



The SA GROUP



# AVIONICS RELATED MANDATES AND GUIDELINES

A number of changes does and will apply to the performance of avionics equipment in order to comply with technical and operational requirements.

This document provides a review of the concepts and technical solutions related to civil aviation and mainly with reference to EASA, FAA, EUROCONTROL & ICAO guidelines.

- ACAS/TCAS-II concept
- Transponder concept (Mode-A/C, ELS, EHS, ADS-B)
- Voice & Data Communication concept
- SBASS-GNSS Navigation concept (PRNAV-RNP)
- Flight Recorder concept (Data & Voice), airborne concept
- Flight Tracking & D-L Recording, ground concept
- RVSM concept
- ELT concept

# COMPLIANCE & APPLICABILITY

## **ACAS/TCAS-II SW 7.1 Traffic Collision Avoidance Systems**

EASA mandate for all aircraft with a Max Take-off Weight above 5,700 kg or 19 PAX to comply with ACAS/TCAS-II requirements, version 7.1 by December, 2015.

## **EGPWS-TAWS**

EASA mandate for all FW aircraft with MTOW above 5700Kg and MOPSC above 9 PAX.

## **ELT (Emergency Locator Transmitter)**

121,5 & 406 Mhz capability generally mandated for all civil aircraft-Helicopters per ICAO recommendation, still local regulations may apply.

## **FLIGHT DATA MONITORING Systems**

Mandate for FW aircraft above 27.000 kg MTOW,

## **FLIGHT RECORDER Systems** (*Voice & Data recording*)

Several FR requirements either implemented or will apply shortly.

### **CVR (Cockpit Voice Recording) Systems**

- All 30 minute systems must be replaced with 120 minute systems by 2019.01.01
- All CVR system must be solid state 2019.01.01 the latest (Helicopter and fixed wing).
- AC manufactured after 2022.01.01 and with MCTOM above 27.000 kg must have CVR with 25 Hrs recording
- AC manufactured after 2022.09.05 and with MCTOM above 27.000 kg shall be equipped with an alternative power source to which the CVR and cockpit mounted microphone are switched automatically in the event that over all power to CVR is interrupted (RIPS).
- CVR system, "non-deployable" must include an ULB with minimum 90 days transmission time by 2018.06.16
- CVR system, "deployable" must include and automatic locator transmitter
- AC manufactured after 2016.01.01 the operational performance requirement for CVR's should be those laid down in EUROCAE ED-112.

### **FDR (Flight Data Recording) Systems**

- FDR system, “non-deployable” must include an ULB with minimum 90 days transmission time by 2018.06.16
- FDR system, “deployable” must include an automatic locator transmitter.
- AC manufactured after 1998.04.01 to 2016.01.01 the operational performance requirement for FDR’s should be those laid down in EUROCAE ED-55.
- AC manufactured after 2016.01.01 to 2023.01.01 the operational performance requirement for FDR’s should be those laid down in EUROCAE ED-112.
- AC manufactured after 2023.01.01 the operational performance requirement for FDR’s should be those laid down in EUROCAE ED-112A.

### **ULB (Under-Water Locator Beacon) Systems** *for Flight Recorder systems*

- Standard ULB transmitting is 10ms pulse once per second at 37.5 kHz  $\pm$  1kHz for 90 days
- All Flight Recorder systems (CVR-FDR) must be fitted with an ULB
- 2019.01.01, AC with an MTOW of more than 27000Kg and MOPSC of more than 19 shall be fitted with an 8,8 +/- 1 Khz ULB.
- 2019.01.01, AC with an MTOW of more than 45500Kg shall be fitted with an 8,8 +/- 1 Khz ULB.  
Unless the operation is less than 180 NM offshore or qualified alternative means apply

### **LDR (Lightweight Data Recording) Systems.**

- AC manufactured after 2022.09.05 with an MCTOM of 2250kg or more or with MOPSC of more than 9 shall be equipped with a flight recorder.

