sation may not be disclosed except upon the written approval of the Bureau (20 CFR 1.21). Further, in any case of doubt, the matter should be handled in accordance with the general rule under paragraph (a) of this section. Where information is furnished hereunder in response to a court order, it is advisable that certified copies rather than originals be furnished and that, where original records shall be produced, the assistance of the U.S. Attorney or U.S. Marshal be required so that custody be kept of the records.

(R.S. 161, sec. 5031, 70A Stat. 278, as amended; 5 U.S.C. 22, 10 U.S.C. 5031; E.O. 10561, 19 F.R. 5963, 3 CFR 1954–58 Comp. p. 205)

Dated: December 18, 1964.

By direction of the Secretary of the Navy.

[SEAL] WILFRED HEARN,
Rear Admiral, U.S. Navy, Judge Advocate General of the Navy.

[F.R. Doc. 64-13193; Filed, Dec. 23, 1964; 8:48 a.m.]

SUBCHAPTER C—PERSONNEL

PART 713—NAVAL RESERVE AND MARINE CORPS RESERVE

PART 730—ADMINISTRATIVE DISCHARGES AND RELATED MATTERS CONCERNING SEPARATIONS FROM THE NAVAL SERVICE

Miscellaneous Amendments

Scope and purpose. The amendments update Parts 713 and 730 in accordance with Change 10 to the Bureau of Naval Personnel Manual as distributed to naval commands in due course.

1. Section 713.36 is revised to read as follows:

§ 713.36 Termination of status.

(a) A Reservist who completes the courses of study required for graduation from an approved school of medicine, dentistry or theology must request appointment or reappointment in the appropriate Staff Corps, resignation or discharge. Failure to take one of these actions will result in discharge through administrative action due to his possessing a rating or designator incompatible with his civilian qualifications. A waiver to retain his present designator may be requested if a grave injustice, through rank disparity, would result because of his appointment in the Staff Corps. Such waiver, however, will not in itself authorize retention in the Ready Reserve, active duty for training with pay, or assignment in a pay billet.

(b) A Medical or Dental Officer in the Ready Reserve who is an Intern or Resident, including a Berry Plan participant:

(1) Will be assigned to the Active Status Pool while deferred from active duty, unless he volunteers for assignment to a Reserve Unit for a minimum of one year.

(2) Will not be issued mobilization orders while a member of the Active Status Pool. (The Berry Plan is the Armed Forces Physicians' Appointment and Residency Consideration Program as disseminated to medical interns.)

(c) A member of the Ready Reserve who is enrolled in an approved school of medicine or dentistry:

(1) Will be relieved of training requirements if he requests and accepts an appointment as Ensign 1915 or 1925.

(2) Will be transferred to Standby Reserve if he is eligible and is not appointed as Ensign 1915 or 1925 and is needed as an individual reinforcement.

(3) Will be required to serve on active duty if he remains in the Ready Reserve other than as Ensign 1915 or 1925 and is needed as an individual reinforcement.

(4) Is not eligible for assignment to a Naval Reserve unit in pay status.

(d) A member of the Ready Reserve who is enrolled in an approved school of theology:

(1) Will be transferred to the Standby Reserve, unless he accepts an appointment as Ensign 1945, or otherwise executes a written agreement to remain in the Ready Reserve for at least 1 year.

(2) Is not eligible for assignment to a Naval Reserve unit in pay status.

2. Section 713.68 is revised to read as follows:

§ 713.68 Equipment loaned to States for use of Naval Militia.

Such vessels, equipment, material, armament, or other facilities of the Navy as are or may be made available for the Naval Reserve may also be made available for issue or loan to the several states, territories or the District of Columbia for the use of the Naval Militia. No such facilities of the Navy will be furnished for use by any portion or unit of the Naval Militia, however, unless at least 95 percent of its personnel are members of the Naval or Marine Corps Reserve and are attached to or associated with pay units of the Naval or Marine Corps Reserve, and unless its training, organization, and administration conform to standards that will be prescribed from time to time by the Secretary of the Navy. (BUPERS Instruction 4423.1 (series) concerns loan of rifles.)

3. Section 713.214 is amended by revising paragraph (d) to read as follows:

§ 713.214 Officer service record, inactive officers.

* * * * *

(d) *Maintenance responsibility.* An officer service record shall be maintained for each inactive officer. Where this will be depends upon whether or not the officer is participating.

(1) For those who are not participating (do not have orders for any type of inactive duty training) the service record will be maintained by the Commanding Officer, Naval Reserve Manpower Center, Bainbridge, Md.

(2) The service records of inactive officers who are participating in any program (those who have orders to appropriate and/or other duty), except under the cognizance of the Chief of Naval Air Reserve Training, will be maintained by the commandant who wrote the orders. In most cases, this will be in the same naval district where the officer resides.

(3) For officers participating in a training program under the cognizance of the Chief of Naval Air Reserve Training, the officer service record will be maintained by the commanding officer of the naval air station or naval air reserve training unit, having responsibility for the training program.

* * * * *

4. Section 713.222 is amended by deleting paragraph (b).

§ 713.222 Enlisted service record.

* * * * *

(b) [Deleted]

5. Section 713.325 is amended by revising paragraph (a) to read as follows:

§ 713.325 Qualifications for original appointment.

(a) Except as otherwise approved by the Secretary of the Navy, the limiting ages for original appointments in the Naval Reserve of all officers are prescribed as follows:

Grade	Line (less SDO (law)) SC [1]	CEC [2]	Medical Service Corps	Nurse Corps [2]	MC, DC, ChC, and SDO (law)	MC and DC students
LCDR	39½–48½	39½–48½	39½–48½		39½–48½	
LT	33½–39½	33½–39½	33½–39½	21–40	33½–39½	
LTJG	27½–33½	21–33½	21–33½	21–35	21–33½	
ENS	19–27½	19–27½	[3] 21–32	21–34		
ENS 19X5					19–30	[4] 19–33
Warrant	21–44	21–44				

[1] Minimum age for Line/SC, USNR is 20 years for women.
[2] Grade to be offered will depend on professional experience.
[3] Minimum age for appointment in the Women's Specialists Section is 18.
[4] At time of expected graduation. "19X5" designates a Naval Reserve officer (unrestricted line—prospective staff corps) and applies only to officers under instruction in civilian schools.

NOTE: The maximum age limit for men and women with prior active military service may be adjusted on a month-for-month basis, depending upon the number of months of active military service performed, but in no case to exceed 36 months.

* * * * *

6. Section 713.337 is amended by revising paragraphs (a)(1), (b) and (c) to read as follows:

§ 713.337 Extension of enlistment.

(a) *Definitions.* In the discussion of extensions of enlistments in this section the following definitions are applicable:

(1) "Agreement to Extend Enlistment" or "Enlistment as extended"—Whenever these terms are used, the legal form of agreement (Page 1A of the service record (NAVPERS 601–1A/NAVCOMPT 513) is meant and not an unofficial agreement or personal assurance of intention to extend. Agreements on other than the legal form are of an informal and unofficial nature and could be repudiated or withdrawn by the individual.

* * * * *

(b) *Terms of extensions.* Provided they are serving under an enlistment contract, Naval Reserve personnel on inactive duty who meet the qualifications for reenlistment, may extend their enlistments for periods of 1, 2, 3, or 4 years provided such extension together with other extensions, if any, since enlistment or the last reenlistment does not exceed an aggregate of 4 years. Personnel not eligible for reenlistment may not extend their enlistments without prior approval of the Chief of Naval Personnel. Commanding officers should set forth all pertinent facts and their recommendation on the forwarding endorsement to the request for such approval. Former Regular Navy personnel who have been transferred to inactive duty in the Naval Reserve to complete their UMT&S obligation are not eligible to execute an extension of enlistment contract unless they have reenlisted and are serving under an enlistment contract at the time the extension is executed. (Article C-1407 of the Bureau of Naval Personnel Manual should be consulted for provisions regarding extension of enlistment of Naval Reservists on active duty.)

(c) *Execution of extension agreement.* Extensions shall be prepared on the latest revision of Form NAVPERS 601-1A/NAVCOMPT 513 only and, except as otherwise provided in this section, shall be executed by the organization having custody of the service record of the individual concerned. When it is inconvenient or impracticable for the individual to appear in person for the purpose of executing the extension of enlistment at the activity having custody of his service record, the extension form may be mailed to the member for execution and return. See paragraphs (d) and (e) of this section for further information regarding requirements of extensions executed by mail. In order to be valid, an agreement to extend enlistment must be entered into by the individual concerned prior to, or on the date of, expiration of enlistment. In mailing extension forms, necessary precautions must be taken to insure their receipt and execution not later than the individual's expiration of enlistment. An individual should not normally be permitted to agree to extend his enlistment more than 3 months prior to the end of the term of his enlistment, unless agreement to extend is required to acquire sufficient obligated service for recall to active duty.

* * * * *

7. Section 713.375 is amended by revising paragraph (b) to read as follows:

§ 713.375 Selection boards.

* * * * *

(e) For the purpose of complying with paragraph (a) of this section, selection boards will be convened by order of the Secretary of the Navy, from time to time, as may be required. Each such board will normally be composed of not less than 5 officers of the corps and of or above the grade for which selections are to be made. The membership of selection boards considering both regular and reserve personnel shall include an appropriate number of reserve officers otherwise qualified to serve. The membership of selection boards considering reserve personnel only shall include at least a majority of reserve members. The procedure will, in general, be the same as that followed by selection boards for the Regular Navy.

* * * * *

8. Section 713.412 is amended by revising paragraph (a) (3) (iv), adding paragraph (a) (6), revising paragraph (b), redesignating old paragraphs (c) to (e) as (d) to (f), and adding paragraph (c), to read as follows:

§ 713.412 Discharge of inactive-duty enlisted personnel.

(a) * * *

(3) * * *

(iv) Upon request for transfer to a reserve component of another armed service in accordance with the procedures outlined in paragraph (c) of this section.

* * * * *

(6) *Physical disability.* When authorized in accordance with procedures outlined in § 713.413, or when otherwise directed by the Chief of Naval Personnel.

(b) Discharge for cause: Enlisted Reservists on inactive duty are subject to discharge by reason of unsuitability, security, unfitness or misconduct in accordance with articles C-10310 through C-10313 of the Bureau of Naval Personnel Manual (§§ 730.10 to 730.15 of this chapter). The commandant of the naval district in which the Reservist resides is responsible for processing or designating an activity to process such cases. An enlisted person who is subject to undesirable discharge by reason of unfitness or misconduct shall, if his whereabouts is known, be informed as to the basis for the contemplated action and be afforded an opportunity to request or waive, in writing, any or all of the privileges set forth in article C-10311 or C-10312 of the Bureau of Naval Personnel Manual (§ 730.12 or 730.13 of this chapter).

(1) In general, field board hearings afforded under article C-10313 of the Bureau of Naval Personnel Manual (§ 730.15 of this chapter) are to be held at the location of the individual's commanding officer. However, a hearing at that location or at the district headquarters may, in some cases, seriously inconvenience or deprive the individual of substantial rights. Accordingly, if such a Reservist requests that a hearing be held in his case, it is permissible for the commandant to refer the matter to a conveniently located naval activity which has facilities for conducting the hearing. The commanding officer to whom the case is referred should be designated as the individual's commanding officer for this purpose, furnished the individual's service record, or be advised to obtain the record from the NRMC Bainbridge as appropriate, and instructed to afford the individual the privileges. The commandant is to ensure that a sufficient number of officers, including Reserve officers on active duty, are available for appointment to the board. (Note that the privilege of having a service lawyer appointed as the individual's counsel applies only if such a lawyer is reasonably available.) Regardless of where the hearing is to be held, it is incumbent upon the inactive Reservist to furnish his own transportation to the hearing. After the case has been processed at the command, it should be forwarded via the commandant to the Chief of Naval Personnel.

(2) Considerable latitude is afforded for the presentation of the respondent's case. If he requests a hearing but is unable or does not desire to attend the hearing, he may submit written statements for consideration of the field board and may waive representation by counsel. If he is to be represented by counsel, the counsel may take any or all of the following actions:

(i) Present the respondent's written statements.

(ii) Make representations in respondent's behalf.

(iii) Introduce testimony of witnesses for the respondent either orally or in writing, or both.

(iv) Cross-examine government witnesses.

(c) Interservice transfers:

(1) Interservice transfer of persons, not on active duty, between reserve components of the Armed Forces, may be accomplished only in cases wherein the Reservist requests or consents to such transfer and wherein it is mutually agreed by the two Military Departments concerned that such transfers are in the best interests of the Armed Forces.

(2) Service-initiated requests for transfers of individual reservists may be initiated at the area commander level or higher level and transmitted direct to the corresponding service area commander level or higher level for approval. Such requests normally will not be forwarded to the Departments of the Army, Navy, Air Force or Commandant (PR) U.S. Coast Guard, level except in cases of disapproval where the requesting service feels that adjudication at higher level is necessary to the best interests of the Department of Defense. Such transfers will normally be handled at area commander level. For purposes of this paragraph, "area commander" is defined as Army Area Commanders, Naval District Commandants, Chief of Naval Air Reserve Training, Marine Corps District Directors, Commanding General, Marine Corps Air Reserve Training Command, Coast Guard District Commanders, Commanding Generals of the Numbered Air Forces and the Army State Instructors.

(3) Individual reservists may initiate requests for transfer to a reserve component of another armed service. Such requests will be processed in accordance with the procedures outlined herein. Final action on such requests will normally be taken at area commander level unless adjudication at higher level is desired or necessary to the best interests of the Department of Defense.

(4) Under procedures established by the Secretary of Defense, requests for transfer between reserve components of the Armed Forces will be approved under the following conditions:

(i) When the individual concerned will be enlisted in a reserve component of another branch of the Armed Forces incident to enrollment in any officers training program, or will be appointed as a student in an officers training program wherein the individual will have a military status. (In such cases member will be discharged pursuant to § 713.412(a)(3)(ii); or

(ii) When the service to which transfer is desired has a specific vacancy for the individual in an accredited training program within a reasonable distance of the individual's domicile or place of business and will assign him to such program, provided one of the following conditions is met:

(*a*) The service to which the individual belongs has no accredited training program within a reasonable distance of the individual's domicile or place of business to which the reservist may be usefully assigned, or

(*b*) The individual has special experience or professional, educational or technical background which is clearly of greater use to the service to which transfer is requested and outweighs the value of his previous training in his present service.

(5) Requests for transfer to another reserve component will include, (i) a statement from appropriate authority in the service to which transfer is desired covering in detail the requirement specified in paragraph (c)(4) (i) or (ii) of this section as applicable, and (ii) a statement by the individual that in the event of approval of the transfer he will accept assignment to and participate in the accredited training program of the service to which transferred.

(6) Upon approval of a request for transfer, the corresponding service authority will be advised that discharge will be issued upon receipt of notification that the individual has signed enlistment papers or accepted appointment in the gaining service. Disapproved requests will be returned to the corresponding service authority for information or action as desired. Discharges in connection with transfers between reserve components shall be effective the date preceding enlistment or appointment in the gaining service. Cite § 713.402(a)(3)(iv) as authority in effecting discharges, except that in the case of discharge to enlist or enroll in an officer training program, § 713.402(a)(3)(ii) will be cited as the authority. (Where membership in the officer training program does not confer military status, discharge will be for the purpose of immediate enlistment in the reserve component of the gaining armed force.) Discharge certificate should be forwarded to the cognizant authority of the gaining service for delivery. Discharge for this purpose does not constitute a fulfillment of the military obligation. Additional service performed after such discharge will be counted toward fulfillment of such obligation. If appropriate, cognizant authority of the gaining service will be notified of the number of constructive credit points earned by the reservist as of the date of discharge.

(7) *Enlistment of a Naval Reservist in another reserve component without obtaining a conditional release.* When information is received of the enlistment of a Naval Reservist in another reserve component without obtaining a conditional release, the command holding the member's service record is authorized to take the following action:

(i) Discharge effective the date preceding enlistment in the gaining service citing BUPERS Manual Article H-31202 (1)(c)4 (§ 713.402(a)(3)(iv)) as authority, provided one of the following conditions exists:

(*a*) The member is serving on extended active duty of more than six months duration as a member of the reserve component of the other service.

(*b*) The member's transfer to the reserve component of the other service would have been approved under the conditions prescribed in paragraph (c)(4) of this section, and the enlistment appears to have been contracted in good faith by the other service.

(ii) If none of the conditions in subdivision (i) of this subparagraph exists, action shall be initiated to obtain member's discharge from the other service.

(iii) The following cases shall be forwarded to the Chief of Naval Personnel for decision:

(*a*) The other service requests adjudication of the case at the departmental level.

(*b*) The other service requests reconsideration of the case due to certain unusual circumstances and the command holding member's service record considers such referral is appropriate.

(*c*) The individual is performing, or has performed, six months active duty for training in the reserve component of the other service.

(*d*) Reservists will be discharged with the same type and character of discharge as provided for enlisted personnel of the Regular Navy.

(*e*) Full information regarding the reason for discharge together with substantiating evidence where appropriate, shall be filed in the individual's service record.

(*f*) The service records of members of the Naval Reserve on inactive duty who have failed to reply to official correspondence and for whom there is no valid address should be closed out at expiration of obligated service and forwarded to the Chief of Naval Personnel. A discharge certificate will be prepared in accordance with the instructions contained in article C-10504 of the Bureau of Naval Personnel Manual and inserted in the closed-out service record for subsequent delivery to the dischargee. Appropriate entries shall be made in the service record of the fact that discharge was effected at expiration of obligated service.

9. Part 713 is amended by inserting section 713.413 to read as follows:

§ 713.413 Physically disqualified reservists.

Upon notification by the Chief of Naval Personnel that an enlisted reservist on inactive duty has been found by the Chief, Bureau of Medicine and Surgery to be not physically qualified for retention in the Naval Reserve, the Command holding his service record will take the following action:

(a) Inform the member of his status using the following sample:

From: Commanding Officer.
To: (Name of reservist).
Subj: Finding of Physical Disqualification.
Ref: (a) Title 10, United States Code. (b) Section 13, Chapter 3, Part H, BUPERS Manual [§§ 713.421 to 713.430].
Encl: (1) Form for requesting discharge.

1. I regret to inform you that the Chief, Bureau of Medicine and Surgery, Department of the Navy, has found that you are not physically qualified for retention in the Naval Reserve by reason of (state defect. Example: Diabetes mellitus.)

2. Section 1004(c) of reference (a) provides for the removal from the Reserve rolls of the naval service of any person who is not physically qualified for assignment to active duty.

3. In view of the foregoing, it is requested that you take one of the following courses of action:

a. Request discharge by reason of being not physically qualified. Enclosure (1) is a form you may use for this.

b. Request transfer to the Retired Reserve if eligible under the provisions of reference (b).

c. Request a hearing before a physical evaluation board. The purpose of such a hearing is to comply with Section 1214 of reference (a), quoted herewith for your information:

"No member of the armed forces may be retired or separated for physical disability without a full and fair hearing if he demands it."

Appearance must be at your own expense. Moreover, you are not eligible to receive retirement pay, severance pay or any other benefits specified in Chapter 61 of reference (a). Do not use enclosure (1) to request a hearing.

4. If no reply is received from you within 30 days, it will be considered that you do not desire a hearing. Therefore, at that time, action will be taken to discharge you involuntarily by reason of being physically not qualified.

(Signature of Commanding Officer)

Enclosure (1) to Sample Letter to Reservists:

From:

(Rate)

(First Name) (Middle Name) (Last Name)

(Service No.)

(Street Number) (City) (State)

To: Commanding Officer.
Subj: Discharge, request for.
Ref: (a) CO ________ ltr dated ________

1. Having been informed in reference (a) that the Chief, Bureau of Medicine and Surgery, Department of the Navy, has found that I am not physically qualified for retention in the Naval Reserve, I request discharge by reason of Physical Disability.

(Signature)

(b) If discharge is requested, issue appropriate discharge certificate citing Bureau of Naval Personnel Manual, article H-31202(1)(f) (§ 713.412(a)(6)) and the letter informing member of his status as authority therefor. Make appropriate service record entries and forward closed out record to the Chief of Naval Personnel.

(c) If transfer to the Retired Reserve is requested, provided the reservist is eligible therefor under the provisions of Part H, Chapter 3, Section 13 of the Bureau of Naval Personnel Manual

(§§ 713.421 to 713.430), transfer to Retired Reserve in accordance therewith.

(d) If Physical Evaluation Board Hearing is requested, issue authorization as shown in Sample Orders for Physical Evaluation Board Hearing (in this subparagraph, below) for reservist to appear before the board listed in Physical Evaluation Board Address List (see mailing list in this subparagraph, below) nearest the reservist's home.

SAMPLE ORDERS FOR PHYSICAL EVALUATION BOARD HEARING

From: Commanding Officer.
To:
Via: Senior Member, Physical Evaluation Board (insert appropriate mailing address shown in listing below).
Subj: Authorization to appear before a Physical Evaluation Board.
Ref: (a) Disability Separation Manual (NAVEXOS P-1990) [Part 725 of this chapter].
Encl: (1) Statement of Rights in triplicate (NAVEXOS-3332 can be requisitioned from the Forms and Publications Supply Distribution points).

1. When notified by the via addressee that the necessary records are available for presentation of your case, you are authorized to report to that officer for an evaluation of your present physical condition.

2. In the evaluation of your physical condition, the Physical Evaluation Board is directed to conduct the proceedings in all respects as provided for hearings in the case of active duty members except that it will make only the recommended finding that you are or are not physically qualified for active service, and if not so qualified, will set forth the disqualifying defect or disability with the diagnostic nomenclature number therefor and an opinion whether such disability is or is not due to intentional misconduct or willful neglect. The Board's attention is invited to paragraph 0427 of reference (a) [§ 725.427 of this chapter] which sets forth the authority for your hearing.

3. The above is authorized with the understanding that you will not be entitled to reimbursement for mileage or expense in connection therewith. In case you do not desire to bear this expense or if for any reason you fail to report to the Physical Evaluation Board on the date specified, you will regard paragraph 1 of this authorization as revoked.

4. You are advised that if for any reason you are unable to report in person to the Physical Evaluation Board on the date specified, you may waive your right to appear in person. If you waive your right to appear in person, your case will be submitted to the Physical Evaluation Board for an examination on the record. It is requested that you execute the enclosed Statement of Rights and return it to the via addressee prior to the date set for your examination.

5. Whether you appear in person or waive your right to appear in person, you may be represented by counsel if you so desire. You are advised that if you desire counsel to assist or represent you in presenting your case before the Physical Evaluation Board, competent legal assistance is available without expense to you. Should you desire to avail yourself of this service, you may apply to the Senior Member of the Physical Evaluation Board.

6. By endorsement hereon the via addressee is requested to notify you of the date and place you are to appear.

(Signature of Commanding Officer)

Copy to:
BUMED (Code 3351)
Chief of Naval Personnel (Pers B222)
Individual concerned—4

MAILING LIST OF PHYSICAL EVALUATION BOARDS

NOTE: Address all correspondence to Senior Member:

Example: Senior Member, Physical Evaluation Board, Headquarters, Ninth Naval District, Great Lakes, Ill., 60088.

First Naval District:
U.S. Naval Hospital
Chelsea, Mass. 02150
Third Naval District:
U.S. Naval Hospital
St. Albans, L.I., N.Y. 11412
Fourth Naval District:
U.S. Naval Hospital
Philadelphia, Pa. 19145
Fifth Naval District:
U.S. Naval Hospital
Portsmouth, Va. 23708
Sixth and Eighth Naval Districts:
U.S. Naval Hospital
U.S. Naval Base
Charleston, S.C. 29408
U.S. Naval Hospital
Camp Lejeune, N.C. 28542
Ninth Naval District:
Headquarters, Ninth Naval District
Great Lakes, Ill. 60088
Eleventh Naval District:
U.S. Naval Hospital
San Diego, Calif. 92134
U.S. Naval Hospital
Camp Pendleton, Calif. 92055
Twelfth and Thirteenth Naval Districts:
U.S. Naval Hospital
Oakland, Calif. 94614
Potomac River Naval Command:
U.S. Naval Hospital
Bethesda, Md. 20014

NOTE: Do not include entitlement to travel allowance in the authorization to appear before the board, since such must be at the member's own expense. As explained in the letter to the individual (see sample letter in paragraph (a) of this section), the option of requesting a hearing before a physical evaluation board is offered solely to comply with the provision of 10 U.S.C. 1214, which states that no member of the armed forces may be retired or separated for physical disability without a full and fair hearing. Since such hearing will usually serve no useful purpose, particularly in cases of individuals who have never served on active duty and who are not qualified for retention in the Naval Reserve by reason of conditions arising in civilian life, individuals who inquire relative to the advisability of requesting a hearing should be so advised and discouraged from requesting a hearing due to the time and expense involved.

(e) If no reply to the letter informing the reservist of his status is received within 30 days, issue an appropriate discharge certificate citing the Bureau of Naval Personnel Manual, article H-31202 (1)(f) (§ 713.412) and the letter informing the reservist of his status as authority therefor.

10. Section 713.441 is revised to read as follows:

§ 713.441 Travel and residence overseas.

(a) This section pertains to Naval Reserve personnel on inactive duty, including those in retired status, who travel or reside in any country not within the jurisdiction of a Naval District. Those employed aboard merchant vessels or aircraft of the United States or friendly foreign registry are excepted unless homeported in a foreign country.

(b) Upon arrival in and departure from each country, except for brief tours, the reservist shall report to the nearest U.S. Naval Attache.

(c) If travel or residence will exceed 30 days, the Reservist shall submit advance notice to the command holding his service record, giving (1) date of departure from the United States, (2) duration of absence, (3) itinerary, including approximate dates of arrival in and departure from countries where the U.S. Naval Attache will be contacted, and (4) overseas mail addresses (official mail will be forwarded via the nearest U.S. Naval Attache).

(d) Return to the United States shall be reported to the command holding the service record.

(e) The uniform may be worn only when attending, by formal invitation, ceremonies or social functions at which the wearing of the uniform is required by the terms of the invitation or by the regulations or customs of the country, and then only with the approval of the nearest U.S. Naval Attache.

(f) Official naval titles shall not be used in connection with public appearances unless authorized by the nearest U.S. Naval Attache.

(g) Overseas training is covered in § 713.521.

11. Section 713.443 is revised to read as follows:

§ 713.443 Use of official Naval titles.

The use of official naval titles by Reserve personnel on inactive duty is authorized except as provided in § 713.441 (f) and in § 137.8(b) of this title.

12. Section 713.451 is revised to read as follows:

§ 713.451 Requirements.

(a) Officers and enlisted personnel of the Naval Reserve on inactive duty shall possess the minimum uniform items specified in U.S. Navy Uniform Regulations and Bureau of Naval Personnel Instruction 1020.4 (series), respectively.

(b) U.S. Navy Uniform Regulations govern the occasions when wearing of the uniform is mandatory and when it is permissive.

(c) Additionally, commanding officers of Specialist units, Naval Reserve Officers Schools, and Composite companies shall designate a minimum of one drill per quarter as a "drill in uniform" for all nonpay members. Such drills shall begin with a formal personnel inspection.

(d) Commanding officers of all Naval Reserve units shall encourage the wearing of name plates by all members during drills. Name plates shall conform to the standards prescribed in U.S. Navy Uniform Regulations, and shall be positioned on the uniform as prescribed therein.

13. Section 713.517 is amended by revising paragraph (c) (1)(i) and (2)(i) to read as follows:

§ 713.517 Appropriate duty (including air).

* * * * *

(c) * * *

(1) * * *

(i) To 2105, 2205, 2305, and 2905 officers for the performance of medical and dental examinations, and essential services of an administrative nature for Naval Reserve or Marine Corps Reserve units.

* * * * *

(2) * * *

(i) To 2105, 2205, and 2305 officers for duty as consultants at naval activities. (Appointments of officers for this duty must be approved by the commanding officer of the activity concerned and by the Chief, Bureau of Medicine and Surgery.)

* * * * *

14. Section 730.4 is amended by revising paragraphs (e) (5), (10), (11) and (12) to read as follows:

§ 730.4 Separation of enlisted personnel by reason of expiration of enlistment, fulfillment of service obligation, or expiration of tour of active service.

* * * * *

(e) * * *

(5) *Undergoing medical treatment or hospitalization.*

(i) Enlisted personnel of the Regular Navy or Naval Reserve on active duty whose enlistments or enlistments as extended expire while they are suffering disease or injury incident to the service and who are in need of medical care or hospitalization may be retained in service beyond the normal date of expiration of their enlistments or enlistments as extended, with their consent which should be indicated in writing and signed by the individual concerned on the administrative remarks page of the service record. They may be retained until they shall have recovered to the extent which would enable them to meet the physical requirements for discharge and reenlistment, or until it shall have been ascertained that the disease or injury is of a character that recovery to such an extent would be impossible. Tacit consent may be assumed for retention in service beyond expiration of enlistment in cases of mental incompetency or physical incapacity. A person in this category ordinarily will not be retained in excess of 6 months beyond expiration of enlistment. Further retention may be authorized, however, in meritorious cases upon proper recommendation accompanied by the supporting facts. (10 U.S.C. 5537.)

(ii) In the event the member persists in his desire to be separated, effect his separation provided he signs the following entry on page 13 of his service record and on Standard Form 88, witnessed by an officer, at time examined for separation:

I, ________________________, desire to be
(Name)
separated from the Naval Service on my normal expiration of active obligated service date. I understand that I will not be eligible for further follow-up studies or treatment at a U.S. Armed Forces medical facility; that I will be ineligible for disability benefits under laws administered by the Navy and that any further treatment and/or benefits would be under the jurisdiction of the Veterans Administration.

Personnel being processed before a physical evaluation board will not normally be released from active duty or discharged until final action on their case has been completed by the Secretary of the Navy and instructions received from the Chief of Naval Personnel. An untimely separation of a member who is the subject of a physical evaluation board proceeding may prejudice his case in view of the fact that the law requires that the Secretary make the necessary physical disability determinations while the member is entitled to receive basic pay, except in cases of Reservists on training duty of 30 days or less. This should be explained to any member whose enlistment or term of active service is about to expire and who requests discharge or release from active duty prior to the time such determinations are made. Any request for separation which is not withdrawn following such explanation shall be entered on page 13 of the Service Record as follows:

I, ________________________, desire to be
(Name)
separated from the Naval Service notwithstanding the fact that such separation may prejudice any rights or benefits to which I may be entitled as a result of the physical evaluation board hearings under Title 10, U.S. Code, Chapter 61. I have been fully advised of my rights in this matter and request that I be discharged from the Naval Service as soon as possible without further hearing and without disability retirement pay or severance pay and without any compensation whatsoever. I understand that I am not required, and am under no obligation, to give this certificate and I hereby certify that I give the certificate voluntarily.

The foregoing statement shall be signed by the individual and witnessed by an officer.

* * * * *

(10) *Retention as party to a court of inquiry.* When an enlisted member has been named a party to a court of inquiry, and the proceedings have been entered upon prior to the expiration of enlistment or term of obligated service, the individual may be retained in the service as a party to the said court of inquiry, and for resultant trial if such is indicated.

(11) *Voluntarily making up lost time.* Enlisted personnel who before 24 July 1956 lost time in excess of 24 consecutive hours from their enlistments or enlistments as extended due to unauthorized absence, confinement, or nonperformance of duty (civil arrest) as defined in paragraph 044019-1 of the Navy Comptroller Manual (§ 719.203 of this chapter) may be permitted to make up such lost time in order to complete the term for which they enlisted or extended their enlistments. In order to be valid, application to make up lost time must be submitted by the individual and approved by or on behalf of the commanding officer prior to expiration of the enlistment or extension of enlistment during which the time was lost. Appropriate entry shall be made on the administrative remarks page of the service record which shall reflect the date on which the application was approved.

(12) *Mandatorily making up lost time.* Instructions concerning mandatorily making up lost time due to sickness misconduct occurring before, on, or after July 24, 1956, and unauthorized absence, confinement, and nonperformance of duty (civil arrest) occurring on or after July 24, 1956, are contained in § 730.4a.

* * * * *

15. Section 730.5 is amended by revising paragraph (e) (2) to read as follows:

§ 730.5 Separation of enlisted personnel by reason of physical disability.

* * * * *

(e) * * *

(2) If processing of a case by a physical evaluation board has been authorized, retain the individual in service until final disposition is directed by the Chief of Naval Personnel, unless the individual concerned states in writing that he does not desire to be retained until final action has been taken on the recommended findings and proceedings of a physical evaluation board. (See § 730.4(e) (5).)

* * * * *

16. Section 730.6 is revised to read as follows:

§ 730.6 Separation of enlisted personnel for convenience of the Government.

(a) The Chief of Naval Personnel may authorize or direct the separation of enlisted or inducted personnel prior to the expiration of their active obligated service dates for any one of the reasons listed in this section. The term "separation" as used in this section includes discharge or transfer to the Naval Reserve and concurrent release to inactive duty, or release to inactive duty in certain cases of Naval Reservists serving on active duty who have time remaining in service obligation or enlistment contract.

(1) General demobilization, reduction in authorized strength, or by an order applicable to all members of a class of personnel specified in the order.

(2) Acceptance of a permanent appointment as officer in any branch of the armed services.

(3) To permit immediate reenlistment at the request of the individual prior to normal expiration of enlistment in accordance with instructions issued from time to time by the Chief of Naval Personnel.

(4) National health, safety or interest.

(5) Erroneous enlistment, reenlistment, extension or induction.

(6) Other good and sufficient reasons when determined by the Chief of Naval Personnel.

(b) Subject to the following instructions, the commanding officer shall, as appropriate, discharge or transfer for discharge for the convenience of the Government, an enlisted woman for any one of the following reasons: (The instructions contained in this paragraph should not be interpreted as precluding the commanding officer from forwarding any case to the Chief of Naval Personnel for decision should he consider such action appropriate. In the case of either parenthood or pregnancy of a married enlisted woman who has over 18 years of service but insufficient time for retirement the commanding officer will forward the case to the Chief of Naval Personnel for a decision.)

(1) Parenthood, when it is established that a woman is the parent, by birth or adoption, of a child under 18; has personal custody of a child under 18; is the stepparent of a child under 18 and the child resides within the household of the woman for a period of more than 30 days a year; or during her current enlistment or extension of enlistment, has given birth to a living child. In any case wherein a woman is the natural parent of a child born prior to her entry into the naval service and wherein all rights to custody and control of the child are asserted to have been lost through formal adoption proceedings prior to the woman's entry into the service, the commanding officer shall not effect discharge of the woman concerned without specific authorization of the Chief of Naval Personnel.

(2) Pregnancy, regardless of marital status, upon determination by a naval medical officer. The type of discharge shall be as warranted by her service record regardless of marital status. If pregnancy is terminated prior to separation, a full report of the circumstances shall be submitted to the Chief of Naval Personnel including whether or not the termination was a result of a spontaneous or therapeutic abortion or a still birth, or if there is evidence of non-therapeutic abortion, together with servicewoman's desires as to retention in the service and the Commanding Officer's recommendation thereon.

(3) Marriage, upon written request to the commanding officer provided she is not serving at a duty station which is sufficiently close to the location of her husband to permit the establishment of a joint household and further provided member meets all the conditions set forth below which are applicable in her case. (If two or more of the conditions apply, the period of time which results in retaining her to the latest date shall govern). In any case discharge will not be effected earlier than six months from the date of submission of written request therefor except that commanding officers may waive the six months' delay in discharge in those cases wherein a contact relief is not required or at such time as a relief becomes available.

(i) Must have served not less than 12 months subsequent to completion of recruit training and not less than 12 months at current duty station, or not less than 12 months at new duty station if separation requested after issuance of transfer orders.

(ii) If member attended a service school during her enlistment:

(*a*) If length of course was 24 weeks or less, must have served 18 months after completion of the course or disenrollment therefrom.

(*b*) If length of course was over 24 weeks, must have served 24 months after completion of the course or disenrollment therefrom.

Ensure that a copy of the member's request and information as to the command's action thereon is submitted to the Bureau of Naval Personnel (Pers B2122) and the cognizant personnel distributor in all cases. (Article A-4204 of the Bureau of Naval Personnel Manual contains instructions relative to recoupment of reenlistment bonus, if paid.)

(c) Attend college:

(1) Commanding officers are hereby authorized to separate or transfer for separation enlisted personnel for the purpose of commencing or resuming their college education provided eligibility is established in accordance with the following:

(i) The requested date of separation must be within 3 months of the individual's normal expiration of active-obligated service and, within this limitation, not earlier than 10 days prior to the date of registration as prescribed by the educational institution. (Normal expiration of active-obligated service is the date on which the individual would normally be eligible for release to inactive duty. It is not the "advanced" separation date established by any early separation program which may be in effect.)

(ii) The applicant must demonstrate an ability and willingness to make the required payment of an entrance fee, if required, provided he has not already done so. The applicant must also demonstrate that the specific school term for which he is seeking early release is academically the most opportune time for him to begin or resume his education; and that delay of enrollment until a date subsequent to normal separation date would handicap him in the pursuit of his education.

(iii) The applicant must obtain a statement from the educational institution which establishes:

(*a*) That the applicant has been accepted for enrollment without qualification for entrance in a specified school term. (A summer term may be used to fulfill this requirement.)

(*b*) That the applicant will be enrolled in a full-time course of instruction leading to a baccalaureate or higher degree. (Enrollment in an accredited Junior College may be used to fulfill this requirement.)

(*c*) The convening date of class for the specified school term.

(*d*) The registration dates for the specified school term.

(*e*) That the educational institution is currently listed in Part III of the Educational Directory published by U.S. Department of Health, Education and Welfare.

(iv) The applicant's performance of duty must have been such that he is deserving of consideration for early separation. Additionally, requirements for honorable discharge in article C-7821 (10)(b) of the Bureau of Naval Personnel Manual must be met.

(v) The loss occasioned by the early release of the applicant, without immediate replacement, will not reduce the operational readiness of the command to an unacceptable degree.

(vi) The commanding officer will assure, to his satisfaction, that early release is not being requested for the purpose of avoiding service.

(2) Exceptions: The Chief of Naval Personnel, as a policy, will not authorize the early separation of personnel who do not fully meet the requirements set forth in paragraph (c)(1) of this section. In no case will early release for educational purposes be authorized earlier than 3 months in advance of normal expiration of active-obligated service. While the Chief of Naval Personnel does not desire to prevent personnel who are not fully qualified under paragraph (c)(1) of this section above from applying for early release, such personnel should be carefully and completely informed of the Bureau's firm policy in this regard and discouraged from submitting an official request except for unusual reasons. However, if the individual concerned still wishes to submit a request for early release in accordance with article B-1105 of the Bureau of Naval Personnel Manual, the request should be forwarded to the Chief of Naval Personnel (Attn: Pers B222) with the information listed in paragraphs (c)(1) (i) to (iii) of this section. The commanding officer in his endorsement will comment on the factors listed in subdivisions (iv) to (vi) of paragraph (c)(1) of this section.

(3) Personnel not eligible for early release to attend college. Personnel in the following categories are not eligible for early release under the provisions of paragraph (c)(1) of this section.

(i) Aliens seeking to qualify for citizenship by completion of 3 years' active military service, since early release might jeopardize their expeditious naturalization.

(ii) Personnel who will have a reserve obligation remaining upon separation, as determined by article C-1402 of the BUPERS Manual, will not be separated until they have completed 21 months' active duty on their current term of active-obligated service.

(iii) Personnel who are ordered to 6 months' active duty for training.

(iv) Personnel whose services are essential to the mission of the command.

(d) Commanding officers shall discharge or transfer for discharge those non-petty officers serving in their first enlistment who have served continuously on active duty for more than 12 months and are considered to be a burden to the Command due to substandard performance or inability to adapt to military service provided (1) they have a tenth grade education or less or a GCT of 41 or less, (2) are not potential petty officer material, and (3) have average performance marks below the minimum required for honorable discharge and reenlistment.

(e) Full information regarding the reason for separation and a recommendation concerning reenlistment in accordance with article C-10103 of the Bureau of Naval Personnel Manual based upon enlisted performance evaluations (article C-7821 of the Bureau of Naval Personnel Manual and applicable Bureau directives) shall be entered on page 13 of the service record in connection with all cases within the purview of this section.

17. Section 730.7 is amended by revising paragraph (a)(2) to read as follows:

§ 730.7 Discharge of enlisted personnel for own convenience and furlough without pay.

(a) * * *

(2) Returning to school, except as provided in § 730.6(c).

* * * * *

18. Section 730.8 is amended by revising paragraphs (b) to (e) to read as follows:

§ 730.8 Discharge or release to inactive duty for reasons of dependency and hardship.

* * * * *

(b) Enlisted personnel who desire to request discharge or release to inactive duty, as appropriate, for dependency or hardship reasons shall be informed of the proper procedure to follow. It should be clearly explained to each applicant that a request shall be submitted via official channels and that submission of a request is no assurance that discharge or release to inactive duty will be authorized. While each request received is carefully and sympathetically considered, final decision is based upon its individual merits.

(c) Policies governing discharge or release to inactive duty on account of dependency or hardship—

(1) Dependency or hardship discharges, or releases to inactive duty, will not be authorized solely for financial or business reasons; for indebtedness; for personal convenience; when an individual is under charges or in confinement; or because of the member's physical or mental condition.

(2) Discharges or releases to inactive duty will not be disapproved under the provisions of this section solely because an individual's services are needed in his assigned duties, or because he is indebted to the Government or to an individual.

(3) The Chief of Naval Personnel may direct discharge or release to inactive duty when it is considered that undue and genuine hardship exists, that the hardship is not of a temporary nature, that the conditions have arisen or have been aggravated to an excessive degree since entry into the service, and the member has made every reasonable effort by means of application for basic allowance for quarters and voluntary contributions which have proven inadequate; that the discharge or release of the individual will result in the elimination of, or will materially alleviate, the condition and that there are no means of alleviation readily available other than by such discharge or release. Examples of meritorious cases are those in which the evidence shows that, either as a result of the death or disability of a member of an enlisted person's family, the separation of the person concerned is necessary for the support or care of a member or members of the family; or that the individual or the family is undergoing hardships more severe than normally encountered by dependents of families of members of the naval service. Undue hardship does not necessarily exist solely because of altered present or expected income or because the individual is separated from his family or must suffer the inconveniences normally incident to military service. Pregnancy of an enlisted man's wife is not in itself a circumstance for which separation will be authorized.

(d) A written application for discharge or release to inactive duty for dependency or hardship shall be forwarded to the Chief of Naval Personnel via the enlisted person's commanding officer. In unusual circumstances, personnel in an authorized leave status may submit requests for dependency or hardship discharge to the Chief of Naval Personnel. To facilitate and expedite the request and to ensure that it is properly prepared in accordance with existing instructions, it should be prepared by and submitted via the nearest naval activity. The anticipated date of the individual's departure from the leave address must be included in the request. All requests must be accompanied by affidavits substantiating the dependency or hardship claim. Where practicable, one affidavit should be from the dependent concerned. The request should contain the following additional information:

(1) Reason in full for request.

(2) Complete home address of dependent and applicant.

(3) Names and addresses of persons familiar with the situation.

(4) Statement as to marital status and date of marriage.

(5) Financial statement: Complete itemized budget for serviceman and/or dependent family members, including rent, food, clothing, utilities, fuel, medical expenses, and other regular expenses; list of existing debts, including names of creditors, original amount of debt, amount of debt remaining to be paid, amount of monthly payments, date debt contracted and purpose; specific amounts and modes of contributions of serviceman to dependents.

(6) Names, ages, occupations, and monthly incomes of members of the individual's family, if any, and the reasons why these members cannot contribute to the necessary care or support of the individual's family. If dependency is the result of death of a member of the enlisted person's family occurring after entrance into the service, a certificate or other valid proof of death should be furnished. If dependency or hardship is the result of disability of a member of the enlisted person's family occurring after entrance into the service, a physician's certificate should be furnished showing specifically when such disability occurred, diagnosis, duration of hospitalization and/or convalescence.

(7) Other income of dependent family members such as from pensions, insurance, Veterans Administration compensation, rental or sale of real estate, interest on bank deposits or funds invested, fees, alimony, or moneys received of any description whatsoever, whether regular or occasional, or social security benefits.

(8) Documentary evidence if the request is based solely on marital difficulties, i.e., divorce, separation, desertion of wife, or where the serviceman or persons other than the legal spouse have been awarded custody of minor children.

(e) Before forwarding the request the commanding officer shall interview the enlisted person concerned in order to elicit any further information and to insure that the required information is supplied. The forwarding endorsement shall include:

(1) A definite recommendation for approval or disapproval of the request.

(2) A statement regarding the status of any disciplinary action pending with recommended action.

(3) An itemization of all sources of income, including type family separation allowance, if any, as determined from individual's pay record.

(4) An itemization of pay record deductions, including allotments, the amount, to whom registered and effective date.

The Commanding Officer's recommendation on an individual's request for hardship discharge should be confined to the above areas. In no case should this endorsement include a recommendation for a substitute type of discharge, i.e., general, undesirable, etc. A hardship discharge is intended to be used as an instrument to alleviate personal hardships encountered by enlisted personnel when such discharge is the only solution. It is not intended to be used as a means to rid the service of undesirables, misfits or persons considered unsuitable for continuation in the naval service.

* * * * *

19. Section 730.10 is revised to read as follows:

§ 730.10 Discharge of enlisted personnel by reason of unsuitability.

(a) Enlisted personnel may be separated, by reason of unsuitability, with an honorable or general discharge as warranted by their military record. A discharge by reason of unsuitability, regardless of the attendant circumstances, will be effected only when directed by or authorized by the Chief of Naval Personnel.

(b) An enlisted person may be discharged by reason of unsuitability because of:

(1) Inaptitude: Applicable to those persons who are best described as inapt due to lack of general adaptability, want of readiness or skill, unhandiness, or inability to learn.

(2) Character and behavior disorders: Duly diagnosed character and behavior disorders, disorders of intelligence, and transient personality disorders due to acute or special stress, as listed in "Department of Defense Disease and Injury Codes" (NAVMED P-5082).

(3) Apathy, defective attitudes and inability to expend effort constructively: A significant observable defect, apparently beyond the control of the individual, elsewhere not readily describable.

(4) Homosexual tendencies: When there is also evidence of involvement in homosexual acts in the current enlistment, processing must be in accordance with Secretary of the Navy Instruction 1900.9 or revision and § 730.12. Likewise, if there is evidence of homosexual acts prior to enlistment or during a previous enlistment and homosexual tendencies were denied on SF 89, processing in ac-

cordance with § 730.13 for fraudulent enlistment should be considered.

(5) Enuresis.

(6) Alcoholism: Chronic, or addiction to alcohol.

(7) Other good and sufficient reasons, as determined by the Chief of Naval Personnel.

(c) Prior to processing an individual under this section, review §§ 730.12 and 730.13 to insure that processing under one of those sections is not more appropriate. In this regard, chronic military misbehavior or serious involvement with civilian authorities should not be used as the basis for unsuitability processing unless there is accompanying evidence of a psychiatric disorder which significantly contributed to the misbehavior. Military misbehavior and involvement with civilian police subject the respondent to the possibility of undesirable discharge and, therefore should normally be processed under the provisions of § 730.12 or § 730.13 as appropriate.

(d) In each case processed in accordance with this section, the enlisted person shall be informed in writing of the reason(s) he is being considered for discharge and shall be afforded an opportunity to make a statement in his own behalf. In the event a statement cannot be obtained, a page 13 entry of explanation shall be made and a copy of the page 13 forwarded as an enclosure to the letter of transmittal.

(e) Recommendations for discharge by reason of unsuitability shall include the following:

(1) A letter of transmittal prepared in the format given in paragraph (g) of this section.

(2) The respondent's signed statement of awareness and his statement in his own behalf, or statement that he does not desire to make a statement in his own behalf.

(3) Psychiatric or medical evaluation as appropriate.

(4) Copy of page 9 of the service record.

(5) Comment and recommendation of the commanding officer.

(f) Enlisted personnel serving on board ships, overseas stations, and continental U.S. activities lacking separation facilities who are recommended for discharge in accordance with paragraph (b)(2), (4) or (5) of this section, whose immediate transfer is clearly indicated in the best interest of the man concerned, may be transferred to the nearest separation activity to await instructions from the Chief of Naval Personnel. The transfer orders and records must accurately reflect the person's status and reason for transfer in order to ensure that the individual is held pending receipt of the instructions from the Chief of Naval Personnel. In this connection, forward a copy of the letter of transmittal to the separation activity under a separate letter. All other personnel recommended for discharge in accordance with this section shall be retained on board pending receipt of instructions from the Chief of Naval Personnel.

(g) Format of letter of transmittal:

January 15, 1963

From: Commanding Officer, U.S.S. EVERSAIL (DD-00).

To: Chief of Naval Personnel.

Subj: DOE, John Robert, 123 45 67, SN, USN; Recommendation for discharge by reason of unsuitability.

Encl: (1) Statement of DOE; (2) Copy of page 9; (3) Psychiatric evaluation.

1. The following information is submitted in the case of subject man:

a. *Basic record data.*

Date of current enlistment: Nov. 15, 1961 for four years. EAOS: Nov. 16, 1965.

Marital Status: Single. Dependents: 0. Months on Board: 12. Age: 22. GCT: 45. Years education: 12. Total Service: (Active) 1 yr. 2 mos (Inactive) 0.

b. *Diagnosis.* Emotional instability reaction (3210).

c. Military Offenses: Feb. 15, 1962. NJP Page 13-(3)—UA 2 days—2 wks. restr.

d. *Comment and Recommendation of Commanding Officer.* It is recommended that DOE be separated from the naval service by reason of unsuitability. Because of his personality disorder, further retention in the service would not be in the best interest of DOE or the naval service.

A. B. SEE,
Commander, USN.

20. Section 730.12 is revised to read as follows:

§ 730.12 Discharge of enlisted personnel by reason of unfitness.

(a) Enlisted personnel may be separated by reason of unfitness with an undesirable discharge, or with a higher type discharge when it is warranted by the particular circumstances in a given case. A discharge by reason of unfitness, regardless of the attendant circumstances, will be effected only when directed by or authorized by the Chief of Naval Personnel. The provisions of this section are not to be used as a substitute for action under the Uniform Code of Military Justice. Therefore, discharge by reason of unfitness will not be issued in lieu of disciplinary action, except upon the determination by the Chief of Naval Personnel that the interests of the service as well as the individual will best be served by administrative discharge. Accordingly, discharge by reason of unfitness normally will not be recommended in lieu of disciplinary action. Also, where there is a suspended punitive discharge pending, an administrative discharge normally will not be recommended under this section.

(b) An enlisted person may be recommended for discharge by reason of unfitness to free the service of persons whose military record is characterized by one or more of the following:

(1) Frequent involvement of a discreditable nature with civil or military authorities.

(2) Sexual perversion including but not limited to (i) lewd and lascivious acts, (ii) homosexual acts, (iii) sodomy, (iv) indecent exposure, (v) indecent acts with or assault upon a child under age 16, or (vi) other indecent acts or offenses. (Secretary of the Navy Instruction 1900.9 or revision sets forth controlling policy and additional action required in homosexual cases).

(3) Drug addiction or the unauthorized use or possession of habit-forming narcotic drugs or marijuana.

(4) An established pattern of shirking.

(5) An established pattern showing dishonorable failure to pay just debts.

(6) Other good and sufficient reasons, as determined by the Chief of Naval Personnel.

(c) In each case processed in accordance with this section, the individual is subject to an undesirable discharge. If his whereabouts is known, he must be informed in writing as to the circumstances which are the basis for the contemplated action and must be afforded in writing an opportunity to request or waive in writing any or all of the following privileges: (If held by the civil authorities or not on active duty, this may be accomplished by mail).

(1) To have his case heard by a board of not less than three officers.

(2) To appear in person before such board (unless in civil confinement or otherwise unavailable).

(3) To be represented by counsel who, if reasonably available, should be a lawyer.

(4) To submit statements in his own behalf.

If the individual requests that his case be heard by a field board of officers, the commanding officer shall convene an administrative board in accordance with § 730.15. The recorder for the field board shall be furnished a brief of the case completed to the extent possible and the service record of the individual concerned. In the event attempts to obtain a request for or waiver of privileges fail, make a page 13 entry of explanation and forward a copy of the page 13 along with the other processing papers to the Chief of Naval Personnel.

(d) Enlisted personnel, except those processed under paragraph (b)(2) or (3) of this section, shall be retained on board pending receipt of instructions from the Chief of Naval Personnel. Enlisted personnel serving on board ships, overseas stations, and continental U.S. activities lacking separation facilities, who are recommended for discharge in accordance with paragraph (b)(2) or (3) of this section, may be transferred to the nearest separation activity to await instructions from the Chief of Naval Personnel. The transfer orders and records must accurately reflect the person's status and reason for transfer in order to ensure that the individual is held pending receipt of the instructions from the Chief of Naval Personnel. In this connection, forward a copy of the letter of transmittal (less the field board proceedings) to the separation activity under a separate letter.

(e) A letter of transmittal shall be prepared in the format given in paragraph (f) of this section and shall contain the following information:

(1) *Principal reason for processing,* Indicate reason as given in paragraph (b) of this section, such as repeated military offenses, indebtedness, homosexual involvement, etc.

(2) *Summary of military offenses.* List in chronological order all disciplinary action during current enlistment. Include service record entry page numbers, date of nonjudicial punishment or court-martial by type, description of offense(s), nonjudicial punishment or sentence as approved and approval date, and all violations of brig or disciplinary command regulations during current confinement with action taken thereon.

(3) *Unclean habits, if any.* Substantiate all unclean habits including the occurrence of repeated venereal disease infections during the current enlistment. When reporting venereal diseases, indicate the date of each admission and nature of the infection.

(4) *Civil convictions, if any, on the basis of information contained in the service record or otherwise readily available.* List date and court in which convicted, offense, and sentence awarded.

(5) *Remarks.* Include location of the individual and his records, any disciplinary action pending, identification of any other military personnel involved and action taken or contemplated in regard thereto, and other information pertinent to the case.

(6) *Findings and recommendation of field board, if held.*

(7) *Comment and recommendation of the Commanding Officer.* (If discharge is recommended, include type and reason.)

(8) *Enclosures.* (i) Request for or waiver of privileges. Must include the following signed statement:

I understand that I am being considered for an administrative discharge because of (one or more of the reasons listed in this section) and that I am subject to and may be separated with an undesirable discharge. I understand that an undesirable discharge is under other than honorable conditions and may deprive me of virtually all veteran's benefits based upon my current period of active service, and that I may expect to encounter substantial prejudice in civilian life in situations wherein the type of service rendered in any branch of the Armed Forces or the character of discharge received therefrom may have a bearing. I understand that I may request or waive the privileges listed below. Understanding all of the foregoing, I desire to avail myself of the privileges I have checked below:

☐ None of the privileges.
☐ To have my case heard by a board of not less than three officers.
☐ To appear in person before such board (unless in civil confinement or otherwise unavailable).
☐ To be represented by counsel who, if reasonably available, should be a lawyer.
☐ To submit statements in my own behalf.

(ii) Copy of page 9 of the service record.

(iii) Statements of subject, if made.

(iv) Proceedings of field board, if held.

(v) Other available documents such as psychiatric or medical evaluation, police reports, etc. If being processed as result of indebtedness, include financial statement as required by article C-11104A of the Bureau of Naval Personnel Manual.

(f) Format of letter of transmittal:

January 15, 1963

From: Commanding Officer, U.S.S. "Eversail" (DD-00).

To: Chief of Naval Personnel.

Subj: DOE, John Robert, 123 45 67, SN, USN; Recommendation for discharge by reason of unfitness.

Encl: (1) Subject's request for privileges; (2) Page 9 (copy of); (3) Statement of subject; (4) Proceedings of field board, if held; (5) Other exhibits.

1. The following information is submitted in the case of subject man:

a. *Primary reason for processing.* (Repeated military offenses, indebtedness, homosexual involvement, etc.)

b. *Basic record data.*

Date of current enlistment: November 15, 1960 for four years. EAOS: February 6, 1965.

Marital status: Single. Dependents: 0. Months on board: 12. Age: 22. GCT: 45. Years of education: 12. Total service (Active) 2 yrs 2 mos. (Inactive) 0.

c. Military offenses:

February 15, 1961 NJP; Pg 13-(3); UA 2 days—2 wks. restr.

April 11, 1961 NJP; Pg 13 -(5); UA 1 day—1 wk. extra duty.

August 5, 1961 NJP; Pg 13-(7); Failed to obey lawful order—2 wks. extra duty.

May 1, 1962 SPCM; Pg 6-(1); UA 15 days—15 days conf. approved.

October 1, 1962 SPCM; Pg 6-(2); UA 20 days—1 month conf. forf. $30.00 a month for 1 mo. approved.

January 5, 1963 NJP; Pg 13-(9); UA 5 hrs.—1 wk. restr.

d. *Other involvements.*

September 12, 1961—Convicted by civil authorities of drunkenness and fined $5.00.

December 5, 1962—Contracted VD infection.

e. *Remarks.* DOE retained on board to await action by Chief of Naval Personnel. (In accordance with authority contained in § 730.12(d), DOE being transferred on January 20, 1963 to RecSta, T. I., to await action by CNP.) Other naval personnel involved: SMITH, T. H., 645 32 21, TN, USN. Commanding Officer, U.S.S. "Lexington" has been notified.

f. *Findings, recommendation, and opinion of Board.* Had frequent involvement of a discreditable nature with military authorities. Discharge under other than honorable conditions (discharge under honorable conditions, retain, etc.).

g. *Comment and recommendation of Commanding Officer.* Concur in recommendation and opinion of field board. Recommend undesirable discharge by reason of unfitness (or other appropriate recommendation).

A. B. SEE,
Commander, USN.

21. Section 730.13 is revised to read as follows:

§ 730.13 Discharge of enlisted personnel by reason of misconduct.

(a) Enlisted personnel may be separated by reason of misconduct with an undesirable discharge, or with a higher type discharge when it is warranted by the particular circumstances in a given case. A discharge by reason of misconduct, regardless of the attendant circumstances, will be effected only when directed by or authorized by the Chief of Naval Personnel.

(b) Processing in accordance with this section is mandatory in any of the following cases:

(1) Conviction by civil authorities (foreign or domestic) or action taken which is tantamount to a finding of guilty of an offense for which the maximum penalty under the Uniform Code of Military Justice (10 U.S.C. 801-940) is death or confinement in excess of one year; or which involves moral turpitude; or where the offender is adjudged a juvenile delinquent, wayward minor or youthful offender as a result of an offense involving moral turpitude. If the offense is not listed in the MCM Table of Maximum Punishments or is not closely related to an offense listed therein, the maximum punishment authorized by the U.S. Code or the District of Columbia Code, whichever is lesser, applies. For the purpose of this subparagraph only, an individual shall be considered as having been convicted even though an appeal is pending or is subsequently filed.

