International Standards
and Recommended Practices

Annex 10
to the Convention on
International Civil Aviation

Aeronautical Telecommunications

Volume V
Aeronautical Radio Frequency
Spectrum Utilization

This edition incorporates all amendments adopted by the Council prior to 28 February 2013 and supersedes, on 14 November 2013, all previous editions of Annex 10, Volume V.

For information regarding the applicability of the Standards and Recommended Practices, *see* Foreword.

Third Edition
July 2013

International Civil Aviation Organization

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AMENDMENTS

Amendments are announced in the supplements to the *Catalogue of ICAO Publications;* the Catalogue and its supplements are available on the ICAO website at www.icao.int. The space below is provided to keep a record of such amendments.

RECORD OF AMENDMENTS AND CORRIGENDA

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71–88-A*	Incorporated in this edition		
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FOREWORD

Historical background

Standards and Recommended Practices for Aeronautical Telecommunications were first adopted by the Council on 30 May 1949 pursuant to the provisions of Article 37 of the Convention on International Civil Aviation (Chicago 1944) and designated as Annex 10 to the Convention. They became effective on 1 March 1950. The Standards and Recommended Practices were based on recommendations of the Communications Division at its Third Session in January 1949.

Up to and including the Seventh Edition, Annex 10 was published in one volume containing four parts together with associated attachments: Part I — Equipment and Systems, Part II — Radio Frequencies, Part III — Procedures, and Part IV — Codes and Abbreviations.

By Amendment 42, Part IV was deleted from the Annex; the codes and abbreviations contained in that part were transferred to a new document, Doc 8400.

As a result of the adoption of Amendment 44 on 31 May 1965, the Seventh Edition of Annex 10 was replaced by two volumes: Volume I (First Edition) containing Part I — Equipment and Systems, and Part II — Radio Frequencies, and Volume II (First Edition) containing Communication Procedures.

As a result of the adoption of Amendment 70 on 20 March 1995, Annex 10 was restructured to include five volumes: Volume I — *Radio Navigation Aids*; Volume II — *Communication Procedures*; Volume III — *Communication Systems*; Volume IV — *Surveillance Radar and Collision Avoidance Systems*; and Volume V — *Aeronautical Radio Frequency Spectrum Utilization*. By Amendment 70, Volumes III and IV were published in 1995 and Volume V was published in 1996 with Amendment 71.

Table A shows the origin of amendments to Annex 10, Volume V subsequent to Amendment 71, together with a summary of the principal subjects involved and the dates on which the Annex and the amendments were adopted by Council, when they became effective and when they became applicable.

Action by Contracting States

Notification of differences. The attention of Contracting States is drawn to the obligation imposed by Article 38 of the Convention by which Contracting States are required to notify the Organization of any differences between their national regulations and practices and the International Standards contained in this Annex and any amendments thereto. Contracting States are invited to extend such notification to any differences from the Recommended Practices contained in this Annex and any amendments thereto, when the notification of such differences is important for the safety of air navigation. Further, Contracting States are invited to keep the Organization currently informed of any differences which may subsequently occur, or of the withdrawal of any differences previously notified. A specific request for notification of differences will be sent to Contracting States immediately after the adoption of each amendment to this Annex.

The attention of States is also drawn to the provisions of Annex 15 related to the publication of differences between their national regulations and practices and the related ICAO Standards and Recommended Practices through the Aeronautical Information Service, in addition to the obligation of States under Article 38 of the Convention.

Promulgation of information. The establishment and withdrawal of and changes to facilities, services and procedures affecting aircraft operations provided in accordance with the Standards, Recommended Practices and Procedures specified in Annex 10 should be notified and take effect in accordance with the provisions of Annex 15.

Use of the text of the Annex in national regulations. The Council, on 13 April 1948, adopted a resolution inviting the attention of Contracting States to the desirability of using in their own national regulations, as far as practicable, the precise language of those ICAO Standards that are of a regulatory character and also of indicating departures from the Standards, including any additional national regulations that were important for the safety or regularity of air navigation. Wherever possible, the provisions of this Annex have been deliberately written in such a way as would facilitate incorporation, without major textual changes, into national legislation.

Status of Annex components

An Annex is made up of the following component parts, not all of which, however, are necessarily found in every Annex; they have the status indicated:

1.— *Material comprising the Annex proper:*

a) *Standards* and *Recommended Practices* adopted by the Council under the provisions of the Convention. They are defined as follows:

Standard: Any specification for physical characteristics, configuration, matériel, performance, personnel or procedure, the uniform application of which is recognized as necessary for the safety or regularity of international air navigation and to which Contracting States will conform in accordance with the Convention; in the event of impossibility of compliance, notification to the Council is compulsory under Article 38.

Recommended Practice: Any specification for physical characteristics, configuration, matériel, performance, personnel or procedure, the uniform application of which is recognized as desirable in the interest of safety, regularity or efficiency of international air navigation, and to which Contracting States will endeavour to conform in accordance with the Convention.

b) *Appendices* comprising material grouped separately for convenience but forming part of the Standards and Recommended Practices adopted by the Council.

c) *Definitions* of terms used in the Standards and Recommended Practices which are not self-explanatory in that they do not have accepted dictionary meanings. A definition does not have independent status but is an essential part of each Standard and Recommended Practice in which the term is used, since a change in the meaning of the term would affect the specification.

d) *Tables* and *Figures* which add to or illustrate a Standard or Recommended Practice and which are referred to therein, form part of the associated Standard or Recommended Practice and have the same status.

2.— *Material approved by the Council for publication in association with the Standards and Recommended Practices*:

a) *Forewords* comprising historical and explanatory material based on the action of the Council and including an explanation of the obligations of States with regard to the application of the Standards and Recommended Practices ensuing from the Convention and the Resolution of Adoption;

b) *Introductions* comprising explanatory material introduced at the beginning of parts, chapters or sections of the Annex to assist in the understanding of the application of the text;

c) *Notes* included in the text, where appropriate, to give factual information or references bearing on the Standards or Recommended Practices in question, but not constituting part of the Standards or Recommended Practices;

d) *Attachments* comprising material supplementary to the Standards and Recommended Practices, or included as a guide to their application.

Disclaimer regarding patents

Attention is drawn to the possibility that certain elements of Standards and Recommended Practices in this Annex may be the subject of patents or other intellectual property rights. ICAO shall not be responsible or liable for not identifying any or all such rights. ICAO takes no position regarding the existence, validity, scope or applicability of any claimed patents or other intellectual property rights, and accepts no responsibility or liability therefore or relating thereto.

Selection of language

This Annex has been adopted in four languages — English, French, Russian and Spanish. Each Contracting State is requested to select one of those texts for the purpose of national implementation and for other effects provided for in the Convention, either through direct use or through translation into its own national language, and to notify the Organization accordingly.

Editorial practices

The following practice has been adhered to in order to indicate at a glance the status of each statement: *Standards* have been printed in light face roman; *Recommended Practices* have been printed in light face italics, the status being indicated by the prefix **Recommendation**; *Notes* have been printed in light face italics, the status being indicated by the prefix *Note*.

The following editorial practice has been followed in the writing of specifications: for Standards the operative verb “shall” is used, and for Recommended Practices the operative verb “should” is used.

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

Any reference to a portion of this document, which is identified by a number and/or title, includes all subdivisions of that portion.

Table A. Amendments to Annex 10, Volume V

Amendment	*Source(s)*	*Subject(s)*	*Adopted* *Effective* *Applicable*
71	Air Navigation Commission; SP COM/OPS/95 Divisional Meeting; third meeting of the Aeronautical Mobile Communications Panel (AMCP)	Introduction of new Volume V consisting of existing Annex material and addition of material relating to the introduction of 8.33 kHz channel spacing and changes to material related to the protection of air-ground communications in the VHF band.	12 March 1996 15 July 1996 7 November 1996
72	Air Navigation Commission; fourth meeting of the Aeronautical Mobile Communications Panel (AMCP)	Definition for VHF digital link; amendment to Table 4-1 *(bis)*.	12 March 1997 21 July 1997 6 November 1997
73	—	No change.	—
74	Air Navigation Commission	Introduction of: a) an interpilot air-to-air channel; and b) changes to specifications on emergency locator transmitters.	18 March 1999 19 July 1999 4 November 1999
75	Air Navigation Commission; sixth meeting of the Aeronautical Mobile Communications Panel (AMCP)	Clarification of guidance material on VDL interference immunity performance.	13 March 2000 17 July 2000 2 November 2000
76 (2nd Edition)	Seventh meeting of the Aeronautical Mobile Communications Panel (AMCP)	Integrated voice and data link system (VDL Mode 3); data link satisfying surveillance applications (VDL Mode 4); update of references to the ITU Radio Regulations.	12 March 2001 16 July 2001 1 November 2001
77	Secretariat	Consequential changes resulting from GNSS SARPs which provide for GBAS data broadcast in the band 108 – 117.975 MHz.	27 February 2002 15 July 2002 28 November 2002
78	—	No change.	—
79	—	No change.	—
80	—	No change.	—
81	—	No change.	—
82	—	No change.	—
83	—	No change.	—
84	—	No change.	—