### **DLR, (Data Link Recording) Systems**

- AC with individual CoA on-after 2014.04.08 with capability to operate Data-Link communication and with CVR requirement, shall record all ATS DL communication messages relates to ATS communication to-from an AC including messages applying to controller-pilot communication (CPDLC).

## **FANS-1A**

FANS 1/A North Atlantic Tracks (NAT) – six “highways” – will apply to all flight levels in these tracks in 2020.

FANS-1/A Entire NAT Region - All Flight Levels 2020.01.01

## **FLIGHT TRACKING (FTS) & LOCATING (FLS) Systems**

### **FLIGHT TRACKING**

Flights shall be tracked by operator from Take-Off to Landing except for planned routes, including diversion routes are fully in airspace blocks where,

- ATS surveillance service is normally provided and supported by ATC surveillance systems locating the AC at time intervals with adequate duration and
- The operator has provided to competent air navigation service providers necessary contact information

### **FTS apply to following aircraft**

- AC with MCTOM above 27.000 kg and MOPSC above 19 PAX and First CoA before 2018.12.16 and in addition to Secondary surveillance Transponder.
- All AC above 27.000 kg and MOPSC above 19 PAX and First CoA on-after 2018.12.16
- All AC above 45.500 kg and First CoA on-after 2018.12.16

### **FLIGHT LOCATING (Distress)**

The following aircraft shall be equipped with robust and automatic means to accurately determine location of a severely damaged AC after an accident,

- AC with MCTOM above 27.000 kg and MOPSC above 19PAX and First CoA before 2021.01.01.
- All AC above 45.500 kg and First CoA on-after 2021.0.01.

## **GBAS (Ground based augmentation to increase GNSS accuracy)**

No mandates apply, typically local and/or government applications.

## **RVSM (Reduced Vertical Separation Minima)**

Typically mandated between FL-290 & FL-410.

## **SBAS-GNSS NAVIGATION Systems RNAV (LNAV, VNAV, LPV-APV) & RNP Navigation**

Not a mandate but becoming requirement for more and more airspace operations in more and more territories and airports. Non-compliance expected to imply more and more de-routings and delays.

## **TRANSPONDER Systems** (*Mode-A, C & S, ELS, EHS & ADS-B concepts*)

### **Mode-A/C**

Mandated for IFR. Requirements differ for VFR flights within the individual States, consult appropriate AICs/AIPs.

### **ELS, Mode-S**

Aircraft operating IFR within EASA airspace must be Mode-S ELS compliant.

### **EHS, Mode-S**

Fixed wing aircraft operating IFR within EASA airspace and having a maximum take-off mass greater than 5.700 kg or a maximum cruising true airspeed above 250 kts, must be Mode-S EHS compliant.

### **ADS-B, Mode-S** (*Automatic Dependant Surveillance Broadcast System*)

All aircraft within European airspace and with a Max Take-off Weight above 5.700 kg or Maximum True Air Speed above 250 kts. must be compliant with Mode-S and “ADS-B out” per 2016.06.08 for new AC and by 2020.12.07 for existing AC.

National Transponder (VFR) requirements may still apply.

## **VOICE & DATA COMMUNICATION Systems**

### **VHFCOM 8.33kHz Channel Spacing Voice Systems** (*additional voice channels*).

- Phase-I & II have implemented 8,33Kc in different regions and application already for all IFR operation.
- Phase-III aim for full deployment in all European airspace however National regulation still apply.

### **LINK 2000+ European Data-link systems**

EASA mandate for all aircraft above FL285 to have a compliant system installed by 2021.01.01, based on CPDLC VDL-Mode2.

Aircraft with FANS-1/A equipage before 2014.01.01 is exempted as well as certain (older) aircraft types may be exempted.

### **CPDLC**, *Controller-Pilot-Data-Link-Communication*

Different requirements for different applications.

