

European Aviation Safety Agency

DECISION n° 2006/12/R
OF THE EXECUTIVE DIRECTOR OF THE EUROPEAN AVIATION SAFETY
AGENCY

of 22 December 2006

**amending the Annex to Decision No 2003/12/RM of the Executive
Director of 5 November 2003 on general acceptable means of
compliance for airworthiness of products, parts and appliances**

(« AMC-20 »)

THE EXECUTIVE DIRECTOR OF THE EUROPEAN AVIATION SAFETY AGENCY

Having regard to Regulation (EC) No 1592/2002 of 15 July 2002 (hereinafter referred to as the "Basic Regulation") on common rules in the field of civil aviation and establishing a European Aviation Safety Agency (hereinafter referred to as the "Agency"), and in particular Articles 13 and 14 thereof,

Having regard to the Commission Regulation (EC) No 1702/2003 of 24 September 2003 laying down implementing rules for the airworthiness and environmental certification of aircraft and related products, parts and appliances, as well as for the certification of design and production organisations,¹ and in particular 21A.16A of Part 21 thereof,

Having regard to the Decision No 2003/12/RM of the Executive Director of the Agency of 5 November 2003 on general acceptable means of compliance for airworthiness of products, parts and appliances (« AMC-20 »)

Whereas:

- (1) The Agency shall issue certification specifications, including airworthiness codes and acceptable means of compliance, as well as guidance material for the application of the Basic Regulation and its implementing rules.
- (2) The Agency, pursuant to Article 43 of the Basic Regulation and articles 5(3) and 6 of the EASA rulemaking procedure², has widely consulted interested parties (see: NPA No 11-2005³) on the matters which are the subject of this Decision and has provided thereafter a written response to the comments received (see: CRD No 11-2005⁴).
- (3) The general acceptable means of compliance for airworthiness of products, parts and appliances as adopted by Decision No 2003/12/RM

¹ OJ L 243, 27.09.2003, p. 6.

² Decision of the Management Board concerning the procedure to be applied by the Agency for the issuing of opinions, certification specifications and guidance material ("rulemaking procedure"), as adopted by EASA MB/7/03, 27.6.2003.

³ NPA 11-2005 is available at http://www.easa.europa.eu/doc/Rulemaking/NPA/NPA_11_2005.pdf

⁴ CRD 11-2005 is available at <http://www.easa.europa.eu/doc/Rulemaking/CRD-11-2005.pdf>

of the Executive Director of the Agency of 5 November 2003 are amended as laid down in the Annex to this Decision.

HAS DECIDED AS FOLLOWS:

Article 1

The Annex "General Acceptable Means of Compliance for Airworthiness of Products, Parts and Appliances (AMC-20)" to Decision No 2003/12/RM of the Executive Director of the Agency is hereby modified in accordance with the Annex to this Decision.

Article 2

This Decision shall enter into force on 29 December 2006.

Done in Cologne, 22 December 2006

P. GOUDOU

The following new AMC are inserted in the table of CONTENTS.

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AMC 20-9 Acceptable Means of Compliance for the Approval of
Departure Clearance via Data Communications over
ACARS.

AMC 20-10 Acceptable Means of Compliance for the Approval of Digital
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AMC 20-12 Recognition of FAA Order 8400.12a for RNP 10 Operations.

AMC 20-13 Certification of Mode S Transponder Systems for Enhanced
Surveillance.

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Insert the following new AMC 20 following AMC 20-8

AMC 20-9 Acceptable Means of Compliance for the Approval of Departure Clearance via Data Communications over ACARS

1 PREAMBLE

1.1 This AMC is issued in response to the EUROCONTROL Convergence and Implementation Plan that recommends an interim deployment of air-to-ground and ground-to-air data link applications based on the existing airline ACARS technology. One such application is Departure Clearance (DCL) data link now operational at various airports in Europe (as indicated in AIPs). Aircraft operators, on a voluntary basis, may take advantage of DCL over ACARS where it is available, subject to any arrangements that may be required by their responsible operations authority.

1.2 The use of ACARS for data link purposes is a transitional step to data link applications that will use VDL Mode 2 and the Aeronautical Telecommunications Network (ATN), compliant with ICAO SARPS, as proposed in the EUROCONTROL LINK2000+ programme¹.

1.3 Described in EUROCAE document ED-85A (hereafter “ED-85A”), Data Link Application System document (DLASD) for the “Departure Clearance” Data Link Service, DCL over ACARS is a control tower application providing direct communication between the flight crew and the air traffic controller. ED-85A addresses three domains: airborne, ground ATC, and communication service providers. It deals also with associated flight crew and controller procedures. ED-85A takes account of EUROCAE document ED-78 which describes the global processes including approval planning, co-ordinated requirements determination, development and qualification of a system element, entry into service, and operations.

2 PURPOSE

2.1 This AMC is intended for operators seeking to use Departure Clearance via data link over ACARS as described in ED-85A. It may assist also other stakeholders such as airspace planners, air traffic service providers, ATS system manufacturers, communication service providers, aircraft and equipment manufacturers, and ATS regulatory authorities to advise them of the airborne requirements and procedures, and the related assumptions.

2.2 This AMC provides a method for evaluating compliance of a data link system to the requirements of ED-85A, and the means by which an aircraft operator can satisfy an authority that operational considerations have been addressed.

3 SCOPE

3.1 This AMC addresses DCL over ACARS using the ARINC 623 protocol as elaborated in EUROCAE document ED-85A and promoted by the EUROCONTROL Convergence and Implementation Plan as an interim data link application pending maturity of the LINK2000+ programme. The AMC is not directly applicable to Pre-Departure

¹ Information on LINK2000+ is available at web site www.eurocontrol.int/link2000

Clearance (PDC) as used in the USA and some other states. For PDC approval, guidance may be found in FAA document *Safety and Interoperability Requirements for Pre-Departure Clearance*, issued by AIR-100 on April 21, 1998. A comparison of PDC with DCL may be found in Appendix 1.

3.2 This AMC is not applicable to the phased implementation of data link services within the EUROCONTROL LINK2000+ programme, in particular, DCL over the Aeronautical Telecommunications Network via VHF Digital Data Link (VDL) Mode 2. In this case, the Safety and Performance Requirements (EUROCAE ED-120) and the Interoperability Requirements (EUROCAE ED-110) are established using EUROCAE document ED-78A, *Guidelines for Approval of the Provision and use of Air Traffic Services supported by Data Communications*. Guidance for the implementation of DCL over ATN may be found in EASA document AMC 20-11.

3.3 The operational requirements for the DCL application are published in the EUROCONTROL document OPR/ET1/ST05/1000, Edition 2, October 15, 1996, *Transition guidelines for initial air ground data communication services*. The EUROCONTROL document includes the re-issued clearance capability, however document ED-85A does not address this capability and it is not included in the scope of this AMC.

3.4 For the remainder of this document, the acronym DCL should be interpreted to mean DCL over ACARS using the ARINC 623 protocol unless stated otherwise.

4 REFERENCE DOCUMENTS

4.1 Related Requirements

CS/FAR 25.1301, 25.1307, 25.1309, 25.1322, 25.1431, 25.1581, or equivalent requirements of CS 23, 27 and 29 if applicable.

4.2 Related Standards and Guidance Material

ICAO	Doc 9694 AN/955	Manual of Air Traffic Services (ATS) Data Link Applications
	Doc 4444	Rules of the Air and Air Traffic Services
	Draft Proposal	PANS-Air Traffic Management
	Annex 11	Air Traffic Services
	Doc 8585	Designators for Aircraft Operating agencies, Aeronautical Authorities and Services.
	Doc 8643	Aircraft Type Designators
EASA	AMC 25-11	Electronic Display Systems
EUROCONTROL	CIP: COM.ET2.SO4; 2.1.5	Implement Air/Ground Communication Services- Interim step on non-ATN (ACARS) services.
	OPR/ET1/ST05/10	Transition guidelines for initial air ground

	00	data communication services
	ESARR 4	Risk assessment and mitigation in ATM
FAA	AC 25-11	Electronic Display Systems.
	AC 120-COM	Initial Air Carrier Operational Approval for use of Digital Communication Systems
	AC 20-140	Guidelines for design approval of aircraft data communications systems
	98-Air-PDC	Safety and Interoperability requirement for Pre-Departure-Clearance (PDC). (Air-100, April 21,1998)
EUROCAE	ED 78	Guidance material for the establishment of data link supported ATS Services
	ED-85A	Data Link Application System document (DLASD) for the “ departure Clearance ” data link service
	ED-112	Minimum operational performance specification for Crash protected airborne recorder systems
RTCA	DO 224	Minimum Aviation System Performance Standards (MASPS) for Advanced VHF Digital Data Communications Including Compatibility with Digital Voice Techniques.
SAE	ARP 4791	Human Machine Interface on the flight deck

5 ASSUMPTIONS

Applicants should note that this AMC is based on the assumptions stated in Chapter 3 of ED-85A together with the following that concern the measures taken by the responsible airspace authorities to safeguard DCL operations.

5.1 ATS Provider

5.1.1 The data link service for DCL has been shown to satisfy applicable airspace safety regulations and the relevant ATS domain performance, safety and interoperability requirements of ED-85A.

5.1.2 Procedures for the use of DCL take account of the performance limitations of ACARS and the airborne implementation capabilities meeting at least the provisions of this AMC.

Note: Some aircraft ACARS installations approved to earlier standards are classified as “Non Essential” without guarantees of performance or integrity. Consequently,

procedures are necessary to compensate for any deficiency and to safeguard operations. ED-85A addresses this issue.

5.1.3 Appropriate procedures are established to minimise the possibility of failure to detect inconsistency in the case of a complex clearance.

5.1.4 Each ATS provider has published a list of communication service providers that may be used by aircraft operators for the DCL application. The list should take account of internetworking arrangements between service providers.

5.1.5 The procedures of the ATS provider state the actions that should be taken in the event of an inadequate communication service from the communications service provider (CSP).

5.2 Communications Service Provider

The communications service provider does not modify the operational information (content and format) exchanged between the ATS provider and the airborne equipment.

5.3 Aeronautical Information Service

Each State offering a DCL service by data link publishes in its AIP, or equivalent notification, availability of the service, relevant procedures, and confirmation of compliance with ED-85A.

5.4 Message Integrity

The Cyclic Redundancy Check (CRC) is implemented as required by ED-85A and is providing integrity of the end-to-end data link transmission path. On this basis, Performance Technical Requirement PTR_3 of ED-85A need not be demonstrated.

