link capability report by Comm-B broadcast (3.1.2.6.11.4) for BDS1 = 1 (33-36) and BDS 2 = 0 (37-40). The transponder shall initiate, generate and transmit the revised capability report even if the aircraft data link capability is degraded or lost. The transponder shall set the BDS code for the data link capability report.

7. (S7) Change paragraph 3.1.2.6.10.3 as follows:

3.1.2.6.10.3 *Validation of declared on-the-ground ~~status-automatic means for~~ declaring the on-the-ground status.*

Note.— For aircraft with an automatic means of determining vertical status, the CA field reports whether the aircraft is airborne or on the ground. ACAS II acquires aircraft using the short or extended squitter, both of which contain the CA field. If an aircraft reports on-the-ground status, that aircraft will not be interrogated by ACAS II in order to reduce unnecessary interrogation activity. If the aircraft is equipped to report extended squitter messages, the function that formats these messages may have information available to validate that an aircraft reporting “on-the-ground” is actually airborne

3.1.2.6.10.3.1 Aircraft with an automatic means for determining the on-the-ground condition that are equipped to format extended squitter messages shall perform the following validation check:

If the automatically determined air/ground status is not available or is “airborne”, no validation shall be performed. If the automatically determined air/ground status is available and “on-the-ground” condition is being reported, the air/ground status shall be overridden and changed to “airborne” if the conditions given for the vehicle category in Table 3-6 are satisfied.

Note.— While this test is only required for aircraft that are equipped to format extended squitter messages, this feature is desirable for all aircraft.

Table 3-6. Validation of the on-the-ground status

Determination of airborne status					
A/V category	Ground Speed		Airspeed		Radio Altitude
No information	No change to on-the-ground status				
Weight < 15 500 lbs (7 031 kg)	No change to on-the-ground status				
Weight ≥15 500 lbs (7 031 kg)	>100 knots	or	>100 knots	or	>50 feet
High performance (>5 g acceleration and >400 knots)	>100 knots	or	>100 knots	or	>50 feet
Rotorcraft	No change to on-the-ground status				

8. (S8) Change paragraph 3.1.2.6.11.1.1 as follows:

3.1.2.6.11.1.1 *Comm-A technical acknowledgement.* Acceptance of a Comm-A interrogation shall be automatically technically acknowledged by the transponder, by the transmission of the requested reply (3.1.2.10.5.2.2.1).

*Note.— The receipt of a reply from the transponder according to the rules of 3.1.2.4.1.2.3 d) and 3.1.2.4.1.3.2.2.2 is the acknowledgement to the interrogator that the message **interrogation** has been received **accepted** and stored by the transponder. If either uplink or downlink fail, this reply will be missing and the interrogator will normally send the message again. In the case of downlink failure the transponder may receive the message more than once.*

9. (S6) Change paragraph 3.1.2.8.6.7 as follows:

3.1.2.8.6.7 *Airborne/surface state determination.* Aircraft with an automatic means of determining on-the ground conditions shall use this input to select whether to report the airborne or surface message types. Aircraft without such means shall report the airborne type messages, **except as specified in the table. Use of this table shall only be applicable to aircraft that are equipped to provide data for radio altitude AND as a minimum, airspeed OR ground speed. Otherwise, aircraft in the specified categories that are only equipped to provide data for airspeed and ground speed shall broadcast the surface format if:**

airspeed < 50 knots AND ground speed < 50 knots

Note 1:- Use of this technique may result in the surface position format being transmitted when the air ground status in the CA fields indicates “airborne or on the ground”.

Aircraft with or without such automatic on-the-ground determination shall use position message types as commanded by control codes in TCS (3.1.2.6.1.4.1f). After time-out of the TCS commands, control of airborne/surface determination shall revert to the means described above.

Note 2:- Extended squitter ground stations determine aircraft airborne or surface status by monitoring aircraft position, altitude and ground speed. Aircraft determined to be on the ground that are not reporting the surface position message type will be commanded to report the surface format via TCS (3.1.2.6.1.4.1 f). The normal return to the airborne position message type is via a ground command to report the airborne message type. To guard against loss of communications after take-off, commands to report the surface position message automatically time out.