Amendment	*Source(s)*	*Subject(s)*	*Adopted Effective Applicable*
85	—	No change.	—
86	—	No change.	—
87	—	No change.	—
88-A (3rd Edition)	Aeronautical Communications Panel (ACP)	a) Alignment of SARPs with prior updates to the ITU Radio Regulations and Annex 10, Volume III; b) Revision of VHF frequency assignment planning provisions.	27 February 2013 15 July 2013 14 November 2013
88-B	—	No change.	—
89	—	No change.	—
90	Thirteenth meeting of the Remotely Piloted Aircraft Systems Panel (RPASP/13)	Frequency bands allocated to the C2 Link supporting remotely piloted aircraft systems (RPAS) operations	1 March 2021 12 July 2021 26 November 2026
91	Third meeting of the Frequency Spectrum Management Panel (FSMP/3) Seventh meeting of the Navigation Systems Panel (NSP/7)	a) introduction of new definitions and Standards and Recommended Practices (SARPs) related to wireless avionics intra-communications (WAIC); and b) update of references to guidance material and to partly obsolete provisions in relation to frequency utilization for instrument landing system (ILS), VHF omnidirectional radio range (VOR), distance measuring equipment (DME) and ground-based augmentation system (GBAS).	28 March 2025 4 August 2025 27 November 2025

INTERNATIONAL STANDARDS AND RECOMMENDED PRACTICES

CHAPTER 1. DEFINITIONS

Note.— All references to "Radio Regulations" are to the Radio Regulations published by the International Telecommunication Union (ITU). Radio Regulations are amended from time to time by the decisions embodied in the Final Acts of World Radiocommunication Conferences held normally every two to three years. Further information on the ITU processes as they relate to aeronautical radio system frequency use is contained in the Handbook on Radio Frequency Spectrum Requirements for Civil Aviation *(Doc 9718).*

When the following terms are used in this volume of the Annex, they have the following meanings:

Alternative means of communication. A means of communication provided with equal status, and in addition to the primary means.

C2 Link. The data link between the remotely piloted aircraft and the remote pilot station for the purposes of managing the flight.

Double channel simplex. Simplex using two frequency channels, one in each direction.

Note.— This method was sometimes referred to as cross-band.

Duplex. A method in which telecommunication between two stations can take place in both directions simultaneously.

Frequency channel. A continuous portion of the frequency spectrum appropriate for a transmission utilizing a specified class of emission.

Note.— The classification of emissions and information relevant to the portion of the frequency spectrum appropriate for a given type of transmission (bandwidths) are specified in the Radio Regulations, Article 2 and Appendix 1.

Offset frequency simplex. A variation of single channel simplex wherein telecommunication between two stations is effected by using in each direction frequencies that are intentionally slightly different but contained within a portion of the spectrum allotted for the operation.

Operational control communications. Communications required for the exercise of authority over the initiation, continuation, diversion or termination of a flight in the interest of the safety of the aircraft and the regularity and efficiency of a flight.

Note.— Such communications are normally required for the exchange of messages between aircraft and aircraft operating agencies.

Primary means of communication. The means of communication to be adopted normally by aircraft and ground stations as a first choice where alternative means of communication exist.

Remote pilot station (RPS). The component of the remotely piloted aircraft system containing the equipment used to pilot the remotely piloted aircraft.

Remotely piloted aircraft (RPA). An unmanned aircraft which is piloted from a remote pilot station.

Remotely piloted aircraft system (RPAS). A remotely piloted aircraft, its associated remote pilot station(s), the required C2 Link(s) and any other component as specified in the type design.

Simplex. A method in which telecommunication between two stations takes place in one direction at a time.

Note.— In application to the aeronautical mobile service, this method may be subdivided as follows:

a) single channel simplex;

b) double channel simplex;

c) offset frequency simplex.

Single channel simplex. Simplex using the same frequency channel in each direction.

VHF digital link (VDL). A constituent mobile subnetwork of the aeronautical telecommunication network (ATN), operating in the aeronautical mobile VHF frequency band. In addition, the VDL may provide non-ATN functions such as, for instance, digitized voice.

WAIC component. Any tangible entity of a WAIC network on board an aircraft.

WAIC network. A network comprised of interrelated WAIC components, such as components used for wireless communications, security or network management.

WAIC system. A system which provides wireless communications between points on board a single aircraft. A WAIC system may be comprised of one or more WAIC networks necessary for establishing, maintaining and securing wireless communications. A WAIC system consists of interrelated sets of WAIC components on board the same aircraft, so that a single aircraft contains only a single WAIC system.

Wireless avionics intra-communications (WAIC). Radiocommunication between two or more aircraft stations located on board a single aircraft for aircraft applications supporting the safe operation of the aircraft.

CHAPTER 2. DISTRESS FREQUENCIES

Introduction

The ITU Radio Regulations Article 30 provides general conditions for distress and safety communications for all mobile services. The aeronautical mobile service is also permitted under Article 30, Section III, No. 30.9 to conform to special arrangements between governments where these have been agreed. ICAO Annexes constitute such agreements.

The Standards and Recommended Practices relating to radio frequencies for distress communications take into account certain procedures that have been adopted by ICAO and also certain provisions made by the ITU in its Radio Regulations.

Annex 10, Volume II requires that an aircraft in distress when it is airborne should use the frequency in use for normal communications with aeronautical stations at the time. However, it is recognized that, after an aircraft has crashed or ditched, there is a need for designating a particular frequency or frequencies to be used in order that uniformity may be attained on a worldwide basis, and so that a guard may be maintained or set up by as many stations as possible including direction-finding stations, and stations of the maritime mobile service.

The frequency 2 182 kHz also offers possibilities for communication between aircraft and stations of the maritime mobile service. The ITU Radio Regulations specify in Article 30, Section III, No. 30.11 that the frequency 2 182 kHz is the international distress frequency for radiotelephony to be used for emergency communications by ship, aircraft and survival craft stations using frequencies in the authorized bands between 1 605 kHz and 4 000 kHz when requesting assistance from, or communicating with, the maritime service.

With respect to emergency locator transmitters (ELTs) designed to be detected and located by satellite, the Radio Regulations authorize the use of these devices, which are referenced in ITU as satellite emergency position indicating radio beacons (EPIRBs). ITU Radio Regulations Article 31, Section I, No. 31.1 specifies that the band 406 – 406.1 MHz is used exclusively by satellite EPIRBs in the earth-to-space direction.

The frequency 4 125 kHz is also authorized by the ITU to enable communications between stations in the maritime mobile service and aircraft stations in distress. The current ITU Radio Regulations (RR 5.130 and Articles 31 and 32) state that the carrier frequency 4 125 kHz may be used by aircraft stations to communicate with stations of the maritime mobile service for distress and safety purposes. The aeronautical mobile (R) service frequencies 3 023 kHz and 5 680 kHz may be employed for coordinated search and rescue operations with the maritime mobile service under RR 5.115.

With respect to survival craft stations, the Radio Regulations provide for the use of the frequencies 8 364 kHz, 2 182 kHz, 121.500 MHz and 243 MHz, if the survival craft is capable of operating in the bands 4 000 – 27 500 kHz, 1 605 – 2 850 kHz, 117.975 – 137.000 MHz and 235 – 328.6 MHz respectively (RR Articles 31 and 32).

2.1 Frequencies for emergency locator transmitters (ELTs) for search and rescue

2.1.1 All emergency locator transmitters carried in compliance with Standards of Annex 6, Parts I, II and III shall operate on both 406 MHz and 121.500 MHz.

Note 1.— ITU Radio Regulations (5.256) provide for the use of 243 MHz in addition to the above frequencies.

Note 2.— Specifications for ELTs are found in Annex 10, Volume III, Part II, Chapter 5 and the ITU Radio Regulations Article 34, Section I, No. 34.1.

2.2 Search and rescue frequencies

2.2.1 Where there is a requirement for the use of high frequencies for search and rescue scene of action coordination purposes, the frequencies 3 023 kHz and 5 680 kHz shall be employed.