(2) Procurement of a fraudulent enlistment, induction, or period of obligated service through any deliberate material misrepresentation or concealment which, except for such misrepresentation or concealment, may have resulted in rejection. The enlistment of a minor with false representation as to age or without proper consent will not in itself be considered as a fraudulent enlistment.

(3) Prolonged unauthorized absence. When unauthorized continuous absence of 1 year or more has been established but punitive discharge has not been authorized by competent authority.

(c) In each case processed in accordance with this section, the individual is subject to an undesirable discharge. If his whereabouts is known, he must be informed in writing as to the circumstances which are the basis for the contemplated action and must be afforded in writing an opportunity to request or waive, in writing, any or all of the following privileges: (If held by civil authorities or not on active duty this may be accomplished by mail.)

(1) To have his case heard by a board of not less than three officers.

(2) To appear in person before such board (unless in civil confinement or otherwise unavailable).

(3) To be represented by counsel who, if reasonably available, should be a lawyer.

(4) To submit statements in his own behalf.

If the individual requests that his case be heard by a field board of officers, the commanding officer shall convene an administrative board in accordance with § 730.15. The recorder for the field board shall be furnished a brief of the case completed to the extent possible and the service record of the individual concerned. In the event attempts to obtain a request for or waiver of privileges fail, make a page 13 entry of explanation and forward a copy of the page 13 along with the other processing papers to the Chief of Naval Personnel.

(d) Personnel processed in accordance with this section normally shall be retained on board pending instructions from the Chief of Naval Personnel. However, if the particular circumstances clearly indicate that the individual should be transferred, a request for transfer, indicating the reason therefor, may be submitted to the Chief of Naval Personnel.

(e) A letter of transmittal shall be prepared in the format given in paragraph (f) of this section and shall contain the following information:

(1) Circumstances of offense(s): Include a brief resume of the circumstances surrounding the offense (must include sufficient detail to clarify reasons for initial arrest).

(2) Action of civil authorities: Include citation of any civil statute(s) violated, charge on which tried and convicted, court in which convicted, sentence of court, and maximum punishment which could have been imposed for such a conviction under the UCMJ, D.C. Code, or U.S. Code as applicable.

(3) Previous civil convictions, if any, on the basis of information contained in the service record or otherwise readily available: List date and court in which convicted, offense, and sentence awarded.

(4) Summary of military offenses, if any: List in chronological order all disciplinary action during current enlistment. Include service record entry page numbers, date of nonjudicial punishment or court-martial by type, description of offense(s), nonjudicial punishment or sentence as approved and date of approval, and all violations of brig or disciplinary command regulations during the current confinement, with action taken thereon.

(5) Remarks: Include location of the individual and his records, any unauthorized absence involved, and disciplinary action taken or pending, identification of any other military personnel involved in the case and action taken or contemplated in regard thereto, and other information pertinent to the case.

(6) Findings and recommendation of field board, if held.

(f) Format of letter of transmittal:

January 15, 1963

From: Commanding Officer, U.S.S. EVERSAIL (DD-00).

To: Chief of Naval Personnel.

Subj: DOE, John Robert, 123 45 67, SN, USN; Recommendation for discharge by reason of misconduct.

Encl: (1) Subject's request for privileges; (2) Arrest report; (3) Page 9 (copy of); (4) Statement of subject; (5) Proceedings of field board, if held; (6) Other exhibits.

1. The following information is submitted in the case of subject man:

a. *Primary reason for processing*. (Civil conviction, fraudulent enlistment, or prolonged unauthorized absence).

b. *Basic record data*.

Date of current enlistment: November 15, 1960 for four years. EAOS: Undetermined. Marital status: Single. Dependents: 0. Months on board: 12. Age: 22. GCT: 45. Years education: 12. Total service (Active) 2 yrs. 2 mos. (Inactive) 0.

(Active) (Inactive)

c. *Circumstances of offense(s) in detail*. While on authorized leave on 1/1/63, arrested by the civil authorities of Colorado Springs, Colorado, on the charge of auto theft.

d. *Action of civil authorities*. Tried on 1/5/63 at Colorado Springs, Colorado, for violation of Title 29, Chapter 133.24 (Car theft) and convicted. Received an indeterminate term up to five years confinement. Presently serving his sentence at the Colorado State Prison, Canon City, Colorado. Maximum penalty—Article 121, UCMJ, 5 years.

e. *Summary of Military Offense(s)*. 4/11/61; NJP; Pg 13-(5); UA 1 day—1 wk. extra duty.

f. *Remarks*. Records and effects located at this command. Other personnel involved: SMITH, T. H., 645 32 21, TN, USN. Commanding Officer, U.S.S. LEXINGTON, has been notified.

g. *Findings, recommendation and opinion of Board*. Convicted as indicated above. Discharge under other than honorable conditions (discharge under honorable conditions, retain, etc.).

h. *Comment and recommendation of Commanding Officer*. Concur in recommendation and opinion of field board. Recommend undesirable discharge by reason of misconduct (or other appropriate recommendation).

A. B. SEE,
Commander, USN.

(7) Comment and recommendation of the Commanding Officer: (If discharge is recommended, include type and reason.)

(8) Enclosures:

(i) Request for or waiver of privileges. Must include the following signed statement:

I understand that I am being considered for an administrative discharge because of (one of the reasons listed in § 730.13) and that I am subject to and may be separated with an undesirable discharge. I understand that an undesirable discharge is under other than honorable conditions and may deprive me of virtually all veteran's benefits based upon my current period of active service, and that I may expect to encounter substantial prejudice in civilian life in situations wherein the type of service rendered in any branch of the Armed Forces or the character of discharge received therefrom may have a bearing. I understand that I may request or waive the privileges listed below. Understanding all of the foregoing, I desire to avail myself of the privileges I have checked below.

☐ None of the privileges.
☐ To have my case heard by a board of not less than three officers.
☐ To appear in person before such board (unless in civil confinement or otherwise unavailable).
☐ To be represented by counsel who, if reasonably available, should be a lawyer.
☐ To submit statements in my own behalf.

ii. Statement of witnesses, arrest reports, copies of court records, probation orders, or any other pertinent documents.

iii. Copy of page 9 of the service record.

iv. Statements of subject, if made.

v. Proceedings of field board, if held.

vi. Other pertinent exhibits.

§ 730.14 [Deleted]

22. Section 730.14 is deleted.

23. Section 730.15 is revised to read as follows:

§ 730.15 Field board of officers.

(a) *Appointment and composition*. When a field board hearing is to be held, the commanding officer shall appoint a board of not less than three commissioned officers in an active duty status to consider the case. The board may be composed of Regular or Reserve Navy or Marine Corps officers, or a combination thereof. If the individual under consideration (hereinafter called respondent) is a woman, the board must include a woman officer. The commanding officer shall also appoint as recorder an officer in an active duty status. The senior member of the board presides at the hearing and is responsible for its proper conduct. Prior to the hearing, the senior member shall ensure that all members of the board are familiar with the provisions of pertinent sections of this part.

(1) *Reserve membership*. If the respondent is a Reservist the membership of the board shall, if available, include a majority of Reserve officers. In any instance where a majority of Reserve officers is not available, the board will include not less than one Reserve officer among its members.

(2) *Counsel for the respondent*. If the respondent requests in writing that he be represented by counsel but does not specify a particular person, the commanding officer shall appoint an officer he considers qualified to act as counsel for the respondent. When practicable, a person selected by the respondent will be appointed as his counsel. The respondent may retain civilian counsel at his own expense, and any previously appointed counsel may accordingly be excused. The hearing should not be unduly delayed to permit attendance by counsel. If undue delay appears likely, other counsel who is immediately available should be selected or appointed.

(3) *Recorder*. The recorder is responsible for the clerical and preliminary work of the hearing, but is not a member of the board. He conducts a preliminary review of available evidence and prior to the hearing interviews prospective witnesses after warning them of their rights under article 31, UCMJ, where appropriate. After consultation with the commanding officer and the senior member, he notifies the members, respondent, and counsel as to the time, date, and place of the hearing. Subject to the provisions of paragraph (2) of this section, the recorder arranges for the attendance at the hearing of the respondent, all witnesses for the government, and military witnesses for the respondent. He verifies the information contained in the brief concerning the respondent and assembles pertinent directives, regulations and records for use by the board. At the hearing he presents the case against the respondent. He is responsible for preparing the report of the hearing.

(4) *Reporter*. Although a summary of testimony will normally suffice, the recorder or senior member may request a reporter for the purpose of making a verbatim record of the testimony if it appears that a substantial number of witnesses will testify, that the testimony will be lengthy, or that other good reason exists for making a verbatim record.

(b) *Obtaining witnesses*. No authority exists for the issuance of subpoenas in connection with these hearings. Appearance as witnesses of civilians including members of the Armed Forces on inactive duty may be arranged for on a voluntary basis. Appropriations are not available to pay witnesses' fees or reimbursement for travel and other expenses of such persons and this fact shall be made known to them if and when they are invited to appear and testify at the hearing. Attendance at the hearing of military personnel on active duty who are in the local area shall be arranged for by the recorder if reasonably available. Testimony of active duty military personnel not in the immediate area, if needed, should be obtained and presented in the form of written statements.

(c) *ONI reports.* If an ONI report is involved which cannot be made available to the respondent and his counsel, the commanding officer should request the District or Area Intelligence Officer to furnish a resume of the report which may be made available to the respondent and his counsel in accordance with current ONI instructions. The resume but not the ONI report may be considered by the field board. The purpose of this provision is to ensure that the field board considers only matters which are also available to the respondent and his counsel.

(d) *General procedural instructions.* The proceedings of boards of officers under the provisions of this section need not conform to provisions of the Manual for Courts Martial United States, or of the JAG Manual. Such provisions may, however, be followed in specific cases and, if followed, will satisfy the requirement of this section. Whenever applicable, article 31 of the Uniform Code of Military Justice (10 U.S.C. 831) is to be complied with. Attention is directed to the fact that (1) Military personnel on active duty may not be compelled to testify or produce evidence that will incriminate them, nor may they be required to answer questions not material to the issue which might tend to degrade them and (2) Civilians, including members of the Armed Forces on inactive duty, may not be compelled to testify or produce evidence at the hearing. The board should consider any matter presented which is relevant to the issue whether written or oral, sworn or unsworn. Real evidence as distinct from testimonial evidence may be exhibited to the board and should be accurately described or reproduced for the record. The board may refuse to consider or to consider further any oral or written matter presented if it is irrelevant, immaterial, or unnecessarily repetitive and cumulative, but no such matter should be rejected or withheld from consideration on the ground that it would be incompetent for presentation to a court of law. The board will rely on its own judgment and experience in determining the weight and credibility to be given material received in evidence. Board proceedings under this section should not be in the nature of a formal fact-finding tribunal, or judicial trial, but should be formalized to the extent of assuring full opportunity for presentation of the respondent's case. If an objection is made at any stage during the proceedings the senior member will ensure that the objection and the basis therefor are noted in the record but should not make a formal ruling thereon. Any member of the board may be challenged but only on grounds which show that the member cannot render a fair and impartial decision. The challenged member may be examined by the respondent, his counsel, and other members of the board. The commanding officer, upon being informed of the circumstances of the challenge and the recommendation of the other members, may appoint a substitute for the challenged member if he deems such action appropriate.

(e) *Conduct of hearing.* (1) The senior member, upon calling the meeting to order, should direct the recorder to make a record as to the time, date, and place of the hearing, the identity and presence of the appointed members of the board and of the recorder, the respondent, his counsel, and any witnesses. The senior member should then commence the hearing by explaining in substance that:

(i) The board has been convened for the purpose of considering the pertinent facts relating to the case of (name, service number, rate, and class), who it is alleged (state the specific allegations against the respondent). The board will make findings of fact, a recommendation as to the disposition to be made in this case, and will render an opinion as to character of separation to be given if separation is recommended by the board.

(ii) The proceedings are administrative in nature, and the board is not bound by formal rules of evidence.

(iii) The respondent has the right to present evidence, to cross-examine all witnesses who appear at the hearing and to hear all evidence against him. (If evidence is classified observe the provisions of Department of the Navy Security Manual for Classified Information.)

(iv) The respondent has the right to submit an oral or written statement in his own behalf.

(v) The respondent may testify in his own behalf or remain silent, and, if he testifies he may be examined on his testimony and on the question of his general credibility.

(vi) There is no right of peremptory challenge, but a member may be challenged for cause.

(vii) Objections will be heard and noted, but there should be no formal ruling thereon.

(2) After the preliminary procedures have been completed, the recorder will present the case against the respondent who will be afforded the opportunity for rebuttal and for presentation of evidence. The general procedural instruction stated in paragraph (d) of this section will be followed. Witnesses will be excluded except while testifying. Before testifying, each witness and the respondent will be asked whether or not he elects to give his testimony under oath or affirmation. After all evidence is in and questioning and oral argument, if any, are complete the hearing will be closed.

(f) *Report of board.* The board will make and render its findings, recommendation, and opinion in closed session. The report of the field board of officers shall be completed, using the form set forth in paragraph (h) of this section as a guide, and shall be signed by all members. The dissent of any member will be duly recorded therein. Where a verbatim record has been made, only so much of the verbatim oral testimony as bears upon the critical situations of the case should be incorporated into the record of proceedings. The remainder may be summarized. Written testimony and statements which have been furnished the board shall be attached to the record as exhibits. The complete record will be authenticated by the senior member or by another member if he is not immediately available. Upon request the respondent will be provided with a copy of the record of proceedings with all exhibits, but he will not be furnished a copy of the report of the board or brief accompanying the case.

(g) *Review and forwarding of reports.* After reviewing the record of the hearing and the report of the board, the commanding officer shall note on the report his concurrence or nonconcurrence in the findings, recommendation, and opinion of the board and enter any additional comment deemed appropriate. If the commanding officer determines that the respondent should be retained in the service, he may close the case except where sexual perversion or drug addiction within the purview of § 730.12 or any case within the purview of § 730.13 is an issue. Cases in which sexual perversion or drug addiction or misconduct within the purview of the aforesaid sections is an issue must be forwarded to the Chief of Naval Personnel for final action.

(h) *Format of report of field board of officers.*

REPORT OF FIELD BOARD OF OFFICERS IN THE CASE OF

Name, DOE, John Robert; Service number, 123 45 67; Rate, SN; Class, USN.

Findings of the Board: The respondent (has) (is)

(Use one or more of the following as appropriate):

a. Had frequent involvement of a discreditable nature with civil or military authorities.

b. Chronic alcoholism or addicted to alcohol.*

c. Without authority (used) (possessed) habit forming narcotic drugs or marijuana.

d. A sexual pervert.

e. Committed homosexual acts in current enlistment.

f. Homosexual tendencies.*

g. Committed homosexual acts not in current enlistment.

h. An established pattern showing dishonorable failure to pay just debts.

i. An established pattern of shirking.

j. Been convicted of a civil offense within the purview of § 730.13.

k. Prolonged unauthorized absence within the purview of § 730.13.

l. Perpetrated a fraudulent (enlistment) (induction).

m. Other (explain).

Board Recommendation: ☐ Discharge ☐ Retain ☐ Release to inactive duty.

Opinion of Board as to character of separation: ☐ Honorable ☐ Under honorable conditions ☐ Under conditions other than honorable.

* If discharge is recommended under this finding it should be for unsuitability rather than unfitness or misconduct and the provisions of § 730.10 must be complied with.

Signature of Board Members: (include name, grade, and component).

Dissent: (Reasons).

(Signature—Include name, grade, and component)

Findings, Recommendation and Opinion of Majority ☐ Concurrence ☐ Nonconcurrence

(Comment, if any)

(Commanding officer—include name, grade, and component)

(i) *Board of officers convened by the Chief of Naval Personnel.* There is established in the Bureau of Naval Personnel an Enlisted Performance Evaluation Board composed of not less than three officers which considers cases referred to it, including performance cases submitted under § 730.12 or § 730.13. The Board will examine all evidence submitted and will make recommendation to the Chief of Naval Personnel as to final disposition. The Board will consider each case on its individual merits. All matters of record, including such variables as the person's military record, civil record, age, GCT/AFQT, education, length of service, performance marks, psychiatric and medical determinations, duty stations, nature of offense and actions taken thereon, length of time since commission of last offense, individual's statement, the field board action (when applicable), commanding officer's comments and recommendations, and other pertinent factors are carefully considered, evaluated, and correlated in arriving at a decision.

(j) *Action by the Chief of Naval Personnel.* Final disposition of performance cases acted upon under the provisions of this section will be directed by the Chief of Naval Personnel. Disposition of each case will be based upon the recommendation of the Commanding Officer, field board of officers, and the Enlisted Performance Evaluation Board together with policy or legal considerations.

(2) The final action approved by the Chief of Naval Personnel in an individual case will not, as a matter of policy and/or law, include a discharge under other than honorable conditions unless such action is proposed by the Enlisted Performance Evaluation Board. If the final action approved is less favorable to the individual than that proposed by the field board, the Chief of Naval Personnel will generally afford the individual an opportunity to make representations in an effort to show cause why the less favorable action should not be taken. If the less favorable action is an undesirable discharge and the individual so requests in writing to his commanding officer, he will be offered an opportunity to appear in person, with or without counsel, before the Enlisted Performance Evaluation Board. Instructions incident to such appearance will be included in the letter directing discharge. Personal appearance before the Board will not be authorized in the cases of personnel in civil confinement or otherwise not available.

(3) When considered appropriate, the Chief of Naval Personnel will authorize or direct that the individual be retained in the service in a probationary status. In such a case, the action of the Chief of Naval Personnel will include instructions concerning the terms of the probation and will specify the type of discharge which is to be executed without reference to the Bureau of Naval Personnel in the event the individual does not fulfill the terms of his probation. A discharge other than the type specified will not be given the probationer unless his case is reprocessed under the provisions of this section which govern discharge by reason of unsuitability, unfitness, or misconduct, as applicable, and such discharge is directed by the Chief of Naval Personnel.

24. Section 730.16 is revised to read as follows:

§ 730.16 General provisions and restrictions relating to enlisted separations.

(a) *Effective time of discharge.* Subject to any law providing otherwise, the discharge of an enlisted person on active duty, regardless of the reason for separation, takes effect upon delivery of the discharge certificate. In the case of a person discharged while absent without authority or in civil confinement, constructive delivery of the discharge certificate is accomplished at the time it is signed by proper authority. If a discharge is effected as a result of a person's immediate entry in the same or any other component of the Armed Forces in the same or any other status, the discharge will, for administrative purposes, be dated as of the date preceding such entry or re-entry.

(b) *Effective time of release to inactive duty.* Subject to any law providing otherwise, the release to inactive duty of a Reservist who was called to active duty as a Reservist takes effect at the actual time of his arrival home or at the expiration of his authorized travel time, whichever is earlier. The release to inactive duty of members of the Regular Navy transferred to the Naval Reserve and concurrently released to inactive duty takes effect upon delivery of the separation documents.

NOTE: When a discharged member is seriously injured while returning home and is taken to a Navy hospital, he may be eligible for hospitalization and other benefits from the Veterans Administration and should be advised to file an appropriate claim with that agency.

(c) *Civilian clothing.* An enlisted member who is discharged by reason of unsuitability, security, unfitness, or misconduct with an honorable or general discharge or who is discharged for any reason with a dishonorable, bad conduct, or undesirable discharge shall surrender the outer garments and distinctive parts of the uniform which are in the member's possession at time of discharge. When the items of clothing authorized to be retained by the dischargee are insufficient to provide the dischargee with one outfit of civilian clothing suitable for wearing home, necessary items of civilian clothing may be issued at no cost to the dischargee to augment the retained clothing. These clothes shall be furnished without regard to the state of member's accounts or amount of personal funds in the member's possession. However, no extra items of clothing such as a spare shirt or socks and no accessories such as an umbrella or luggage may be issued to the dischargee. The items procured for issuance must be moderately priced but need not be the lowest quality available. Members transferred prior to the actual execution of the discharge shall take all their uniforms with them to the place to which transferred. Issuance of the outfit of civilian clothing under this paragraph is subject to the following exceptions:

(1) The clothing may be issued to a person discharged in absentia pursuant to article C-10201 (6) of the Bureau of Naval Personnel Manual only if he requests the clothing, and all conditions set forth in the first two sentences of this paragraph are met.

(2) The clothing is not to be issued to a person who is discharged while on leave granted in accordance with current instructions (see Secretary of the Navy Instruction 1050.3 (§ 719.206 of this chapter) or revisions thereof) to await completion of appellate review of a court-martial sentence which includes punitive discharge.

(For detailed instructions regarding issuance of civilian clothing, its cost, and recovery of uniforms of dischargees, see Bureau of Supplies and Accounts Manual, paragraph 25940.)

(d) *Wearing of uniform after discharge.* Enlisted personnel discharged with an honorable or general discharge (except those discharged by reason of unsuitability, security, unfitness, or misconduct), are entitled to retain their uniforms and may within 3 months after discharge wear them from place of discharge to their homes, except that persons who have served less than 6 months on active duty subsequent to last authorization of an initial clothing allowance, unless discharged to accept a direct commission or appointment as an officer or warrant officer, are entitled to retain only one complete uniform appropriate to the season. The 3-month period relates to the period between the date of discharge and the date of the person's arrival home, and does not permit the wearing of the uniform after arrival home, even though the 3-month period has not expired. Enlisted personnel discharged to accept a commission or appointment as an officer or warrant officer may retain all clothing in their possession.

(e) *Cash allowance.* An enlisted person who is discharged for any reason with a dishonorable, bad conduct, or undesirable discharge and who would be otherwise without funds to meet his immediate needs shall, upon discharge, be paid a sum not to exceed $25 or such portion thereof as will, together with other funds available to the individual concerned, total $25. The cash allowance is not payable to a member who is discharged while on leave granted in accordance with current instructions (see Secretary of the Navy Instruction (§ 719.206 of this chapter) or revisions thereof) to await completion of appellate review of a court-martial sentence which includes punitive discharge.

(f) *Not recommended for reenlistment.* Every enlisted person discharged who is not recommended for reenlistment shall be informed orally that fraudulent enlistment in any branch of the service undoubtedly will be detected by fingerprints, and that if concealment of previous service and discharge results in reenlistment that person will be subject to disciplinary action.

(g) *Information concerning the Honorable Discharge Button.* Information concerning the Honorable Discharge Button is set forth in article B-2107 of the Bureau of Naval Personnel Manual.

(h) *Information concerning recoupment of reenlistment bonus.* Information concerning recoupment of reenlistment bonus is set forth in article A-4204 of the Bureau of Naval Personnel Manual.

(R.S. 161, secs. 280, 1162, 5031, 6291-6298, 70A Stat. 14, 89, 278, 391-393, as amended; 5 U.S.C. 22, 10 U.S.C. 280, 1162, 5031, 6291-6298)

By direction of the Secretary of the Navy.

Dated: December 22, 1964.

[SEAL] WILFRED HEARN,
Rear Admiral, U.S. Navy, Judge Advocate General of the Navy.

[F.R. Doc. 64-13302; Filed, Dec. 23, 1964; 8:48 a.m.]

Title 5—ADMINISTRATIVE PERSONNEL

Chapter I—Civil Service Commission

PART 213—EXCEPTED SERVICE

Positions Other Than Those of Confidential or Policy-Determining Character for Which it is Not Practicable To Examine.

Effective upon publication in the FEDERAL REGISTER, paragraph (b) of § 213.3101, having expired by its own terms, is revoked.

(R.S. 1753, sec. 2, 22 Stat. 403, as amended; 5 U.S.C. 631, 633; E.O. 10577, 19 F.R. 7521, 3 CFR, 1954-1958 Comp., p. 218)

UNITED STATES CIVIL SERVICE COMMISSION,
[SEAL] MARY V. WENZEL,
Executive Assistant to the Commissioners.

[F.R. Doc. 64-13305; Filed, Dec. 23, 1964; 8:49 a.m.]

PART 213—EXCEPTED SERVICE

Department of the Army

Section 213.3307 is amended to show the exception under Schedule C of the position of Special Assistant to the Assistant Secretary of the Army (Installations and Logistics) for Planning. Effective upon publication in the FEDERAL REGISTER, subparagraph (15) is added to paragraph (a) of § 213.3307 as set out below.

§ 213.3307 Department of the Army.

(a) *Office of the Secretary.* * * *

(15) One Special Assistant to the Assistant Secretary of the Army (Installations and Logistics) for Planning.

* * * * *

(R.S. 1753, sec. 2, 22 Stat. 403, as amended; 5 U.S.C. 631, 633; E.O. 10577, 19 F.R. 7521, 3 CFR, 1954-1958 Comp., p. 218)

UNITED STATES CIVIL SERVICE COMMISSION,
[SEAL] MARY V. WENZEL,
Executive Assistant to the Commissioners.

[F.R. Doc. 64-13306; Filed, Dec. 23, 1964; 8:49 a.m.]

PART 213—EXCEPTED SERVICE

Department of Labor

Section 213.3315 is amended to show the exception under Schedule C of the position of Director, Neighborhood Youth Corps. Effective upon publication in the FEDERAL REGISTER, subparagraph (19) is added to paragraph (a) of § 213.3315 as set out below.

§ 213.3315 Department of Labor.

(a) *Office of the Secretary.* * * *

(19) The Director, Neighborhood Youth Corps.

* * * * *

(R.S. 1753, sec. 2, 22 Stat. 403, as amended; 5 U.S.C. 631, 633; E.O. 10577, 19 F.R. 7521, 3 CFR, 1954-1958 Comp., p. 218)

UNITED STATES CIVIL SERVICE COMMISSION,
[SEAL] MARY V. WENZEL,
Executive Assistant to the Commissioners.

[F.R. Doc. 64-13307; Filed, Dec. 23, 1964; 8:49 a.m.]

Title 22—FOREIGN RELATIONS

Chapter II—Agency for International Development, Department of State

[A.I.D. Reg. 1]

PART 201—RULES AND PROCEDURES APPLICABLE TO COMMODITY TRANSACTIONS FINANCED BY A.I.D.

Part 201 of Chapter II, Title 22 (A.I.D. Regulation 1), is amended as follows:

In § 201.86 designate the present text as paragraph (a) and add the following new paragraph (b).

As amended § 201.86 reads as follows:

§ 201.86 Continuation in effect of certain prior issuances.

(a) The following documents, if issued or executed by A.I.D. or any predecessor agency or corporation prior to the effective date of this Part 201, will continue in effect subject to all the terms and conditions of such documents and, to the extent applicable, all the terms and conditions of Regulation 1 as in effect on the date of the issuance of such documents: Project agreements, procurement authorizations and project implementation orders, United States Government agency purchase requisitions, loan agreements and implementation letters, letters of commitment and letters of notification to banks, requests for the opening of a special letter of credit and letters of commitment to suppliers. Authorizations, bank contracts, letters of guaranty to banks or suppliers issued by A.I.D. or any predecessor agency or corporation prior to the effective date of this Part 201 will continue in effect in accordance with their terms. Amendments to any of the above documents may continue to be made in accordance with the procedures in effect prior to the effective date of this Part 201.

(b) Whenever a Supplier's Certificate A.I.D. Form 280 is required to be submitted under the provisions of this part as in effect prior to November 1, 1964, a Supplier's Certificate A.I.D. Form 281 completed and executed in accordance with the provisions of § 201.52(a)(6) and (b) may, at the election of the supplier, be submitted in lieu of such Supplier's Certificate A.I.D. Form 280, and, if such Supplier's Certificate A.I.D. Form 281 is submitted, the supplier executing the same shall be bound by the provisions thereof and by the provisions of this part as in effect at the time of his execution of such Supplier's Certificate.

Dated: December 9, 1964.

WILLIAM S. GAUD,
Deputy Administrator.

[F.R. Doc. 64-13220; Filed, Dec. 23, 1964; 8:46 a.m.]

Title 42—PUBLIC HEALTH

Chapter I—Public Health Service, Department of Health, Education, and Welfare

PART 21—COMMISSIONED OFFICERS

Prescription of Numbers in Grade

Section 21.111 of Subpart G is amended to read as follows:

§ 21.111 Prescription of numbers in grade.

The following maximum number of officers is authorized to be on active duty in the Regular Corps in each of the grades from the junior assistant grade to the director grade, inclusive, during the fiscal year beginning July 1, 1964, and ending June 30, 1965:

Director grade	665
Senior grade	830
Full grade	710
Senior Assistant grade	500
Assistant grade	65
Junior Assistant grade	30

(Sec. 206, 58 Stat. 694, as amended; 42 U.S.C. and Sup., 207)

This amendment shall be effective as of July 1, 1964.

Dated: December 2, 1964.

[SEAL] LUTHER L. TERRY,
Surgeon General.

Approved: December 16, 1964.

ANTHONY J. CELEBREZZE,
Secretary.

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Title 14—AERONAUTICS AND SPACE

Chapter I—Federal Aviation Agency

[Docket No. 5066; Amdts. 1–6; 91–10]

PART 1—DEFINITIONS AND ABBREVIATIONS [NEW]

PART 4a—AIRPLANE AIRWORTHINESS

PART 4b—AIRPLANE AIRWORTHINESS; TRANSPORT CATEGORIES

PART 25—AIRWORTHINESS STANDARDS: TRANSPORT CATEGORY AIRPLANES [NEW]

PART 91—GENERAL OPERATING AND FLIGHT RULES [NEW]

This amendment adds Part 25 [New] to the Federal Aviation Regulations to replace Part 4b of the Civil Air Regulations, and is a part of the Agency recodification program announced in Draft Release 61–25, published in the FEDERAL REGISTER on November 15, 1961 (26 F.R. 10698).

Part 25 [New] was published as a notice of proposed rule making in the FEDERAL REGISTER on June 2, 1964 (29 F.R. 7169), and given further distribution as Notice No. 64–28.

During the life of the recodification project, Chapter I of Title 14 may contain more than one part bearing the same number. To differentiate between the two, the recodified parts, such as this one, are labeled "[New]". The label will be dropped at the completion of the project as all of the regulations will be new.

Many of the comments received recommended specific substantive changes to the regulations. Many of these recommendations appear to be meritorious. However, they cannot be adopted as a part of the recodification program, since the purpose of the program is simply to streamline and clarify present regulatory language and delete obsolete or redundant provisions. To attempt substantive changes, other than relaxatory ones that are completely noncontroversial, would delay the project and be contrary to the ground rules specified for it in Draft Release 61–25. However, all comments of this nature will be preserved and considered in any later substantive revision of this part.

Present CAR Part 4b reflects the various writing styles used by those who have worked on it in the past. The recodification has allowed us to use one style throughout Part 25 [New]. The style changes that have been made do not affect substance. They have been made to ensure consistency in language throughout the new Federal Aviation Regulations, thereby making them easier to understand and apply. Part 25 [New] substitutes the word "must" for "shall". This has been done to reflect the fact that airworthiness standards are simply conditions precedent that are required to be met for the issue of a type certificate. The imperative "shall" would be inappropriate in this case. The failure to meet the standards simply results in a denial of the issue of the type certificate.

The sections in Part 25 [New] have been rearranged and renumbered so that the requirements of this part have the same number as comparable requirements in Parts 23 [New], 27 [New], and 29 [New]. Where there is no comparable requirement in Part 25, there is a gap in the section numbering (in addition to gaps from the use of odd section numbers only and the "growth" gaps between subtopics). In addition, some material has been rearranged in order to more logically place some requirements within the part. An example of this was the grouping of the parts of §§ 4b.117, 4b.361, 4b.362, 4b.437, 4b.640, 4b.719, 4b.736, 4b.740 through 4b.743, and SR 422B sections 4T.123 and 4T.743, dealing with recording of information and data in the Airplane Flight Manual, into the Airplane Flight Manual subdivision of this part. A similar rearrangement was made by combining the flutter requirements of §§ 4b.190(a), 4b.210(c)(3), and 4b.308 into § 25.629 and vibration requirements of these same sections into § 25.251.

The most significant changes to Part 25 since the notice are listed below. The numbers in parentheses refer to the section number in the notice and in former Part 4b, respectively.

Section 25.1001 (§ 25.733) (§ 4b.437) has been revised by changing the requirement for a placard to warn flight crewmembers against jettisoning fuel with flaps lowered (if it has not been shown that it is safe to do so with them lowered). It now reads "means (including flaps, slots, and slats) for changing the airflow across or around the wing" instead of the word flaps. This was done to update the language as these other devices (slats and slots) take the place of the flaps in some airplanes and are referred to in other regulations (particularly in ADs).

In § 25.611 (§ 25.401) (§ 4b.305) "periodic inspection" has been replaced with "recurring inspection". This avoids any potential conflict between the intent of the subject section, to cover all inspections that occur at regular intervals, and the more specific use of the term "periodic inspection" in Parts 43 [New] and 91 [New].

In response to a comment, a cross reference to § 25.1145(b) has been added to § 25.1307 (§ 25.947) (§ 4b.605) to make it clear that a ganged ignition switch may be used to satisfy the subject requirement.

Other minor changes of a technical clarifying nature have been made. They are not substantive and do not impose any burden on regulated persons. For example, the Agency is standardizing the language used to describe an aircraft, with respect to the type of engine installed, as follows:

An aircraft powered by a reciprocating engine is a "reciprocating engine powered aircraft".

An aircraft powered by a turbine engine is a "turbine engine powered aircraft".

An aircraft powered by a particular subtype of turbine engine is a "turbopropeller powered aircraft" or "turbojet powered aircraft", whichever is appropriate.

In the notice, it was proposed to convert references to "miles" and "miles per hour" to their nautical equivalents. The only comment received was favorable. To make this part uniform and to conform to modern practice, "nautical miles" and "knots" have been used throughout. The associated values have been adjusted so that no increase in burden results.

This part incorporates Amendment 4b–15, Installation of Cockpit Voice Recorders, published in the FEDERAL REGISTER July 3, 1964, and Amendment 4b–16, Flutter Deformation and Vibration Requirements, published in the FEDERAL REGISTER on September 5, 1964.

The definitions, abbreviations, and rules of construction contained in Part 1 [New] of the Federal Aviation Regulations apply to Part 25 [New].

When Part 1 [New] was adopted, its preamble stated that it would be amended as necessary in order to apply to specific regulations as they were recodified. As part of this action, Part 1 [New] is being amended to incorporate definitions and abbreviations found to be necessary because of the adoption of subsequently issued Federal Aviation Regulations, including Subchapter C.

The definition of "accelerate-stop distance" has been incorporated from Parts 4b, 40, 41, and 42, that of "critical altitude", from Parts 3, 4b, 6, 7, and 13, and that of "load factor", from Parts 3, 4b, 6, and 7. The definitions of "clearway" and "stopway" have been incorporated from Special Civil Air Regulations 422A and 422B and, as a result, § 91.37 is being amended to delete the definitions of "clearway" and "stopway" in paragraph (d). Also, since SRs 422A and 422B, together, set forth the certification procedures for all turbine engine powered airplanes certificated after September 30, 1958, the references to the two SRs in § 91.37 have been replaced by references to their respective periods of effectiveness.

In addition to these definitions, Part 1 [New] is being amended to correctly reflect the "½" in the definition of "true airspeed" as a power rather than as a multiplicand.

The abbreviations and symbols set forth below have been incorporated from Parts 3, 4b, 6, and 7.

The performance and Airplane Flight Manual requirements of SR 422B are in this part. The corresponding requirements of SRs 422 and 422A are being deleted as they may no longer be used for airplanes to be certificated under this part. They will have the same status as any superseded section of a current rule. The operating rules of SRs 422, 422A, and 422B where current, will be put in the Air Carrier Operating rules.

As CAR Part 4a, "Airplane Airworthiness" has not been used for certification of new airplanes since 1947, it is being deleted. This action is consistent with the recodification aim of eliminating obsolete or unnecessary provisions and is similar to the action taken with Part 33 of the Civil Air Regulations and Parts 450, 560, and 580 of the Regulations of the Administrator. CAR 4a will have the same status as any superseded section of a current rule.

Interested persons have been afforded an opportunity to participate in the making of this regulation and due consideration has been given to all relevant matter presented. The Agency is particularly appreciative of the cooperative spirit in which the public's comments were submitted.

In consideration of the foregoing, Chapter I of Title 14 is amended as follows, effective February 1, 1965.

1. By deleting items 1 and 2 of SR 422.

2. By deleting items 1, 2, and 5 of SR 422A.

3. By deleting items 1, 2, and 5 of SR 422B.

4. By deleting Part 4a "Airplane Airworthiness".

5. By deleting Part 4b "Airplane Airworthiness, Transport Category".

6. By amending Part 1 "Definitions and Abbreviations" [New] as follows:

(a) By inserting the following new definitions in § 1.1:

"Accelerate-stop distance" means the distance required to accelerate an airplane to a specified speed and, assuming failure of the critical engine at the instant that speed (V_1) is attained, to bring the airplane to a stop.

"Clearway" means:

(1) For turbine engine powered airplanes certificated after August 29, 1959, an area beyond the runway, not less than 500 feet wide, centrally located about the extended centerline of the runway, and under the control of the airport authorities. The clearway is expressed in terms of a clearway plane, extending from the end of the runway with an upward slope not exceeding 1.25 percent, above which no object nor any terrain protrudes. However, threshold lights may protrude above the plane if their height above the end of the runway is 26 inches or less and if they are located to each side of the runway.

(2) For turbine engine powered airplanes certificated after September 30, 1958, but before August 30, 1959, an area beyond the takeoff runway extending no less than 300 feet on either side of the extended centerline of the runway, at an elevation no higher than the elevation of the end of the runway, clear of all fixed obstacles, and under the control of the airport authorities.

"Critical altitude" means the maximum altitude at which, in standard atmosphere, it is possible to maintain, at a specified rotational speed, a specified power or a specified manifold pressure. Unless otherwise stated, the critical altitude is the maximum altitude at which it is possible to maintain, at the maximum continuous rotational speed, one of the following:

(1) The maximum continuous power, in the case of engines for which this power rating is the same at sea level and at the rated altitude.

(2) The maximum continuous rated manifold pressure, in the case of engines, the maximum continuous power of which is governed by a constant manifold pressure.

"Load factor" means the ratio of a specified load to the total weight of the aircraft. The specified load is expressed in terms of any of the following: aerodynamic forces, inertia forces, or ground or water reactions.

"Stopway" means an area beyond the takeoff runway, no less wide than the runway and centered upon the extended centerline of the runway, able to support the airplane during an aborted takeoff, without causing structural damage to the airplane, and designated by the airport authorities for use in decelerating the airplane during an aborted takeoff.

(b) By amending the definition of "True airspeed" in § 1.1 to read as follows:

"True airspeed" means the airspeed of an aircraft relative to undisturbed air. True airspeed is equal to equivalent airspeed multiplied by $(\rho 0/\rho)^{1/2}$.

(c) By inserting the following new abbreviations and symbols in § 1.2:

EAS means equivalent airspeed.
IAS means indicated airspeed.
M means mach number.
PAR means precision approach radar.
TAS means true airspeed.
V_A means design maneuvering speed.
V_B means design speed for maximum gust intensity.
V_C means design cruising speed.
V_D means design diving speed.
V_{DF}/M_{DF} means demonstrated flight diving speed.
V_F means design flap speed.
V_{FC}/M_{FC} means maximum speed for stability characteristics.
V_{FE} means maximum flap extended speed.
V_H means maximum speed in level flight with rated r.p.m. and power.
V_{LE} means maximum landing gear extended speed.
V_{LO} means maximum landing gear operating speed.
V_{LOF} means lift-off speed.
V_{MC} means minimum control speed with the critical engine inoperative.
V_{MO}/M_{MO} means maximum operating limit speed.
V_{MU} means minimum unstick speed.
V_{NE} means never-exceed speed.
V_R means rotation speed.
V_S means the stalling speed or the minimum steady flight speed at which the airplane is controllable.
V_{S_0} means the stalling speed or the minimum steady flight speed in the landing configuration.
V_{S_1} means the stalling speed or the minimum steady flight speed obtained in a specified configuration.
V_X means speed for best angle of climb.
V_Y means speed for best rate of climb.
V_1 means critical-engine-failure speed.
V_2 means takeoff safety speed.
$V_{2\,min}$ means minimum takeoff safety speed.

7. By amending § 91.37 to read as follows:

§ 91.37 Transport category civil airplane weight limitations.

(a) No person may take off any transport category airplane (other than a turbine engine powered airplane certificated after September 30, 1958) unless—

(1) The takeoff weight does not exceed the authorized maximum takeoff weight for the elevation of the airport of takeoff;

(2) The elevation of the airport of takeoff is within the altitude range for which maximum takeoff weights have been determined;

(3) Normal consumption of fuel and oil in flight to the airport of intended landing will leave a weight on arrival not in excess of the authorized maximum landing weight for the elevation of that airport; and

(4) The elevations of the airport of intended landing and of all specified alternate airports are within the altitude range for which maximum landing weights have been determined.

(b) No person may operate a turbine engine powered transport category airplane certificated after September 30, 1958 contrary to the Airplane Flight Manual, nor take off that airplane unless—

(1) The takeoff weight does not exceed the takeoff weight specified in the Airplane Flight Manual for the elevation of the airport and for the ambient temperature existing at the time of takeoff;

(2) Normal consumption of fuel and oil in flight to the airport of intended landing and to the alternate airports will leave a weight on arrival not in excess of the landing weight specified in the Airplane Flight Manual for the elevation of each of the airports involved and for the ambient temperatures expected at the time of landing;

(3) The takeoff weight does not exceed the weight shown in the Airplane Flight Manual to correspond with the minimum distances required for takeoff considering the elevation of the airport, the runway to be used, the effective runway gradient, and the ambient temperature and wind component existing at the time of takeoff; and

(4) Where the takeoff distance includes a clearway, the clearway distance is not greater than one-half of—

(i) The takeoff run, in the case of airplanes certificated after September 30, 1958 and before August 30, 1959; or

(ii) The runway length, in the case of airplanes certificated after August 29, 1959.

(c) No person may take off a turbine engine powered transport category airplane certificated after August 29, 1959 unless, in addition to the requirements of paragraph (b) of this section—

(1) The accelerate-stop distance is no greater than the length of the runway

plus the length of the stopway (if present);

(2) The takeoff distance is no greater than the length of the runway plus the length of the clearway (if present); and

(3) The takeoff run is no greater than the length of the runway.

8. By adding a Part 25 [New] reading as hereinafter set forth.

Issued in Washington, D.C., on November 3, 1964.

N. E. HALABY,
Administrator.

AUTHORITY: The provisions of this Part 25 issued under secs. 313(a), 601, 603, Federal Aviation Act of 1958; 49 U.S.C. 1354(a), 1421, and 1423.

Subpart A—General

§ 25.1 Applicability.

(a) This part prescribes airworthiness standards for the issue of type certificates, and changes to those certificates, for transport category airplanes.

(b) Each person who applies under Part 21 [New] for such a certificate or change must show compliance with the applicable requirements in this part.

Subpart B—Flight

GENERAL

§ 25.21 Proof of compliance.

(a) Each requirement of this subpart must be met at each appropriate combination of weight and center of gravity within the range of loading conditions for which certification is requested. This must be shown—

(1) By tests upon an airplane of the type for which certification is requested, or by calculations based on, and equal in accuracy to, the results of testing; and

(2) By systematic investigation of each probable combination of weight and center of gravity, if compliance cannot be reasonably inferred from combinations investigated.

(b) If there is less than a 2 knot difference in the forward and rearward c.g. stalling speeds, the flying qualities may be based upon the forward c.g. stalling speeds.

(c) The controllability, stability, trim, and stalling characteristics of the airplane must be shown for each altitude up to the maximum expected in operation.

(d) The following general tolerances from specified values are allowed during flight testing. However, greater tolerances may be allowed in particular tests. These tolerances are plus or minus variations unless otherwise noted in the particular test:

Item	*Tolerance*
Weight	+5%, −10%.
Critical items affected by weight.	+5%, −1%.
C.G	7% total travel.
Airspeed	3 knots or 3%, whichever is higher.
Power	5%.
Wind (takeoff and landing tests).	As low as possible but not to exceed approximately 12% V_{S_1} or 10.0 knots, whichever is lower, along the runway—measured at a height of six feet above the runway surface.

§ 25.23 Load distribution limits.

(a) Ranges of weights and centers of gravity within which the airplane may be safely operated must be established. If a weight and center of gravity combination is allowable only within certain load distribution limits (such as spanwise) that could be inadvertently exceeded, these limits and the corresponding weight and center of gravity combinations must be established.

(b) The load distribution limits may not exceed—

(1) The selected limits;

(2) The limits at which the structure is proven; or

(3) The limits at which compliance with each applicable flight requirement of this subpart is shown.

§ 25.25 Weight limits.

(a) *Maximum weight.* The maximum weight (the highest weight at which compliance with each applicable requirement of this part is shown) must be established so that it is not more than—

(1) The highest weight selected by the applicant;

(2) The design maximum weight (the highest weight at which compliance with each applicable structural loading condition of this part is shown; or

(3) The highest weight at which compliance with each applicable flight requirement is shown.

(b) *Minimum weight.* The minimum weight (the lowest weight at which compliance with each applicable requirement of this part is shown) must be established so that it is not less than—

(1) The lowest weight selected by the applicant;

(2) The design minimum weight (the lowest weight at which compliance with each structural loading condition of this part is shown); or

(3) The lowest weight at which compliance with each applicable flight requirement is shown.

§ 25.27 Center of gravity limits.

The extreme forward and the extreme aft center of gravity limitations must be established for each practicably separable operating condition. No such limit may lie beyond—

(a) The extremes selected by the applicant;

(b) The extremes within which the structure is proven; or

(c) The extremes within which compliance with each applicable flight requirement is shown.

§ 25.29 Empty weight and corresponding center of gravity.

(a) The empty weight and corresponding center of gravity must be determined by weighing the airplane with—

(1) Fixed ballast;

(2) Unusable fuel determined under § 25.959;

(3) Undrainable oil; and

(4) Hydraulic fluid.

(b) The condition of the airplane at the time of determining empty weight must be one that is well defined and can be easily repeated.

§ 25.31 Removable ballast.

Removable ballast may be used in showing compliance with the flight requirements of this subpart.

§ 25.33 Propeller speed and pitch limits.

(a) The propeller speed and pitch must be limited to values that will ensure—

(1) Safe operation under normal operating conditions; and

(2) Compliance with the performance requirements in §§ 25.45 through 25.75 for reciprocating engine powered airplanes, and §§ 25.101 through 25.125 for turbopropeller powered airplanes.

(b) There must be a propeller speed limiting means at the governor. It must limit the maximum possible governed engine speed to a value not exceeding the maximum allowable r.p.m.

(c) The low pitch blade stop, or other means used to limit the low pitch position of the propeller blades, must be set so that the engine speed does not exceed 103 percent of the maximum allowable engine r.p.m. with—

(1) The propeller blades at the low pitch limit and governor inoperative; and

(2) Takeoff manifold pressure with the airplane stationary under standard atmospheric conditions.

PERFORMANCE: RECIPROCATING ENGINE POWERED AIRPLANES

§ 25.45 General.

(a) For reciprocating engine powered airplanes, compliance with each applicable performance requirement of this subpart must be shown—

(1) For still air with a standard atmosphere; and

(2) Where engine power affects performance, with air at 80 percent relative humidity, in accordance with paragraph (c) of this section.

(b) Performance data required for a particular flight condition must be determined with each powerplant accessory absorbing the normal amount of power appropriate to that condition.

(c) Engine power corrections for vapor pressure must be made in accordance with the following table:

Altitude H (ft.)	Vapor pressure e (in. Hg.)	Specific humidity w (Lb. moisture per lb. dry air)	Density ratio $\sigma = \frac{\rho}{0.0023769}$
0	0.403	0.00849	0.99508
1,000	.354	.00773	.96672
2,000	.311	.00703	.93895
3,000	.272	.00638	.91178
4,000	.238	.00578	.88514
5,000	.207	.00523	.85910
6,000	.1805	.00472	.83361
7,000	.1566	.00425	.80870
8,000	.1356	.00382	.78434
9,000	.1172	.00343	.76053
10,000	.1010	.00307	.73722
15,000	.0463	.001710	.62868
20,000	.01978	.000896	.53263
25,000	.00778	.000436	.44806

§ 25.47 Wing flap position.

Takeoff, en route, approach, and landing wing flap positions must be selected by the applicant. Flap positions may vary with weight and altitude.

§ 25.49 Stalling speeds.

(a) V_{S_0} is the calibrated stalling speed, or the minimum steady speed, in knots, at which the airplane is controllable, with the—

(1) Engines idling, throttles closed (or at not more than the power necessary for zero thrust at a speed not more than 110 percent of the stalling speed);

(2) Propeller pitch in the takeoff position;

(3) Landing gear extended;

(4) Wing flaps in the landing position;

(5) Cowl flaps closed;

(6) Center of gravity in the most unfavorable position within the allowable landing range; and

(7) Weight used when V_{S_0} is being used as a factor to determine compliance with a required performance standard.

(b) V_{S_1} is the calibrated stalling speed, or the minimum steady speed, in knots, at which the airplane is controllable, with the—

(1) Engines idling, throttles closed (or at not more than the power necessary for zero thrust at a speed not more than 110 percent of the stalling speed);

(2) Propeller pitch in the takeoff position;

(3) Airplane in other respects (such as flaps and landing gear) in the condition existing in the test in which V_{S_1} is being used; and

(4) Weight used when V_{S_1} is being used as a factor to determine compliance with a required performance standard.

(c) The stalling speeds V_{S_0} and V_{S_1} are the minimum speeds obtained in flight tests conducted as follows:

(1) At a speed great enough above the probable stall speed to ensure steady conditions, apply the elevator control at a rate so that the airplane speed reduction does not exceed one knot per second.

(2) During these tests—

(i) The airplane must be trimmed at 1.4 V_{S_1} except that airplanes with adjustable stabilizers may be trimmed at any speed from 1.2 V_{S_1} to 1.4 V_{S_1}; and

(ii) The flight requirements of § 25.203 must be met.

§ 25.51 Takeoff.

(a) The takeoff speeds described in § 25.55, the accelerate-stop distance described in § 25.57, and the takeoff path described in § 25.59, must be determined—

(1) At each weight and altitude selected by the applicant;

(2) With a constant takeoff flap position for the weight and altitude; and

(3) With the operating engines within approved operating limitations.

(b) No takeoff made to determine the data required by this section may require exceptional piloting skill or alertness.

(c) The takeoff data must be based on—

(1) A smooth, dry, hard-surfaced runway, in the case of landplanes and amphibians;

(2) Smooth water, in the case of seaplanes and amphibians; and

(3) Smooth, dry snow, in the case of skiplanes.

(d) Temperature accountability corrections must be made in accordance with § 25.61.

§ 25.55 Takeoff speeds.

(a) V_1 must be selected by the applicant and must be at least the minimum calibrated airspeed at which controllability is shown (during the takeoff run) to be adequate to safely continue the takeoff, using normal piloting skill, when the critical engine is suddenly made inoperative. This need not be shown if the engine failure is assumed to occur at V_2 or above.

(b) V_2, in terms of calibrated airspeed, must be selected by the applicant to allow the rate of climb required in § 25.67 (a) and b). However, V_2 may not be less than—

(1) 1.2 V_{S_1} for two-engine airplanes;

(2) 1.15 V_{S_1} for airplanes with more than two engines; or

(3) 1.10 times V_{MC} established under § 25.149.

§ 25.57 Accelerate-stop distance.

(a) Means other than wheel brakes may be used to determine the accelerate-stop distance if that means—

(1) Is safe and reliable;

(2) Is used so that consistent results can be expected under normal operating conditions; and

(3) Is such that exceptional skill is not required to control the airplane.

(b) The landing gear must remain extended throughout the accelerate-stop distance.

§ 25.59 Takeoff path.

(a) The takeoff path consists of the following elements:

(1) The distance required to accelerate to V_2, assuming the critical engine fails at V_1.

(2) The horizontal distance traversed, and the height reached, by the airplane in the time required to retract the landing gear at V_2, with the landing gear extended, the critical engine inoperative, and—

(i) The propeller of the inoperative engine windmilling and its control in a position normally used during takeoff until (if applicable) the rotation is stopped; and

(ii) The propeller of the inoperative engine feathered (if applicable) for the rest of the gear retraction time.

(3) If applicable, the horizontal distance traversed and the height reached by the airplane in the time elapsed from the end of the element in paragraph (a)(2) of this section until the rotation of the propeller of the inoperative engine is stopped—

(i) With the stopping of the propeller begun no earlier than the time at which the airplane is 50 feet above the takeoff surface;

(ii) At V_2;

(iii) With the landing gear retracted; and

(iv) With the propeller of the inoperative engine windmilling with the propeller control in the normal takeoff position.

(4) If applicable, the horizontal distance traversed and the height reached by the airplane in the time from the end of the element in paragraph (a)(3) until the time limit on the use of takeoff power is reached—

(i) At V_2;

(ii) With the propeller of the inoperative engine stopped; and

(iii) With the landing gear retracted.

(5) The slope of the flight path followed by the airplane in the configuration prescribed in paragraph (a)(4) with not more than maximum continuous power on the operating engines.

(b) For automatically feathering propellers for which the net work produced, from the instant of engine failure to completion of feathering under any kind of engine failure, is positive (using a datum based on feathered propeller drag), it may be assumed that the propeller of the failed engine is in the feathered drag condition from the instant V_2 is reached.

§ 25.61 Temperature accountability.

(a) Operating correction factors for temperatures above and below standard must be determined for takeoff weight and distance.

(b) The average full temperature accountability must be computed for the range of weights, altitudes above sea level, and ambient temperatures expected in operations. The effect of temperature on the aerodynamic characteristics and on engine power must be considered. Full temperature accountability, in terms of a weight correction, a takeoff distance correction, and a change, if any, in V_1, must be expressed per degree change in temperature.

(c) The operating correction factors for the weight and takeoff distance must be at least one-half of the full accountability values. The value of V_1 must be further corrected by the average amount necessary to ensure that the airplane can stop within the runway length at the ambient temperature. However, the corrected value of V_1 may not be less than the minimum at which the airplane can be controlled with the critical engine inoperative.

§ 25.65 Climb: all engines operating.

(a) *Cruising configuration.* The steady rate of climb in feet per minute at 5,000 feet, in the cruising configuration, must be at least 9.0 V_{S_0} (that is, the number of feet per minute is obtained by multiplying the number of knots by 9.0). In addition, the steady rate of climb must be determined at any altitude at which the airplane is expected to operate and at any weight for which certification is requested. The steady rate of climb must be shown under the following conditions:

(1) Landing gear fully retracted.

(2) Wing flaps in the most favorable position.

(3) Cowl flaps (or other means of controlling the engine cooling air supply) in the position that provides adequate cooling in the hot-day condition.

(4) Most unfavorable center of gravity position.

(5) Engines operating within the maximum continuous power limitations.

(6) Maximum takeoff weight.

(b) *Landing configuration.* The steady rate of climb in feet per minute in the landing configuration must be at least 0.092 $V_{S_0}^2$ at any altitude within the range of altitudes in which landing weight is certificated, and must be shown under the following conditions:

(1) Landing gear extended.

(2) Wing flaps in the landing position.

(3) Cowl flaps in the position normally used in an approach to a landing.

(4) The most unfavorable center of gravity allowed for landing.

(5) Engines operating at the takeoff power available at that altitude.

(6) The weight equal to maximum landing weight for that altitude.

(7) A climb speed not more than 1.4 V_{S_0}.

§ 25.67 Climb: one engine inoperative.

(a) *Flaps in takeoff position; landing gear extended.* The steady rate of climb without ground effect must be at least 50 ft./min. at any altitude within the range of takeoff altitudes for which certification is requested, and must be shown at V_2 with—

(1) Wing flaps in the takeoff position;

(2) Cowl flaps in the normal takeoff position;

(3) The most unfavorable center of gravity allowed for takeoff;

(4) The critical engine inoperative and (except as provided in paragraph (c) of this section) its propeller windmilling with the propeller control in a normal takeoff position;

(5) The remaining engines operating at the available takeoff power;

(6) The maximum takeoff weight for the takeoff altitude; and

(7) Landing gear extended.

(b) *Flaps in takeoff position; landing gear retracted.* With the landing gear retracted, the steady rate of climb in feet per minute must be at least 0.046 $V_{S_1}^2$ under the conditions described in paragraph (a) of this section.

(c) *Automatic feathering.* The propeller of the inoperative engine may be in the feathered condition during the landing gear extended or retracted conditions if—

(1) The propeller would be completely feathered at the beginning of these segments of the takeoff flight path; or

(2) The net work produced by the feathering propeller during the segment is positive, using a datum based on feathered propeller drag.

(d) *Flaps in en route position.* The steady rate of climb in feet per minute, at any expected operating altitude and at any weight within the range of weights for which certification is requested, must be determined. At a standard altitude of 5,000 feet and at the maximum takeoff weight, this rate must be at least

$$\left(0.079-\frac{0.106}{N}\right)V_{S_0}^2,$$

where N is the number of engines. The steady rate of climb must be shown with the—

(1) Landing gear retracted;

(2) Wing flaps in the most favorable position;

(3) Cowl flaps (or other means of controlling the engine-cooling air supply) in the position that provides adequate cooling in the hot-day condition;

(4) The most unfavorable center of gravity;

(5) Critical engine inoperative and its propeller stopped; and

(6) Remaining engines at the maximum continuous power available for the altitude.

(e) *Flaps in approach position.* The steady rate of climb in feet per minute must be at least 0.053 $V_{S_0}^2$ at any altitude within the range of altitudes for which landing weight is certificated, and must be shown with the—

(1) Landing gear retracted;

(2) Wing flaps set in position so that V_{S_1} does not exceed 1.10 V_{S_0};

(3) Cowl flaps in the normal approach position;

(4) The most unafavorable center of gravity position allowed for landing;

(5) Critical engine inoperative and its propeller stopped;

(6) Remaining engines at the available takeoff power;

(7) Weight equal to the maximum landing weight for the altitude; and

(8) Climb speed not more than 1.5 V_{S_1}.

§ 25.69 Climb: two engines inoperative.

For airplanes with four or more engines, the steady rate of climb at any expected operating altitude, and at any weight within the range of weights specified in the Airplane Flight Manual, must be determined with the—

(a) Landing gear retracted;

(b) Wing flaps in the most favorable position;

(c) Cowl flaps (or other means of controlling the engine cooling air supply) in the position that provides adequate cooling in the hot-day condition;

(d) The most unfavorable center of gravity;

(e) Two critical engines on one side of the airplane inoperative and their propellers stopped; and

(f) Remaining engines at the maximum continuous power available at each altitude.

§ 25.75 Landing.

(a) The horizontal distance necessary to land and to come to a complete stop (or to a speed of approximately 3 knots for water landings) from a point 50 feet above the landing surface must be determined (for the range of weights and altitudes selected by the applicant) as follows:

(1) A steady gliding approach, with a calibrated airspeed of at least 1.3 V_{S_0}, must be maintained down to the 50 foot height.