# CONCEPT DESCRIPTIONS

## **ACARS**

Aircraft Communications Addressing and Reporting System.

ACARS system is currently fulfilling a significant 'niche' role in ATC communications however not seen as a suitable system for the more widespread ATC use of Data-Link which is expected to come in the future.

## **ACAS/TCAS**

Aircraft/Traffic Collision Avoidance System. System designed to reduce the incidence of mid-air collisions between aircraft.

ACAS/TCAS require support and interface to relevant Transponder system.

## **AC TRACKING SYSTEM (ATS)**

A ground based process that maintains and updates, at standardized intervals, a record of the 4 dimensional positions of individual AC in flight and which relies on ATS in order to identify abnormal flight behavior and provide alert.

**ATC**, *Air Traffic Control.*

**ATN**, *Aeronautical Telecommunications Network.*

**BeiDou**, *Chinese developed and managed GPS system.*

## **CPDLC** *Controller Pilot Data Link Communications*

A method by which air traffic controllers can communicate with pilots over a Data-Link system.

CPDLC reduces pilot workload through a decrease in voice-radiotelephony. The availability of a second communications channel will reduce communication errors and aircrew fatigue and will thus contribute to higher safety levels.

# & CLARIFICATIONS

Verbal radio communications have a number of drawbacks in today's busy traffic environment. Pilots have to listen to each controller-initiated communication while approximately only one in twenty communications is addressed to the flight in question. This leads to aircrew fatigue, blocking of frequencies by simultaneous transmissions and stuck microphone buttons are a common occurrence. A reduction of the pilot's communication workload will allow him to concentrate on other tasks and thus contribute to higher safety levels.

The use of CPDLC will reduce the voice channel occupancy by up to 75 percent during realistic operations in busy en-route airspace.

**EASA**, *European Aviation Safety Agency.*

## **EGNOS**

European Geostationary Navigation Overlay Service is a satellite based augmentation system (SBAS) developed by the European Space Agency, the European Commission and EUROCONTROL.

Similar to FAA WAAS concept.

## **ELT** (*Emergency Locator Transmitter*)

Automatically, G-Force, activated system which transmit position and identity on 121,5 & 406 Mhz for search & rescue services.

**FAA**, *Federal Aviation Administration.*

**FANS-1/A**, *Future Air Navigation System.*

The Future Air Navigation System (FANS-1/A) is an avionics concept developed by Boeing and Airbus in order to increase aircraft safety and minimize the level of human errors.

- FANS-1/A provides direct data link communication between the pilot and the air traffic controller via text messaging and position reporting based on SAT-COM technology.
- FANS 1/A provide CPDLC for oceanic/remote regions operations with SAT-COM as the primary means of communication.
- FANS 1/A is utilized on the North Atlantic Tracks (NAT) – a series of six “highways” across the North Atlantic.
- FANS 1/A provides (voluntary) ADS-C (automated position reporting) which is a significant benefit over using HF for voice reports.

**FL-xxx**, *Flight Level.*

**FMS**, *Flight Management System.*

**GPS**, *Global Positioning System.*

**GAGAN**, Indian developed and managed GPS system.

**GLONASS**, Russian developed and managed GPS system.

**GBAS** (*Ground based augmentation to increase GNSS accuracy*)

Ground based GNSS receiver transmit accurate local GNSS position to relevantly equipment AC for lower landing minima.

**IFR/GAT**, *Instrumental Flight Rules.*



### **LINK 2000+** (*European CPDLC*)

Link 2000+ is a Eurocontrol programme which coordinates the European implementation of Controller Pilot Data-Link Communications (CPDLC) in upper airspace.

Link2000+ may be complied with by different technical solutions, some aircraft are well prepared and systems may be modified, others will need a “start from scratch” solution as for example:

Link 2000+ is similar to the FANS/CPDLC system used in North Atlantic Airspace. The difference being, Link 2000+ uses VDL Mode 2 Data-Link and Aeronautical Telecommunications Network (ATN) instead of ACARS.

