Flight Radio Operator Certificates

Second Edition

October 15, 1956

Introductory Note

Civil Aeronautics Manual 33 contains in a consolidated form (1) Civil Air Regulations Part 33, Flight Radio Operator Certificates, adopted by the Civil Aeronautics Board and amendments 33–1 through 33–8; and (2) the rules, policies, and interpretations issued by the Administrator of Civil Aeronautics in application to the various sections of the regulations.

CAA *rules* are supplementary regulations issued pursuant to authority expressly conferred on the Administrator in the Civil Air Regulations. Such rules are mandatory and must be complied with.

CAA *policies* provide detailed technical information on recommended methods of complying with the Civil Air Regulations. Such policies are for the guidance of the public and are not mandatory in nature.

CAA *interpretations* define or explain words and phrases of the Civil Air Regulations. Such interpretations are for the guidance of the public and will be followed by the Administrator in determining compliance with the regulations.

This manual is arranged to give the number, title, and text of each section of the regulations followed by any rules, policies, or interpretations applicable to that section. These rules, policies, or interpretations of the Administrator are identified by consecutive dash numbers appended to the regulation section number.

This manual contains all material published as Supplement No. 1, dated June 16, 1950, Supplement No. 2, dated April 8, 1951, and Supplement No. 3, dated July 2, 1951, to Civil Aeronautics Manual 33. It will be revised from time to time in accordance with changes in the Civil Air Regulations Part 27, or as the need for additional explanations are brought to the attention of the Administrator.

Contents

Flight Radio Operator Certificates

33.0 *Applicability of this part.* This part establishes certification and general operating rules for flight radio operators.

33.1 *Definitions.*

(a) As used in this part the words below shall be defined as follows:

(1) *Flight radio operator.* A flight radio operator shall mean an individual whose primary assigned duty during flight over any route or route segment is to communicate by radio with other stations.

(2) *Authorized representative of the Administrator.* An authorized representative of the Administrator shall mean any employee of the Civil Aeronautics Administration or any private person, authorized by the Administrator to perform any of the duties imposed upon him by the provisions of this part.

Certification Rules

33.5 *Application for certificate.* An application for a certificate shall be made on a form and in a manner prescribed by the Administrator.[1]

33.6 *Issuance.*

(a) A flight radio operator certificate shall be issued by the Administrator to an applicant who meets the requirements of this part.

(b) Pending a review of the applicant's application and supplementary documents and the issuance of a certificate by the Administrator, an authorized representative of the Administrator may, subject to such conditions and limitations as the Administrator may prescribe, issue a temporary flight radio operator certificate to an applicant who meets the requirements of this part.

33.7 *Duration.*

(a) A flight radio operator issued to a United States citizen shall remain in effect until surrendered, suspended, revoked, or otherwise terminated by order of the Board. A certificate issued to an applicant other than a United States citizen shall remain in effect for a period no longer than 12 months after the date of issuance, but it may be reissued without further demonstration of technical competence.

(b) A temporary flight radio operator certificate shall remain in effect for a period no longer than 3 months after the date of isuance.

(c) After revocation, and upon request after suspension, the certificate shall be returned to the Administrator.

(d) Nothing in this section shall be construed to deny or defeat the jurisdiction of the Federal courts, the Administrator, or the Board to impose any authorized sanction, including revocation of the certificate, for a violation of the Act or of the Civil Air Regulations occurring during the effective period of the certificate.

33.8 *Exchange of certificates.* All flight radio operator certificates issued prior to February 15, 1950, shall expire on May 1, 1953. Each certificate holder who surrenders his outstanding certificate to the Administrator on or before May 1, 1953, shall be issued a new certificate if he meets or has met the requirements of this part. Between May 1, 1953, and May 1, 1954, the Administrator may at his discretion renew or reissue a certificate without requiring a reexamination or further demonstration of technical competence.

33.9 *Display.* A flight radio operator shall upon request, present his airman and medical

[1] Since a flight radio operator, as a prerequisite to obtaining a certificate under the provisions of this part, is required to hold a radio-telegraph operator license of second class, or higher, complying with the international requirements, an applicant for a flight radio operator certificate who is a United States citizen should apply for the FCC license at an appropriate field office of the FCC and accomplish the written examination required for the issuance of such license prior to making application to the Administrator for the issuance of a flight radio operator certificate. Applicants who are not United States citizens should make application at any CAA international field office or United States district office located near international airports used by foreign flag air carriers.

certificates for examination by any authorized representative of the Civil Aeronautics Board or Administrator or by any State or local law enforcement officer.

33.10 *Change of address.* Within 30 days after any change in the permanent mailing address of a certificated flight radio operator, he shall notify the Administrator in writing of his new address. The notice shall be mailed the Administrator of Civil Aeronautics, attention Airman Records Branch, Washington 25, D. C.

General Certificate Requirements

33.21 *Citizenship.* An applicant for a flight radio operator certificate may be a citizen of any country or a person without nationality.

33.22 *Age.* An applicant shall be at least 18 years of age.

33.23 *Education.* An applicant shall be able to read, write, and understand the English language and speak the same without any accent or impediment of speech that would interfere with two-way radio conversation.

33.24 *Examinations and tests.* Examinations and tests shall be conducted by an authorized representative of the Administrator at such times and places as the Administrator may designate. The passing grade for all oral and written examinations shall be at least 70 percent. The practical examination shall be accomplished to the satisfaction of the authorized representative of the Administrator.

33.25 *Reexamination after failure.* An applicant who has failed any prescribed written [2] or practical examination or test may not apply for reexamination within a 30-day period unless he presents a signed statement by a person authorized by the Administrator to give instruction in the subject or subjects in which reexamination is desired that the applicant has received an additional 5 hours of instruction in the subject or subjects failed and is considered competent to pass the examination or test.

33.26 *Substantiation of experience.* An applicant shall present to the Administrator satisfactory documentary evidence to substantiate the experience qualifications for a flight radio operator certificate.

33.27 *Physical standards.* An applicant shall present evidence that he has, within the 12 months immediately preceding the date of application, met the physical standards of the third class prescribed in Part 29 of the Civil Air Regulations: Provided, That an applicant who is unable to distinguish aviation signal red, aviation signal green, and white shall be issued an airman certificate appropriately endorsed to prohibit the holder thereof from exercising the privileges of such certificate except under such conditions, or with the use of such equipment, which would not require the ability to distinguish such aviation signal colors.

Qualifications for a Certificate

33.31 *Experience.* An applicant shall hold a radiotelegraph operator license of second class, or higher, complying with the requirements specified in the general radio regulations annexed to the International Telecommunications Convention; [3] and

(a) Shall have had at least 12 months of satisfactory experience as a radio operator in aircraft, maritime, or ground stations, commercial or military, including at least four months of experience as a radiotelegraph operator; and shall have had at least 50 hours of experience in the operation of aircraft radio during flight; or

(b) Within 90 days immediately preceding application shall have completed successfully a course of instruction which the Administrator approves as adequate for the training of a flight radio operator.

33.31-1 *Qualifications for flight radio operator certificate—experience (CAA policies which apply to sec. 33.31 (a)).*

(a) *Change in radio operator license requirements.* In May 1949, the international standards for licensing aviation personnel became binding on the member states of ICAO. Such states, prior to this date, could permit air crewmen other than pilots to serve in their respective

[2] The regulations of the Federal Communications Commission regarding the issuance of radiotelegraph operator licenses provide that an applicant for such a license who has failed the prescribed written examination for the issuance of such license is ineligible for 2 months to retake such examination.