(2) After reaching the 50 foot height—

(i) The nose may not be depressed; and

(ii) Forward thrust may not be increased by the application of power.

(3) The flaps must be in the landing position from a point immediately before landing to the point at which the airplane is on the landing surface and the calibrated airspeed is reduced to 0.9 V_{S_0}.

(4) The landing must be made without excessive vertical acceleration, tendency to bounce, nose over, ground loop, porpoise, or water loop.

(5) The landing may not require exceptionally favorable conditions.

(b) For landplanes and amphibians, the landing distance on land must be determined on a dry, hard-surfaced runway. In addition—

(1) The pressures on the wheel braking system may not exceed those specified by the brake manufacturer;

(2) The brakes may not be used so as to cause tire skidding or excessive heating requiring replacement during a series of five test landings; and

(3) Means other than wheel brakes may be used if that means—

(i) Is safe and reliable;

(ii) Is used so that consistent results can be expected in service; and

(iii) Is such that exceptional skill is not required to control the airplane.

(c) For seaplanes and amphibians, the landing distance on water must be determined on smooth water.

(d) For skiplanes, the landing distance on snow must be determined on smooth, dry snow.

Performance: Turbine Engine Powered Airplanes

§ 25.101 General.

(a) Unless otherwise prescribed, turbine powered airplanes must meet the applicable performance requirements of this subpart for ambient atmospheric conditions and still air.

(b) The performance, as affected by engine power or thrust, must be based on a relative humidity of—

(1) 80 percent, at and below standard temperatures; and

(2) 34 percent, at and above standard temperatures plus 50° F.

Between these two temperatures, the relative humidity must vary linearly.

(c) The performance must correspond to the propulsive thrust available under the particular ambient atmospheric conditions, the particular flight condition, and the relative humidity specified in paragraph (b) of this section. The available propulsive thrust must correspond to engine power or thrust, not exceeding the approved power or thrust, less—

(1) Installation losses; and

(2) The power or equivalent thrust absorbed by the accessories and services appropriate to the particular ambient atmospheric conditions and the particular flight condition.

(d) Unless otherwise prescribed, the applicant must select the takeoff, en route, approach, and landing configurations for the airplane.

(e) The airplane configurations may vary with weight, altitude, and temperature, to the extent they are compatible with the operating procedures required by paragraph (f) of this section.

(f) Unless otherwise prescribed, in determining the accelerate-stop distances, takeoff flight paths, takeoff distances, and landing distances, changes in the airplane's configuration, speed, power, and thrust, must be made in accordance with procedures established by the applicant for operation in service.

(g) Procedures for the execution of balked landings and missed approaches associated with the conditions prescribed in §§ 25.119 and 25.121(d) must be established.

(h) The procedures established under paragraphs (f) and (g) of this section must—

(1) Be able to be consistently executed in service by crews of average skill;

(2) Use methods or devices that are safe and reliable; and

(3) Include allowance for any time delays, in the execution of the procedures, that may reasonably be expected in service.

§ 25.103 Stalling speed.

(a) V_S is the calibrated stalling speed, or the minimum steady flight speed, in knots, at which the airplane is controllable, with—

(1) Zero thrust at the stalling speed, or, if the resultant thrust has no appreciable effect on the stalling speed, with engines idling and throttles closed;

(2) Propeller pitch controls (if applicable) in the position necessary for compliance with subparagraph (1) of this paragraph and the airplane in other respects (such as flaps and landing gear) in the condition existing in the test in which V_S is being used;

(3) The weight used when V_S is being used as a factor to determine compliance with a required performance standard; and

(4) The most unfavorable center of gravity allowable.

(b) The stalling speed V_S is the minimum speed obtained as follows:

(1) Trim the airplane for straight flight at any speed not less than 1.2 V_S or more than 1.4 V_S. At a speed sufficiently above the stall speed to ensure steady conditions, apply the elevator control at a rate so that the airplane speed reduction does not exceed one knot per second.

(2) Meet the flight characteristics provisions of § 25.203.

§ 25.105 Takeoff.

(a) The takeoff speeds described in § 25.107, the accelerate-stop distance described in § 25.109, the takeoff path described in § 25.111, and the takeoff distance and takeoff run described in § 25.113, must be determined—

(1) At each weight, altitude, and ambient temperature within the operational limits selected by the applicant; and

(2) In the selected configuration for takeoff.

(b) No takeoff made to determine the data required by this section may require exceptional piloting skill or alertness.

(c) The takeoff data must be based on—

(1) A smooth, dry, hard-surfaced runway, in the case of land planes and amphibians;

(2) Smooth water, in the case of seaplanes and amphibians; and

(3) Smooth, dry snow, in the case of skiplanes.

(d) The takeoff data must include, within the established operational limits of the airplane, the following operational correction factors:

(1) Not more than 50 percent of nominal wind components along the takeoff path opposite to the direction of takeoff, and not less than 150 percent of nominal wind components along the takeoff path in the direction of takeoff.

(2) Effective runway gradients.

§ 25.107 Takeoff speeds.

(a) V_1 must be selected by the applicant and must be at least the minimum calibrated airspeed at which controllability by primary aerodynamic controls alone is shown (during the takeoff run) to be adequate to safely continue the takeoff, using normal piloting skill, when the critical engine is suddenly made inoperative.

(b) $V_{2\,min}$, in terms of calibrated airspeed, may not be less than—

(1) 1.2 V_S for—

(i) Two-engine and three-engine turbopropeller powered airplanes; and

(ii) Turbojet powered airplanes without provisions for obtaining a significant reduction in the one-engine-inoperative power-on stalling speed;

(2) 1.15 V_S for—

(i) Turbopropeller powered airplanes with more than three engines; and

(ii) Turbojet powered airplanes with provisions for obtaining a significant reduction in the one-engine-inoperative power-on stalling speed; and

(3) 1.10 times V_{MC} established under § 25.149.

(c) V_2, in terms of calibrated airspeed, must be selected by the applicant to provide at least the gradient of climb required by § 25.121(b) but may not be less than—

(1) $V_{2\,min}$; and

(2) V_R plus the speed increment attained (in accordance with § 25.111(c)(2)) before reaching a height of 35 feet above the takeoff surface.

(d) V_{MU} is the calibrated airspeed at and above which the airplane can safely lift off the ground, and continue the takeoff. V_{MU} speeds must be selected by the applicant for the all-engines-operating and the one-engine-inoperative conditions. These speeds may be established from free air data if these data are verified by ground takeoff tests.

(e) V_R, in terms of calibrated airspeed, must be selected in accordance with the conditions of subparagraphs (1) through (4) of this paragraph:

(1) V_R may not be less than—

(i) V_1;

(ii) 105 percent of V_{MC};

(iii) The speed (determined in accordance with § 25.111(c)(2)) that allows reaching V_2 before reaching a height of 35 feet above the takeoff surface; or

(iv) A speed that, if the airplane is rotated at its maximum practicable rate, will result in a V_{LOF} of not less than 110 percent of V_{MU} in the all-engines-operating condition or less than 105 percent of V_{MU} in the one-engine-inoperative condition.

(2) For any given set of conditions (such as weight, configuration, and temperature), a single value of V_R, obtained in accordance with this paragraph, must be used to show compliance with both the one-engine-inoperative and the all-engines-operating takeoff provisions.

(3) It must be shown that the one-engine-inoperative takeoff distance, using a rotation speed of 5 knots less than V_R established in accordance with subparagraphs (1) and (2) of this paragraph, does not exceed the corresponding one-engine-inoperative takeoff distance using the established V_R. The takeoff distances must be determined in accordance with § 25.113(a)(1).

(4) Reasonably expected variations in service from the established takeoff procedures for the operation of the airplane (such as over-rotation of the airplane and out-of-trim conditions) may not result in unsafe flight characteristics or in marked increases in the scheduled takeoff distances established in accordance with § 25.113(a).

(f) V_{LOF} is the calibrated airspeed at which the airplane first becomes airborne.

§ 25.109 Accelerate-stop distance.

(a) The accelerate-stop distance is the sum of the distances necessary to—

(1) Accelerate the airplane from a standing start to V_1; and

(2) Come to a full stop from the point at which V_1 is reached, assuming that the critical engine fails at V_1.

(b) Means other than wheel brakes may be used to determine the accelerate-stop distance if that means—

(1) Is safe and reliable;

(2) Is used so that consistent results can be expected under normal operating conditions; and

(3) Is such that exceptional skill is not required to control the airplane.

(c) The landing gear must remain extended throughout the accelerate-stop distance.

(d) If the accelerate-stop distance includes a stopway with surface characteristics substantially different from those of a smooth hard-surfaced runway, the takeoff data must include operational correction factors for the accelerate-stop distance. The correction factors must account for the particular surface characteristics of the stopway and the variations in these characteristics with seasonal weather conditions (such as temperature, rain, snow, and ice) within the established operational limits.

§ 25.111 Takeoff path.

(a) The takeoff path extends from a standing start to a point in the takeoff at which the airplane is 1,500 feet above the takeoff surface, or at which the transition from the takeoff to the en route configuration is completed and a speed is reached at which compliance with § 25.121(c) is shown, whichever point is higher. In addition—

(1) The takeoff path must be based on the procedures prescribed in § 25.101(c);

(2) The airplane must be accelerated on the ground to V_1, at which point the critical engine must be made inoperative and remain inoperative for the rest of the takeoff; and

(3) After reaching V_1, the airplane must be accelerated to V_2.

(b) During the acceleration to speed V_2, the nose gear may be raised off the ground at a speed not less than V_R. However, landing gear retraction may not be begun until the airplane is airborne.

(c) During the takeoff path determination in accordance with paragraphs (a) and (b) of this section—

(1) The slope of the airborne part of the takeoff path must be positive at each point;

(2) The airplane must reach V_2 before it is 35 feet above the takeoff surface and must continue at a speed as close as practical to, but not less than V_2, until it is 400 feet above the takeoff surface;

(3) At each point along the takeoff path, starting at the point at which the airplane reaches 400 feet above the takeoff surface, the available gradient of climb may not be less than—

(i) 1.2 percent for two-engine airplanes;

(ii) 1.5 percent for three-engine airplanes; and

(iii) 1.7 percent for four-engine airplanes; and

(4) Except for gear retraction and propeller feathering, the airplane configuration may not be changed until the airplane is 400 feet above the takeoff surface.

(d) The takeoff path must be determined by a continuous demonstrated takeoff or by synthesis from segments. If the takeoff path is determined by the segmental method—

(1) The segments must be clearly defined and must be related to the distinct changes in the configuration, power or thrust, and speed;

(2) The weight of the airplane, the configuration, and the power or thrust must be constant throughout each segment and must correspond to the most critical condition prevailing in the segment;

(3) The flight path must be based on the airplane's performance without ground effect; and

(4) The takeoff path data must be checked by continuous demonstrated takeoffs up to the point at which the airplane is out of ground effect and its speed is stabilized, to ensure that the path is conservative relative to the continous path.

The airplane is considered to be out of the ground effect when it reaches a height equal to its wing span.

§ 25.113 Takeoff distance and takeoff run.

(a) Takeoff distance is the greater of—

(1) The horizontal distance along the takeoff path from the start of the takeoff to the point at which the airplane is 35 feet above the takeoff surface, determined under § 25.111; or

(2) 115 percent of the horizontal distance along the takeoff path, with the engines operating, from the start of the takeoff to the point at which the airplane is 35 feet above the takeoff surface, as determined by a procedure consistent with § 25.111.

(b) If the takeoff distance includes a clearway, the takeoff run is the greater of—

(1) The horizontal distance along the takeoff path from the start of the takeoff to a point equidistant between the point at which V_{LOF} is reached and the point at which the airplane is 35 feet above the takeoff surface, as determined under § 25.111; or

(2) 115 percent of the horizontal distance along the takeoff path, with the engines operating, from the start of the takeoff to a point equidistant between the point at which V_{LOF} is reached and the point at which the airplane is 35 feet above the takeoff surface, determined by a procedure consistent with § 25.111.

§ 25.115 Takeoff flight path.

(a) The takeoff flight path begins 35 feet above the takeoff surface at the end of the takeoff distance determined in accordance with § 25.113(a).

(b) The net takeoff flight path data must be determined so that they represent the actual takeoff flight paths (determined in accordance with § 25.111 and with paragraph (a) of this section) reduced at each point by a gradient of climb equal to—

(1) 0.8 percent for two-engine airplanes;

(2) 0.9 percent for three-engine airplanes; and

(3) 1.0 percent for four-engine airplanes.

(c) The prescribed reduction in climb gradient may be applied as an equivalent reduction in acceleration along that part of the takeoff flight path at which the airplane is accelerated in level flight.

§ 25.117 Climb: general.

Compliance with the requirements of §§ 25.119 and 25.121 must be shown at each weight, altitude, and ambient temperature within the operational limits established for the airplane and with the most unfavorable center of gravity for each configuration.

§ 25.119 Landing climb: All-engine-operating.

In the landing configuration, the steady gradient of climb may not be less than 3.2 percent, with—

(a) The engines at the power or thrust that is available eight seconds after initiation of movement of the power or thrust controls from the minimum flight idle to the takeoff position; and

(b) A climb speed of not more than 1.3 V_S.

§ 25.121 Climb: One-engine-inoperative.

(a) *Takeoff; landing gear extended.* In the critical takeoff configuration existing along the flight path (between the points at which the airplane reaches V_{LOF} and at which the landing gear is fully retracted) and in the configuration used in § 25.111 but without ground effect, the steady gradient of climb must be positive for two-engine airplanes, and not less than 0.3 percent for three-engine airplanes or 0.5 percent for four-engine airplanes, at V_{LOF} and with—

(1) The critical engine inoperative and the remaining engines at the power or thrust available when retraction of the landing gear is begun in accordance with § 25.111 unless there is a more critical power operating condition existing later along the flight path but before the point at which the landing gear is fully retracted; and

(2) The weight equal to the weight existing when retraction of the landing gear is begun, determined under § 25.77.

(b) *Takeoff; landing gear retracted.* In the takeoff configuration existing at the point of the flight path at which the landing gear is fully retracted, and in the configuration used in § 25.111 but without ground effect, the steady gradient of climb may not be less than 2.4 percent for two-engine airplanes, 2.7 percent for three-engine airplanes, and 3.0 percent for four-engine airplanes, at V_2 and with—

(1) The critical engine inoperative, the remaining engines at the takeoff power or thrust available at the time the landing gear is fully retracted, determined under § 25.111, unless there is a more critical power operating condition existing later along the flight path but before the point where the airplane reaches a height of 400 feet above the takeoff surface; and

(2) The weight equal to the weight existing when the airplane's landing gear is fully retracted, determined under § 25.111.

(c) *Final takeoff.* In the en route configuration at the end of the takeoff path determined in accordance with § 25.111, the steady gradient of climb may not be less than 1.2 percent for two-engine airplanes, 1.5 percent for three-engine airplanes, and 1.7 percent for four-engine airplanes, at not less than 1.25 V_S and with—

(1) The critical engine inoperative and the remaining engines at the available maximum continuous power or thrust; and

(2) The weight equal to the weight existing at the end of the takeoff path, determined under § 25.111.

(d) *Approach.* In the approach configuration corresponding to the normal all-engines-operating procedure in which V_S for this configuration does not exceed 110 percent of the V_S for the related landing configuration, the steady gradient of climb may not be less than 2.1 percent for two-engine airplanes, 2.4 percent for three-engine airplanes, and 2.7 percent for four-engine airplanes, with—

(1) The critical engine inoperative, the remaining engines at the available takeoff power or thrust;

(2) The maximum landing weight; and

(3) A climb speed established in connection with normal landing procedures, but not exceeding 1.5 V_S.

§ 25.123 En route flight paths.

(a) For the en route configuration, the flight paths prescribed in paragraphs (b) and (c) of this section must be determined at each weight, altitude, and ambient temperature, within the operating limits established for the airplane. The variation of weight along the flight path, accounting for the progressive consumption of fuel and oil by the operating engines, may be included in the computation. The flight paths must be determined at any selected speed, with—

(1) The most unfavorable center of gravity;

(2) The critical engines inoperative;

(3) The remaining engines at the available maximum continuous power or thrust; and

(4) The means for controlling the engine-cooling air supply in the position that provides adequate cooling in the hot-day condition.

(b) The one-engine-inoperative net flight path data must represent the actual climb performance diminished by a gradient of climb of 1.1 percent for two-engine airplanes, 1.4 percent for three-engine airplanes, and 1.6 percent for four-engine airplanes.

(c) For three- or four-engine airplanes, the two-engine-inoperative net flight path data must represent the actual climb performance diminished by a gradient of climb of 0.3 percent for three-engine airplanes and 0.5 percent for four-engine airplanes.

§ 25.125 Landing.

(a) The horizontal distance necessary to land and to come to a complete stop (or to a speed of approximately 3 knots for water landings) from a point 50 feet above the landing surface must be determined (for standard temperatures, at each weight, altitude, and wind within the operational limits established by the applicant for the airplane) as follows:

(1) The airplane must be in the landing configuration.

(2) A steady gliding approach, with a calibrated airspeed of not less than 1.3 V_S, must be maintained down to the 50 foot height.

(3) Changes in configuration, power or thrust, and speed, must be made in accordance with the established procedures for service operation.

(4) The landing must be made without excessive vertical acceleration, tendency to bounce, nose over, ground loop, porpoise, or water loop.

(5) The landings may not require exceptional piloting skill or alertness.

(b) For landplanes and amphibians, the landing distance on land must be determined on a level, smooth, dry, hard-surfaced runway. In addition—

(1) The pressures on the wheel braking systems may not exceed those specified by the brake manufacturer;

(2) The brakes may not be used so as to cause excessive wear of brakes or tires; and

(3) Means other than wheel brakes may be used if that means—

(i) Is safe and reliable;

(ii) Is used so that consistent results can be expected in service; and

(iii) Is such that exceptional skill is not required to control the airplane.

(c) For seaplanes and amphibians, the landing distance on water must be determined on smooth water.

(d) For skiplanes, the landing distance on snow must be determined on smooth, dry, snow.

(e) The landing distance data must include correction factors for not more than 50 percent of the nominal wind components along the landing path opposite to the direction of landing, and not less than 150 percent of the nominal wind components along the landing path in the direction of landing.

(f) If any device is used that depends on the operation of any engine, and if the landing distance would be noticeably increased when a landing is made with that engine inoperative, the landing distance must be determined with that engine inoperative unless the use of compensating means will result in a landing distance not more than that with each engine operating.

CONTROLLABILITY AND MANEUVERABILITY

§ 25.143 General.

(a) The airplane must be safely controllable and maneuverable during—

(1) Takeoff;

(2) Climb;

(3) Level flight;

(4) Descent; and

(5) Landing.

(b) It must be possible to make a smooth transition from one flight condition to any other without exceptional piloting skill, alertness, or strength and without danger of exceeding the limit-load factor under any probable operating conditions (including the sudden failure of any engine).

(c) If, during the testing required by paragraphs (a) and (b) of this section, marginal conditions exist with regard to required pilot strength, the "strength of pilots" limits may not exceed the limits prescribed in the following table:

Values in pounds of force as applied to the control wheel or rudder pedals.	Pitch	Roll	Yaw
For temporary application	75	60	180
For prolonged application	10	5	20

(d) In showing the temporary control force limitations of paragraph (c) of this section, approved operating procedures or conventional operating practices must be followed (including being as nearly trimmed as possible at the next preceding steady flight condition, except that, in the case of takeoff, the airplane must be trimmed in accordance with approved operating procedures).

(e) For the purpose of complying with the prolonged control force limitations of paragraph (c) of this section, the airplane must be as nearly trimmed as possible.

§ 25.145 Longitudinal control.

(a) It must be possible at any speed between the trim speed prescribed in § 25.49(c)(2)(i) and V_{S_1} (for reciprocating engine powered airplanes), or at any speed between the trim speed prescribed in § 25.103(b)(i) and V_S (for turbine engine powered airplanes), to pitch the nose downward so that the acceleration to this selected trim speed is prompt with—

(1) The airplane trimmed at the trim speed prescribed in § 25.49(c)(2)(i) (for reciprocating engine powered airplanes), or in § 25.103(b)(1) (for turbine engine powered airplanes);

(2) The landing gear extended;

(3) The wing flaps (i) retracted and (ii) extended; and

(4) Power (i) off and (ii) at maximum continuous power on the engines.

(b) With the landing gear extended, no change in trim control, or exertion of more than 50 pounds control force (representative of the maximum temporary force that readily can be applied by one hand) may be required for the following maneuvers:

(1) With power off, flaps retracted, and the airplane trimmed at 1.4 V_{S_1}, extend the flaps as rapidly as possible while maintaining the airspeed at approximately 40 percent above the stalling speed existing at each instant throughout the maneuver.

(2) Repeat subparagraph (1) except initially extend the flaps and then retract them as rapidly as possible.

(3) Repeat subparagraph (2) except with takeoff power.

(4) With power off, flaps retracted, and the airplane trimmed at 1.4 V_{S_1}, apply takeoff power rapidly while maintaining the same airspeed.

(5) Repeat subparagraph (4) except with flaps extended.

(6) With power off, flaps extended, and the airplane trimmed at 1.4 V_{S_1}, obtain and maintain airspeeds between 1.1 V_{S_1} and 1.7 V_{S_1} or V_{FE}, whichever is less.

(c) It must be possible, without exceptional piloting skill, to prevent loss of altitude when flap retraction from any position is begun during steady, straight, level flight at 1.1 V_{S_1} with—

(1) Simultaneous application of not more than maximum continous power;

(2) The landing gear extended; and

(3) The maximum sea level landing weight.

§ 25.147 Directional and lateral control.

(a) *Directional control; general.* It must be possible, while holding the wings approximately level, to safely make reasonably sudden changes in heading in both directions. This must be shown at 1.4 V_{S_1} for heading changes up to 15° (except that the heading change at which the rudder pedal force is 180 pounds need not be exceeded), and with—

(1) The critical engine inoperative and its propeller in the minimum drag position;

(2) The power required for level flight at 1.4 V_{S_1}, but not more than maximum continuous power;

(3) The most unfavorable center of gravity;

(4) Landing gear retracted;

(5) Flaps in the approach position; and

(6) Maximum landing weight.

(b) *Directional control; airplanes with four or more engines.* Airplanes with four or more engines must meet the requirements of paragraph (a) of this section except that—

(1) The two critical engines must be inoperative with their propellers (if applicable) in the minimum drag position;

(2) The center of gravity must be in the most forward position; and

(3) The flaps must be in the most favorable climb position.

(c) *Lateral control; general.* It must be possible to make 20° banked turns, with and against the inoperative engine, from steady flight at a speed equal to 1.4 V_{S_1}, with—

(1) The critical engine inoperative and its propeller (if applicable) in the minimum drag position;

(2) The remaining engines at maximum continuous power;

(3) The most unfavorable center of gravity;

(4) Landing gear (i) retracted and (ii) extended;

(5) Flaps in the most favorable climb position; and

(6) Maximum takeoff weight.

(d) *Lateral control; airplanes with four or more engines.* Airplanes with four or more engines must be able to make 20° banked turns, with and against the inoperative engines, from steady flight at a speed equal to 1.4 V_{S_1}, with maximum continuous power, and with the airplane in the configuration prescribed by paragraph (b) of this section.

(e) *Lateral control; all engines operating.* With the engines operating, roll response must allow normal maneuvers (such as recovery from upsets produced by gusts and the initiation of evasive maneuvers). There must be enough excess lateral control in sideslips (up to sideslip angles that might be required in normal operation), to allow a limited amount of maneuvering and to correct for gusts. Lateral control must be enough at any speed up to V_{FC}/M_{FC} to provide a peak roll rate necessary for safety, without excessive control forces or travel.

§ 25.149 Minimum control speed.

(a) V_{MC} is the calibrated airspeed, at which, when the critical engine is suddenly made inoperative, it is possible to recover control of the airplane with that engine still inoperative, and maintain straight flight either with zero yaw or, at the option of the applicant, with an angle of bank of not more than five degrees.

(b) For reciprocating engine powered airplanes, V_{MC} may not exceed 1.2 V_{S_1} with—

(1) Takeoff or maximum available power on the engines;

(2) The rearmost center of gravity;

(3) The airplane trimmed for takeoff;

(4) The maximum sea level takeoff weight (or any lesser weight necessary to show V_{MC});

(5) Flaps in the takeoff position;

(6) Landing gear retracted;

(7) Cowl flaps in the normal takeoff position;

(8) The propeller of the inoperative engine—

(i) Windmilling;

(ii) In the most probable position for the specific design of the propeller control; or

(iii) Feathered, if the airplane has an automatic feathering device acceptable for showing compliance with the climb requirements of § 25.67; and

(9) The airplane airborne and the ground effect negligible.

(c) For turbine engine powered airplanes, V_{MC} may not exceed 1.2 V_S with—

(1) Maximum available takeoff power or thrust on the engines;

(2) The most unfavorable center of gravity;

(3) The airplane trimmed for takeoff;

(4) The maximum sea level takeoff weight (or any lesser weight necessary to show V_{MC});

(5) The airplane in the most critical takeoff configuration existing along the flight path after the airplane becomes airborne, except with the landing gear retracted; and

(6) The airplane airborne and the ground effect negligible.

(d) The rudder forces required to maintain control at V_{MC} may not exceed 180 pounds nor may it be necessary to reduce power or thrust of the operative engines. During recovery, the airplane may not assume any dangerous attitude or require exceptional piloting skill, alertness, or strength to prevent a heading change of more than 20 degrees.

TRIM

§ 25.161 Trim.

(a) *General.* Each airplane must meet the trim requirements of this section after being trimmed, and without further pressure upon, or movement of, either the primary controls or their corresponding trim controls by the pilot or the automatic pilot.

(b) *Lateral and directional trim.* The airplane must maintain lateral and directional trim with the most adverse lateral displacement of the center of gravity within the relevant operating limitations, during normally expected conditions of operation (including operation at any speed from 1.4 V_{S_1} to V_{MO}/M_{MO}).

(c) *Longitudinal trim.* The airplane must maintain longitudinal trim during—

(1) A climb with maximum continuous power at a speed not more than 1.4 V_{S_1}, with the landing gear retracted, and the flaps (i) retracted and (ii) in the takeoff position;

(2) A glide with power off at a speed not more than 1.4 V_{S_1}, with the landing gear extended, the wing flaps (i) retracted and (ii) extended, the most forward center of gravity position approved for landing with the maximum landing weight, and with the most forward center of gravity position approved for landing regardless of weight; and

(3) Level flight at any speed from 1.4 V_{S_1} to V_{MO}/M_{MO}, with the landing gear and flaps retracted, and from 1.4 V_{S_1} to V_{LE} with the landing gear extended.

(d) *Longitudinal, directional, and lateral trim.* The airplane must maintain longitudinal, directional, and lateral trim (and for lateral trim, the angle of bank may not exceed five degrees) at 1.4 V_{S_1} during climbing flight with—

(1) The critical engine inoperative;

(2) The remaining engines at maximum continuous power; and

(3) The landing gear and flaps retracted.

(e) *Airplanes with four or more engines.* Each airplane with four or more engines must maintain trim in rectilinear flight—

(1) At the climb speed, configuration, and power required by § 25.69 for the purpose of establishing the rate of climb;

(2) With the most unfavorable center of gravity position; and

(3) At the weight at which the two-engine-inoperative climb is equal to at least 0.013 $V_{S_0}{}^2$ at an altitude of 5,000 feet.

STABILITY

§ 25.171 General.

The airplane must be longitudinally, directionally, and laterally stable in accordance with the provisions of §§ 25.173 through 25.177. In addition, suitable stability is required in any condition normally encountered in service, if flight tests show it is necessary for safe operation.

§ 25.173 Static longitudinal stability.

Under the conditions specified in § 25.175, the characteristics of the elevator control forces (including friction) and the elevator control surface displacement must be as follows:

(a) A pull must be required to obtain and maintain speeds below the specified trim speed, and a push must be required to obtain and maintain speeds above the specified trim speed. In addition, if the elevator control forces are not dependent upon the hinge moments of the elevator control surface, it must also be shown that upward displacement of the elevator trailing edge is required to obtain and maintain speeds below the specified trim speed, and a downward displacement of the elevator trailing edge is required to obtain and maintain speeds above the specified trim speed. This must be shown at any speed that can be obtained except speeds higher than the landing gear or wing flap operating limit speeds or V_{FC}/M_{FC}, whichever is appropriate, or lower than the minimum speed for steady, unstalled flight.

(b) The airspeed must return to within 10 percent of the original trim speed when the control force is slowly released from any speed within the range specified in paragraph (a) of this section.

(c) The stable slope of the stick force versus speed curve may not be less than 0.5 pound for each three knots or exceed a value beyond which control of the airplane is difficult.

§ 25.175 Demonstration of static longitudinal stability.

Static longitudinal stability must be shown as follows:

(a) *Climb.* The stick force curve and, if required by § 25.173(a), the elevator angle curve must have stable slopes at speeds between 85 and 115 percent of the speed at which the airplane—

(1) Is trimmed, with—

(i) Wing flaps retracted;

(ii) Landing gear retracted;

(iii) Maximum takeoff weight; and

(iv) 75 percent of maximum continuous power for reciprocating engines or the maximum power or thrust selected by the applicant as an operating limitation for use during climb for turbine engines; and

(2) Is trimmed at the speed for best rate-of-climb except that the speed need not be less than 1.4 V_{S_1}.

(b) *Cruise.* Static longitudinal stability must be shown in the cruise condition as follows:

(1) With the landing gear retracted at high speed, the stick force curve and, if required by § 25.173(a), the elevator angle curve must have stable slopes at speeds from V_{FC}/M_{FC} to the lower of $V_{FC}-\left(\frac{V_{FC}-1.4\,V_{S_1}}{2}\right)$, or 50 knots less than the trim speed specified in subdivision (iv) of this subparagraph (however, the speed need not be less than 1.4 V_{S_1}) and the stick force may not exceed 50 pounds with—

(i) Flaps retracted;

(ii) The most critical weight between maximum landing weight and maximum takeoff weight;

(iii) 75 percent of maximum continuous power for reciprocating engines or, for turbine engines, the maximum cruising power (though it need not exceed that power required at V_{MO}/M_{MO}) selected by the applicant as an operating limitation; and

(iv) The airplane trimmed for level flight with the power required in subdivision (iii) of this subparagraph.

(2) With the landing gear retracted at low speed, the stick force curve and, if required by § 25.173(a) the elevator angle curve must have stable slopes at speeds from a speed equal to $V_{FC}-\left(\frac{V_{FC}-1.4\,V_{S_1}}{2}\right)$ to 1.4 V_{S_1}, and the stick force may not exceed 50 pounds, with—

(i) Flaps retracted;

(ii) The most critical weight between the maximum landing weight and maximum takeoff weight;

(iii) Power required for level flight at a speed equal to $V_{FC}-\left(\frac{V_{FC}-1.4\,V_{S_1}}{2}\right)$; and

(iv) The airplane trimmed for level flight with the power required in subdivision (iii) of this subparagraph.

At altitudes where Mach number is critical, the calibrated airspeed corresponding to M_{FC} may be used to calculate the speed $V_{FC}-\left(\frac{V_{FC}-1.4\,V_{S_1}}{2}\right)$.

(3) With the landing gear extended, the stick force curve and, if required by § 25.173(a), the elevator angle curve must have stable slopes at speeds between 1.4 V_{S_1} and V_{LE}, and the stick force may not exceed 50 pounds with—

(i) Wing flaps retracted;

(ii) The most critical weight between the maximum landing weight and maximum takeoff weight;

(iii) Power required for level flight at V_{LE}; and

(iv) The airplane trimmed for level flight with the power required in subparagraph (3)(iii) of this paragraph.

(c) *Approach.* The stick force curve and, if required by § 25.173(a), the elevator angle curve must have stable slopes at speeds between 1.1 V_{S_1} and 1.8 V_{S_1}, with—

(1) Wing flaps in the approach position;

(2) Landing gear retracted;

(3) Maximum landing weight; and

(4) The airplane trimmed at 1.4 V_{S_1} with enough power to maintain level flight at this speed.

(d) *Landing.* The stick force curve and, if required by § 25.173(a), the elevator angle curve must have stable slopes, and the stick force may not exceed 80 pounds, at speeds between 1.1 V_{S_0} and 1.8 V_{S_0} with—

(1) Wing flaps in the landing position;

(2) Landing gear extended;

(3) Maximum landing weight;

(4) Power or thrust off on the engines; and

(5) The airplane trimmed at 1.4 V_{S_0} with power or thrust off.

§ 25.177 Static directional and lateral stability.

(a) The static directional stability (as shown by the tendency to recover from a skid with the rudder free) must be positive for any landing gear and flap position and symmetrical power condition, at speeds from 1.2 V_{S_1} up to V_{FE}, V_{LE}, or V_{FC}/M_{FC} (as appropriate).

(b) The static lateral stability (as shown by the tendency to raise the low wing in a sideslip with the aileron controls free and for any landing gear and flap position and symmetrical power condition) must be positive at V_{FE}, V_{LE}, or V_{FC}/M_{FC} (as appropriate) and may not be negative at 1.2 V_{S_1}.

(c) In straight, steady, sideslips (unaccelerated forward slips) the aileron and rudder control movements and forces must be substantially proportional to the angle of sideslip, and the factor of proportionality must lie between limits found necessary for safe operation throughout the range of sideslip angles appropriate to the operation of the airplane. At greater angles, up to the angle at which full rudder control is used or a rudder pedal force of 180 pounds is obtained, the rudder pedal forces may not reverse and increased rudder deflection must produce increased angles of sideslip. Unless the airplane has a yaw indicator, there must be enough bank accompanying sideslipping to clearly indicate any departure from steady unyawed flight.

§ 25.181 Dynamic longitudinal, directional, and lateral stability.

Any short period oscillation occurring between stalling speed and maximum allowable speed appropriate to the configuration of the airplane (for example, V_{FE}, V_{LE}, or V_{FC}/M_{FC}) must be heavily damped with the primary controls (1) free and (2) in a fixed position.

STALLS

§ 25.201 Stall demonstration.

(a) Stalls must be shown in straight flight and in 30 degree banked turns with—

(1) Power off; and

(2) The power necessary to maintain level flight at 1.6 V_{S_1} (where V_{S_1} corresponds to the stalling speed with flaps in the approach position, the landing gear retracted, and maximum landing weight).

(b) In either condition required by paragraph (a) of this section, it must be possible to meet the applicable requirements of § 25.203 with—

(1) Flaps and landing gear in any likely combination of positions;

(2) Representative weights within the range for which certification is requested; and

(3) The most adverse center of gravity for recovery.

(c) The following procedure must be used to show compliance with § 25.203:

(1) With the airplane trimmed for straight flight at the speed prescribed in § 25.49(c)(2)(i) for reciprocating engine powered airplanes, or in § 25.103(b)(1) for turbine engine powered airplanes, reduce the speed with the elevator control until it is steady at slightly above stalling speed. Apply elevator control so that the speed reduction does not exceed one knot per second until (i) the airplane is stalled, or (ii) the control reaches the stop.

(2) The airplane is considered stalled when, at an angle of attack measurably greater than that of maximum lift, the inherent flight characteristics give a clear indication to the pilot that the airplane is stalled. Typical indications of a stall are a nose-down pitch, or a roll, that cannot be readily arrested, or, if clear enough, a loss of control effectiveness, an abrupt change in control force or motion, characteristic buffeting, or a distinctive vibration of the pilot's controls. However, for airplanes with unmistakable inherent aerodynamic warning (such as buffeting, small amplitude pitch or roll oscillations, or distinctive shaking of the pilot's control) associated with the stall in each required configuration, the speed need not be reduced below a value providing an adequate stall warning margin as specified in § 25.207.

(3) As soon as the airplane is stalled, recover by normal recovery techniques.

§ 25.203 Stall characteristics.

(a) It must be possible to produce and to correct roll and yaw by unreversed use of the aileron and rudder controls, up to the time the airplane is stalled. No abnormal nose-up pitching may occur. The longitudinal control force must be positive up to and throughout the stall. In addition, it must be possible to promptly prevent stalling and to recover from a stall by normal use of the controls.

(b) For level wing stalls, the roll occurring between the stall and the completion of the recovery may not exceed approximately 20 degrees.

(c) For turning flight stalls, the action of the airplane after the stall may not be so violent or extreme as to make it difficult, with normal piloting skill, to effect a prompt recovery and to regain control of the airplane.

§ 25.205 Stalls: Critical engine inoperative.

(a) It must be possible to safely recover from a stall with the critical engine inoperative—

(1) Without applying power to the inoperative engine;

(2) With flaps and landing gear retracted; and

(3) With the remaining engines at up to 75 percent of maximum continuous power, or up to the power at which the wings can be held level with the use of maximum control travel, whichever is less.

(b) The operating engines may be throttled back during stall recovery from stalls with the critical engine inoperative.

§ 25.207 Stall warning.

(a) Stall warning with sufficient margin to prevent inadvertent stalling with the flaps and landing gear in any normal position must be clear and distinctive to the pilot in straight and turning flight.

(b) The warning may be furnished either through the inherent aerodynamic qualities of the airplane or by a device that will give clearly distinguishable indications under expected conditions of flight. However, a visual stall warning device that requires the attention of the crew within the cockpit is not acceptable by itself.

(c) The stall warning must begin at a speed exceeding the stalling speed by seven percent or at any lesser margin if the stall warning has enough clarity, duration, distinctiveness, or similar properties.

GROUND AND WATER HANDLING CHARACTERISTICS

§ 25.231 Longitudinal stability and control.

(a) Landplanes may have no uncontrollable tendency to nose over in any reasonably expected operating condition or when rebound occurs during landing or takeoff. In addition—

(1) Wheel brakes must operate smoothly and may not cause any undue tendency to nose over; and

(2) If a tail-wheel landing gear is used, it must be possible, during the takeoff ground run on concrete, to maintain any attitude up to thrust line level, at 80 percent of V_{S_1}.

(b) For seaplanes and amphibians, the most adverse water conditions safe for takeoff, taxiing, and landing, must be established.

§ 25.233 Directional stability and control.

(a) There may be no uncontrollable ground-looping tendency in 90° cross winds, up to a wind velocity of 0.2 V_{S_0} at any speed at which the airplane may be expected to be operated on the ground. This may be shown while establishing the cross wind component velocity required by § 25.237.

(b) Landplanes must be satisfactorily controllable, without exceptional piloting skill or alertness, in power-off landings at normal landing speed, without using brakes or engine power to maintain a straight path. This may be shown during power-off landings made in conjunction with other tests.

(c) The airplane must have adequate directional control during taxiing. This may be shown during taxiing prior to takeoffs made in conjunction with other tests.

§ 25.235 Taxiing condition.

The shock absorbing mechanism may not damage the structure of the airplane when the airplane is taxied on the roughest ground that may reasonably be expected in normal operation.

§ 25.237 Wind velocities.

(a) For landplanes, a cross component of wind velocity, shown to be safe for takeoff and landing, must be established.

(b) For seaplanes and amphibians, the following wind velocities must be established:

(1) A lateral wind component, not less than 0.2 V_{S_0}, up to which takeoff and landing is safe under any water condition that may reasonably be expected in normal operation.

(2) A wind velocity up to which taxiing is safe in any direction under water conditions that may reasonably be expected in normal operation.

§ 25.239 Spray characteristics and control stability on water.

(a) For seaplanes and amphibians, during takeoff, taxiing, and landing, and in the conditions set forth in paragraph (b) of this section, there may be no—

(1) Spray characteristics that would impair the pilot's view, cause damage, or result in the taking in of an undue quantity of water;

(2) Dangerously uncontrollable porpoising, bounding, or swinging tendency; or

(3) Immersion of auxiliary floats or sponsons, wing tips, propeller blades, or other parts not designed to withstand the resulting water loads.

(b) Compliance with the requirements of paragraph (a) of this section must be shown—

(1) In water conditions, from smooth to the most adverse condition established in accordance with § 25.231;

(2) In wind and cross-wind velocities, water currents, and associated waves and swells that may reasonably be expected in operation on water;

(3) At speeds that may reasonably be expected in operation on water;

(4) With sudden failure of the critical engine at any time while on water; and

(5) At each weight and center of gravity position, relevant to each operating condition, within the range of loading conditions for which certification is requested.

(c) In the water conditions of paragraph (b) of this section, and in the corresponding wind conditions, the seaplane or amphibian must be able to drift for five minutes with engines inoperative, aided, if necessary, by a sea anchor.

MISCELLANEOUS FLIGHT REQUIREMENTS

§ 25.251 Vibration and buffeting.

(a) The airplane must be designed to withstand any vibration and buffeting that might occur in any likely operating condition. This must be shown by calculations, resonance tests, or other tests found necessary by the Administrator.

(b) Each part of the airplane must be shown in flight to be free from excessive vibration, under any appropriate speed and power conditions up to at least the minimum value of V_D allowed in § 25.335. The maximum speeds shown must be used in establishing the operating limitations of the airplane in accordance with § 25.1505. In addition, it must be shown by analysis or tests, that the airplane is free from such vibration that would prevent safe flight under the conditions in § 25.629(d).

(c) There may be no buffeting condition, in normal flight, severe enough to interfere with the control of the airplane, to cause excessive fatigue to the crew, or to cause structural damage. Stall warning buffeting within these limits is allowable.

§ 25.253 High-speed characteristics.

(a) *Speed increase and recovery characteristics.* The following speed increase and recovery characteristics must be met:

(1) Operating conditions and characteristics likely to cause inadvertent speed increases (including upsets in pitch and roll) must be simulated with the airplane trimmed at any likely cruise speed up to V_{MO}/M_{MO}. These conditions and characteristics include gust upsets, inadvertent control movements, low stick force gradient in relation to control friction, passenger movement, leveling off from climb, and descent from Mach to airspeed limit altitudes.

(2) Allowing for pilot reaction time after effective inherent or artificial speed warning occurs, it must be shown that the airplane can be recovered to a normal altitude and its speed reduced to V_{MO}/M_{MO}, without—

(i) Exceptional piloting strength or skill;

(ii) Exceeding V_D/M_D, V_{DF}/M_{DF}, or the structural limitations; and

(iii) Buffeting that would cause structure damage.

(3) There may be no control reversal about any axis at any speed up to V_{DF}/M_{DF}. Any reversal of elevator control force or tendency of the airplane to pitch, roll, or yaw must be mild and readily controllable, using normal piloting techniques.

(b) *Maximum speed for stability characteristics,* V_{FC}/M_{FC}. V_{FC}/M_{FC} is the maximum speed at which the requirements of §§ 25.147(e), 25.175(b)(1), 25.177, 25.181, and 25.187 must be met with flaps and landing gear retracted. It may not be less than a speed midway between V_{MO}/M_{MO} and V_{DF}/M_{DF}, except that, for altitudes where Mach number is the limiting factor, M_{FC} need not exceed the Mach number at which effective speed warning occurs.

Subpart C—Structure

GENERAL

§ 25.301 Loads.

(a) Strength requirements are specified in terms of limit loads (the maximum loads to be expected in service) and ultimate loads (limit loads multiplied by prescribed factors of safety). Unless otherwise provided, prescribed loads are limit loads.

(b) Unless otherwise provided, the specified air, ground, and water loads must be placed in equilibrium with inertia forces, considering each item of mass in the airplane. These loads must be distributed to conservatively approximate or closely represent actual conditions.

(c) If deflections under load would significantly change the distribution of external or internal loads, this redistribution must be taken into account.

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§ 25.303 Factor of safety.

Unless otherwise provided, a factor of safety of 1.5 must be used.

§ 25.305 Strength and deformation.

(a) The structure must be able to support limit loads without detrimental permanent deformation. At any load up to limit loads, the deformation may not interfere with safe operation.

(b) The structure must be able to support ultimate loads without failure for at least three seconds. However, when proof of strength is shown by dynamic tests simulating actual load conditions, the three second limit does not apply.

(c) Where structural flexibility is such that any rate of load application likely to occur in the operating conditions might produce transient stresses appreciably higher than those corresponding to static loads, the effects of this rate of application must be considered.

§ 25.307 Proof of structure.

(a) Compliance with the strength and deformation requirements of this subpart must be shown for each critical loading condition. Structural analysis may be used only if the structure conforms to those for which experience has shown this method to be reliable. In other cases, substantiating load tests must be made.

(b) Compliance with the fatigue evaluation requirements of §§ 25.571 and 25.573 must be shown.

(c) Certain parts of the structure must be tested as specified in § 25.601.

FLIGHT LOADS

§ 25.321 General.

(a) Flight load factors represent the ratio of the aerodynamic force component (acting normal to the assumed longitudinal axis of the airplane) to the weight of the airplane. A positive load factor is one in which the aerodynamic force acts upward with respect to the airplane.

(b) Considering compressibility effects at each speed, compliance with the flight load requirements of this subpart must be shown—

(1) At each critical altitude within the range of altitudes selected by the applicant;

(2) At each weight from the design minimum weight to the design maximum weight; and

(3) For each required altitude and weight, for any practicable distribution of disposable load within the operating limitations recorded in the Airplane Flight Manual.

FLIGHT MANEUVER AND GUST CONDITIONS

§ 25.331 General.

(a) *Procedure.* The analysis of symmetrical flight must include at least the conditions specified in paragraphs (b) through (d) of this section. The following procedure must be used:

(1) Enough points on the maneuvering and gust envelopes must be investigated to ensure that the maximum load for each part of the airplane structure is obtained. A conservative combined envelope may be used.

(2) The significant forces acting on the airplane must be placed in equilibrium in a rational or conservative manner. The linear inertia forces must be considered to be in equilibrium with wing and horizontal tail surface loads, while the angular (pitching) inertia forces must be considered to be in equilibrium with wing and fuselage aerodynamic moments and horizontal tail surface loads.

(3) Where sudden displacement of a control is specified, the assumed rate of displacement need not exceed the rate that could be applied by the pilot.

(4) In determining elevator angles and chordwise load distribution (in the maneuvering conditions of paragraphs (b) and (c) of this section) in turns and pullups, the effect of corresponding pitching velocities must be taken into account.

(b) *Maneuvering balanced conditions.* Assuming the airplane to be in equilibrium with zero pitching acceleration, the maneuvering conditions A through I on the maneuvering envelope in § 25.333(b) must be investigated.

(c) *Maneuvering pitching conditions.* The following conditions involving pitching acceleration must be investigated:

(1) *Maximum elevator displacement at V_A.* The airplane is assumed to be flying in steady level flight (point A_1, § 25.333(b)) and, except as limited by pilot effort in accordance with § 25.397(b), the pitching control is suddenly moved to obtain extreme positive pitching (nose up).

(2) *Checked maneuver at speeds between V_A and V_D.* The airplane is assumed to be subjected to a checked maneuver (a maneuver in which the pitching control is suddenly displaced in one direction and then suddenly moved in the opposite direction) from steady level flight (points A_1 to D_1, § 25.333(b)), and from the positive load factor (points A_2 to D_2, § 25.333(b)) as follows:

(i) Unless lesser values could not be exceeded, a positive pitching acceleration (nose up) is assumed to be reached concurrently with the airplane load factor of 1.0 (points A_1 to D_1, § 25.333(b)). This positive acceleration must be equal to at least $\frac{39}{V} n\ (n-1.5)$ (radians/sec.²), where—

(*a*) n is the positive load factor at the speed under consideration; and

(*b*) V is the airplane equivalent speed in knots.

(ii) Unless lesser values could not be exceeded, a negative pitching acceleration (nose down) is assumed to be reached concurrently with the positive maneuvering load factor (points A_2 to D_2, § 25.333(b)). This negative pitching acceleration must be equal to at least

$$-\frac{26}{V} n\ (n-1.5) \text{ (radians/sec.}^2\text{)}$$

where—

(*a*) n is the positive load factor at the speed under consideration; and

(*b*) V is the airplane equivalent speed in knots.

(3) *Specified control displacement.* Instead of the conditions in subparagraph (2) of this paragraph, a checked maneuver, based on a rational pitching control motion vs. time profile, may be established in which the design limit load factor specified in § 25.337 will not be exceeded. Unless lesser values cannot be exceeded, the airplane response must result in pitching accelerations not less than those specified in subparagraph (2).

(d) *Gust conditions.* The gust conditions B' through J', § 25.333(c), must be investigated. The following provisions apply:

(1) The air load increment due to a specified gust must be added to the initial balancing tail load corresponding to steady level flight.

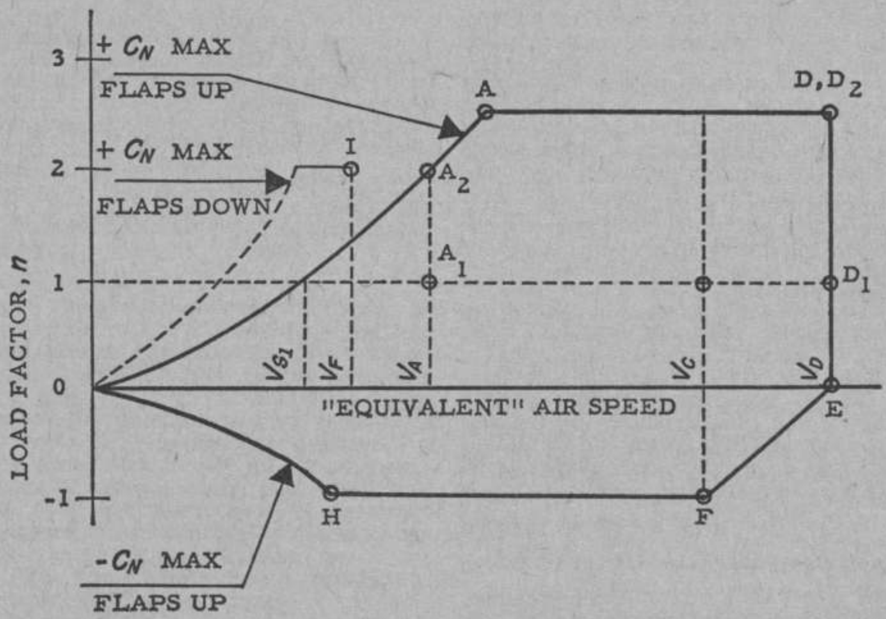
(2) The alleviating effect of wing down-wash and of the airplane's motion in response to the gust may be included in computing the tail gust load increment.

(3) Instead of a rational investigation of the airplane response, the gust alleviation factor K_g may be applied to the specified gust intensity for the horizontal tail.

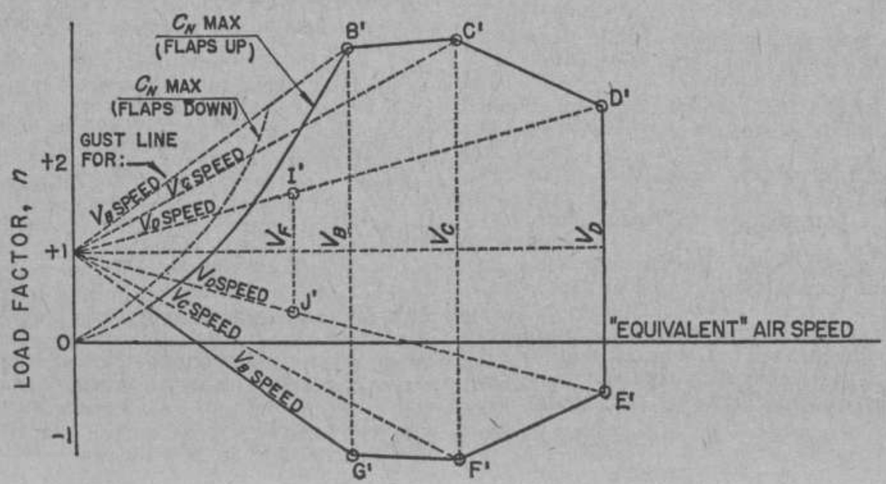
§ 25.333 Flight envelope.

(a) *General.* The strength requirements must be met at each combination of airspeed and load factor on and within the boundaries of the representative maneuvering and gust envelopes (V–n diagrams) of paragraphs (b) and (c) of this section. These envelopes must also be used in determining the airplane structural operating limitations as specified in § 25.1501.

(b) *Maneuvering envelope.*



(c) *Gust envelope.*



§ 25.335 Design airspeeds.

The selected design airspeeds are equivalent airspeeds (EAS). Estimated values of V_{S_0} and V_{S_1} must be conservative.

(a) *Design cruising speed, V_C.* For V_C, the following apply:

(1) The minimum value of V_C must be sufficiently greater than V_B to provide for inadvertent speed increases likely to occur as a result of severe atmospheric turbulence.

(2) In the absence of a rational investigation substantiating the use of other values, V_C may not be less than V_B+43 knots. However, it need not exceed the maximum speed in level flight at maximum continuous power for the corresponding altitude.

(3) At altitudes where V_D is limited by Mach number, V_C may be limited to a selected Mach number.

(b) *Design dive speed, V_D.* The selected design dive speed must be used in determining the maximum operating limit speed for the airplane in accordance with § 25.1505.

(c) *Design maneuvering speed V_A.* For V_A, the following apply:

(1) V_A may not be less than $V_{S_1}\sqrt{n}$ where—

(i) n is the limit positive maneuvering load factor at V_C; and

(ii) V_{S_1} is the stalling speed with flaps retracted.

(2) V_A and V_S must be evaluated at the design weight and altitude under consideration.

(3) V_A need not be more than V_C or the speed at which the positive $C_{N\ max}$ curve intersects the positive maneuver load factor line, whichever is less.

(d) *Design speed for maximum gust intensity, V_B.* For V_B, the following apply:

(1) V_B may not be less than the speed determined by the intersection of the line representing the maximum positive lift $C_{N\ max}$ and the line representing the rough air gust velocity on the gust V-n diagram, or $(\sqrt{n_g})\ V_{S_1}$, whichever is less, where—

(i) n_g is the positive airplane gust load factor due to gust, at speed V_C (in accordance with § 25.341), and at the particular weight under consideration; and

(ii) V_{S_1} is the stalling speed with the flaps retracted at the particular weight under consideration.

(2) V_B need not be greater than V_C.

(e) *Design flap speeds, V_F.* For V_F, the following apply:

(1) The design flap speed for each flap position (established in accordance with § 25.697(a)) must be sufficiently greater than the operating speed recommended for the corresponding stage of flight (including balked landings) to allow for probable variations in control of airspeed and for transition from one flap position to another.

(2) If an automatic flap positioning or load limiting device is used, the speeds and corresponding flap positions programmed or allowed by the device may be used.

(3) V_F may not be less than—

(i) 1.6 V_{S_1} with the flaps in takeoff position at maximum takeoff weight;

(ii) 1.8 V_{S_1} with the flaps in approach position at maximum landing weight; and

(iii) 1.8 V_{S_0} with the flaps in landing position at maximum landing weight.

§ 25.337 Limit maneuvering load factors.

(a) Except where limited by maximum (static) lift coefficients, the airplane is assumed to be subjected to symmetrical maneuvers resulting in the limit maneuvering load factors prescribed in this section. Pitching velocities appropriate to the corresponding pull-up and steady turn maneuvers must be taken into account.

(b) The positive limit maneuvering load factor n for any speed up to V_D may not be less than 2.5.

(c) The negative limit maneuvering load factor—

(1) May not be less than −1.0 at speeds up to V_C, and

(2) Must vary linearly with speed from the value at V_C to zero at V_D.

(d) Maneuvering load factors lower than those specified in this section may be used if the airplane has design features that make it impossible to exceed these values in flight.

§ 25.341 Gust loads.

(a) The airplane is assumed to be subjected to symmetrical vertical gusts in level flight. The resulting limit load factors must correspond to the conditions determined as follows:

(1) Positive (up) and negative (down) rough air gusts of 66 fps at V_B must be considered at altitudes between sea level and 20,000 feet. The gust velocity may

be reduced linearly from 66 fps at 20,000 feet to 38 fps at 50,000 feet.

(2) Positive and negative gusts of 50 fps at V_C must be considered at altitudes between sea level and 20,000 feet. The gust velocity may be reduced linearly from 50 fps at 20,000 feet to 25 fps at 50,000 feet.

(3) Positive and negative gusts of 25 fps at V_D must be considered at altitudes between sea level and 20,000 feet. The gust velocity may be reduced linearly from 25 fps at 20,000 feet to 12.5 fps at 50,000 feet.

(b) The following assumptions must be made:

(1) The shape of the gust is

$$U=\frac{U_{de}}{2}\left(1-\cos\frac{2\pi s}{25\bar{C}}\right)$$

where—

s=distance penetrated into gust (ft);
$\bar{C}$=mean geometric chord of wing (ft); and
U_{de}=derived gust velocity referred to in paragraph (a) (fps).

(2) Gust load factors vary linearly between the specified conditions B′ through G′, as shown on the gust envelope in § 25.333(c).

(c) In the absence of a more rational analysis, the gust load factors must be computed as follows:

$$n=1+\frac{K_g\,U_{de}\,Va}{498\,(W/S)}$$

where—

$K_g=\frac{0.88\mu_g}{5.3+\mu_g}$=gust alleviation factor;
$\mu_g=\frac{2(W/S)}{\rho\bar{C}ag}$=airplane mass ratio;
U_{de}=derived gust velocities referred to in paragraph (a) (fps);
ρ=density of air (slugs/cu. ft.);
W/S=wing loading (psf);
$\bar{C}$=mean geometric chord (ft.);
g=acceleration due to gravity (ft/sec.^{2});
V=airplane equivalent speed (knots); and
a=slope of the airplane normal force coefficient curve C_{N_A} per radian if the gust loads are applied to the wings and horizontal tail surfaces simultaneously by a rational method. The wing lift curve slope C_L per radian may be used when the gust load is applied to the wings only and the horizontal tail gust loads are treated as a separate condition.

§ 25.343 Design fuel and oil loads.

(a) The disposable load combinations must include each fuel and oil load in the range from zero fuel and oil to the selected maximum fuel and oil load. A structural reserve fuel condition, not exceeding 45 minutes of fuel under the operating conditions in § 25.1001(c), may be selected.

(b) If a structural reserve fuel condition is selected, it must be used as the minimum fuel weight condition for showing compliance with the flight load requirements as prescribed in this subpart. In addition—

(1) The structure must be designed for a condition of zero fuel and oil in the wing at limit loads corresponding to—

(i) A maneuvering load factor of +2.25; and

(ii) Gust intensities equal to 85 percent of the values prescribed in § 25.341; and

(2) Fatigue evaluation of the structure must account for any increase in operating stresses resulting from the design condition of subparagraph (b)(1) of this paragraph; and

(3) The flutter, deformation, and vibration requirements must also be met with zero fuel.

§ 25.345 High lift devices.

(a) If flaps are to be used during takeoff, approach, or landing, at the design flap speeds established for these stages of flight under § 25.335(e) and with the flaps in the corresponding positions, the airplane is assumed to be subjected to symmetrical maneuvers and gusts within the range determined by—

(1) Maneuvering to a positive limit load factor of 2.0; and

(2) Positive and negative 25 fps derived gusts acting normal to the flight path in level flight.

