Deviations request # for an ETSO approval for CS-ETSO applicable to Turn and Slip Instruments (ETSO-3d), and Direction Instrument, Magnetic (Gyroscopically Stabilized) (ETSO-C6e)
Consultation Paper

1. Introductory note

The hereby presented deviation requests shall be subject to public consultation, in accordance with EASA Management Board Decision No 7-2004 as amended by EASA Management Board Decision No 12-2007[1] products certification procedure dated 11th September 2007, 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."

2. ETSO-C3d#3 Turn and Slip Instruments

Deviate from SAE AS8004 §4.1 and exceed maximum Turn Indicator "starting" time of 3 minutes when aircraft is static on-ground.

Requirement:

SAE AS8004 §4.1 Turn Indicator Starting:

Instrument performance must be achieved within three (3) minutes after normal rated power is applied for both air and electric operated instruments. By application of 50% of rated suction of air operated indicators and 80% of rated voltage for electrically operated indicators, the gyro must start, continue to rotate, and provide an adequate indication of turning motions. However, under the reduced power conditions, the turn indicator sensitivity and damping requirements do not apply. If the instrument incorporates a gyro speed monitoring device which provides a positive indication when the gyro speed is below that necessary to meet instrument performance, the starting time may exceed three minutes.

Industry:

The Inertial Reference System (IRS) integrates both Turn and Direction Instrument (ETSO C3d, C5e, and C6e respectively) into one instrument and also shares the same start-up characteristics.

AS 8004 paragraph 4.1 specifies that the "instrument performance" must be achieved within 3 minutes after normal rated power is applied. For power-up starting performance SAE AS8021 and AS8013A paragraph 4.1 (called respectively by ETSOs C5e and C6e)

[1] Cf. EASA Web: http://easa.europa.eu/management-board/docs/management-board-meetings/2007/04/MB%20Decision%2012-2007%20amending%20the%20certification%20procedure.pdf

allows for starting time to be greater than 3 minutes provided that the “gyro speed” is monitored but it shall not be greater than 5 minutes.

The IRS has been developed using ARINC 738 (Air Data and Inertial Reference System) as guidance. As a consequence, as well as primary inertial reference parameters, the IRS also provides navigation parameters such as position and velocities which require longer start-up duration.

The availability of those parameters might be different depending on the power on in flight or on ground and the output channels validity, as presented in the following.

When starting the equipment on ground, after 30s after Power-up, the IRS enters in alignment phase and the Turn indicator is generated but stays as ‘invalid’ during the time the IRS stays in alignment phase. During this start-up Time the aircraft cannot be moved.

If aircraft is moved before the end of alignment, the alignment fails with pilot awareness and the equipment has to be power-off and then on, to start a new sequence.

Note : when starting the equipment in flight, the equipment is in another mode and start-up mode, the Turn indicator starting time is compliant to starting time requirement §4.1.

Equivalent level of Safety:

As far as

- the aircraft is static on Ground,
- Turn Indicator information status (concerning data validity and alignment phase progress and readiness) is provided,
- monitoring regarding A/C movement before end of alignment is performed,

and those limitations being well documented in Installation and User manual, deviating from SAE AS8004 §4.1 exceeding maximum Turn Indicator “starting” time of 3 minutes when aircraft is static on-ground provides an equivalent level of safety.

EASA:

EASA accepts the deviation.

3. ETSO-C3d#4 Turn and Slip Instruments

Deviate from SAE Aerospace Standard AS 8004 “Turn and Slip Instruments“, dated September 1975 to use one of the applicable revisions of RTCA DO-160 (as defined in CS_ETSO) instead of RTCA DO-138 for the standard for Environmental Conditions and Test Procedures for Airborne Equipment.

Requirement:

SAE AS8004 §5
Unless otherwise specified herein, the measurement procedures applicable to a determination of the performance of turn and slip instruments under environmental conditions are set forth in Radio Technical Commission for Aeronautics (RTCA) Document No. DO-138, entitled "Environmental Conditions and Test Procedures for Airborne Electronic/Electrical Equipment and Instruments” dated 27 June 1968.

Industry:

Equivalent Level of Safety is provided by use of more recent requirement's document (DO-160) for environmental testing, as applicable in CS_ETSO subpart A.

EASA:

EASA accepts the deviation.

4. ETSO-C6e#1 Direction Instrument, Magnetic (Gyroscopically Stabilized)

Deviate from ETSO-C6e §3.1.1 for SAE AS 8013A §4.1 for maximum "starting" time of 3 minutes when aircraft is static on-ground.

Requirement:

SAE AS8013A §4.1 requires :
Rated instrument performance rotor speed shall be achieved within 3 minutes after normal power is applied for both air and electric operated instruments. If the instrument incorporates a gyro speed monitoring device which provides a positive indication when the gyro speed is below that necessary to meet instrument performance, the starting time may exceed 3 minutes, but shall not be greater than 5 minutes.

Industry:

The IRS integrates both Direction and Turn Instrument (ETSO C5e, C6e and C3d respectively) into one instrument and also shares the same start-up characteristics.

For power-up starting performance SAE AS8013A paragraph 4.1 allows for starting time to be greater than 3 minutes provided that the "gyro speed" is monitored but it shall not be greater than 5 minutes.

The IRS has been developed using ARINC 738 (Air Data and Inertial Reference System) as guidance. As well as primary inertial reference parameters, the IRS also provides navigation parameters as position and velocities. These require longer start-up duration.

The availability of those parameters might be different depending on power on in flight or on ground and on the output channels, as presented in the following.

In addition, IRS doesn't use a magnetic sensitive unit but a mathematical model of magnetic deflection using current date and current position to be added in NAV mode to true heading. In ATT mode, Magnetic heading is initialized by avionics.

When starting the equipment on ground, after 30s after Power-up, the IRS enters in alignment phase and the Magnetic Heading is generated but stays as 'invalid' during the time the IRS stays in alignment phase. During this start-up Time the aircraft cannot be moved.

If aircraft is moved before the end of alignment, the alignment fails with pilot awareness and the equipment has to be power-off and then on, to start a new sequence.

Note : when starting the equipment in flight, the equipment is in a 'degraded' start-up mode, where the Magnetic Heading needs to be initialized by Avionics. Magnetic Heading is available at IRS output after a 30 seconds duration phase of stabilized flight. If aircraft does not respect this phase, Magnetic Heading remains not available until a

complete 30 s stabilized flight duration. The IRS design is compliant to the requirement provided that the initialisation of magnetic heading is performed by avionics within 3 minutes after Start-up.

Equivalent level of Safety:

Provided that

- the aircraft is static on Ground,
- Magnetic Heading information status (concerning data validity and alignment phase progress and readiness) is provided,
- monitoring regarding A/C movement before end of alignment is performed,

and those limitations being well documented in Installation and User manual, deviating from SAE AS 8013A §4.1 exceeding maximum “starting” time of 3 minutes when aircraft is static on-ground provides an equivalent level of safety.

In addition the installation limitation mentioning the equipment needs an external **Magnetic Heading** input for initialization in flight is necessary to provide equivalent level of safety when starting up in flight.

EASA:

EASA accepts the deviation.