2.2.2 **Recommendation.—** *Where specific frequencies are required for communication between rescue coordination centres and aircraft engaged in search and rescue operations, they should be selected regionally from the appropriate aeronautical mobile frequency bands in light of the nature of the provisions made for the establishment of search and rescue aircraft.*

Note.— Where civil commercial aircraft take part in search and rescue operations, they will normally communicate on the appropriate en-route channels with the flight information centre associated with the rescue coordination centre concerned.

CHAPTER 3. UTILIZATION OF FREQUENCIES BELOW 30 MHz

Introduction

High frequency bands allocated to the
aeronautical mobile (R) service

The frequency bands between 2.8 MHz and 22 MHz allocated to the aeronautical mobile (R) service are given in Article 5 of the ITU Radio Regulations. The utilization of these bands must be in accordance with the relevant provisions of the Radio Regulations and in particular Appendix 27 to the Radio Regulations. In the utilization of these bands, States' attention is drawn to the possibility of harmful radio interference from non-aeronautical sources of radio frequency energy and the need to take appropriate measures to minimize its effects.

3.1 Method of operations

3.1.1 In the aeronautical mobile service, single channel simplex shall be used in radiotelephone communications utilizing radio frequencies below 30 MHz in the bands allocated exclusively to the aeronautical mobile (R) service.

3.1.2 Assignment of single sideband channels

3.1.2.1 Single sideband channels shall be assigned in accordance with Annex 10, Volume III, Part II, Chapter 2, 2.4.

3.1.2.2 For the operational use of the channels concerned, administrations shall take into account the provisions of 27/19 of Appendix 27 of the ITU Radio Regulations.

3.1.2.3 **Recommendation.—** *The use of aeronautical mobile (R) frequencies below 30 MHz for international operations should be coordinated as specified in Appendix 27 of the ITU Radio Regulations as follows:*

27/19 The International Civil Aviation Organization (ICAO) co-ordinates radiocommunications of the aeronautical mobile (R) service with international aeronautical operations and this Organization should be consulted in all appropriate cases in the operational use of the frequencies in the Plan.

3.1.2.4 **Recommendation.—** *Where international operating requirements for HF communications cannot be satisfied by the Frequency Allotment Plan at Part 2 of Appendix 27 to the Radio Regulations, an appropriate frequency may be assigned as specified in Appendix 27 by the application of the following provisions:*

27/20 It is recognized that not all the sharing possibilities have been exhausted in the Allotment Plan contained in this Appendix. Therefore, in order to satisfy particular operational requirements which are not otherwise met by this Allotment Plan, Administrations may assign frequencies from the aeronautical mobile (R) bands in areas other than those to which they are allotted in this Plan. However, the use of the frequencies so assigned must not reduce the protection to the same frequencies in the areas where they are allotted by the Plan below that determined by the application of the procedure defined in Part I, Section II B of this Appendix.

Note.— Part I, Section II B of Appendix 27 relates to Interference Range Contours, and application of the procedure results in a protection ratio of 15 dB.

27/21 When necessary to satisfy the needs of international air operations Administrations may adapt the allotment procedure for the assignment of aeronautical mobile (R) frequencies, which assignments shall then be the subject of prior agreement between Administrations affected.

27/22 The co-ordination described in No. 27/19 shall be effected where appropriate and desirable for the efficient utilization of the frequencies in question, and especially when the procedures of No. 27/21 are unsatisfactory.

3.1.2.5 The use of classes of emission J7B and J9B shall be subject to the following provisions of Appendix 27:

27/12 For radiotelephone emissions, the audio frequencies will be limited to between 300 and 2 700 Hz and the occupied bandwidth of other authorized emissions will not exceed the upper limit of J3E emissions. In specifying these limits, however, no restriction in their extension is implied in so far as emissions other than J3E are concerned, provided that the limits of unwanted emissions are met (see Nos. 27/73 and 27/74).

27/14 On account of the possibility of interference, a given channel should not be used in the same allotment area for radiotelephony and data transmissions.

27/15 The use of channels derived from the frequencies indicated in 27/18 for the various classes of emissions other than J3E and H2B will be subject to special arrangements by the Administrations concerned and affected in order to avoid harmful interference which may result from the simultaneous use of the same channel for several classes of emission.

3.1.3 Assignment of frequencies for aeronautical operational control communications

3.1.3.1 Worldwide frequencies for aeronautical operational control communications are required to enable aircraft operating agencies to meet the obligations prescribed in Annex 6, Part I. Assignment of these frequencies shall be in accordance with the following provisions of Appendix 27:

27/9 A world-wide allotment area is one in which frequencies are allotted to provide long distance communications between an aeronautical station within that allotment area and aircraft operating anywhere in the world.[1]

27/217 The world-wide frequency allotments appearing in the tables at No. 27/213 and Nos. 27/218 to 27/231, except for carrier (reference) frequencies 3 023 kHz and 5 680 kHz, are reserved for assignment by administrations to stations operating under authority granted by the administration concerned for the purpose of serving one or more aircraft operating agencies. Such assignments are to provide communications between an appropriate aeronautical station and an aircraft station anywhere in the world for exercising control over regularity of flight and for safety of aircraft. Worldwide frequencies are not to be assigned by administrations for MWARA, RDARA and VOLMET purposes. Where the operational area of an aircraft lies wholly within a RDARA or sub-RDARA boundary, frequencies allotted to those RDARAs and sub-RDARAs shall be used.

Note 1.— Tables 27/213 and 27/218 to 27/231 appearing in Appendix 27 to the ITU Radio Regulations refer to, respectively, the Frequency Allotment Plan, listing frequencies by areas, and the Frequency Allotment Plan, listing frequencies in numerical order.

Note 2.— Guidance material on the assignment of worldwide frequencies is contained in Attachment B.

1. The type of communications referred to in 27/9 may be regulated by administrations.

3.2 NDB frequency management

3.2.1 **Recommendation.—** *NDB frequency management should take into account the following:*

a) the interference protection required at the edge of the rated coverage;

b) the application of the figures shown for typical ADF equipment;

c) the geographical spacings and the respective rated coverages;

d) the possibility of interference from spurious radiation generated by non-aeronautical sources (e.g. electric power services, power line communication systems, industrial radiation, etc.).

Note 1.— Guidance material to assist in determining the application of the foregoing is given in Attachment A.

Note 2.— Attention is drawn to the fact that some portions of the bands available for aeronautical beacons are shared with other services.

3.2.2 **Recommendation.—** *To alleviate frequency congestion problems at locations where two separate ILS facilities serve opposite ends of a single runway, the assignment of a common frequency to both of the outer locators should be permitted, and the assignment of a common frequency to both of the inner locators should be permitted, provided that:*

a) the operational circumstances permit;

b) each locator is assigned a different identification signal; and

c) arrangements are made whereby locators using the same frequency cannot radiate simultaneously.

Note.— The Standard in Annex 10, Volume I, 3.4.4.4, specifies the equipment arrangements to be made.

CHAPTER 4. UTILIZATION OF FREQUENCIES ABOVE 30 MHz

Note.— Details pertaining to the allocation of spectrum to aeronautical services, including footnoted allocations and restrictions, are contained in both the International Telecommunication Union (ITU) Radio Regulations and the ICAO Handbook on Radio Frequency Spectrum Requirements for Civil Aviation *(Doc 9718)*.

4.1 Utilization in the frequency band 117.975 – 137.000 MHz

Introduction

Section 4.1 deals with Standards and Recommended Practices (SARPs) relating to the use of the frequency band 117.975 – 137.000 MHz and includes matters pertaining to the selection of particular frequencies for various aeronautical purposes. These SARPs are introduced by the following preface, which sets out the principles upon which the utilization of this frequency band on a worldwide basis with due regard to economy is being planned.

Preface

The utilization of the frequency band 117.975 – 137.000 MHz on a worldwide basis with due regard to economy and practicability requires a plan that will take into account:

a) the need for an orderly evolution towards improved operation and the required degree of worldwide standardization;

b) the desirability of providing for an economic transition from present utilization to optimum utilization of the frequencies available, taking into account the maximum possible utilization of existing equipment;

c) the need to provide for coordination between international and national utilization so as to ensure mutual protection from interference;

d) the need for providing a global framework for the coordinated development of Regional Plans;

e) the need, in certain regions, to have more detailed plans and planning criteria in addition to the provisions in this section;

f) the desirability of incorporating in any group of frequencies to be used those now in use for international air services;

g) the need for keeping the total number of frequencies and their grouping in appropriate relation to the airborne equipment known to be widely used by international air services;

h) a requirement for the provision of a single frequency that may be used for emergency purposes on a worldwide basis and, also, in certain regions, for another frequency that may be used as a common frequency for special purposes; and

i) the need for providing sufficient flexibility to allow for the differences in application necessitated by regional conditions.