(b) The airplane must be designed for the conditions prescribed in paragraph (a) of this section, except that the airplane load factor need not exceed 1.0, taking into account, as separate conditions, the effects of—

(1) Propeller slipstream corresponding to maximum continuous power at the design flap speeds V_F, and with takeoff power at not less than 1.4 times the stalling speed for the particular flap position and associated maximum weight; and

(2) A head-on gust of 25 feet per second velocity (EAS).

(c) If flaps or similar high lift devices are to be used as speed brakes in en route conditions, and with flaps in the appropriate position at speeds up to the flap design speed chosen for these conditions, the airplane is assumed to be subjected to symmetrical maneuvers and gusts within the range determined by—

(1) Maneuvering to a positive limit load factor of 2.5; and

(2) Positive and negative derived gusts as prescribed in § 25.341 acting normal to the flight path in level flight.

§ 25.349 Rolling conditions.

The airplane must be designed for rolling loads resulting from the conditions specified in paragraphs (a) and (b) of this section. Unbalanced aerodynamic moments about the center of gravity must be reacted in a rational or conservative manner, considering the principal masses furnishing the reacting inertia forces.

(a) *Maneuvering.* The following conditions, speeds, and aileron deflections (except as the deflections may be limited by pilot effort) must be considered in combination with an airplane load factor of zero and of two-thirds of the positive maneuvering factor used in design. In determining the required aileron deflections, the torsional flexibility of the wing must be considered in accordance with § 25.301(b):

(1) Conditions corresponding to steady rolling velocities must be investigated. In addition, conditions corresponding to maximum angular acceleration must be investigated for airplanes with engines or other weight concentrations outboard of the fuselage. For the angular acceleration conditions, zero rolling velocity may be assumed in the absence of a rational time history investigation of the maneuver.

(2) At V_A, a sudden deflection of the aileron to the stop is assumed.

(3) At V_C, the aileron deflection must be that required to produce a rate of roll not less than that obtained in subparagraph (2) of this paragraph.

(4) At V_D, the aileron deflection must be that required to produce a rate of roll not less than one-third of that in subparagraph (2) of this paragraph.

(b) *Unsymmetrical gusts.* The condition of unsymmetrical gusts must be considered by modifying the symmetrical flight conditions B′ or C′ (in § 25.333(c)) whichever produces the greater load factor. It is assumed that 100 percent of the wing air load acts on one side of the airplane and 80 percent acts on the other side.

§ 25.351 Yawing conditions.

The airplane must be designed for loads resulting from the conditions specified in paragraphs (a) and (b) of this section. Unbalanced aerodynamic moments about the center of gravity must be reacted in a rational or conservative manner considering the principal masses furnishing the reacting inertia forces:

(a) *Maneuvering.* At speeds from V_{MO} to V_A, the following maneuvers must be considered. In computing the tail loads, the yawing velocity may be assumed to be zero:

(1) With the airplane in unaccelerated flight at zero yaw, it is assumed that the rudder control is suddenly displaced to the maximum deflection, as limited by the control stops or by a 300 lb. rudder pedal force, whichever is critical.

(2) With the rudder deflected as specified in subparagraph (1) of this paragraph, it is assumed that the airplane yaws to the resulting sideslip angle.

(3) With the airplane yawed to the static sideslip angle corresponding to the rudder deflection specified in subparagraph (1) of this paragraph, it is assumed that the rudder is returned to neutral.

(b) *Lateral gusts.* The airplane is assumed to encounter derived gusts normal to the plane of symmetry while in unaccelerated flight. The derived gusts and airplane speeds corresponding to conditions B′ through J′ (in § 25.333(c)) (as determined by §§ 25.341 and 25.345(a)(2) or 25.345(c)(2)) must be investigated. The shape of the gust must be as specified in § 25.341. In the absence of a rational investigation of the airplane's response to a gust, the gust loading on the vertical tail surfaces must be computed as follows:

$$L_t = \frac{K_{g_t} U_{de} V a_t S_t}{498}$$

where—

L_t = vertical tail load (lbs.);

$K_{g_t} = \frac{0.88\mu_{g_t}}{5.3+\mu_{g_t}}$ = gust alleviation factor;

$\mu_{g_t} = \frac{2W}{\rho \bar{C}_t g a_t S_t}\left(\frac{K}{l_t}\right)^2$ = lateral mass ratio;

U_{de} = derived gust velocity (fps);

ρ = air density (slugs/cu. ft.);

W = airplane weight (lbs.);

S_t = area of vertical tail (ft.^{2});

$\bar{C}_t$ = mean geometric chord of vertical surface (ft.);

a_t = lift curve slope of vertical tail (per radian);

K = radius of gyration in yaw (ft.);

l_t = distance from airplane c.g. to lift center of vertical surface (ft.);

g = acceleration due to gravity (ft./sec.^{2}); and

V = airplane equivalent speed (knots).

Supplementary Conditions

§ 25.361 Engine torque.

(a) Each engine mount and its supporting structures must be designed for engine torque effects combined with—

(1) The limit engine torque corresponding to takeoff power and propeller speed acting simultaneously with 75 percent of the limit loads from flight condition A of § 25.333(b);

(2) The limit engine torque corresponding to maximum continuous power and propeller speed acting simultaneously with the limit loads from flight condition A of § 25.333(b); and

(3) For turbopropeller installations, in addition to the conditions specified in subparagraphs (1) and (2) of this paragraph, the limit engine torque corresponding to takeoff power and propeller speed multiplied by a factor of 1.6 acting simultaneously with 1g level flight loads.

(b) For turbine engine installations, the limit engine torque load imposed by sudden engine stoppage due to malfunction or structural failure (such as compressor jamming) must be considered in the design of the engine mounts and supporting structure.

(c) The limit engine torque is obtained by multiplying the mean torque for maximum continuous power by a factor of—

(1) 1.25 for turbopropeller installations;

(2) 1.33 for reciprocating engines with five or more cylinders; or

(3) Two, three, or four, for engines with four, three, or two cylinders, respectively.

§ 25.363 Side load on engine mount.

(a) Each engine mount and its supporting structure must be designed for a limit load factor in a lateral direction, for the side load on the engine mount, at least equal to the maximum load factor obtained in the yawing conditions but not less than—

(1) 1.33; or

(2) One-third of the limit load factor for flight condition A.

(b) The side load prescribed in paragraph (a) of this section may be assumed to be independent of other flight conditions.

§ 25.365 Pressurized cabin loads.

For each pressurized compartment for occupants, the following apply:

(a) The airplane structure must be strong enough to withstand the flight loads combined with pressure differential loads from zero up to the maximum relief valve setting.

(b) The external pressure distribution in flight, and stress concentrations and fatigue effects must be accounted for.

(c) If landings may be made with the cabin pressurized, landing loads must be combined with pressure differential loads from zero up to the maximum allowed during landing.

(d) The airplane structure must be strong enough to withstand the pressure differential loads corresponding to the maximum relief valve setting multiplied by a factor of 1.33, omitting other loads.

(e) If a pressurized cabin has two or more compartments separated by partitions, bulkheads, or floors, the structure supporting the prescribed flight and grounds loads (and any other structure that, if it failed, could interfere with continued safe flight and landing) must be designed to withstand the effects of sudden release of pressure in any compartment through an opening resulting from the failure or penetration of an external door, window, or windshield panel, or from structural fatigue or penetration of the fuselage in this compartment, unless it is shown that the probability of failure or penetration is extremely remote.

(f) In determining the probability of failure or penetration and probable size of openings, the fail-safe features of the design may be considered if possible improper operation of closure devices and inadvertent door openings are also considered. The pressure relief provided by intercompartment venting may also be considered.

(g) Reasonable design precautions must be taken to minimize the probability of parts becoming detached and injuring occupants while in their seats.

§ 25.367 Unsymmetrical loads due to engine failure.

(a) The airplane must be designed for the unsymmetrical loads resulting from the failure of the critical engine. Turbopropeller airplanes must be designed for the following conditions in combination with a single malfunction of the propeller drag limiting system, considering the probable pilot corrective action on the flight controls:

(1) At speeds between V_{MC} and V_D, the loads resulting from power failure because of fuel flow interruption are considered to be limit loads.

(2) At speeds between V_{MC} and V_C, the loads resulting from the disconnection of the engine compressor from the turbine or from loss of the turbine blades are considered to be ultimate loads.

(3) The time history of the thrust decay and drag build-up occurring as a result of the prescribed engine failures must be substantiated by test or other data applicable to the particular engine-propeller combination.

(4) The timing and magnitude of the probable pilot corrective action must be conservatively estimated, considering the characteristics of the particular engine-propeller-airplane combination.

(b) Pilot corrective action may be assumed to be initiated at the time maximum yawing velocity is reached, but not earlier than two seconds after the engine failure. The magnitude of the corrective action may be based on the control forces specified in § 25.397(b) except that lower forces may be assumed where it is shown by analysis or test that these forces can control the yaw and roll resulting from the prescribed engine failure conditions.

§ 25.371 Gyroscopic loads.

The structure supporting the engines must be designed for gyroscopic loads associated with the conditions specified in §§ 25.331, 25.349, and 25.351, with the engines at maximum continuous r.p.m.

§ 25.373 Speed control devices.

If speed control devices (such as spoilers and drag flaps) are installed for use in en route conditions—

(a) The airplane must be designed for the symmetrical maneuvers and gusts prescribed in §§ 25.333, 25.337, and 25.341, and the yawing maneuvers and lateral gusts in § 25.351, with the device extended at speeds up to the placard device extended speed; and

(b) If the device has automatic operating or load limiting features, the airplane must be designed for the maneuver and gust conditions prescribed in paragraph (a) of this section, at the speeds and corresponding device positions that the mechanism allows.

Control Surface and System Loads

§ 25.391 Control surface loads: general.

The control surfaces must be designed for the limit loads resulting from the flight conditions in §§ 25.331, 25.349, and 25.351 and the ground gust conditions in § 25.415, considering the requirements for—

(a) Loads parallel to hinge line, in § 25.393;

(b) Pilot effort effects, in § 25.397;

(c) Trim tab effects, in § 25.407;

(d) Unsymmetrical loads, in § 25.427; and

(e) Outboard fins, in § 25.445.

§ 25.393 Loads parallel to hinge line.

(a) Control surfaces and supporting hinge brackets must be designed for inertia loads acting parallel to the hinge line.

(b) In the absence of more rational data, the inertia loads may be assumed to be equal to KW, where—

(1) K=24 for vertical surfaces;

(2) K=12 for horizontal surfaces; and

(3) W=weight of the movable surfaces.

§ 25.395 Control system.

(a) Elevator, aileron, and rudder control systems and their supporting structures must be designed for loads corresponding to 125 percent of the computed hinge moments of the movable control surface in the conditions prescribed in § 25.391.

(b) The system limit loads, except the loads resulting from ground gusts, need not exceed the loads that can be produced by the pilot (or pilots) and by automatic devices operating the controls. The loads must be great enough to provide a rugged system for service use, considering jamming, ground gusts, taxiing tail to wind, control inertia, and friction.

§ 25.397 Control system loads.

(a) *General.* The maximum and minimum pilot forces, specified in paragraph (c) of this section, are assumed to act at the appropriate control grips or pads (in a manner simulating flight conditions) and to be reacted at the attachment of the control system to the control surface horn.

(b) *Pilot effort effects.* In the control surface flight loading condition, the air loads on movable surfaces and the corresponding deflections need not exceed those that would result in flight from the application of any pilot force within the ranges specified in paragraph (c) of this section. Two-thirds of the maximum values specified for the aileron and elevator may be used if control surface hinge moments are based on reliable data. In applying this criterion, the effects of servo mechanisms, tabs, and automatic pilot systems, must be considered.

(c) *Limit pilot forces.* The limit pilot forces are as follows:

Control	Maximum forces	Minimum forces
Aileron:		
Stick	100 lbs.	40 lbs.
Wheel*	80 D in.-lbs.**	40 D in.-lbs.
Elevator:		
Stick	250 lbs.	100 lbs.
Wheel	300 lbs.	100 lbs.
Rudder	300 lbs.	130 lbs.

*The critical parts of the aileron control system must be designed for a single tangential force with a limit value equal to 1.25 times the couple force determined from these criteria.

**D=wheel diameter (inches).

§ 25.399 Dual control system.

(a) Each dual control system must be designed for the pilots operating in opposition, using individual pilot forces not less than—

(1) 0.75 times those obtained under § 25.395; or

(2) The minimum forces specified in § 25.397(c).

(b) The control system must be designed for pilot forces applied in the same direction, using individual pilot forces not less than 0.75 times those obtained under § 25.395.

§ 25.405 Secondary control system.

Secondary controls, such as wheel brake, spoiler, and tab controls, must be designed for the maximum forces that a pilot is likely to apply to those controls. The following values may be used:

PILOT CONTROL FORCE LIMITS (SECONDARY CONTROLS)

Control	Limit pilot forces
Miscellaneous: *Crank, wheel, or lever.	$\left(\frac{1+R}{3}\right)\times 50$ lbs., but not less than 50 lbs. nor more than 150 lbs. (R=radius). (Applicable to any angle within 20° of plane of control).
Twist	133 in.-lbs.
Push-pull	To be chosen by applicant.

*Limited to flap, tab, stabilizer, spoiler, and landing gear operation controls.

§ 25.407 Trim tab effects.

The effects of trim tabs on the control surface design conditions must be accounted for only where the surface loads are limited by maximum pilot effort. In these cases, the tabs are considered to be deflected in the direction that would assist the pilot, and the deflections are—

(a) For elevator trim tabs, those required to trim the airplane at any point within the positive portion of the pertinent flight envelope in § 25.333(b), except as limited by the stops; and

(b) For aileron and rudder trim tabs, those required to trim the airplane in the critical unsymmetrical power and loading conditions, with appropriate allowance for rigging tolerances.

§ 25.409 Tabs.

(a) *Trim tabs.* Trim tabs must be designed to withstand loads arising from all likely combinations of tab setting, primary control position, and airplane speed (obtainable without exceeding the flight load conditions prescribed for the airplane as a whole), when the effect of the tab is opposed by pilot effort forces up to those specified in § 25.397(b).

(b) *Balancing tabs.* Balancing tabs must be designed for deflections consistent with the primary control surface loading conditions.

(c) *Servo tabs.* Servo tabs must be designed for deflections consistent with the primary control surface loading conditions obtainable within the pilot maneuvering effort, considering possible opposition from the trim tabs.

§ 25.415 Ground gust conditions.

(a) The control system must be designed as follows for control surface loads due to ground gusts and taxiing downwind:

(1) The control system between the stops nearest the surfaces and the cockpit controls must be designed for loads corresponding to the limit hinge moments H of subparagraph (2) of this paragraph. These loads need not exceed—

(i) The loads corresponding to the maximum pilot loads in § 25.397(c) for each pilot alone; or

(ii) 0.75 times these maximum loads for each pilot when the pilot forces are applied in the same direction.

(2) The control system stops nearest the surfaces, the control system locks, and the parts of the systems (if any) between these stops and locks and the control surface horns, must be designed for limit hinge moments H obtained from the formula, $H=KcSq$, where—

H=limit hinge moment (ft. lbs.);

c=mean chord of the control surface aft of the hinge line (ft.);

S=area of the control surface aft of the hinge line (sq. ft.);

q=dynamic pressure (p.s.f.) based on a design speed not less than $14.6\sqrt{W/S}+14.6$ (f.p.s.), except that the design speed need not exceed 88 f.p.s.; and

K=limit hinge moment factor for ground gusts derived in paragraph (b) of this section.

(b) The limit hinge moment factor K for ground gusts must be derived as follows:

Surface	K	Position of controls
(a) Aileron	0.75	Control column locked or lashed in mid-position.
(b) Aileron	*±0.50	Ailerons at full throw.
(c) (d) Elevator	*±0.75	(c) Elevator full down. (d) Elevator full up.
(e) (f) Rudder	0.75	(e) Rudder in neutral. (f) Rudder at full throw.

*A positive value of K indicates a moment tending to depress the surface, while a negative value of K indicates a moment tending to raise the surface.

§ 25.427 Unsymmetrical loads.

(a) Horizontal tail surfaces and their supporting structure must be designed for unsymmetrical loads arising from yawing and slipstream effects, in combination with the prescribed flight conditions.

(b) In the absence of more rational data, the following apply:

(1) For airplanes that are conventional in regard to location of propellers, wings, tail surfaces, and fuselage shape—

(i) 100 percent of the maximum loading from the symmetrical flight conditions may be assumed to act on the surface on one side of the plane of symmetry; and

(ii) 80 percent of this loading may be assumed to act on the other side.

(2) For airplanes that are not conventional (such as where the horizontal tail surfaces have appreciable dihedral or are supported by the vertical tail surfaces), the surfaces and supporting structures may be designed for combined vertical and horizontal surface loads resulting from the prescribed maneuvers.

§ 25.445 Outboard fins.

(a) If outboard fins are on the horizontal tail surface, the tail surfaces must be designed for the maximum horizontal surface load in combination with the corresponding loads induced on the vertical surfaces by endplate effects. These induced effects need not be combined with other vertical surface loads.

(b) To provide for unsymmetrical loading when outboard fins extend above and below the horizontal surface, the critical vertical surface loading (load per unit area) determined under § 25.391 must also be applied as follows:

(1) 100 percent to the area of the vertical surfaces above (or below) the horizontal surface.

(2) 80 percent to the area below (or above) the horizontal surface.

§ 25.457 Wing flaps.

Wing flaps, their operating mechanisms, and their supporting structures must be designed for critical loads occurring in the conditions prescribed in § 25.345, accounting for the loads occurring during transition from one flap position and airspeed to another.

§ 25.459 Special devices.

The loading for special devices using aerodynamic surfaces (such as slots and spoilers) must be determined from test data.

GROUND LOADS

§ 25.471 General.

(a) *Loads and equilibrium.* For limit ground loads—

(1) Limit ground loads obtained under this subpart are considered to be external forces applied to the airplane structure; and

(2) In each specified ground load condition, the external loads must be placed in equilibrium with the linear and angular inertia loads in a rational or conservative manner.

(b) *Critical centers of gravity.* The critical centers of gravity within the range for which certification is requested must be selected so that the maximum design loads are obtained in each landing gear element.

(c) *Design weights.* Design weights may be used for structural design only.

(d) *Landing gear dimension data.* Figure (1) of Appendix A contains the basic landing gear dimension data.

§ 25.473 Ground load conditions and assumptions.

(a) For the landing conditions specified in §§ 25.479 through 25.485, the following apply:

(1) The selected limit vertical inertia load factors at the center of gravity of the airplane may not be less than the values that would be obtained—

(i) In the attitude and subject to the drag loads associated with the particular landing condition;

(ii) With a limit descent velocity of 10 f.p.s. at the design landing weight (the maximum weight for landing conditions at the maximum descent velocity); and

(iii) With a limit descent velocity of 6 f.p.s. at the design takeoff weight (the maximum weight for taxiing conditions and landing conditions at a reduced descent velocity).

(2) A wing lift, not exceeding the airplane weight, may be assumed to exist throughout the landing impact and to act through the center of gravity of the airplane.

(b) The prescribed descent velocities may be modified if it is shown that the airplane has design features that make it impossible to develop these velocities.

(c) The minimum limit inertia load factors corresponding to the required limit descent velocities must be determined in accordance with § 25.723(a).

§ 25.477 Landing gear arrangement.

Sections 25.479 through 25.485 apply to airplanes with conventional arrangements of main and nose gears, or main and tail gears, when normal operating techniques are used.

§ 25.479 Level landing conditions.

(a) In the level attitude, the airplane is assumed to contact the ground at forward velocity components, ranging from V_{L_1} to 1.25 V_{L_2}, parallel to the ground, and to be subjected to the load factors prescribed in § 25.473(a)(1) with—

(1) V_{L_1} equal to V_{S_0} (TAS) at the appropriate landing weight and in standard sea level conditions; and

(2) V_{L_2} equal to V_{S_0} (TAS) at the appropriate landing weight and altitudes in a hot day temperature of 41 degrees F. above standard.

(b) The effects of increased contact speeds must be investigated if approval of downwind landings exceeding 10 knots is desired.

(c) Assuming that the following combinations of vertical and drag components act at the axle centerline, the following apply:

(1) For the condition of maximum wheel spin-up load, drag components simulating the forces required to accelerate the wheel rolling assembly up to the specified ground speed must be combined with the vertical ground reactions existing at the instant of peak drag loads. The coefficient of friction between the tires and the ground may be established by considering the effects of skidding velocity and tire pressure. However, this coefficient of friction need not be more than 0.8. This condition must be applied to the landing gear, directly affected attaching structure, and large mass items such as external fuel tanks and nacelles.

(2) For the condition of maximum wheel vertical load, an aft acting drag component of not less than 25 percent of the maximum vertical ground reaction must be combined with the maximum ground reaction of § 25.473.

(3) For the condition of maximum springback load, forward-acting horizontal loads resulting from a rapid reduction of the spin-up drag loads must be combined with the vertical ground reactions at the instant of the peak forward load. This condition must be applied to the landing gear, directly affected attaching structure, and large mass items such as external fuel tanks and nacelles.

(d) For the level landing attitude for airplanes with tail wheels, the conditions specified in paragraph (a) of this section must be investigated with the airplane horizontal reference line horizontal in accordance with figure 2 of Appendix A.

(e) For the level landing attitude for airplanes with nose wheels, shown in Figure 2 of Appendix A, the conditions specified in paragraphs (a) through (c) of this section must be investigated, assuming the following attitudes:

(1) An attitude in which the main wheels are assumed to contact the ground with the nose wheel just clear of the ground.

(2) If reasonably attainable at the specified descent and forward velocities, an attitude in which the nose and main wheels are assumed to contact the ground simultaneously. For this attitude—

(i) The nose and main gear may be separately investigated under the conditions in paragraph (c)(1) and (3) of this section; and

(ii) The pitching moment is assumed, under the condition in paragraph (c)(2) of this section, to be resisted by the nose gear.

§ 25.481 Tail-down landing conditions.

(a) In the tail-down attitude, the airplane is assumed to contact the ground at forward velocity components, ranging from V_{L_1} to V_{L_2}, parallel to the ground, and is subjected to the load factors prescribed in § 25.473(a)(1) with—

(1) V_{L_1} equal to V_{S_0} (TAS) at the appropriate landing weight and in standard sea level conditions; and

(2) V_{L_2} equal to V_{S_0} (TAS) at the appropriate landing weight and altitudes in a hot day temperature of 41 degrees F. above standard.

The combination of vertical and drag components specified in § 25.479(c)(1) and (3) is considered to be acting at the main wheel axle centerline.

(b) For the tail-down landing condition for airplanes with tail wheels, the main and tail wheels are assumed to contact the ground simultaneously, in accordance with figure 3 of Appendix A. Ground reaction conditions on the tail wheel are assumed to act—

(1) Vertically; and

(2) Up and aft through the axle at 45 degrees to the ground line.

(c) For the tail-down landing condition for airplanes with nose wheels, the airplane is assumed to be at an attitude corresponding to either the stalling angle or the maximum angle allowing clearance with the ground by each part of the airplane other than the main wheels, in accordance with figure 3 of Appendix A, whichever is less.

§ 25.483 One-wheel landing conditions.

For the one-wheel landing condition, the airplane is assumed to be in the level attitude and to contact the ground on one side of the main landing gear, in accordance with Figure 4 of Appendix A. In this attitude—

(a) The ground reactions must be the same as those obtained on that side under § 25.479(c)(2); and

(b) Each unbalanced external load must be reacted by airplane inertia in a rational or conservative manner.

§ 25.485 Side load conditions.

(a) For the side load condition, the airplane is assumed to be in the level attitude with only the main wheels contacting the ground, in accordance with figure 5 of Appendix A.

(b) Side loads of 0.8 of the vertical reaction (on one side) acting inward and 0.6 of the vertical reaction (on the other side) acting outward must be combined with one-half of the maximum vertical ground reactions obtained in the level landing conditions. These loads are assumed to be applied at the ground contact point and to be resisted by the inertia of the airplane. The drag loads may be assumed to be zero.

§ 25.487 Rebound landing condition.

(a) The landing gear and its supporting structure must be investigated for the loads occurring during rebound of the airplane from the landing surface.

(b) With the landing gear fully extended and not in contact with the ground, a load factor of 20.0 must act on the unsprung weights of the landing gear. This load factor must act in the direction of motion of the unsprung weights as they reach their limiting positions in extending with relation to the sprung parts of the landing gear.

§ 25.489 Ground handling conditions.

Unless otherwise prescribed, the landing gear and airplane structure must be investigated for the conditions in §§ 25.491 through 25.509 with the airplane at the design takeoff weight. No wing lift may be considered. The shock absorbers and tires may be assumed to be in their static position.

§ 25.491 Takeoff run.

The landing gear and the airplane structure are assumed to be subjected to loads not less than those obtained under conditions described in § 25.235.

§ 25.493 Braked roll conditions.

(a) An airplane with a tail wheel is assumed to be in the level attitude with the load on the main wheels, in accordance with figure 6 of Appendix A. The limit vertical load factor is 1.2 at the design landing weight, and 1.0 at the design takeoff weight. A drag reaction equal to the vertical reaction multiplied by a coefficient of friction of 0.8, must be combined with the vertical ground reaction and applied at the ground contact point.

(b) For an airplane with a nose wheel, the limit vertical load factor is 1.2 at the design landing weight, and 1.0 at the design takeoff weight. A drag reaction equal to the vertical reaction, multiplied by a coefficient of friction of 0.8, must be combined with the vertical reaction and applied at the ground contact point of each wheel with brakes. The following two attitudes, in accordance with figure 6 of Appendix A, must be considered:

(1) The level attitude with the wheels contacting the ground and the loads distributed between the main and nose gear. Zero pitching acceleration is assumed.

(2) The level attitude with only the main gear contacting the ground and with the pitching moment resisted by angular acceleration.

(c) A drag reaction lower than that prescribed in paragraphs (a) and (b) of this section may be used if it is substantiated that an effective drag force of 0.8 times the vertical reaction cannot be attained under any likely loading condition.

§ 25.495 Turning.

In the static position, in accordance with figure 7 of Appendix A, the airplane is assumed to execute a steady turn by nose gear steering, or by application of sufficient differential power, so that the limit load factors applied at the center of gravity are 1.0 vertically and 0.5 laterally. The side ground reaction of each wheel must be 0.5 of the vertical reaction.

§ 25.497 Tail-wheel yawing.

(a) A vertical ground reaction equal to the static load on the tail wheel, in combination with a side component of equal magnitude, is assumed.

(b) If there is a swivel, the tail wheel is assumed to be swiveled 90° to the airplane longitudinal axis with the resultant load passing through the axle.

(c) If there is a lock, steering device, or shimmy damper the tail wheel is also assumed to be in the trailing position with the side load acting at the ground contact point.

§ 25.499 Nose-wheel yaw.

(a) A vertical load factor of 1.0 at the airplane center of gravity, and a side component at the nose wheel ground contact equal to 0.8 of the vertical ground reaction at that point, are assumed.

(b) With the airplane assumed to be in static equilibrium with the loads resulting from the use of brakes on one side of the main landing gear, the nose gear, its attaching structure, and the fuselage structure must be designed for the following loads:

(1) A vertical load factor at the center of gravity of 1.0.

(2) A forward acting load at the airplane center of gravity of 0.8 times the vertical load on one main gear.

(3) Side and vertical loads at the ground contact point on the nose gear that are required for static equilibrium.

(4) A side load factor at the airplane center of gravity of zero.

(c) If the loads prescribed in paragraph (a) of this section result in a nose gear side load higher than 0.8 times the vertical nose gear load, the design nose gear side load may be limited to 0.8 times the vertical load, with unbalanced yawing moments assumed to be resisted by airplane inertia forces.

(d) For the landing gear and airplane structure, the loading conditions are those prescribed in paragraph (b) of this section, except that—

(1) A lower drag reaction may be used if an effective drag force of 0.8 times the vertical reaction cannot be reached under any likely loading condition; and

(2) The forward acting load at the center of gravity need not exceed the maximum drag reaction on one main gear, determined in accordance with § 25.493(b).

§ 25.503 Pivoting.

(a) The airplane is assumed to pivot about one side of the main gear with the brakes on that side locked. The limit vertical load factor must be 1.0 and the coefficient of friction 0.8.

(b) The airplane is assumed to be in static equilibrium, with the loads being applied at the ground contact points, in accordance with figure 8 of Appendix A.

§ 25.507 Reversed braking.

(a) The airplane must be in a three point static ground attitude. Horizontal reactions parallel to the ground and directed forward must be applied at the ground contact point of each wheel with brakes. The limit loads must be equal to 0.55 times the vertical load at each wheel or to the load developed by 1.2 times the nominal maximum static brake torque, whichever is less.

(b) For airplanes with nose wheels, the pitching moment must be balanced by rotational inertia.

(c) For airplanes with tail wheels, the resultant of the ground reactions must pass through the center of gravity of the airplane.

§ 25.509 Towing loads.

(a) The towing loads specified in paragraph (d) of this section must be considered separately. These loads must be applied at the towing fittings and must act parallel to the ground. In addition—

(1) A vertical load factor equal to 1.0 must be considered acting at the center of gravity;

(2) The shock struts and tires must be in their static positions; and

(3) With W_T as the design maximum takeoff weight, the towing load, F_{TOW}, is—

(i) 0.3 W_T for W_T less than 30,000 pounds;

(ii) $\frac{6W_T+450{,}000}{70}$ for W_T between 30,000 and 100,000 pounds; and

(iii) 0.15 W_T for W_T over 100,000 pounds.

(b) For towing points not on the landing gear but near the plane of symmetry of the airplane, the drag and side tow load components specified for the auxiliary gear apply. For towing points located outboard of the main gear, the drag and side tow load components specified for the main gear apply. Where the specified angle of swivel cannot be reached, the maximum obtainable angle must be used.

(c) The towing loads specified in paragraph (d) of this section must be reacted as follows:

(1) The side component of the towing load at the main gear must be reacted by a side force at the static ground line of the wheel to which the load is applied.

(2) The towing loads at the auxiliary gear and the drag components of the towing loads at the main gear must be reacted as follows:

(i) A reaction with a maximum value equal to the vertical reaction must be applied at the axle of the wheel to which the load is applied. Enough airplane inertia to achieve equilibrium must be applied.

(ii) The loads must be reacted by airplane inertia.

(d) The prescribed towing loads are as follows:

Tow point	Position	Load		
		Magnitude	No.	Direction
Main gear.		0.75 F_{TOW} per main gear unit.	1 2 3 4	Forward, parallel to drag axis. Forward, at 30° to drag axis. Aft, parallel to drag axis. Aft, at 30° to drag axis.
Auxiliary gear.	Swiveled forward.	1.0 F_{TOW}.	5 6	Forward. Aft.
	Swiveled aft.		7 8	Forward. Aft.
	Swiveled 45° from forward.	0.5 F_{TOW}.	9 10	Forward, in plane of wheel. Aft, in plane of wheel.
	Swiveled 45° from aft.		11 12	Forward, in plane of wheel. Aft, in plane of wheel.

§ 25.511 Ground load; unsymmetrical loads on multiple-wheel units.

(a) *General.* Multiple-wheel landing gear units are assumed to be subjected to the limit ground loads prescribed in this subpart under paragraphs (b) through (f) of this section. In addition—

(1) A tandem strut gear arrangement is a multiple-wheel unit; and

(2) In determining the total load on a gear unit with respect to the provisions of paragraphs (b) through (f) of this section, the transverse shift in the load centroid, due to unsymmetrical load distribution on the wheels, may be neglected.

(b) *Distribution of limit loads to wheels; tires inflated.* The distribution of the limit loads among the wheels of the landing gear must be established for each landing, taxiing, and ground handling condition, taking into account the effects of the following factors:

(1) The number of wheels and their physical arrangements. For truck type landing gear units, the effects of any seesaw motion of the truck during the landing impact must be considered in determining the maximum design loads for the fore and aft wheel pairs.

(2) Any differentials in tire diameters resulting from a combination of manufacturing tolerances, tire growth, and tire wear. A maximum tire-diameter differential equal to ⅔ of the most unfavorable combination of diameter variations that is obtained when taking into account manufacturing tolerances, tire growth, and tire wear, may be assumed.

(3) Any unequal tire inflation pressure, assuming the maximum variation to be ±5 percent of the nominal tire inflation pressure.

(4) A runway crown of zero and a runway crown having a convex upward shape that may be approximated by a slope of 1½ percent with the horizontal. Runway crown effects must be considered with the nose gear unit on either slope of the crown.

(5) The airplane attitude.

(6) Any structural deflections.

(c) *Deflated tires.* The effect of deflated tires on the structure must be considered with respect to the loading conditions specified in paragraphs (d) through (f) of this section, taking into account the physical arrangement of the gear components. In addition—

(1) The deflation of any one tire for each multiple wheel landing gear unit, and the deflation of any two critical tires for each landing gear unit using four or more wheels per unit, must be considered; and

(2) The ground reactions must be applied to the wheels with inflated tires except that, for multiple-wheel gear units with more than one shock strut, a rational distribution of the ground reactions between the deflated and inflated tires, accounting for the differences in shock strut extensions resulting from a deflated tire, may be used.

(d) *Landing conditions.* For one and for two deflated tires, the applied load to each gear unit is assumed to be 60 percent and 50 percent, respectively, of the limit load applied to each gear for each of the prescribed landing conditions. However, for the drift landing condition of § 25.485, 100 percent of the vertical load must be applied.

(e) *Taxiing and ground handling conditions.* For one and for two deflated tires—

(1) The applied side or drag load factor, or both factors, at the center of gravity must be the most critical value up to 50 percent and 40 percent, respectively, of the limit side or drag load factors, or both factors, corresponding to the most severe condition resulting from consideration of the prescribed taxiing and ground handling conditions;

(2) For the braked roll conditions of § 25.493(a) and (b)(2), the drag loads on each inflated tire may not be less than those at each tire for the symmetrical load distribution with no deflated tires;

(3) The vertical load factor at the center of gravity must be 60 percent and 50 percent, respectively, of the factor with no deflated tires, except that it may not be less than 1g; and

(4) Pivoting need not be considered.

(f) *Towing conditions.* For one and for two deflated tires, the towing load, F_{TOW}, must be 60 percent and 50 percent, respectively, of the load prescribed.

WATER LOADS

§ 25.521 General.

(a) Seaplanes must be designed for the water loads developed during takeoff and landing, with the seaplane in any attitude likely to occur in normal operation, and at the appropriate forward and sinking velocities under the most severe sea conditions likely to be encountered.

(b) Unless a more rational analysis of the water loads is made, or the standards in ANC-3 are used, §§ 25.523 through 25.537 apply.

(c) The requirements of this section and §§ 25.523 through 25.537 apply also to amphibians.

§ 25.523 Design weights and center of gravity positions.

(a) *Design weights.* The water load requirements must be met at each operating weight up to the design landing weight except that, for the takeoff condition prescribed in § 25.531, the design takeoff weight must be used.

(b) *Center of gravity positions.* The critical centers of gravity within the limits for which certification is requested must be considered to reach maximum design loads for each part of the seaplane structure.

§ 25.525 Application of loads.

(a) Unless otherwise prescribed, the seaplane as a whole is assumed to be subjected to the loads corresponding to the load factors specified in § 25.527.

(b) In applying the loads resulting from the load factors prescribed in § 25.527, the loads may be distributed over the hull or main float bottom (in order to avoid excessive local shear loads and bending moments at the location of water load application) using pressures not less than those prescribed in § 25.533 (b).

(c) For twin float seaplanes, each float must be treated as an equivalent hull on a fictitious seaplane with a weight equal to one-half the weight of the twin float seaplane.

(d) Except in the takeoff condition of § 25.531, the aerodynamic lift on the seaplane during the impact is assumed to be ⅔ of the weight of the seaplane.

§ 25.527 Hull and main float load factors.

(a) Water reaction load factors n_W must be computed in the following manner:

(1) For the step landing case

$$n_W=\frac{C_1 V_{S_0}{}^2}{\tan^{2/3}\beta W^{1/3}}$$

(2) For the bow and stern landing cases

$$n_W=\frac{C_1 V_{S_0}{}^2}{\tan^{2/3}\beta W^{1/3}}\times\frac{K_1}{(1+r_x{}^2)^{2/3}}.$$

(b) The following values are used:

(1) n_W=water reaction load factor (that is, the water reaction divided by seaplane weight).

(2) C_1=empirical seaplane operations factor equal to 0.012 (except that this factor may not be less than that necessary to obtain the minimum value of step load factor of 2.33).

(3) V_{S_0}=seaplane stalling speed with flaps extended in the appropriate landing position and with no slipstream effect.

(4) β=angle of dead rise at the longitudinal station at which the load factor is being determined, in accordance with figure 1 of Appendix B.

(5) W=seaplane design landing weight in pounds.

(6) K_1=empirical hull station weighing factor, in accordance with figure 2 of Appendix B.

(7) r_x=ratio of distance, measured parallel to hull reference axis, from the center of gravity of the seaplane to the hull longitudinal station at which the load factor is being computed to the radius of gyration in pitch of the seaplane, the hull reference axis being a straight line, in the plane of symmetry, tangential to the keel at the main step.

(c) For a twin float seaplane, because of the effect of flexibility of the attachment of the floats to the seaplane, the factor K_1 may be reduced at the bow and stern to 0.8 of the value shown in figure 2 of Appendix B. This reduction applies only to the design of the carry-through and seaplane structure.

§ 25.529 Hull and main float landing conditions.

(a) *Symmetrical step, bow, and stern landing.* For symmetrical step, bow, and stern landings, the limit water reaction load factors are those computed under § 25.527. In addition—

(1) For symmetrical step landings, the resultant water load must be applied at the keel, through the center of gravity, and must be directed perpendicularly to the keel line;

(2) For symmetrical bow landings, the resultant water load must be applied at the keel, one-fifth of the longitudinal distance from the bow to the step, and must be directed perpendicularly to the keel line; and

(3) For symmetrical stern landings, the resultant water load must be applied at the keel, at a point 85 percent of the longitudinal distance from the step to the stern post, and must be directed perpendicularly to the keel line.

(b) *Unsymmetrical landing for hull and single float seaplanes.* Unsymmetrical step, bow, and stern landing conditions must be investigated. In addition—

(1) The loading for each condition consists of an upward component and a side component equal, respectively, to 0.75 and 0.25 tan β times the resultant load in the corresponding symmetrical landing condition; and

(2) The point of application and direction of the upward component of the load is the same as that in the symmetrical condition, and the point of application of the side component is at the same longitudinal station as the upward component but is directed inward perpendicularly to the plane of symmetry at a point midway between the keel and chine lines.

(c) *Unsymmetrical landing; twin float seaplanes.* The unsymmetrical loading consists of an upward load at the step of each float of 0.75 and a side load of 0.25 tan β at one float times the step landing load reached under § 25.527. The side load is directed inboard, perpendicularly to the plane of symmetry midway between the keel and chine lines of the float, at the same longitudinal station as the upward load.

§ 25.531 Hull and main float takeoff condition.

For the wing and its attachment to the hull or main float—

(a) The aerodynamic wing lift is assumed to be zero; and

(b) A downward inertia load, corresponding to a load factor computed from the following formula, must be applied:

$$n=\frac{C_{TO}V_{S_1}^2}{\tan^{2/3}\beta W^{1/3}}$$

where—

n=inertia load factor;

C_{TO}=empirical seaplane operations factor equal to 0.004;

V_{S_1}=seaplane stalling speed at the design takeoff weight with the flaps extended in the appropriate takeoff position;

β=angle of dead rise at the main step (degrees); and

W=seaplane design takeoff weight in pounds.

§ 25.533 Hull and main float bottom pressures.

(a) *General.* The hull and main float structure, including frames and bulkheads, stringers, and bottom plating, must be designed under this section.

(b) *Local pressures.* For the design of the bottom plating and stringers and their attachments to the supporting structure, the following pressure distributions must be applied:

(1) For an unflared bottom, the pressure at the chine is 0.75 times the pressure at the keel, and the pressures between the keel and chine vary linearly, in accordance with figure 3 of Appendix B. The pressure at the keel (psi) is computed as follows:

$$P_k=C_2\frac{K_2V_{S_1}^2}{\tan\beta_k}$$

where—

P_k=pressure at the keel;

C_2=0.00213;

K_2=hull station weighing factor, in accordance with figure 2 of Appendix B;

V_{S_1}=seaplane stalling speed at the design takeoff weight with flaps extended in the appropriate takeoff position; and

β_k=angle of dead rise at keel, in accordance with figure 1 of Appendix B.

(2) For a flared bottom, the pressure at the beginning of the flare is the same as that for an unflared bottom, and the pressure between the chine and the beginning of the flare varies linearly, in accordance with figure 3 of Appendix B. The pressure distribution is the same as that prescribed in subparagraph (1) of this paragraph for an unflared bottom except that the pressure at the chine is computed as follows:

$$P_{ch}=C_3\frac{K_2V_{S_1}^2}{\tan\beta}$$

where—

P_{ch}=pressure at the chine;

C_3=0.0016;

K_2=hull station weighing factor, in accordance with figure 2 of Appendix B;

V_{S_1}=seaplane stalling speed at the design takeoff weight with flaps extended in the appropriate takeoff position; and

β=angle of dead rise at appropriate station.

The area over which these pressures are applied must simulate pressures occurring during high localized impacts on the hull or float, but need not extend over an area that would induce critical stresses in the frames or in the overall structure.

(c) *Distributed pressures.* For the design of the frames, keel, and chine structure, the following pressure distributions apply:

(1) Symmetrical pressures are computed as follows:

$$P=C_4\frac{K_2V_{S_0}^2}{\tan\beta}$$

where—

P=pressure;

C_4=0.078 C_1 (with C_1 computed under § 25.527);

K_2=hull station weighing factor, determined in accordance with figure 2 of Appendix B;

V_{S_0}=seaplane stalling speed with landing flaps extended in the appropriate position and with no slipstream effect; and

β=angle of dead rise at appropriate station.

(2) The unsymmetrical pressure distribution consists of the pressures prescribed in subparagraph (1) of this paragraph on one side of the hull or main float centerline and one-half of that pressure on the other side of the hull or main float centerline, in accordance with figure 3 of Appendix B.

These pressures are uniform and must be applied simultaneously over the entire hull or main float bottom. The loads obtained must be carried into the sidewall structure of the hull proper, but need not be transmitted in a fore and aft direction as shear and bending loads.

§ 25.535 Auxiliary float loads.

(a) *General.* Auxiliary floats and their attachments and supporting structures must be designed for the conditions prescribed in this section. In the cases specified in paragraphs (b) through (e) of this section, the prescribed water loads may be distributed over the float bottom to avoid excessive local loads, using bottom pressures not less than those prescribed in paragraph (g) of this section.

(b) *Step loading.* The resultant water load must be applied in the plane of symmetry of the float at a point three-fourths of the distance from the bow to the step and must be perpendicular to the keel. The resultant limit load is computed as follows, except that the value of L need not exceed three times the weight of the displaced water when the float is completely submerged:

$$L=\frac{C_5 V_{S_0}^2 W^{2/3}}{\tan^{2/3}\beta_s(1+r_y^2)^{2/3}}$$

where—

L=limit load;

C_5=0.0053;

V_{S_0}=seaplane stalling speed with landing flaps extended in the appropriate position and with no slipstream effect;

W=seaplane design landing weight in pounds;

β_s=angle of dead rise at a station ¾ of the distance from the bow to the step, but need not be less than 15 degrees; and

r_y=ratio of the lateral distance between the center of gravity and the plane of symmetry of the float to the radius of gyration in roll.

(c) *Bow loading*. The resultant limit load must be applied in the plane of symmetry of the float at a point one-fourth of the distance from the bow to the step and must be perpendicular to the tangent to the keel line at that point. The magnitude of the resultant load is that specified in paragraph (b) of this section.

(d) *Unsymmetrical step loading*. The resultant water load consists of a component equal to 0.75 times the load specified in paragraph (a) of this section and a side component equal to 0.25 tan β times the load specified in paragraph (b) of this section. The side load must be applied perpendicularly to the plane of symmetry of the float at a point midway between the keel and the chine.

(e) *Unsymmetrical bow loading*. The resultant water load consists of a component equal to 0.75 times the load specified in paragraph (b) of this section and a side component equal to 0.25 tan β times the load specified in paragraph (c) of this section. The side load must be applied perpendicularly to the plane of symmetry at a point midway between the keel and the chine.

(f) *Immersed float condition*. The resultant load must be applied at the centroid of the cross section of the float at a point one-third of the distance from the bow to the step. The limit load components are as follows:

$$\text{vertical} = \rho g V,$$

$$\text{aft} = C_x \frac{\rho}{2} V^{2/3} (K V_{S_0})^2$$

$$\text{side} = C_y \frac{\rho}{2} V^{2/3} (K V_{S_0})^2$$

where—

ρ=mass density of water;

V=volume of float;

C_x=coefficient of drag force, equal to 0.133;

C_y=coefficient of side force, equal to 0.106;

K=0.8, except that lower values may be used if it is shown that the floats are incapable of submerging at a speed of 0.8 V_{S_0} in normal operations;

V_{S_0}=seaplane stalling speed with landing flaps extended in the appropriate position and with no slipstream effect; and

g=acceleration due to gravity (ft/sec²).

(g) *Float bottom pressures*. The float bottom pressures must be established under § 25.533. The angle of dead rise to be used in determining the float bottom pressures is set forth in paragraph (b) of this section.

§ 25.537 Seawing loads.

Seawing design loads must be based on applicable test data.

EMERGENCY LANDING CONDITIONS

§ 25.561 General.

(a) The airplane, although it may be damaged in emergency landing conditions on land or water, must be designed as prescribed in this section to protect each occupant under those conditions.

(b) The structure must be designed to give each occupant every reasonable chance of escaping serious injury in a minor crash landing when—

(1) Proper use is made of seats, belts, and all other safety design provisions;

(2) The wheels are retracted (where applicable); and

(3) The occupant experiences the following ultimate inertia forces relative to the surrounding structure:

(i) Upward—2.0 *g*.

(ii) Forward—9.0 *g*.

(iii) Sideward—1.5 *g*.

(iv) Downward—4.5 *g*, or any lesser force that will not be exceeded when the airplane absorbs the landing loads resulting from impact with an ultimate descent velocity of five f.p.s. at design landing weight.

(c) The supporting structure must be designed to restrain, under all loads up to those specified in paragraph (b)(3) of this section, each item of mass that could injure an occupant if it came loose in a minor crash landing.

§ 25.563 Structural ditching provisions.

Structural strength considerations of ditching provisions must be in accordance with § 25.801(e).

FATIGUE EVALUATION

§ 25.571 Fatigue evaluation of flight structure.

(a) *Strength, detail design, and fabrication*. Those parts of the structure (including wings, fixed and movable control surfaces, the fuselage, and their related primary attachments), whose failure could result in catastrophic failure of the airplane, must be evaluated under the provisions of either paragraph (b) or (c) of this section.

(b) *Fatigue strength*. The structure must be shown by analysis, tests, or both, to be able to withstand the repeated loads of variable magnitude expected in service. In addition, the following apply:

(1) The evaluation must include—

(i) The typical loading spectrum expected in service;

(ii) Identification of principal structural elements and detail design points, the fatigue failure of which could cause catastrophic failure of the airplane; and

(iii) An analysis or repeated load tests, or a combination of analysis and load tests, of principal structural elements and detail design points identified in subdivision (ii) of this subparagraph.

(2) The service history of airplanes of similar structural design, taking due account of differences in operating conditions and procedures, may be used.

(3) If substantiation of the pressure cabin by fatigue tests is required, the cabin, or representative parts of it, must be cycle-pressure tested, using the normal operating pressure plus the effects of external aerodynamic pressure combined with the flight loads. The effects of flight loads may be represented by an increased cabin pressure or may be omitted if they are shown to have no significant effect upon fatigue.

(c) *Fail safe strength*. It must be shown by analysis, tests, or both, that catastrophic failure or excessive structural deformation, that could adversely affect the flight characteristics of the airplane, are not probable after fatigue failure or obvious partial failure of a single principal structural element. After these types of failure of a single principal structural element, the remaining structure must be able to withstand static loads corresponding to the following:

(1) An ultimate maneuvering load factor of 2.0 at V_C.

(2) Gust loads as specified in §§ 25.341 and 25.351(b) except that these gust loads are considered to be ultimate loads and the gust velocities are—

(i) At speed V_B, 49 fps from sea level to 20,000 feet, thereafter decreasing linearly to 28 fps at 50,000 feet;

(ii) At speed V_C, 33 fps from sea level to 20,000 feet, thereafter decreasing linearly to 16.5 fps at 50,000 feet; and

(iii) At speed V_D, 15 fps from sea level to 20,000 feet, thereafter decreasing linearly to 6 fps at 50,000 feet.

(3) Eighty percent of the limit loads resulting from the conditions specified in § 25.427. These loads are considered to be ultimate loads.

(4) Eighty percent of the limit maneuvering loads resulting from the conditions specified in § 25.351(a), except that the load need not exceed 100 percent of the critical load obtained in compliance with § 25.351(a), using a pilot effort of 180 pounds. This load is an ultimate load.

The loads prescribed in this paragraph must be multiplied by a factor of 1.15 unless the dynamic effects of failure under static load are otherwise considered. For a pressurized cabin, the normal operating pressures combined with the expected external aerodynamic pressures must be applied simultaneously with the flight loading conditions specified in this paragraph.

§ 25.573 Fatigue evaluation of landing gear.

(a) The strength, detail design, and fabrication of those parts of the airplane landing gear and its attachment fittings in which fatigue may be critical, must be evaluated under either the provisions of paragraph (b) or (c) of this section.

(b) The fatigue strength of the landing gear must be evaluated as follows:

(1) The evaluation must include—

(i) The typical loading spectrum expected in service;

(ii) Identification of principal structural elements and detail design points, the fatigue failure of which could cause catastrophic failure of the landing gear; and

(iii) Analysis or repeated load testing of the principal structural elements and detail design points identified in subdivision (ii) of this subparagraph.

(2) Where the evaluation indicates its necessity, inspection or other procedures must be established to prevent catastrophic fatigue failure.

(3) The service history of airplanes of similar structural design, taking due account of differences in operating conditions and procedures, may be used.

(c) The fail-safe strength of the landing gear must be shown as follows:

(1) It must be shown by analysis or tests that catastrophic failure is not probable after fatigue failure, or obvious partial failure, of any single principal structural element.

(2) After these kinds of failure, the remaining structure must be able to withstand static loads corresponding to 80 percent of the limit loads resulting from the conditions prescribed in § 25.473. These static loads are ultimate loads.

Subpart D—Design and Construction

GENERAL

§ 25.601 General.

The airplane may not have design features or details that experience has shown to be hazardous or unreliable. The suitability of each questionable design detail and part must be established by tests.

§ 25.603 Materials.

The suitability and durability of materials used in the structure must—

(a) Be established on the basis of experience or tests; and

(b) Conform to approved specifications (such as industry or military specifications, or Technical Standard Orders) that ensure their having the strength and other properties assumed in the design data.

§ 25.605 Fabrication methods.

The methods of fabrication used must produce a consistently sound structure. If a fabrication process (such as gluing, spot welding, or heat treating) requires close control to reach this objective, the process must be performed under an approved process specification.

§ 25.607 Self-locking nuts.

No self-locking nut may be used on any bolt subject to rotation during airplane operation.

§ 25.609 Protection of structure.

Each part of the structure must—

(a) Be suitably protected against deterioration or loss of strength in service due to any cause, including—

(1) Weathering;

(2) Corrosion; and

(3) Abrasion; and

(b) Have provisions for ventilation and drainage where necessary for protection.

§ 25.611 Inspection provisions.

There must be means to allow close examination of each part requiring recurring inspection, adjustment for proper alignment and function, or lubrication.

§ 25.613 Material strength properties and design values.

(a) Material strength properties must be based on enough tests of material meeting approved specifications to establish design values on a statistical basis.

(b) Design values must be chosen so that the probability of any structure being understrength because of material variations is extremely remote.

(c) The effects of temperature on allowable stresses used for design in an essential component or structure must be considered where thermal effects are significant under normal operating conditions.

(d) The strength, detail design, and fabrication of the structure must minimize the probability of disastrous fatigue failure, particularly at points of stress concentration.

(e) Unless they are shown to be inapplicable in a particular case, the design values must be those contained in the following publications (obtainable from the Superintendent of Documents, Government Printing Office, Washington, D.C., 20402):

MIL-HDBK-5, "Metallic Materials and Elements for Flight Vehicle Structure";
MIL-HDBK-17, "Plastics for Flight Vehicles";
ANC-18, "Design of Wood Aircraft Structures"; and
MIL-HDBK-23, "Composite Construction for Flight Vehicles".

§ 25.615 Design properties.

(a) Design properties outlined in MIL-HDBK-5 may be used subject to the following conditions:

(1) Where applied loads are eventually distributed through a single member within an assembly, the failure of which would result in the loss of the structural integrity of the component involved, the guaranteed minimum design mechanical properties ("A" values) listed in MIL-HDBK-5 must be met.

(2) Redundant structures, in which the failure of individual elements would result in applied loads being safely distributed to other load-carrying members, may be designed on the basis of the "90 percent probability ("B" values)" listed in MIL-HDBK-5.

(b) Design values greater than the guaranteed minimums required by paragraph (a) of this section may be used where only guaranteed minimum values are normally allowed if a "premium selection" of the material is made in which a specimen of each individual item is tested before use to determine that the actual strength properties of that particular item will equal or exceed those used in design.

§ 25.619 Special factors.

The factors of safety prescribed in § 25.303 must be multiplied by the special factors of safety prescribed in §§ 25.621 through 25.625 for each part of the structure whose strength is—

(a) Uncertain;

(b) Likely to deteriorate in service before normal replacement; or

(c) Subject to appreciable variability because of uncertainties in manufacturing processes or inspection methods.

§ 25.621 Casting factors.

(a) *General.* The factors, tests, and inspections specified in paragraphs (b) through (d) of this section must be applied in addition to those necessary to establish foundry quality control. The inspections must meet approved specifications. Paragraphs (c) and (d) of this section apply to any structural castings except castings that are pressure tested as parts of hydraulic or other fluid systems and do not support structural loads.

(b) *Bearing stresses and surfaces.* The casting factors specified in paragraphs (c) and (d) of this section—

(1) Need not exceed 1.25 with respect to bearing stresses regardless of the method of inspection used; and

(2) Need not be used with respect to the bearing surfaces of a part whose bearing factor is larger than the applicable casting factor.

(c) *Critical castings.* For each casting whose failure would preclude continued safe flight and landing of the airplane or result in serious injury to occupants, the following apply:

(1) Each critical casting must—

(i) Have a casting factor of not less than 1.25; and

(ii) Receive 100 percent inspection by visual, radiographic, and magnetic particle or penetrant inspection methods or approved equivalent nondestructive inspection methods.

(2) For each critical casting with a casting factor less than 1.50, three sample castings must be static tested and shown to meet—

(i) The strength requirements of § 25.305 at an ultimate load corresponding to a casting factor of 1.25; and

(ii) The deformation requirements of § 25.305 at a load of 1.15 times the limit load.

(3) Examples of these castings are structural attachment fittings, parts of flight control systems, control surface hinges and balance weight attachments, seat, berth, safety belt, and fuel and oil tank supports and attachments, and cabin pressure valves.

(d) *Noncritical castings.* For each casting other than those specified in paragraph (c) of this section, the following apply:

(1) Except as provided in subparagraphs (2) and (3) of this paragraph, the casting factors and corresponding inspections must meet the following table:

Casting factor	*Inspection*
2.0 or more	100 percent visual.
Less than 2.0 but more than 1.5.	100 percent visual, and magnetic particle or penetrant or equivalent nondestructive inspection methods.
1.25 through 1.50.	100 percent visual, magnetic particle or penetrant, and radiographic, or approved equivalent nondestructive inspection methods.

(2) The percentage of castings inspected by nonvisual methods may be reduced below that specified in subparagraph (1) of this paragraph when an approved quality control procedure is established.

(3) For castings procured to a specification that guarantees the mechanical properties of the material in the casting and provides for demonstration of these properties by test of coupons cut from the castings on a sampling basis—

(i) A casting factor of 1.0 may be used; and

(ii) The castings must be inspected as provided in subparagraph (1) of this paragraph for casting factors of "1.25 through 1.50" and tested under paragraph (c)(2) of this section.

§ 25.623 Bearing factors.

(a) Except as provided in paragraph (b) of this section, each part that has clearance (free fit), and that is subject to pounding or vibration, must have a bearing factor large enough to provide for the effects of normal relative motion.

(b) No bearing factor need be used for a part for which any larger special factor is prescribed.

§ 25.625 Fitting factors.

For each fitting (a part or terminal used to join one structural member to another), the following apply:

(a) For each fitting whose strength is not proven by limit and ultimate load tests in which actual stress conditions are simulated in the fitting and surrounding structures, a fitting factor of at least 1.15 must be applied to each part of—

(1) The fitting;

(2) The means of attachment; and

(3) The bearing on the joined members.

(b) No fitting factor need be used—

(1) For joints made under approved practices and based on comprehensive test data (such as continuous joints in metal plating, welded joints, and scarf joints in wood); or

(2) With respect to any bearing surface for which a larger special factor is used.

(c) For each integral fitting, the part must be treated as a fitting up to the point at which the section properties become typical of the member.

§ 25.629 Flutter, deformation, and fail-safe criteria.

(a) *General.* Compliance with this section must be shown by calculations, resonance tests, or other tests found necessary by the Administrator.

(b) *Flutter and divergence prevention.* The dynamic evaluation of the airplane must include an investigation of the significant elastic, inertia, and aerodynamic forces associated with the rotations and displacements of the plane of the propeller. In addition the following apply:

(1) The airplane must be designed to be free from flutter and divergence (unstable structural distortion due to aerodynamic loading) at speeds up to 1.2 V_D.

(2) A smaller margin above V_D may be used if—

(i) The characteristics of the airplane (including the effects of compressibility) make a speed of 1.2 V_D unlikely to be reached;

(ii) A proper margin of damping exists at V_D; and

(iii) There is no large and rapid reduction in damping as V_D is approached.

(3) If concentrated balance weights are used on control surfaces, their effectiveness and strength, including supporting structure, must be substantiated.

For the purposes of subparagraph (2) of this paragraph, in the absence of more accurate data, the terminal velocity in a dive of 30 degrees to the horizontal may be used as the maximum speed likely to be reached.

(c) *Loss of control due to structural deformation.* The airplane must be designed to be free from control reversal and from undue loss of longitudinal, lateral, and directional stability and control, as a result of structural deformation (including that of the control surface covering) at speeds up to the speed prescribed in paragraph (b) of this section for flutter prevention.