If ACARS is installed in the aircraft it will depend on the system whether it is upgradeable to fulfil Link2000+ requirements or a new system is required.

**MTOW**, *Max Take-Off Weight*.

**P-RNAV**, see GNSS

### **Transponder Systems**

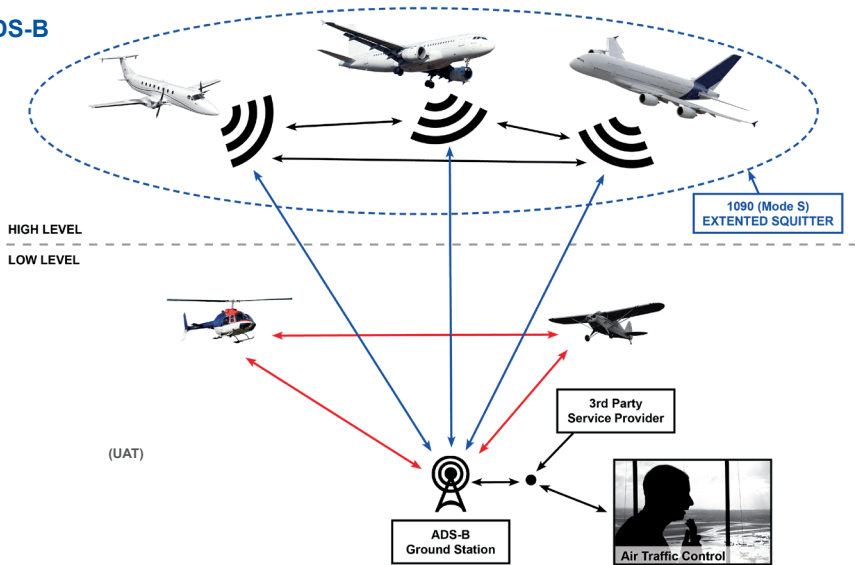
Previously Mode-A & C requirements and now Mode-S requirement.

Mode-S (Select) is referring to an aviation transponder interrogation mode and is designed to help avoiding over-interrogation of the transponder (having many radars in busy areas) and to allow automatic collision avoidance.

Mode-S elements,

- ELS, Elementary Surveillance System
- EHS, Enhanced Surveillance System
- ADS-B, Automatic Dependant Surveillance Broadcast System

## ADS-B



ADS-B is a cornerstone of the FAA & EASA's transition to satellite-based surveillance and navigation under the NextGen Air Transportation System plan.

ADS-B "OUT" means that the aircraft's avionics system automatically transmits messages containing position and velocity information to the ATC which makes the aircraft visible, real-time, to the ATC and other appropriately equipped ADS-B OUT aircraft.

ADS-B allows ATC to monitor and separate aircraft efficiently, with more precision because it uses GPS signals and for example also expands surveillance services into remote areas where little or no radar coverage exists.

FAA have two ADS-B concepts, "UAT" for, mainly non-commercial operation below FL-185 and "1090 Mhz Extended Squitter" for operation above FL-185, however UAT is not implemented in Europe at this time and not discussed in this document.

All European ADS-B activity is based on 1090Mhz technology.

ADS-B is further development of the European Mode-S enhanced surveillance (EHS) concept and do require WAAS/EGNOS/GPS/FMS input.

ADS-B European certification requirements may cause certain confusion concerning the DO260( ) basis. Requirements have evolved over time but now DO260B must be complied with in the future.

ADS-B "IN" in consideration in order to apply further capabilities of the system.

### **GNSS NAVIGATION Systems** (PRNAV-LPV (APV) & RNP Navigation)

A mean to supplement and/or replace traditional navigation concepts (ILS, VOR, DME, ADF etc) with Performance based Satellite based capabilities.