[3] To operate a radio station on an aircraft of United States registry with a radio station licensed by the Federal Communications Commission, an individual must hold, in addition to his airman certificate, the appropriate radio operator's license issued by the Federal Communications Commission.

capacity without airman certificates. Those states which did not require air crewmen to hold certificates prior to May, 1949, can now issue certificates in accordance with the international standards, or validate certificates of other member states which meet the international requirements. For this reason, it appears that certain member states may decide to have their crewmen hold certificates or licenses issued by other member states rather than institute procedures to issue their own certificates. In view of this, it appears extremely desirable that the U. S. be in a position to issue flight radio operator airman certificates to citizens of other member states, if those states so desire.

As originally written, Part 33 of the Civil Air Regulations permitted only those U. S. citizens holding second class, or higher, radiotelegraph operator licenses issued by the FCC to apply for the U. S. flight radio operator certificate. It will be noted that the recent amendment to Part 33 now makes it possible for certain eligible foreign citizens to apply for the U. S. airman certificate should they so desire. This amendment does not affect U. S. citizens in any way but permits the U. S., through the Civil Aeronautics Administration, to fulfill its reciprocity agreements by issuing certificates to citizens of other countries with which the U. S. has reciprocity in the issuance of such certificates. Although the U. S. has had reciprocal agreements with numerous foreign governments in the issuance of flight radio operator certificates, the CAA could not issue airman certificates to applicants other than U. S. citizens because of the prerequisite that applicants must hold a Federal Communications Commission radio operator license which is available to U. S. citizens only. There are no changes in the requirements that any individual serving on an aircraft of U. S. registry with radio station licensed by the FCC must hold the appropriate radio operator license as well as the CAA flight radio operator airman certificate.

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33.31–2 *Requirements for approved flight radio operator courses (CAA rules which apply to sec. 33.31 (b)).*

(a) *General.* Graduates of a flight radio operator course approved by the Administrator are deemed to have met the experience requirements for the certificate. This means that they are accepted on equal terms with an applicant who has met the minimum experience requirements. For these reasons, it is essential that the requirements for approved flight radio operator courses include adequate training facilities and sufficient coverage of the subject to insure acceptable proficiency of flight radio operators who apply for certification as graduates of an approved course.

(b) *Application for approval.* The agency or applicant desiring approval of a flight radio operator course must submit to the local agent three copies of the course outline, a description of the facilities and equipment to be used, and a list of instructors with their qualifications, together with a letter to the Administrator requesting approval.

(c) *Training course outline.* It is not mandatory that the training course outline have the subject headings arranged exactly as listed in the following example. Any arrangement of general headings and subheadings will be satisfactory provided all the subject material listed herein is included. *Each general subject of the outline shall be broken down in detail showing items to be covered.*

Additional subjects, such as international law, flight hygiene, advanced aircraft electrical systems, flight navigation, or others not closely associated with flight radio operating, may not be included in hourly requirements of the approved training outline. If an operator desires to add such subjects to a training course outline, they shall be separated from the required flight radio operator subjects and the time devoted thereto shall not be applied toward meeting the established time minimums.

(1) *Format of training outline.* The ground course outline and the flight course outline shall be combined in one loose-leaf binder and shall include a table of contents divided into two parts—ground course and flight course. Each part of the table of contents must contain a list of the major subjects, together with hours allotted to each subject and the total classroom and flight hours.

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(2) *Ground course outline.*

Subject	*Classroom hours*
Duties of a Flight Radio Operator	3
Regulations	15
Aircraft Radio Installations	90
Aircraft Electrical System	10
Ground Radio Aids	10
Radio Navigation	32
Operating Procedures	80
TOTAL CLASSROOM HOURS	240

(i) *Duties of a flight radio operator.* Brief history of this airman in airline operations. General outline of duties and responsibilities. Cooperation with other crew members.

(ii) *Regulations.*

(*a*) *Civil Air Regulations.* Pertinent sections of the Civil Air Regulations taken from Parts 4b, 16, 29, 33, 40, 41, 42, 44, 60 and 61. Sections to be covered include: CAA requirements for storage batteries, generators and associated switches and controls; type certification of radio equipment; flight radio operator requirements; radio equipment required on U. S. scheduled and U. S. irregular air carriers; radio communications; general flight crew subjects.

(*b*) *International civil aviation organization (ICAO) practices.* Familiarity with general flight radio operating provisions contained in the following ICAO documents: Communication Procedures; ICAO Q Code; The Notam Code; Air Traffic Control; Meteorology (Weather Codes); Search and Rescue; International Air Service Operations.

(iii) *Aircraft radio installations.*

(*a*) *Communications equipment.* HF and MF communications transmitters and receivers; VHF communications units.

(*b*) *Radio navigation equipment.* Range receiver and filter, ADF and MDF; marker beacon receiver; omni-range receiver; ILS receivers and indicator; LORAN; radio altimeter.

(*c*) *Other equipment.* Intercom; audio control boxes; isolation amplifier; liferaft radio; aircraft antennas; radio control panels; flux gate compass.

(iv) *Aircraft electrical system.* Student should be familiar with the basic primary electrical system of one of the long-range aircraft (Constellation, DC–4, DC–6, or Boeing 377), including at least the following items:

(*a*) *Generators.* Principles of operation; method of mounting and driving; rated output; connection to main bus; carbon-pile voltage regulators; differential-voltage reverse-current relays; field circuit breakers; equalizers; field switches; procedure in event of generator failure.

(*b*) *Batteries.* Location; ampere-hour capacity; connection in system; utilization of outside power on ground.

(*c*) *General.* Type of wiring (single or two-wire) in electrical system; use of a. c. on aircraft; means of obtaining a. c.; fuses, precaution in changing fuses; circuit breakers; bonding and shielding.

(v) *Ground radio aids.*

(*a*) *Communications.* Agencies furnishing ground-to-air communications in United States; outside United States.

(*b*) *Radio range stations.* Four-course aural; VOR; VAR; MOR.

(*c*) *Radio beacons.* Class "H" facilities; marine radio beacons; aerophares; fan marker beacons; "Z" marker beacons; bone-shaped marker beacons; Racon beacons.

(*d*) *Other radio aids to navigation.* Ground D/F; broadcast stations; ocean station vessels (OSV's); Consol.

(vi) *Radio navigation.*

(*a*) *Aircraft D/F procedures.* Relative bearings; magnetic bearings; true bearings; homing; abeams; orientation; distance-off; overheads.

(*b*) *Errors and corrections in radio direction-finding.* Coastline effect; terrain error; night effect; Mercator correction; turning and banking errors; quadrantal error.

(*c*) *Radio navigation charts.* Description of charts used in long-range operations; plotting radio bearings.

(*d*) *Radio letdowns.* Range; QDM; ILS; GCA.

(*e*) *LORAN.* Basic theory; operation aboard aircraft.

(vii) *Operating procedures.*

(*a*) Preflight inspection and radio

check. Action in the event of radio failure.

(*b*) Communications facilities provided and nature of service given to aircraft.

(*c*) Position reporting, calling, acknowledgment, departure and arrival radio procedure.

(*d*) Suitable frequencies for DAY and NIGHT long-distance flights, changing radio guard.

(*e*) ICAO air-to-ground radio procedures—routine and emergency—radiotelegraph and radiotelephone.

(*f*) Conditions justifying transmission of distress, urgency, and safety signals; procedure during distress traffic; radio communications during ditchings and forced landings; cancellation of aircraft distress and emergency traffic; use of liferaft radio.

(*g*) ICAO "Q" Code,[1] abbreviations and complementary code.