(d) *Fail-safe criteria.* The following fail-safe criteria must be met:

(1) It must be shown, by analysis or tests, that the airplane is free from such flutter or divergence that would preclude safe flight, at any speed up to V_D, after—

(i) Each of the failures, malfunctions, or adverse conditions listed in subparagraph (4) of this paragraph; and

(ii) Any other reasonably probable single failure, malfunction, or adverse condition affecting flutter or divergence.

(2) If a failure, malfunction, or adverse condition described in subparagraph (4) of this paragraph is simulated during a flight test in showing compliance with this paragraph, the maximum speed investigated need not exceed V_{FC} if it is shown, by correlation of the flight test data with other test data or analyses, that hazardous flutter or divergence will not occur at any speed up to V_D.

(3) The structural failures described in subparagraph (4)(i) and (4)(ii) of this paragraph need not be considered in showing compliance with this paragraph if engineering data substantiate that the probability of their occurrence is negligible by showing that the structural element is designed with—

(i) Conservative static strength margins for each ground and flight loading condition specified in this part; or

(ii) Sufficient fatigue strength for the loading spectrum expected in operation.

(4) The failures, malfunctions, or adverse conditions used to show compliance with this paragraph are as follows:

(i) Failure of any single element of the structure supporting any engine, independently mounted propeller shaft, large auxiliary power unit, or large externally mounted aerodynamic body (such as an external fuel tank).

(ii) Any single failure of the engine structure, on turbopropeller airplanes, that would reduce the yaw or pitch rigidity of the propeller rotational axis.

(iii) Absence of propeller aerodynamic forces resulting from the feathering of any single propeller, and, for airplanes with four or more engines, the feathering of the critical combination of two propellers. In addition, any single feathered propeller must be paired with the failures, specified in subdivision (i) of this subparagraph, involving failure of any single element of the structure supporting any engine or independently mounted propeller shaft, and the failures specified in subdivision (ii) of this subparagraph.

(iv) Any single propeller rotating at the highest likely overspeed.

(v) Failure of each principal structural element for which compliance with the alternative provisions of § 25.571(c) is selected. Safety following a failure may be substantiated by showing that possible losses in rigidity or changes in frequency, modal form, or damping, resulting from the failure, are within the general parameter variations covered in the flutter and divergence investigations.

(vi) Failure, malfunction, or disconnection of any single element in the main flight control system (including automatic flight control systems, if installed), in any tab control system, or in any flutter damper connected to a control surface or tab. Investigation of the forced structural vibrations, other than flutter resulting from failures, malfunctions, or adverse conditions in the automatic flight control system, may be limited to airspeeds up to V_C.

CONTROL SURFACES

§ 25.651 Proof of strength.

(a) Limit load tests of control surfaces are required. These tests must include the horn or fitting to which the control system is attached.

(b) Compliance with the special factors requirements of §§ 25.619 through 25.625 and 25.657 for control surface hinges must be shown by analysis or individual load tests.

§ 25.655 Installation.

(a) Movable tail surfaces must be installed so that there is no interference between any surfaces when one is held in its extreme position and the others are operated through their full angular movement.

(b) If an adjustable stabilizer is used, it must have stops that will limit its range of travel to the maximum for which the airplane is shown to meet the trim requirements of § 25.161.

§ 25.657 Hinges.

(a) Control surface hinges, except ball and roller bearing hinges, must have a factor of safety of not less than 6.67 with respect to the ultimate bearing strength of the softest material used as a bearing.

(b) For ball or roller bearing hinges, the approved rating of the bearing may not be exceeded.

(c) Hinges must have enough strength and rigidity for loads parallel to the hinge line.

CONTROL SYSTEMS

§ 25.671 General.

(a) Each control and control system must operate with the ease, smoothness, and positiveness appropriate to its function.

(b) Each element of each flight control system must be designed, or distinctively and permanently marked, to minimize the probability of incorrect assembly that could result in the malfunctioning of the system.

(c) Each tab control system must be designed so that disconnection or failure of any element at speeds up to V_C cannot jeopardize safety.

(d) Each adjustable stabilizer must have means to allow any adjustment necessary for continued safety of the flight after the occurrence of any reasonably probable single failure of the actuating system.

§ 25.673 Two-control airplanes.

Two-control airplanes must be able to continue safely in flight and landing if any one connecting element in the directional-lateral flight control system fails.

§ 25.675 Stops.

(a) Each control system must have stops that positively limit the range of motion of the control surfaces.

(b) Each stop must be located so that wear, slackness, or take-up adjustments will not adversely affect the control characteristics of the airplane because of a change in the range of surface travel.

(c) Each stop must be able to withstand any loads corresponding to the design conditions for the control system.

§ 25.677 Trim systems.

(a) Trim controls must be designed to prevent inadvertent or abrupt operation and to operate in the plane, and with the sense of motion, of the airplane.

(b) There must be means adjacent to the trim control to indicate the direction of the control movement relative to the airplane motion. In addition, there must be clearly visible means to indicate the position of the trim device with respect to the range of adjustment.

(c) Trim devices must be able to continue normal operation if any one connecting or transmitting element of the primary flight control system fails. Trim control systems must be designed to prevent creeping in flight. Trim tab controls must be irreversible unless the tab is appropriately balanced and shown to be free from flutter.

(d) If an irreversible tab control system is used, the part from the tab to the attachment of the irreversible unit to the airplane structure must consist of a rigid connection.

§ 25.679 Control system gust locks.

(a) There must be a device to prevent damage to the control surfaces (including tabs), and to the control system, from gusts striking the airplane while it is on the ground or water. If the device, when engaged, prevents normal operation of the control surfaces by the pilot, it must—

(1) Automatically disengage when the pilot operates the primary flight controls in a normal manner; or

(2) Limit the operation of the airplane so that the pilot receives unmistakable warning at the start of takeoff.

(b) The device must have means to preclude the possibility of it becoming inadvertently engaged in flight.

§ 25.681 Limit load static tests.

(a) Compliance with the limit load requirements of this Part must be shown by tests in which—

(1) The direction of the test loads produces the most severe loading in the control system; and

(2) Each fitting, pulley, and bracket used in attaching the system to the main structure is included.

(b) Compliance must be shown (by analyses or individual load tests) with the special factor requirements for control system joints subject to angular motion.

§ 25.683 Operation tests.

It must be shown by operation tests that, when the controls are operated from the pilot compartment with the system loaded to correspond to 80 percent of the limit load specified for the system, the system is free from—

(a) Jamming;

(b) Excessive friction; and

(c) Excessive deflection.

§ 25.685 Control system details.

(a) Each detail of each control system must be designed and installed to prevent jamming, chafing, and interference from cargo, passengers, or loose objects.

(b) There must be means in the cockpit to prevent the entry of foreign objects into places where they would jam the system.

(c) There must be means to prevent the slapping of cables or tubes against other parts.

(d) Sections 25.689 and 25.693 apply to cable systems and joints.

§ 25.689 Cable systems.

(a) Each cable, cable fitting, turnbuckle, splice, and pulley must be approved. In addition—

(1) No cable smaller than ⅛ inch in diameter may be used in the aileron, elevator, or rudder systems; and

(2) Each cable system must be designed so that there will be no hazardous change in cable tension throughout the

range of travel under operating conditions and temperature variations.

(b) Each kind and size of pulley must correspond to the cable with which it is used. Pulleys and sprockets must have closely fitted guards to prevent the cables and chains from being displaced or fouled. Each pulley must lie in the plane passing through the cable so that the cable does not rub against the pulley flange.

(c) Fairleads must be installed so that they do not cause a change in cable direction of more than three degrees.

(d) Clevis pins subject to load or motion and retained only by cotter pins may not be used in the control system.

(e) Turnbuckles must be attached to parts having angular motion in a manner that will positively prevent binding throughout the range of travel.

(f) There must be provisions for visual inspection of fairleads, pulleys, terminals, and turnbuckles.

§ 25.693 Joints.

Control system joints (in push-pull systems) that are subject to angular motion, except those in ball and roller bearing systems must have a special factor of safety of not less than 3.33 with respect to the ultimate bearing strength of the softest material used as a bearing. This factor may be reduced to 2.0 for joints in cable control systems. For ball or roller bearings, the approved ratings, including those established in MIL-HDBK-5 "Metallic Materials and Elements for Flight Vehicle Structure", may not be exceeded.

§ 25.695 Power-boost and power-operated control system.

(a) If a power-boost or power-operated control system is used, an alternate system must be immediately available to allow continued safe flight and landing in the event of a single failure in the power portion.

(b) Each alternate system may be a duplicate power portion or a manually operated mechanical system. The power portion includes the power source, such as hydraulic pumps, and such items as valves, lines, and actuators.

(c) The failure of mechanical parts (such as piston rods and links) and the jamming of power cylinders must be considered unless they are extremely remote.

(d) Both the primary and alternate systems must be operable if any engine fails. For airplanes with more than two engines, at least one system must be operable if any two engines fail. It must be shown by analysis that the airplane is controllable if all engines fail.

§ 25.697 Wing flap controls.

(a) Each wing flap control must be designed so that the flight crew can place the flaps in any takeoff, en route, approach, and landing position established under § 25.47. The flaps must maintain these positions, except for flap movement produced by an automatic flap positioning or load limiting device, without further attention by the flight crew.

(b) The wing flap control must be designed and located to make inadvertent operation improbable.

(c) The rate of motion of the flaps in response to the operation of the control and the characteristics of the automatic flap positioning or load limiting device must give satisfactory flight and performance characteristics under steady or changing conditions of airspeed, engine power, and airplane attitude.

(d) The wing flap control must be designed to retract the flaps from the fully extended position, during steady flight at maximum continuous engine power, at any speed below $V_F+8.5$ (knots).

§ 25.699 Wing flap position indicator.

(a) There must be means to indicate the takeoff, en route, approach, and landing flap positions.

(b) If any extension of the flaps beyond the landing position is possible, the flap control must be clearly marked to identify this range of extension.

§ 25.701 Flap interconnection.

(a) The motion of flaps on opposite sides of the plane of symmetry must be synchronized by a mechanical interconnection unless the airplane has safe flight characteristics with the flaps retracted on one side and extended on the other.

(b) If a mechanical interconnection is used, there must be means to prevent hazardous unsymmetrical operation of the wing flaps after any reasonably possible single failure of the flap actuating system.

(c) If a wing flap interconnection is used, it must be designed to account for the applicable unsymmetrical loads, including those resulting from flight with the engines on one side of the plane of symmetry inoperative and the remaining engines at takeoff power.

(d) For airplanes with flaps that are not subjected to slipstream conditions, the structure must be designed for the loads imposed when the wing flaps on one side are carrying the most severe load occurring in the prescribed symmetrical conditions and those on the other side are carrying not more than 80 percent of that load.

Landing Gear

§ 25.721 General.

(a) The landing gear must meet the requirements of this section and §§ 25.723 through 25.737.

(b) The shock absorbing elements for the main, nose, and tail wheel units must be substantiated by the tests specified in §§ 25.723 through 25.727. The shock absorbing ability of the landing gear in taxiing must be shown by the tests prescribed in § 25.235.

(c) The landing gear must withstand the tests prescribed in §§ 25.723 through 25.727.

§ 25.723 Shock absorption tests.

(a) It must be shown by energy absorption tests that the limit load factors selected for design in accordance with § 25.471(c) for takeoff and landing weights, respectively, will not be exceeded.

(b) The landing gear may not fail in a test, demonstrating its reserve energy absorption capacity, simulating a descent velocity of 12 f.p.s. at design landing weight, assuming wing lift not greater than the airplane weight acting during the landing impact.

§ 25.725 Limit drop tests.

(a) If compliance with § 25.723(a) is shown by free drop tests, these tests must be made on the complete airplane, or on units consisting of a wheel, tire, and shock absorber, in their proper positions, from free drop heights not less than—

(1) 18.7 inches for the design landing weight conditions; and

(2) 6.7 inches for the design takeoff weight conditions.

(b) If wing lift is simulated in free drop tests, the landing gear must be dropped with an effective weight equal to

$$W_e=W\left(\frac{h+(1-L)d}{h+d}\right)$$

where—

W_e=the effective weight to be used in the drop test (lbs.);

h=specified free drop height (inches);

d=deflection under impact of the tire (at the approved inflation pressure) plus the vertical component of the axle travel relative to the drop mass (inches);

$W=W_M$ for main gear units (lbs.), equal to the static weight on that unit with the airplane in the level attitude (with the nose wheel clear in the case of nose wheel type airplanes);

$W=W_T$ for tail gear units (lbs.), equal to the static weight on the tail unit with the airplane in the tail-down attitude;

$W=W_N$ for nose wheel units (lbs.), equal to the vertical component of the static reaction that would exist at the nose wheel, assuming that the mass of the airplane acts at the center of gravity and exerts a force of $1.0g$ downward and $0.25g$ forward; and

L=the ratio of the assumed wing lift to the airplane weight, but not more than 1.0.

(c) The attitude in which a landing gear unit is drop tested must simulate the critical airplane landing conditions for the unit.

(d) The value of d used in the computation of W_e in paragraph (b) of this section may not exceed the value actually obtained in the drop test.

(e) The limit inertia load factor n must be determined from the free drop test in paragraph (b) of this section according to the following formula:

$$n=n_j\frac{W_e}{W}+L$$

where—

n_j=the load factor developed in the drop test (that is, the acceleration dv/dt in g's recorded in the drop test) plus 1.0; and

W_e, W, and L are the same as in the drop test computation.

(f) The value of n determined in paragraph (e) of this section may not be more than the limit inertia load factor used in the landing conditions in § 25.473.

§ 25.727 Reserve energy absorption drop tests.

(a) If compliance with the reserve energy absorption condition specified in § 25.723(b) is shown by free drop tests, the drop height may not be less than 27 inches.

(b) If wing lift equal to the airplane weight is simulated, the units must be dropped with an effective mass equal to $W_e=W\left(\frac{h}{h+d}\right)$ where the symbols and other details are the same as in § 25.725(b).

§ 25.729 Retracting mechanism.

(a) *General.* For airplanes with retractable landing gear, the following apply:

(1) The landing gear retracting mechanism, wheel well doors, and supporting structure, must be designed for—

(i) The loads occurring in the flight conditions when the gear is in the retracted position;

(ii) The combination of friction, inertia, brake torque, and air loads, occurring during retraction and extension at any airspeed up to 1.6 V_{S_1} (with the flaps in the approach position at design landing weight); and

(iii) Any load factor up to those specified in § 25.345 for the flaps extended condition.

(2) Unless there are other means to decelerate the airplane in flight at this speed, the landing gear, the retracting mechanism, and the airplane structure (including wheel well doors) must be designed to withstand the flight loads occurring with the landing gear in the extended position at any speed up to 0.67 V_C.

(3) Landing gear doors, their operating mechanism, and their supporting structures must be designed for the yawing maneuvers prescribed for the airplane in addition to the conditions of airspeed and load factor prescribed in subparagraphs (1) and (2) of this paragraph.

(b) *Landing gear lock.* There must be positive means to keep the landing gear extended, in flight and on the ground.

(c) *Emergency operation.* There must be an emergency means for extending the landing gear in the event of—

(1) Any reasonably probable failure in the normal retraction system; or

(2) The failure of any single source of hydraulic, electric, or equivalent energy supply.

(d) *Operation test.* The proper functioning of the retracting mechanism must be shown by operation tests.

(e) *Position indicator and warning device.* If a retractable landing gear is used, there must be a landing gear position indicator (as well as necessary switches to actuate the indicator) or other means to inform the pilot that the gear is secured in the extended (or retracted) position. This means must be designed as follows:

(1) If switches are used, they must be located and coupled to the landing gear mechanical systems in a manner that prevents an erroneous indication of "down and locked" if the landing gear is not in a fully extended position, or of "up and locked" if the landing gear is not in the fully retracted position. The switches may be located where they are operated by the actual landing gear locking latch or device.

(2) Landplanes must have an aural warning device that will function continuously when one or more throttles are closed, if the landing gear is not fully extended and locked.

(3) If there is a manual shutoff for the warning device prescribed in subparagraph (2) of this paragraph, it must be installed so that reopening the throttles will reset the warning mechanism.

(4) Landplanes must have an aural warning device that will function continuously, when the wing flaps are extended beyond the maximum approach position determined under § 25.67(e), if the gear is not fully extended and locked. There may not be a manual shutoff for this warning device. The flap position sensing unit may be installed at any suitable location. The system for this device may use any part of the system (including the aural warning device) for the device required in subparagraph (2) of this paragraph.

(f) *Protection of equipment in wheel wells.* Equipment that is essential to safe operation of the airplane and that is located in wheel wells must be protected from the damaging effects of—

(1) A bursting tire, unless it is shown that a tire cannot burst from overheat; and

(2) A loose tire tread, unless it is shown that a loose tire tread cannot cause damage.

§ 25.731 Wheels.

(a) Each main and nose wheel must be approved.

(b) The maximum static load rating of each wheel may not be less than the corresponding static ground reaction with—

(1) Design takeoff weight; and

(2) Critical center of gravity.

(c) The maximum limit load rating of each wheel must equal or exceed the maximum radial limit load determined under the applicable ground load requirements of this part.

§ 25.733 Tires.

(a) Each landing gear wheel must have a tire—

(1) That is a proper fit on the rim of the wheel; and

(2) Whose load rating is not exceeded under—

(i) Equal static loads, corresponding to the most critical combination of maximum takeoff weight and center of gravity position, on each main wheel tire; and

(ii) Equal loads corresponding to the ground reactions in paragraph (b) of this section, on each nose wheel tire.

(b) The applicable ground reactions are as follows:

(1) The static ground reaction for the tire with the most critical combination of takeoff weight and center of gravity position. This load may not exceed the static rating of the tire.

(2) The dynamic ground reaction for the tire at maximum landing weight, assuming that the mass of the airplane is concentrated at the most critical location of the center of gravity for this weight and is exerting a force of 1.0g downward and 0.31g forward with the reactions being distributed to the nose and main wheels by the principles of statics and with a 0.31g drag reaction at the ground applied at each wheel with brakes. This load may not exceed the dynamic rating of the tire.

(3) The dynamic ground reaction for the tire at design takeoff weight, assuming that the mass of the airplane is concentrated at the most critical location of the center of gravity for this weight and is exerting a force of 1.0g downward and 0.20g forward. The reactions in this case must be distributed to the nose and main wheels by the principles of statics and a 0.20g drag reaction at the ground is applied at each wheel with brakes. This load may not exceed the dynamic rating of the tire.

§ 25.735 Brakes.

(a) Each brake must be approved.

(b) The brake system must be designed and constructed so that, if any connecting or transmitting element (excluding the operating pedal or handle) fails, or if any single source of hydraulic or other brake operating energy supply is lost, it is possible to bring the airplane to rest under conditions specified in § 25.75, with a mean deceleration during the landing roll of at least 50 percent of that obtained in determining the landing distance as prescribed in that section. Unless the leakage of hydraulic fluid resulting from failure of the sealing elements in hydraulic brakes, the brake drum, shoes, and actuators, (or their equivalents) does not reduce the braking effectiveness below that required by this paragraph, these units are considered to be connecting or transmitting elements.

(c) Brake controls may not require excessive control force in their operation.

(d) The airplane must have a parking control that, when set by the pilot, will without further attention, prevent the airplane from rolling on a paved, level runway with takeoff power on the critical engine.

(e) If antiskid devices are installed, the devices and associated systems must be designed so that no single probable malfunction will result in a hazardous loss of braking ability or directional control of the airplane. Antiskid devices meeting the airworthiness portions of Military Specification MIL–B–8075 (ASG) and any amendments thereto, are acceptable.

(f) The brake kinetic energy capacity rating of each main wheel-brake assembly may not be less than the kinetic energy absorption requirements determined under either of the following methods:

(1) The brake kinetic energy absorption requirements must be based on a

rational analysis of the sequence of events expected during operational landings at maximum landing weight. This analysis must include conservative values of airplane speed at which the brakes are applied, braking coefficient of friction between tires and runway, aerodynamic drag, propeller drag or powerplant forward thrust, and (if more critical) the most adverse single engine or propeller malfunction.

(2) Instead of a rational analysis, the kinetic energy absorption requirements for each main wheel brake assembly may be derived from the following formula, which assumes an equal distribution of braking between main wheels:

$$KE = \frac{0.0444\, W V_{S_0}^2}{N}$$

where—

KE = kinetic energy per wheel (ft. lb.);
W = design landing weight (lb.);
V_{S_0} = power-off stalling speed of the airplane at sea level, at the design landing weight, and in the landing configuration; and
N = number of main wheels.

The formula must be modified in cases of unequal braking distribution.

(g) The minimum stalling speed rating of each main wheel-brake assembly (that is, the initial speed used in the dynamometer tests) may not be more than the V_{S_0} used in the determination of kinetic energy in accordance with paragraph (f) of this section, assuming that the test procedures for wheel-brake assemblies involve a specified rate of deceleration, and, therefore, for the same amount of kinetic energy, the rate of energy absorption (the power absorbing ability of the brake) varies inversely with the initial speed.

§ 25.737 Skis.

Each ski must be approved. The maximum limit load rating of each ski must equal or exceed the maximum limit load determined under the applicable ground load requirements of this Part.

FLOATS AND HULLS

§ 25.751 Main float buoyancy.

Each main float must have—

(a) A buoyancy of 80 percent in excess of that required to support the maximum weight of the seaplane or amphibian in fresh water; and

(b) Not less than five watertight compartments approximately equal in volume.

§ 25.753 Main float design.

Each main float must be approved and must meet the requirements of § 25.521.

§ 25.755 Hulls.

(a) Each hull must have enough watertight compartments so that, with any two adjacent compartments flooded, the buoyancy of the hull and auxiliary floats (and wheel tires, if used) provides a margin of positive stability great enough to minimize the probability of capsizing in rough, fresh water.

(b) Bulkheads with watertight doors may be used for communication between compartments.

PERSONNEL AND CARGO ACCOMMODATIONS

§ 25.771 Pilot compartment.

(a) Each pilot compartment and its equipment must allow the minimum flight crew (established under § 25.1523) to perform their duties without unreasonable concentration fatigue.

(b) The primary controls listed in § 25.779(a), excluding cables and control rods, must be located with respect to the propellers so that no member of the minimum flight crew (established under § 25.1523), or part of the controls, lies in the region between the plane of rotation of any inboard propeller and the surface generated by a line passing through the center of the propeller hub making an angle of five degrees forward or aft of the plane of rotation of the propeller.

(c) If provision is made for a second pilot, the airplane must be controllable with equal safety from either pilot seat.

(d) The pilot compartment must be constructed so that, when flying in rain or snow, it will not leak in a manner that will distract the crew or harm the structure.

(e) The airplane must have a door, between the passenger and pilot compartments, that has a locking means to prevent passengers from opening it without the pilot's permission.

(f) Vibration and noise characteristics of cockpit equipment may not interfere with safe operation of the airplane.

§ 25.773 Pilot compartment view.

(a) *Nonprecipitation conditions.* For nonprecipitation conditions, the following apply:

(1) Each pilot compartment must be arranged to give the pilots a sufficiently extensive, clear, and undistorted view, to enable them to safely perform any maneuvers within the operating limitations of the airplane, including taxiing, takeoff, approach, and landing.

(2) Each pilot compartment must be free of glare and reflection that could interfere with the normal duties of the minimum flight crew (established under § 25.1523). This must be shown in day and night flight tests under nonprecipitation conditions.

(b) *Precipitation conditions.* For precipitation conditions, the following apply:

(1) The airplane must have a means to maintain a clear portion of the windshield, during precipitation conditions, sufficient for both pilots to have a sufficiently extensive view along the flight path in normal flight attitudes of the airplane. This means must be designed to function, without continuous attention on the part of the crew, in—

(i) Heavy rain at speeds up to 1.6 V_{S_1}, with flaps retracted; and

(ii) The icing conditions specified in § 25.1419 if certification with ice protection provisions is requested.

(2) The first pilot must have a window that—

(i) When the cabin is not pressurized, is openable under the conditions prescribed in subparagraph (1) of this paragraph and provides the view specified in that paragraph; and

(ii) Gives sufficient protection from the elements against impairment of the pilot's vision.

§ 25.775 Windshields and windows.

(a) Nonsplintering safety glass must be used in internal glass panes.

(b) Windshield panes directly in front of the pilots in the normal conduct of their duties, and the supporting structures for these panes, must withstand, without penetration, the impact of a four-pound bird when the velocity of the airplane (relative to the bird along the airplane's flight path) is equal to the value of V_C, at sea level, selected under § 25.335(a).

(c) Unless it can be shown by analysis or tests that the probability of occurrence of a critical windshield fragmentation condition is of a low order, the airplane must have a means to minimize the danger to the pilots from flying windshield fragments due to bird impact. This must be shown for each transparent pane in the cockpit that—

(1) Appears in the front view of the airplane;

(2) Is inclined 15 degrees or more to the longitudinal axis of the airplane; and

(3) Has any part of the pane located where its fragmentation will constitute a hazard to the pilots.

(d) The design of windshields and windows in pressurized airplanes must be based on factors peculiar to high altitude operation, including the effects of continuous and cyclic pressurization loadings, the inherent characteristics of the material used, and the effects of temperatures and temperature differentials. The windshield and window panels must be strong enough to withstand the maximum cabin pressure differential loads combined with critical aerodynamic pressure and temperature effects, after failure of any load-carrying element of the windshield or window. It may be assumed that, after a single failure that is obvious to the flight crew (established under § 25.1523), the cabin pressure differential is reduced from the maximum, in accordance with appropriate operating limitations, to allow continued safe flight of the airplane with a cabin pressure altitude of not more than 15,000 feet.

§ 25.777 Cockpit controls.

(a) Each cockpit control must be located to provide convenient operation and to prevent confusion and inadvertent operation.

(b) The direction of movement of cockpit controls must meet the requirements of § 25.779. Wherever practicable, the sense of motion involved in the operation of other controls must correspond to the sense of the effect of the operation upon the airplane or upon the part operated. Controls of a variable nature using a rotary motion must move clockwise from the off position, through an increasing range, to the full on position.

(c) The controls must be located and arranged, with respect to the pilots' seats, so that there is full and unrestricted movement of each control without interference from the cockpit structure or the clothing of the minimum flight crew (established under § 25.1523) when any member of this flight crew, from 5′2″ to 6′0″ in height, is seated with the seat belt fastened.

(d) Identical powerplant controls for each engine must be located to prevent confusion as to the engines they control.

(e) Wing flap controls and other auxiliary lift device controls must be located on top of the pedestal, aft of the throttles, centrally or to the right of the pedestal centerline, and not less than 10 inches aft of the landing gear control.

(f) The landing gear control must be located forward of the throttles and must be operable by each pilot when seated with seat belts fastened.

(g) Control knobs must be shaped in accordance with § 25.781. In addition, the knobs must be of the same color, and this color must contrast with the color of control knobs for other purposes and the surrounding cockpit.

(h) If a flight engineer is required as part of the minimum flight crew (established under § 25.1523), the airplane must have a flight engineer station located and arranged so that the flight crewmembers can perform their functions efficiently and without interfering with each other.

§ 25.779 Motion and effect of cockpit controls.

Cockpit controls must be designed so that they operate in accordance with the following movement and actuation:

(a) Aerodynamic controls:

(1) *Primary.*

Controls	*Motion and effect*
Aileron	Right (clockwise) for right wing down.
Elevator	Rearward for nose up.
Rudder	Right pedal forward for nose right.

(2) *Secondary.*

Controls	*Motion and effect*
Flaps (or auxiliary lift devices).	Forward for flaps up; rearward for flaps down.
Trim tabs (or equivalent).	Rotate to produce similar rotation of the airplane about an axis parallel to the axis of the control.

(b) Powerplant and auxiliary controls:

(1) *Powerplant.*

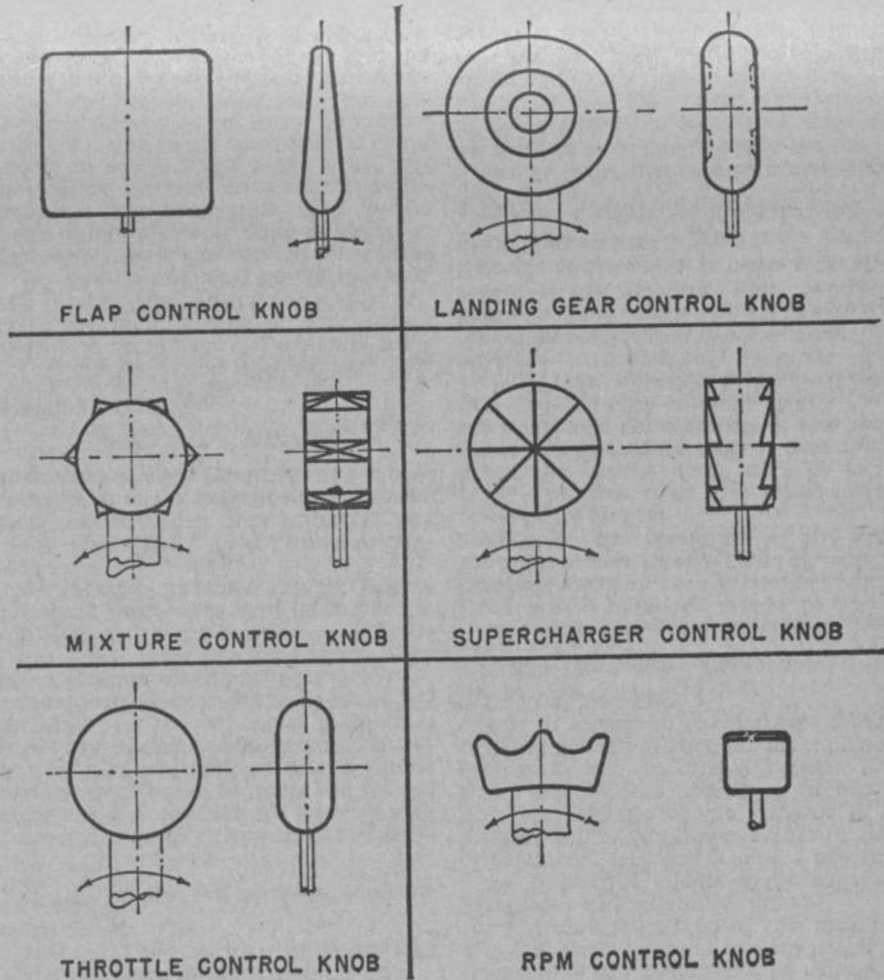
Controls	*Motion and effect*
Throttles	Forward to increase forward thrust and rearward to increase rearward thrust.
Propellers	Forward to increase rpm.
Mixture	Forward or upward for rich.
Carburetor air heat.	Forward or upward for cold.
Supercharger.	Forward or upward for low blower. For turbosuperchargers, forward, upward, or clockwise, to increase pressure.

(2) *Auxiliary.*

Controls	*Motion and effect*
Landing gear	Down to extend.

§ 25.781 Cockpit control knob shape.

Cockpit control knobs must conform to the general shapes (but not necessarily the exact sizes or specific proportions) in the following figure:



§ 25.783 Doors.

(a) Each cabin must have at least one easily accessible external door.

(b) There must be a means to lock and safeguard each external door against opening in flight (either inadvertently by persons or as a result of mechanical failure). Each external door must be openable from both the inside and the outside, even though persons may be crowded against the door on the inside of the airplane. Inward opening doors may be used if there are means to prevent occupants from crowding against the door to an extent that would interfere with the opening of the door. The means of opening must be simple and obvious and must be arranged and marked so that it can be readily located and operated, even in darkness. Auxiliary locking devices may be used.

(c) Each external door must be reasonably free from jamming as a result of fuselage deformation in a minor crash.

(d) Each external door must be located where persons using them will not be endangered by the propellers when appropriate operating procedures are used.

(e) There must be a provision for direct visual inspection of the locking mechanism by crewmembers to determine whether external doors, for which the initial opening movement is outward (including passenger, crew, service, and cargo doors), are fully locked. In addition, there must be a visual means to signal to appropriate crewmembers when normally used external doors are closed and fully locked.

(f) Cargo and service doors not suitable for use as an exit in an emergency need only meet paragraph (e) of this section and be safeguarded against opening in flight as a result of mechanical failure.

§ 25.785 Seats, berths, safety belts, and harnesses.

(a) Each seat, berth, safety belt, harness, and adjacent part of the airplane at each station designated as occupiable during takeoff and landing must be designed so that a person making proper use of these facilities will not suffer serious injury in an emergency landing as a result of the inertia forces specified in § 25.561.

(b) Each seat and berth must be approved.

(c) Each occupant must be protected from head injury by—

(1) A safety belt and shoulder harness that will prevent the head from contacting any injurious object;

(2) A safety belt plus the elimination of any injurious object within striking radius of the head; or

(3) A safety belt plus a cushioned rest that will support the arms, shoulders, head, and spine.

(d) If the seat backs do not have a firm hand hold, there must be a hand grip or rail along each aisle to enable occupants to steady themselves while using the aisles in moderately rough air.

(e) Each projecting object that would injure persons seated or moving about the airplane in normal flight must be padded.

(f) Each berth must be designed so that the forward part has a padded end board, canvas diaphragm, or equivalent means, that can withstand the static load reaction of the occupant when subjected to the forward inertia force specified in § 25.561. Berths must be free from corners and protuberances likely to cause serious injury to a person occupying the berth during emergency conditions.

(g) Each crewmember seat at flight deck stations must have provisions for a shoulder harness. These seats must meet the strength requirements of paragraph (i) of this section.

(h) Cabin attendant seats must be in the passenger compartment near approved floor level emergency exits.

(i) Each seat berth, and its supporting structure, must be designed for an occupant weight of 170 pounds, considering the maximum load factors, inertia forces, and reactions between the occupant, seat, and safety belt or harness, at each relevant flight and ground load condition (including the emergency landing conditions prescribed in § 25.561). For berths, the forward inertia force must be considered in accordance with paragraph (f) of this section and need not be considered with respect to the safety belt. In addition—

(1) The structural analysis and testing of the seats, berths, and their supporting structures may be determined by—

(i) Assuming that the critical load in the forward, sideward, downward, and rearward directions (as determined from the prescribed flight, ground, and emergency landing conditions) acts separately; and

(ii) Using selected combinations of loads if the required strength in each specified direction is substantiated;

(2) Each pilot seat must be designed for the reactions resulting from the application of the pilot forces prescribed in § 25.395; and

(3) The inertia forces specified in § 25.561 must be multiplied by a factor of 1.33 (instead of the fitting factor prescribed in § 25.625) in determining the strength of the attachment of—

(i) Each seat to the structure; and

(ii) Each belt or harness to the seat or structure.

§ 25.787 Cargo and baggage compartments.

(a) Each cargo and baggage compartment must be designed for its placarded maximum weight of contents and for the critical load distributions at the appropriate maximum load factors corresponding to the specified flight and ground load conditions, except the emergency landing conditions of § 25.561.

(b) There must be a means to prevent the contents in the compartments from becoming a hazard by shifting, under the loads specified in paragraph (a) of this section.

(c) There must be a means to protect the occupants from injury by the contents of any compartment, under the emergency landing conditions of § 25.561.

EMERGENCY PROVISIONS

§ 25.801 Ditching.

(a) If certification with ditching provisions is requested, the airplane must meet the requirements of this section and §§ 25.807(d), 25.1411, and 25.1415(a).

(b) Each practicable design measure, compatible with the general characteristics of the airplane, must be taken to minimize the probability that in an emergency landing on water, the behavior of the airplane would cause immediate injury to the occupants or would make it impossible for them to escape.

(c) The probable behavior of the airplane in a water landing must be investigated by model tests or by comparison with airplanes of similar configuration for which the ditching characteristics are known. Scoops, flaps, projections, and any other factor likely to affect the hydrodynamic characteristics of the airplane, must be considered.

(d) It must be shown that, under reasonably probable water conditions, the flotation time and trim of the airplane will allow the occupants to leave the airplane and enter the liferafts required by § 25.1415. If compliance with this provision is shown by buoyancy and trim computations, appropriate allowances must be made for probable structural damage and leakage. If the airplane has fuel tanks (with fuel jettisoning provisions) that can reasonably be expected to withstand a ditching without leakage, the jettisonable volume of fuel may be considered as buoyancy volume.

(e) Unless the effects of the collapse of external doors and windows are accounted for in the investigation of the probable behavior of the airplane in a water landing (as prescribed in paragraphs (c) and (d) of this section), the external doors and windows must be designed to withstand the probable maximum local pressures.

§ 25.803 Emergency evacuation.

(a) Each crew and passenger area must have emergency means to allow rapid evacuation in crash landings, with the landing gear extended and retracted, considering the possibility of the airplane being on fire.

(b) The passenger and crew access doors and service doors may be considered as emergency exits if they meet the applicable requirements of this section and §§ 25.805 through 25.813.

(c) If the airplane is divided into separate compartments without the minimum unobstructed passageway between compartments required by § 25.813, this section and §§ 25.805 through 25.815 apply to each compartment independently.

§ 25.805 Flight crew emergency exits.

Except for airplanes with a passenger capacity of 20 or less in which the proximity of passenger emergency exits to the flight crew area offers a convenient and readily accessible means of evacuation for the flight crew, the following apply:

(a) There must be either one exit on each side of the airplane or a top hatch, in the flight crew area.

(b) Each exit must be of sufficient size and must be located so as to allow rapid evacuation of the crew. An exit size and shape of other than at least 19 by 20 inches unobstructed rectangular opening may be used only if exit utility is satisfactorily shown, by a typical flight crewmember, to the Administrator.

§ 25.807 Passenger emergency exits.

(a) *Type and location.* For the purpose of this part, the types and locations of exits are as follows:

(1) *Type I:* This type must have a rectangular opening of not less than 24 inches wide by 48 inches high, with corner radii not greater than ⅓ the width of the exit. The first Type I exit on each side of the fuselage must be in the rearward part of the passenger compartment unless another location affords a more effective means of passenger evacuation. Type I exits must be floor level exits.

(2) *Type II:* This type must have a rectangular opening of not less than 20 inches wide by 44 inches high, with corner radii not greater than ⅓ the width of the exit. Unless Type I exits are required, one Type II exit on each side of the fuselage must be in the rearward part of the passenger compartment unless another location affords a more effective means of passenger evacuation. Type II exits must be floor level exits unless located over the wing, in which case they may not have a step-up inside the airplane of more than 10 inches nor a step-down outside the airplane of more than 17 inches.

(3) *Type III:* This type must have a rectangular opening of not less than 20 inches wide by 36 inches high, with corner radii not greater than ⅓ the width of the exit, located over the wing, with a step-up inside the airplane of not more than 20 inches and a step-down outside the airplane of not more than 27 inches.

(4) *Type IV:* This type must have a rectangular opening of not less than 19 inches wide by 26 inches high, with corner radii not greater than ⅓ the width of the exit, located over the wing, with a step-up inside the airplane of not more than 29 inches and a step-down outside the airplane of not more than 36 inches.

Step-down distance as used in this section means the actual distance between the bottom of the required opening and a usable foothold, extending out from the fuselage, that is large enough to be effective without searching by sight or feel.

(b) *Accessibility.* Each required passenger emergency exit must be accessible to the passengers and located where it will afford the most effective means of passenger evacuation. Openings larger than those specified in this section, whether or not of rectangular shape, may be used if—

(1) The specified rectangular opening can be inscribed within the opening; and

(2) The base of the inscribed rectangular opening meets the specified step-up and step-down heights.

(c) *Passenger emergency exits; side-of-fuselage.* The exits prescribed in this paragraph need not be diametrically opposite each other, but must be provided as follows:

(1) Except as provided in subparagraphs (2) through (5) of this paragraph, the number and type of passenger emergency exits must be in accordance with the following table:

Passenger seating capacity	Emergency exits for each side of the fuselage			
	Type I	Type II	Type III	Type IV
1 through 10	-------	-------	-------	1
11 through 19	-------	-------	1	-------
20 through 39	-------	1	-------	1
40 through 59	1	-------	-------	1
60 through 79	1	-------	1	-------
80 through 109	1	-------	1	1
110 through 139	2	-------	1	-------
140 through 179	2	-------	2	-------
180 through 219	2	2	-------	-------

(2) Two Type IV exits may be installed instead of each required Type III exit.

(3) Additional exits, providing an effective means of passenger evacuation consistent with the minimum number prescribed in subparagraph (1) of this paragraph, are required for airplanes with a passenger capacity of 220 or more.

(4) If, there are additional emergency evacuation means on the airplane, the passenger/emergency exit relationship may be increased by not more than 10 passengers beyond the limits specified in subparagraph (1) of this paragraph. If this means is an approved inflatable slide installed at each floor level exit (other than over-the-wing exits), the passenger/emergency exit relationship may be increased by—

(i) Not more than five passengers on airplanes with at least two of these exits; and

(ii) Not more than 10 passengers on airplanes with at least four of these exits.

(5) For airplanes on which the vertical location of the wing does not allow the installation of over-the-wing exits, an exit of at least the dimensions of a Type III must be installed instead of each Type III and each Type IV exit required by subparagraph (1) of this paragraph.

(d) *Ditching emergency exits.* In addition to the requirements of paragraph (c) of this section, the following apply:

(1) There must be at least one emergency exit for each unit (or part of a unit) of 35 passengers, but no less than two such exits, both above the waterline with one on each side of the airplane, meeting the minimum dimensions of—

(i) A Type IV exit for airplanes with a passenger seating capacity of 10 or less; and

(ii) A Type III exit for airplanes with a passenger seating capacity of 11 or more.

(2) If side exits cannot be above the waterline, the side exits must be replaced by an equal number of overhead hatches of not less than the dimensions of a Type III exit except that, for airplanes with a passenger capacity of 35 or less, the two required Type III side exits need be replaced by only one overhead hatch.

(3) Two Type IV exits may be installed instead of each required Type III exit.

§ 25.809 Emergency exit arrangement.

(a) Each emergency exit, including a flight crew emergency exit, must be a movable door or hatch in the external walls of the fuselage, allowing unobstructed opening to the outside.

(b) Each emergency exit must be openable from the inside and the outside except that sliding window emergency exits in the flight crew area need not be openable from the outside if other approved exits are convenient and readily accessible to the flight crew area.

(c) The means of opening emergency exists must be simple and obvious and may not require exceptional effort. Internal exit-opening means involving sequence operations (such as operation of two handles or latches or the release of safety catches) may be used for flight crew emergency exits if it can be reasonably established that these means are simple and obvious to crewmembers trained in their use.

(d) There must be a means to lock each emergency exit and to safeguard against its opening in flight, either inadvertently by persons or as a result of mechanical failure. In addition, there must be a means for direct visual inspection of the locking mechanism by crewmembers to determine that each emergency exit, for which the initial opening movement is outward, is fully locked.

(e) There must be provisions to minimize the probability of jamming of the emergency exits resulting from fuselage deformation in a minor crash landing.

(f) Each landplane emergency exit (other than exits located over the wing) more than six feet from the ground with the airplane on the ground and the landing gear extended, must have an approved means to assist the occupants in descending to the ground. In addition—

(1) The assist device for crew exits may be a rope or any other device demonstrated to be suitable for the purpose;

(2) The assist device for passenger exits may be an inflatable slide, a non-inflatable slide, or other approved device; and

(3) Ropes and ladders may not be used at passenger floor level exits.

(g) The proper functioning of each emergency exit must be shown by tests.

§ 25.811 Emergency exit marking.

(a) Each passenger emergency exit, its means of access, and its means of opening must be conspicuously marked.

(b) The identity and location of each emergency exit must be recognizable from a distance equal to the width of the cabin.

(c) The location of each emergency exit operating handle and the instructions for opening must be marked on or adjacent to the emergency exit, and this marking must be readable from a distance of 30 inches.

(d) A source of light, independent of the main lighting system, must be installed to illuminate each passenger emergency exit marking.

(e) Each exit light must be designed to function automatically in a crash landing and to operate manually.

(f) Each emergency exit that is required to be openable from the outside, and its means of opening, must be marked on the outside of the airplane.

(g) Exits marked as emergency exits, though in excess of the required number of emergency exits, must meet the requirements for emergency exits of the particular type. Emergency exits customarily used in entering or leaving the airplane need only be marked with the word "EXIT".

§ 25.813 **Emergency exit access.**

(a) Except as provided in § 25.803(c) with regard to passageways between individual compartments, each passageway between individual passenger areas, and passageways leading to Type I and Type II emergency exits, must be unobstructed and at least 20 inches wide.

(b) For each emergency exit covered by § 25.809(f), there must be enough space adjacent to that exit to allow a crewmember to assist in the evacuation of passengers without reducing the unobstructed width of the passageway below that required for that exit.

(c) There must be access from the main aisle to each Type III and Type IV exit. The access may not be obstructed by seats, berths, or other protrusions, to an extent that would reduce the effectiveness of the exit. However, there may be minor obstructions if there are compensating factors to maintain the effectiveness of the exit.

(d) If it is necessary to pass through a doorway to reach any required emergency exit from any seat in the passenger cabin, the door must have a means to latch it in the open position.

§ 25.815 **Width of main aisle.**

The main passenger aisle width at any point between seats must equal or exceed the values in the following table:

Passenger seating capacity	Minimum main passenger aisle width	
	Less than 25 inches from floor	25 inches and more from floor
	Inches	*Inches*
10 or less	12	18
11 through 19	12	20
20 or more	15	20

VENTILATION AND HEATING

§ 25.831 **Ventilation.**

(a) Each passenger and crew compartment must be ventilated, and each crew compartment must have enough fresh air (but not less than 10 cu. ft. per minute per crewmember) to enable crewmembers to perform their duties without undue discomfort or fatigue.

(b) Crew and passenger compartment air must be free from harmful or hazardous concentrations of gases or vapors. In meeting this requirement, the following apply:

(1) Carbon monoxide concentrations in excess of one part in 20,000 parts of air are considered hazardous. For test purposes, any acceptable carbon monoxide detection method may be used.

(2) Carbon dioxide in excess of three percent by volume (sea level equivalent) is considered hazardous in the case of crewmembers. Higher concentrations of carbon dioxide may be allowed in crew compartments if appropriate protective breathing equipment is available.

(c) There must be provisions made to ensure that the conditions prescribed in paragraph (b) of this section are met after reasonably probable failures or malfunctioning of the ventilating, heating, pressurization, or other systems and equipment.

(d) If accumulation of hazardous quantities of smoke in the cockpit area is reasonably probable, smoke evacuation must be readily accomplished, starting with full pressurization and without depressurizing beyond safe limits.

(e) There must be a means to enable the crew to control the temperature and quantity of ventilating air supplied to the crew compartment, independently of the temperature and quantity of ventilating air supplied to other compartments.

§ 25.833 **Heating systems.**

(a) Combustion heaters must be approved and must meet the fire protection requirements of § 25.859.

(b) Engine exhaust heaters must meet the provisions of § 25.1125.

PRESSURIZATION

§ 25.841 **Pressurized cabins.**

(a) Pressurized cabins and compartments to be occupied must be equipped to provide a cabin pressure altitude of not more than 8,000 feet at the maximum operating altitude of the airplane under normal operating conditions. If certification for operation over 25,000 feet is requested, the airplane must be able to maintain a cabin pressure altitude of not more than 15,000 feet in the event of any reasonably probable failure or malfunction in the pressurization system.

(b) Pressurized cabins must have at least the following valves, controls, and indicators for controlling cabin pressure:

(1) Two pressure relief valves (at least one of which is the normal regulating valve) to automatically limit the positive pressure differential to a predetermined value at the maximum rate of flow delivered by the pressure source. The combined capacity of the relief valves must be large enough so that the failure of any one valve would not cause an appreciable rise in the pressure differential. The pressure differential is positive when the internal pressure is greater than the external.

(2) Two reverse pressure differential relief valves (or their equivalents) to automatically prevent a negative pressure differential that would damage the structure. One valve is enough, however, if it is of a design that reasonably precludes its malfunctioning.

(3) A means by which the pressure differential can be rapidly equalized.

(4) An automatic or manual regulator for controlling the intake or exhaust airflow, or both, for maintaining the required internal pressures and airflow rates.

(5) Instruments at the pilot or flight engineer station to show the pressure differential, the absolute pressure in the cabin, and the rate of change of the absolute pressure.

(6) Warning indication at the pilot or flight engineer station to indicate when the safe or preset pressure differential and absolute cabin pressure limits are exceeded. Appropriate warning markings on the cabin pressure differential indicator meet the warning requirement for pressure differential limits and an aural or visual signal (in addition to cabin altitude indicating means) meets the warning requirement for absolute cabin pressure limits if it warns the flight crew when the cabin absolute pressure is below that equivalent to 10,000 feet.

(7) A warning placard at the pilot or flight engineer station if the structure is not designed for pressure differentials up to the maximum relief valve setting in combination with landing loads.

§ 25.843 **Tests for pressurized cabins.**

(a) *Strength test.* The complete pressurized cabin, including doors, windows, and valves, must be tested as a pressure vessel for the pressure differential specified in § 25.365(d).

(b) *Functional tests.* The following functional tests must be performed:

(1) Tests of the functioning and capacity of the positive and negative pressure differential valves, and of the emergency release valve, to simulate the effects of closed regulator valves.

(2) Tests of the pressurization system to show proper functioning under each possible condition of pressure, temperature, and moisture, up to the maximum altitude for which certification is requested.

(3) Flight tests, to show the performance of the pressure supply, pressure and flow regulators, indicators, and warning signals, in steady and stepped climbs and descents at rates corresponding to the maximum attainable within the operating limitations of the airplane, up to the maximum altitude for which certification is requested.

(4) Tests of each door and emergency exits, to show that they operate properly after being subjected to the flight tests prescribed in subparagraph (3) of this paragraph.

FIRE PROTECTION

§ 25.851 Fire extinguishers.

(a) *Hand fire extinguishers.* For hand fire extinguishers the following apply:

(1) Each hand fire extinguisher must be approved.

(2) The types and quantities of each extinguishing agent used must be appropriate to the kinds of fires likely to occur where used.

(3) Each extinguisher for use in a personnel compartment must be designed to minimize the hazard of toxic gas concentrations.

(4) A readily accessible hand fire extinguisher must be available for use in each Class A cr Class B cargo compartment.

(b) *Built-in fire extinguishers.* If a built-in fire extinguishing system is required—

(1) The capacity of each system, in relation to the volume of the compartment where used and the ventilation rate, must be adequate for any fire likely to occur in that compartment; and

(2) Each system must be installed so that—

(i) No extinguishing agent likely to enter personnel compartments will be hazardous to the occupants; and

(ii) No discharge of the extinguisher can cause structural damage.

§ 25.853 Compartment interiors.

For each compartment to be used by the crew or passengers—

(a) The materials must be at least flash-resistant;

(b) The wall and ceiling linings, and the covering of upholstery, floors, and furnishings must be at least flame resistant;

(c) Each compartment where smoking is to be allowed must have self-contained, removable, ash trays, and each other compartment must be placarded against smoking;

(d) Each receptacle for towels, paper, or waste must be at least fire resistant and must have means for containing possible fires;

(e) There must be at least one hand fire extinguisher for use by the flight crewmembers; and

(f) There must be at least the following number of hand fire extinguishers conveniently located in passenger compartments:

Passenger capacity:	Minimum number of hand fire extinguishers
7 through 30	1
31 through 60	2
61 or more	3

§ 25.855 Cargo and baggage compartments.

(a) Each cargo and baggage compartment (including tie-down equipment) must be constructed of materials that are at least flame resistant.

(b) No compartment may contain any controls, wiring, lines, equipment, or accessories whose damage or failure would affect safe operation, unless those items are protected so that—

(1) They cannot be damaged by the movement of cargo in the compartment; and

(2) Their breakage or failure will not create a fire hazard.

(c) There must be means to prevent cargo or baggage from interfering with the functioning of the fire-protective features of the compartment.

(d) Sources of heat within the compartment must be shielded and insulated to prevent igniting the cargo.

(e) Cargo compartments must meet one of the class requirements of § 25.857. In addition, flight tests must be conducted to show compliance with the provisions of § 25.857 concerning—

(1) Compartment accessibility;

(2) The entry of hazardous quantities of smoke or extinguishing agent into compartments occupied by the crew or passengers; and

(3) The dissipation of the extinguishing agent in Class C compartments.

During these tests, it must be shown that no inadvertent operation of smoke or fire detectors in any compartment would occur as a result of fire contained in any one compartment, either during or after extinguishment, unless the extinguishing system floods each such compartment simultaneously.

§ 25.857 Cargo compartment classification.

(a) *Class A.* A Class A cargo or baggage compartment is one in which—

(1) The presence of a fire would be easily discovered by a crewmember while at his station; and

(2) Each part of the compartment is easily accessible in flight.

(b) *Class B.* A Class B cargo or baggage compartment is one in which—

(1) There is sufficient access in flight to enable a crew member to effectively reach any part of the compartment with the contents of a hand fire extinguisher;

(2) When the access provisions are being used, no hazardous quantity of smoke, flames, or extinguishing agent, will enter any compartment occupied by the crew or passengers;

(3) There is a separate approved smoke detector or fire detector system to give warning at the pilot or flight engineer station; and

(4) There is a fire-resistant lining.

(c) *Class C.* A Class C cargo or baggage compartment is one not meeting the requirements for either a Class A or B compartment but in which—

(1) There is a separate approved smoke detector or fire detector system to give warning at the pilot or flight engineer station;

(2) There is an approved built-in fire-extinguishing system controllable from the pilot or flight engineer stations;

(3) There are means to exclude hazardous quantities of smoke, flames, or extinguishing agent, from any compartment occupied by the crew or passengers;

(4) There are means to control ventilation and drafts within the compartment so that the extinguishing agent used can control any fire that may start within the compartment; and

(5) There is a fire-resistant lining.

(d) *Class D.* A Class D cargo or baggage compartment is one in which—

(1) A fire occurring in it will be completely confined without endangering the safety of the airplane or the occupants;

(2) There are means to exclude hazardous quantities of smoke, flames, or other noxious gases, from any compartment occupied by the crew or passengers;

(3) Ventilation and drafts are controlled within each compartment so that any fire likely to occur in the compartment will not progress beyond safe limits;

(4) There is a fire-resistant lining; and

(5) Consideration is given to the effect of heat within the compartment on adjacent critical parts of the airplane.

For compartments of 500 cu. ft. or less, an airflow of 1500 cu. ft. per hour is acceptable.

(e) *Class E.* A Class E cargo compartment is one on airplanes used only for the carriage of cargo and in which—

(1) There is a fire-resistant lining;

(2) There is a separate approved smoke or fire detector system to give warning at the pilot or flight engineer station;

(3) There are means to shut off the ventilating airflow to, or within, the compartment, and the controls for these means are accessible to the flight crew in the crew compartment;

(4) There are means to exclude hazardous quantities of smoke, flames, or noxious gases, from the flight crew compartment; and

(5) The required crew emergency exists are accessible under any cargo loading condition.

§ 25.859 Combustion heater fire protection.

(a) *Combustion heater fire zones.* The following combustion heater fire zones must be protected from fire in accordance with the applicable provisions of §§ 25.1181 through 25.1191 and 25.1195 through 25.1203:

(1) The region surrounding the heater, if this region contains any flammable fluid system components (excluding the heater fuel system), that could—

(i) Be damaged by heater malfunctioning; or

(ii) Allow flammable fluids or vapors to reach the heater in case of leakage.

(2) The region surrounding the heater, if the heater fuel system has fittings that, if they leaked, would allow fuel or vapors to enter this region.

(3) The part of the ventilating air passage that surrounds the combustion chamber. However, no fire extinguishment is required in cabin ventilating air passages.

(b) *Ventilating air ducts.* Each ventilating air duct passing through any fire zone must be fireproof. In addition—

(1) Unless isolation is provided by fireproof valves or by equally effective means, the ventilating air duct downstream of each heater must be fireproof

for a distance great enough to ensure that any fire originating in the heater can be contained in the duct; and

(2) Each part of any ventilating duct passing through any region having a flammable fluid system must be constructed or isolated from that system so that the malfunctioning of any component of that system cannot introduce flammable fluids or vapors into the ventilating airstream.

(c) *Combustion air ducts.* Each combustion air duct must be fireproof for a distance great enough to prevent damage from backfiring or reverse flame propagation. In addition—

(1) No combustion air duct may have a common opening with the ventilating airstream unless flames from backfires or reverse burning cannot enter the ventilating airstream under any operating condition, including reverse flow or malfunctioning of the heater or its associated components; and

(2) No combustion air duct may restrict the prompt relief of any backfire that, if so restricted, could cause heater failure.

(d) *Heater controls; general.* Provision must be made to prevent the hazardous accumulation of water or ice on or in any heater control component, control system tubing, or safety control.

(e) *Heater safety controls.* For each combustion heater there must be the following safety control means:

(1) There must be means for each heater, independent of the components provided for the normal continuous control of air temperature, airflow, and fuel flow, to automatically shut off the ignition and fuel supply to that heater at a point remote from that heater, when—

(i) The heat exchanger temperature or ventilating air temperature exceeds safe limits; or

(ii) Either the combustion airflow or the ventilating airflow becomes inadequate for safe operation.

(2) The means of complying with subparagraph (1) of this paragraph for any individual heater must be independent of any component serving any other heater whose heat output is essential for safe operation.

(3) There must be means to warn the crew when any heater whose heat output is essential for safe operation has been shut off by the automatic means prescribed in subparagraph (1) of this paragraph.

(f) *Air intakes.* Each combustion and ventilating air intake must be located so that no flammable fluids or vapors can enter the heater system under any operating condition—

(1) During normal operation; or

(2) As a result of the malfunctioning of any other component.

(g) *Heater exhaust.* Heater exhaust systems must meet the provisions of §§ 25.1121 and 25.1123. In addition, there must be provisions in the means exhaust system to safely expel the products of combustion to prevent the occurrence of—

(1) Fuel leakage from the exhaust to surrounding compartments;

(2) Exhaust gas impingement on surrounding equipment or structure;

(3) Ignition of flammable fluids by the exhaust, if the exhaust is in a compartment containing flammable fluid lines; and

(4) Restriction by the exhaust of the prompt relief of backfires that, if so restricted, could cause heater failure.

(h) *Heater fuel systems.* Each heater fuel system must meet each powerplant fuel system requirement affecting safe heater operation. Each heater fuel system component within the ventilating airstream must be protected by shrouds so that no leakage from those components can enter the ventilating airstream.

(i) *Drains.* There must be means to safely drain fuel that might accumulate within the combustion chamber or the heat exchanger. In addition—

(1) Each part of any drain that operates at high temperatures must be protected in the same manner as heater exhausts; and

(2) Each drain must be protected from hazardous ice accumulation under any operating condition.

§ 25.863 Flammable fluid fire protection.

If flammable fluids or vapors might be liberated by the leakage of fluid systems, there must be means to—

(a) Prevent the ignition of those fluids or vapors by any other equipment; or

(b) Control any fire resulting from that ignition.

MISCELLANEOUS

§ 25.871 Leveling marks.

There must be reference marks for leveling the airplane on the ground.