4.1.1 General allotment of frequency band 117.975 – 137.000 MHz

Note.[1]— The plan includes a general Allotment Table that subdivides the complete frequency band 117.975 – 137.000 MHz, the chief subdivisions being the frequency bands allocated to both national and international services, and the frequency bands allocated to national services. Observance of this general subdivision should keep to a minimum the problem of coordinating national and international application.

Note 2.— As of 26 November 2026, subject to the conditions stated in 5.2.1, the frequency 136.925 MHz may be used for the provision of remotely piloted aircraft systems (RPAS) C2 Link communication services described in Annex 10, Volume V, Chapter 5.

4.1.1.1 The block allotment of the frequency band 117.975 – 137.000 MHz shall be as shown in Table 4-1.

4.1.2 Frequency separation and limits of assignable frequencies

Note.— In the following text, the channel spacing for 8.33 kHz channel assignments is defined as 25 kHz divided by 3 which is 8.333 ... kHz.

4.1.2.1 In the frequency band 117.975 – 137.000 MHz, the lowest assignable frequency shall be 118.000 MHz and the highest 136.975 MHz.

4.1.2.2 The minimum separation between assignable frequencies in the aeronautical mobile (R) service shall be 8.33 kHz.

Note.— It is recognized that in some regions or areas, 25 kHz channel spacing provides an adequate number of frequencies suitably related to international and national air services and that equipment designed specifically for 25 kHz channel spacing will remain adequate for services operating within such regions or areas. It is further recognized that assignments based on 25 kHz channel spacing as well as 8.33 kHz channel spacing may continue to co-exist within one region or area.

4.1.2.3 Requirements for mandatory carriage of equipment specifically designed for 8.33 kHz channel spacing shall be made on the basis of regional air navigation agreements which specify the airspace of operation and the implementation timescales for the carriage of equipment, including the appropriate lead time.

Note.— No changes will be required to aircraft systems or ground systems operating solely in regions not using 8.33 kHz channel spacing.

4.1.2.4 Requirements for mandatory carriage of equipment specifically designed for VDL Mode 2, VDL Mode 3 and VDL Mode 4 shall be made on the basis of regional air navigation agreements which specify the airspace of operation and the implementation timescales for the carriage of equipment, including the appropriate lead time.

4.1.2.4.1 The agreement indicated in 4.1.2.4 shall provide at least two years' notice of mandatory carriage of airborne systems.

[1] As of 26 November 2026, this Note becomes Note 1.

4.1.2.5 In regions where 25 kHz channel spacing (DSB-AM and VHF digital link (VDL)) and 8.33 kHz DSB-AM channel spacing are in operation, the publication of the assigned frequency or channel of operation shall conform to the channel contained in Table 4-1 (*bis*).

Note.— Table 4-1 (bis) *provides the frequency channel pairing plan which retains the numerical designator of the 25 kHz DSB-AM environment and allows unique identification of a 25 kHz VDL and 8.33 kHz channel.*

Table 4-1. Allotment table

	Block allotment frequencies (MHz)	*Worldwide utilization*	*Remarks*
a)	118.000 – 121.450 inclusive	International and National Aeronautical Mobile Services	Specific international allotments will be determined in the light of regional agreement. National assignments are covered by the provisions in 4.1.4.8 and 4.1.4.9.
b)	121.500	Emergency frequency	See 4.1.3.1. In order to provide a guard band for the protection of the aeronautical emergency frequency, the nearest assignable frequencies on either side of 121.500 MHz are 121.450 MHz and 121.550 MHz.
c)	121.550 – 121.9917 inclusive	International and National Aerodrome Surface Communications	Reserved for ground movement, pre-flight checking, air traffic services clearances, and associated operations.
d)	122.000 – 123.050 inclusive	National Aeronautical Mobile Services	Reserved for national allotments. National assignments are covered by the provisions of 4.1.4.8 and 4.1.4.9.
e)	123.100	Auxiliary frequency SAR	See 4.1.3.4. In order to provide a guard band for the protection of the aeronautical auxiliary frequency, the nearest assignable frequencies on either side of 123.100 MHz are 123.050 MHz and 123.150 MHz.
f)	123.150 – 123.6917 inclusive	National Aeronautical Mobile Services	Reserved for national allotments, with the exception of 123.450 MHz which is also used as an air-to-air communications channel (see g)). National assignments are covered by the provisions of 4.1.4.8 and 4.1.4.9.
g)	123.450	Air-to-air communications	Designated for use as provided for in 4.1.3.2.
h)	123.700 – 129.6917 inclusive	International and National Aeronautical Mobile Services	Specific international allotments will be determined in light of regional agreement. National assignments are covered by the provisions in 4.1.4.8 and 4.1.4.9.
i)	129.700 – 130.8917 inclusive	National Aeronautical Mobile Services	Reserved for national allotments but may be used in whole or in part, subject to regional agreement, to meet the requirements mentioned in 4.1.6.1.3.
j)	130.900 – 136.875 inclusive	International and National Aeronautical Mobile Services	Specific international allotments will be determined in light of regional agreement. National assignments are covered by the provisions in 4.1.4.8 and 4.1.4.9.
k)	136.900 – 136.975 inclusive	International and National Aeronautical Mobile Services	Reserved for VHF air-ground data link communications.

Table 4-1 *(bis)*. Channelling/frequency pairing

Frequency (MHz)	*Time slot**	*Channel spacing (kHz)*	*Channel*
118.0000		25	118.000
118.0000	A	25	118.001
118.0000	B	25	118.002
118.0000	C	25	118.003
118.0000	D	25	118.004
118.0000		8.33	118.005
118.0083		8.33	118.010
118.0167		8.33	118.015
118.0250	A	25	118.021
118.0250	B	25	118.022
118.0250	C	25	118.023
118.0250	D	25	118.024
118.0250		25	118.025
118.0250		8.33	118.030
118.0333		8.33	118.035
118.0417		8.33	118.040
118.0500		25	118.050
118.0500	A	25	118.051
118.0500	B	25	118.052
118.0500	C	25	118.053
118.0500	D	25	118.054
118.0500		8.33	118.055
118.0583		8.33	118.060
118.0667		8.33	118.065
118.0750	A	25	118.071
118.0750	B	25	118.072
118.0750	C	25	118.073
118.0750	D	25	118.074
118.0750		25	118.075
118.0750		8.33	118.080
118.0833		8.33	118.085
118.0917		8.33	118.090
118.1000		25	118.100
etc.			

* Time slot indication is for VDL Mode 3 channels. (Ref. Annex 10, Volume III, Part I, Chapter 6 for characteristics of VDL Mode 3 operation)

4.1.3 Frequencies used for particular functions

4.1.3.1 *Emergency channel*

4.1.3.1.1 The emergency channel (121.500 MHz) shall be used only for genuine emergency purposes, as broadly outlined in the following:

a) to provide a clear channel between aircraft in distress or emergency and a ground station when the normal channels are being utilized for other aircraft;

b) to provide a VHF communication channel between aircraft and aerodromes, not normally used by international air services, in case of an emergency condition arising;

c) to provide a common VHF communication channel between aircraft, either civil or military, and between such aircraft and surface services, involved in common search and rescue operations, prior to changing when necessary to the appropriate frequency;

d) to provide air-ground communication with aircraft when airborne equipment failure prevents the use of the regular channels;

e) to provide a channel for the operation of emergency locator transmitters (ELTs), and for communication between survival craft and aircraft engaged in search and rescue operations;

f) to provide a common VHF channel for communication between civil aircraft and intercepting aircraft or intercept control units and between civil or intercepting aircraft and air traffic services units in the event of interception of the civil aircraft.

Note 1.— The use of the frequency 121.500 MHz for the purpose outlined in c) is to be avoided if it interferes in any way with the efficient handling of distress traffic.

Note 2.— The ITU Radio Regulations (RR 5.200) permit the use of the aeronautical emergency frequency 121.500 MHz by mobile stations of the maritime mobile service under the conditions laid down in Article 31 of the Radio Regulations for distress and safety purposes with stations of the aeronautical mobile service.

4.1.3.1.2 The frequency 121.500 MHz shall be provided at:

a) all area control centres and flight information centres;

b) aerodrome control towers and approach control offices serving international aerodromes and international alternate aerodromes; and

c) any additional location designated by the appropriate ATS authority,

where the provision of that frequency is considered necessary to ensure immediate reception of distress calls or to serve the purposes specified in 4.1.3.1.1.

Note.— Where two or more of the above facilities are collocated, provision of 121.500 MHz at one would meet the requirement.