(*h*) Communications in air traffic control; air traffic control standards and procedures; oceanic air traffic control (OATC); communication in GCA work.

(*i*) Meteorological broadcasts; codes.

(*j*) Time signals.

(*k*) Search and Rescue procedure; ocean station vessels (OSV's).

(3) *Flight course outline.*

(i) *Flight training.* A minimum of 25 hours of flight training will be required on a multiengine aircraft incorporating a built-in flight radio operator station. This training may be conducted on flights which are engaged in other than training operations, including scheduled air carrier or other operations where passengers or cargo are carried for hire. All flight training, however, must be given under the direct supervision of a certificated flight radio operator.

Approximately 50 percent of the flight training should be devoted to practical radio navigation. The remainder should be allotted to CW and VOICE communications.

Two students may be credited with equal flight time if the installation is arranged to permit one student to operate the communications equipment while the second student performs radio navigational training.

Students should endeavor to carry out the following exercises on every flight:

Attend briefing and preflight discussion.
Collect necessary codes, papers, and equipment.
Preflight test of radio equipment, establish communication with tower.
Establish communication with control station.
Carry out communication procedure for departure.
Maintain watch on control frequency.
Send periodical position reports to base via CW.
Make all necessary airways VOICE contacts.
Obtain loop bearings and fixes, plot fixes.
Obtain weather reports, decode and pass to pilot.
Home on "broadcast" station or aerophare, determine overhead or close abeams.
Listen in to pilot using radio approach and landing aids.
Complete a radio log.

At various stages during flight training the instructor should set simple faults in the radio and associated equipment to give the student practice in determining, locating, and rectifying faults.

(d) *Equipment.*

(1) *Classroom.* The classroom radio equipment should include at least one each of the various units incorporated in a typical aircraft installation utilizing a flight radio operator. For example:

Aircraft communications transmitter, A1, A2, A3 emission, medium-frequency and high-frequency, with external loading unit.
Aircraft communications receiver covering bands approximately 200 kc/s to 18 mc/s.
Aircraft VHF communications transceiver.
Automatic direction-finder with manual rotation control.
Marker beacon receiver.
LORAN receiver—indicator.
Liferaft transmitter.

[1] "Q" Signals:
QAB through QAZ, QBA, QBC, (used with QMI, QFT, QBJ, QMZ, and QTH). QBF, QBG, QBH, QBI, QBS, QBV, QBX, QCB, QCE, QDL, QDM, QDR, QDT, QDX, QFE, QFG, QFH, QFM, QFS, QGE, QGJ, QGQ, QGZ, QHH, QID, QLH, QMH, QMZ, QNI, QNT, QRD, QUG, QUO, QUR, QUS, QUU, QUV, QUX.

Jack boxes, microphones, headphones, range filter, appropriate power supplies, circuit-breakers, and trouble-shooting equipment.

Charts and instruction manuals covering such items as: basic primary electrical systems on DC–4, DC–6, Constellation, and Stratocruiser aircraft; flux gate or other electronic compass; radio altimeter; ILS, GCA, CONSOL, VAR, VOR.

(2) *Aircraft.* The aircraft shall be equipped with at least one each of the following units:

Aircraft communications transmitter, A1, A2, A3 emission, medium-frequency and high-frequency, with external loading unit.

Aircraft communications receiver covering bands approximately 200 kc/s to 18 mc/s.

Aircraft VHF communications transceiver.

Automatic direction-finder with manual rotation control.

Marker beacon receiver.

Jack boxes, microphones, headphones, range filter, appropriate power supplies.

The approved course operator may contract or obtain written agreements with aircraft operators for the use of suitable aircraft. A copy of the contract or written agreement with an aircraft operator shall be attached to each of the three copies of the course outline submitted for approval. In all cases, the approved course operator is responsible for the nature and quality of instruction given during flight.

(3) *Ground station.* The school shall maintain a ground radio station, or have arrangements with other agencies to provide two-way radio communication (CW and VOICE) with the training aircraft.

(e) *Instructors.*

(1) Sufficient classroom instructors must be available to prevent an excessive ratio of students to instructors. Any ratio in excess of 25 to 1 will be considered unsatisfactory.

(2) At least one ground instructor must possess a valid flight radio operator certificate and be utilized to coordinate instruction of ground school subjects.

(3) Instructors who conduct flight training must possess valid flight radio operator certificates.

(f) *Revision of training course.* Requests for revisions to course outline, facilities, and equipment shall follow procedures for original approval of the course. Revisions should be submitted in such form that an entire page or pages of the approved outline can be removed and replaced by the revisions.

The list of instructors may be revised at any time without request for approval, provided the minimum requirement of section 33.31–2 (e) above is maintained.

(g) *Student records and reports.* Approval of a course shall not be continued in effect unless the course operator keeps an accurate record of each student, including a chronological log of all instructions, subjects covered, and course examinations and grades, and unless he prepares and transmits to the CAA not later than January 31 of each year, a report containing the following information:

(1) The names of all students graduated, together with school grades for ground and flight courses.

(2) The names of all students failed or dropped, together with school grades and reasons for dropping.

(h) *Quality of instruction.* Approval of a course shall not be continued in effect unless at least 80 percent of the students who apply within 90 days after graduation are able to qualify on the first attempt for certification as flight radio operators.

(i) *Statement of graduation.* Each student who successfully completes the approved flight radio operator course shall be given a statement of graduation. An acceptable statement of graduation is:

CIVIL AERONAUTICS ADMINISTRATION,
Washington 25, D. C.

GENTLEMEN: This is to certify that

_____
(Name of graduate)

on _____
(Date of graduation)

successfully completed a course of training for flight radio operators which is approved by the Administrator of Civil Aeronautics.

Signed _____

Title _____

School _____

(j) *Change of ownership, name, or location.*

(1) *Change of ownership.* An approved course for flight radio operators shall not be transferable from one course operator to another.

(2) *Change in name.* An approved course changed in name but not changed in ownership shall remain valid if the change is reported by the approved course operator to the local agent who will issue a letter of approval under the new name.

(3) *Change in location.* An approved course shall remain in effect even though the approved course operator changes location if the change is reported without delay by the operator to the local agent who will inspect the facilities to be used in the new location and, if they are found to be adequate, issue a letter of approval showing the new location.

(k) *Cancellation of approval.* Failure to meet or maintain any of the standards set forth herein for the approval or operation of an approved flight radio operator course shall be considered sufficient reason for discontinuing approval of the course.

If an operator should desire voluntary cancellation of his approved course, a letter requesting cancellation should be directed to the Administrator of Civil Aeronautics through the local agent.

(l) *Duration.* The authority to operate an approved flight radio operator course shall expire two years from the date of issuance; provided, that any such authorization which was granted prior to January 1, 1949, shall expire on December 31, 1950.

(m) *Renewal.* Application for renewal of an approved flight radio operator course may be made by letter to the Administrator through the local CAA agent at any time within 60 days prior to the expiration date. Renewal of approval will depend upon the course operator meeting the conditions for original approval and having a satisfactory record as an operator.