6 AIRWORTHINESS CONSIDERATIONS

6.1 General

6.1.1 The installation will need to be shown compliant with the airborne domain requirements allocated as per ED-85A (§7.1) covering the Interoperability Operational Requirements, the Interoperability Technical Requirements, the Performance Technical Requirements, the Safety Operational & Technical Requirements.

6.1.2 If multiple ATS data link applications are available to the aircraft, the crew interface and related crew procedures will need to be based on a common and compatible philosophy.

6.2 Required Functions

An acceptable minimum airborne installation comprises the following functions:

- (a) A means of data communication appropriate to the area of operation, e.g. plain old ACARS over AVLK (Aviation VHF Link Control) through VHF or SATCOM;

Note: VDL Mode 2 equipment can be used provided that radio transceiver is compliant with ED-92A.

- (b) A means to manage data communications and to control the data communications system;
- (c) A means to easily check and modify the parameters of the DCL request;
- (d) “Visual” alerting of an incoming message, visible to both pilots;
- (e) Means to display the text message, e.g. a single display readable by both crewmembers or a dedicated display for each pilot.
- (f) A means to accept the DCL delivered by the ATS.

6.3 Recommended Functions

- (a) “Audible” alerting of an incoming message;
- (b) A means to print the messages;
- (c) Recording of DCL messages and flight crew responses on an accident flight recorder.

Note: Data Link recording may be required in accordance with OPS rules.

7 ACCEPTABLE MEANS OF AIRWORTHINESS COMPLIANCE

7.1 Airworthiness

7.1.1 When demonstrating compliance with this AMC, the following specific points should be noted:

- (a) Compliance with the airworthiness requirements for intended function and safety may be demonstrated by equipment qualification, safety analysis of the interface between the communications management system and data sources, structural analyses of new antenna installations, equipment cooling verification, and evidence of a suitable human to machine interface. The DCL function will need to be demonstrated by end-to-end ground testing that verifies system operation, either with an appropriate ATS unit, or by means of test equipment that has been shown to be representative of the actual ATS unit.

Note: This limited testing assumes that the communication systems (VHF or SATCOM) have been shown to satisfactorily perform their intended functions in the flight environment in accordance with applicable requirements.

- (b) The safety analysis of the interface between the communications management system and its data sources should show that, under normal or fault conditions, no unwanted interaction which adversely affects essential systems can occur.

7.1.2 To minimise the certification effort for follow-on installations credit may be granted for applicable certification and test data obtained from equivalent aircraft installations.

7.2 Performance

The installation should be shown to meet the airborne domain performance requirements allocated by ED-85A (§7.1). Demonstration of Performance Technical Requirement PTR_A1 may be difficult for some airborne installations. The applicant may choose an alternative acceptable means of compliance for PTR_A1 consisting in an end-to-end demonstration of PTR_5 & PTR-6 of ED-85A (§5.2) with an appropriate ATS unit and communication service provider.

7.3 Aircraft Flight Manual

The Flight Manual should state the following limitation.

Note: This limited entry assumes that a detailed description of the installed system and related operating instructions are available in other operating or training manuals and that operating procedures take account of ED-85A.

Limitation: The Departure Clearance (DCL) over ACARS application has been demonstrated with data link services declared compliant with EUROCAE document ED-85A.

7.4 Existing installations

The applicant will need to submit a compliance statement that shows how the criteria of this AMC have been satisfied for existing installations. Compliance may be established by inspection of the installed system to confirm the availability of required features and functionality.

Note: It is not intended that aircraft which have received airworthiness approval in compliance with ED-85 requirement should be reinvestigated where the installation is compliant with Section 6, 7 and 8 of this AMC.

8 OPERATIONAL CONSIDERATIONS

8.1 Flight Plan Information

8.1.1 The Aircraft Identification transmitted by data link will need to conform to the ICAO format and correspond with the flight identity as entered in the applicable flight plan.

8.1.2 Aircraft type designator includes both *Aircraft Type* and *Sub-type* and shall be coded in accordance with the format described in ICAO document 8643 at its latest edition. However, certain ACARS equipment can be pre-programmed only with Aircraft Type with the possibility of manual insertion of *Sub-type* via the system control panel. Absence of the *Sub-type* information may lead either to a rejected departure clearance request at some airports, or the issue of an inappropriate clearance where the aircraft performance capability is not taken into account. Where, to obtain the DCL service, *Sub-type* needs to be entered manually, the entry should be verified.

8.2 Operational Safety Aspects

8.2.1 Failure Conditions are presented in ED-85A (§6) together with the resulting safety requirements and operational means of mitigation. Failure Condition FC3 (undetected erroneous SID) is discussed further in the following paragraphs.

8.2.2 When a SID construct is simple and unambiguous (e.g. only one SID for one runway magnetic orientation (QFU) and one destination) so allowing the flight crew and the ATS controller to independently detect any inconsistency in the DCL, then additional means of mitigation are not required.

8.2.3 For other, more complex cases where the SID construction prevents the flight crew and the controller from readily detecting any inconsistency, a specific flight crew to controller procedure will need to be implemented to verify the clearance. This may be stated in the AIP or other notification issued by the State where aircraft will operate and use DCL service.

Note (1): In some countries (e.g. United Kingdom, AIC 125/1999, France AIC A19/00), following the investigation of level violations, voice confirmation of cleared altitude or flight level and SID identification is already required even for voice delivered departure clearance on the first contact with the approach control/departure radar. In such cases, no additional confirmation procedure is required.

Note (2): The ATS may agree that voice confirmation is not required where the data link function is certificated with an integrity level corresponding to the Essential category of CS25.1309.

8.2.4 In all cases, flight crews will need to comply with any mitigating procedures published by the States where aircraft will operate and use DCL service.

8.2.5 The assumptions of Section 5 need to be satisfied as a condition for operational use.

8.3 Operations Manual and Training

8.3.1 The Operations Manual shall reflect the Flight Manual statement of paragraph 7.3 and define operating procedures for use of the DCL.

8.3.2 Flight crew training should address:

- (a) The different data link services available using the same airborne equipment (e.g. differences between DCL and PDC applications as described in Annex 1);
- (b) ATS procedures for DCL; and
- (c) The required format for the flight identification input.

8.3.3 Subject to any arrangements that may be required by the responsible operations authority in respect of amendments to the Operations Manual, and the approval of training programmes, the aircraft operator may implement operations using DCL over ACARS.

8.4 Incident reporting

Significant incidents associated with a departure clearance transmitted by data link that affects or could affect the safe operation of the aircraft will need to be reported in accordance with applicable operational rules, and to the authority responsible for the airport where the DCL service was provided.

AVAILABILITY OF DOCUMENTS

EUROCAE documents may be purchased from EUROCAE, 17 rue Hamelin, 75783 Paris Cedex 16, France, (Fax: 33 1 45 05 72 30). Web site: www.eurocae.org.

JAA documents are available from the JAA publisher Information Handling Services (IHS). Information on prices, where and how to order is available on both the JAA web site www.jaa.nl and the IHS web site www.avdataworks.com.

EUROCONTROL documents may be requested from EUROCONTROL, Documentation Centre, GS4, Rue de la Fusee, 96, B-1130 Brussels, Belgium; (Fax: 32 2 729 9109 or web site www.eurocontrol.int).

ICAO documents may be purchased from Document Sales Unit, International Civil Aviation Organisation, 999 University Street, Montreal, Quebec, Canada H3C 5H7, (Fax: 1 514 954 6769, e-mail: sales_unit@icao.org) or through national agencies.

FAA documents may be obtained from Department of Transportation, Subsequent Distribution Office SVC-121.23, Ardmore East Business Centre, 3341 Q 75th Avenue, Landover, MD 20785, USA. Web site www.faa.gov/aviation.htm

RTCA documents may be obtained from RTCA Inc, 1828 L Street, NW., Suite 805, Washington, DC 20036, USA., (Tel: 1 202 833 9339; Fax 1 202 833 9434). Web site: www.rtca.org.

SAE documents may be obtained from SAE World Headquarters, 400 Commonwealth Drive, Warrendale, PA 15096-0001, USA. Telephone 1-877-606-7323 (U.S. and Canada only) or 724/776-4970 (elsewhere). Web site www.sae.org.

Appendix 1 PDC versus DCL: A Comparison

The US Pre-Departure Clearance.

In the United States, the concept of Pre-departure Clearance is used where PDC messages are delivered via the airlines own ACARS network and operational host computer. The airline host, or the flight crew, initiates the process for the generation of the PDC by submitting the flight plan information to the air traffic service, which in turn forwards the flight strip information to the appropriate airport control tower. Approximately 30 minutes before the aircraft is scheduled to depart, the approved PDC is transmitted from the tower via ground-ground data link to the airline host computer. The airline host responds with an acknowledgement that ultimately feeds back to the tower PDC workstation. Depending upon the airline capabilities, the PDC may then be transmitted directly to the aircraft flight deck via the ACARS data link. If the aircraft is not equipped with ACARS, the approved PDC is sent to an airport gate printer for delivery by hand in printed format to the aircraft. For a clearance requested from the aircraft, the flight crew will initiate a PDC request via the ACARS data link network to the airline host computer. The host will then respond via the ACARS network with the approved PDC.

Thus, the airline is responsible for ensuring that the clearance is delivered to the flight crew. Without PDC, Instrument Flight Rule (IFR) clearances for departing aircraft are provided by the clearance-delivery controller via a tower voice channel.

The PDC is pre-formatted in an ARINC 620 free text message. The ARINC 623 standard also may be used but it is not required. All failures are classified Minor by the fact that flight crew has to follow a procedure to verify the information with the initial flight plan and, by voice communication, with departure control.

Guidance on the use of PDC may be found in FAA document *Safety and Interoperability Requirements for Pre-Departure Clearance*, issued by AIR-100 on April 21, 1998.

The European Departure Clearance.

In Europe, departure clearance over ACARS is a direct ATC to pilot data link communication based on the EUROCAE ED-85A and ARINC 623 standards. The clearance delivered by data link is fully considered as an ATC departure clearance and it is not the responsibility of the airline to ensure delivery via its own facilities. ARINC 623 provides enhanced integrity of end-to-end communication, compared to ARINC 620 as used in the USA. However, flight crew verification procedures may still be required due to departure clearance options such as alternative SIDs, or to satisfy AIP requirements for local safety reasons.

Current operational implementation in Europe does not include a re-issued clearance capability, which is under study by some ATS providers.

Appendix 2 Common Terms

Reference should be made to EUROCAE document ED-85A for definition of terms.