4.1.3.1.3 The frequency 121.500 MHz shall be available to intercept control units where considered necessary for the purpose specified in 4.1.3.1.1 f).

4.1.3.1.4 The emergency channel shall be guarded continuously during the hours of service of the units at which it is installed.

4.1.3.1.5 The emergency channel shall be guarded on a single channel simplex operation basis.

4.1.3.1.6 The emergency channel (121.500 MHz) shall be available only with the characteristics as contained in Annex 10, Volume III, Part II, Chapter 2 (25 kHz).

4.1.3.2 *Air-to-air communications channel*

4.1.3.2.1 An air-to-air VHF communications channel on the frequency of 123.450 MHz shall be designated to enable aircraft engaged in flights over remote and oceanic areas out of range of VHF ground stations to exchange necessary operational information and to facilitate the resolution of operational problems.

Note.— Use of the air-to-air channel can cause interference to and from aircraft using the same frequency for air-ground communications.

4.1.3.2.2 In remote and oceanic areas out of range of VHF ground stations, the air-to-air VHF communications channel on the frequency 123.450 MHz shall be available only with the characteristics as contained in Annex 10, Volume III, Part II, Chapter 2 (25 kHz).

4.1.3.3 *Common signalling channels for VDL*

4.1.3.3.1 *Common signalling channel VDL Mode 2.* The frequency 136.975 MHz is reserved on a worldwide basis to provide a common signalling channel (CSC) to the VHF digital link Mode 2 (VDL Mode 2). This CSC uses the Mode 2 VDL modulation scheme and carrier sense multiple access (CSMA).

4.1.3.3.2 *Common signalling channels VDL Mode 4.* In areas where VDL Mode 4 is implemented, the frequencies 136.925 MHz and 113.250 MHz shall be provided as common signalling channels (CSCs) to the VHF digital link Mode 4 (VDL Mode 4). These CSCs use the VDL Mode 4 modulation scheme.

4.1.3.4 *Auxiliary frequencies for search and rescue operations*

4.1.3.4.1 Where a requirement is established for the use of a frequency auxiliary to 121.500 MHz, as described in 4.1.3.1.1 c), the frequency 123.100 MHz shall be used.

4.1.3.4.2 The auxiliary search and rescue channel (123.100 MHz) shall be available only with the characteristics as contained in Annex 10, Volume III, Part II, Chapter 2 (25 kHz).

Note.— The ITU Radio Regulations (RR 5.200) permit the use of the aeronautical auxiliary frequency 123.100 MHz by mobile stations of the maritime mobile service under the conditions laid down in Article 31 of the Radio Regulations for distress and safety purposes with stations of the aeronautical mobile service.

4.1.4 Provisions concerning the deployment of VHF frequencies and the avoidance of harmful interference

Note.— In this section, the protected service volume of each facility is meant in the sense of avoidance of harmful interference.

4.1.4.1 The geographical separation between facilities operating on the same frequency shall, except where there is an operational requirement for the use of common frequencies for groups of facilities, be such that the protected service volume of one facility is separated from the protected service volume of another facility by a distance not less than that required to provide a desired to undesired signal ratio of 20 dB or by a separation distance not less than the sum of the distances to the associated radio horizon of each service volume, whichever is smaller.

4.1.4.2 For areas where frequency assignment congestion is severe or is anticipated to become severe, the geographical separation between facilities operating on the same frequency shall, except where there is an operational requirement for the use of common frequencies for groups of facilities, be such that the protected service volume of one facility is separated from the protected service volume of another facility by a distance not less than that required to provide a desired to undesired signal ratio of 14 dB or by a separation distance not less than the sum of the distances to the associated radio horizon of each service volume, whichever is smaller. This provision shall be implemented on the basis of a regional air navigation agreement.

Note 1.— Guidance material relating to the establishment of the minimum separation distance based on the desired to undesired signal protection ratio of 20 dB or 14 dB and radio line-of-sight is contained in Volume II of the Handbook on Radio Frequency Spectrum Requirements for Civil Aviation *(Doc 9718).*

Note 2.— The application of the minimum separation distance based on the sum of the radio horizon distance of each facility assumes that it is highly unlikely that two aircraft will be at the closest points between and at the maximum altitude of the protected service volume of each facility.

Note 3.— The distance to the radio horizon from a station in an aircraft is normally given by the formula:

$$D = K \sqrt{h}$$

where D = *distance in nautical miles;*
h = *height of the aircraft station above earth;*
K = *(corresponding to an effective earth's radius of 4/3 of the actual radius);*
= *2.22 when* h *is expressed in metres; and*
= *1.23 when* h *is expressed in feet.*

Note 4.— In calculating the radio line-of-sight distance between a ground station and an aircraft station, the distance from the radio horizon of the aircraft station computed from Note 3 must be added to the distance from the radio horizon of the ground station. In calculating the latter, the same formula is employed, taking for h *the height of the ground station transmitting antenna.*

Note 5.— The criteria contained in 4.1.4.1 and 4.1.4.2 are applicable in establishing minimum geographical separation between VHF facilities, with the object of avoiding co-channel air-to-air interference. Guidance material relating to the establishment of separation distances between ground stations and between aircraft and ground stations for co-channel operations is contained in the Handbook on Radio Frequency Spectrum Requirements for Civil Aviation *(Doc 9718).*

4.1.4.3 The geographical separation between facilities operating on adjacent channels shall be such that points at the edge of the protected service volume of each facility are separated by a distance sufficient to ensure operations free from harmful interference.

Note.— Guidance material covering separation distances and related system characteristics is contained in the Handbook on Radio Frequency Spectrum Requirements for Civil Aviation *(Doc 9718).*

4.1.4.4 The protection height shall be a height above a specified datum associated with a particular facility, such that below it harmful interference is improbable.

4.1.4.5 The protection height to be applied to functions or to specific facilities shall be determined regionally, taking into consideration the following factors:

a) the nature of the service to be provided;

b) the air traffic pattern involved;

c) the distribution of communication traffic;

d) the availability of frequency channels in airborne equipment;

e) probable future developments.

4.1.4.6 **Recommendation.—** *Where the protected service volume is less than operationally desirable, separation between facilities operating on the same frequency should not be less than that necessary to ensure that an aircraft at the upper edge of the operational service volume of one facility does not come above the radio horizon with respect to emissions belonging to the service of adjacent facilities.*

Note.— The effect of this recommendation is to establish a geographical separation distance below which harmful interference is probable.

4.1.4.7 The geographical separation between VHF VOLMET stations shall be determined regionally and shall be such that operations free from harmful interference are secured throughout the protected service volume of each VOLMET station.

Note.— Guidance material on the interpretation of 4.1.4.7 is contained in the Handbook on Radio Frequency Spectrum Requirements for Civil Aviation *(Doc 9718).*

4.1.4.8 In the frequency band 117.975 – 137.000 MHz, the frequencies used for National Aeronautical Mobile Services, unless worldwide or regionally allotted to this specific purpose, shall be so deployed that no harmful interference is caused to facilities in the International Aeronautical Mobile Services.

4.1.4.9 **Recommendation.—** *The problem of inter-State interference should be resolved by consultation between the States concerned.*

4.1.4.10 The communication coverage provided by a VHF ground transmitter shall, in order to avoid harmful interference to other stations, be kept to the minimum consistent with the operational requirement for the function.

4.1.5 Method of operation

4.1.5.1 Single channel simplex operation shall be used in the frequency band 117.975 – 137.000 MHz at all stations providing service for aircraft engaged in international air navigation.

4.1.5.2 In addition to the above, the ground-to-air voice channel associated with an ICAO standard radio navigation aid may be used, subject to regional agreement, for broadcast or communication purposes or both.

4.1.6 Plan of assignable VHF radio frequencies for use in the international aeronautical mobile service

Introduction

This plan designates the list of frequencies available for assignment, together with provision for the use by the aeronautical mobile (R) service of all frequencies with a channel spacing of 25 kHz, and of all frequencies with a channel width and spacing of 8.33 kHz.

The plan provides that the total number of frequencies required in any region would be determined regionally.

In many regions particular frequencies have already been allotted for particular functions such as, for instance, aerodrome or approach control. The plan does not make such allotments (except as provided for in 4.1.1.1), such action being taken regionally if considered desirable.

4.1.6.1 The frequencies in the frequency band 117.975 – 137.000 MHz for use in the aeronautical mobile (R) service shall be selected from the lists in 4.1.6.1.1.

Note 1.— The frequencies 136.500 – 136.975 MHz inclusive are not available for assignment to channels of less than 25 kHz width.

Note 2.— Services that continue operation using 25 kHz assignments will be protected in regions implementing 8.33 kHz channel spacing.