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33.31–3 *Countries signatory to the international telecommunications convention (CAA interpretation which apply to sec. 33.31).*

Applicants for the flight radio operator certificate must possess a radiotelegraph operator's license of second class or higher issued by a country included in the following list:

Aden (British)
Afghanistan
Alaska (U. S. A.)
Albania, People's Republic of
Argentine Republic
Australia, Commonwealth of
Austria
Bahamas (British)
Barbados (British)
Basutoland (British)
Bechuanaland (Protectorate of) (British)
Belgian Congo
Belgium
Bermuda (British)
Bolivia
Brazil
British Guiana (British)
British Honduras (British)
Bulgaria
Burma
Byelorussia, S. S. Republic of
Canada (including Newfoundland)
Canal Zone (U. S. A.)
Ceylon (British)
China
Cironaica (Italian)
Colombia, Republic of
Colony of Gilbert and Ellis Islands (British)
Cuba, Republic of
Cyprus (British)
Czechoslovakia
Danzig, Free City of
Denmark
Dominican Republic
Egypt
Eire (Ireland)
Eritrea (Italian)
Estonia
Ethiopia
Falkland Islands and Dependencies (British)
Fiji (British)
Finland
France
French Colonies, Protectorates and Territories under French Mandate
French Indo China
Gambia (Colony and Protectorate) (British)
Germany
Gibraltar (British)
Gold Coast (Ashanti Colony, Northern Territories and Togo-land under British Mandate) (British)
Greece
Greenland
Guatemala
Haiti, Republic of
Hawaii (U. S. A.)
Honduras, Republic of
Hong Kong (British)
Hungary
Iceland

India
Indonesia
Iran (Persia)
Iraq
Ireland (Eire)
Israel, State of
Italian East Africa
Italian Aegean Islands
Italian Somaliland
Italy
Jamaica (including the Turks and Caicos Islands and the Cayman Islands) (British)
Japan
Karafuto (Japanese)
Kenya (Colony and Protectorate) (British)
Lebanon
Leeward Islands (Antigua, Montserrat, St. Kitts, and Nevis, Virgin Islands) (British)
Libya (Italian)
Luxemburg
Malay States (Straits Settlements and Federated Malay States of Perak, Selanger, Negri Sembilan and Pahang, and the non-Federated Malay States of Johore, Kedah, Kelantan, Trengganu, Brunei) (British)
Malta (British)
Mauritius (British)
Mexico
Monaco (Principality of)
Mongolia, S. S. R.
Morocco (French)
Morocco (Spanish)
Nauru (Australian)
Netherlands West Indies (Curacao)
Netherlands, The
New Guinea (Australian)
New Hebrides (British)
New Hebrides (French)
New Zealand
Nicaragua
Nigeria (British)
Norfolk, Island of (Australian)
North Borneo, State of (British)
Northern Rhodesia (British)
Norway
Nyasaland, (British Protectorate)
Pakistan
Panama, Republic of
Papua (Australian)
Paraguay
Philippines, Republic of the
Poland, Republic of
Polynesia, (U. S. A. possessions in)
Portugal
Portuguese Colonies
Puerto Rico (U. S. A.)
Roumania
Ruanda-Urundi (Belgian)
Saudi Arabia, Kingdom of
St. Helena and Ascension Islands (British)
Sarawak (British)
Seychelles (British)
Siam (Thailand)
Sierra Leone (Colony and Protectorate) (British)
Solomon Islands (British Protectorate)
Somaliland, (British Protectorate)
Southern Rhodesia
Spain
Spanish Colonies
Straits Settlements (United Kingdom)
Surninam
Swaziland (British)
Sweden
Swiss Confederation
Syria
Tanganyika, Territory of (British)
Thailand (Siam)
Tonga
Transjordan (Hashemite Kingdom of)
Trinidad and Tobago (British)
Tripolitania (Italian)
Tunisia
Turkey
Uganda (Protectorate of) (British)
Ukraine, Soviet Socialist Republic of the
Union of South Africa, and Mandated Territory of Southwest Africa)
Union of Soviet Socialist Republics
United Kingdom of Great Britain and Northern Ireland
United States of America
Uruguay, Oriental Republic of
Vatican City, State of
Venezuela, United States of
West Indies (U. S. A. possessions in)
Western Samoa, Trust Territory of (New Zealand)
Windward Islands (Grenada, St. Lucia, Dominica and St. Vicente) (British)
Yemen
Yugoslavia, People's Federated Republic of
Zanzibar (Protectorate of) (British)

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33.32 *Knowledge.*

(a) An applicant shall satisfactorily accomplish a written examination[4] on the following subjects:

(1) The provisions of the Civil Air Regulations applicable to the duties of a flight radio operator;

(2) Aircraft radio equipment, domestic and foreign;

(3) Radio navigation of aircraft;

(4) Aircraft radio operating procedures, domestic and foreign.

33.32–1 Qualifications for flight radio operator certificate—knowledge (CAA policies which apply to sec. 33.32 (a)).

(a) *CAA–FCC joint written examination.* Effective February 15, 1950, the Federal Communications Commission (FCC) amended Title 47, Part 13, Rules Governing Commercial Radio Operators, by adding under section 13.21 a new Element 7, AIRCRAFT RADIOTELEGRAPH. This means that a radio operator may not serve on U. S. aircraft employing radiotelegraphy unless he has completed a supplementary FCC written examination and code test (if he does not hold a first-class radiotelegraph license), or has served as a flight radio operator on U. S. aircraft employing radiotelegraphy.

The written examination subjects included in Element 7 of Part 13 of the FCC, Rules and Regulations, are the same as those subjects incorporated in section 33.32 (a) of the Civil Air Regulations; therefore, it becomes necessary to coordinate examining procedures between FCC and CAA to avoid overlapping or duplication between respective regulations pertaining to the flight radio operator. The CAA and FCC through appropriate coordination have designed a single written examination which will meet the flight radio operator knowledge requirements of the amended Civil Air Regulation, the FCC aircraft radiotelegraph endorsement, and those standards established by the International Civil Aviation Organization (ICAO). The written examination will be revised at periodic intervals with CAA and FCC personnel coordinating such revisions.

Although the flight radio operator written examination is a combined FCC–CAA examination, FCC policies do not permit that agency to delegate any part of its aircraft radiotelegraph examining functions to another agency such as CAA; therefore, to avoid taking duplicate examinations, U. S. citizens desiring to apply for the written examination should do so at a field office of the FCC. The written examination consists of one hundred questions of the multiple-choice type on the following subjects: (1) Civil Air Regulations and the International Civil Aviation Organization (ICAO) procedures; (2) Theory and Operation of Aircraft Radio Equipment; (3) Radio Navigation of Aircraft; (4) Aircraft Radio Operating Procedures.

Upon satisfactory completion of the examination together with code test, if the applicant does not hold a radiotelegraph first-class license, the FCC will insert their aircraft radiotelegraph endorsement on the operator's license. The CAA will accept a license so endorsed as evidence that the holder meets the knowledge requirements and code proficiency for a flight radio operator airman certificate. If the applicant meets the requirements of Part 33 of the Civil Air Regulations, the CAA will conduct the practical examination and issue the airman certificate.

To comply with reciprocity provisions as set forth in Part 33 of the Civil Air Regulations, an eligible foreign citizen desiring to take the U. S. airman certificate examination for flight radio operators may apply at any CAA international field office or U. S. district office located near international airports used by foreign flag air carriers. Agents in these offices will administer both the written and practical tests and issue the airman certificate.

(Published in 15 F. R. 5842, Aug. 30, 1950, effective upon publication.)

33.32–2 *The content and scope of the written examination required for a flight radio operator*

[4] The subjects included under the knowledge requirement are those subjects on which an applicant will be required to accomplish satisfactorily a written examination. These subjects are over and above the minimum requirements for the issuance of a radiotelegraph operator license of second class as set forth by the International Telecommunications Convention. The Federal Communications Commission issues a license to radiotelegraph operators of second class or higher for specified service in aircraft which includes examinations adequately covering the above-mentioned subjects. Therefore, an applicant who submits satisfactory documentary evidence to the Administrator that he has successfully accomplished the FCC written examination for a radiotelegraph operator's license for aircraft operation will not be required to take the written examination prescribed herein.

certificate as proof of aeronautical knowledge (CAA policies which apply to sec. 33.32).