Abbreviations

ACARS	Aircraft Communication, Addressing and Reporting System
AIP	Aeronautical Information Publication
ARINC	Aeronautical Radio Inc.
ATS	Air Traffic Services
CPDLC	Controller-Pilot Data Link Communication
DCL	Departure Clearance
ESARR	EUROCONTROL Safety Regulatory Requirement
EUROCAE	European Organisation for Civil Aircraft Equipment
PDC	Pre-departure Clearance (as used in USA)
PTR	Performance Technical Requirement
RTCA	RTCA Inc.
SAE	Society of Automotive Engineers
SARPS	ICAO Standards and Recommended Practices
SID	Standard Instrument Departure
VDL	VHF Digital Link

AMC 20-10 Acceptable Means of Compliance for the Approval of Digital ATIS via Data Link over ACARS

1 PREAMBLE

1.1 This AMC is issued in response to the EUROCONTROL Convergence and Implementation Plan that recommends an interim deployment of air-to-ground and ground-to-air data link applications based on the existing airline ACARS technology. One such application is Digital Automated Terminal Information Services (D-ATIS) now planned to be operational at various airports in Europe. Aircraft operators, on a voluntary basis, may take advantage of D-ATIS where it is available, provided the service is verified in accordance with operational procedures acceptable to the responsible operations authority.

1.2 The use of ACARS for data link purposes is a transitional step to data link applications that will use VHF Digital Link (VDL) Mode 2 and the Aeronautical Telecommunications Network (ATN), compliant with ICAO SARPS, as proposed in the EUROCONTROL LINK2000+ programme¹.

1.3 Described in EUROCAE document ED-89A, *Data Link Application System document (DLASD) for the "ATIS" Data Link Service*, D-ATIS is a control tower application providing direct communication of ATIS information to the flight crew and, optionally automatic updating of this information. The ED-89A document addresses three domains: airborne, ground ATC, and communication service providers. It deals also with associated flight crew and air traffic service provider procedures. ED-89A incorporates the protocols and message formats formerly published in ARINC Specification 623, and takes account of EUROCAE document ED-78 which describes the global processes including approval planning, co-ordinated requirements determination, development and qualification of a system element, entry into service, and operations.

2. PURPOSE

2.1 This AMC is intended for operators intending to use Digital ATIS over ACARS as described in document EUROCAE ED-89A. It may assist also other stakeholders such as airspace planners, air traffic service providers (ATSP), ATS system manufacturers, communication service providers (CSP), aircraft and equipment manufacturers, and ATS regulatory authorities to advise them of the airborne requirements and procedures, and the related assumptions.

2.2 This AMC provides a method for evaluating compliance of a data link system to the requirements of ED-89A, and the means by which an aircraft operator can satisfy an authority that operational considerations have been addressed.

3 SCOPE

3.1 This AMC addresses D-ATIS over ACARS using the ARINC 623 protocol as elaborated in EUROCAE document ED-89A and promoted by the EUROCONTROL

¹ Information on LINK2000+ is available at web site www.eurocontrol.int/link2000

Convergence and Implementation Plan as an interim data link application pending maturity of the LINK 2000+ programme.

3.2 Other implementation of D-ATIS service may exist in the world. They are not necessarily identical to the service defined within this AMC and EUROCAE document ED-89A. For example, application message formats may differ. Similarly, the ATSP may send ATIS information to an ACARS communication service provider who then distributes it to subscriber operators. This should not be considered as an air traffic service offered directly by an ATSP. In the USA, guidance on ATIS data link approval for use in the US airspace, may be found in FAA document *98-AIR D-ATIS: Safety and Interoperability Requirements for ATIS*.

3.3 This AMC is not applicable to the phased implementation of data link services within the EUROCONTROL LINK2000+ programme, in particular, D-ATIS over the Aeronautical Telecommunications Network via VHF Digital Link (VDL) Mode 2. In this case, the Safety and Performance Requirements (EUROCAE ED-120) and the Interoperability Requirements (EUROCAE ED-110) have been established using EUROCAE document ED-78A, *Guidelines for Approval of the Provision and use of Air Traffic Services supported by Data Communications*. Guidance for the implementation of data link over ATN may be found in EASA document AMC 20-11.

3.4 The operational requirements for the D-ATIS application are published in EUROCONTROL document OPR/ET1/ST05/1000, *Transition guidelines for initial air ground data communication services*.

3.5 For the remainder of this document, the acronym D-ATIS should be interpreted to mean *D-ATIS over ACARS* using the ARINC 623 protocol in accordance with ED-89A unless stated otherwise.

4 REFERENCE DOCUMENTS

4.1 Related Requirements

CS/FAR 25.1301, 25.1307, 25.1309, 25.1322, 25.1431, 25.1581, or equivalent requirements of CS 23, 27 and 29, if applicable.

4.2 Related Standards and Guidance Material

ICAO	Doc 9694 AN/955	Manual of Air Traffic Services (ATS) Data Link Applications
	Doc 4444	Rules of the Air and Air Traffic Services
	Annex 11	Air Traffic Services
	Doc 8585	Designators for Aircraft Operating agencies, Aeronautical Authorities and Services.
EASA	AMC 25-11	Electronic Display Systems
EUROCONTROL	CIP: COM. ET2.SO4; 2.1.5	Implement Air/Ground Communication Services- Interim step on non-ATN (ACARS) services.
	OPR/ET1/ST05/1000	Transition guidelines for initial air ground data communication services
	ESARR 4	Risk assessment and mitigation in ATM
FAA	AC 25-11	Electronic Display Systems.
	AC 120-70	Initial Air Carrier Operational Approval for use of Digital Communication Systems
	AC 20-140	Guidelines for design approval of aircraft data communications systems
	98-Air-D-ATIS	Safety and Interoperability requirement for D-ATIS (Air-100, April 21,1998)
EUROCAE	ED 78	Guidance material for the establishment of data link supported ATS Services
	ED-89A	Data Link Application System document (DLASD) for the “ATIS” data link service
	ED-92A	Minimum Operational Performance specification for an airborne VDL Mode 2 Transceiver
	ED-112	Minimum operational performance specification for Crash protected airborne recorder systems Note: Includes criteria for recording of data link messages.
RTCA	DO-224	Minimum Aviation System Performance Standards (MASPS) for Advanced VHF Digital Data Communications Including Compatibility with Digital Voice Techniques.
SAE	ARP 4791	Human Machine Interface on the flight deck

5 ASSUMPTIONS

Applicants should note that this AMC is based on the assumptions stated in Chapter 3 of document ED-89A together with the following that concern the measures taken by the responsible airspace authorities to safeguard operations affected by the transmission of D-ATIS.

5.1 ATS Provider

5.1.1 The data link service for ATIS has been shown to satisfy applicable airspace safety regulations and the relevant ATS domain performance, safety and interoperability requirements of ED-89A.

5.1.2 The ATS Provider ensures that information provided through D-ATIS service is fully consistent with the voice information broadcast over VHF.

5.1.3 Appropriate procedures are established to minimise the possibility of failure to detect any inconsistency in ATIS information for approach, landing and take off.

5.1.4 Each ATS provider has published a list of communication service providers that may be used by aircraft operators for the D-ATIS application. The list should take account of internetworking arrangements between service providers.

5.1.5 The procedures of the ATS provider state the actions that should be taken in the event of an inadequate communication service from the communications service provider.

5.2 Communications Service Provider

The communications service provider does not modify the operational information (content and format) exchanged between the ATS provider and the airborne equipment.

5.3 Aeronautical Information Service

The availability of the D-ATIS service, a statement of compliance with ED-89A, and additional relevant procedures are published in the AIP or other notification issued by the States where D-ATIS is offered.

5.4 Message Integrity

The Cyclic Redundancy Check (CRC) is implemented as required by ED-89A and is providing integrity of the end-to-end data link transmission path. On this basis, Performance Technical Objective PTO_3 of ED-89A need not be demonstrated by end systems. The PTO_3 requirement is applicable only to the Communication Service Provider and limits the amount of corrupted messages that would be detected and rejected by end-systems.

Note: The CRC is described in ARINC Specification 622 Chapter 5.

6 AIRWORTHINESS CONSIDERATIONS

6.1 General

6.1.1 The installation will need to meet the airborne domain requirements allocated as per ED-89A (§7.1) covering the Interoperability Operational Requirements, the Interoperability Technical Requirements, the Performance Technical Requirements, and the Safety Operational & Technical Requirements.

6.1.2 If multiple ATS data link applications are available to the aircraft, the crew interface and related crew procedures will need to be based on a common and compatible philosophy.

6.2 Required Functions

An acceptable minimum airborne installation comprises the following functions:

- (a) A means of data communication appropriate to the area of operation, e.g. plain old ACARS over AVLIC (Aviation VHF Link Control) through VHF or SATCOM;
Note: VDL Mode 2 equipment can be used provided that radio transceiver is compliant with ED-92A.
- (b) A means to manage data communications and to control the data communications system.
- (c) A means to easily check and modify the D-ATIS request parameters.
- (d) A means of attracting the attention of the flight crew to an incoming message.
Notes: (1) Activation of a printer may suffice to meet this need.
(2) The means used will need to be such as to avoid confusion with other, non-data link, flight deck alerting devices.
(3) The need for temporary suppression of the attention-getter during critical flight phases should be considered.
- (e) Means to display the text message, e.g. a single display readable by both pilots or a dedicated display for each pilot. For the interim deployment of D-ATIS over ACARS, a printer may serve as the primary display for messages subject to compliance with paragraph 7.3 of this AMC.

6.3 Recommended Functions

- (a) A means to print the message.
- (b) Recording of D-ATIS messages and flight crew requests on an accident flight recorder.

Note: Data Link recording may be required in accordance with OPS rules.

7 ACCEPTABLE MEANS OF AIRWORTHINESS COMPLIANCE

7.1 Airworthiness

7.1.1 When demonstrating compliance with this AMC, the following should be noted:

(a) Compliance with the airworthiness requirements for intended function and safety may be demonstrated by equipment qualification, safety analyses of the interfaces between components of the airborne communications equipment, structural analyses of new antenna installations, equipment cooling verification, and evidence of a suitable human to machine interface. The D-ATIS function will need to be demonstrated by end-to-end ground testing that verifies system operation, either with an appropriate ATS unit, or by means of test equipment that has been shown to be representative of an actual ATS unit.

Note:

This limited testing assumes that the communication systems (VHF or SATCOM) have been shown to satisfactorily perform their intended functions in the flight environment in accordance with applicable requirements.

(b) The safety analysis of the interface between the ACARS and other systems should show that, under normal or fault conditions, no unwanted interaction that adversely affects essential systems can occur.

(c) Where a printer is used as the primary display of the ATIS message, its readability should be shown to be adequate for this purpose, and that it does not present an unacceptable risk of an erroneous display.