4.1.6.1.1 *List of assignable frequencies:*

List A — assignable frequencies in regions or areas where 25 kHz frequency assignments are deployed:

118.000 – 121.450 MHz in 25 kHz steps
121.550 – 123.050 MHz in 25 kHz steps
123.150 – 136.975 MHz in 25 kHz steps

List B — assignable frequencies in regions or areas where 8.33 kHz frequency assignments are deployed:

118.000 – 121.450 MHz in 8.33 kHz steps
121.550 – 123.050 MHz in 8.33 kHz steps
123.150 – 136.475 MHz in 8.33 kHz steps

4.1.6.1.2 **Recommendation.—** *Frequencies for operational control communications may be required to enable aircraft operating agencies to meet the obligations prescribed in Annex 6, Part I, in which case they should be selected from a dedicated band which is determined regionally.*

Note.— It is recognized that the assignment of such frequencies and the licensing of the operation of the related facilities are matters for national determination. However, in regions where a problem exists with respect to the provision of frequencies for operational control purposes, it may be advantageous if States endeavour to coordinate the requirements of aircraft operating agencies for such channels prior to regional meetings.

4.1.6.2 The frequencies that may be allotted for use in the aeronautical mobile (R) service in a particular region shall be limited to the number determined as being necessary for operational needs in the region.

Note.— The number of frequencies required in a particular region is normally determined by the Council on the recommendations of Regional Air Navigation Meetings.

4.2 Utilization in the frequency band 108 – 117.975 MHz

4.2.1 The block allotment of the frequency band 108 – 117.975 MHz shall be as follows:

— *Band 108 – 111.975 MHz:*

a) ILS in accordance with 4.2.2 and Annex 10, Volume I, 3.1.3; provided that only frequencies ending in *odd tenths* of a megahertz or *odd tenths plus a twentieth* of a megahertz are used;

b) VOR provided that only frequencies ending in either *even tenths* or *even tenths plus a twentieth* of a megahertz are used; and

c) GNSS ground-based augmentation system (GBAS) in accordance with Annex 10, Volume I, 3.7.3.5.

— *Band 111.975 – 117.975 MHz:*

a) VOR;

b) GNSS ground-based augmentation system (GBAS) in accordance with Annex 10, Volume I, 3.7.3.5.

Note 1.— Guidance material relating to the distance separation required to prevent harmful interference between ILS, VOR and GBAS/VHF data broadcast (VDB) when using the band 108 – 111.975 MHz is found in the Handbook on Radio Frequency Spectrum Requirements for Civil Aviation *(Doc 9718), Volume II* – Frequency assignment planning criteria for aeronautical radio communication and navigation systems.

Note 2.— Guidance material relating to the distance separation required to prevent harmful interference between VOR and GBAS when using the band 112.050 – 117.900 MHz is found in the Handbook on Radio Frequency Spectrum Requirements for Civil Aviation *(Doc 9718), Volume II* – Frequency assignment planning criteria for aeronautical radio communication and navigation systems.

Note 3.— As of 26 November 2026, subject to the conditions stated in 5.2.1, the frequency 113.250 MHz may be used for the provision of RPAS C2 Link communication services described in Annex 10, Volume V, Chapter 5.

4.2.2 For regional assignment planning, the frequencies for ILS facilities shall be selected in the following order:

a) localizer channels ending in *odd tenths* of a megahertz and their associated glide path channels;

b) localizer channels ending in *odd tenths plus a twentieth* of a megahertz and their associated glide path channels.

4.2.2.1 ILS channels identified by localizer frequencies ending in an *odd tenth plus one twentieth* of a megahertz in the band 108 – 111.975 MHz shall be permitted to be utilized on the basis of regional agreement for general use on or after 1 January 1976.

4.2.3 For regional assignment planning, the frequencies for VOR facilities shall be selected in the following order:

a) frequencies ending in *odd tenths* of a megahertz in the band 111.975 – 117.975 MHz;

b) frequencies ending in *even tenths* of a megahertz in the band 111.975 – 117.975 MHz;

c) frequencies ending in *even tenths* of a megahertz in the band 108 – 111.975 MHz;

d) frequencies ending in *50 kHz* in the band 111.975 – 117.975 MHz, except as provided in 4.2.3.1;

e) frequencies ending in *even tenths plus a twentieth* of a megahertz in the band 108 – 111.975 MHz except as provided in 4.2.3.1.

4.2.3.1 Frequencies for VOR facilities ending in *even tenths plus a twentieth* of a megahertz in the band 108 – 111.975 MHz and all frequencies ending in *50 kHz* in the band 111.975 – 117.975 MHz shall be permitted to be utilized for general use on the basis of a regional agreement when they have become applicable in accordance with the following:

a) in the band 111.975 – 117.975 MHz at least one year after the approval of the regional agreement concerned;

b) in the band 108 – 111.975 MHz giving a period of two years or more after the approval of the regional agreement concerned.

4.2.4 To protect the operation of airborne equipment during the initial stages of deploying VORs utilizing 50 kHz channel spacing in an area where the existing facilities may not fully conform with the Standards in Annex 10, Volume I, Chapter 3, all existing VORs within interference range of a facility utilizing 50 kHz channel spacing shall be modified to comply with the provisions of Annex 10, Volume I, 3.3.5.7.

4.2.5 *Frequency deployment.* The geographical separation between facilities operating on the same and adjacent frequencies shall be determined regionally and shall be based on the following criteria:

a) the required functional service radii of the facilities;

b) the maximum flight altitude of the aircraft using the facilities;

c) the desirability of keeping the minimum IFR altitude as low as the terrain will permit.

Note.— Guidance material on this subject is contained in the Handbook on Radio Frequency Spectrum Requirements for Civil Aviation *(Doc 9718), Volume II* – Frequency assignment planning criteria for aeronautical radio communication and navigation systems.

4.2.6 **Recommendation.—** *To alleviate frequency congestion problems at locations where two separate ILS facilities serve opposite ends of the same runway or different runways at the same airport, the assignment of identical ILS localizer and glide path paired frequencies should be permitted, provided that:*

a) the operational circumstances permit;

b) each localizer is assigned a different identification signal; and

c) arrangements are made whereby the localizer and glide path not in operational use cannot radiate.

Note.— The Standards in Annex 10, Volume I, 3.1.2.7.2 and 3.1.3.9, specify the equipment arrangements to be made.

4.3 Utilization in the frequency band 960 – 1 215 MHz for DME

Note[2].— Guidance on the frequency planning of channels for distance measuring equipment (DME) systems is given in the Handbook on Radio Frequency Spectrum Requirements for Civil Aviation *(Doc 9718), Volume II* – Frequency assignment planning criteria for aeronautical radio communication and navigation systems.

2. As of 26 November 2026, this Note becomes Note 1.

Note 2.— As of 26 November 2026, subject to the conditions stated in 5.2.1, the frequency band 960 – 1 164 MHz may be shared with RPAS C2 Link communication services described in Annex 10, Volume V, Chapter 5.

4.3.1 DME operating channels bearing the suffix "X" or "Y" in Table A, Chapter 3 of Annex 10, Volume I shall be chosen on a general basis without restriction.

Note.— The channel pairing plan provides for the use of certain Y channels with either VOR or MLS. The guidance material in Annex 10, Volume I, Attachment C, Section 7, includes specific provisions relating to situations where the same, or adjacent channel, is used in the same area for both systems.

4.3.2 DME channels bearing the suffix "W" or "Z" in Table A, Chapter 3 of Annex 10, Volume I, shall be chosen on the basis of regional agreement when they become applicable in accordance with the following:

a) for restricted regional use on or after, whichever is the later:

   1) 1 January 1989; or

   2) a date prescribed by the Council giving a period of two years or more following approval of the regional agreement concerned;

b) for general use on or after, whichever is the later:

   1) 1 January 1995; or

   2) a date prescribed by the Council giving a period of two years or more following approval of the regional agreement concerned.

Note.— "Restricted use" is intended to refer to the limited use of the channel by only suitably equipped aircraft and in such a manner that:

a) the performance of existing DME equipment not capable of operating on these multiplexed channels will be protected from harmful interference;

b) a general requirement for the carriage of DME airborne equipment capable of operating on these multiplexed channels will not be imposed; and

c) operational service provided to international operators using existing DME equipment without the multiplexed channel capability is not derogated.