The new policy of CAA–FCC coordination in preparing a single written examination for flight radio operator applicants is described in section 33.32–1. As a result of this change in examining procedure, United States citizens who are applicants for this certificate should take the written examination at FCC offices in the United States. This practice permits the applicant to take his written examination required by both FCC and CAA at one session, thereby avoiding duplication. FCC practices with regard to the actual administering of the examination apply in these cases.

The written examination is designed for the purpose of determining whether or not an applicant possesses the basic theoretical knowledge required for the safe performance of his duties as a flight radio operator. Since the desired aeronautical knowledge required of a flight radio operator is extensive in scope, complete coverage in the examination is not feasible. The written theoretical examination is, therefore, a sampling device wherein a limited number of questions are proposed for the purpose of determining this knowledge.[2]

(Published in 16 F. R. 3405, Apr. 19, 1951, effective May 1, 1951.)

33.33 *Skill.* **An applicant shall (a) satisfactorily accomplish a practical examination on the inspection, adjustment, and routine repair of aircraft radio communications (telegraphy and telephony) and radio navigational equipment; (b) satisfactorily accomplish a practical flight examination on the operation of aircraft radio communications (telegraphy and telephony) and radio navigation; and (c) demonstrate his ability to send and receive international Morse code at a speed of 20 words per minute code groups, and 25 words per minute plain language.[3]**

Satisfactory evidence that an applicant meets the speed requirement shall be the possession of a radiotelegraph operator license, first class, issued under the minimum standards as prescribed by the International Telecommunications Convention.

Since the FCC requires an applicant for a radiotelegraph operator license of second class for aircraft operation to meet this speed requirement, such license will be acceptable to the Civil Aeronautics Administration in lieu of a practical demonstration of his code ability.

33.33–1 *The content and scope of the practical examination required for a flight radio operator certificate in proof of aeronautical skill (CAA policies which apply to sec. 33.33).*

All applicants for a CAA flight radio operator airman certificate must take the practical examination which is conducted by a CAA Aviation Safety Agent or a CAA designated flight radio operator examiner in the industry. The practical examination is designed for the specific purpose of determining whether or not an applicant possesses the necessary skill required for the safe performance of his duties as a flight radio operator.[3]

(Published in 16 F. R. 3405, Apr. 19, 1951, effective May 1, 1951.)

Operating Rules

33.41 *Certificate required.* **No individual shall serve as a flight radio operator in air commerce on an aircraft of United States registry without or in violation of the terms of a certificate issued in accordance with the provisions of this part. He shall have his certificate in his personal possession when performing his duties.**

33.42 *Medical certificate.* **No individual shall exercise the privileges accorded by a flight radio operator certificate unless he has in his personal possession while so serving a medical certificate or other evidence satisfactory to the Administrator showing that he has met the physical requirements appropriate thereto within the preceding 12 months.**

33.43 *Operation during physical deficiency.* **No individual shall exercise the privileges accorded by a flight radio operator certificate during any period of known physical**

[2] The Administrator has compiled a study guide to aid applicants in preparing for the flight radio operator certificate written examination. This guide is contained in appendix A of the Civil Aeronautics Manual 33.

[3] This speed requirement in sending and receiving international Morse code is higher than the minimum International Telecommunications Convention requirements for a radiotelegraph operator license of second class. An applicant who holds a second-class radiotelegraph operator license will be required to demonstrate his ability to meet this speed requirement or furnish satisfactory evidence that he does meet this requirement.

[3] The administrator has compiled a guide to aid applicants in preparing for the flight radio operator certificate practical examination. This guide is contained in appendix B of Civil Aeronautics Manual 33.

deficiency or increase in physical deficiency which would render him unable to meet the physical requirements prescribed for the issuance of his currently effective medical certificate.

33.44 *Grace period for periodic tests and other qualification procedures.* Whenever this part requires an examination, test, or other qualifying procedure at stated intervals, a grace period of 15 days shall be allowed: *Provided,* That the effective date of the examination, test, or other qualifying procedure, if met within the grace period, shall be the same as it would have been if met on the day immediately preceding the beginning of such grace period.

33.45 *Recent experience.* No individual shall perform, or be assigned to perform, the duties of a flight radio operator (a) unless within the preceding 12 months he has had at least 50 hours of satisfactory experience as a flight radio operator, or (b) until an authorized representative of the Administrator has checked the individual and has determined that he is familiar with all current radio information pertaining to the routes to be flown and competent with respect to the operating procedures and radio equipment to be used.

33.46 *Identification.* The holder of a certificate issued under the provisions of this part shall not, except while engaged in operations conducted by a scheduled air carrier, exerciset he privileges conferred by the certificate unless he has in his personal possession a current airman identification card or other identification card acceptable to the Administrator which duly describes him. The airman identification card may be obtained from the Administrator who shall prescribe its form and the manner of applying for it.

Appendix A

Study Guide for the Written Examination for a Flight Radio Operator Certificate

(a) Taking the Examination.

The applicant should read each statement or question carefully so that it is fully and completely understood before looking at the multiple choices given as possible answers. An attempt should be made by the applicant to frame in his mind not only the problem, but also what he conceives to be a satisfactory answer. After this process is followed, the applicant should then determine which answer among those given more exactly corresponds with the answer which he has arrived at from reading and understanding the problem involved. Many of the questions posed are operational. The applicant, therefore, is required to know not only the rule but also its application.

Only one of the alternate answers given is correct in its entirety. The others may be answers that are a direct result of an incorrect procedure, wrong interpretations of the question, or popular misconceptions. The applicant should see that he thoroughly understands the question or lead-in statement and then select the answer which he considers to be the best and most complete answer.

If difficulty is encountered with a particular problem, the applicant should proceed to the next problem where the answer is known, returning to those unanswered problems after going through the examination. By utilizing this procedure, the applicant's time and energy will be conserved to maximum advantage in the demonstration.

An applicant who is adequately prepared will have ample time to complete his work within the time limit established. An applicant's inability to complete the examination within the time specified may indicate that he has not acquired adequate proficiency or that his reactions and thinking processes are not sufficiently rapid to assure reasonable skill in making decisions and taking appropriate action. If the applicant remembers these facts and if he knows the subject matter on which he is being tested, he will have no difficulty with the examination.

The applicant's answer sheet, together with any papers used during the examination for computation, should be surrendered to the examining officer before leaving the examination room.

Listed below are subjects from which the actual questions are drawn, together with a group of sample questions to acquaint the applicant with the type of questions he will be required to answer. Certain reference material is listed to aid in preparing for the examination.

(b) Study Outline for Flight Radio Operator Certification Examination.

(1) *Civil Air Regulations.* Applicant should be familiar with the more pertinent Parts of the Civil Air Regulations such as 4b, 16, 29, 33, 40, 41, 42, 43, 44, and 60; ANC Air Traffic Control Manual. The only concern with Part 4b will be those portions pertaining to the radio and associated electrical equipment requirements. From these regulations, examination questions of two distinct types are drawn; those which pertain to aircraft radio and associated electrical equipment insofar as the Civil Aeronautics Administration is concerned, and those questions that deal with general allied matters of concern to flight crew members in general, such as operations, air traffic control and communications, with particular emphasis on Parts 41 and 42.