Note:

This does not preclude the use of a printer classified as non-essential provided it has demonstrated a satisfactory in-service record that supports compliance with paragraph 7.3 of this AMC.

7.1.2 To minimise the certification effort for follow-on installations, the applicant may claim credit, from the responsible authority, for applicable certification and test data obtained from equivalent aircraft installations.

7.2 Performance

The installation will need to be shown compliant with the airborne domain performance requirements allocated by ED-89A (§7.1). Demonstration of Performance Technical Requirement PTR_A1 may be difficult for some airborne installations. The applicant may choose an alternative acceptable means of compliance for PTR_A1 consisting in an end-to-end demonstration of PTR_5 & PTR_6 of ED-89A (§5.2) with an appropriate ATS unit and communication service provider.

7.3 Safety Objectives

7.3.1 Failure Conditions are presented in ED-89A (§6) together with the resulting safety objectives and operational means of mitigation. Failure Condition FC3 (Non-detected corrupted ATIS presented to an aircrew) requires that the occurrence of such a hazard at the aircraft level be demonstrated improbable.

7.3.2 ED-89A takes into account the possibility of using ACARS approved to earlier standards and classified as “non-essential” without guarantees of performance or integrity. Consequently, additional procedures are necessary to compensate for any deficiency and to safeguard operations. (See §8 of this AMC)

7.4 Aircraft Flight Manual

The Aircraft Flight Manual (AFM) or the Pilot's Operating Handbook (POH), whichever is applicable, should identify the D-ATIS over ACARS application as having been demonstrated with data link services declared compliant with EUROCAE document ED-89A.

If certification was not achieved at the level "essential", the AFM or POH, whichever is applicable, shall remind the crew that they are responsible for checking the D-ATIS information received over ACARS is consistent with their request, or revert to a voice ATIS.

7.5 Existing installations

The applicant will need to submit a compliance statement that shows how the criteria of this AMC have been satisfied for existing installations. Compliance may be established by inspection of the installed system to confirm the availability of required features and functionality.

Note: It is not intended that aircraft which have received airworthiness approval in compliance with ED 89 requirement should be reinvestigated where the installation is compliant with Section 6, 7 and 8 of this AMC.

8 OPERATIONAL CONSIDERATIONS

8.1 Operational Safety Aspects

8.1.1 Failure Conditions are presented in ED-89A (§6) together with the resulting safety requirements and operational means of mitigation. Failure Condition FC3 (Non-detected corrupted ATIS presented to an aircrew) is discussed further in the following paragraphs.

8.1.2 Applying existing ICAO operational procedures can independently verify the majority of ATIS parameters. Certain information may need to be verified by additional operational procedures. Examples include runway surface conditions, air and dew point temperatures, and other essential operational information.

8.1.3 If the aircraft system is classified and certified as "non-essential", additional flight crew verification procedures will need to be defined to compensate for this deficiency.

8.1.4 When the airborne system is certified as "essential", then integrity and performance can be considered as acceptable without a voice ATIS cross check unless otherwise required by the AIP.

8.1.5 It is important that crew are aware that they remain responsible for checking that received ATIS information corresponds to their request in terms of airfield name, date, type of ATIS (D or A) and type of contract. In case of inconsistency, reversion to voice ATIS is required.

Note: ED-89A (§6) SOR-A1 (check of name of airfield), SOR-A2 (ATIS letter acknowledgement at first contact) and SOR-A3 (check of global consistency of information) require checks irrespective of the level of classification of the data link system

8.1.6 Flight crews will need to comply with any additional mitigating procedures published by the States where aircraft will operate and use a D-ATIS service.

8.1.7 The assumptions of Section 5 of this AMC need to be satisfied as a condition for operational use.

8.2 Operations Manual and Training

8.2.1 The Operations Manual shall reflect the Flight Manual statement of paragraph 7.4, and to define operating procedures for the use of D-ATIS via ACARS taking into account the *Operational Considerations* discussed in paragraph 8 of this AMC.

8.2.2 Similarly, flight crew training shall address:

- (a) The different data link services available using the same airborne equipment (e.g. differences between ATIS provided through D-ATIS service that are declared to conform to ED-89A requirements, and ATIS received through other means such as ACARS AOC).
- (b) The procedures for safe use of D-ATIS over ACARS.

8.2.3 Subject to any arrangements that may be required by the responsible operations authority in respect of amendments to the Operations Manual, and the approval of training programmes, the aircraft operator may implement operations using D-ATIS over ACARS without the need for further formal operational approval.

8.3 Incident reporting

Significant incidents associated with a D-ATIS transmitted by data link that affects or could affect the safe operation of the aircraft will need to be reported in accordance with applicable operational rules. The incident should be reported also to the ATS authority responsible for the airport where the D-ATIS service is provided.

AVAILABILITY OF DOCUMENTS

EUROCAE documents may be purchased from EUROCAE, 17 rue Hamelin, 75783 Paris Cedex 16, France, (Fax: 33 1 45 05 72 30). Web site: www.eurocae.org

JAA documents are available from the JAA publisher Information Handling Services (IHS). Information on prices, where and how to order is available on both the JAA web site: www.jaa.nl and the IHS web site: www.avdataworks.com. JAA documents transposed to publications of the European Aviation Safety Agency (EASA) are available on the EASA web site www.easa.eu.int

EUROCONTROL documents may be requested from EUROCONTROL, Documentation Centre, GS4, Rue de la Fusee, 96, B-1130 Brussels, Belgium; (Fax: 32 2 729 9109). Web site: www.eurocontrol.int

ICAO documents may be purchased from Document Sales Unit, International Civil Aviation Organisation, 999 University Street, Montreal, Quebec, Canada H3C 5H7, (Fax: 1 514 954 6769, e-mail: sales_unit@icao.org) or through national agencies.

FAA documents may be obtained from Department of Transportation, Subsequent Distribution Office SVC-121.23, Ardmore East Business Centre, 3341 Q 75th Avenue, Landover, MD 20785, USA.

RTCA documents may be obtained from RTCA Inc, 1828 L Street, NW. Suite 805, Washington, DC 20036, USA., (Tel: 1 202 833 9339; Fax 1 202 833 9434). Web site: www.rtca.org

SAE documents may be obtained from SAE World Headquarters, 400 Commonwealth Drive, Warrendale, PA 15096-0001, USA. Telephone 1-877-606-7323 (U.S. and Canada only) or 724/776-4970 (elsewhere). Web site: www.sae.org

Appendix 1

Common Terms

Reference should be made to EUROCAE document ED-89A for definition of terms.

Abbreviations

ACARS	Aircraft Communication, Addressing and Reporting System
AIP	Aeronautical Information Publication
ATIS	Automatic Terminal Information Service
ATSP	Air Traffic Service Provider
D-ATIS	Digital ATIS
ARINC	Aeronautical Radio Inc.
ATS	Air Traffic services
CPDLC	Controller-Pilot Data Link Communication
ESARR	EUROCONTROL Safety Regulatory Requirement
EUROCAE	European Organisation for Civil Aircraft Equipment
NAS	National Airspace System (USA)
PTR	Performance Technical Requirement
PTO	Performance Technical Objective
RTCA	RTCA Inc.
SAE	Society of Automotive Engineers
SARPS	ICAO Standards and Recommended Practices
VDL	VHF Digital Link

AMC 20-12 Recognition Of FAA Order 8400.12a For RNP-10 Operations.

1. PURPOSE

This AMC calls attention to the FAA Order 8400.12A "Required Navigation Performance 10 (RNP-10) Operational Approval", issued 9th February 1998. FAA Order 8400.12A addresses RNP-10 requirements, the operational approval process, application principles, continuing airworthiness and operational requirements. This AMC explains how the technical content and the operational principles of the Order may be applied as a means, but not the only means, to obtain EASA approval for RNP-10 operations.

2. REFERENCE DOCUMENTS

2.1 Related Requirements

CS/FAR 25.1301, 25.1307, 25.1309, 25.1316, 25.1321, 25.1322, 25.1329, 25.1431, 25.1335 25.1581.

CS/FAR 23.1301, 23.1309, 23.1311, 23.1321, 23.1322, 23.1329, 23.1335, 23.1431, 23.1581.

2.2 Related Guidance Material

2.2.1 ICAO

ICAO Doc 7030/4	Regional Supplementary Procedures
ICAO Doc 9613-AN/937	Manual on Required Navigational Performance

2.2.2 EASA/JAA

EASA AMC 25-11	Electronic Display Systems.
EASA AMC 20-5	Airworthiness Approval and Operational Criteria for the use of the Navstar Global Positioning System (GPS).

JAA Leaflet No 9	Recognition of EUROCAE Document ED-76 (RTCA DO-200A): Standards for Processing Aeronautical Data.
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2.2.3 FAA

Order 8400.12A	Required Navigation Performance 10 (RNP-10) Operational Approval, issued February 1998.
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Order 8110.60	GPS as Primary Means of Navigation for Oceanic/Remote Operations.
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AC 25-4	Inertial Navigation Systems (INS).
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AC 25-11	Electronic Display Systems.
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AC 25-15	Approval of Flight Management Systems in Transport Category Airplanes.
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AC 20-130A	Airworthiness Approval of Navigation or Flight Management Systems Integrating Multiple Navigation Sensors.
AC 20-138	Airworthiness Approval of NAVSTAR Global Positioning System (GPS) for use as a VFR and IFR Supplemental Navigation System.
14 CFR Part 121 Appendix G	Doppler Radar and Inertial Navigation System (INS): Request for Evaluation; Equipment and Equipment Installation; Training Program; Equipment Accuracy and Reliability; Evaluation Program.

2.2.4 Technical Standard Orders

ETSO-2C115() / TSO-C115()	Airborne Area Navigation Equipment Using Multi-sensor Inputs.
ETSO-C129a / TSO-C129()	Airborne Supplemental Navigation Equipment Using the Global Positioning System (GPS)
ETSO-C145/ TSO-C145()	Airborne Navigation Sensors Using the Global Positioning System (GPS) Augmented by the Wide Area Augmentation System (WAAS).
ETSO-C146/ TSO-C146()	Stand-Alone Airborne Navigation Equipment Using the Global Positioning System (GPS) Augmented by the Wide Area Augmentation System (WAAS).

2.2.5 EUROCAE / RTCA and ARINC

ED-75A / DO-236A	Minimum Aviation System Performance Standards: Required Navigation Performance for Area Navigation.
ED-76 / DO-200A	Standards for Processing Aeronautical Data.
ED-77 / DO-201A	Standards for Aeronautical Information.
DO-229B	Minimum Operational Performance Standards for Global Positioning System/Wide Area Augmentation System Airborne equipment.
ARINC 424	Navigation System Data Base.