### **P-RNAV**

Precision-Area Navigation (P-RNAV) is the European terminal airspace RNAV application and it is the natural progression from Basic RNAV which became mandatory in European airspace in April 1998. P-RNAV offers the ability to use RNAV functionality in all phases of flight except final approach and missed approach.

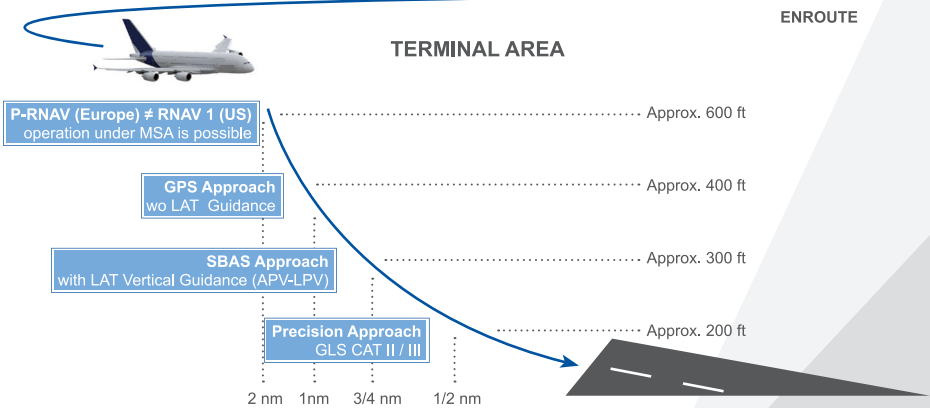
P-RNAV Basic: GPS operation in terminal area to FAF (First Approach. Fix), Technical Cert. via TGL-10.

Additional options:

- 1) LNAV-RNP Approach (GPS) Technical cert via AMC20-27A (Previous Terminology, GPS Approach)
- 2) VNAV-(GPS-BARO), Technical cert via AMC20-27A, Advisory only (Typically NDB minima)
- 2A) VNAV-(SBAS/EGNOS-WAAS), Technical cert via AMC20-27A, Advisory only (Typically NDB minima)
- 3) VNAV-LNAV & LPV (SBAS/EGNOS-WAAS), Technical cert via AMC20-27A and AMC20-28, Advisory only (Typically LOC minima)

PRNAV & RNP approaches may or may not be coupled to FD/AP, coupling involve specific/additional certification.

B-RNAV (Europe) = RNP 5 (Middle East)  
≈ RNP 2 (US) Operation only on (over MSA)



P-RNAV, Precision-Area Navigation is the European terminal airspace RNAV (-1) application and it is the natural progression from B-RNAV (En-route) which became mandatory in European airspace in April 1998. P-RNAV (Terminal area) offers the ability to use RNAV functionality in all phases of flight except final approach and missed approach.

P-RNAV airborne equipment automatically determines aircraft desired flight path by a series of way points held in a database. P-RNAV procedures are designed to a common set of design principles specific to RNAV equipped aircraft. These procedures will replace the current multitude of RNAV procedures many of which are unsuitable for a wide range of aircraft types.

APV-LPV (GNSS Approach Procedure (Localizer performance with Vertical guidance)

Instrument procedure which uses lateral and vertical guidance but does not meet the requirements established for precision approach and landing operations. Still more accurate navigation capabilities than P-RNAV and consequently providing guidance to lower minima.

Two types of APV procedures apply:

### **APV Baro,**

Vertically guided approach that can be flown by modern aircraft with VNAV functionality using barometric inputs.

(Most Boeing and Airbus aircraft already have this capability meaning that a large part of the fleet is already equipped).

### **APV SBAS**

Supported by satellite based augmentation systems such as WAAS in the US and EGNOS in Europe to provide lateral and vertical guidance. The lateral guidance is equivalent to an ILS localizer and the vertical guidance is provided against a geometrical path in space rather than a barometric altitude. APV(LPV)/SBAS are the highest precision GPS (WAAS enabled) aviation instrument approach procedure currently available without specialized aircrew training requirements. Landing minima may be close to those in an instrument landing system (ILS), which is a decision height of 200 feet (61 m) and visibility of 1/2 mile.