§ 25.875 Reinforcement near propellers.

(a) Each part of the airplane near the propeller tips must be strong and stiff enough to withstand the effects of the induced vibration and of ice thrown from the propeller.

(b) No window may be near the propeller tips unless it can withstand the most severe ice impact likely to occur.

Subpart E—Powerplant

General

§ 25.901 Installation.

(a) For the purpose of this part, the airplane powerplant installation includes each component that—

(1) Is necessary for propulsion;

(2) Affects the control of the major propulsive units; or

(3) Affects the safety of the major propulsive units between normal inspections or overhauls.

(b) For each powerplant—

(1) The engine installation must meet the applicable provisions of this subpart;

(2) The components of the installation must be constructed, arranged, and installed so as to ensure their continued safe operation between normal inspections or overhauls;

(3) The installation must be accessible for necessary inspections and maintenance; and

(4) The major components of the installation must be electrically bonded to the other parts of the airplane.

§ 25.903 Engines.

(a) *Engine type certification.* Each engine must be type certificated under Part 33 [New].

(b) *Engine isolation.* The powerplants must be arranged and isolated from each other to allow operation, in at least one configuration, so that the failure or malfunction of any engine, or of any system that can affect the engine, will not—

(1) Prevent the continued safe operation of the remaining engines; or

(2) Require immediate action by any crewmember for continued safe operation.

(c) *Control of engine rotation.* There must be a means to individually stop and restart the rotation of any engine in flight unless, for turbine engine installations, continued rotation could not jeopardize the safety of the airplane. Each component of the stopping and restarting system on the engine side of the firewall, and that might be exposed to fire, must be at least fire resistant. If hydraulic propeller feathering systems are used for this purpose, the feathering lines must be at least fire resistant under the operating conditions that may be expected to exist during feathering.

(d) *Turbine engine installations.* Unless the engine type certificate specifies that the engine rotor cases can contain damage resulting from rotor blade failure, turbine engine powerplant installations must have a protection means so that rotor blade failure in any engine will not affect the operation of remaining engines or jeopardize continued safety. In addition, design precautions must be taken to minimize the probability of jeopardizing safety if an engine turbine rotor fails, unless—

(1) The engine type certificate specifies that the turbine rotors can withstand damage-inducing factors (such as those that might result from abnormal rotor speed, temperature, or vibration); and

(2) The powerplant systems associated with engine control devices, systems, and instrumentation give reasonable assurance that those engine operating limitations that adversely affect turbine rotor structural integrity will not be exceeded in service.

§ 25.905 Propellers.

(a) Each propeller must be type certificated under Part 35 [New].

(b) Engine power and propeller shaft rotational speed may not exceed the limits for which the propeller is certificated.

§ 25.907 Propeller vibration.

(a) The magnitude of the propeller blade vibration stresses under any normal condition of operation must be determined by actual measurement or by comparison with similar installations for which these measurements have been made.

(b) The determined vibration stresses may not exceed values that have been shown to be safe for continuous operation.

§ 25.925 Propeller clearance.

Unless smaller clearances are substantiated, propeller clearances with the airplane at maximum weight, with the most adverse center of gravity, and with the propeller in the most adverse pitch position, may not be less than the following:

(a) *Ground clearance.* There must be a clearance of at least seven inches (for each airplane with nose wheel landing gear) or nine inches (for each airplane with tail wheel landing gear) between each propeller and the ground with the landing gear statically deflected and in the level takeoff, or taxiing attitude, whichever is most critical. In addition, there must be positive clearance between the propeller and the ground when in the level takeoff attitude with the critical tire completely deflated and the corresponding landing gear strut bottomed.

(b) *Water clearance.* There must be a clearance of at least 18 inches between each propeller and the water, unless compliance with § 25.239(a) can be shown with a lesser clearance.

(c) *Structural clearance.* There must be—

(1) At least one inch radial clearance between the blade tips and the airplane structure, plus any additional radial clearance necessary to prevent harmful vibration;

(2) At least one-half inch longitudinal clearance between the propeller blades or cuffs and stationary parts of the airplane; and

(3) Positive clearance between other rotating parts of the propeller or spinner and stationary parts of the airplane.

§ 25.929 Propeller deicing.

(a) For airplanes intended for use where icing may be expected, there must be a means to prevent or remove hazardous ice accumulation on propellers or on accessories where ice accumulation would jeopardize engine performance.

(b) If combustible fluid is used for propeller deicing, §§ 25.1181 through 25.1185 and 25.1189 apply.

§ 25.933 Reversing systems.

(a) Reversing systems intended for ground operation only must be designed so that no single failure or malfunction of the system will result in unwanted reverse thrust under any expected operating condition. Failure of structural elements need not be considered if the probability of this kind of failure is extremely remote.

(b) Turbojet reversing systems intended for inflight use must be designed so that no unsafe condition will result during normal operation of the system, or from any failure (or reasonably likely combination of failures) of the reversing system, under any anticipated condition of operation of the airplane. Failure of structural elements need not be considered if the probability of this kind of failure is extremely remote.

(c) Compliance with this section may be shown by failure analysis, testing, or both, for propeller systems that allow propeller blades to move from the flight low-pitch position to a position that is substantially less than that at the normal flight low-pitch stop position. The analysis may include or be supported by the analysis made to show compliance with the requirements of § 35.21 for the propeller and associated installation components.

§ 25.937 Turbopropeller-drag limiting systems.

Turbopropeller powered airplane propeller-drag limiting systems must be designed so that no single failure or malfunction of any of the systems during normal or emergency operation results in propeller drag in excess of that for which the airplane was designed under § 25.367. Failure of structural elements of the drag limiting systems need not be considered if the probability of this kind of failure is extremely remote.

§ 25.939 Turbine engine powerplant operating characteristics.

Turbine engine powerplant operating characteristics must be investigated in flight to determine that no adverse characteristics (such as stall, surge, or flameout) are present to a hazardous degree, during normal and emergency operation within the range of operating limitations of the airplane and of the engine.

Fuel System

§ 25.951 General.

(a) Each fuel system must be constructed and arranged to ensure a flow of fuel at a rate and pressure established for proper engine functioning under each likely operating condition, including any maneuver for which certification is requested.

(b) Each fuel system must be arranged so that—

(1) No fuel pump can draw fuel from more than one tank at a time; or

(2) There are means to prevent introducing air into the system.

§ 25.953 Fuel system independence.

Each fuel system must meet the requirements of § 25.903(b) by—

(a) Allowing the supply of fuel to each engine through a system independent of each part of the system supplying fuel to any other engine; or

(b) Any other acceptable method.

§ 25.955 Fuel flow.

(a) Each fuel system must provide at least 100 percent of the fuel flow required under each intended operating condition and maneuver. Compliance must be shown as follows:

(1) Fuel must be delivered to each engine at a pressure within the limits specified in the engine type certificate.

(2) The quantity of fuel in the tank may not exceed the amount established as the unusable fuel supply for that tank under the requirements of § 25.959 plus that necessary to show compliance with this section.

(3) Each main pump must be used that is necessary for each operating condition and attitude for which compliance with this section is shown, and the appropriate emergency pump must be substituted for each main pump so used.

(4) If there is a fuel flowmeter, it must be blocked and the fuel must flow through the meter or its bypass.

(b) If an engine can feed from more than one fuel tank, the fuel system must supply the full fuel pressure to that engine in not more than 20 seconds after switching to any other fuel tank when engine malfunctioning becomes apparent due to the depletion of the fuel supply in any tank from which the engine can be fed.

§ 25.957 Flow between interconnected tanks.

If fuel can be pumped from one tank to another in flight, the fuel tank vents and the fuel transfer system must be designed so that no structural damage to the tanks can occur because of overfilling.

§ 25.959 Unusable fuel supply.

The unusable fuel supply for each tank must be established as not less than that quantity at which the first evidence of malfunctioning occurs under the most adverse fuel feed condition occurring under each intended operation and flight maneuver involving that tank.

§ 25.961 Fuel system hot weather operation.

(a) The fuel system must perform satisfactorily in hot weather operation. This must be shown by climbing from the altitude of the airport elected by the applicant to the altitude corresponding to that at which the one-engine-inoperative best rate of climb is not more than the en route climb with the configuration and weight specified in § 25.67(d). There may be no evidence of vapor lock or other malfunctioning during the climb test conducted under the following conditions:

(1) For reciprocating engine powered airplanes, the engines must operate at maximum continuous power, except that takeoff power must be used for the altitudes from 1,000 feet below the critical altitude through the critical altitude. The time interval during which takeoff power is used may not be less than the takeoff time limitation.

(2) For turbine engine powered airplanes, the engines must operate at takeoff power for the time interval selected for showing the takeoff flight path, and at maximum continuous power for the rest of the climb.

(3) The weight of the airplane must be the weight with full fuel tanks, minimum crew, and the ballast necessary to maintain the center of gravity within allowable limits.

(4) The speed of climb may not exceed that allowing compliance with the minimum climb requirement specified in § 25.65(a).

(5) The fuel temperature must be at least 110° F.

(b) The test prescribed in paragraph (a) of this section may be performed in flight or on the ground under closely simulated flight conditions. If a flight test is performed in weather cold enough to interfere with the proper conduct of the test, the fuel tank surfaces, fuel lines, and other fuel system parts subject to cold air must be insulated to simulate, insofar as practicable, flight in hot weather.

§ 25.963 Fuel tanks: general.

(a) Each fuel tank must be able to withstand, without failure, the vibration, inertia, fluid, and structural loads that it may be subjected to in operation.

(b) Flexible fuel tank liners must be approved or must be shown to be suitable for the particular application.

(c) Integral fuel tanks must have facilities for interior inspection and repair.

(d) Fuel tanks within the fuselage contour must be able to resist rupture, and to retain fuel, under the inertia forces prescribed for the emergency landing conditions in § 25.561. In addition, these tanks must be in a protected position so that exposure of the tanks to scraping action with the ground is unlikely.

(e) The augmentation liquid tank capacity available for the use of each engine must be large enough to allow operation of the airplane under the approved procedures for the use of liquid-augmented power. The computation of liquid consumption must be based on the maximum approved rate appropriate for the desired engine output, and must include the effect of temperature on engine performance as well as any other factors that might vary the amount of liquid required.

§ 25.965 Fuel tank tests.

(a) It must be shown by tests that the fuel tanks, as mounted in the airplane, can withstand, without failure or leakage, the more critical of the pressures resulting from the conditions specified in subparagraphs (1) and (2) of this paragraph. In addition, it must be shown by either analysis or tests, that tank surfaces subjected to more critical pressures resulting from the condition of subparagraphs (3) and (4) of this paragraph, are able to withstand the following pressures:

(1) An internal pressure of 3.5 psi.

(2) 125 percent of the maximum air pressure developed in the tank from ram effect.

(3) Fluid pressures developed during maximum limit accelerations, and deflections, of the airplane with a full tank.

(4) Fluid pressures developed during the most adverse combination of airplane roll and fuel load.

(b) Each metallic tank with large unsupported or unstiffened flat surfaces, whose failure or deformation could cause fuel leakage, must be able to withstand the following test, or its equivalent, without leakage or excessive deformation of the tank walls:

(1) Each complete tank assembly and its supports must be vibration tested while mounted to simulate the actual installation.

(2) Except as specified in subparagraph (4) of this paragraph, the tank assembly must be vibrated for 25 hours at an amplitude of not less than $\frac{1}{32}$ of an inch (unless another amplitude is substantiated) while $\frac{2}{3}$ filled with water or other suitable test fluid.

(3) The test frequency of vibration must be as follows:

(i) If no frequency of vibration resulting from any r.p.m. within the normal operating range of engine speeds is critical, the test frequency of vibration, in number of cycles per minute, must be the number obtained by multiplying the maximum continuous engine speed (r.p.m.) by 0.9.

(ii) If only one frequency of vibration resulting from any r.p.m. within the normal operating range of engine speeds is critical, that frequency of vibration must be the test frequency.

(iii) If more than one frequency of vibration resulting from any r.p.m. within the normal operating range of engine speeds is critical, the most critical of these frequencies must be the test frequency.

(4) Under subparagraph (3) (ii) and (iii) of this paragraph, the time of test must be adjusted to accomplish the same number of vibration cycles that would be accomplished in 25 hours at the frequency specified in subparagraph (3)(i) of this paragraph.

(5) During the test, the tank assembly must be rocked at the rate of 16 to 20 complete cycles per minute, through an angle of 15° on both sides of the horizontal (30° total), about the most critical axis, for 25 hours. If motion about more than one axis is likely to be critical, the tank must be rocked about each critical axis for 12½ hours.

(c) Except where satisfactory operating experience with a similar tank in a similar installation is shown, nonmetallic tanks must withstand the test specified in paragraph (b)(5) of this section, with fuel at a temperature of 110° F. During this test, a representative specimen of the tank must be installed in a supporting structure simulating the installation in the airplane.

§ 25.967 Fuel tank installations.

(a) Each fuel tank must be supported so that tank loads (resulting from the weight of the fuel in the tanks) are not concentrated on unsupported tank surfaces. In addition—

(1) There must be pads, if necessary, to prevent chafing between the tank and its supports;

(2) Padding must be nonabsorbent or treated to prevent the absorption of fluids;

(3) If a flexible tank liner is used, it must be supported so that it is not required to withstand fluid loads; and

(4) Each interior surface of the tank compartment must be smooth and free of projections that could cause wear of the liner unless—

(i) Provisions are made for protection of the liner at these points; or

(ii) The construction of the liner itself provides that protection.

(b) Spaces adjacent to tank surfaces must be ventilated to avoid fume accumulation due to minor leakage. If the tank is in a sealed compartment, ventilation may be limited to drain holes large enough to prevent excessive pressure resulting from altitude changes.

(c) The location of each tank must meet the requirements of § 25.1185(a).

(d) No engine nacelle skin immediately behind a major air outlet from the engine compartment may act as the wall of an integral tank.

(e) Each fuel tank must be isolated from personnel compartments by a fumeproof and fuelproof enclosure.

§ 25.969 Fuel tank expansion space.

Each fuel tank must have an expansion space of not less than two percent of the tank capacity. It must be impossible to fill the expansion space inadvertently with the airplane in the normal ground attitude.

§ 25.971 Fuel tank sump.

(a) Each fuel tank must have a sump with an effective capacity, in the normal ground attitude, of not less than the greater of 0.10 percent of the tank capacity or one-sixteenth of a gallon unless operating limitations are established to ensure that the accumulation of water in service will not exceed the sump capacity.

(b) Each fuel tank must allow drainage of any hazardous quantity of water from any part of the tank to its sump with the airplane in the ground attitude.

(c) Each fuel tank sump must have an accessible drain that—

(1) Allows complete drainage of the sump on the ground;

(2) Discharges clear of each part of the airplane; and

(3) Has manual or automatic means for positive locking in the closed position.

§ 25.973 Fuel tank filler connection.

Each fuel tank filler connection must prevent the entrance of fuel into any part of the airplane other than the tank itself. In addition—

(a) Each filler must be marked as prescribed in § 25.1557(c);

(b) Each recessed filler connection that can retain any appreciable quantity of fuel must have a drain that discharges clear of each part of the airplane; and

(c) Each filler cap must provide a fuel-tight seal.

§ 25.975 Fuel tank vents and carburetor vapor vents.

(a) *Fuel tank vents.* Each fuel tank must be vented from the top part of the expansion space so that venting is effective under any normal flight condition. In addition—

(1) Each vent must be arranged to avoid stoppage by dirt or ice formation;

(2) The vent arrangement must prevent siphoning of fuel during normal operation;

(3) The venting capacity and vent pressure levels must maintain acceptable differences of pressure between the interior and exterior of the tank, during—

(i) Normal flight operation;

(ii) Maximum rate of ascent and descent; and

(iii) Refueling and defueling (where applicable);

(4) Airspaces of tanks with interconnected outlets must be interconnected;

(5) There may be no point in any vent line where moisture can accumulate with the airplane in the ground attitude or the level flight attitude, unless drainage is provided; and

(6) No vent or drainage provision may end at any point—

(i) Where the discharge of fuel from the vent outlet would constitute a fire hazard; or

(ii) From which fumes could enter personnel compartments.

(b) *Carburetor vapor vents.* Each carburetor with vapor elimination connections must have a vent line to lead vapors back to one of the fuel tanks. In addition—

(1) Each vent system must have means to avoid stoppage by ice; and

(2) If there is more than one fuel tank, and it is necessary to use the tanks in a definite sequence, each vapor vent return line must lead back to the fuel tank used for takeoff and landing.

§ 25.977 Fuel tank outlet.

There must be a fuel strainer with 8 to 16 meshes per inch for the fuel tank outlet or for the booster pump. In addition—

(a) The clear area of each fuel tank outlet strainer must be at least five times the area of the outlet line;

(b) The diameter of each strainer must be at least that of the fuel tank outlet; and

(c) Each finger strainer must be accessible for inspection and cleaning.

§ 25.979 Under-wing fueling provisions.

(a) Each under-wing fuel tank connection must have means to prevent the escape of hazardous quantities of fuel from that tank, while the cover plate is removed, if the fuel entry valve malfunctions.

(b) A means, in addition to the normal means for limiting the tank content, must be installed to prevent damage to the tank if the normal means fails.

Fuel System Components

§ 25.991 Fuel pumps.

(a) *Main pumps.* Each fuel pump required for proper engine operation, or required to meet the fuel system requirements of this subpart (other than those in paragraph (b) of this section), is a main pump. For each main pump, provision must be made to allow the bypass of each positive displacement fuel pump other than a fuel injection pump (a pump that supplies the proper flow and pressure for fuel injection when the injection is not accomplished in a carburetor) approved as part of the engine.

(b) *Emergency pumps.* There must be emergency pumps or another main pump to feed each engine immediately after failure of any main pump (other than a fuel injection pump approved as part of the engine).

§ 25.993 Fuel system lines and fittings.

(a) Each fuel line must be installed and supported to prevent excessive vibration and to withstand loads due to fuel pressure and accelerated flight conditions.

(b) Each fuel line connected to components of the airplane between which relative motion could exist must have provisions for flexibility.

(c) Each flexible connection in fuel lines that may be under pressure and subjected to axial loading must use flexible hose assemblies.

(d) Flexible hose must be approved or must be shown to be suitable for the particular application.

(e) No flexible hose that might be adversely affected by exposure to high temperatures may be used where excessive temperatures will exist during operation or after engine shut-down.

§ 25.995 Fuel valves.

In addition to the requirements of § 25.1189 for shutoff means, each fuel valve must—

(a) Have positive stops or suitable index provisions in the "on" and "off" positions; and

(b) Be supported so that no loads resulting from their operation or from accelerated flight conditions are transmitted to the lines attached to the valve.

§ 25.997 Fuel strainer or filter.

(a) There must be a fuel strainer or filter between the tank outlet and the fuel metering device of the engine. In addition, the fuel strainer or filter must be—

(1) Between the tank outlet and the engine-driven pump inlet, if there is an engine-driven fuel pump;

(2) Accessible for drainage and cleaning and, for the strainer screen, easily removable; and

(3) Mounted so that its weight is not supported by the connecting lines or by the inlet or outlet connections of the strainer or filter itself.

(b) Unless there are means in the fuel system to prevent the accumulation of ice on the filter, there must be means to automatically maintain the fuel flow if ice-clogging of the filter occurs.

(c) The fuel strainer or filter must be of adequate capacity (with respect to operating limitations established to ensure proper service) and of appropriate mesh to ensure proper engine operation, with the fuel contaminated to a degree (with respect to particle size and density) that can be reasonably expected in service. The degree of fuel filtering may not be less than that established for the engine under Part 33 [New].

§ 25.999 **Fuel system drains.**

(a) Drainage of the fuel system must be accomplished by the use of fuel strainer and fuel tank sump drains.

(b) Each drain must discharge clear of each part of the airplane and must have manual or automatic means for positive locking in the closed position.

§ 25.1001 **Fuel jettisoning system.**

(a) If the maximum takeoff weight is more than 105 percent of the maximum landing weight, there must be a fuel jettisoning system able to jettison enough fuel to bring the takeoff weight down to the maximum landing weight. The average rate of fuel jettisoning must be at least 1 percent of the maximum takeoff weight per minute, except that the time required to jettison the fuel need not be less than 10 minutes. This must be shown at maximum takeoff weight, with flaps and landing gear up, and in—

(1) A power-off glide at 1.4 V_{S_1};

(2) A climb at the one-engine-inoperative best rate-of-climb speed, with the critical engine inoperative and the remaining engines at maximum continuous power; and

(3) Level flight at 1.4 V_{S_1}, if the results of the tests in the conditions specified in subparagraphs (1) and (2) of this paragraph show that this condition could be critical.

(b) During the flight tests prescribed in paragraph (a) of this section, it must be shown that—

(1) The fuel jettisoning system and its operation are free from fire hazard;

(2) The fuel discharges clear of any part of the airplane;

(3) Fuel or fumes do not enter any parts of the airplane; and

(4) The jettisoning operation does not adversely affect the controllability of the airplane.

(c) For reciprocating engine powered airplanes, the jettisoning system must be designed so that it is not possible to jettison the fuel in the tanks used for takeoff and landing below the level allowing 45 minutes flight at 75 percent maximum continuous power. However, if there is an auxiliary control independent of the main jettisoning control, the system may be designed to jettison all the fuel.

(d) For turbine engine powered airplanes the jettisoning system must be designed so that it is not possible to jettison fuel in the tanks used for takeoff and landing below the level allowing climb from sea level to 10,000 feet and thereafter allowing 45 minutes cruise at a speed for maximum range.

(e) The fuel jettisoning valve must be designed to allow flight personnel to close the valve during any part of the jettisoning operation.

(f) Unless it is shown that using any means (including flaps, slots, and slats) for changing the airflow across or around the wings does not adversely affect fuel jettisoning, there must be a placard, adjacent to the jettisoning control, to warn flight crewmembers against jettisoning fuel while the means that change the airflow are being used.

(g) The fuel jettisoning system must be designed so that any reasonably probable single malfunction in the system will not result in a hazardous condition due to unsymmetrical jettisoning of, or inability to jettison, fuel.

OIL SYSTEM

§ 25.1011 **General.**

(a) Each engine must have an independent oil system that can supply it with an appropriate quantity of oil at a temperature not above that safe for continuous operation.

(b) The usable oil capacity may not be less than the product of the endurance of the airplane under critical operating conditions and the approved maximum allowable oil consumption of the engine under the same conditions, plus a suitable margin to ensure system circulation. Instead of a rational analysis of airplane range for the purpose of computing oil requirements for reciprocating engine powered airplanes, the following fuel/oil ratios may be used:

(1) For airplanes without a reserve oil or oil transfer system, a fuel/oil ratio of 30:1 by volume.

(2) For airplanes with either a reserve oil or oil transfer system, a fuel/oil ratio of 40:1 by volume.

(c) Fuel/oil ratios higher than those prescribed in paragraphs (b) (1) and (2) of this section may be used if substantiated by data on actual engine oil consumption.

§ 25.1013 **Oil tanks.**

(a) *Installation.* Each oil tank installation must meet the requirements of § 25.967. However, an engine oil tank may be in a designated fire zone if the tank and its supports are fireproof to the extent that damage by fire to any non-fireproof part will not cause leakage or spillage of oil.

(b) *Expansion space.* Oil tank expansion space must be provided as follows:

(1) Each oil tank must have an expansion space of not less than the greater of—

(i) 10 percent of the tank capacity; or

(ii) 0.5 gallon.

(2) Each reserve oil tank not directly connected to any engine may have an expansion space of not less than two percent of the tank capacity.

(3) It must be impossible to fill the expansion space inadvertently with the airplane in the normal ground attitude.

(c) *Filler connection.* Each recessed oil tank filler connection that can retain any appreciable quantity of oil must have a drain that discharges clear of each part of the airplane. In addition—

(1) Each oil tank filler cap must provide an oil-tight seal; and

(2) Each oil filler must be marked under § 25.1557(c).

(d) *Vent.* Oil tanks must be vented as follows:

(1) Each oil tank must be vented from the top part of the expansion space so that venting is effective under any normal flight condition.

(2) Oil tank vents must be arranged so that condensed water vapor that might freeze and obstruct the line cannot accumulate at any point.

(e) *Outlet.* There must be means to prevent entrance into the tank itself, or into the tank outlet, of any object that might obstruct the flow of oil through the system. No oil tank outlet may be enclosed by any screen or guard that would reduce the flow of oil below a safe value at any operating temperature.

(f) *Flexible oil tank liners.* Each flexible oil tank liner must be approved or must be shown to be suitable for the particular application.

§ 25.1015 **Oil tank tests.**

Each oil tank must be designed and installed so that—

(a) It can withstand, without failure, each vibration, inertia, and fluid load that it may be subjected to in operation; and

(b) It meets the provisions of § 25.965, except—

(1) The test pressure must be five p.s.i. instead of the pressure specified in § 25.965(a); and

(2) The test fluid must be oil at 250° F. instead of the fluid specified in § 25.965(c).

§ 25.1017 **Oil lines and fittings.**

(a) Each oil line must meet the requirements of § 25.993 and each oil line and fitting in any designated fire zone must meet the requirements of § 25.1183.

(b) Breather lines must be arranged so that—

(1) Condensed water vapor that might freeze and obstruct the line cannot accumulate at any point;

(2) The breather discharge does not constitute a fire hazard if foaming occurs or causes emitted oil to strike the pilot's windshield; and

(3) The breather does not discharge into the engine air induction system.

§ 25.1019 **Oil strainer or filter.**

Each oil strainer or filter in the powerplant installation must be constructed and installed so that oil will flow at the normal rate through the rest of the system with the strainer or filter element completely blocked.

§ 25.1021 **Oil drains.**

There must be at least one accessible drain that—

(a) Allows safe drainage of the entire oil system; and

(b) Has manual or automatic means for positive locking in the closed position.

§ 25.1023 **Oil radiators.**

(a) Each oil radiator must be able to withstand, without failure, any vibration, inertia, and oil pressure load to which it would be subjected in operation.

(b) Each oil radiator air duct must be located so that, in case of fire, flames coming from normal openings of the engine nacelle cannot impinge directly upon the radiator.

§ 25.1025 **Oil valves.**

(a) Each oil shutoff must meet the requirements of § 25.1189.

(b) The closing of oil shutoff means may not prevent propeller feathering.

(c) Each oil valve must have positive stops or suitable index provisions in the "on" and "off" positions and must be supported so that no loads resulting from its operation or from accelerated flight conditions are transmitted to the lines attached to the valve.

§ 25.1027 **Propeller feathering system.**

(a) If the propeller feathering system depends on engine oil, there must be means to trap an amount of oil in the tank if the supply becomes depleted due to failure of any part of the lubricating system other than the tank itself.

(b) The amount of trapped oil must be enough to accomplish the feathering operation and must be available only to the feathering pump.

(c) The ability of the system to accomplish feathering with the trapped oil must be shown. This may be done on the ground using an auxiliary source of oil for lubricating the engine during operation.

COOLING

§ 25.1041 **General.**

The powerplant cooling provisions must be able to maintain the temperatures of powerplant components and engine fluids within the temperature limits established for these components and fluids, under ground, water, and flight operating conditions.

§ 25.1043 **Cooling tests.**

(a) *General.* Compliance with § 25.1041 must be shown by tests, under critical ground, water, and flight operating conditions. For these tests, the following apply:

(1) If the tests are conducted under conditions deviating from the maximum ambient atmospheric temperature, the recorded powerplant temperatures must be corrected under paragraphs (c) and (d) of this section.

(2) No corrected temperatures determined under subparagraph (1) of this paragraph may exceed established limits.

(3) For reciprocating engines, the fuel used during the cooling tests must be the minimum grade approved for the engines, and the mixture settings must be those normally used in the flight stages for which the cooling tests are conducted. The test procedures must be as prescribed in § 25.1045.

(b) *Maximum ambient atmospheric temperature.* A maximum ambient atmospheric temperature corresponding to sea level conditions must be established as a limitation on the operation of the airplane. The temperature lapse rate is 3.6° F. per thousand feet of altitude above sea level until a temperature of −69.7° F. is reached, above which altitude, the temperature is considered constant at −69.7° F.

(c) *Correction factor (except cylinder barrels).* Unless a more rational correction applies, temperatures of engine fluids and powerplant components (except cylinder barrels) for which temperature limits are established, must be corrected by adding to them the difference between the maximum ambient atmospheric temperature and the temperature of the ambient air at the time of the first occurrence of the maximum component or fluid temperature recorded during the cooling test.

(d) *Correction factor for cylinder barrel temperatures.* Unless a more rational correction applies, cylinder barrel temperatures must be corrected by adding to them 0.7 times the difference between the maximum ambient atmospheric temperature and the temperature of the ambient air at the time of the first occurrence of the maximum cylinder barrel temperature recorded during the cooling test.

§ 25.1045 **Cooling test procedures.**

(a) Compliance with § 25.1041 must be shown for the takeoff, climb, en route, and landing stages of flight that correspond to the applicable performance requirements. The cooling tests must be conducted with the airplane in the configuration, and operating under the conditions, that are critical relative to cooling during each stage of flight. For the cooling tests, a temperature is "stabilized" when its rate of change is less than two degrees F. per minute.

(b) Temperatures must be stabilized under the conditions from which entry is made into each stage of flight being investigated, unless the entry condition normally is not one during which component and engine fluid temperatures would stabilize (in which case, operation through the full entry condition must be conducted before entry into the stage of flight being investigated in order to allow temperatures to reach their natural levels at the time of entry). The takeoff cooling test must be preceded by a period during which the powerplant component and engine fluid temperatures are stabilized with the engines at ground idle.

(c) Cooling tests for each stage of flight must be continued until—

(1) The component and engine fluid temperatures stabilize;

(2) The stage of flight is completed; or

(3) An operating limitation is reached.

(d) For reciprocating engine powered airplanes, it may be assumed, for cooling test purposes, that the takeoff stage of flight is complete when the airplane reaches an altitude of 1,500 feet above the takeoff surface or reaches a point in the takeoff where the transition from the takeoff to the en route configuration is completed and a speed is reached at which compliance with § 25.67(d) is shown, whichever point is at a higher altitude.

(e) For hull seaplanes and amphibians, cooling must be shown during taxiing downwind for 10 minutes, at five knots above step speed.

INDUCTION SYSTEM

§ 25.1091 **Air induction.**

(a) The air induction system for each engine must supply—

(1) The air required by that engine under each operating condition for which certification is requested; and

(2) The air for proper fuel metering and mixture distribution with the induction system valves in any position.

(b) Each reciprocating engine must have an alternate air source that prevents the entry of rain, ice, or any other foreign matter.

(c) Air intakes may not open within the cowling, unless—

(1) That part of the cowling is isolated from the engine accessory section by means of a fireproof diaphragm; or

(2) There are means to prevent the emergence of backfire flames.

(d) For turbine engine powered airplanes—

(1) There must be means to prevent hazardous quantities of fuel leakage or overflow from drains, vents, or other components of flammable fluid systems from entering the engine intake system; and

(2) The air inlet ducts must be located or protected so as to minimize the ingestion of foreign matter during takeoff, landing, and taxiing.

§ 25.1093 **Induction system deicing and anti-icing provisions.**

(a) *Reciprocating engines.* Each reciprocating engine air induction system must have means to prevent and eliminate icing. Unless this is done by other means, it must be shown that, in air free of visible moisture at a temperature of 30° F., each airplane with altitude engines using—

(1) Conventional venturi carburetors has a preheater that can provide a heat rise of 120° F. with the engine at 60 percent of maximum continuous power; or

(2) Carburetors tending to reduce the probability of ice formation has a preheater that can provide a heat rise of 100° F. with the engine at 60 percent of maximum continuous power.

(b) *Turbine engines.* Each turbine engine must be able to operate throughout its flight power range without adverse effect on engine operation or serious loss of power or thrust, under the icing conditions specified in Appendix C. In addition, there must be means to indicate to appropriate flight crewmembers the functioning of the powerplant ice protection system.

§ 25.1101 **Carburetor air preheater design.**

Each carburetor air preheater must be designed and constructed to—

(a) Ensure ventilation of the preheater when the engine is operated in cold air;

(b) Allow inspection of the exhaust manifold parts that it surrounds; and

(c) Allow inspection of critical parts of the preheater itself.

§ 25.1103 **Induction system ducts.**

(a) Each induction system duct upstream of the first stage of the supercharger must have a drain to prevent the hazardous accumulation of fuel and moisture in the ground attitude. The drains may not discharge in locations that might cause a fire hazard.

(b) Each induction system duct must be—

(1) Strong enough to prevent induction system failures resulting from normal backfire conditions; and

(2) Fire-resistant if it is in any fire zone for which a fire-extinguishing system is required.

(c) Each duct connected to components between which relative motion could exist must have means for flexibility.

§ 25.1105 **Induction system screens.**

If induction system screens are used—

(a) Each screen must be upstream of the carburetor;

(b) No screen may be in any part of the induction system that is the only passage through which air can reach the engine, unless it can be deiced by heated air;

(c) No screen may be deiced by alcohol alone; and

(d) It must be impossible for fuel to strike any screen.

§ 25.1107 **Inter-coolers and after-coolers.**

Each inter-cooler and after-cooler must be able to withstand any vibration, inertia, and air pressure load to which it would be subjected in operation.

EXHAUST SYSTEM

§ 25.1121 **General.**

(a) Each exhaust system must ensure safe disposal of exhaust gases without fire hazard or carbon monoxide contamination in any personnel compartment. For test purposes, any acceptable carbon monoxide detection method may be used to show the absence of carbon monoxide.

(b) Unless suitable precautions are taken, no exhaust system part may be dangerously close to parts of any system carrying flammable fluids or vapors, or under parts of such a system that may leak.

(c) Each component that hot exhaust gases could strike, or that could be subjected to high temperatures from exhaust system parts, must be fireproof. All exhaust system components must be separated by fireproof shields from adjacent parts of the airplane that are outside the engine compartment.

(d) No exhaust gases may discharge so as to cause a fire hazard with respect to any flammable fluid vent or drain.

(e) No exhaust gases may discharge where they will cause a glare seriously affecting pilot vision at night.

(f) Each exhaust system component must be ventilated to prevent points of excessively high temperature.

(g) Each exhaust shroud must be ventilated or insulated to avoid, during normal operation, a temperature high enough to ignite any flammable fluids or vapors external to the shroud.

§ 25.1123 **Exhaust piping.**

(a) Exhaust piping must be heat and corrosion resistant, and must have provisions to prevent failure due to expansion by operating temperatures.

(b) Piping must be supported to withstand any vibration and inertia loads to which it would be subjected in operation; and

(c) Piping connected to components between which relative motion could exist must have means for flexibility.

§ 25.1125 **Exhaust heat exchangers.**

(a) Each exhaust heat exchanger must be constructed and installed to withstand each vibration, inertia, and other load to which it would be subjected in operation. In addition—

(1) Each exchanger must be suitable for continued operation at high temperatures and resistant to corrosion from exhaust gases;

(2) There must be means for the inspection of the critical parts of each exchanger;

(3) Each exchanger must have cooling provisions wherever it is subject to contact with exhaust gases; and

(4) No exhaust heat exchanger or muff may have any stagnant areas or liquid traps that would increase the probability of ignition of flammable fluids or vapors that might be present in case of the failure or malfunction of components carrying flammable fluids.

(b) If an exhaust heat exchanger is used for heating ventilating air—

(1) There must be a secondary heat exchanger between the primary exhaust gas heat exchanger and the ventilating air system; or

(2) Other means must be used to preclude the harmful contamination of the ventilating air.

§ 25.1127 **Exhaust driven turbo-superchargers.**

(a) Each exhaust driven turbo-supercharger must be approved or shown to be suitable for the particular application. It must be installed and supported to ensure safe operation between normal inspections and overhauls. In addition, there must be provisions for expansion and flexibility between exhaust conduits and the turbine.

(b) There must be provisions for lubricating the turbine and for cooling turbine parts where temperatures are critical.

(c) If the normal turbo-supercharger control system malfunctions, the turbine speed may not exceed its maximum allowable value. Except for the waste gate operating components, the components provided for meeting this requirement must be independent of the normal turbo-supercharger controls.

POWERPLANT CONTROLS AND ACCESSORIES

§ 25.1141 **Powerplant controls: general.**

Each powerplant control must be located, arranged, and designed under §§ 25.777 through 25.781 and marked under § 25.1555. In addition, it must meet the following requirements:

(a) Each control must be located so that it cannot be inadvertently operated by persons entering, leaving, or moving normally in, the cockpit.

(b) Each flexible control must be approved or must be shown to be suitable for the particular application.

(c) Each control must have sufficient strength and rigidity to withstand operating loads without failure and without excessive deflection.

(d) Each control must be able to maintain any set position without constant attention by flight crewmembers and without creep due to control loads or vibration.

§ 25.1143 **Throttle and antidetonant injection system controls.**

(a) There must be a separate throttle control for each engine.

(b) Throttle controls must be arranged to allow—

(1) Separate control of each engine; and

(2) Simultaneous control of all engines.

(c) Each throttle control must provide a positive and immediately responsive means of controlling its engine.

(d) If there is an antidetonant injection system, the flow of A.D.I. fluid must be automatically controlled with relation to the amount of power produced by the engine. In addition to the automatic control, there must be a separate control for the A.D.I. pumps.

§ 25.1145 **Ignition switches.**

(a) Ignition switches must control each engine ignition circuit on each engine.

(b) There must be means to quickly shut off all ignition by the grouping of switches or by a master ignition control.

(c) Each master ignition control must have a guard to prevent its inadvertent operation.

§ 25.1147 **Mixture controls.**

(a) If there are mixture controls, each engine must have a separate control. The controls must be grouped and arranged to allow—

(1) Separate control of each engine; and

(2) Simultaneous control of all engines.

(b) Each intermediate position of the mixture controls that corresponds to a normal operating setting must be identifiable by feel and sight.

(c) The mixture controls must be accessible to both pilots. However, if there is a separate flight engineer station with a control panel, the controls need be accessible only to the flight engineer.

§ 25.1149 **Propeller speed and pitch controls.**

(a) There must be a separate propeller speed and pitch control for each propeller.

(b) The controls must be grouped and arranged to allow—

(1) Separate control of each propeller; and

(2) Simultaneous control of all propellers.

(c) The controls must allow synchronization of all propellers.

(d) The propeller speed and pitch controls must be to the right of, and at least one inch below, the pilot's throttle controls.

§ 25.1153 **Propeller feathering controls.**

(a) There must be a separate propeller feathering control for each propeller. The control must have means to prevent its inadvertent operation.

(b) If feathering is accomplished by movement of the propeller pitch or speed control lever, there must be means to prevent the movement of this lever to the feathering position during normal operation.

§ 25.1155 **Reverse thrust controls.**

Reverse thrust controls must have a means to prevent their inadvertent operation. The means must have a positive lock or stop at the flight idle position and must require a separate and distinct operation by the crew to displace the control from the flight regime (forward thrust regime for turbojet powered airplanes).

§ 25.1157 **Carburetor air temperature controls.**

There must be a separate carburetor air temperature control for each engine.

§ 25.1159 **Supercharger controls.**

Each supercharger control must be accessible to the pilots or, if there is a separate flight engineer station with a control panel, to the flight engineer.

§ 25.1161 **Fuel jettisoning system controls.**

Each fuel jettisoning system control must have guards to prevent inadvertent operation. No control may be near any fire extinguisher control or other control used to combat fire.

§ 25.1163 **Powerplant accessories.**

(a) Engine-mounted accessories must be approved for installation on the engine concerned and use the provisions on the engine for mounting.

(b) Electrical equipment subject to arcing or sparking must be installed to minimize the probability of contact with any flammable fluids or vapors that might be present in a free state.

(c) If continued rotation of an engine-driven cabin supercharger or of any remote accessory driven by the engine is hazardous if malfunctioning occurs, there must be means to prevent rotation without interfering with the continued operation of the engine.

§ 25.1165 **Engine ignition systems.**

(a) Each battery ignition system must be supplemented by a generator that is automatically available as an alternate source of electrical energy to allow continued engine operation if any battery becomes depleted.

(b) The capacity of batteries and generators must be large enough to meet the simultaneous demands of the engine ignition system and the greatest demands of any electrical system components that draw electrical energy from the same source.

(c) The design of the engine ignition system must account for—

(1) The condition of an inoperative generator;

(2) The condition of a completely depleted battery with the generator running at its normal operating speed; and

(3) The condition of a completely depleted battery with the generator operating at idling speed, if there is only one battery.

(d) Magneto ground wiring (for separate ignition circuits) that lies on the engine side of the fire wall, must be installed, located, or protected, to minimize the probability of simultaneous failure of two or more wires as a result of mechanical damage, electrical faults, or other cause.

(e) No ground wire for any engine may be routed through a fire zone of another engine unless each part of that wire within that zone is fireproof.

(f) Each ignition system must be independent of any electrical circuit not used for analyzing the operation of that system.

(g) There must be means to warn appropriate flight crewmembers if the malfunctioning of any part of the electrical system is causing the continuous discharge of any battery necessary for engine ignition.

POWERPLANT FIRE PROTECTION

§ 25.1181 **Designated fire zones: regions included.**

(a) Designated fire zones are—

(1) The engine power section;

(2) The engine accessory section;

(3) Any complete powerplant compartment in which no isolation is provided between the engine power section and the engine accessory section;

(4) Any auxiliary power unit compartment;

(5) Any fuel-burning heater and other combustion equipment installation described in § 25.859;

(6) The compressor and accessory sections of turbine engines; and

(7) Combustor, turbine, and tailpipe sections of turbine engine installations that contain lines or components carrying flammable fluids or gases.

(b) Each designated fire zone must meet the requirements of §§ 25.1185 through 25.1205.

(c) The nacelle area immediately behind the fire wall must meet the requirements of §§ 25.863, 25.1103(b), 25.1165 (d) and (e), 25.1183, 25.1185(c), 25.1187, 25.1189, and 25.1195 through 25.1203. If there is a retractable landing gear in this area, compliance with this paragraph need be shown only with the landing gear retracted.

§ 25.1183 **Lines and fittings.**

(a) Except as provided in paragraph (b), each line and fitting carrying flammable fluids in any area subject to engine fire conditions, and each fuel line or fitting in a designated fire zone, must meet the following requirements:

(1) The line and fitting must be at least fire resistant.

(2) Flexible hose assembly (hose and end fitting) must be approved.

(b) Paragraph (a) of this section does not apply to—

(1) Lines and fittings forming an integral part of an engine; and

(2) Vent and drain lines, and their fittings, whose failure will not result in, or add to, a fire hazard.

§ 25.1185 **Flammable fluids.**

(a) No tank or reservoir that is part of a system containing flammable fluids or gases may be in a designated fire zone unless the fluid contained, the design of the system, the materials used in the tank, the shutoff means, and all connections, lines, and control provide a degree of safety equal to that which would exist if the tank or reservoir were outside such a zone.

(b) There must be at least one-half inch of clear airspace between each tank or reservoir and each firewall or shroud isolating a designated fire zone.

(c) Absorbent materials close to flammable fluid system components that might leak must be covered or treated to prevent the absorption of hazardous quantities of fluids.

§ 25.1187 **Drainage and ventilation of fire zones.**

(a) There must be complete drainage of each part of each designated fire zone to minimize the hazards resulting from failure or malfunctioning of any component containing flammable fluids. The drainage means must be—

(1) Effective under conditions expected to prevail when drainage is needed; and

(2) Arranged so that no discharged fluid will cause an additional fire hazard.

(b) Each designated fire zone must be ventilated to prevent the accumulation of flammable vapors.

(c) No ventilation opening may be where it would allow the entry of flammable fluids, vapors, or flame from other zones.

(d) Each ventilation means must be arranged so that no discharged vapors will cause an additional fire hazard.

(e) Unless the extinguishing agent capacity and rate of discharge are based on maximum air flow through a zone, there must be means to allow the crew to shut off sources of forced ventilation to any fire zone except the engine power section of the nacelle and the combustion heater ventilating air ducts.

§ 25.1189 **Shutoff means.**

(a) Except for lines forming an integral part of an engine, each engine and each fire zone specified in § 25.1181(a) (4) and (5) must have a means to shut off or otherwise prevent hazardous quantities of fuel, oil, deicer, and other flammable fluids, from flowing into, within, or through any designated fire zone.

(b) The closing of any fuel shutoff valve for any engine may not make fuel unavailable to the remaining engines.

(c) Operation of any shutoff may not interfere with the later emergency operation of other equipment, such as the means for feathering the propeller.

(d) Each shutoff must be outside of designated fire zones, unless an equal degree of safety is otherwise provided.

(e) No hazardous quantity of flammable fluid may drain into any designated fire zone after shutoff.

(f) There must be means to guard against inadvertent operation of the shutoff means and to make it possible for the crew to reopen the shutoff means in flight after it has been closed.

§ 25.1191 Firewalls.

(a) Each engine, auxiliary power unit, fuel-burning heater, other combustion equipment intended for operation in flight, and the combustion, turbine, and tailpipe sections of turbine engines, must be isolated from the rest of the airplane by firewalls, shrouds, or equivalent means.

(b) Each firewall and shroud must be—

(1) Fireproof;

(2) Constructed so that no hazardous quantity of air, fluid, or flame can pass from the compartment to other parts of the airplane;

(3) Constructed so that each opening is sealed with close fitting fireproof grommets, bushings, or firewall fittings; and

(4) Protected against corrosion.

§ 25.1193 Cowling and nacelle skin.

(a) Each cowling must be constructed and supported so that it can resist any vibration, inertia, and air load to which it may be subjected in operation.

(b) Cowling must meet the drainage and ventilation requirements of § 25.1187.

(c) On airplanes with a diaphragm isolating the engine power section from the engine accessory section, each part of the accessory section cowling subject to flame in case of fire in the engine power section of the powerplant must—

(1) Be fireproof; and

(2) Meet the requirements of § 25.1191.

(d) Each part of the cowling subject to high temperatures due to its nearness to exhaust system parts or exhaust gas impingement must be fireproof.

(e) Each airplane must—

(1) Be designed and constructed so that no fire originating in any fire zone can enter, either through openings or by burning through external skin, any other zone or region where it would create additional hazards;

(2) Meet subparagraph (1) of this paragraph with the landing gear retracted (if applicable); and

(3) Have fireproof skin in areas subject to flame if a fire starts in the engine power or accessory sections.

§ 25.1195 Fire extinguishing systems.

(a) Except for combustor, turbine, and tail pipe sections of turbine engine installations that contain lines or components carrying flammable fluids or gases for which it is shown that a fire originating in these sections can be controlled, there must be a fire extinguisher system serving each designated fire zone.

(b) An individual "one shot" fire extinguishing system may be used for auxiliary power units, fuel-burning heaters, and other combustion equipment. The fire extinguishing system, the quantity of extinguishing agent, and the rate of discharge, in other designated fire zones must be able to provide two adequate discharges. It must be possible to direct both discharges to any main engine installation.

(c) The fire-extinguishing system for a nacelle must be able to simultaneously protect each zone of the nacelle for which protection is provided.

§ 25.1197 Fire extinguishing agents.

(a) Extinguishing agents must be methyl bromide, carbon dioxide, or any other agent with equal extinguishing action.

(b) If methyl bromide, carbon dioxide, or any other toxic extinguishing agent is used, provisions must be made to prevent harmful concentrations of fluid or fluid vapors (from leakage during normal operation of the airplane or as a result of discharging the fire extinguisher on the ground or in flight) from entering any personnel compartment, even though a defect may exist in the extinguishing system. This must be shown by test except for built-in carbon dioxide fuselage compartment fire extinguishing systems for which—

(1) Five pounds or less of carbon dioxide will be discharged, under established fire control procedures, into any fuselage compartment; or

(2) There is protective breathing equipment for each flight crewmember on flight deck duty.

(c) Each methyl bromide container must be charged with a dry agent and sealed. This must be done by the fire extinguisher manufacturer or any person using appropriate recharging equipment.

§ 25.1199 Extinguishing agent containers.

(a) Each extinguishing agent container must have a pressure relief to prevent bursting of the container by excessive internal pressures.

(b) Each discharge line from a relief connection must terminate outside the airplane in a location convenient for inspection on the ground.

(c) There must be a visual discharge indicator at the discharge end of each discharge line.

(d) The temperature of each container must be maintained, under intended operating conditions, to prevent the pressure in the container from—

(1) Falling below that necessary to provide an adequate rate of discharge; or

(2) Rising high enough to cause premature discharge.

§ 25.1201 Fire extinguishing system materials.

(a) No material in any fire extinguishing system may react chemically with any extinguishing agent so as to create a hazard.

(b) Each system component in an engine compartment must be fireproof.

§ 25.1203 Fire-detector system.

(a) There must be approved, quick acting fire or overheat detectors in each designated fire zone, and in the combustion, turbine, and tailpipe sections of turbine engine installations, in numbers and locations ensuring prompt detection of fire in those zones.

(b) Each fire detector must be constructed and installed to withstand the vibration, inertia, and other loads to which it may be subjected to in operation.

(c) No fire detector may be affected by any oil, water, other fluids, or fumes that might be present.

(d) There must be means to allow the crew to check, in flight, the functioning of each fire-detector electric circuit.

(e) Wiring and other components of each fire-detector system in a fire zone must be at least fire-resistant.

(f) No fire-detector system component for any fire zone may pass through another fire zone, unless—

(1) It is protected against the possibility of false warnings resulting from fires in zones through which its passes; or

(2) Each zone involved is simultaneously protected by the same detector and extinguishing system.

§ 25.1205 Fire protection: other components.

(a) Surfaces to the rear of the nacelles, within one nacelle diameter of the nacelle centerline, must be at least fire-resistant.

(b) Paragraph (a) of this section does not apply to tail surfaces to the rear of the nacelles that could not be readily affected by heat, flames, or sparks coming from a designated fire zone or engine compartment of any nacelle.

Subpart F—Equipment

GENERAL

§ 25.1301 Function and installation.

Each item of installed equipment must—

(a) Be of a kind and design appropriate to its intended function;

(b) Be labeled as to its identification, function, or operating limitations, or any applicable combination of these factors;

(c) Be installed according to limitations specified for that equipment; and

(d) Function properly when installed.

§ 25.1303 Flight and navigation instruments.

(a) The following are required flight and navigation instruments:

(1) An airspeed indicating system. If airspeed limitations vary with altitude, the indicator must have a maximum allowable airspeed indication showing the variation of V_{MO}/M_{MO} with (i) altitude and (ii) compressibility limitations.

(2) An altimeter (sensitive or precision).

(3) A rate-of-climb indicator (vertical speed).

(4) A free air temperature indicator.

(5) A clock (sweep-second pointer).

(6) A rate-of-turn indicator (gyroscopic, with integral bank or slip indicator).

(7) A bank and pitch indicator (gyroscopically stabilized).

(8) A direction indicator (gyroscopically stabilized, magnetic or nonmagnetic).

(9) A direction indicator (nonstabilized magnetic compass).

(10) A machmeter (for airplanes with compressibility limitations not otherwise indicated under § 25.1545 to the pilot).

(11) A speed warning device (for each turbine engine powered airplane and each other airplane with V_{MO}/M_{MO} greater than 0.8 V_{DF}/M_{DF} or 0.8 V_D/M_D).

(b) The speed warning device required by subparagraph (a)(11) of this section must give effective aural warning (differing distinctively from aural warnings used for other purposes) to the pilots, whenever the speed exceeds V_{MO} plus six knots or $M_{MO}+0.01$. The upper limit of the production tolerance for the warning device may not exceed the prescribed warning speed.

§ 25.1305 Powerplant instruments.

The following are required powerplant instruments:

(a) A carburetor air temperature indicator for each reciprocating engine.

(b) A cylinder head temperature indicator for each air-cooled reciprocating engine.

(c) A gas temperature indicator for each turbine engine.

(d) A manifold pressure indicator for each reciprocating engine.

(e) A fuel pressure indicator (to indicate the pressure at which the fuel is supplied) for each reciprocating engine.

(f) A fuel pressure warning means for each engine, or a master warning means for all engines with provision for isolating the individual warning means from the master warning means.

(g) A fuel flowmeter indicator for each turbine engine.

(h) A fuel flowmeter, or fuel mixture indicator, for each reciprocating engine without an automatic altitude mixture control.

(i) A fuel quantity indicator for each fuel tank.

(j) An augmentation liquid quantity indicator (appropriate for the manner in which the liquid is to be used in operation) for each tank.

(k) An oil quantity indicator for each oil tank.

(l) An oil pressure indicator for each independent pressure oil system of each engine.

(m) An oil pressure warning means for each engine, or a master warning means for all engines with provision for isolating the individual warning means from the master warning means.

(n) An oil temperature indicator for each engine.

(o) A tachometer for each reciprocating engine.

(p) A tachometer (to indicate the speed of the rotors with established limiting speeds) for each turbine engine.

(q) Fire-warning indicators.

(r) An indicator to indicate a change in thrust resulting from any deficiency in the engine, or to indicate a gas stream pressure that can be related to thrust, for each turbojet engine.

(s) A torque indicator for each turbopropeller engine.

(t) A device that indicates, to the flight crew (during flight), any change in the power output, for each reciprocating engine with—

(1) An automatic propeller feathering system, whose operation is initiated by a power output measuring system; or

(2) A total engine piston displacement of 2,000 cubic inches or more.

(u) Position indicating means to indicate to the flight crew when the propeller blade angle is below the flight low pitch position, for each turbopropeller engine propeller.

(v) A means to indicate to the pilot when the propeller is in reverse pitch, for each reversing propeller of reciprocating engines.

(w) A position indicating means to indicate to the flight crew when the thrust reversing device is in the reverse thrust position, for each turbine engine using a thrust reversing device.

§ 25.1307 Miscellaneous equipment.

The following is required miscellaneous equipment:

(a) An approved seat for each occupant.

(b) An approved safety belt for each occupant.

(c) An adequate source of electrical energy.

(d) Electrical protective devices.

(e) A two way radio communication system.

(f) A radio navigation system.

(g) A windshield wiper, or equivalent, for each pilot station.

(h) An ignition switch for each engine meeting the requirements of § 25.1145(b).

(i) An approved portable fire extinguisher.

§ 25.1309 Equipment systems and installations.

(a) The equipment systems and installations whose functioning is required by this subchapter, must be designed and installed to ensure that they perform their intended functions under any foreseeable operating condition.

(b) The equipment systems and installations must be designed to prevent hazards to the airplane if they malfunction or fail.

(c) Each installation whose functioning is required by this subchapter, and that requires a power supply, is an "essential load" on the power supply. The power sources and the system must be able to supply the following power loads in probable operating combinations and for probable durations:

(1) Loads connected to the system with the system functioning normally.

(2) Essential loads, after failure of any one prime mover, power converter, or energy storage device.

(3) Essential loads after failure of—

(i) Any one engine, on two- or three-engine airplanes; and

(ii) Any two engines on four-or-more-engine airplanes.

(d) In determining compliance with paragraph (c) (2) and (3) of this section, the power loads may be assumed to be reduced under a monitoring procedure consistent with safety in the kinds of operation authorized. Loads not required in controlled flight need not be considered for the two-engine-inoperative condition on airplanes with four or more engines.

(e) In showing compliance with paragraphs (a) and (b) of this section with regard to the electrical system and equipment design and installation, critical environmental conditions must be considered. For electrical generation, distribution, and utilization equipment required by or used in complying with this chapter, except equipment covered by Technical Standard Orders containing environmental test procedures, the ability to provide continuous, safe service under foreseeable environmental conditions may be shown by environmental tests, design analysis, or reference to previous comparable service experience on other aircraft.

INSTRUMENTS: INSTALLATION

§ 25.1321 Arrangement and visibility.

(a) Duplicate instrument arrangements at two or more crew stations may be used—

(1) To meet the instrument visibility requirements of this section; and

(2) If required by the operating rules of this chapter for reliability, or cross-check purposes, in particular kinds of operations.

(b) Each flight, navigation, and powerplant instrument for use by any pilot must be plainly visible to him from his station with the minimum practicable deviation from his normal position and line of vision when he is looking forward along the flight path.

(c) The flight instruments required by § 25.1303 must be grouped on the instrument panel and centered as nearly as practicable about the vertical plane of the pilot's forward vision. In addition—

(1) The instrument that most effectively indicates attitude must be on the panel in the top center position;

(2) The instrument that most effectively indicates airspeed must be adjacent to and directly to the left of the instrument in the top center position;

(3) The instrument that most effectively indicates altitude must be adjacent to and directly to the right of the instrument in the top center position; and

(4) The instrument that most effectively indicates direction of flight must be adjacent to and directly below the instrument in the top center position.

(d) Required powerplant instruments must be closely grouped on the instrument panel. In addition—

(1) The location of identical powerplant instruments for the engines must prevent confusion as to which engine each instrument relates; and

(2) Powerplant instruments vital to the safe operation of the airplane must be plainly visible to the appropriate crewmembers.

(e) Instrument panel vibration may not damage or impair the accuracy of any instrument.

§ 25.1323 Airspeed indicating system.

For each airspeed indicating system, the following apply:

(a) Each airspeed indicating instrument must be approved and must be calibrated to indicate true airspeed (at sea level with a standard atmosphere) with a minimum practicable instrument calibration error when the corresponding pitot and static pressures are applied.

(b) Each system must be calibrated to determine the system error (that is, the relation between IAS and CAS) in flight and during the accelerated takeoff ground run. The ground run calibration must be determined—

(1) From 0.8 of the minimum value of V_1 to the maximum value of V_2, considering the approved ranges of altitude and weight; and

(2) With the flaps and power settings corresponding to the values determined in the establishment of the takeoff path under § 25.59 or § 25.111 assuming that the critical engine fails at the minimum value of V_1.

(c) The airspeed error of the installation, excluding the airspeed indicator instrument calibration error, may not exceed three percent or five knots, whichever is greater, throughout the speed range, from—

(1) V_{MO} to 1.3 V_{S_1} with flaps retracted; and

(2) 1.3 V_{S_0} to V_{FE} with flaps in the landing position.

(b) Each system must be arranged, so far as practicable, to prevent malfunction or serious error due to the entry of moisture, dirt, or other substances.

(e) Each system must have a heated pitot tube or an equivalent means of preventing malfunction due to icing.

(f) Where duplicate airspeed indicators are required, their respective pitot tubes must be far enough apart to avoid damage to both tubes in a collision with a bird.

§ 25.1325 Static air vent and pressure altimeter systems.

(a) Each instrument with static air case connections must be vented to the outside atmosphere through an appropriate piping system.

(b) Each vent must be located where its orifices are least affected by airflow variation moisture, or other foreign matter.

(c) Except for the vent into the atmosphere, each system must be airtight.

(d) Each pressure altimeter must be approved and must be calibrated to indicate pressure altitude in a standard atmosphere, with a minimum practicable calibration error when the corresponding static pressures are applied.