3. BACKGROUND

3.1 Airspace in various oceanic and remote regions of the world is being restructured progressively to provide capacity and operating benefits for the aircraft traffic. This restructuring involves reduced route spacing (e.g. 50NM in place of 100NM) that, in turn, demands improved aircraft navigational performance. Airspace for this purpose is designated as RNP-10 airspace.

3.2 The RNP-10 implementation is for the oceanic and remote phases of flight where ground based navigation aids do not exist except possibly at isolated locations. Hence aircraft navigation will need to be based on a long range navigation capability of acceptable performance using inertial navigation and/or global positioning systems.

3.3 Aircraft may qualify for RNP-10 airspace operational approval on the basis of compliance with an appropriate RNP build standard. The navigation performance of aircraft already in service also may qualify and this AMC provides a means of determining their eligibility.

3.4 It is not intended that RNP-10 operational approvals already granted by national authorities in compliance with FAA Order 8400.12A should be re-investigated.

4 CERTIFICATION CRITERIA

4.1 Airworthiness Approval

FAA Order 8400.12A discusses required system performance (paragraphs 10 and 15), certification actions (paragraph 16), continued airworthiness considerations (paragraph 14), and provides guidance (paragraph 12) for demonstrating eligibility for RNP-10 approval. Key aspects of the FAA Order are summarised in the following paragraphs of this AMC. These should be applied in conjunction with the technical content of the Order for the purposes of obtaining RNP-10 approval under EASA regulations.

4.2 Required Equipment and Performance

4.2.1 Aircraft operating in RNP-10 airspace shall have a 95% cross-track error of less than 10 NM. This includes positioning error, flight technical error (FTE), path definition error and display error. The aircraft shall have also a 95% along-track positioning error of less than 10 NM.

4.2.2 Loss of all long range navigation information should be Improbable (Remote), and displaying misleading navigational or positional information simultaneously on both pilot's displays should be Improbable (Remote). This requirement can be satisfied by the carriage of at least dual independent, long range navigation systems compliant with the criteria of this AMC and the FAA Order. See also EASA AMC 25-11.

4.3 Eligibility for RNP-10 Operations

In respect of system navigational performance, the Order defines three aircraft groups, which may be eligible for RNP-10 operations:

- Aircraft eligibility through RNP certification (Eligibility Group 1).
- Aircraft eligibility through prior navigation system certification (Eligibility Group 2).
- Aircraft eligibility through Data Collection (Eligibility Group 3).

In all cases, where navigation relies on inertial systems, a usage limit of 6.2 hours is set from the time the inertial system is placed into the navigation mode. The FAA Order explains, in paragraph 12d, the options available to extend the time limits for use of inertial systems.

RNP containment integrity/continuity, as defined in EUROCAE ED-75() (or RTCA DO-236() “MASPS for RNP Area Navigation”), are not required functions for RNP-10 operations.

4.3.1 Aircraft eligibility through RNP certification (Eligibility Group 1).

Group 1 aircraft are those that have obtained formal certification and approval of RNP capable systems integrated in the aircraft.

If RNP compliance is stated in the Aircraft Flight Manual (AFM), the operational approval of Group 1 aircraft will be based upon the performance defined in that statement.

Note: RNP value in AFM is typically not limited to RNP-10. The AFM will state RNP levels that have been demonstrated. An airworthiness approval specifically addressing only RNP-10 performance may be requested and granted.

4.3.2 Aircraft eligibility through prior navigation system certification (Eligibility Group 2).

Group 2 represents aircraft that can equate their level of performance, certified against earlier standards, to the RNP-10 criteria. Group 2 aircraft are sub-divided into three parts:

(a) Aircraft equipped with Inertial Systems

These aircraft are considered to meet all of the RNP-10 requirements for up to 6.2 hours of flight time if the inertial systems have been shown to meet the intent of CFR Part 121, Appendix G¹, or equivalent criteria. This time starts when the system is placed in the navigation mode and no en-route facility for radio updating is available. Operators may seek approval to extend this time limit by demonstrating inertial system accuracy, better than the assumed 2 NM per hour radial error, by means of an additional data collection.

If systems are updated en-route (radio navigation updating), the 6.2 hour limit can be extended taking account of the accuracy of the update. See paragraph 4.5 of this AMC.

(b) Aircraft where GPS provides the only means of long range navigation.

For aircraft in this group where GPS provides the only means of long range navigation (i.e. inertial systems are not carried) when out of range of conventional ground stations (VOR/DME), the aircraft flight manual should indicate that the GPS installation is approved as a primary means of navigation for oceanic and remote operations in accordance with FAA Notice 8110.60². These aircraft are considered to meet the RNP-10 requirements without time limitations. At least dual GPS equipment, compliant with ETSO-C129a/TSO-C129(), are required, together with an approved availability prediction program for fault detection and exclusion (FDE) for use prior to dispatch. For RNP-10 operations, the maximum allowable period of time for which the FDE capability is predicted to be unavailable is 34 minutes.

(c) Multisensor Systems Integrating GPS with Inertial Data.

Multisensor systems integrating GPS with RAIM, FDE or an equivalent integrity method that are approved in accordance with FAA AC 20-130A are considered to meet RNP-10 requirements without time limitations. In this case, the inertial system will need to meet the intent of CFR Part 121, Appendix G, or equivalent criteria.

¹ See Annex 2

² Notice 8110.60 is recognised by AMC 20-5. The material is now incorporated in AC 20-138A as Appendix 1

4.3.3 Aircraft eligibility through Data Collection (Eligibility Group 3).

Group 3 represents older out-of-production aircraft that contain widely varying navigation capability.

A data collection program, acceptable to the Agency, may be used by the applicant to demonstrate that the aircraft and navigation systems provide the flight crew with acceptable navigational situational awareness relative to the intended RNP-10 route. The Order describes the essential aspects of a data collection programme.

The Agency will accept as evidence, inertial system performance data obtained and analysed during previous programmes for RNP-10 approval including data that validates extended flight time.

4.4 Operational Approval and Procedures.

The operational principles given in the FAA Order may be used as the basis for RNP-10 operational approval. To obtain approval, the applicant should address at least the following:

4.4.1 Eligibility for RNP-10.

Evidence should be made available confirming that the aircraft has an approved RNP-10 navigation capability.

4.4.2 Aircraft Equipment and Minimum Equipment List.

The applicant should provide a configuration list of equipment to be used for RNP-10 operations. The MEL(MMEL) should be reviewed to ensure its compatibility with RNP-10 operations. Specific attention should be directed to the need for three inertial navigation units for dispatch if RNP-10 approval is based on a triple-mix solution.

4.4.3 Operational Procedures and Training.

4.4.3.1 Applicant should demonstrate to the responsible authority that the training items related to RNP-10 operations are incorporated into flight crew training. Training for other personnel should be included where appropriate (e.g., dispatchers and maintenance personnel).

4.4.3.2 Operating manuals and checklists should be revised to include information and guidance appropriate to RNP-10 operations. The manuals should include operating instructions for the navigation equipment, and RNP-10 operational procedures (see Appendix 4 of the Order).

4.4.3.3 Operating procedures will need to take account of the RNP-10 time limit declared for the inertial system, if applicable, considering also the effect of weather conditions that could affect flight duration in RNP-10 airspace. Where an extension to the time limit is permitted, the flight crew will need to ensure en-route radio facilities are serviceable before departure, and to apply radio updates in accordance with any Flight Manual limits.

4.4.3.4 Manuals and checklists will need to be submitted to the responsible authority for review as part of the approval process.

4.5 Position Updating

Subject to approval, operators may extend their RNP-10 inertial navigation time by position updating as discussed in paragraph 12e and Appendix 7 of the Order. For position updating approval, aircraft operators will need to calculate, using statistically based typical winds for each planned route, points at which updates can be made, and the points at which further updates will not be possible.

4.5.1 Automatic radio position update.

Automatic radio position updating is acceptable for operations in RNP-10 airspace as discussed in paragraph 12f of the Order.

4.5.2 Manual radio position update.

Subject to an approved procedure, manual radio updating is permitted as discussed in the paragraph 12g and Appendix 7, of the Order.

4.6 Incident reporting.

Significant incidents associated with the operation of the aircraft that affect or could affect the safety of RNP-10 operations (i.e. navigation error) will need to be reported in accordance with applicable operational rules.

5. AVAILABILITY OF DOCUMENTS

JAA documents are available from the JAA publisher Information Handling Services (IHS). Information on prices, where and how to order is available on the JAA website and at www.avdataworks.com.

EUROCAE documents may be purchased from EUROCAE, 17 rue Hamelin, 75783 Paris Cedex 16, France, (Fax : 33 1 45 05 72 30). Web site: www.eurocae.org

FAA documents may be obtained from Department of Transportation, Subsequent Distribution Office SVC-121.23, Ardmore East Business Centre, 3341 Q 75th Avenue, Landover, MD 20785, USA. Web site www.faa.gov/aviation.htm

RTCA documents may be obtained from RTCA Inc, 1828 L Street, NW., Suite 805, Washington, DC 20036, USA., (Tel: 1 202 833 9339; Fax 1 202 833 9434). Web site www.rtca.org

ICAO documents may be purchased from Document Sales Unit, International Civil Aviation Organisation, 999 University Street, Montreal, Quebec, Canada H3C 5H7, (Fax: 1 514 954 6769, e-mail: sales_unit@icao.org) or through national agencies.

ARINC documents may be purchased from ARINC Incorporated; Document Section, 2551 Riva Road, Annapolis, MD 21401-7465, USA, web site www.ARINC.com

AMC 20-13 Certification of Mode S Transponder Systems for Enhanced Surveillance

1 PREAMBLE

Operating regulations require that an operator shall not operate an aircraft unless it is equipped with;

- (1) a pressure altitude reporting SSR transponder; and
- (2) any other SSR transponder capability required for the route being flown.

In accordance with the European Air Traffic Management Plan, the implementation of Enhanced Surveillance requires aircraft to have the capability to down-link aircraft derived data via a Mode S transponder.

2 PURPOSE

2.1 This AMC has been prepared to provide guidance for the installation, certification and maintenance of Mode S SSR transponder systems for Enhanced Surveillance. It provides a method by which equipment installers and aircraft operators can satisfy an authority that the transponder capability required by airspace regulations has been addressed. This AMC is not mandatory and does not constitute a regulation. In lieu of following this method without deviation, an alternative method may followed provided it is found by the responsible authority to be in compliance with applicable airworthiness certification specifications, operational and airspace requirements This document does not change, create, authorise, or permit deviations from, regulatory requirements.