(2) *Aircraft Electrical System.* Applicant should be familiar with the basic primary

electrical system of one of the long-range aircraft (Constellation, DC–4, or DC–6) including at least the following items:

(i) *Generators.* Principles of operation; method of mounting and driving; rated output; connection to main bus; carbon-pile voltage regulators; differential-voltage reverse-current relays; field circuit breakers; equalizing resistors; field switches; procedure in event of generator failure.

(ii) *Batteries.* Location; ampere-hour capacity; connection in system; precautions in using auxiliary power.

(iii) *General.* Trip-free and non-trip-free circuit breakers; type of wiring (single or two-wire) in electrical system; main radio circuit breaker; means of obtaining a. c. on the aircraft; equipment requiring a. c.; precaution when changing fuses; running load.

(3) *Bonding and Shielding.* Object in bonding and shielding radio and electrical equipment on aircraft; resistance limitations in bonding; material used for bonding connections or straps; length of straps; particular aircraft electrical circuit which does not lend itself to noise suppression by wideband filters; material used for shielding.

(4) *Precipitation Static.* Type of precipitation causing most severe electrostatic build-ups on aircraft; potential of aircraft with respect to precipitation; latest steps toward preventing aircraft from going into corona; ultimate objective in development of aircraft antennas; advantage of insulated antenna; discharge wicks; large-diameter wire.

(5) *VHF Communications Unit.* Power output of VHF aircraft transmitters; radiated power not a direct function of installed power; advantages of VHF for control-tower communication; "line-of-sight" for various cruising altitudes; purpose of squelch control; guard channel; VHF emergency frequencies.

(6) *Aircraft D F Loops.* Principles of operation; physical size and structure; purpose of loop housing; purpose and method of shielding; cardioid and "figure-8" patterns; factors upon which range of loop depends; reason for using null instead of maximum signal; factors upon which width and definition of null depend; frequency bands normally used in aircraft D/F; quadrantal error—effect of frequency on quadrantal error; loop calibration methods; error at cardinal points of azimuth; calibration curve; compensating mechanism; principles of ADF including sense antenna; use of thyratrons, threshold sensitivity control, hunting, rotatable azimuth scale, use of dual ADF; anti-static use of loop; wave fronts and polarization in aircraft D/F.

(7) *Radio Direction Finding.*

(i) *General.* Relative bearings; magnetic bearings; true bearings; deviation; variation; flying QDM's; distance-off with radio bearings; flying QDR's; need for BFO in MDF; running fix on single station; disadvantages of running fix on single station; establishing radio fix on two stations; establishing radio fix on three stations; advancing and retarding radio bearings; speed lines; course lines; obtaining best accuracy in rough air, doubling the angle off the course; use of magnetic compass, flux gate compass, gyro compass when taking radio bearings.

(ii) *Homing.* With drift, without drift, disadvantage of homing without correction for drift.

(iii) *Orientation.* Principles; pointer-progression method; heading-progression method; reason for bringing station abeam; recommended procedure in rough air.

(iv) *Boxing.* Principles; advantages and disadvantages; effect of high wind; pattern under no-wind conditions; relative bearings during 90° turns.

(v) *Overheads.* Method of determining overhead with manual D/F, with automatic D/F; close abeams; volume control when making overhead manually.

(8) *Errors and Corrections in Radio Direction Finding.*

(i) *Coastline Effect.* Angle causing greatest error; angle causing no error; angle causing least error; results when aircraft taking bearing; results when ground station taking bearing.

(ii) *Terrain Errors.* Type of terrain causing greatest and least error in radio bearings; remedies.

(iii) *Night Effect.* Causes; indications; hours during which it is most pronounced; steps aboard aircraft to reduce night effect; frequency band subjected to greatest night effect;

approximate distance from station at which night effect disappears.

(iv) *Mercator Correction.* Reason for applying correction; correction tables; mid. latitude and difference of longitude; sign of correction when aircraft taking bearings; when ground station taking bearings; when aircraft is due north of station.

(v) *Miscellaneous Errors.* Turning or banking error; heterodyne error (synchronized stations); operator error; plotting error; precipitation static.

(9) *Calculating Radio Bearings.*

Given: True heading, desired true bearing.
Find: Relative bearing which will give desired true bearing.

Given: Magnetic heading, desired QDM.
Find: Relative bearing which will give desired QDM.

Given: True bearing of aircraft from radio station; compass heading, deviation, variation.
Find: Relative bearing.

Given: Compass heading of aircraft; deviation, variation, quadrantal error, and relative bearing.
Find: True bearing.

Given: Magnetic heading, variation, relative bearing, quadrantal error.
Find: True bearing.

Given: DR position of aircraft; position of station; compass heading; deviation; variation; relative bearing; Mercator tables.
Find: Bearing to plot on Mercator chart.

Given: Compass heading, deviation, variation, relative bearing in degrees right or left of nose, quadrantal error.
Find: True bearings.

(10) *Aircraft Receivers.* General familiarity with air carrier aircraft receivers including: normal frequency coverage for communications; power supply; purpose of BFO, AVC, output limiter, antenna phasing control, crystal filter; range receiver; marker beacon receiver.

(11) *Aircraft Transmitters.* General familiarity with air carrier aircraft transmitters including: necessary frequency coverage; normal power output on aircraft transmitters; arcing at high altitudes; purpose of change-over relay; tuning for plate current dip; attempting to secure same antenna current on all frequencies; PI network; purpose of loading unit; power supply; types of emission.

(12) *Aircraft Antennas.* Various types used for VHF, HF and MF communication; most suitable antenna for range flying; antennas used with radio altimeter; ILS equipment, LORAN, and marker beacon receiver; sense antenna.

(13) *Miscellaneous Equipment.* Principles of isolation amplifier, interphone, range filter; liferaft transmitter.

(14) *LORAN.* Principles of operation; master station; slave station; pulse received first aboard aircraft; duration of pulse; recurrence interval; time difference; indicated time difference; stations required for a single line-of-position; stations required for a radio fix; operational steps in securing a line-of-position; accuracy of lines; accuracy of fix, sky waves; ground waves; One-Hop-E waves, One-Hop-F waves; usable distance by day and night; effect when using trailing antenna on Loran receiver; blinking signals; charts; interpreting legend appearing on charts; lines of constant time difference; purpose of interval between master station pulse and slave station pulse; base line; base line extension; number of channels and frequencies in use at present time; status of low frequency Loran; apparent advantages of low frequency Loran; agencies responsible for U. S. Loran facilities; basic adjustments on Loran receiver; coding delay; arrangement of station pairs; sky wave correction; uncertainty of sky wave correction; interference in the Loran receiver; "grass" on the scope; effect, if any, of quadrantal error, coastline error, night effect; most favorable position of aircraft for greatest accuracy; least favorable position of aircraft for greatest accuracy; method of compilation of Loran charts; matching and identifying signals.

(15) *Radio Range Stations.*

(i) *Low Frequency, 4-Course Aural.* Principle of operation; general advantages and disadvantages; SBRA, MRA, MRL; disadvan-

(d) Sample Examination Questions.

Typical questions, similar to those used in official flight radio operator written examinations, appear in the following test. Answers will be found in appendix A (e). It should be noted that these questions are only "samples" and do not include all types asked in examinations, or all topics tested. The ability to answer these questions, therefore, does not necessarily indicate that the applicant is adequately prepared to take the examination. However, the questions will acquaint an applicant with the general form in which questions are presented and will enable instructors to construct similar questions to cover the entire field. Applicants should realize that proper preparation for this examination requires a considerable expenditure of time and effort, as well as guidance from a competent instructor.