10. (S5) Change paragraph 3.1.2.8.7.4.1 as follows:

add a sentence to the end of Note 1 as follows:

3.1.2.8.7.4.1 *Initialization.* At power up initialization, the non-transponder device shall commence operation in a mode in which it does not broadcast any squitters. The non-transponder device shall initiate the broadcast of ES/NT squitters for airborne position, surface position, airborne velocity and aircraft identification when data are available for inclusion in the ME field of these squitter types. This determination shall be made individually for each squitter type. When ES/NT squitters are broadcast, transmission rates shall be as indicated in 3.1.2.8.6.4.2 to 3.1.2.8.6.4.6.

Note 1.— This suppresses the transmission of extended squitters from aircraft that are unable to report position, velocity or identity. If input to the register for squitter types stops for 60 seconds, broadcast for this extended squitter type will cease until data insertion resumes, except for an ES/NT device operating on the surface (as specified in Annex 10, Volume III Part I, Appendix 1 to Chapter 5, paragraph 2.4.4)

Note 2.— After timeout (3.1.2.8.7.6) this squitter type may contain an ME field of all zeros.

11. (S5) Change paragraph 3.1.2.8.7.6 as follows:

Paragraph 3.1.2.8.7.6. – Add a reference to the end of the paragraph as follows:

3.1.2.8.7.6 *Register timeout.* The non-transponder device shall clear all 56-bits of the airborne position, surface position and velocity registers used for these messages if these registers are not updated within two seconds of the previous update. This timeout shall be determined separately for each of these registers. Termination of extended squitter shall be as specified in Annex 10, Volume III, Part I, Appendix 1 to Chapter 5, paragraphs 2.4.3 and 2.4.4.

Note.— These registers are cleared to prevent the reporting of outdated position and velocity information

12. (S7) Change paragraph 3.1.2.8.7.7 as follows:

3.1.2.8.7.7 *Airborne/surface state determination.* Aircraft with an automatic means of determining on-the-ground condition shall use this input to select whether to report the airborne or surface message types except as specified in 3.1.2.6.10.3.1. Aircraft without such means shall report the airborne type messages, except as specified in 3.1.2.8.6.7

13. (S3) Change paragraph 3.1.2.10.1.1 as follows:

3.1.2.10.1.1 *Reply ratio in the presence of interference*

Note.— The following paragraphs present measures of the performance of the Mode S transponder in the presence of interfering Mode A/C interrogation pulses and low level in band CW interference.

3.1.2.10.1.1.1 *Reply ratio in the presence of an interfering pulse.* Given a Mode S interrogation which requires a reply (3.1.2.4), the reply ratio of a transponder shall be at least 95 per cent in the presence of an interfering Mode A/C interrogation pulse if the level of the interfering pulse is 6 dB or more below the signal level for Mode S input signal levels between –68 dBm and –21 dBm and the interfering pulse overlaps the P_6 pulse of the Mode S interrogation anywhere after the sync phase reversal.

Under the same conditions, the reply ratio shall be at least 50 per cent if the interference pulse level is 3 dB or more below the signal level.

3.1.2.10.1.1.2 *Reply ratio in the presence of pulse pair interference.* Given an interrogation which requires a reply (3.1.2.4), the reply ratio of a transponder shall be at least 90 per cent in the presence of an interfering $P_1 - P_2$ pulse pair if the level of the interfering pulse pair is 9 dB or more below signal level for input signal levels between – 68 dBm and –21 dBm and the P_1 pulse of the interfering pair occurs no earlier than the P_1 pulse of the Mode S signal.

3.1.2.10.1.1.3 *Reply ratio in the presence of low level asynchronous interference.* For all received signals between – 65 dBm and –21 dBm and given a Mode S interrogation that requires a reply according to 3.1.2.4 and if no lockout condition is in effect, the transponder shall reply correctly with at least 95 per cent reply ratio in the presence of asynchronous interference. Asynchronous interference shall be taken to be a single Mode A/C interrogation pulse occurring at all repetition rates up to 10 000 Hz at a level 12 dB or more below the level of the Mode S signal.

Note.— Such pulses may combine with the P_1 and P_2 pulses of the Mode S interrogation to form a valid Mode A/C-only all-call interrogation. The Mode S transponder does not respond to Mode A/C-only all-call interrogations. A preceding pulse may also combine with the P_2 of the Mode S interrogation to form a valid Mode A or Mode C interrogation. However, the $P_1 - P_2$ pair of the Mode S preamble takes precedence (3.1.2.4.1.1.1). The Mode S decoding process is independent of the Mode A/Mode C decoding process and the Mode S interrogation is accepted.