(e) Each system must be designed and installed so that the error in indicated pressure altitude, at sea level, with a standard atmosphere, excluding instrument calibration error, does not result in an error of more than ±30 feet per 100 knots speed for the appropriate configuration in the speed range between 1.3 V_{S_0} with flaps extended and 1.8 V_{S_1} with flaps retracted. However, the error need not be less than ±30 feet.

§ 25.1327 Magnetic direction indicator.

(a) Each magnetic direction indicator must be installed so that its accuracy is not excessively affected by the airplane's vibration or magnetic fields.

(b) The compensated installation may not have a deviation, in level flight, greater than 10 degrees on any heading.

§ 25.1329 Automatic pilot system.

(a) Each automatic pilot system must be approved and must be designed so that the automatic pilot can be quickly and positively disengaged by the pilots to prevent it from interfering with their control of the airplane.

(b) Unless there is automatic synchronization, each system must have a means to readily indicate to the pilot the alignment of the actuating device in relation to the control system it operates.

(c) Each manually operated control for the system must be readily accessible to the pilots.

(d) Quick release (emergency) controls must be on both control wheels, on the side of each wheel opposite the throttles.

(e) Attitude controls must operate in the plane and sense of motion specified in §§ 25.777(b) and 25.779(a) for cockpit controls. The direction of motion must be plainly indicated on, or adjacent to, each control.

(f) The system must be designed and adjusted so that, within the range of adjustment available to the human pilot, it cannot produce hazardous loads on the airplane, or create hazardous deviations in the flight path, under any condition of flight appropriate to its use, either during normal operation or in the event of a malfunction, assuming that corrective action begins within a reasonable period of time.

(g) If the automatic pilot integrates signals from auxiliary controls or furnishes signals for operation of other equipment, there must be positive interlocks and sequencing of engagement to prevent improper operation. Protection against adverse interaction of integrated components, resulting from a malfunction, is also required.

§ 25.1331 Instruments using a power supply.

(a) For each rate-of-turn, bank and pitch, and direction indicator required by § 25.1303(a) (6), (7), and (8), that uses a power supply, the following apply:

(1) Each instrument must have a visual means integral with, or adjacent to, the instrument, to indicate when power adequate to sustain proper instrument performance is not being supplied. The power must be measured at or near the point where it enters the instruments. For electric instruments, the power is considered to be adequate when the voltage is within approved limits.

(2) Each instrument must have two independent power sources and a means for selecting either source. For duplicate independent instruments with independent power sources, source selection is not required.

(3) Each instrument and its related power supply system must be designed and installed so that failure of one instrument, or the failure of the energy supply from one source, or a fault in any part of the power distribution system, does not interfere with the proper supply of energy from the other source.

(b) As used in this section, "instrument" includes devices that are physically contained in one unit, and devices that are composed of two or more physically separate units or components connected together (such as a remote indicating gyroscopic direction indicator that includes a magnetic sensing element, a gyroscopic unit, an amplifier, and an indicator connected together).

§ 25.1333 Duplicate instrument systems.

If duplicate flight instruments are required by any operating rule in this chapter—

(a) Each operating system for flight instruments for the first pilot, and required to be duplicated at other flight crew stations, must be independent of the operating system for other flight crew stations;

(b) Only the required flight instruments, and duplicates of required instruments, provided for the first pilot may be connected to the operating system provided for the first pilot; and

(c) If instruments other than required instruments and their duplicates are connected to systems other than the first pilot's operating system, there must be means to disconnect or isolate these instruments in flight.

§ 25.1337 Powerplant instruments.

(a) *Instrument lines.* Each powerplant instrument line must meet the requirements of §§ 25.993 and 25.1183. Each line carrying flammable fluids or gases under pressure must have restricting orifices or equivalent safety devices, at the source of the pressure, to prevent the escape of excessive fluid or gas if the line fails.

(b) *Fuel quantity indicator.* There must be means to indicate to the flight crewmembers, the quantity, in gallons or equivalent units, of usable fuel in each tank during flight. In addition—

(1) Each fuel quantity indicator must be calibrated to read "zero" during level flight when the quantity of fuel remaining in the tank is equal to the unusable fuel supply determined under § 25.959;

(2) Tanks with interconnected outlets and airspaces may be treated as one tank and need not have separate indicators; and

(3) Each exposed sight gauge, used as a fuel quantity indicator, must be protected against damage.

(c) *Fuel flowmeter system.* If a fuel flowmeter system is installed, each metering component must have a means for bypassing the fuel supply if malfunction of that component severely restricts fuel flow.

(d) *Oil quantity indicator.* There must be a stick gauge or equivalent means to indicate the quantity of oil in each tank. If an oil transfer or reserve oil supply system is installed, there must be a means to indicate to the flight crew, in flight, the quantity of oil in each tank.

(e) *Turbopropeller blade position indicator.* Required turbopropeller blade position indicators must begin indicating before the blade moves more than eight degrees below the flight low pitch stop. The source of indication must directly sense the blade position.

(f) *Fuel pressure indicator.* There must be means to measure fuel pressure, in each system supplying reciprocating engines, at a point downstream of any fuel pump except fuel injection pumps. In addition—

(1) If necessary for the maintenance of proper fuel delivery pressure, there must be a connection to transmit the carburetor air intake static pressure to the proper pump relief valve connection; and

(2) If a connection is required under subparagraph (1) of this paragraph, the gauge balance lines must be independently connected to the carburetor inlet pressure to avoid erroneous readings.

ELECTRICAL SYSTEMS AND EQUIPMENT

§ 25.1351 General.

(a) *Electrical system capacity.* The required generating capacity, and number and kinds of power sources must—

(1) Be determined by an electrical load analysis; and

(2) Meet the requirements of § 25.1309.

(b) *Generating system.* The generating system includes electrical power sources, main power busses, transmission cables, and associated control, regulation, and protective devices. It must be designed so that—

(1) Power sources function properly when independent and when connected in combination;

(2) No failure or malfunction of any power source can create a hazard or impair the ability of remaining sources to supply essential loads;

(3) The system voltage and frequency (as applicable) at the terminals of all essential load equipment can be maintained within the limits for which the equipment is designed, during any probable operating condition; and

(4) System transients due to switching, fault clearing, or other causes do not make essential loads inoperative, and do not cause a smoke or fire hazard.

(5) There are means accessible, in flight, to appropriate crewmembers for the individual and collective disconnection of the electrical power sources from the system.

(6) There are means to indicate to appropriate crewmembers the generating system quantities essential for the safe operation of the system, such as the voltage and current supplied by each generator.

§ 25.1353 Electrical equipment and installations.

(a) Electrical equipment, controls, and wiring must be installed so that operation of any one unit or system of units will not adversely affect the simultaneous operation of any other electrical unit or system essential to the safe operation.

(b) Cables must be grouped, routed, and spaced so that damage to essential circuits will be minimized if there are faults in heavy current-carrying cables.

(c) Storage batteries must be designed and installed as follows:

(1) Safe cell temperatures and pressures must be maintained during any probable charging or discharging condition. No uncontrolled increase in cell temperature may result when the battery is recharged (after previous complete discharge)—

(i) At maximum regulated voltage;

(ii) During a flight of maximum duration; and

(iii) Under the most adverse cooling condition likely to occur in service.

(2) Compliance with subparagraph (1) of this paragraph must be shown by test unless experience with similar batteries and installations has shown that maintaining safe cell temperatures and pressures presents no problem.

(3) No explosive or toxic gases emitted by any battery in normal operation, or as the result of any probable malfunction in the charging system or battery installation, may accumulate in hazardous quantities within the airplane.

(4) No corrosive fluids or gases that may escape from the battery may damage surrounding airplane structures or adjacent essential equipment.

§ 25.1355 Distribution system.

(a) The distribution system includes the distribution busses, their associated feeders, and each control and protective device.

(b) Each system must be designed so that essential load circuits can be supplied in the event of reasonably probable faults or open circuits.

(c) If two independent sources of electrical power for particular equipment or systems are required by this chapter, their electrical energy supply must be ensured by means such as duplicate electrical equipment, throwover switching, or multi-channel or loop circuits separately routed.

§ 25.1357 Circuit protective devices.

(a) Automatic protective devices must be used to minimize distress to the electrical system and hazard to the airplane in the event of wiring faults or serious malfunction of the system or connected equipment.

(b) The protective and control devices in the generating system must be designed to de-energize and disconnect faulty power sources and power transmission equipment from their associated busses with sufficient rapidity to provide protection from hazardous over-voltage and other malfunctioning.

(c) Each resettable circuit protective device must be designed so that, when an overload or circuit fault exists, it will open the circuit irrespective of the position of the operating control.

(d) If the ability to reset a circuit breaker or replace a fuse is essential to safety in flight, that circuit breaker or fuse must be located and identified so that it can be readily reset or replaced in flight.

(e) Each circuit for essential loads must have individual circuit protection. However, individual protection for each circuit in an essential load system (such as each position light circuit in a system) is not required.

(f) If fuses are used, there must be spare fuses for use in flight equal to at least 50 percent of the number of fuses of each rating required for complete circuit protection.

(g) Automatic reset circuit breakers may be used as integral protectors for electrical equipment (such as thermal cut-outs) if there is circuit protection to protect the cable to the equipment.

§ 25.1359 Electrical system fire and smoke protection.

(a) Components of the electrical system must meet the applicable fire and smoke protection requirements of §§ 25.831(c), 25.863, and 25.1205.

(b) Electrical cables, terminals, and equipment in designated fire zones, that are used during emergency procedures, must be at least fire-resistant.

§ 25.1363 Electrical system tests.

(a) When laboratory tests of the electrical system are conducted—

(1) The tests must be performed on a mock-up using the same generating equipment used in the airplane;

(2) The equipment must simulate the electrical characteristics of the distribution wiring and connected loads to the extent necessary for valid test results; and

(3) Laboratory generator drives must simulate the actual prime movers on the airplane with respect to their reaction to generator loading, including loading due to faults.

(b) For each flight condition that cannot be simulated adequately in the laboratory or by ground tests on the airplane, flight tests must be made.

§ 25.1369 Lightning strike protection.

Parts that are electrically insulated from the basic airframe must be connected to it through lightning arrestors unless a lightning strike on the insulated part—

(a) Is improbable because of shielding by other parts; or

(b) Is not hazardous.

LIGHTS

§ 25.1381 Instrument lights.

(a) The instrument lights must—

(1) Make each instrument, switch, and other device for which they are provided easily readable; and

(2) Be installed so that—

(i) Their direct rays are shielded from the pilot's eyes; and

(ii) No objectionable reflections are visible to the pilot.

(b) Unless undimmed instrument lights are satisfactory under each expected flight condition, there must be a means to control the intensity of illumination.

§ 25.1383 Landing lights.

(a) Each landing light must be approved, and must be installed so that—

(1) No objectionable glare is visible to the pilot;

(2) The pilot is not adversely affected by halation; and

(3) It provides enough light for night landing.

(b) Except when one switch is used for the lights of a multiple light installation at one location, there must be a separate switch for each light.

(c) There must be a means to indicate to the pilots when the landing lights are extended.

§ 25.1385 Position light system installation.

(a) *General.* Each part of each position light system must meet the applicable requirements of this section and each system as a whole must meet the requirements of §§ 25.1387 through 25.1397.

(b) *Forward position lights.* Forward position lights must consist of a red and a green light spaced laterally as far apart as practicable and installed forward on the airplane so that, with the airplane in the normal flying position, the red light is on the left side and the green light is on the right side. Each light must be approved.

(c) *Rear position light.* The rear position light must be a white light mounted as far aft as practicable, and must be approved.

(d) *Light covers and color filters.* Each light cover or color filter must be at least flame resistant and may not change color or shape or lose any appreciable light transmission during normal use.

(e) *Passing light.* If an additional steady red light (commonly known as a passing light) is installed, it must be—

(1) Within the left landing light unit;

(2) On the centerline of the airplane nose; or

(3) In the leading edge of the left wing, outboard of the propeller disc.

§ 25.1387 Position light system dihedral angles.

(a) Each forward and rear position light must, as installed, show unbroken light within the dihedral angles described in this section.

(b) Dihedral angle *L* (left) is formed by two intersecting vertical planes, the first parallel to the longitudinal axis of the airplane, and the other at 110 degrees to the left of the first, as viewed when looking forward along the longitudinal axis.

(c) Dihedral angle *R* (right) is formed by two intersecting vertical planes, the first parallel to the longitudinal axis of the airplane, and the other at 110 degrees to the right of the first, as viewed when looking forward along the longitudinal axis.

(d) Dihedral angle *A* (aft) is formed by two intersecting vertical planes making angles of 70 degrees to the right and to the left, respectively, to a vertical plane passing through the longitudinal axis, as viewed when looking aft along the longitudinal axis.

§ 25.1389 Position light distribution and intensities.

(a) *General.* The intensities prescribed in this section must be provided by new equipment with light covers and color filters in place. Intensities must be determined with the light source operating at a steady value equal to the average luminous output of the source at the normal operating voltage of the airplane. The light distribution and intensity of each position light must meet the requirements of paragraph (b) of this section.

(b) *Forward and rear position lights.* The light distribution and intensities of forward and rear position lights must be expressed in terms of minimum intensities in the horizontal plane, minimum intensities in any vertical plane, and maximum intensities in overlapping beams, within dihedral angles *L*, *R*, and *A*, and must meet the following requirements:

(1) *Intensities in the horizontal plane.* Each intensity in the horizontal plane (the plane containing the longitudinal axis of the airplane and perpendicular to the plane of symmetry of the airplane) must equal or exceed the values in § 25.1391.

(2) *Intensities in any vertical plane.* Each intensity in any vertical plane (the plane perpendicular to the horizontal plane) must equal or exceed the appropriate value in § 25.1393, where *I* is the minimum intensity prescribed in § 25.1391 for the corresponding angles in the horizontal plane.

(3) *Intensities in overlaps between adjacent signals.* No intensity in any overlap between adjacent signals may exceed the values given in § 25.1395, except that higher intensities in overlaps may be used with main beam intensities substantially greater than the minima specified in §§ 25.1391 and 25.1393 if the overlap intensities in relation to the main beam intensities do not adversely affect signal clarity. When the peak intensity of the forward position lights is more than 100 candles, the maximum overlap intensities between them may exceed the values given in § 25.1395 if the overlap intensity in Area A is not more than 10 percent of peak position light intensity and the overlap intensity in Area B is not greater than 2.5 percent of peak position light intensity.

§ 25.1391 Minimum intensities in the horizontal plane of forward and rear position lights.

Each position light intensity must equal or exceed the applicable values in the following table:

Dihedral angle (light included)	Angle from right or left of longitudinal axis, measured from dead ahead	Intensity (candles)
L and *R* (forward red and green).	0° to 10°	40
	10° to 20°	30
	20° to 110°	5
A (rear white)	110° to 180°	20

§ 25.1393 Minimum intensities in any vertical plane of forward and rear position lights.

Each position light intensity must equal or exceed the applicable values in the following table:

Angle above or below the horizontal plane:	*Intensity*
0°	1.00 *I*.
0° to 5°	0.90 *I*.
5° to 10°	0.80 *I*.
10° to 15°	0.70 *I*.
15° to 20°	0.50 *I*.
20° to 30°	0.30 *I*.
30° to 40°	0.10 *I*.
40° to 90°	0.05 *I*.

§ 25.1395 Maximum intensities in overlapping beams of forward and rear position lights.

No position light intensity may exceed the applicable values in the following table, except as provided in § 25.1389 (b) (3).

Overlaps	Maximum intensity	
	Area A (candles)	Area B (candles)
Green in dihedral angle *L*	10	1
Red in dihedral angle *R*	10	1
Green in dihedral angle *A*	5	1
Red in dihedral angle *A*	5	1
Rear white in dihedral angle *L*	5	1
Rear white in dihedral angle *R*	5	1

Where—

(a) Area A includes all directions in the adjacent dihedral angle that pass through the light source and intersect the common boundary plane at more than 10 degrees but less than 20 degrees; and

(b) Area B includes all directions in the adjacent dihedral angle that pass through the light source and intersect the common boundary plane at more than 20 degrees.

§ 25.1397 **Color specifications.**

Each position light color must have the applicable International Commission on Illumination chromaticity coordinates as follows:

(a) *Aviation red—*

"y" is not greater than 0.335; and
"z" is not greater than 0.002.

(b) *Aviation green—*

"x" is not greater than $0.440-0.320y$;
"x" is not greater than $y-0.170$; and
"y" is not less than $0.390-0.170x$.

(c) *Aviation white—*

"x" is not less than 0.350;
"x" is not greater than 0.540; and
"$y-y_0$" is not numerically greater than 0.01, "y_0" being the y coordinate of the Planckian radiator for which $x_0=x$.

§ 25.1399 **Riding light.**

(a) Each riding (anchor) light required for a seaplane or amphibian must be installed so that it can—

(1) Show a white light for at least two nautical miles at night under clear atmospheric conditions; and

(2) Show the maximum unbroken light practicable when the airplane is moored or drifting on the water.

(b) Externally hung lights may be used.

§ 25.1401 **Anticollision light system.**

(a) *General.* The airplane must have an anticollision light system that—

(1) Consists of one or more approved anticollision lights located so that their light will not impair the crew's vision or detract from the conspicuity of the position lights; and

(2) Meets the requirements of paragraphs (b) through (f) of this section.

(b) *Field of coverage.* The system must consist of enough lights to illuminate the vital areas around the airplane considering the physical configuration and flight characteristics of the airplane. The field of coverage must extend in each direction within at least 30 degrees above and 30 degrees below the horizontal plane of the airplane, except that a solid angle or angles of obstructed visibility totaling not more than 0.03 steradians is allowable within a solid angle equal to 0.15 steradians centered about the longitudinal axis in the rearward direction.

(c) *Flashing characteristics.* The arrangement of the system, that is, the number of light sources, beam width, speed of rotation, and other characteristics, must give an effective flash frequency of not less than 40, nor more than 100, cycles per minute. The effective flash frequency is the frequency at which the airplane's complete anticollision light system is observed from a distance, and applies to each sector of light including any overlaps that exist when the system consists of more than one light source. In overlaps, flash frequencies may exceed 100, but not 180, cycles per minute.

(d) *Color.* Each anticollision light must be aviation red and must meet the requirements of § 25.1397(a).

(e) *Light intensity.* The minimum light intensities in all vertical planes, measured with the red filter and expressed in terms of "effective" intensities, must meet the requirements of paragraph (f) of this section. The following relation must be assumed:

$$I_e=\frac{\int_{t_1}^{t_2} I(t)\,dt}{0.2+(t_2-t_1)};$$

where:

I_e=effective intensity (candles).
$I(t)$=instantaneous intensity as a function of time.
t_2-t_1=flash time interval (seconds).

Normally, the maximum value of effective intensity is obtained when t_2 and t_1 are chosen so that the effective intensity is equal to the instantaneous intensity at t_2 and t_1.

(f) *Minimum effective intensities for anticollision lights.* Each anticollision light effective intensity must equal or exceed the applicable values in the following table.

Angle above or below the horizontal plane:	*Effective intensity (candles)*
0° to 5°	100
5° to 10°	60
10° to 20°	20
20° to 30°	10

SAFETY EQUIPMENT

§ 25.1411 **General.**

(a) *Accessibility.* Required safety equipment to be used by the crew in an emergency, such as automatic liferaft releases, must be readily accessible.

(b) *Stowage provisions.* Stowage provisions for required emergency equipment must be furnished and must—

(1) Be arranged so that the equipment is directly accessible and its location is obvious; and

(2) Protect the safety equipment from inadvertent damage.

(c) *Emergency exit descent device.* The stowage provisions for the emergency exit descent device required by § 25.807(c)(4) must be at the exits for which they are intended.

(d) *Liferafts.* The stowage provisions for the liferafts described in § 25.1415 must accommodate enough rafts for the maximum number of occupants for which certification for ditching is requested. Liferafts must be stowed near exits through which the rafts can be launched during an unplanned ditching. Rafts automatically or remotely released outside the airplane must be attached to the airplane by means of the static line prescribed in § 25.1415.

(e) *Long-range signaling device.* The stowage provisions for the long-range signaling device required by § 25.1415 must be near an exit available during an unplanned ditching.

(f) *Life preserver stowage provisions.* The stowage provisions for life preservers described in § 25.1415 must accommodate one life preserver for each occupant for which certification for ditching is requested. Each life preserver must be within easy reach of each seated occupant.

(g) *Life line stowage provisions.* If certification for ditching under § 25.801 is requested, there must be provisions to store life lines. These provisions must—

(1) Allow one life line to be attached to each side of the fuselage; and

(2) Be arranged to allow the life lines to be used to enable the occupants to stay on the wing after ditching.

§ 25.1413 **Safety belts.**

(a) If there are means to indicate to the passengers when safety belts should be fastened, they must be installed to be operated from either pilot seat.

(b) The rated strength of safety belts may not be less than that required to withstand the ultimate load factors specified in § 25.561, considering the dimensional characteristics of the belt installation for the specific seat or berth arrangement.

(c) Each belt must be attached so that no part of the anchorage can fail at a load lower than that which would result from the application of ultimate load factors equal to those specified in § 25.561, multiplied by a factor of 1.33. This factor must be used instead of the fitting factor prescribed in § 25.625. The forward load factor need not be applied to safety belts for berths.

§ 25.1415 **Ditching equipment.**

(a) Ditching equipment used in airplanes to be certificated for ditching under § 25.801, and operated under the operating rules of this chapter, must meet the requirements of this section.

(b) Each liferaft and each life preserver must be approved. In addition—

(1) Unless excess rafts of enough capacity are provided, the buoyancy and seating capacity beyond the rated capacity of the rafts must accommodate all occupants of the airplane in the event of a loss of one raft of the largest rated capacity; and

(2) Each raft must have a trailing line, and must have a static line designed to hold the raft near the airplane but to release it if the airplane becomes totally submerged.

(c) Approved survival equipment must be attached to each liferaft.

(d) There must be an approved long-range signaling device for use in one liferaft.

(e) For airplanes not certificated for ditching under § 25.801 and not having approved life preservers, there must be an approved flotation means for each occupant. This means must be within easy reach of each seated occupant and must be readily removable from the airplane.

§ 25.1419 **Ice protection.**

(a) If certification with ice protection provisions is desired, compliance with this section must be shown.

(b) The airplane must be able to safely operate in the continuous maximum and intermittent maximum icing conditions determined under Appendix C. An analysis must be performed to establish, on the basis of the airplane's operational needs, the adequacy of the ice protection system for the various components of the airplane.

(c) In addition to the analysis and physical evaluation prescribed in paragraph (b) of this section, the effectiveness of the ice protection system and its components must be shown by—

(1) Laboratory dry air or simulated icing tests, or a combination of both, of the components or models of the components;

(2) Flight dry air tests of the ice protection system as a whole, or of its individual components;

(3) Flight tests of the airplane or its components in measured simulated icing conditions; or

(4) Flight tests of the airplane in measured natural atmospheric icing conditions.

(d) For turbine engine powered airplanes, the ice protection provisions of this section are considered to be applicable primarily to the airframe. For the powerplant installation, certain additional provisons of Subpart E of this part may be found applicable.

MISCELLANEOUS EQUIPMENT

§ 25.1431 Electronic equipment.

(a) In showing compliance with § 25.1309 (a) and (b) with respect to radio and electronic equipment and their installations, critical environmental conditions must be considered.

(b) Radio and electronic equipment must be supplied with power under the requirements of § 25.1355(c).

(c) Radio and electronic equipment, controls, and wiring must be installed so that operation of any one unit or system of units will not adversely affect the simultaneous operation of any other radio or electronic unit, or system of units, required by this chapter.

§ 25.1433 Vacuum systems.

(a) There must be means, in addition to the normal pressure relief, to automatically relieve the pressure in the discharge lines from the vacuum air pump when the delivery temperature of the air becomes unsafe.

(b) Each vacuum air system line and fitting on the discharge side of the pump that might contain flammable vapors or fluids must meet the requirements of § 25.1183 if they are in a designated fire zone.

(c) Other vacuum air system components in designated fire zones must be at least fire resistant.

§ 25.1435 Hydraulic systems.

(a) *Design.* Each hydraulic system must be designed as follows:

(1) Each element of the hydraulic system must be designed to withstand, without detrimental, permanent deformation, any structural loads that may be imposed simultaneously with the maximum operating hydraulic loads.

(2) Each element of the hydraulic system must be designed to withstand pressures sufficiently greater than those prescribed in paragraph (b) of this section to show that the system will not rupture under service conditions.

(3) There must be means to indicate the pressure in each main hydraulic power system.

(4) There must be means to ensure that no pressure in any part of the system will exceed a safe limit above the maximum operating pressure of the system, and to prevent excessive pressures resulting from any fluid volumetric change in lines likely to remain closed long enough for such a change to take place. The possibility of detrimental transient (surge) pressures during operation must be considered.

(5) Each hydraulic line, fitting, and component must be installed and supported to prevent excessive vibration and to withstand inertia loads. Each element of the installation must be protected from abrasion, corrosion, and mechanical damage.

(6) Means for providing flexibility must be used to connect points in a hydraulic fluid line, between which relative motion or differential vibration exists.

(b) *Tests.* Each element of the system must be tested to a proof pressure of 1.5 times the maximum pressure to which that element will be subjected in normal operation, without failure, malfunction, or detrimental deformation of any part of the system.

(c) *Fire protection.* Each hydraulic system using flammable hydraulic fluid must meet the applicable requirements of §§ 25.863, 25.1183, 25.1185, and 25.1189.

§ 25.1439 Protective breathing equipment.

(a) If there is a class A, B, or E cargo compartment, protective breathing equipment must be installed for the use of appropriate crewmembers.

(b) For protective breathing equipment required by paragraph (a) of this section or by any operating rule of this chapter, the following apply:

(1) The equipment must be designed to protect the flight crew from smoke, carbon dioxide, and other harmful gases while on flight deck duty and while combating fires in cargo compartments.

(2) The equipment must include—

(i) Masks covering the eyes, nose, and mouth; or

(ii) Masks covering the nose and mouth, plus accessory equipment to cover the eyes.

(3) The equipment, while in use, must allow the flight crew to use the radio equipment and to communicate with each other, while at their assigned duty stations.

(4) The part of the equipment protecting the eyes may not cause any appreciable adverse effect on vision and must allow corrective glasses to be worn.

(5) The equipment must supply protective oxygen of 15 minutes duration per crewmember at a pressure altitude of 8,000 feet with a respiratory minute volume of 30 liters per minute BTPD. If a demand oxygen system is used, a supply of 300 liters of free oxygen at 70° F. and 760 mm. Hg. pressure is considered to be of 15-minute duration at the prescribed altitude and minute volume. If a continuous flow protective breathing system is used (including a mask with a standard rebreather bag) a flow rate of 60 liters per minute at 8,000 feet (45 liters per minute at sea level) and a supply of 600 liters of free oxygen at 70° F. and 760 mm. Hg. pressure is considered to be of 15-minute duration at the prescribed altitude and minute volume. BTPD refers to body temperature conditions (that is, 37° C., at ambient pressure, dry).

(6) The equipment must meet the requirements of paragraphs (b) and (c) of § 25.1441.

§ 25.1441 Oxygen equipment and supply.

(a) If certification with supplemental oxygen equipment is requested, the equipment must meet the requirements of this section and §§ 25.1443 through 25.1453.

(b) The oxygen system must be free from hazards in itself, in its method of operation, and in its effect upon other components.

(c) There must be a means to allow the crew to readily determine, during flight, the quantity of oxygen available in each source of supply.

(d) The oxygen flow rate and the oxygen equipment for airplanes for which certification for operation above 40,000 feet is requested must be approved.

§ 25.1443 Minimum mass flow of supplemental oxygen.

(a) If continuous flow equipment is installed for use by flight crewmembers, the minimum mass flow of supplemental oxygen required for each crewmember may not be less than the flow required to maintain, during inspiration, a mean tracheal oxygen partial pressure of 149 mm. Hg. when breathing 15 liters per minute, BTPS, and with a maximum tidal volume of 700 cc. with a constant time interval between respirations.

(b) If demand equipment is installed for use by flight crewmembers, the minimum mass flow of supplemental oxygen required for each crewmember may not be less than the flow required to maintain, during inspiration, a mean tracheal oxygen partial pressure of 122 mm. Hg., up to and including a cabin pressure altitude of 35,000 feet, and 95 percent oxygen between cabin pressure altitudes of 35,000 and 40,000 feet, when breathing 20 liters per minute BTPS. In addition, there must be means to allow the crew to use undiluted oxygen at their discretion.

(c) For passengers and cabin attendants, the minimum mass flow of supplemental oxygen required for each person at various cabin pressure altitudes may not be less than the flow required to maintain, during inspiration and while using the oxygen equipment (including masks) provided, the following mean tracheal oxygen partial pressures:

(1) At cabin pressure altitudes above 10,000 feet up to and including 18,500 feet, a mean tracheal oxygen partial pressure of 100 mm. Hg. when breathing 15 liters per minute, BTPS, and with a tidal volume of 700 cc. with a constant time interval between respirations.

(2) At cabin pressure altitudes above 18,500 feet up to and including 40,000 feet, a mean tracheal oxygen partial pressure of 83.8 mm. Hg. when breathing

30 liters per minute, BTPS, and with a tidal volume of 1,100 cc. with a constant time interval between respirations.

(d) If first-aid oxygen equipment is installed, the minimum mass flow of oxygen to each user may not be less than four liters per minute, STPD. However, there may be a means to decrease this flow to not less than two liters per minute, STPD, at any cabin altitude. The quantity of oxygen required is based upon an average flow rate of three liters per minute per person for whom first-aid oxygen is required.

(e) If portable oxygen equipment is installed for use by crewmembers, the minimum mass flow of supplemental oxygen is the same as specified in paragraph (a) or (b) of this section, whichever is applicable.

§ 25.1445 Equipment standards for the oxygen distributing system.

(a) When oxygen is supplied to both crew and passengers, the distribution system must be designed for either—

(1) A source of supply for the flight crew on duty and a separate source for the passengers and other crewmembers; or

(2) A common source of supply with means to separately reserve the minimum supply required by the flight crew on duty.

(b) Portable walk-around oxygen units of the continuous flow, diluter-demand, and straight demand kinds may be used to meet the crew or passenger breathing requirements.

§ 25.1447 Equipment standards for oxygen dispensing units.

If oxygen dispensing units are installed, the following apply:

(a) There must be an individual dispensing unit for each occupant for whom supplemental oxygen is to be supplied. Units must be designed to cover the nose and mouth and must be equipped with a suitable means to retain the unit in position on the face. Flight crew masks for supplemental oxygen must have provisions for the use of communication equipment.

(b) If certification for operation up to and including 25,000 feet is requested, an oxygen supply terminal and unit of oxygen dispensing equipment for the immediate use of oxygen by each crewmember must be within easy reach of that crewmember. For any other occupants, the supply terminals and dispensing equipment must be located to allow the use of oxygen as required by the operating rules in this chapter.

(c) If certification for operation above 25,000 feet is requested, there must be oxygen dispensing equipment meeting the following requirements:

(1) There must be an oxygen dispensing unit connected to oxygen supply terminals immediately available to each occupant, wherever seated. If certification for operation above 30,000 feet is requested, the dispensing units providing the required oxygen flow rate must be automatically presented to the occupants. The total number of dispensing units and outlets must exceed the number of seats by at least 10 percent. The extra units must be as uniformly distributed throughout the cabin as practicable.

(2) Crewmembers on flight deck duty must be provided with demand equipment. In addition, there must be an oxygen dispensing unit, connected to an oxygen supply terminal, immediately available to each flight crewmember when seated at his station.

(3) There must be at least two outlets and units of dispensing equipment of a type similar to that required by subparagraph (1) of this paragraph in—

(i) Each washroom; and

(ii) Each lavatory, if separate from the washroom.

(4) Portable oxygen equipment must be immediately available for each cabin attendant.

§ 25.1449 Means for determining use of oxygen.

There must be a means to allow the crew to determine whether oxygen is being delivered to the dispensing equipment.

§ 25.1451 Fire protection for oxygen equipment.

(a) Oxygen equipment and lines may not be in any designated fire zone.

(b) Oxygen equipment and lines must be protected from heat that may be generated in, or escape from, any designated fire zone.

(c) Oxygen equipment and lines must be installed so that escaping oxygen cannot cause ignition of grease, fluid, or vapor accumulations that are present in normal operation or as a result of failure or malfunction of any system.

§ 25.1453 Protection of oxygen equipment from rupture.

Oxygen pressure tanks, and lines between tanks and the shutoff means, must be—

(a) Protected from unsafe temperatures; and

(b) Located where the probability and hazards of rupture in a crash landing are minimized.

§ 25.1455 Draining of fluids subject to freezing.

If fluids subject to freezing may be drained overboard in flight or during ground operation, the drains must be designed and located to prevent the formation of ice on the airplane as a result of the drainage.

§ 25.1457 Cockpit voice recorders.

(a) Each cockpit voice recorder required by the operating rules of this chapter must be approved and must be installed so that it will record—

(1) Voice communications transmitted from or received in the airplane by radio;

(2) Voice communications of flight crewmembers on the flight deck;

(3) Voice communications of flight crewmembers on the flight deck, using the airplane's interphone system;

(4) Voice communications of flight crewmembers using the loud speaker system (if there is one); and

(5) Voice or audio signals identifying navigation or approach aids introduced into a headset or speaker.

(b) The recording requirements of paragraph (a)(2) of this section must be met by installing one or more cockpit-mounted area microphones arranged to pick up continuously any voice communication by flight crewmembers when at their assigned stations on the flight deck. The microphones must be located, and the preamplifiers and filters of the recorder must be adjusted or supplemented, if necessary, so that the intelligibility of the recorded communications will be as high as practicable, when recorded under flight cockpit noise conditions and played back. Repeated aural or visual playback of the record may be used in evaluating intelligibility.

(c) Each cockpit voice recorder must be installed so that the part of the communication or audio signals specified in paragraph (a) of this section obtained from each of the following sources is recorded on a separate channel:

(1) For the first channel, from each microphone, headset, or speaker used at the first pilot station.

(2) For the second channel, from each microphone, headset, or speaker used at the second pilot station.

(3) For the third channel, from the cockpit-mounted area microphone best located for recording voice communications originating at the first and second pilot stations.

(4) For the fourth channel, from each other source including—

(i) Each second cockpit-mounted area microphone, if one is required for any required flight crewmember station other than the first or second pilot station;

(ii) Each microphone, headset, or speaker used at the station for a third crewmember (if required), if the signals at that station are not picked up by another channel; and

(iii) Each microphone on the flight deck that is used with the airplane's loud speaker system, if its signals are not picked up by another channel.

(d) Each cockpit voice recorder must be installed so that—

(1) It receives its electric power from the bus that provides the maximum reliability for operation of the cockpit voice recorder without jeopardizing service to essential or emergency loads;

(2) There is an automatic means to stop each erasure feature from functioning at the instant of crash impact; and

(3) There is an aural or visual means for preflight checking of the recorder for proper operation.

(e) The record container must be located and mounted to minimize the probability of rupture of the container as a result of crash impact and consequent heat damage to the record from fire. In meeting this requirement, the record container must be as far aft as practicable, but may not be where aft mounted engines may crush the container during impact. However, it need not be outside of the pressurized compartment.

(f) If the cockpit voice recorder has a bulk erasure device, the installation must be designed to minimize the probability of inadvertent operation and actuation of the device during crash impact.

(g) Each recorder container must be bright orange.

Subpart G—Operating Limitations and Information

§ 25.1501 General.

Each operating limitation specified in §§ 25.1503 through 25.1533 and other information necessary for safe operation must be—

(a) Included in the Airplane Flight Manual;

(b) Expressed in markings and placards; and

(c) Made available by any other means that will convey the information to the crewmembers.

OPERATING LIMITATIONS

§ 25.1503 Airspeed limitations: general.

When airspeed limitations are a function of weight, weight distribution, altitude, or Mach number, limitations corresponding to each critical combination of these factors must be established.

§ 25.1505 Maximum operating limit speed.

(a) The maximum operating limit speed (V_{MO}/M_{MO}—airspeed or Mach number, whichever is critical at a particular altitude) is a speed that may not be deliberately exceeded in any regime of flight (climb, cruise, or descent), unless a higher speed is authorized for flight test or pilot training operations. V_{MO}/M_{MO} must be established so that it is not greater than the design cruising speed V_C and so that it is sufficiently below V_D/M_D or V_{DF}/M_{DF} to make it highly improbable that the latter speeds will be inadvertently exceeded in operations. The speed margin between V_{MO}/M_{MO} and V_D/M_D or V_{DF}/M_{DF} must be determined under the detailed requirements of paragraph (b) of this section or may be selected in accordance with paragraph (c) of this section. However, the speed margin may not be less than the margin found necessary in the flight tests conducted under § 25.253.

(b) The minimum speed margin is the greater of the values determined under subparagraphs (1) and (2) of this paragraph:

(1) From an initial condition of stabilized flight at V_{MO}/M_{MO}, the airplane is assumed to be upset, flown for 20 seconds along a flight path 7.5 degrees below the initial path, and then pulled up at a load factor of 1.5 (.5g acceleration increment). The speed increase occurring in this maneuver may be calculated if reliable or conservative aerodynamic data are used. Power, as specified in § 25.173(a), is assumed until the pullup is initiated, at which time power reduction and the use of pilot controlled drag devices may be assumed.

(2) The minimum speed margin must be enough to provide for atmospheric variations (such as horizontal gusts, penetration of jet stream or cold front) and for instrument errors and airframe production variations. These factors may be considered on a probability basis. However, the margin at altitudes where M_{MO} is limited by compressibility effects may not be less than 0.05M.

(c) The minimum speed margin may be chosen so that V_{MO}/M_{MO} is not greater than $0.8\,V_D/M_D$ or $0.8\,V_{DF}/M_{DF}$.

§ 25.1507 Maneuvering speed.

The maneuvering speed must be established so that it does not exceed the design maneuvering speed V_A determined under § 25.335(c).

§ 25.1511 Flap extended speed.

The established flap extended speed V_{FE} must be established so that it does not exceed the design flap speed V_F chosen under §§ 25.335(e) and 25.345, for the corresponding flap positions and engine powers.

§ 25.1513 Minimum control speed.

The minimum control speed V_{MC} determined under § 25.149 must be established as an operating limitation.

§ 25.1515 Landing gear speeds.

(a) The established landing gear operating speed V_{LO} may not exceed the speed at which it is safe to extend or retract the landing gear, as determined under § 25.729 or by flight characteristics.

(b) The established landing gear extended speed V_{LE} may not exceed the speed at which it is safe to fly with the landing gear secured in the fully extended position, and that determined under § 25.729.

§ 25.1519 Weight, center of gravity, and weight distribution.

The airplane weight, center of gravity, and weight distribution limitations determined under §§ 25.23 through 25.27 must be established as operating limitations.

§ 25.1521 Powerplant limitations.

(a) *General.* The powerplant limitations prescribed in this section must be established so that they do not exceed the corresponding limits for which the engines or propellers are type certificated.

(b) *Takeoff operation.* The powerplant takeoff operation must be limited by—

(1) The maximum rotational speed (r.p.m.);

(2) The maximum allowable manifold pressure (for reciprocating engines);

(3) The maximum allowable gas temperature (for turbine engines);

(4) The time limit for the use of the power or thrust corresponding to the limitations established in subparagraphs (1) through (3) of this paragraph; and

(5) If the time limit established in subparagraph (4) of this paragraph exceeds two minutes, or if the maximum cylinder head and oil temperatures differ from the maximum limits for continuous operation, the maximum allowable cylinder head (for reciprocating engines) and oil temperatures.

(c) *Continuous operation.* The continuous operation must be limited by—

(1) The maximum rotational speed;

(2) The maximum allowable manifold pressure (for reciprocating engines);

(3) The maximum allowable gas temperature (for turbine engines); and

(4) The maximum allowable cylinder head and oil temperatures.

(d) *Fuel grade or designation.* The minimum fuel grade (for reciprocating engines), or fuel designation (for turbine engines), must be established so that it is not less than that required for the operation of the engines within the limitations in paragraphs (b) and (c) of this section.

(e) *Ambient temperature.* Ambient temperature limitations must be established as the maximum ambient atmospheric temperature at which compliance with the cooling provisions of §§ 25.1041 through 25.1045 is shown.

§ 25.1523 Minimum flight crew.

The minimum flight crew must be established so that it is sufficient for safe operation, considering—

(a) The workload on individual crewmembers;

(b) The accessibility and ease of operation of necessary controls by the appropriate crewmember; and

(c) The kind of operation authorized under § 25.1525.

§ 25.1525 Kinds of operation.

The kinds of operation to which the airplane is limited are established by the category in which it is eligible for certification and by the installed equipment.

§ 25.1527 Maximum operating altitude.

The maximum altitude up to which operation is allowed, as limited by flight, structural, powerplant, functional, or equipment characteristics, must be established.

§ 25.1531 Maneuvering flight load factors.

Load factor limitations, not exceeding the positive limit load factors determined from the maneuvering diagram in § 25.333(b), must be established.

§ 25.1533 Additional operating limitations for turbine engine powered airplanes.

(a) Additional operating limitations for turbine engine powered airplanes must be established as follows:

(1) The maximum takeoff weights must be established as the weights at which compliance is shown with the applicable provisions of this part (including the takeoff climb provisions of § 25.121(a) through (c), for altitudes and ambient temperatures).

(2) The maximum landing weights must be established as the weights at which compliance is shown with the applicable provisions of this part (including the landing and takeoff climb provisions of §§ 25.119 and 25.121 for altitudes and ambient temperatures).

(3) The minimum takeoff distances must be established as the distances at which compliance is shown with the applicable provisions of this part (including the provisions of §§ 25.109 and 25.113, for weights, altitudes, temperatures, wind components, and runway gradients).

(b) The extremes for variable factors (such as altitude, temperature, wind, and runway gradients) are those at which compliance with the applicable provisions of this part is shown.

MARKINGS AND PLACARDS

§ 25.1541 General.

(a) The airplane must contain—

(1) The specified markings and placards; and

(2) Any additional information, instrument markings, and placards required for the safe operation if there are unusual design, operating, or handling characteristics.

(b) Each marking and placard prescribed in paragraph (a) of this section—

(1) Must be displayed in a conspicuous place; and

(2) May not be easily erased, disfigured, or obscured.

§ 25.1543 Instrument markings: general.

For each instrument—

(a) When markings are on the cover glass of the instrument, there must be means to maintain the correct alignment of the glass cover with the face of the dial; and

(b) Each arc and line must be wide enough, and located, to be clearly visible to the pilot.

§ 25.1545 Airspeed limitation information.

The airspeed limitations required by § 25.1583(a) must be easily read and understood by the flight crew.

§ 25.1547 Magnetic direction indicator.

(a) A placard meeting the requirements of this section must be installed on, or near, the magnetic direction indicator.

(b) The placard must show the calibration of the instrument in level flight with the engines operating.

(c) The placard must state whether the calibration was made with radio receivers on or off.

(d) Each calibration reading must be in terms of magnetic heading in not more than 45 degree increments.

§ 25.1549 Powerplant instruments.

For each required powerplant instrument—

(a) Each maximum and, if applicable, minimum safe operating limit must be marked with a red radial line;

(b) Each normal operating range must be marked with a green arc not extending beyond the maximum and minimum safe operating limits; and

(c) Each takeoff and precautionary range must be marked with a yellow arc.

(d) Each engine or propeller speed range that is restricted because of excessive vibration stresses must be marked with red arcs.

§ 25.1551 Oil quantity indicator.

Each oil quantity indicator must be marked with enough increments to indicate readily and accurately the quantity of oil.

§ 25.1553 Fuel quantity indicator.

If the unusable fuel supply for any tank exceeds one gallon, or five percent of the tank capacity, whichever is greater, a red arc must be marked on its indicator extending from the calibrated zero reading to the lowest reading obtainable in level flight.

§ 25.1555 Control markings.

(a) Each cockpit control, other than primary flight controls and controls whose function is obvious, must be plainly marked as to its function and method of operation.

(b) Each aerodynamic control must be marked under the requirements of §§ 25.677 and 25.699.

(c) For powerplant fuel controls—

(1) Each fuel tank selector control must be marked to indicate the position corresponding to each tank and to each existing cross feed position;

(2) If safe operation requires the use of any tanks in a specific sequence, that sequence must be marked on, or adjacent to, the selector for those tanks; and

(3) Each valve control for each engine must be marked to indicate the position corresponding to each engine controlled.

(d) For accessory, auxiliary, and emergency controls—

(1) Each emergency control (including each fuel jettisoning and fluid shutoff control) must be colored red; and

(2) Each visual indicator required by § 25.729(e) must be marked so that the pilot can determine at any time when the wheels are locked in either extreme position, if retractable landing gear is used.

§ 25.1557 Miscellaneous markings and placards.

(a) *Baggage and cargo compartments, and ballast location.* Each baggage and cargo compartment, and each ballast location must have a placard stating any limitations on contents, including weight, that are necessary under the loading requirements.

(b) *Fuel and oil filler openings.* The following must be marked on, or near, each appropriate filler cover:

(1) The word "fuel", the minimum fuel grade or designation for the engines, and the usable fuel tank capacity.

(2) The word "oil" and the oil tank capacity.

(c) *Emergency exit placards.* Each emergency exit placard must meet the requirements of § 25.811.

(d) *Doors.* Each door that must be used in order to reach any required emergency exit must have a suitable placard stating that the door is to be latched in the open position during takeoff and landing.

§ 25.1561 Safety equipment.

(a) Each safety equipment control to be operated by the crew in emergency, such as controls for automatic liferaft releases, must be plainly marked as to its method of operation.

(b) Each location, such as a locker or compartment, that carries any fire extinguishing, signaling, or other life saving equipment must be marked accordingly.

(c) Stowage provisions for required emergency equipment must be conspicuously marked to identify the contents and facilitate removal of the equipment.

(d) Each liferaft must have obviously marked operating instructions.

(e) Approved survival equipment must be marked for identification and method of operation.

§ 25.1563 Airspeed placard.

A placard showing the maximum airspeeds for flap extension for the takeoff, approach, and landing positions must be installed in clear view of each pilot.

AIRPLANE FLIGHT MANUAL

§ 25.1581 General.

(a) An Airplane Flight Manual must be furnished with each airplane, unless otherwise prescribed.

(b) Each part of the manual listed in §§ 25.1583 through 25.1587, that is appropriate to the airplane, must be furnished, verified, and approved, and must be segregated, identified, and clearly distinguished from each unapproved part of that manual.

(c) Any information not specified in §§ 25.1583 through 25.1587 that is required for safe operation because of unusual design, operating, or handling characteristics, must be furnished.

§ 25.1583 Operating limitations.

(a) *Airspeed limitations.* The following airspeed limitations and any other information necessary to meet the requirements of § 25.1545 must be furnished:

(1) The maximum operating limit speed V_{MO}/M_{MO} and a statement that this speed limit may not be deliberately exceeded in any regime of flight (climb, cruise, or descent) unless a higher speed is authorized for flight test or pilot training.

(2) If an airspeed limitation is based upon compressibility effects, a statement to this effect and information as to any symptoms, the probable behavior of the airplane, and the recommended recovery procedures.

(3) The maneuvering speed V_A and a statement that full application of rudder and aileron controls, as well as maneuvers that involve angles of attack near the stall, should be confined to speeds below this value.

(4) The flap extended speed V_{FE} and the pertinent flap positions and engine powers.

(5) The landing gear operating speed V_{LO} and a statement that this is the maximum speed at which it is safe to extend or retract the landing gear.

(6) The landing gear extended speed V_{LE}, if greater than V_{LO}, and a statement that this is the maximum speed at which the airplane can be safely flown with the landing gear extended.

(b) *Powerplant limitations.* Information must be furnished to explain the powerplant limitations and to allow marking the instruments under §§ 25.1549 through 25.1553.

(c) *Weight and loading distribution.* The weight and center of gravity limits required by §§ 25.25 and 25.27 must be furnished, together with the items included in the empty weight in § 25.29(a). In addition—

(1) There must be loading instructions, for each loading condition within these limits, that affect weight and center of gravity;

(2) If certification for more than one center of gravity range is requested, the appropriate limitations, with regard to weight and loading procedures, for each separate center of gravity range, must be furnished; and

(3) The positive maneuvering limit load factors for which the structure is proven, described in terms of accelerations, and a statement that these accelerations limit the angle of bank in turns and limit the severity of pull-up maneuvers, must be furnished.

(d) *Flight crew.* The number and functions of the minimum flight crew determined under § 25.1523 must be furnished.

(e) *Kinds of operation.* The kinds of operation approved under § 25.1525 must be furnished.

(f) *Altitudes.* The altitude established under § 25.1527 and an explanation of the limiting factors must be furnished.

(g) *Usable fuel.* A statement that the fuel remaining in fuel tanks when the quantity indicator reaches "zero" is not usable in flight must be furnished.

(h) *Turbine engine powered airplanes.* For turbine engine powered airplanes, the operation limitations established under § 25.1533 must be furnished.

§ 25.1585 Operating procedures.

(a) Information and instructions regarding the peculiarities of normal operations (including starting and warming the engines, taxiing, operation of wing flaps, landing gear, and the automatic pilot)* must be furnished, together with recommended procedures for—

(1) Engine failure (including minimum speeds, trim, operation of the remaining engines, and operation of flaps);

(2) Stopping the rotation of propellers in flight;

(3) Restarting turbine engines in flight (including the effects of altitude);

(4) Fire, decompression, and similar emergencies;

(5) Ditching (including the procedures based on the requirements of §§ 25.801, 25.807(d), 25.1411, and 25.1415 (a) through (e)); and

(6) Use of ice protection equipment.

§ 25.1587 Performance information.

(a) *Each airplane.* For each airplane, the Airplane Flight Manual must contain information to warn flight crewmembers against jettisoning fuel when any means (including flaps, slots, and slats) for changing the airflow across or around the wing are being used.

(b) *Reciprocating engine powered airplanes.* For each reciprocating engine powered airplane, the Airplane Flight Manual must contain a summary of any pertinent performance data, including data necessary for the application of any operating rule of this chapter, together with descriptions of the conditions, such as airspeeds, under which these data were determined, and must contain—

(1) The indicated airspeeds, corresponding to those determined for takeoff, and the procedures to be followed if a critical engine fails during takeoff;

(2) Instructions for use and adjustment of flap controls necessary to obtain the pertinent performance data specified in this paragraph;

(3) An explanation of significant or unusual flight or ground handling characteristics; and

(4) Operating correction factors that are determined under § 25.61, and that are approved.

(c) *Turbine engine powered airplanes.* For each turbine engine powered airplane, the Airplane Flight Manual must contain the performance information computed under the applicable provisions of this part (including §§ 25.115, 25.123, and 25.125 for the weights, altitudes, temperatures, wind components, and runway gradients, as applicable) within the operational limits of the airplane, and must contain the following:

(1) The conditions under which the performance information was obtained.

(2) The following performance information (determined by extrapolation and computed for the range of weights between the maximum landing and maximum takeoff weights):

(i) Climb in the landing configuration.

(ii) Climb in the approach configuration.

(iii) Landing distance.

(3) Procedures established under § 25.101(c) that are related to the limitations and information required by § 25.1533 and by this paragraph. These procedures must be in the form of guidance material, including any relevant limitations or information.

(4) An explanation of significant or unusual flight or ground handling characteristics of the airplane.

Appendix A

FIGURE 1—Basic landing gear dimension data.

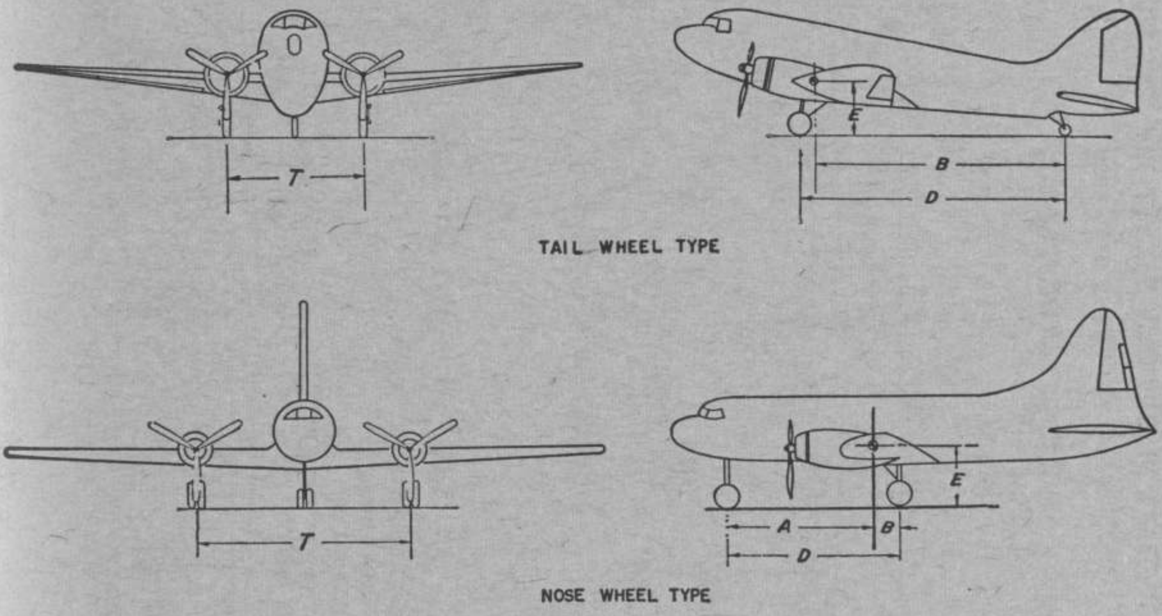


FIGURE 2—Level landing.

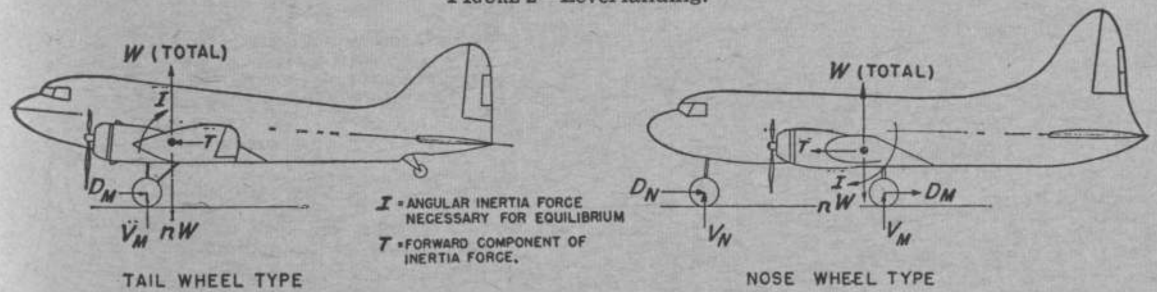
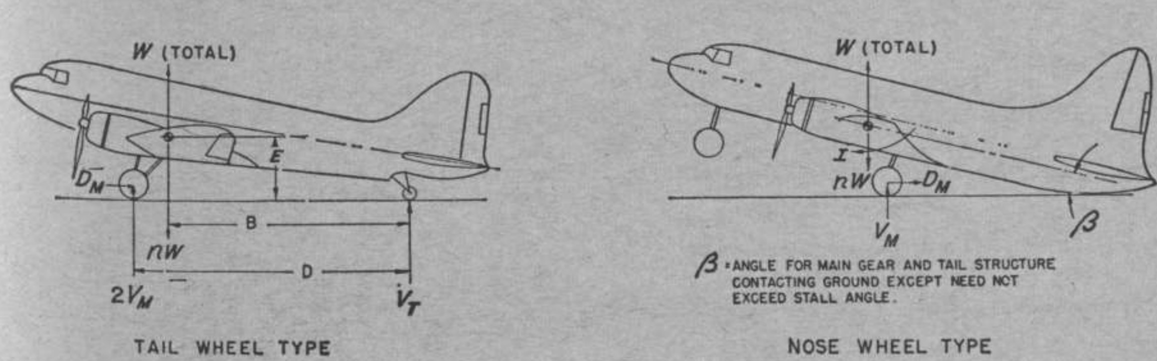


FIGURE 3—Tail-down landing.



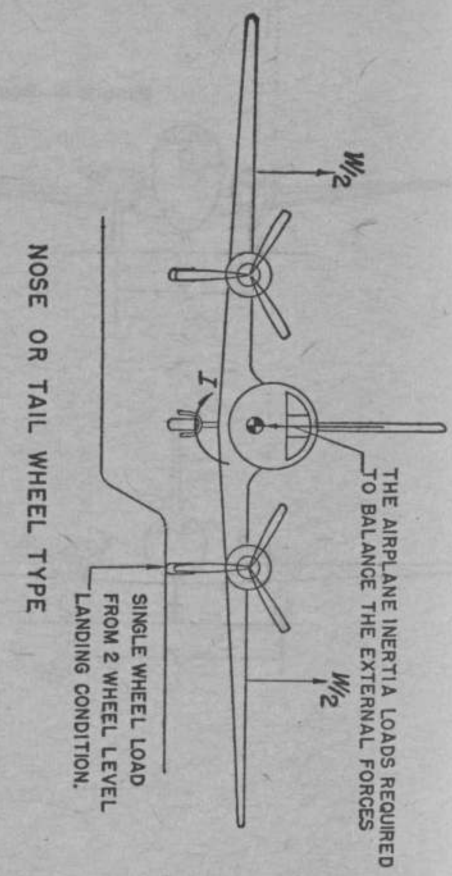


FIGURE 4—One-wheel landing.

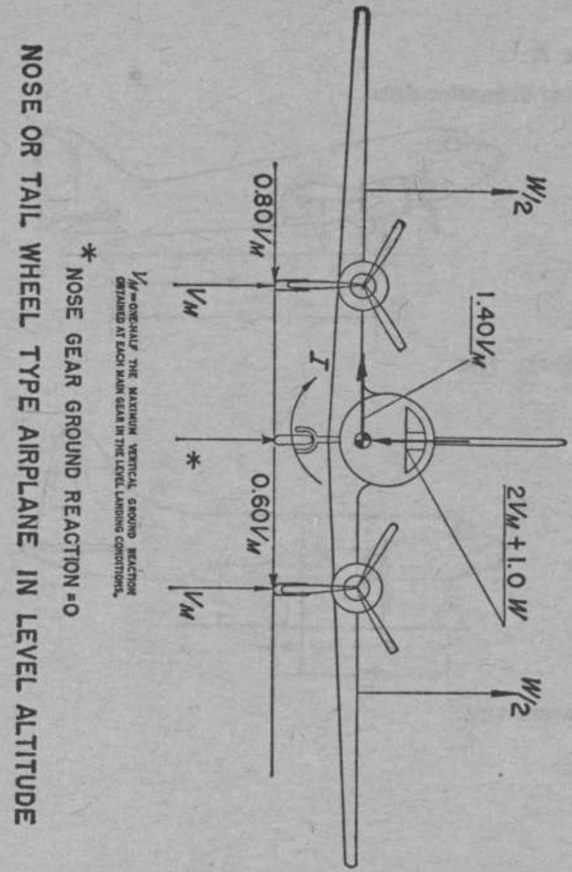


FIGURE 5—Lateral drift landing.