2.2 Where required, the units of measurement used in this document are in accordance with the International System of Units (SI) specified in Annex 5 to the Convention on International Civil Aviation. Non-SI units are shown in parentheses following the base units. Where two sets of units are quoted, it should not be assumed that the pairs of values are equal and interchangeable. It may be inferred, however, that an equivalent level of safety is achieved when either set of units is used exclusively.

3 SCOPE

This AMC addresses only the Mode S transponder for Enhanced Surveillance purposes used in conjunction with interrogating ground stations. It does not deal with Mode S elementary surveillance, or automatic dependent surveillance (ADS-B or ADS-C), or the use of the transponder as a data link component of the Aeronautical Telecommunication Network (ATN), or security aspects relating to unlawful interference with aircraft operation.

4 REFERENCE MATERIAL

4.1 JAA/EASA

- (a) EASA ETSO-2C112b, *Minimum Operational Performance Specification for SSR Mode S Transponders*. (adopts EUROCAE ED-73B,).
- (b) JAA JTSO-C112A, EASA ETSO-2C112a, *Minimum Operational Performance Specification for SSR Mode S Transponders*. (Adopts EUROCAE ED-73A).

- (c) EASA AMC 20-18 Certification of Mode S Transponder Systems for Elementary Surveillance
- (d) JAR-OPS 1: Amendment 6: 1.845 and 1.866 and associated AMCs.
- (e) JAR-OPS 3: Amendment 2: 3.845, 3.860, 3.865, and associated AMCs.
- (f) JAR-OPS 1/3: MEL Policy Document.
- (g) EASA *Certification Specifications* CS-23, CS-25, CS-27, and CS-29, as applicable.

4.2 FAA

- (a) FAR 121.345, Radio equipment.
- (b) TSO-C112, 1986, (Based on RTCA DO-181). This standard of transponder does not provide the full functionality required for the European Region. However, the RTCA document has been updated to DO-181C that defines an acceptable standard. It is expected that the FAA TSO will be updated to reflect this standard.
- (c) FAR 25, 25, 27 and FAR 29 as applicable.

4.3 EUROCONTROL

- (a) Document SUR.ET2.ST02.1000-CNP-01-00, Edition 2, Nov 1996 *The Concept of Operations - Mode S in Europe*.
- (b) Document (Mode S/OHA/001) Edition 1.1, April 2004, *Operational Hazard Assessment of Elementary & Enhanced Surveillance*.
- (c) Document Mode S/SAF/002, Edition 1.1, dated April 2004, *Preliminary System Safety Analysis for the Controller Access Parameter Service delivered by Mode S Enhanced Surveillance*.
- (d) Document SUR/Mode S/ES 3SP MP, Edition 1.0, 30 August 2002, *Mode S Three States Project Master Plan*.
- (e) Document SUR-EHS/02-001, Edition 2.0, July 2003, *Common Framework for the Regulation of Mode S Enhanced Surveillance*.

4.4 ICAO

- (a) Annex 10, Amd. 77, *Aeronautical Communications (Digital Data Communication Systems)*, Volume III, July 2002.
- (b) Annex 10, Amd. 77, *Aeronautical Communications (Surveillance Radar and Collision Avoidance Systems)*, Volume IV, July 2002.
- (c) *Manual of the Secondary Surveillance Radar System*, Doc 9684, Third Edition 2004.
- (d) *EUR Regional Supplementary Procedures*, ICAO Doc 7030/4, as amended.

4.5 EUROCAE

- (a) *Minimum Operational Performance Specification for SSR Mode S Transponders*, ED-73B, January 2003.
- (b) *Minimum Operational Performance Specification for SSR Mode S Transponders*, ED-73A, February 1999.

- (c) *Minimum Operational Performance Specification for Aircraft Data Link Processors*, ED-82A, November 1999.
- (d) *Minimum Operational Performance Specification for Mode S Specific Service Applications*, ED-101, September 2000.
- (e) *Minimum Operational Performance Specification for Light Aviation SSR Transponder*, ED-115, August 2002

4.6 RTCA

- (a) *Minimum Operational Performance Specification for Air Traffic Control Radar Beacon System/ Mode Select (ATCRBS/Mode S) Airborne Equipment*, RTCA DO-181C, June 2001.
- (b) *Minimum Operational Performance Specification for the Mode S Airborne Data Link Processor*, RTCA DO-218B, June 2001

4.7 ARINC

- (a) *Mark 4 Air Traffic Control Transponder (ATCRBS/MODE S)*, ARINC 718A-1, March 2004

5 ASSUMPTIONS

5.1 Applicants should note that this AMC takes account of EUROCONTROL document, Mode S/OHA/001, Operational Hazard Assessment of Elementary and Enhanced Surveillance (reference 4.3.b), and is based on the following assumptions concerning the proposed use of aircraft derived data by the air traffic services:

- (a) The data is intended for display to the air traffic controller (referred to as controller accessed parameters (CAPs)) and that means are implemented, where appropriate, by the air traffic services to verify the validity of received data (e.g. as currently performed by means of the ICAO required controller-pilot verification procedure for the altitude report).
- (b) A safety review is performed to identify the measures needed to confirm an acceptable level of integrity for aircraft derived data, prior to such data being used by the ATC systems (referred to as system accessed parameters (SAPS)) such as safety nets.
- (c) Loss of any parameter is readily detectable by the air traffic controller and/or the ATC system (as applicable).
- (d) The Air Traffic Service Provider supplements the Preliminary System Safety Analysis (reference 4.3(c)) with such additional studies and mitigation as may be necessary to comply with EUROCONTROL Safety and Regulatory Requirements (ESARR) for the introduction of Mode S Enhanced Surveillance.

5.2 On this basis, for the purposes of system certification, Failure Conditions involving lost or erroneous aircraft derived data can be classified as shown in Annex 1, table 2 of this AMC.

5.3 Enhanced Surveillance is not applicable to helicopters. They are only required to install Elementary Surveillance. This does not preclude a helicopter from voluntary installation of Enhanced Surveillance.

6 SYSTEM DESCRIPTION

6.1 The transponder Level is defined by ICAO and identifies the communication protocol capabilities of the transponder.

Level 1 This is the basic transponder permitting surveillance based on Modes A and C as well as Mode S. With a Mode S aircraft address, it has the minimum features for compatible operation with the Mode S system. It has no data communication capability, is not prescribed for international flights, and does not satisfy the European requirement.

Level 2 has the capabilities as Level 1 but permits standard length digital communication from ground to air and air to ground using Comm A and Comm B protocols. It includes automatic aircraft identification reporting.

Level 3 has the capabilities as level 2 but permits extended data communications from the ground to the aircraft using the Comm C protocol. The usefulness of this standard of transponder has been largely overtaken by technological advances.

Level 4 has the capabilities as level 3 but permits extended data communications from the aircraft to the ground using the Comm D protocol.

Level 5 extends these protocols to permit Comm B and extended length and simultaneous data communications with multiple interrogators. This level of transponder has a higher minimum data communication capability than transponders of lower levels.

In addition to the above designations, the letters “e” and “s” are added to indicate that the transponder includes extended squitter functionality and surveillance interrogator (SI) code capability.

Basic functionality with SI code capability is the minimum level permitted for operations in European airspace hence the transponder required is designated ICAO Level 2s. (Amd 77 to ICAO Annex 10, Vol IV, paragraph 2.1.5.1.7).

6.2 The transponder Mark is assigned by ARINC/ EUROCAE and defines required equipment characteristics for the interface between the transponder and other aircraft systems. Equipment characteristics have the objective of standardising those aspects of equipment design which affect interchangeability between different brands.

Mark 3 corresponds to ARINC Characteristic 718.

Mark 4 corresponds to the ARINC Characteristic 718A. This standard of equipment includes extended interface functions which provide for the access of aircraft derived data necessary to fulfil the functions of automatic dependent surveillance -broadcast (ADS-B), extended (112 bit) squitter functions for passive surveillance, the surveillance capabilities specified in the ICAO Manual on Mode S Specific Services, and dedicated communication functions.

Notes:

1. The Mark 4 transponder does not support altitude data in Gillham’s code format and is not backward compatible with the Mark 3 equipment.
2. Compliance with an ARINC Characteristic is not required for certification.

6.3 A detailed technical definition of the aircraft derived data is given in Amd 77 to ICAO Annex 10, Vol III, Part 1, Appendix 1 to Chapter 5, ‘Tables for Section 2’.

7 AIRWORTHINESS CERTIFICATION OBJECTIVES

7.1 For the purposes of certification of an installed transponder system for Enhanced Surveillance, the demonstration of intended function (CS-25.1301) will need to be show that, except as permitted by the Coordinated Exemptions Policy, aircraft derived data can be transmitted to meet the objectives of the Common Framework (reference 4.3(e)).

Note: The Coordinated Exemptions Policy is determined by the responsible airspace authorities and managed by EUROCONTROL in accordance with the Guidance Material of Reference 4.3(e). Further advice may be obtained by contacting the Mode S Exemptions Coordination Cell at www.eurocontrol.int/mode_s or modes.reg@eurocontrol.int.

7.2 The minimum required characteristics of aircraft derived data are shown in Table 1 of Annex 1 to this AMC. Similarly, the criticality classifications of the data that need to be met are shown in Table 2. These classifications take account of the assumptions of Section 5, and correspond with the definitions of EASA Certification Specification CS-25.1309 and associated AMC.

8 FUNCTIONAL CRITERIA

8.1 The Enhanced Surveillance functionality will need to ensure, through Ground Initiated Comm-B (GICB) protocols as defined in ICAO Annex 10 (Amendment 77), Volume III, Part 1, Appendix to Chapter 5, the extraction and transmission of information contained in the following standardised transponder registers (designated by BDS x, y and which may be composed of up to 4 different aircraft data):

BDS Register	Contents of BDS Register
a) BDS 6,0	Heading and Speed report
b) BDS 5,0	Track and Turn report
c) BDS 4,0	Selected vertical intention

8.2 As a minimum, unless a specific exemption has been granted, the data transmitted for Mode S Enhanced Surveillance will need to be:

a) BDS 6,0 (Heading and Speed Report)	Magnetic heading Indicated airspeed Mach no. Vertical rate (Barometric rate of climb/descend or baro-inertial)
b) BDS 5,0 (Track and Turn Report)	Roll angle Track angle rate (or True Airspeed – see Note 2) True track angle Ground speed
c) BDS 4,0 (Selected Vertical Intention)	Selected altitude

Notes:

1. For aircraft that require ACAS II, the Resolution Advisory Report will need to be transmitted also by the transponder (ICAO Annex 10, Volume IV) in BDS 3.0.
2. See Table 1 of Annex 1 for further details relating to the data requirements.