3.1.2.10.1.1.4 *Reply ratio in the presence of low level in band CW interference.* In the presence of non-coherent CW interference at a frequency of 1030 +/- 0.2 MHz. at signal levels of 20 dB or more below the desired Mode A/C or Mode S interrogation signal level, the transponder shall reply correctly to at least 90 percent of the interrogations.

3.1.2.10.1.1.5 *Spurious response*

14. (S3) Change paragraph 3.1.2.10.3.5 as follows:

3.1.2.10.3.5 *Unwanted Mode S replies.* Mode S transponders shall not generate unwanted Mode S replies more often than once in 10 seconds. Installation in the aircraft shall be made in such a manner that this standard shall be achieved when all possible interfering equipments installed in the same aircraft are operating at maximum interference levels.

3.1.2.10.3.5.1 *Unwanted Mode S replies in the presence of low level in band CW interference.* In the presence of non-coherent CW interference at a frequency of 1030 +/- 0.2 MHz. and at signal levels of -60 dBm or less, and in the absence of valid interrogation signals, Mode S transponders shall not generate unwanted Mode S replies more often than once per 10 seconds.

Surface format broadcast without an automatic means of surface determination

ADS-B Emitter Category Set "A"						
Coding	Meaning	Ground Speed		Airspeed		Radio Altitude
0	No ADS-B Emitter Category Information	Always report Airborne Position Message (3.1.2.8.6.3.1)				
1	Light(<15,500 lbs or 7031 kg)	Always report Airborne Position Message (3.1.2.8.6.3.1)				
2	Small (15 500 to 75 000 lbs or 7031 to 34 019 kg)	< 100 knots	and	< 100 knots	and	< 50 feet
3	Large (75 000 lbs to 300 000 lbs or 34 019 to 136 078 kg)	< 100 knots	and	< 100 knots	and	< 50 feet
4	High-Vortex Aircraft	< 100 knots	and	< 100 knots	and	< 50 feet
5	Heavy (> 300,000 lbs or 136078 kg)	< 100 knots	and	< 100 knots	and	< 50 feet
6	High Performance (> 5g acceleration and >400 knots)	< 100 knots	and	< 100 knots	and	< 50 feet
7	Rotorcraft	Always report Airborne Position Message (3.1.2.8.6.3.1)				
ADS-B Emitter Category Set "B"						
Coding	Meaning	Ground Speed		Airspeed		Radio Altitude
0	No ADS-B Emitter Category Information	Always report Airborne Position Message (3.1.2.8.6.3.1)				
1	Glider / Sailplane	Always report Airborne Position Message (3.1.2.8.6.3.1)				
2	Lighter - than- Air	Always report Airborne Position Message (3.1.2.8.6.3.1)				
3	Parachutist / Skydiver	Always report Airborne Position Message (3.1.2.8.6.3.1)				
4	Ultralight / hang-glider / paraglider	Always report Airborne Position Message (3.1.2.8.6.3.1)				
5	Reserved	Reserved				
6	Unmanned Aerial Vehicle	Always report Airborne Position Message (3.1.2.8.6.3.1)				
7	Space / Trans - Atmospheric vehicle	< 100 knots	and	< 100 knots	and	< 50 feet
ADS-B Emitter Category Set "C"						
Coding	Meaning					
0	No ADS-B Emitter Category Information	Always report Airborne Position Message (3.1.2.8.6.3.1)				
1	Surface Vehicle - Emergency Vehicle	Always report Surface Position Message (3.1.2.8.6.3.2)				
2	Surface Vehicle - Service Vehicle	Always report Surface Position Message (3.1.2.8.6.3.2)				
3	Fixed Ground or Tethered Obstruction	Always report Airborne Position Message (3.1.2.8.6.3.1)				
4 - 7	Reserved	Reserved				
ADS-B Emitter Category Set "D"						
Coding	Meaning					
0	No ADS-B Emitter Category Information	Always report Airborne Position Message (3.1.2.8.6.3.1)				
1 - 7	Reserved	Reserved				

END