(1) *Section one—Civil Air Regulations.*

1. In scheduled air carrier operations outside the continental United States, "long distance" operation is an operation
    1. in which dispatch is based entirely on spot weather and destination weather.
    2. in which only four-engine aircraft are used.
    3. in which dispatch is based entirely on forecast weather at intended destination.
    4. in which the time interval between stops is of sufficient duration to require that the dispatch be based entirely on forecasts of weather expected at the intended destination and alternates.
    5. involving routes not longer than 1500 miles between emergency stops.
2. Where a communications channel serves point-to-point contacts in addition to ground-to-plane service
    1. priority will be given plane-to-ground communications provided they do not interfere with observance of the international silent periods.
    2. priority will be given to all plane-to-ground and ground-to-plane communications.
    3. priority will be given only to aircraft in distress.
    4. the aircraft will not call in if the channel is handling point-to-point traffic.
    5. the first 15 minutes of each hour will be reserved for aircraft position reports.
3. The on-course weather reports, made a part of the clearance, must be at the time the aircraft departs no older than
    1. 30 minutes.
    2. 1 hour.
    3. 2 hours.
    4. 1 hour, 30 minutes.
    5. 45 minutes.
4. All airmen noting any irregularity or hazard which, in their opinion, makes for unsafe operation shall report such irregularity or hazard immediately to the
    1. CAB.
    2. dispatcher.
    3. operations manager.
    4. chief pilot.
    5. chief flight radio operator.
5. The steps of only one of the following five procedures are listed in the desired sequence of action. In the event of two-way radio failure, which is most generally accepted as the correct procedure for the pilot in command to follow?
    1. (a) Land as soon as practicable; or
       (b) if weather conditions permit, proceed VFR; or
       (c) proceed according to current flight plan.
    2. (a) If weather conditions permit, proceed VFR; or
       (b) proceed according to current flight plan; or
       (c) land as soon as practicable.
    3. (a) Return to point of departure; or
       (b) land at the nearest airport; or
       (c) proceed in accordance with VFR.
    4. (a) Proceed according to current flight plan; or
       (b) if weather conditions permit, proceed VFR; or
       (c) land as soon as practicable.
    5. (a) Proceed according to current flight plan; or
       (b) land as soon as practicable; or
       (c) if weather conditions permit, proceed VFR.

(2) *Section two—Theory and Operation of Radio.*

1. Shielding of an aircraft D/F loop
    1. allows the aircraft transmitter to be operated without causing erroneous bearings.
    2. permits electromagnetic waves to enter the loop and by-passes electrostatic charges to ground.
    3. permits only electrostatic charges to enter the loop.
    4. permits electromagnetic waves and electrostatic charges to enter the loop.
2. A vertical antenna is nondirectional, and the voltage induced in a vertical antenna is
    1. 45° out of phase with the flux of the radio wave.
    2. in phase with the flux of the radio wave.
    3. 90° out of phase with the flux of the radio wave.
    4. 180° out of phase with the flux of the radio wave.
3. Severe arcing sometimes occurs in aircraft transmitters when the flight is being conducted at extremely high altitudes. This undesirable discharge is caused by
    1. variation in capacitance between the aircraft and ground.
    2. increase in ohmic resistance of all resistors in the transmitter.
    3. breakdown of air-gap at high altitudes.
    4. automatic build-up of plate voltage at high altitudes.
4. The principle of operation of the omnidirectional range is the phase comparison between
    1. the reference audio signal and the audio signal of the simultaneous voice feature, this difference in degrees being a direct indication of the azimuth.
    2. one audio and one RF signal when the phase difference in degrees is a direct indication of the azimuth.
    3. two audio signals, reference and variable, when this difference in phase is made to vary with azimuth.
    4. two RF signals when this difference in phase is made to vary with azimuth.
5. Recent work in precipitation static elimination indicates that one of the most satisfactory means of reducing this static on aircraft is to
    1. install a grounding switch and ground the communications antenna to the hull when precipitation static is heavy.
    2. cover the antennas with insulating material such as polyethelyne.
    3. increase the size of the insulators used in the antenna systems.
    4. trail a long piece of low-resistance copper wire.

(3) *Section three—Radio Navigation.*

1. Which one of the following is a *TRUE* statement?
    1. In plotting radio bearing lines, best accuracy will be attained if the acute angle is 30° or less.
    2. In loop orientation a 5° change in relative bearing is always sufficient for positively checking the station direction.
    3. A ground operator transmits an Adcock bearing of 26° to the aircraft; however, the flight radio operator knows the aircraft's position is south of the station so he plots a bearing of 206°.
    4. An Adcock D/F system is installed to obtain the highest degree of accuracy in bearings.
    5. A loop calibration curve can be considered accurate for any D/F frequency from 200 kc to 1800 kc.
2. The true bearing from a radio station to an aircraft is 063°. The aircraft is flying a compass heading of 018°, deviation 2° West, variation 12° West. The relative bearing given on the aircraft loop is
    1. 239°.
    2. 237°.
    3. 235°.
    4. 249°.
    5. 251°.
3. Which is the *FALSE* statement in the following group?
    1. When night effect is experienced, it will be found that this effect dis-

appears when the aircraft reaches a point where the ground wave from the station predominates.
2. Errors introduced in radio bearings because of terrain effect will be greatest when the terrain between aircraft and ground stations is flat, wet, and sandy.
3. It is advisable to avoid taking radio bearings on synchronized stations.
4. Flying in or near the vicinity of electrical storms may cause erratic functioning of aircraft D/F equipment.
5. When a trailing antenna is extended while taking bearings with an ADF, it is possible that a reciprocal will result if the antenna is reeled out to such a length that it is resonant to a harmonic frequency of the station which bearings are being taken.

4. The principle disadvantage of homing on a station without applying correction for drift is the
   1. gradual approach to an upwind position near the station.
   2. gradual approach to a downwind position near the station.
   3. broad null as the station is approached.
   4. curved track made to the station.
   5. excessive loss in time of an arrival at the station.
5. An aircraft is homing with the manual D/F on an aerophare. It is extremely important that the initial overhead be accurately determined on first attempt. To avoid the possibility of missing the overhead
   1. the D/F receiver should be adjusted for maximum volume.
   2. the aircraft may be turned approximately 5° LEFT before reaching the station, and a close abeam check to the LEFT observed.
   3. the aircraft may be turned approximately 5° RIGHT, before reaching the station and a close abeam check to the RIGHT observed.
   4. the aircraft may be turned approximately 5° LEFT or RIGHT before reaching the station, and a close abeam check observed on either side.
   5. the D/F loop should be set at 0° and no further adjustments made during overhead determination.

(4) *Section four—Operating Procedures.*

1. One high frequency has been approved as the interim safety and emergency frequency in the high frequency spectrum and will remain in effect until adopted internationally or discarded for a more desirable high frequency. This present frequency is:
   1. 6510 kc/s.
   2. 7770 kc/s.
   3. 8280 kc/s.
   4. 9980 kc/s.
2. When it is 1100 GCT in position 34:00N 75:00W, the GCT in position 34:00N 45:00W is
   1. 0700.
   2. 0900.
   3. 1100.
   4. 1300.
3. The pilot of a particular aircraft is concerned about the gustiness at destination airport. He requests the flight radio operator to secure a report on the maximum gust speed at this airport. The appropriate "Q" signal is
   1. QUG.
   2. QNT.
   3. QTL.
   4. QFS.
4. Certain U. S. Coast Guard radiobeacons have been modified to provide
   1. radiotelegraph communication with aircraft.
   2. radiotelephone communication with aircraft on call.
   3. continuous carrier with keyed modulation identification during the 1 minute ON, 2 minutes OFF, 24 hours per day.
   4. continuous carrier for D/F work whenever so requested by an aircraft.
5. When automatic keying is used on the CRT-3 emergency life raft transmitter, the unit transmits "S O S" signals
   1. alternately on 500 kc/s for 60 seconds, then 8280 kc/s for 30 seconds.
   2. on 8280 kc/s only.