FIGURE 6—Braked roll.

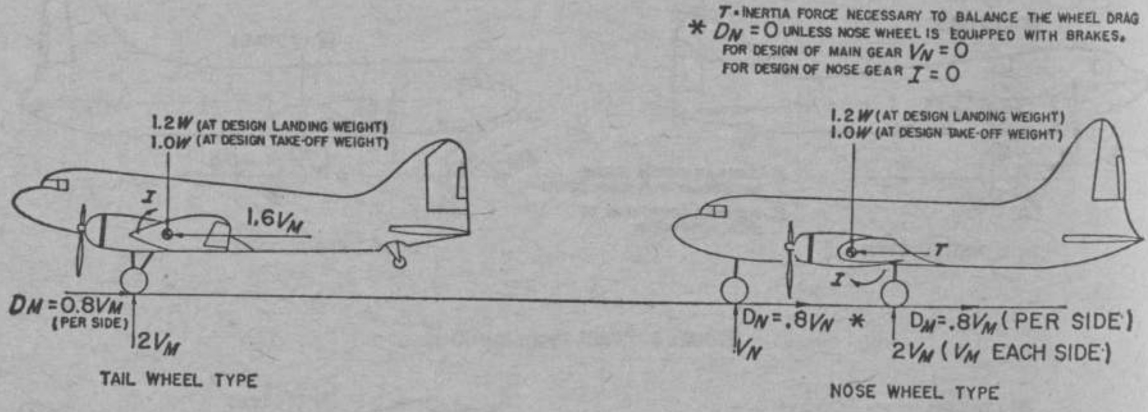
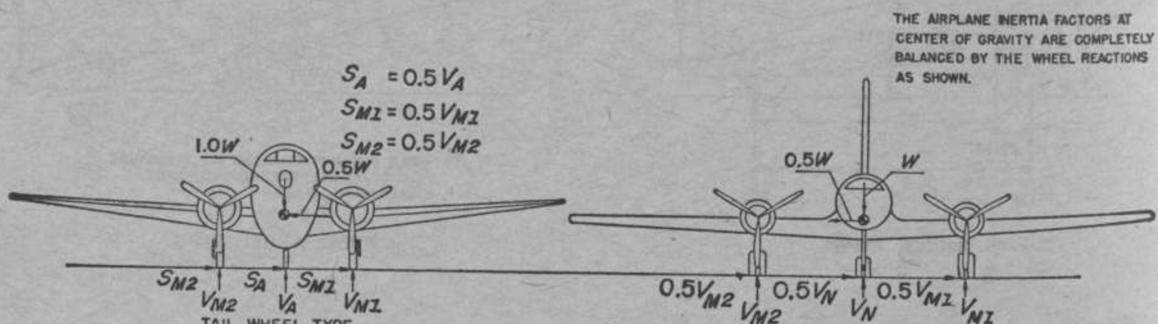


FIGURE 7—Ground turning.



Appendix B

FIGURE 1—Pictorial definition of angles, dimensions, and directions on a seaplane.

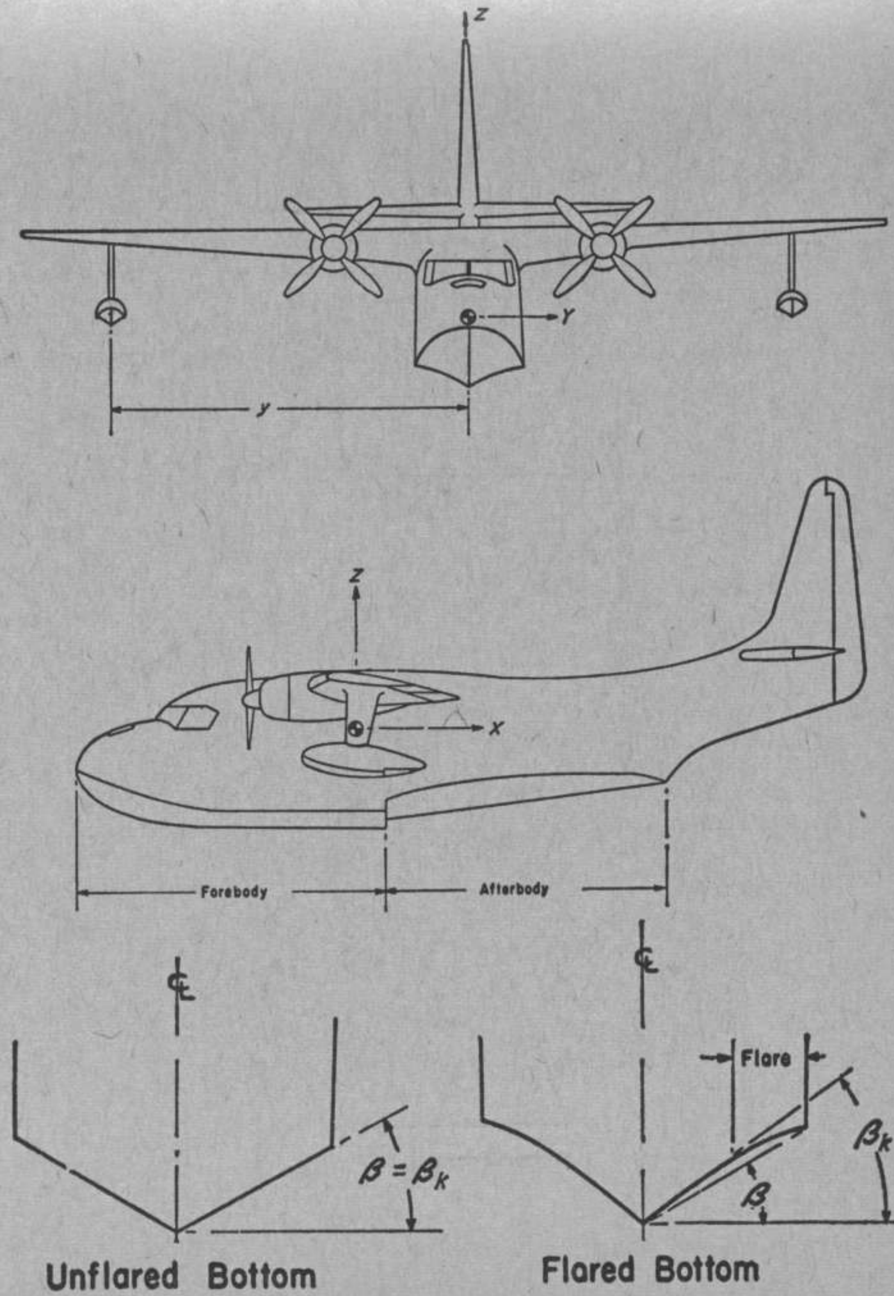


FIGURE 8—Pivoting, nose or tail wheel type.

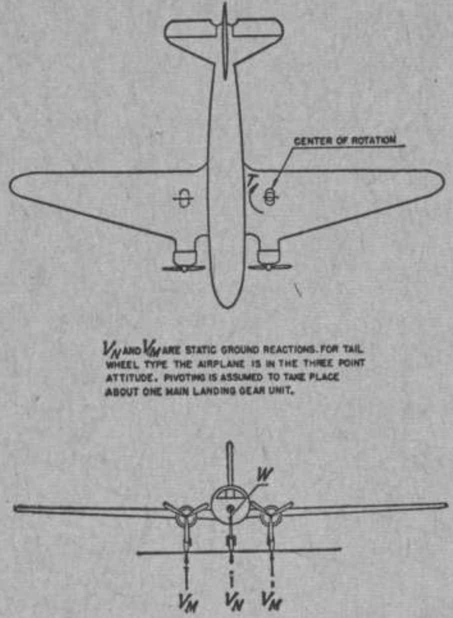


FIGURE 2—Hull station weighing factor.

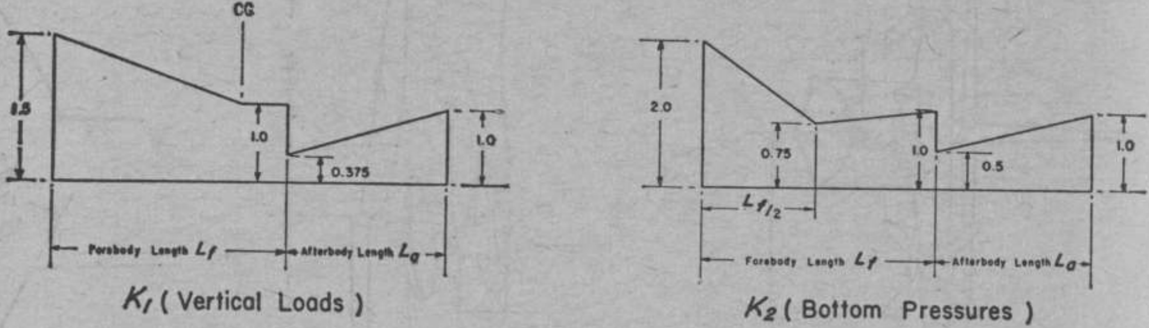
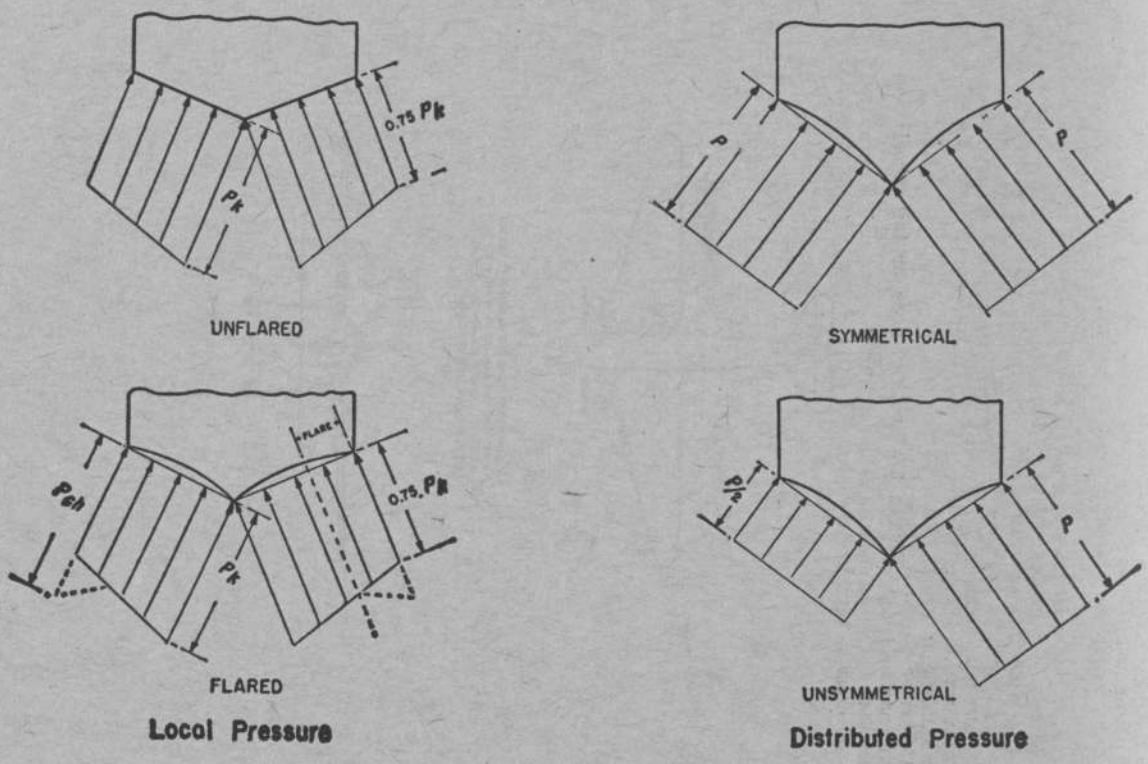


FIGURE 3—Transverse pressure distributions.



Appendix C

(a) *Continuous maximum icing.* The maximum continuous intensity of atmospheric icing conditions (continuous maximum icing) is defined by the variables of the cloud liquid water content, the mean effective diameter of the cloud droplets, the ambient air temperature, and the interrelationship of these three variables as shown in figure 1 of this appendix. The limiting icing envelope in terms of altitude and temperature is given in figure 2 of this appendix. The inter-relationship of cloud liquid water content with drop diameter and altitude is determined from figures 1 and 2. The cloud liquid water content for continuous maximum icing conditions of a horizontal extent, other than 17.4 nautical miles, is determined by the value of liquid water content of figure 1, multiplied by the appropriate factor from figure 3 of this appendix.

(b) *Intermittent maximum icing.* The intermittent maximum intensity of atmospheric icing conditions (intermittent maximum icing) is defined by the variables of the cloud liquid water content, the mean effective diameter of the cloud droplets, the ambient air temperature, and the interrelationship of these three variables as shown in figure 4 of this appendix. The limiting icing envelope in terms of altitude and temperature is given in figure 5 of this appendix. The inter-relationship of cloud liquid water content with drop diameter and altitude is determined from figures 4 and 5. The cloud liquid water content for intermittent maximum icing conditions of a horizontal extent, other than 2.6 nautical miles, is determined by the value of cloud liquid water content of figure 4 multiplied by the appropriate factor in figure 6 of this appendix.

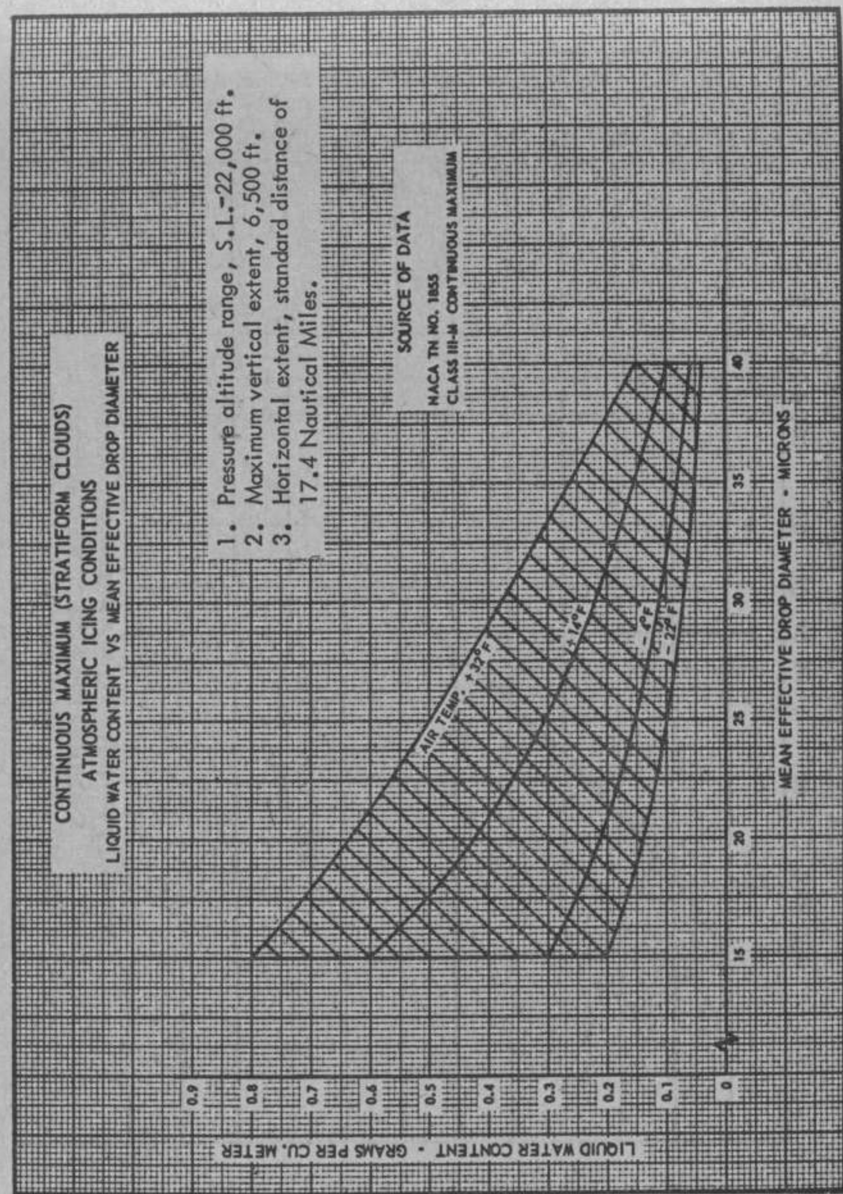


FIGURE 1.

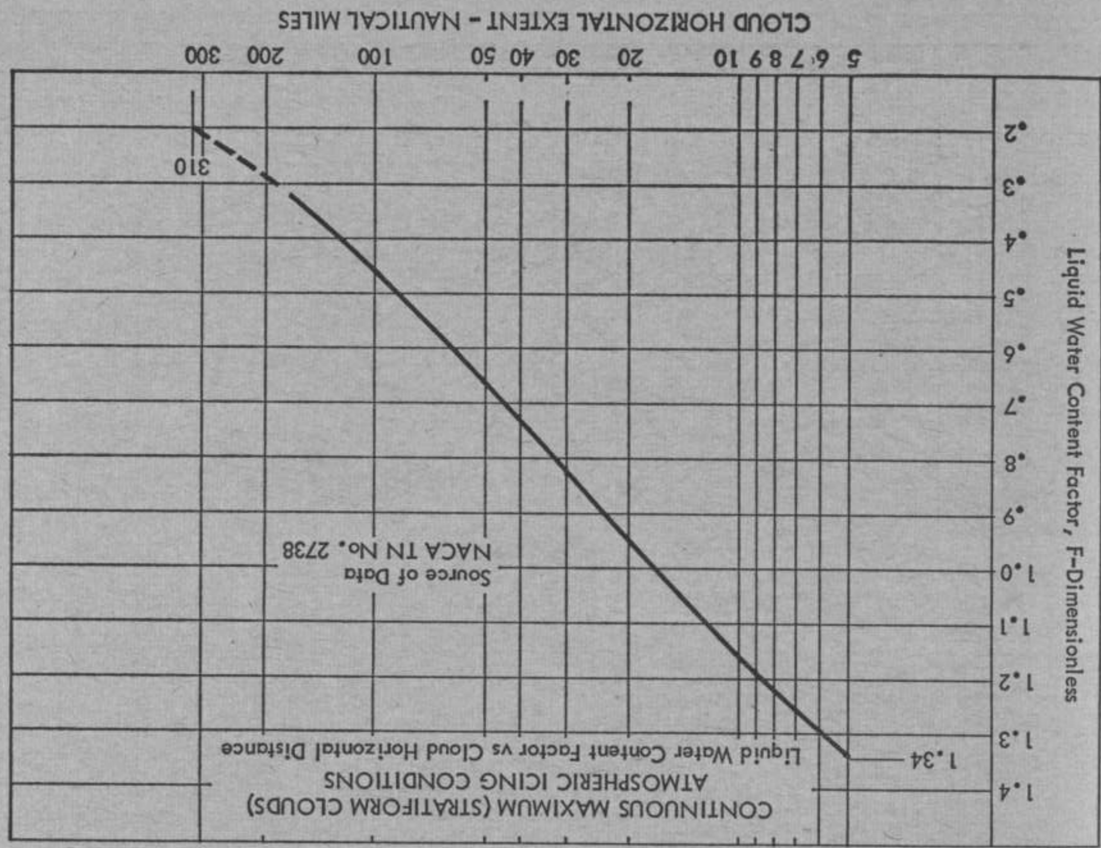


FIGURE 3.

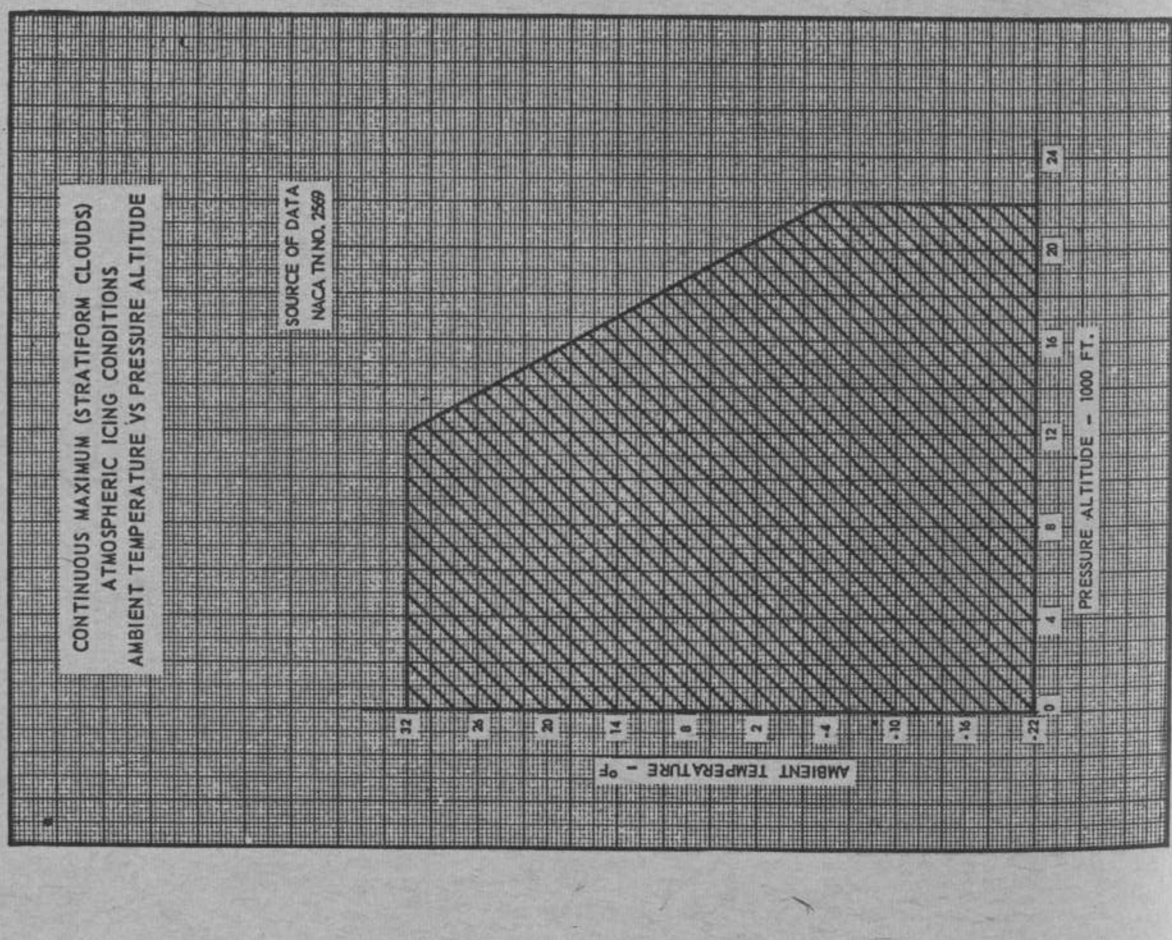


FIGURE 2.

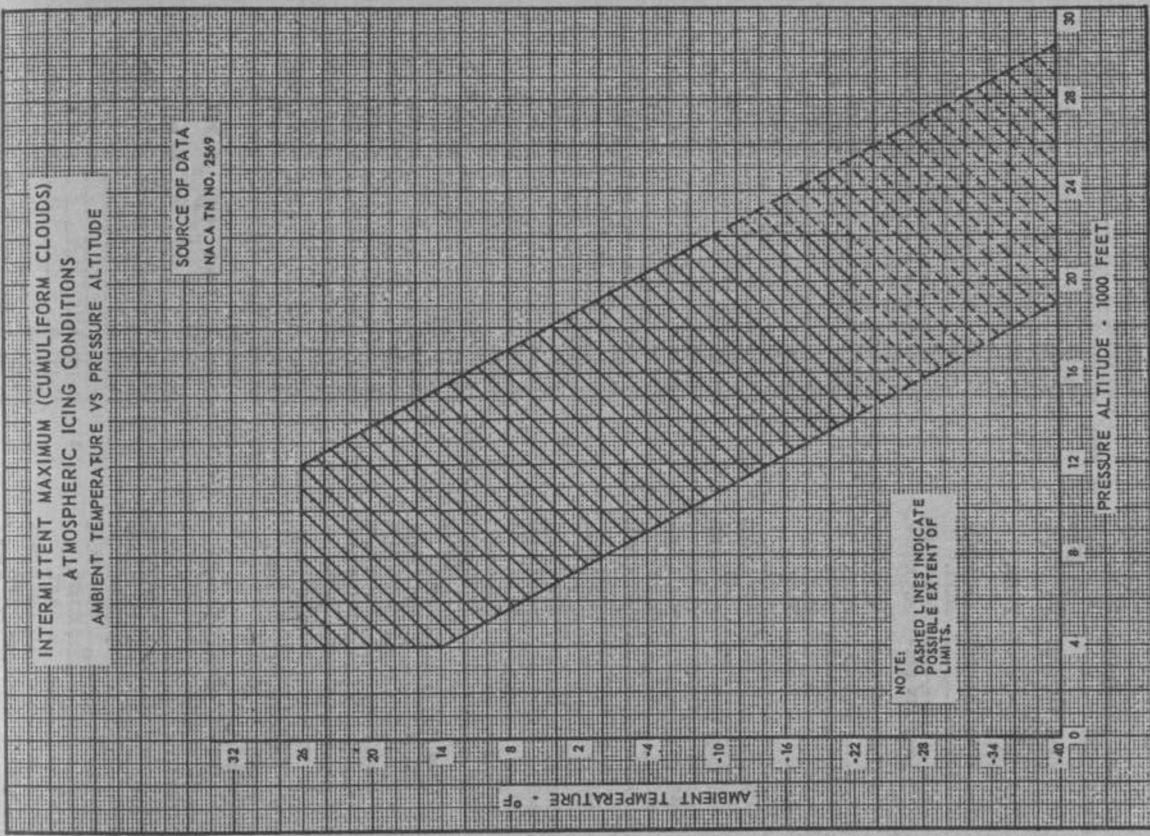


FIGURE 5.

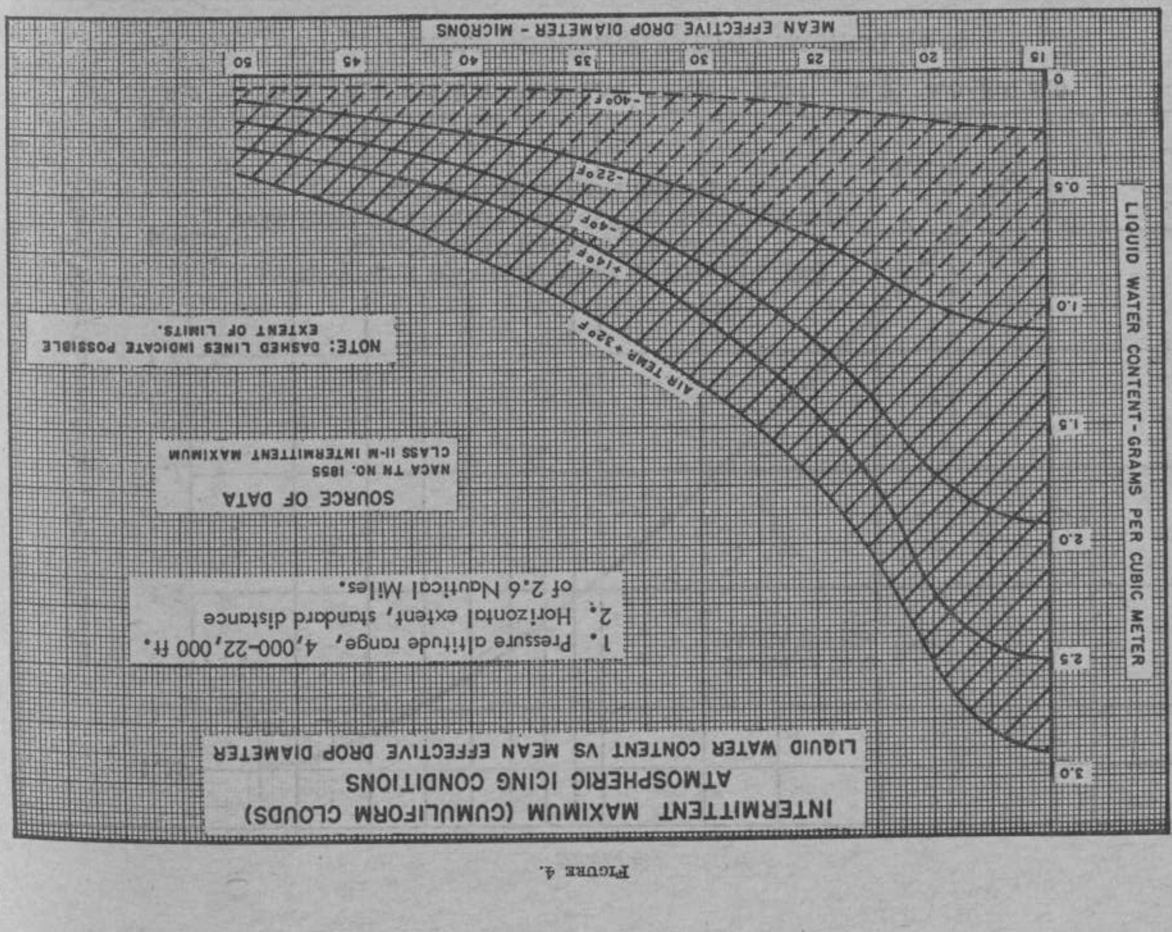


FIGURE 4.

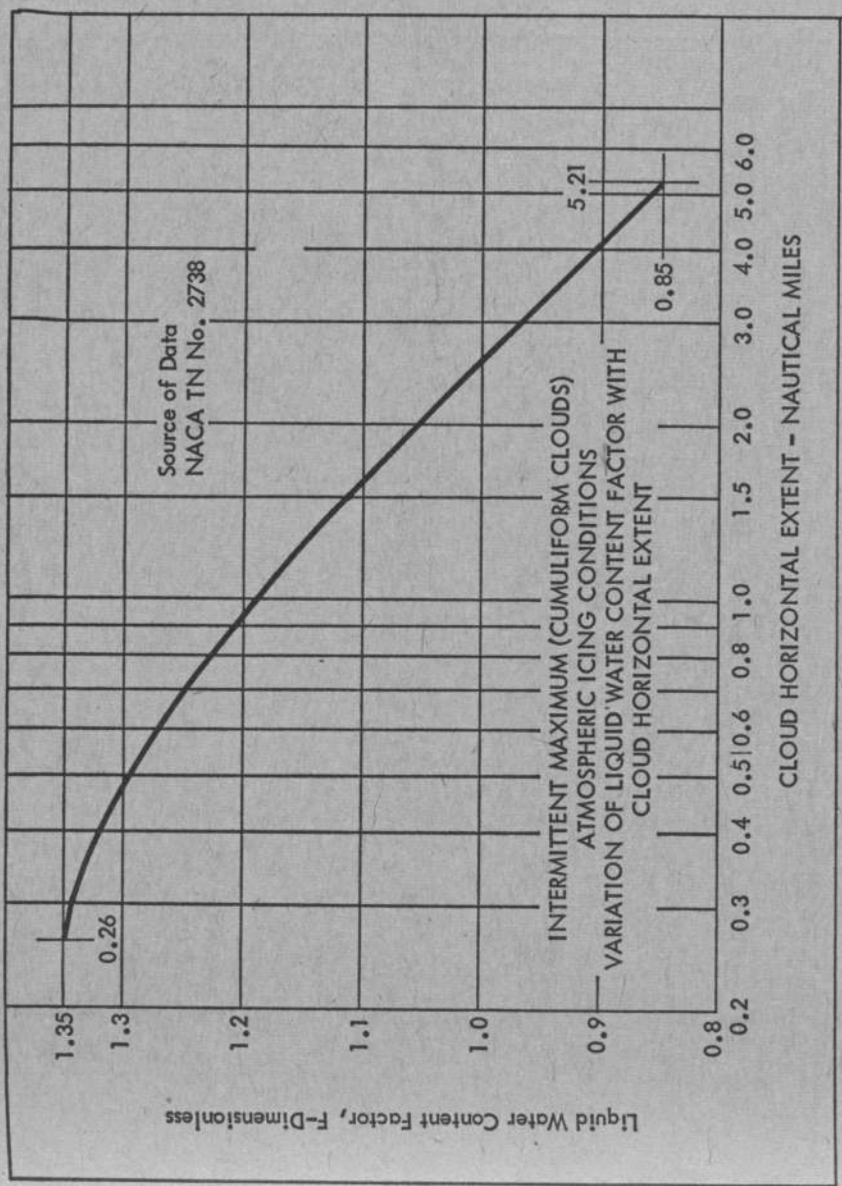


FIGURE 6.

DISTRIBUTION TABLE

Former section	*Revised section*
4b.0	25.1.
4b.1	Transferred to Part 1 [New] or executed.
4b.10 through 4b.19	Transferred to Part 21 [New].
4b.100 (less (d)-(g))	25.21.
4b.100(d)-(g)	Transferred to Part 21 [New].
4b.100-1 (less 1st sentence of (b)(1)).	Not a rule.
4b.100-1 (1st sentence of (b)(1)).	25.21.
4b.100-1 (less (b)(2))	Not a rule.
4b.100-1(b)(2)	25.21.
4b.100-2	Not a rule.
4b.100-3 (less 1st sentence).	Not a rule.
4b.100-3 (1st sentence)	25.21.
4b.101	25.25.
4b.102	25.27.
4b.103	25.23.
4b.104	25.29.
4b.105	25.31.
4b.105-1	Not a rule.
4b.110	25.45.
4b.110-1 (less (a))	Not a rule.
4b.110-1(a)	25.45.
4b.110-2	Not a rule.
4b.111	25.47.
4b.111-1	Not a rule.
4b.112	25.49.
4b.112-1	Not a rule.
4b.113	25.51.
4b.113-1	Not a rule.
4b.113-2	Not a rule.
4b.114	25.55.
4b.114-1	Not a rule.
4b.115(a)	Transferred to Part 1 [New].
4b.115 (less (a))	25.57.
4b.115-1	Not a rule.
4b.115-2	Not a rule.
4b.115-3	Not a rule.
4b.115-4	Not a rule.
4b.116	25.59.
4b.116-1	25.59.
4b.116-2	Not a rule.
4b.117 (introductory paragraph) (21st-35th words).	25.1587.
4b.117 (less intro. para. (21st-35th words)).	25.61.
4b.118	Surplusage.
4b.118-1	Not a rule.
4b.119	25.65.
4b.119-1	Not a rule.
4b.120	25.67.
4b.120-1	25.67.
4b.120-2	Not a rule.
4b.121	25.69.
4b.121-1	Not a rule.
4b.122	25.75.
4b.122-1	Not a rule.
4b.122-2	Not a rule.
4b.122-3	Not a rule.
4b.122-4	Not a rule.
4b.123	25.75.
4b.123-1	25.75.
4b.123-2	Not a rule.
4b.123-3	Not a rule.
4b.123-4	Not a rule.
4b.124	25.75.
4b.124-1	Not a rule.
4b.125	25.75.
4b.125-1	Not a rule.
4b.130	25.143.
4b.130-1	Not a rule.
4b.131	25.145.
4b.131-1	Not a rule.
4b.132	25.147.
4b.132-1	Not a rule.
4b.133	25.149.
4b.133-1	Not a rule.
4b.140	25.161.
4b.140-1	Not a rule.
4b.141	25.161.
4b.141-1	Not a rule.
4b.142	25.161.
4b.142-1	Not a rule.
4b.143	25.161.
4b.143-1	Not a rule.
4b.144	25.161.
4b.144-1	Not a rule.
4b.150	25.171.
4b.151	25.173.
4b.152	25.175.
4b.153	25.175.
4b.154	25.175.
4b.155	25.175.
4b.156	25.187.
4b.156-1	Not a rule.
4b.157	25.177.
4b.157-1	Not a rule.
4b.158	25.181.
4b.158-1	Not a rule.
4b.160(a)-(c)	25.201.
4b.160 (less (a)-(c))	25.203.
4b.160-1	Not a rule.
4b.161	25.205.
4b.161-1	Not a rule.
4b.162	25.207.
4b.162-1 (less last sentence).	Not a rule.
4b.162-1 (last sentence).	25.207.
4b.170	25.231.
4b.170-1	Not a rule.
4b.170-2	Not a rule.
4b.170-3	Not a rule.
4b.171	25.233.
4b.171-1	25.233.
4b.171-2	Not a rule.
4b.171-3	Not a rule.
4b.172	25.235.
4b.172-1	Not a rule.
4b.173	25.237.

DISTRIBUTION TABLE—Continued

Former section	Revised section
4b.173-1	Not a rule.
4b.173-2	Not a rule.
4b.180	25.231.
4b.180-1	Not a rule.
4b.181	25.237.
4b.181-1	Not a rule.
4b.182	25.239.
4b.182-1	Not a rule.
4b.182-2	Not a rule.
4b.190 (as applicable to flutter).	Surplusage.
4b.190 (less applicability to flutter).	25.251.
4b.190-1	Not a rule.
4b.191	25.253.
4b.200 (less (a))	25.301.
4b.200(a)	25.303.
4b.201	25.305.
4b.202	25.307.
4b.210 (less (b) and (c)).	25.321.
4b.210(b)	25.335.
4b.210(c)	25.343.
4b.211 (less (a) and (b)).	25.333.
4b.211(a)	25.337.
4b.211(b)	25.341.
4b.212	25.345.
4b.213	25.331.
4b.214	25.349.
4b.215	25.351.
4b.216 (less (b)-(e))	25.361.
4b.216(b)	25.363.
4b.216(c)	25.365.
4b.216(d)	25.367.
4b.216(e)	25.371.
4b.217	25.373.
4b.220 (less (a)-(e))	25.391.
4b.220(a)	25.397.
4b.220(b)	25.407.
4b.220(c)	25.427.
4b.220(d)	25.445.
4b.220(e)	25.393.
4b.221	25.457.
4b.222	25.409.
4b.223	25.459.
4b.224 (less last two sentences of (a)).	25.395.
4b.224 (last two sentences of (a)).	25.397.
4b.225	25.399.
4b.226	25.415.
4b.227	25.405.
4b.230 (less (b))	25.471.
4b.230(b)(3) (1st sentence).	25.477.
4b.230 (less (b)(3) (1st sentence)).	25.473.
4b.231	25.479.
4b.232	25.481.
4b.233	25.483.
4b.234	25.485.
4b.234a	25.487.

DISTRIBUTION TABLE—Continued

Former section	Revised section
4b.235 (introductory paragraph) (less last sentence).	25.489.
4b.235 (introductory paragraph) (last sentence).	25.493 and 25.499.
4b.235(a)	25.491.
4b.235(b)	25.493.
4b.235(c)	25.495.
4b.235(d)	25.503.
4b.235(e)	25.499.
4b.235(f)	25.497.
4b.235(g)	25.507.
4b.235 (less introductory paragraph and (a) through (g)).	25.509.
4b.236	25.511.
4b.250	25.521.
4b.250-1	25.521.
4b.251	25.523.
4b.252	25.525.
4b.253	25.527.
4b.254	25.529.
4b.255	25.531.
4b.256	25.533.
4b.257	25.535.
4b.258	25.537.
4b.260	25.561.
4b.261	25.563.
4b.270	25.571.
4b.270-1	25.571.
4b.270-2	Not a rule.
4b.271	25.573.
4b.300	25.601.
4b.300-1	Not a rule.
4b.301	25.603.
4b.301-1 (less 1st sentence).	Not a rule.
4b.301-1 (1st sentence)	25.603.
4b.302	25.605.
4b.303 (last sentence)	25.607.
4b.303 (less last sentence).	Not a rule.
4b.304	25.609.
4b.305	25.611.
4b.306 (less (d))	25.613.
4b.306(d)	25.615.
4b.306-1 (less (c))	25.615.
4b.306-1(c)	Not a rule.
4b.307 (less (a)-(c))	25.619.
4b.307(a)	25.621.
4b.307(b)	25.623.
4b.307(c)	25.625.
4b.308 (less (c) and (d) as appropriate to vibration).	25.629.
4b.308 (c) and (d) (as appropriate to vibration).	25.251.
4b.310	Surplusage.
4b.311	25.651.
4b.312	25.655.
4b.313	25.657.
4b.320 (less (b))	25.671.

DISTRIBUTION TABLE—Continued

Former section	Revised section
4b.320(b)	25.695.
4b.321	25.673.
4b.322	25.677.
4b.323 (less (e) and (f)).	25.697.
4b.323 (e) and (f)	25.699.
4b.324	25.701.
4b.324-1	Not a rule.
4b.325	25.675.
4b.326	25.679.
4b.327	25.681.
4b.328	25.683.
4b.329 (less (a) and (b)).	25.685.
4b.329(a)	25.689.
4b.329(b)	25.693.
4b.329-1	Not a rule.
4b.329-2	Not a rule.
4b.329-3	Not a rule.
4b.329-4	Not a rule.
4b.329-5	Not a rule.
4b.329-6	25.693.
4b.330	25.721.
4b.331	25.721.
4b.332 (introductory paragraph).	25.721.
4b.332 (less introductory paragraph, (a) and (b)).	25.727.
4b.332(a)	25.723.
4b.332(b)	25.625.
4b.333	25.625.
4b.334	25.729.
4b.334-1	Not a rule.
4b.334-2	25.729.
4b.335 (a) and (b)	25.731.
4b.335 (less (a) and (b)).	25.735.
4b.336	25.733.
4b.337	25.735.
4b.337-1	Not a rule.
4b.337-2	Not a rule.
4b.337-3	Not a rule.
4b.337-4 (less 1st sentence).	Not a rule.
4b.337-4 (1st sentence)	25.735.
4b.338	25.737.
4b.340	Surplusage.
4b.341 (less (a) and (b)).	25.753.
4b.341 (a) and (b)	25.751.
4b.342	25.755.
4b.350	25.771.
4b.350-1	Not a rule.
4b.351	25.773.
4b.351-1	Not a rule.
4b.351-2	Not a rule.
4b.351-3	Not a rule.
4b.352	25.775.
4b.353	25.777.
4b.353-1	Not a rule.
4b.354	Surplusage.
4b.355	Surplusage.
4b.356	25.783.

DISTRIBUTION TABLE—Continued

Former section	Revised section
4b.356-1 (less last sentence).	Not a rule.
4b.356-1 (last sentence).	25.783.
4b.356-2 (less (a) (1st sentence)).	Not a rule.
4b.356-2(a) (1st sentence).	25.783.
4b.356-3	Not a rule.
4b.356-4	Not a rule.
4b.356-5	Not a rule.
4b.356-6	Not a rule.
4b.358	25.785.
4b.358-1 (less 2d and 3d sentences).	Not a rule.
4b.358-1 (2d and 3d sentences).	25.785.
4b.359	25.787.
4b.360	Surplusage.
4b.361 (introductory paragraph) (last sentence).	25.1585.
4b.361 (less introductory paragraph (last sentence)).	25.801.
4b.362 (introductory paragraph).	25.803.
4b.362(a)	25.805.
4b.362(b)	25.807.
4b.362(c)	25.807.
4b.362(d)	25.807.
4b.362(e)	25.809.
4b.362(f)	25.811.
4b.362(g) (last sentence).	25.1557.
4b.362(g) (less last sentence).	25.813.
4b.362 (less introductory paragraph and (a)-(g)).	25.815.
4b.362-1 (less (a))	25.809 and 25.811.
4b.362-1(a)	25.805.
4b.362-2	25.807.
4b.362-3 (less (a))	25.807.
4b.362-3(a)	Surplusage.
4b.362-4	25.809.
4b.362-5 (less (c))	25.811.
4b.362-5(c)	Not a rule.
4b.362-6	Not a rule.
4b.362-7	Not a rule.
4b.370	Surplusage.
4b.371	25.831.
4b.371-1	25.831.
4b.372	25.833.
4b.372-1	Not a rule.
4b.373	Surplusage.
4b.374	25.841.
4b.375	25.841.
4b.375-1	25.841.
4b.376	25.843.
4b.380 (less (c))	25.851.
4b.380(c)	25.1439.
4b.380-1	Not a rule.
4b.380-2	Not a rule.

DISTRIBUTION TABLE—Continued

Former section	Revised section
4b.381	25.853.
4b.381-1	Not a rule.
4b.382	25.855.
4b.383 (less 2d sentence of (a) and (b)(3)).	25.857.
4b.383 (2d sentence of (a) and (b)(3)).	25.851.
4b.384	25.855.
4b.384-1	Not a rule.
4b.385	25.863.
4b.386	25.859.
4b.390	25.875.
4b.391	25.871.
4b.400	25.901.
4b.400-1	Not a rule.
4b.400-2	Surplusage.
4b.401	25.903.
4b.401-1	Not a rule.
4b.401-2	Not a rule.
4b.401-3	Not a rule.
4b.401-4	Not a rule.
4b.402	25.905.
4b.402-1	Not a rule.
4b.403	25.907.
4b.404	25.33.
4b.405	25.925.
4b.406	25.929.
4b.406-1	Not a rule.
4b.407	25.933.
4b.407-1 (less 1st sentences of (b) and (c)).	25.933.
4b.407-1 (1st sentence of (b) and (c)).	Not a rule.
4b.408	25.937.
4b.409	25.939.
4b.410	25.951.
4b.411	25.953.
4b.413	25.955.
4b.416	25.959.
4b.417	25.961.
4b.417-1	Not a rule.
4b.418	25.957.
4b.420	25.963.
4b.420-1	Not a rule.
4b.421	25.965.
4b.422	25.967.
4b.423	25.969.
4b.424	25.971.
4b.425	25.973.
4b.426	25.975.
4b.427	25.977.
4b.428	25.979.
4b.430	25.991.
4b.430-1	25.991.
4b.432	25.993.
4b.433	25.1183.
4b.434	25.995.
4b.435	25.997.
4b.436	25.999.
4b.437 (less (e) (last sentence)).	25.1001.

DISTRIBUTION TABLE—Continued

Former section	Revised section
4b.437(e) (last sentence).	25.1587.
4b.437-1	Not a rule.
4b.440	25.1011.
4b.441	25.1013.
4b.442	25.1015.
4b.443	25.1013.
4b.444	25.1017.
4b.445	25.1025.
4b.446	25.1023.
4b.447	25.1019.
4b.448	25.1021.
4b.449	25.1027.
4b.449-1	25.1027.
4b.450	25.1041.
4b.451	25.1043.
4b.452	25.1045.
4b.454	25.1045.
4b.460	25.1091.
4b.461	25.1093.
4b.461-1	Not a rule.
4b.462	25.1101.
4b.463	25.1103.
4b.464	25.1105.
4b.466	25.1107.
4b.467(a)	25.1121.
4b.467(b)	25.1123.
4b.467(c)	25.1125.
4b.467(d)	25.1125.
4b.467 (less (a)-(d))	25.1127.
4b.467-1 (less 1st sentence).	Not a rule.
4b.467-1 (1st sentence)	25.1121.
4b.467-2	Not a rule.
4b.470	25.1141.
4b.471	25.1143.
4b.472	25.1145.
4b.473	25.1147.
4b.474(a)	25.1149.
4b.474 (less (a))	25.1153.
4b.474-1	Not a rule.
4b.474a	25.1155.
4b.475	25.1161.
4b.476	25.1157.
4b.476a	25.1159.
4b.477	25.1163.
4b.478	25.1165.
4b.480 (less 21-49 words of (a)(7)).	25.1181.
4b.480 (21-49 words of (a)(7)).	25.1195.
4b.481	25.1185.
4b.482	25.1189.
4b.483	25.1183.
4b.484(a)	25.1195.
4b.484(b)	25.1197.
4b.484(c)	25.1199.
4b.484(d)	25.1199.
4b.484 (less (a)-(d))	25.1201.
4b.484-1 (less 18th-30th words of paragraph (a) and subparagraphs (a) (1) and (2)).	Not a rule.

DISTRIBUTION TABLE—Continued

Former section	Revised section
4b.484-1 (18th-30th words of paragraph (a) and subparagraphs (a) (1) and (2)).	25.1197.
4b.485	25.1203.
4b.485-1	Not a rule.
4b.486	25.1191.
4b.487	25.1193.
4b.489	25.1187.
4b.490	25.1205.
4b.600	25.1301.
4b.601	25.1301.
4b.602	Surplusage.
4b.603	25.1303.
4b.604	25.1305.
4b.605	25.1307.
4b.606	25.1309.
4b.606-1	Not a rule.
4b.606-2	Not a rule.
4b.610	25.1321.
4b.611	25.1321.
4b.611-1	Not a rule.
4b.612(a)	25.1323.
4b.612(b)	25.1325.
4b.612(c)	25.1327.
4b.612(d)	25.1329.
4b.612(e)	25.1331.
4b.612 (less (a)-(c))	25.1333.
4b.612-1	Not a rule.
4b.612-2	Not a rule.
4b.612-3	Not a rule.
4b.612-4	Not a rule.
4b.612-5	Not a rule.
4b.613	25.1337.
4b.620	Surplusage.
4b.621	25.1351.
4b.622	25.1351.
4b.622-1	Not a rule.
4b.623	25.1355.
4b.624	25.1357.
4b.624-1 (1st sentence)	Not a rule.
4b.624-1 (less 1st sentence).	25.1357.
4b.625	25.1353.
4b.625-1 (introductory paragraph) (1st sentence).	25.1353.
4b.625-1 (less introductory paragraph) (1st sentence).	Not a rule.
4b.626	25.1359.
4b.626-1	Not a rule.
4b.627	25.1363.
4b.628	25.1369.
4b.630	25.1387.
4b.631	25.1383.
4b.632	25.1385.
4b.632-1 (1st sentence)	25.1385.
4b.632-1 (less 1st sentence).	Not a rule.
4b.633	25.1387.
4b.634	25.1389.
4b.634-1	25.1389.

DISTRIBUTION TABLE—Continued

Former section	Revised section
4b.635	25.1397.
4b.636	25.1399.
4b.637	25.1401.
4b.640 (less introductory paragraph) (third sentence).	25.1419.
4b.640 (introductory paragraph) (third sentence).	25.1585.
4b.641	Surplusage.
4b.642	Obsolete.
4b.642-1	Not a rule.
4b.643	25.1413.
4b.644	25.1413.
4b.645 (less (e) and applicability to marking).	25.1415.
4b.645 (less (e) as applicable to marking).	25.1561.
4b.645(e)	25.1411.
4b.646 (less 4th sentence of introductory paragraph).	25.1411.
4b.646 (4th sentence of introductory paragraph).	25.1561.
4b.647	25.1415.
4b.650	25.1431.
4b.651(a)	25.1441.
4b.651(b)	25.1443.
4b.651(c)	25.1445.
4b.651(d)	25.1447.
4b.651(e)	25.1449.
4b.651(f)	25.1451.
4b.651(g)	25.1453.
4b.651 (less (a)-(g))	25.1439.
4b.651-1	Not a rule.
4b.651-2	Not a rule.
4b.651-3	Not a rule.
4b.651-4	Not a rule.
4b.651-5(a)	25.1445.
4b.651-5 (less (a))	Not a rule.
4b.651-6	Not a rule.
4b.651-7	Not a rule.
4b.651-8	Not a rule.
4b.651-9	Not a rule.
4b.651-10	Not a rule.
4b.651-11	Not a rule.
4b.651-12	Not a rule.
4b.653	25.1435.
4b.654	25.1435.
4b.655	25.1435.
4b.656	25.1457.
4b.658	25.1433.
4b.660	25.1455.
4b.700	25.1501.
4b.700-1	Not a rule.
4b.710	25.1503.
4b.711	25.1505.
4b.713	25.1507.
4b.714	25.1511.
4b.715	25.1515.
4b.716	25.1515.

DISTRIBUTION TABLE—Continued

Former section	Revised section
4b.717	25.1513.
4b.718	25.1521.
4b.718–1	Not a rule.
4b.719 (1st sentence)	25.1519.
4b.719 (less 1st sentence).	25.1583.
4b.720	25.1523.
4b.721	25.1525.
4b.722	25.1527.
4b.723	25.1531.
4b.730	25.1541.
4b.730–1	Not a rule.
4b.731	25.1543.
4b.732	25.1545.
4b.733	25.1547.
4b.734	25.1549.
4b.735	25.1551.
4b.736 (less last sentence).	25.1553.
4b.736 (last sentence)	25.1583.
4b.737	25.1555.
4b.738(a)	25.1557.
4b.738(b)	25.1557.
4b.738(c)	25.1557.
4b.738(d)	25.1561.
4b.738 (less (a)-(d))	25.1563.
4b.740	25.1581.
4b.740–1	Not a rule.
4b.740–2	Not a rule.
4b.741	25.1583.
4b.742	25.1585.
4b.743	25.1587.
4b.750	Transferred to Part 45 [New].
4b.751	Transferred to Part 45 [New].
Figures	
4b–1	Not a rule.
4b–2	25.333.
4b–3	25.333.
4b–4	25.415.
4b–5	25.397.
4b–6	25.405.
4b–7	Fig. 1 of Appendix A.
4b–8	Fig. 2 of Appendix A.
4b–9	Fig. 3 of Appendix A.
4b–10	Fig. 4 of Appendix A.
4b–11	Fig. 5 of Appendix A.
4b–12	Fig. 6 of Appendix A.
4b–13	Fig. 7 of Appendix A.
4b–14	Fig. 8 of Appendix A.
4b–15a	Fig. 1 of Appendix B.
4b–15b	Fig. 2 of Appendix B.

DISTRIBUTION TABLE—Continued

Former section	Revised section
4b–15c	Fig. 3 of Appendix B.
4b–16	25.779.
4b–17	25.779.
4b–18	25.1391.
4b–19	25.1393.
4b–20	25.1395.
4b–21	Previously deleted.
4b–22	25.781.
4b–23	Previously deleted.
4b–24a	Fig. 1 of Appendix C.
4b–24b	Fig. 2 of Appendix C.
4b–24c	Fig. 3 of Appendix C.
4b–25a	Fig. 4 of Appendix C.
4b–25b	Fig. 5 of Appendix C.
4b–25c	Fig. 6 of Appendix C.
4b–26	25.509.
4b–27	25.1401.
SR 422B	
Item 1	Surplusage.
Item 2, comprised of an introductory paragraph, §§ 4T.110–4T.123, and § 4T.743, distributed as follows:	
Introductory paragraph.	25.101.
4T.110(a)	Surplusage.
4T.110 (less (a))	25.101.
4T.111	25.101.
4T.112 (a) and (b)	25.103.
4T.112 (less (a) and (b)).	25.149.
4T.113	25.105.
4T.114	25.107.
4T.115	25.109.
4T.116	25.111.
4T.117	25.113.
4T.117a	25.115.
4T.118	25.117.
4T.119	25.119.
4T.120	25.121.
4T.121	25.123.
4T.122	25.125.
4T.123(a)	25.1533.
4T.123 (less (a))	25.1587.
4T.743(a)	25.1583.
4T.743 (less (a))	25.1587.
Item 3	Transferred to Part 121 [New].
Item 4	Transferred to Part 91 [New].
SR 422B (less items 1–4).	Transferred to Part 1 [New].

[F.R. Doc. 64–13261; Filed, Dec. 23, 1964; 8:48 a.m.]

[Docket No. 6102; Amdt. 39–16]

PART 39—AIRWORTHINESS DIRECTIVES [NEW]

Boeing Models 707 and 720 Series Aircraft

A proposal to amend Part 507 of the Regulations of the Administrator to include an airworthiness directive requiring the installation of a placard on the cockpit fuel dump chute panel prohibiting speed brake actuation during fuel jettisoning and a notation in the limitations section of the Airplane Flight Manual to this effect on Boeing Models 707 and 720 Series aircraft was published in 29 F.R. 10523. Since the publication of that proposal, Part 507 has been recodified into Part 39 of the Federal Aviation Regulations, effective November 20, 1964, therefore this amendment is being made to Part 39.

Interested persons have been afforded an opportunity to participate in the making of the amendment. Comments received objected to the placard, feeling that the Airplane Flight Manual notation would be sufficient. Both a placard and an Airplane Flight Manual notation are required by the Civil Air Regulations with respect to the prohibition against dumping fuel with the speed brakes extended since this prohibition is an operating limitation of the airplane. A placard is not required regarding the use of full and rapid aileron control while dumping fuel since this is only a precautionary note in the Airplane Flight Manual. In addition, the manufacturer has already accomplished a Flight Manual change to include the note regarding the use of ailerons while dumping fuel and the limitation prohibiting the use of speedbrakes while dumping fuel. As a result of a comment received, the AD has been revised to allow a compliance time of 500 flight hours to be compatible with scheduled routing maintenance periods.

In consideration of the foregoing, and pursuant to the authority delegated to me by the Administrator (25 F.R. 6489), § 39.13 of Part 39 (14 CFR Part 39), is hereby amended by adding the following new airworthiness directive:

BOEING. Applies to Models 707 and 720 Series aircraft.

Compliance required as indicated.

Flight tests have disclosed that speed brake actuation during fuel jettisoning causes fuel to impinge on the horizontal stabilizer. To correct this condition, accomplish the following:

(a) Within 500 hours' time in service after the effective date of this AD, unless already accomplished:

(1) Install a placard on the fuel dump chute panel in the cockpit that reads,

"Do not dump fuel with the speed brakes extended."

(2) Amend the limitations section of the FAA approved Airplane Flight Manual by adding the following two statements under fuel dumping limitations:

(i) "Do not dump fuel with speed brakes extended."

(ii) "NOTE: Do not use full and rapid aileron control while dumping fuel."

(b) Equivalent wording, subject to prior approval by the Chief, Aircraft Engineering Division, FAA Western Region, may be used in lieu of that specified in this AD.

This amendment shall become effective January 23, 1965.

(Secs. 313(a), 601, 603; 72 Stat. 752, 775, 776; 49 U.S.C. 1354(a), 1421, 1423)

Issued in Washington, D.C., on December 17, 1964.

C. W. WALKER,
Acting Director,
Flight Standards Service.

[F.R. Doc. 64–13194; Filed, Dec. 23, 1964; 8:45 a.m.]

[Docket No. 6393; Amdt. 39–15]

PART 39—AIRWORTHINESS DIRECTIVES [NEW]

Piper Model PA–30 Aircraft

Amendment 769, 29 F.R. 9823, AD 64–16–7, as revised by Amendment 798, 29 F.R. 11971, requires the installation of a placard which restricts the airspeed limits until a new design stabilator torque tube is installed on Piper Model PA–30 aircraft. This was to be accomplished on an optional basis. As the result of an additional failure, it has now been determined that the installation of the heavy-walled torque tube should be mandatory, and Amendment 769 is being superseded by a new directive to specify this installation.

As a situation exists which demands immediate adoption of this regulation, it is found that notice and public procedure hereon are impracticable and good cause exists for making this amendment effective in less than 30 days.