8.3 The transponder capability report, as defined in ICAO Annex 10, Volume IV, 3.1.2.6.10.2 and Volume III, Part 1, Appendix to Chapter 5, 2.5.4, will need to be updated to reflect the Enhanced Surveillance capability as implemented and supported in the aircraft. The affected BDS to be appropriately filled are: BDS 1,0; BDS 1,7; BDS 1,8 to 1,C; and BDS 1,D to 1,F. For implementations not supporting MSP services, the correct servicing of register 1,D to 1,F corresponds to at least transmitting 0 in response to extraction of these registers. In such case the setting of the bits corresponding to BDS 1,D to 1,F in BDS 1,8 may be accepted either as being 1 or 0.

9 ACCEPTABLE MEANS OF AIRWORTHINESS COMPLIANCE

9.1 The criteria for Mode S Elementary Surveillance will need to be satisfied prior to, or concurrently with, the certification tasks for Enhanced Surveillance.

9.2 The Mode S Transponder will need to be approved in accordance with EASA European Technical Standard Order ETSO-2C112b, or an equivalent standard that is consistent with applicable ICAO SARPS and which is acceptable to the responsible certification authority. The transponder manufacturer should state in their Declaration of Design and Performance (DDP) whether or not they are fully compliant with the requirements of ED-73B, ED-82A and ICAO Annex 10 amendment 77.

Note: Transponders approved to JTSO-2C112a or ETSO-2C112a may be acceptable if they are fully compliant with ED-73B, ED-82A and ICAO Annex 10 amendment 77. Compliance should be stated in the transponder DDP.

9.3 For the processing of data parameters, information may be found in EUROCAE Minimum Operational Performance Specification for Aircraft Data Link Processors, ED-82A, November 1999. This specification is applicable to the processing within a Mark 4 transponder, or, to the processing within an Aircraft Data Link Processor or equivalent when this function is performed separately from the transponder.

9.4 When demonstrating compliance with this AMC, the following specific points should be noted:

- (a) The applicant will need to submit, to the responsible authority, a compliance statement that shows how the criteria of this AMC have been satisfied, together with evidence resulting from the activities described in the following paragraphs.
- (b) Compliance with the airworthiness certification specifications for intended function and safety may be demonstrated by equipment qualification, safety analysis of the interface between the transponder and data sources, equipment cooling verification, and ground tests. To support the approval application, design data will need to be submitted showing that the objectives and criteria of Sections 7 and 8 of this AMC have been satisfied.

- (c) The safety analysis of the interface between the transponder and its data sources should show no unwanted interaction under normal or fault conditions.

9.5 On the assumption that the transponder installation has been shown to meet the existing criteria for Modes A, and C, Elementary Surveillance, and ACAS II, then the additional functionality introduced for Enhanced Surveillance may be demonstrated by ground testing, using ramp test equipment where appropriate, that verifies:

- correct system operation;
- that the aircraft derived data in the transmitted response, including the 24-bit aircraft address; and
- correct functioning of system fault detectors.

9.6 To minimise the certification effort for transponder follow-on installations, the applicant may claim from the responsible authority, credit for applicable certification and flight test data obtained from equivalent aircraft installations.

9.7 Dual transponder and Dual sensors side installation

Particular attention should be given to the interface between dual (or more than 2 transponders) and dual or multiple sensors. In this context, ‘sensors’ refers to FMS, IRS, AHRS, ADS, GPS, or Data Concentrator (or other) systems used to provide data to the transponder.

Transponder Selection:

Appropriate means should be provided for the flight crew to select the active transponder at any given time. At all times, the active transponder should be selected such that it operates as either the captain’s side or the co-pilot’s side transponder. This is an important consideration when more than 2 transponders are available to the crew.

Sensor Selection:

In an installation where crew sensor selection capability for the active transponder is provided, the crew should be aware, at all times, which sensors (captain’s or co-pilots side) are providing information to the active transponder. The selected active transponder should use the crew selected sensor relevant to the aircraft flight profile.

Note 1: In a ‘standard’ installation, where crew sensor selection for the active transponder is **not** provided, the captain’s side transponder should utilise the captain’s side sensors and the co-pilot’s side transponder should utilise the co-pilot’s side sensors.

Note 2: It is important to note that data parameters from different sensors, of the same type, should not be mixed. For example, Mode-C or Mode-S altitude reporting information from ADC source #1 should not mixed with reporting of TAS, Baro Vertical Rate, Mach from ADC source #2. In this case partially blocking of data output from either ADC source #1 or #2 will cause uncorrelated results. This could result in problems with ATC ground processing of the data.

9.8 Where only single sensors are available (i.e. single FMS) it is permissible to connect the single sensor to both transponders. It should be noted that this may result in reduced operational availability of the transponder function should the single sensor fail.

9.9 Guidance on the classification (minor or major change) are stated in GM 21A.91. Table 3, Annex 1 of this AMC offers additional guidance for the classification of Elementary and Enhanced Surveillance modifications.

9.10 An aircraft is considered to be '**EHS capable**' if the full list of 8 Downlink Aircraft Parameters, as detailed in Table 1, Annex 1, can be transmitted to the ATC ground system.

Note: Table 1 lists 9 parameters, however Indicated Airspeed and Mach No. may be considered as a single DAP and either parameter may be supplied. If an aircraft can provide both, it should do so.

10 FLIGHT MANUAL

10.1 The Aircraft Flight Manual (AFM) or the Pilot's Operating Handbook (POH), whichever is applicable, should provide at least the following information.

- A statement of compliance that the transponder system(s) comply with the criteria of ICAO Doc 7030/4 Regional Supplementary Procedures for operations where Enhanced Surveillance is required.

10.2 The Limitations Section should identify those parameters that, at the time of certification, the transponder are unable to transmit due to the installation configuration, as permitted by the Coordinated Exemptions Policy.

Note: Annex 2 provides a template for an AFM Supplement.

10.3 In the absence of, or as an alternative to, information in the AFM, appropriate information may be given in the Operations Manual.

11 MINIMUM EQUIPMENT LIST

The MEL will need to be revised to indicate the mandatory carriage of a serviceable system to meet applicable operational requirements for flight in designated airspace. Despatch with partial unserviceability of the system, or non-availability of some required aircraft derived data, may be permitted in accordance with the Coordinated Exemptions Policy (see Section 7).

12 GROUND TESTING

12.1 All the BDS registers containing data as defined in Table 1, Annex 1, should be tested to ensure correct data is received and transmitted by the Mode S transponder.

12.2 The rate parameters are particularly difficult to measure statically. To ensure that the rate parameters are correctly received and transmitted by the transponder it is acceptable to test that the correct BDS register is transmitted (by the transponder) and that the parameter value is valid and set to zero.

Where a parameter is not available, and therefore not provided to the transponder, it is acceptable to test that the correct BDS register is transmitted and that the parameter is declared invalid in the reply to the appropriate interrogation. This will prove that the BDS register is received by the Mode S ground test set and declared invalid.

12.3 Other parameters listed in Table 1 Annex 1, which are derived from an Inertial Reference System, may also be difficult to measure statically, i.e. Ground Speed. A similar method as described in paragraph 12.2 may be used.

12.4 A test should be performed to ensure that the transponder:

- i. does not respond to an 'All Call' interrogation (Mode A/C/S all-call and Mode S only all-call) when on ground, and
- ii. does respond when interrogated with its Mode S aircraft address when on ground, and
- iii. does provide DF-11 Acquisition Squitter transmissions in the air (on ground acquisition squitter is replaced by extended squitter DF-17, when enabled).

These tests are required to ensure that the transponder reacts correctly to the on ground condition.

Note: These tests are not required if they were conducted as part of the Mode S Elementary Surveillance ground testing.

12.5 The Mode S transponder system(s) should be tested to ensure it has no effect on other aircraft systems. Similarly, testing should ensure that the aircraft systems have no effect on the Mode S transponder system(s).

13 FLIGHT TESTING

No specific flight testing is required assuming a full ground test of all the parameters listed in Table 1, Annex 1, is performed. Installation of Mode S antenna's not previously approved, may require a flight test to ensure adequate performance of the antenna's in the new position. The Agency should be contacted to define the level of flight testing required for adequate performance.

14 MAINTENANCE

14.1 Maintenance testing of altitude reporting transponders should be suitably screened to minimise the risk of nuisance traffic or collision resolution advisories in operating aircraft. When performing transponder testing which involves the use of the altitude changes, it is advisable to ensure the transponder is in 'standby' or 'off' whilst the air data system is set to the required altitude. The transponder should only be operated during the testing phase to minimise the risk of interference with other aircraft. Following completion of the testing, the transponder should be returned to 'standby' or 'off'. The air data system may then be returned to atmospheric pressure. Note: Before performing any transponder testing involving altitude changes the local Air Traffic Controller should be contacted and a 'safe test altitude(s)' agreed.

14.2 Maintenance tests should include a periodic verification check of aircraft derived data including the ICAO 24 bit aircraft address using suitable ramp test equipment. The check of

the aircraft address should be made also in the event of a change of state of registration of the aircraft.

14.3 Where possible, maintenance tests should check the correct functioning of system fault detectors.

14.4 Maintenance tests for encoding altitude sensors with Gillham's code output should be based on the transition points defined in EUROCAE ED-26, Table 13. (Included as Annex 3 to this guidance material).

15 AVAILABILITY OF DOCUMENTS

JAA documents are available from the JAA publisher Information Handling Services (IHS). Information on prices, where and how to order is available on the JAA website and at www.avdataworks.com. JAA documents transposed to publications of the European Aviation Safety Agency (EASA) are available on the EASA web site www.easa.eu.int

EUROCAE documents may be purchased from EUROCAE, 17 rue Hamelin, 75783 Paris Cedex 16, France, (Fax : 33 1 45 05 72 30). Web site: www.eurocae.org

FAA documents may be obtained from Department of Transportation, Subsequent Distribution Office SVC-121.23, Ardmore East Business Centre, 3341 Q 75th Avenue, Landover, MD 20785, USA. Web site www.faa.gov/aviation.htm

RTCA documents may be obtained from RTCA Inc, 1828 L Street, NW., Suite 805, Washington, DC 20036, USA., (Tel: 1 202 833 9339; Fax 1 202 833 9434), Web site www.rtca.org

ICAO documents may be purchased from Document Sales Unit, International Civil Aviation Organisation, 999 University Street, Montreal, Quebec, Canada H3C 5H7, (Fax: 1 514 954 6769, e-mail: sales_unit@icao.org or through national agencies.