A number of initiatives are necessary in order to ensure APV compliance and an aircrafts compliance depend on the GPS/FMS systems as well as the aircraft sensors and instrumentation.

Due to the complexity of the EASA Approach regulations and the variety of on-board system setup does compliance verification involve a detailed study of a.o. equipment, configuration, modification status and operational requirements.

### **VHFCOM 8.33 kHz Channel Spacing**

Despite of more data communication between aircraft and ground will the voice requirement consist for long and capability even needing expansion.

Some existing VHFCOM systems may be upgraded to 8.33Khz channel spacing however is a replacement often the most cost-effective solution.

Eurocontrol has launched a website with all the latest relevant information regarding the 8.33 kHz channel spacing requirements.

Go to <https://833radio.com/> to register.

**WAAS**, *Wide Area Augmentation System*,

An air navigation aid developed by the Federal Aviation Administration (prime contractor Raytheon Company) to augment the Global Positioning System (GPS), with the goal of improving its accuracy, integrity, and availability. Essentially, WAAS is intended to enable aircraft to rely on GPS for all phases of flight, including precision approaches to any airport within its coverage area. Equivalent to European EGNOS concept.

**SATCOM**, *Satellite communication*.

**VDL**, *VHF data link*.



# COMPLETE TURN-KEY AVIONICS SOLUTIONS

With more than 40 years of experience within avionics solutions and expert know-ledge about the coming avionics mandates and requirements, Scandinavian Avionics provides turn-key solutions to prepare your aircraft for future operation in european airspace.

## Design, Engineering & Certification

With in-house EASA Part-21J Design Organization, Scandinavian Avionics offers development or sales of STCs for installation of mandated and required equipment for any aircraft type.

## Production

Scandinavian Avionics holds the EASA Part-21G Production Organization approval. This enables us to deliver complete kits, including custom manufactured electrical and structural parts, with an EASA Form 1. Besides production of installation kits and wire looms for various avionics upgrades, we also produce quite a range of custom designed avionics and aircraft electronics devices for various applications.

## Aircraft Upgrade – Installation

As an EASA- & FAA Part-145 approved Maintenance Organization, Scandinavian Avionics provides installation of all mandated and required equipment in any type of aircraft.

## MRO – Maintenance, Repair & Overhaul

Scandinavian Avionics has an extensive in-house capability and supports both FAA and EASA (Dual Release) Part-145. Furthermore, SA has a substantial capability by means of a number of selected and trusted partnerships which fulfils SA's requirements for quality, customer service and turnaround time.

## Logistics & Parts Support

With more than 100 different avionics partners, such as Garmin, Sandel, Honeywell, Rockwell Collins, Cobham, L3, Telephonics, Universal Avionics Systems Corp. etc., Scandinavian Avionics provides all required equipment to make your aircraft compliant with the upcoming mandates and operational requirements.

## Training

With an EASA Part-147 Training Approval, AEROTEAM Training Solutions - Part of The SA Group, provides technical and operational courses to all market requirements.

## Non-obligation Proposal

Based on information about the aircraft, the current avionics configuration and other relevant information, Scandinavian Avionics offers to provide a non-obligation proposal in order to prepare the aircraft for the coming mandates and operational requirements.

Please feel free to contact us today to discuss your specific requirements.

The SA Group is represented in 9 countries, on 14 locations in Europe, the Middle East, India and Southeast Asia. Scandinavian Avionics A/S serves as HQ of The SA Group. It was established in 1978, and is located in Billund, Denmark.

### Approvals:

EASA Part-145 | EASA Part-21J | EASA Part-21G | EASA Part-147  
FAA Part-145 | TCCA Part-145 | BCAA Part-145 | GAR Part-145 | DOT RIN N083

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