4.3.3 For regional assignment planning, the channels for DME associated with MLS shall be selected from Table 4-2.

Table 4-2

Group	*DME channels*	*Associated paired VHF channels*	*Remarks*	*Assignment procedure*
1	EVEN 18X to 56X	ILS 100 kHz spacings	Would normally be used if a single DME is paired with ILS and is part of MLS	
2	EVEN 18Y to 56Y	ILS 50 kHz spacings		
3	EVEN 80Y to 118Y	VOR 50 kHz spacings Odd tenths of a MHz		for general use (see 4.3.1)
4	ODD 17Y to 55Y	VOR 50 kHz spacings		
5	ODD 81Y to 119Y	VOR 50 kHz spacings Even tenths of a MHz		
6	EVEN 18W to 56W	No associated paired VHF channel		
7	EVEN 18Z to 56Z	No associated paired VHF channel		
8	EVEN 80Z to 118Z	No associated paired VHF channel		for later use (see 4.3.2)
9	ODD 17Z to 55Z	No associated paired VHF channel		
10	ODD 81Z to 119Z	No associated paired VHF channel		

Note.— DME channels in Groups 1 and 2 may be used in association with ILS and/or MLS. DME channels in Groups 3, 4 and 5 may be used in association with VOR or MLS.

4.3.3.1 *Groups 1 to 5.* These DME channels shall be permitted to be used generally. In selecting channels for assignment purposes, the following rules are applicable:

a) when an MLS/DME is intended to operate on a runway in association with an ILS, the DME channel, if possible, shall be selected from Group 1 or 2 and paired with the ILS frequency as indicated in the DME channelling and pairing table in Table A of Annex 10, Volume I, Chapter 3. In cases where the composite frequency protection cannot be satisfied for all three components, the MLS channel may be selected from Group 3, 4 or 5;

b) when an MLS/DME is intended to operate on a runway without the coexistence of an ILS, the DME channel to be used shall preferably be selected from Group 3, 4 or 5.

4.3.3.2 *Groups 6 to 10.* These DME channels shall be permitted to be used on the basis of a regional agreement when they have become applicable in accordance with the conditions specified at 4.3.2.

4.3.4 **Recommendation.—** *Coordination of regional DME channel assignments should be effected through ICAO.*

4.4 Utilization in the frequency band 5 030.4 – 5 150.0 MHz

Note 1.— Guidance material on the frequency protection planning of MLS facilities is contained in Attachment G to Annex 10, Volume I.

Note 2.— Guidance on determining coordination distances between MLS facilities and ground stations providing feeder links to non-geostationary mobile satellites is contained in ITU-R Recommendation S.1342.

Note 3.— As of 26 November 2026, subject to the conditions stated in 5.2.1, this frequency band is shared with RPAS C2 Link terrestrial communication services in the portion 5 030.4 – 5 091 MHz, as described in Annex 10, Volume V, Chapter 5.

4.4.1 The MLS channels shall be selected from Table A, Chapter 3 of Annex 10, Volume I.

4.4.2 For regional planning purposes, MLS channels shall be selected in accordance with the conditions specified in 4.3.3 for the associated DME facility.

4.4.3 Channel assignments in addition to those specified in 4.4.1 shall be made within the 5 030.4 – 5 150.0 MHz sub-band as necessary to satisfy future air navigation requirements.

4.5 Utilization in the frequency band 4 200 – 4 400 MHz

4.5.1 Utilization for radio altimeters

(To be developed)

4.5.2 Utilization for wireless avionics intra-communications (WAIC) systems

Note.— The following provisions for WAIC define the requirements that ensure that WAIC systems and radio altimeters can provide their intended functions while multiple aircraft are in mutual radio range. Coexistence between WAIC systems and radio altimeters installed on board the same aircraft is addressed by the specific implementation and established airworthiness certification processes. Further guidance on those implementation issues is addressed in the European Organisation for Civil Aviation Equipment (EUROCAE)/RTCA documents ED-319 and DO-402 Minimum Operating Performance Specification (MOPS) for Wireless Avionics Intra-Communication Equipment within 4 200 – 4 400 MHz. In addition, considerations on protecting aircraft systems from unauthorized interactions are addressed in EUROCAE/RTCA ED-203A and DO-356A Airworthiness Security Methods and Considerations.

4.5.2.1 WAIC systems shall only be used for communications related to the safety and regularity of flight between two or more points on a single aircraft.

4.5.2.2 WAIC systems shall not cause harmful interference to radio altimeter systems and WAIC systems on other aircraft.

Note.— Compliance with 4.5.2.2 is achieved by limiting the power of WAIC emissions below the level at which altimeter performance may be affected, consistent with 4.5.2.4 below. Furthermore, careful consideration is necessary when accommodating components of the WAIC system located outside of the aircraft fuselage. EUROCAE/RTCA documents ED-260A and DO-378A provide one acceptable method of demonstrating compliance with that power limit.

4.5.2.3 A WAIC system located on board one aircraft shall perform its intended function while subject to emissions from WAIC and radio altimeter systems located on board other aircraft.

Note.— EUROCAE/RTCA documents ED-260A and DO-378A provide one acceptable method of demonstrating compliance with 4.5.2.3 via test. Alternatively, the critical coexistence scenario described in those documents may also be used to develop appropriate analyses to demonstrate compliance with 4.5.2.3.

4.5.2.4 Radio frequency (RF) characteristics of WAIC systems

4.5.2.4.1 WAIC systems shall operate in the frequency band 4 200 – 4 400 MHz.

4.5.2.4.2 The power of the total aggregate emissions of all WAIC transmitters on board an aircraft shall not exceed an equivalent isotropic radiated power of –20 dBm, referenced to a point source, which is assumed to be located at the geometrical centre of the aircraft.

Note.— Refer to EUROCAE/RTCA documents ED-260A and DO-378A Minimum Aviation System Performance Standard (MASPS) for Coexistence of Wireless Avionics Intra-Communication (WAIC) Systems within 4 200 – 4 400 MHz, which adopt the total aggregate effective isotropic radiated power (EIRP) limit for WAIC systems and provide a practical verification procedure on how to ascertain whether the limit is satisfied.

4.5.2.4.3 The overall occupied bandwidth shall be maintained completely within the allocated frequency band 4 200 – 4 400 MHz including any offsets such as Doppler shift or frequency tolerances, where the occupied bandwidth is defined as the bandwidth for which 99 per cent of the signal energy falls within the lower and upper frequency limits.

Note.— The ITU Radio Regulations define the occupied bandwidth as "the width of a frequency band such that, below the lower and above the upper frequency limits, the mean powers emitted are each equal to a specified percentage β/2 of the total mean power of a given emission", the value of β/2 being 0.5 per cent.

4.5.2.4.4 The necessary bandwidth (NB) of the WAIC transmitter shall be calculated according to Appendix 1 of the ITU Radio Regulations.

4.5.2.4.5 The boundary between the out-of-band and spurious domains shall be determined according to Annex 1, Appendix 3 of the ITU Radio Regulations. The required attenuation of the mean power of any unwanted emission relative to the total mean power *P* shall meet or exceed the following conditions:

— 50 per cent of NB < *f* < 150 per cent of NB: Linear increase (in dB) from 24d B to 35 dB within a reference bandwidth of 4 kHz (Note 1);

— 150 per cent of NB < *f* < start of the spurious domain: 35 dB within a reference bandwidth of 4 kHz (Note 1); and

— Spurious domain: 56+10log(*P*) or 40 dB, whichever is less stringent, measured in a reference bandwidth of 1 MHz (Note 2).

Note 1.— Reference bandwidth of 4 kHz within the out-of-band domain in accordance with Annex 11, Recommendation ITU-R SM.1541-6 of the ITU Radio Regulations. The parameter f is the frequency separation from the centre frequency of the transmit signal.

Note 2.— Reference bandwidth of 1 MHz within the spurious domain in accordance with Appendix 3, paragraph 7 of the ITU Radio Regulations and determination of attenuation for low-power device radio equipment in accordance Appendix 3, paragraph 13 of the ITU Radio Regulations.

4.5.2.5 Out-of-band interference tolerance of a WAIC receiver

Note.— These requirements describe the out-of-band tolerance in which the WAIC receiver must meet its performance requirements without taking into account any mitigation afforded by its installation.

4.5.2.5.1 Receivers shall tolerate interference from sources operating outside of the frequency band 4 200 – 4 400 MHz whose total combined emitted power falling within the frequency band 4 200 – 4 400 MHz as measured at the receiver does not exceed a power spectral density of –120 dBm/MHz.

4.5.2.5.2 Receivers shall tolerate interference from sources operating outside of the frequency band 4 200 – 4 400 MHz whose total combined power as measured at the receiver does not exceed –20 dBm.