ARINC documents may be purchased from ARINC Incorporated; Document Section, 2551 Riva Road, Annapolis, MD 21401-7465, USA, web site www.ARINC.com

16 List of Abbreviations:

ACAS	Airborne Collision Avoidance System
ADS	Air Data System
ADS-B	Automatic Dependent Surveillance – Broadcast
ADS-C	Automatic Dependent Surveillance – Contract
AFM	Aircraft Flight Manual
AHRS	Attitude, Heading and Reference System
ATC	Air Traffic Control
ATN	Aeronautical Telecommunication Network
BDS	Comm B Data Selector
CAPs	Controller Accessed Parameters
CNS-ATM	Communication, Navigation & Surveillance – Air Traffic Management
CS	Certification Specification
DAP	Downlinked Aircraft Parameter
EASA	European Aviation Safety Agency
ED	Eurocae Document
EHS	Enhanced Surveillance
ELS	Elementary Surveillance
ETSO	European Technical Standard Order
ESARR	Eurocontrol Safety and Regulatory Requirements
FAR	Federal Airworthiness Requirements
FMS	Flight Management System
GAT	General Air Traffic
GPS	Global Positioning System
ICAO	International Civil Aviation Organisation
IFR	Instrument Flight Rules
IRS	Inertial Reference System
JAA	Joint Aviation Authorities
JAR	Joint Airworthiness Requirements
JTSO	JAA Technical Standard Order
MSSS	Mode S Specific Services
MEL	Minimum Equipment List
MCP	Management Control Panel
NPA	Notice of Proposed Amendment
POH	Pilot's Operating Handbook
FCU	Flight Control Panel
SAPS	System Accessed Parameters
SSR	Secondary Surveillance Radar
TAS	True Airspeed
TGL	Temporary Guidance Material
TMA	Terminal Manoeuvring Area
TSO	Technical Standard Order
WOW	Weight on Wheels

Table 1: Minimum Required Characteristics of Aircraft Derived Data for Enhanced Surveillance

Annex 1

Item	Parameter	Range	Minimum Resolution	Accuracy Limits	Remarks
5	Magnetic Heading	-180, +180 degrees	90/512	As installed sensor	BDS Register 6,0
6	Indicated Airspeed (Note 9)	As installed sensor	1 kt	As installed sensor	BDS Register 6,0
7	Mach No. (Note 9)	As installed sensor	2.048/512	As installed sensor	BDS Register 6,0
8	Vertical Rate	-4994, +4984m/minute (-16384, +16352 ft/minute)	8192/256	As installed sensor	BDS Register 6,0
9	Roll Angle	-90, +90 degrees	45/256	As installed sensor	BDS Register 5,0
10	Track Angle Rate (Note 8)	-16, +16 degrees/second	8/256	As installed sensor	BDS Register 5,0
11	True Track Angle	-180, +180 degrees	90/512	As installed sensor	BDS Register 5,0
12	Ground Speed	As installed sensor	2 kt	As installed sensor	BDS Register 5,0
13	Selected Altitude	As installed sensor	5m (16ft)	See notes 5 & 6	BDS Register 4,0

- Notes:**
- 1 See JAA TGL 13 for details of parameters 1 through 4.
 - 2 The minimum parameter characteristics shown above are applicable to the data source and need to be maintained through any intermediate data processing systems until delivered to the transponder.
 - 3 The required characteristics of the transponder BDS registers are defined in Amd 77 to ICAO 10, Vol III, Part 1, Chapter 5, Appendix 1, 'Tables for Section 2'.
 - 4 Where reference is made to "As installed sensor", this should be interpreted to mean either the primary system used to fly the aircraft, or an approved system of equivalent performance and capability.
 - 5 The value of Selected Altitude, transmitted by the transponder, will need to correspond within +/-8m (+/- 25ft) to the value displayed to the flight crew or the associated output to the flight control/guidance system.
 - 6 The Selected Altitude data to be provided by BDS 4,0 is the "MCP/FCU SELECTED ALTITUDE" (bits 2-13), together with bit 1 (STATUS), and bits 48 to 51, set as described in the register definition. In addition, where readily available, Barometric Pressure Setting in bits 28 to 40 of BDS 4,0 should be provided as defined in Annex 10, Table 2-64 BDS 4,0. The transponder subtracts 800 mb from the Barometric Pressure Setting prior to loading into the register.
 - 7 The transponder capability report, as defined in ICAO Annex 10, Vol IV, 3.1.2.6.10.2 and Vol III, Part 1, Appendix to Chapter 5, 2.5.4, will need to reflect the enhanced surveillance capability, as implemented and supported in the aircraft. The affected BDS to be appropriately filled are:- BDS 1,0; BDS 1,7; BDS 1,8 to 1,C; and BDS 1,D to 1,F.
 - 8 If the Track Angle Rate parameter, as defined in the ARINC 429 data bus specification, Label 335, cannot be readily provided because the aircraft configuration is based on the GAMA 429 specification then 'True Airspeed' (TAS) should be substituted. If the aircraft is supplying TAS then ARINC Label 335 should not be transmitted.
 - 9 Indicated Airspeed and Mach No. are considered as a single DAP. If an aircraft can provide both, it should do so.

Table 2: Failure Condition Categories of Aircraft Derived Data for Enhanced Surveillance

Annex 1

1. The Failure Condition categories listed here assume that aircraft derived data are used only as air traffic controller accessed parameters (CAP) and are subject to a correspondence check by means of radio communication with the pilot, or verification by the end user by other equivalent means. It is assumed also, that loss of any parameter is readily detectable by the air traffic controller and ATC system (if applicable). Aircraft derived data used as system accessed parameters (SAPs) for air traffic safety nets involving automated processing may require higher levels of integrity yet to be established. In anticipation of increasing reliance by the air traffic services on automatic processing of data for safety nets, the aircraft system should be designed such as to provide, so far as is practicable, data of high accuracy, high availability and high integrity.
2. Use of aircraft derived data for other purposes such as Automatic Dependent Surveillance- Broadcast, is expected to require data meeting more demanding availability and integrity criteria. Designers of Mode S systems are strongly recommended to take account of such expectations.
3. The Failure Condition categories listed here take account of advice from EUROCONTROL based on safety analyses to support Enhanced Surveillance. (See reference documents 4.3 (b) and (c)).

Parameter	Loss of Parameter	Undetected Erroneous Parameter
Magnetic Heading	Minor	Minor
Indicated Airspeed	Minor	Minor
Mach No.	Minor	Minor
Vertical Rate	Minor	Minor
Roll Angle	Minor	Minor
Track Angle Rate (or True Airspeed)	Minor	Minor
True Track Angle	Minor	Minor
Groundspeed	Minor	Minor
Selected Altitude (including Barometric Pressure Setting)	Minor	Minor

Table 3 Examples of Modification Classification for Mode S Elementary & Enhanced Surveillance Aircraft Installations

Mass of Aircraft	Is Cruising TAS > 250 kts?	Elementary & Enhanced Surveillance?	Pressurised Yes/No	Example No.	Proposed Classification (Major /Minor Change)	Reason/Justification for Classification
Less than 5700 Kgs	No	Elementary Surveillance only required	No	1	Minor	Assuming a simple replacement of existing transponder and no antenna change.
				2	Major	STC required to install Mode S transponder on aircraft where no transponder was previously fitted. Consideration should be given to antenna location and flight test may be required to ensure adequate antenna performance
				3	Major	If Mode S transponder <i>is elementary and enhanced capable</i> and ‘enhanced’ parameters are loaded into transponder (due to connection to an ADC – transponder will also strip off ARINC 429 labels required for enhanced surveillance) then a Flight Manual Supplement or Pilot’s Operating Handbook Supplement should be raised to record which ‘enhanced’ parameters are downloaded – See NPA 20-12b.
			Yes	Major	4	If Mode S transponder <i>is elementary and enhanced capable</i> and ‘enhanced’ parameters are loaded into transponder (due to connection to an ADC – transponder will also strip off ARINC 429 labels required for enhanced surveillance) then a Flight Manual Supplement or Pilot’s Operating Handbook Supplement should be raised to record which ‘enhanced’ parameters are downloaded – See NPA 20-12b.
					5	Minor
Yes	Elementary & Enhanced Surveillance Required	Either pressurised or un-pressurised	6	Major	Major change because of Flight Manual Supplement and potential technical complexity	
More than 5700 kgs	No		7	Major	Major change because of Flight Manual Supplement and potential technical complexity	
	Yes		(antenna diversity also required)	8	Major	Major change because of Flight Manual Supplement and potential technical complexity

Template for Aircraft Flight Manual (AFM) Supplement

(Aircraft Type) Flight Manual [or POH as appropriate] Reference (XXXX)

(Company Name)

FLIGHT MANUAL SUPPLEMENT (1) ISSUE (1)

Registration Mark: _____ Serial Number: _____

SSR MODE S ENHANCED SURVEILLANCE

Modification Number (XXXX)

ADDITIONAL LIMITATIONS AND INFORMATION

The limitations and information contained herein either supplement or, in the case of conflict, override those in the flight manual.

LIMITATIONS

1 The installed Mode S system satisfies the data requirements of ICAO Doc 7030/4, Regional Supplementary Procedures for SSR Mode S Enhanced Surveillance in designated European airspace. The capability to transmit data parameters is shown in column 2: [mark as applicable]:

Parameter	Available/Not Available
Magnetic Heading	
Indicated Airspeed	
Mach No	
Vertical Rate	
Roll Angle	
Track Angle Rate / True Airspeed *	
True Track Angle	
Groundspeed	
Selected Altitude	
Barometric Pressure Setting	

To be inserted in the flight manual and record sheet amended accordingly.

Page 1 of (X)

Authority Approval:

Date:

[*delete as applicable]

Extract from EUROCAE Document ED-26: Table 13:Altitude Encoding Transition Points

Nominal Transition Altitude (feet)	Transition Pulse	Enabled Information Pulses.										
		D ₂	D ₄	A ₁	A ₂	A ₄	B ₁	B ₂	B ₄	C ₁	C ₂	C ₄
-950	C ₁										1	
										1	1	
-850	C ₂									1	1	
										1		
-750	B ₄									1		
									1	1		
-450	C ₄									1		1
										1		1
-250	B ₂									1		1
								1	1			1
750	B ₁								1			1
							1	1				1
2750	A ₄							1				1
						1	1					1
6750	A ₂					1						1
					1	1						1
14750	A ₁				1							1
				1	1							1
30750	D ₄			1								1
			1	1								1
62750	D ₂		1									1
		1	1									1