3. on 500 kc/s and 8280 kc/s simultaneously.
4. on 500 kc/s and 8280 kc/s alternately, changing frequency every 40 to 50 seconds.

(e) Answers to Sample Questions.

(1) *Civil Air Regulations.*

Question	*Answer*
1	4
2	2
3	4
4	3
5	4

(2) *Theory and Operation of Radio.*

Question	*Answer*
1	2
2	2
3	3
4	3
5	2

(3) *Radio Navigation.*

Question	*Answer*
1	4
2	1
3	2
4	4
5	4

(4) *Operating Procedures.*

Question	*Answer*
1	3
2	3
3	2
4	3
5	4

(f) Reproduction and Dissemination of Current Examination Materials.

Part 635, Regulations of the Administrator, prohibits the reproduction and dissemination of current examination materials. This regulation states that:

". . . No person shall use, reproduce, publish, or disseminate in whole or in part, without the consent of the Administrator:

"(a) Any examination questions in use by the Administration for the examination of applicants for airman or ground instructor certificate, or

"(b) Any material which purports to be a key sheet of specific answers to any multiple-choice examination paper in use by the Administration for the examination of applicants for airman or ground instructor certificates."

Appendix B

Study Guide for Practical Examination for a Flight Radio Operator Certificate

(a) Taking the Examination.

The applicant for certification as a flight radio operator must make his own arrangements for access to, and the use of, a suitable aircraft upon which the practical examination may be conducted. A suitable aircraft is a multi-engine aircraft incorporating a built-in flight radio operator station.

(b) Practical Examination.

The practical examination is divided into two portions; ORAL (ground) and OPERATIONAL (flight).

(1) *Oral.* This test should be completed in a single session, and only one applicant will be examined at one time. Primary electrical power will not be required during the ORAL test since this section is arranged to require the applicant to demonstrate his familiarity with the entire radio and associated electrical system by locating the equipment and describing orally the functions of the following items:

1. Aircraft Antennas.
2. Aircraft Transmitters (HF and LF).
3. Communications Receivers.
4. VHF Communications Unit.
5. Manual Direction Finder (MDF).
6. Automatic Direction Finder (ADF).
7. Range Receiver and Filter.
8. Marker Beacon Receiver.
9. Localizer Receiver.
10. Glide Path Receiver.
11. Localizer-Glide Path Indicator.
12. Isolation Amplifier and Interphone.
13. FRO Radio Control Panel.
14. Cockpit Radio Control Panels.
15. Loran.
16. Radio Altimeter.
17. Life Raft Radio.
18. Spare Radio Parts.
19. Primary Electrical System.
20. Inverters.
21. Fuses and Circuit Breakers.
22. Flux Gate or Other Electronic Compass System.
23. Emergency Equipment and Exits.

The applicant should be able to discuss the equipment repairs which can be made by the flight radio operator both in flight and at remote landing areas where special test equipment is not available. While this section of the examination will include the foregoing items, this portion of the examination will not necessarily be limited to them, if in the opinion of the examining representative additional items should be covered.

(2) *Operational.* This portion of the examination shall also be completed in a single session and only one applicant will be examined at one time. There are no restrictions as to the type of flight upon which this test may be given; it may be scheduled or nonscheduled, test, training crew checkout, or any other type of flight. The applicant will be required to demonstrate his ability to perform a preflight inspection and to operate all communications, including CW, and radio navigational equipment with any necessary frequency changes. While the operational portion of the examination will include all of the following items, the examination will not necessarily be limited to them, if in the opinion of the examining representative conditions warrant greater coverage. The CAA Aviation Safety Agent or flight radio operator examiner conducting the test will check the applicant on all the following listed items:

1. Preflight Inspection and Radio Check. Visual inspection of radio equipment; operational check of units, radio test contact with appropriate guard station.

2. Tuning Transmitters (HF and LF).
3. Tuning Communications Receivers.
4. Use of VHF Communications Unit.
5. Ground Communications Facilities. Knowledge of guard station circuits and operating agencies; available air-to-ground frequencies.
6. Radio Operating Procedures. General knowledge of typical message forms and operating procedures used in overseas aircraft communications; ICAO procedures.
7. Handling CW Communications. Evidence of meeting the code requirements of Part 33 may be shown in any of the following methods:

   U. S. Citizens—

   (a) actual demonstration of the applicant's code proficiency.
   (b) possession of an FCC radiotelegraph license of first class.
   (c) possession of an FCC radiotelegraph second-class license endorsed for aircraft radiotelegraphy.
   (d) possession of a statement from a U. S. air carrier or operator of an approved flight radio operator course certifying to the applicant's code proficiency.

   Foreign Citizens—

   (a) actual demonstration of the applicant's code proficiency.
   (b) possession of a foreign radiotelegraph operator's license of the first class issued in accordance with the requirements of the general radio regulations annexed to the International Telecommunications Convention (ITC).

8. Handling Voice Communications.
9. Weather Requests and Broadcasts. General knowledge of weather dissemination facilities; types of meteo codes; decoding weather reports.
10. Knowledge of "Q" Signals.
11. Use of Time Signals. Familiarity with various sources of time signals; ability to select appropriate station and frequency and interpret time signals.
12. Radio Aids to Navigation. Overall knowledge of available ground radio aids to navigation and limitations of these facilities; familiarity with H. O. Publication Radio Navigational Aids.
13. Use of Range Receiver and Filter.
14. Use of Manual Direction Finder (MDF).
15. Use of Automatic Direction Finder (ADF).
16. Use of Loran.
17. Determining Errors in Bearings. Ability to recognize and evaluate errors; night effect and terrain effect; averaging shifting nulls; proper selection of stations and frequencies.
18. Correcting and Plotting Bearings. Use of loop calibration curves; Mercator conversion tables; ability to apply necessary corrections and plot bearings taken by the aircraft and ground stations.
19. Emergency Radio Procedures. Action in event of noncommunication; authority to send urgent and distress signals and information; action in case of structural failure, fire, or other major emergencies; cancelling urgent or distress messages; choice of frequencies for distress work; action prior to ditching.
20. Knowledge of Search and Rescue. Procedure for alerting U. S. and foreign Search and Rescue units.
21. Surface Vessel Contacts. Use of aircraft radio for contacting surface vessels; type of vessels that can be contacted with a particular aircraft installation; Ocean Station Vessels (OSV's); and various services offered by these vessels.
22. Airways Traffic Control. General knowledge of U. S. airways traffic control procedures and oceanic airways traffic control; importance of reporting altitude changes; descent during emergencies.

23. Keeping Logs and Records.
24. Locating and Correcting Equipment Trouble. General trouble shooting in radio installation; interchange of units to effect emergency communication or radio navigation.
25. Knowledge of Letdowns (Range, ILS, GCA, QDM). General knowledge of various types of letdowns and importance of arranging communications prior to starting letdowns; assisting pilots whenever possible.

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Supplement 2 - April 9, 1951
Supplement 3 - July 2, 1951

} now in new CAM 33 dated 10/15/56

CAM 33 includes Study Guide & list of suggested study material
Supp 1 11/31/56 (Sup CAM-22)