CHAPTER 5. UTILIZATION OF FREQUENCIES FOR RPAS C2 LINK COMMUNICATION SERVICES

Applicable as of 26 November 2026

5.1 Satellite-based C2 Link systems

5.1.1 Satellite-based RPAS C2 Link systems shall operate in the following frequency bands:

a) frequency bands with an appropriate allocation to aeronautical safety services under the aeronautical mobile-satellite (route) service (AMS(R)S). Frequency bands that meet these criteria and can be used for RPAS C2 Links, subject to the conditions associated with the allocations, are: 1 610 – 1 626.5 MHz and 5 000 – 5 150 MHz;

Note.— The SARPs contained in Annex 10, Volume III, Part I, Chapter 4 and Part II, Chapter 2 address requirements for air traffic control (ATC) communications.

b) frequency bands with an allocation to aeronautical safety services under the mobile-satellite service (MSS) where AMS(R)S operations have priority access. Frequency bands that meet these criteria and can be used for RPAS C2 Links are: 1 545 – 1 555 MHz and 1 646.5 – 1 656.5 MHz*;*

Note.— The SARPs contained in Annex 10, Volume III, Part I, Chapter 4 and Part II, Chapter 2 address requirements for ATC communications.

c) frequency bands with an allocation to the fixed satellite service (FSS) where the conditions in ITU Resolution 155 (WRC-15) are met. Frequency bands in which this resolution applies are:

— 10.95 – 11.2 GHz (space-to-Earth);
— 11.45 – 11.7 GHz (space-to-Earth);
— 11.7 – 12.2 GHz (space-to-Earth) in Region 2;
— 12.2 – 12.5 GHz (space-to-Earth) in Region 3;
— 12.5 – 12.75 GHz (space-to-Earth) in Regions 1 and 3;
— 19.7 – 20.2 GHz (space-to-Earth);
— 14.0 – 14.47 GHz (Earth-to-space); and
— 29.5 – 30.0 GHz (Earth-to-space) with an ITU satellite earth station class of “UG”.

Note 1.— UG is an earth station on board an unmanned aircraft communicating with a space station of a geostationary-satellite network in the fixed-satellite service for the control and non-payload communications of unmanned aircraft systems in non-segregated airspaces in the frequency bands listed under resolves 1 of ITU Resolution 155 (WRC-15).

Note 2.— Particular note needs to be taken of the timing and order of functions as delineated in ITU Resolution 155 (WRC-15), and in particular the references to necessary actions.

5.1.2 Remotely piloted aircraft (RPA) and remote pilot station (RPS) earth stations shall operate within the notified and recorded technical parameters of the associated satellite network, including specific or typical earth stations as published by the ITU.

5.1.3 RPA and RPS earth stations operating in accordance with 5.1.1 c) shall use FSS assignments that have been successfully coordinated under Article 9 of the ITU Radio Regulations and recorded in the Master International Frequency Register (MIFR) with a favourable finding under Article 11 of the ITU Radio Regulations including Nos. 11.31, 11.32 or 11.32A where applicable, and except those assignments that have not successfully completed coordination procedures under No. 11.32 by applying Appendix 5 paragraph 6.d.i of the ITU Radio Regulations.

5.2 Terrestrial C2 Link communication systems

5.2.1 Terrestrial RPAS C2 Link systems shall operate in bands allocated to the Aeronautical Mobile (Route) Service (AM(R)S). Frequency bands with such allocations include 113.250 MHz and 136.925 MHz (common signalling channels for VDL Mode 4), 960-1164 MHz and 5030-5091 MHz. The operation of the C2 Link within any of these bands shall be implemented so as to be compatible with the systems currently using these allocations. Compatibility shall be ensured through the development and application of necessary SARPs and determined on the basis of regional air navigation agreements.

ATTACHMENT A. CONSIDERATIONS AFFECTING THE DEPLOYMENT OF LF/MF FREQUENCIES AND THE AVOIDANCE OF HARMFUL INTERFERENCE

1. Particularly in areas of high density of NDBs, it is recognized that efficient planning is essential in order to: a) ensure satisfactory operation of ADF equipment, and b) provide the most efficient usage of the limited frequency spectrum available for the NDB service. It is axiomatic that regional meetings will so plan facilities as to ensure that all facilities will receive the best possible protection from harmful interference. Nevertheless, in certain regions, congestion of facilities has been such that regional meetings have had to plan in terms of a *minimum* protection ratio.

Regional meetings include in their planning consideration of such factors as:

a) the possibility of reducing the number of NDBs required, by coordination of system plans;

b) the possibility of reducing the coverage where a lesser grade of service than that obtainable within the rated coverage is acceptable;

c) the characteristics of ADF equipment in use;

d) the atmospheric noise grades, appropriate to the area concerned;

e) ground conductivity; and

f) interference protection required at the edge of the rated coverage.

Of the foregoing factors, that which is most susceptible to improvement of a technical kind is c).

2. The 1979 World Administrative Radio Conference adopted regulations concerning the assignment of frequencies for aeronautical radio beacons operating in the LF/MF frequency bands. A minimum protection ratio (wanted/ unwanted signal ratio) of 15 dB is to be used as the basis for frequency assignment planning (RR Appendix 12). The following data concerning the attenuation characteristics of ADF equipment were used in the EUR region to aid in the frequency assignment process:

Frequency difference (kHz)	*Attenuation (dB)*
0	0
1	1
2	6
2.4	10
3	20
3.6	30
4.3	40
5	50
6	65
7	80

The above figures (or distance separation criteria derived from them) have also been applied in other regions in determining the minimum protection ratio.

Where a bearing accuracy of ±5 degrees is required at the edge of cover, a minimum protection of 15 dB by day should be used as the basis for LF/MF channel assignment planning.

3. In view of the fact that in many regions there is a need to improve the planning criteria, it is considered that the main source from which improvement can be derived is recognition of higher attenuation figures than those given above. Regional meetings are accordingly advised that, when the congestion is such that the use of the above figures no longer permits efficient planning of the LF/MF frequency spectrum available, the following figures represent, from a technical point of view, the best that can be accepted in determining distance separation criteria:

Frequency difference (kHz)	*Attenuation (dB)*
0	0
1	6
3	35
5	65
6	80

When using these figures, it should be noted that the RF selectivity of modern ADF equipment is, in general, better than these figures and that, while the RF selectivity of older ADF equipment is not better than these figures, consideration of the dynamic characteristic of this older equipment shows this to be better. It could therefore be expected that frequency planning based on the new figures would considerably improve the service provided to users of modern equipment, and would not materially reduce the service presently provided to those aircraft using the older equipment.

Nevertheless, in their planning, regional meetings would need to consider this question most carefully.

4. It is further noted that, in certain regions, many NDBs are used with voice channels and that this usage is aligned with the Note at the head of Annex 10, Volume I, 3.4.6. It is expected that regional meetings will take this fact into account when establishing criteria for frequency planning.

ATTACHMENT B. GUIDING PRINCIPLES FOR LONG DISTANCE OPERATIONAL CONTROL COMMUNICATIONS

Note.— The numerical sequence of the clauses below does not signify any order of relative importance.

1. Aeronautical Operational Control (AOC) HF Stations should be authorized where no other means for the exercise of long distance operational control are available or where the use of the normal communication services provided for safety and regularity of flights are unsuitable or inadequate.

2. The total number of ground stations on the worldwide radio channels should be kept to a minimum consistent with economic and operational efficiency. Consequently,

a) there should normally be not more than one station per State; and

b) where an agreed affinity of interest exists between adjoining States, a single station may be provided by agreement among them to serve the needs of all the aircraft operating agencies requiring a service into those States.

3. Depending on the national policy of the State or States, aeronautical stations could be operated by States on behalf of one or more aircraft operating agencies provided that the agencies' requirements for flexibility and direct communication to their aircraft can be met, or aeronautical stations could be operated by an aircraft operating agency or a communication agency serving the interests of one or more aircraft operating agencies and operating under licence issued by the State or States concerned.

4. The licences should be issued on a regular renewal basis and, pursuant to RR 4.11 and in accordance with RR 43.4, should prohibit "public correspondence", or point-to-point type traffic, or other communications traffic not meeting the definition of operational control communications.

5. VHF (general purpose or AOC channels) and not HF should be used when an aircraft is within the coverage of an appropriate VHF aeronautical station.

Note.— The specific categories of messages that may be handled on aeronautical mobile (R) service channels are prescribed in Annex 10, Volume II, Chapter 5, 5.1.8. The same chapter defines the standard communications procedures for the service including the requirements for maintaining watch in Annex 10, Volume II, Chapter 5, 5.2.2. In accordance with RR 18.6 of the ITU Radio Regulations, licences should define the purpose of the station for aeronautical operational control (as defined in Annex 6, Part I) and should specify the general characteristics in accordance with Appendix 27 of the Radio Regulations.

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