Transport Airship Requirements

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submitted by:

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AIRWORTHINESS REQUIREMENTS FOR TRANSPORT CATEGORY AIRSHIPS

Foreword

1 The Civil Aviation Authorities Luftfahrt-Bundesamt of Germany and Rijksluchtvaartdienst of The Netherlands have agreed common comprehensive airworthiness requirements for large airships to accomodate Type Certification applications for such aircraft in their countries. The new category Transport Airships is defined in Appendix C.

2 Existing airworthiness codes FAR P8110-2 of the Federal Aviation Administration of the United States of America and JAR-25 of the Joint Aviation Authorities of Europe have been selected to form the basis of these Transport Airship Requirements (TAR).

3 Certain of the requirements of this TAR, in particular those in Subpart F, call for the installation of equipment and in some cases prescribe requirements for the design and performance of that equipment. These requirements, in common with the remainder of the TAR, are intended to be acceptable to the Authorities as showing compliance, but it should be borne in mind that an importing country may require equipment additional to those in this TAR for operational purposes.

4 The performance requirements of Subparts B and G have been developed on the assumption that the resulting scheduled performance data will be used in conjunction with airship performance operating rules which are complementary to these performance requirements.

5 Terms used in this TAR are as contained in JAR-1, "Definitions and Abbreviations". Airship related Definitions and Abbreviations are presented in Appendix C.

6 Future development of the requirements for this TAR will be in accordance with an agreed amendment procedure. The two Aviation Authorities have agreed they should not unilaterally initiate amendment of the code.

7 Amendments to the text in this TAR will usually be issued initially as 'Orange Paper' Amendments.

8 Comment/Response Documents developed following Notice of Proposed Amendment (NPA) consultation produced by the two Aviation Authorities as a method of publicly responding to comments received are published with each Orange Paper amendment (OP) that contains the affected proposals. These texts will not be reproduced when those OPs are incorporated into a Change. Readers should therefore either retain Comment/Response Documents for future reference, or apply to the two Aviation Authorities for copies of specific Comment/Response Documents as required.

9 Units are transformed according the SI-system. However, in some cases the units where kept in order not to alter the known shape.

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Preambles

31.3.2000

The TAR consists of nine Subparts including subparts J for APUs, and 3 Appendices.

Section 1 - Requirements

1 General

I. This code is originally based on P8810-2 of the Federal Aviation Regulations, named Airship Design Criteria, applicable for conventional, near-equilibrium non-rigid airships with nine passenger seats or less, and it is termed "Transport Airship Requirements". JAR-25 requirements for large airplanes have been considered and incorporated where applicable to achieve a comparable level of safety.

II. Several JAR-25 NPAs, which face incorporation in the JAR-25 text in the near future, have been considered and incorporated where applicable in the TAR.

III. The definition of Transport Airships in Appendix C encompasses all types of construction, whether they be non- or semi-rigid, conventional rigid, metal rigid or metal pressure airships and whether they perform horizontal or vertical take-offs and landings.

2 Presentation

I. The requirements of TAR are presented in two columns on loose pages, each page being identified by the date of issue or the Change number under which it is amended or reissued. A checklist of pages will be provided when the first changes are incorporated.

II. In general, the TAR paragraphs carry the same number as the corresponding FAR- or JAR paragraph. In cases where new airship material is introduced, and there is no corresponding paragraph in FAR/JAR, a number is chosen for it which attempts to place the new material in the right context within the FAR/JAR numbering system.

III. AC material is now shown in the related paragraphs but will be taken up in a new Section 2 in later issues.

IV. Advisory material is now shown in the related paragraphs but will be taken up in a new Section 3 in later issues.

V. Where appropriate, reference is made to existing JAR-25 ACJ and AMJ material.

VI. New, amended and corrected text is enclosed within heavy brackets [xx].

Section 2 - Acceptable Means of Compliance and Interpretations (AC)

(reserved)

Section 3 - Advisory material

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Subpart A - General

TAR 1 Applicability

(a) These regulations prescribe acceptable airworthiness requirements for the issue of type certificates and changes to those certificates, applicable to near equilibrium, conventional airships in the transport category as defined in Appendix C.

(b) Each person who applies for such a certificate or change must show compliance with the applicable requirements in this code.

(c) Additional requirements may be stipulated to cover airship design features or operational characteristics not envisioned in this document.

(1) The Authority may prescribe Special Conditions for an airship, if the airworthiness requirements do not contain adequate or appropriate safety standards for the product, because:

(i) the product has novel or unusual design features relative to the design practices on which the applicable requirement is based; or:

(ii) the intended use of the product is unconventional

(2) The Special Conditions contain such safety standards as the Authority finds necessary to establish a level of safety equivalent to that intended in the regulations.

(d) The Authority may exempt the applicant from the need to show that the product complies with particular requirements, where this is warranted taking account of the safe operation of the airship and is established on the basis of sound experience.

Subpart B - Flight

GENERAL

TAR 21 Proof of compliance

(a) Each requirement of these regulations must be met at each appropriate combination of total mass, static heaviness and lightness and centre of gravity within the range of loading conditions that may occur during the operations for which certification is requested. This must be shown by tests upon an airship of the type for which certification is requested, or by calculations based on and equal in accuracy to the results of testing or a combination of each.

(b) Systematic investigation is required of each probable combination of mass and centre of gravity, if compliance cannot be reasonably inferred from combinations investigated.

(c) The controllability, stability, trim, and stalling characteristics of the airship must be shown at all airspeeds with various ballonet or gas cell levels.

(d) The following general tolerances from specified values are allowed during flight testing:

Item	Tolerance
Mass	+5%, -10%
Critical items affected by mass	+5%, -1%
Centre of gravity	±7%
Airspeed	±3 knots or ±3%, whichever is higher

The manner and extent to which variations of other relevant data of the airship are to be taken into account in establishing compliance with the performance requirement, and in scheduling performance data, must be established by the applicant.

(e) If compliance with the flight characteristics requirements is dependent upon a stability augmentation system or upon any other automatic or power-operated system, compliance must be shown with TAR 672.

(f) For take-off, landing and ground handling the wind and gust velocity must be measured at the height of hull axis when moored, or corrected for the height at which the wind velocity is measured.

TAR 23 Load distribution limits

(a) Ranges of mass, static heaviness and lightness and lift and corresponding centres of gravity and lift must be established, within which the airship may be safely operated.

(b) The load distribution limits may not exceed the:

(1) selected limits;

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

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

TAR 25 Mass limits

(a) Maximum mass: the maximum mass is the highest mass at which compliance with each applicable requirement of these regulations is shown. The maximum mass must be established so that it is:

(1) not more than:

(i) the highest mass selected by the applicant,

(ii) the design maximum mass, which is the highest mass at which compliance with each applicable structural loading condition of these regulations is shown, or

(iii) The highest mass at which compliance with each applicable flight requirement is shown;

(2) not less than that which can be achieved with the payload-car or keel loaded to its maximum design mass

(b) Minimum mass: the minimum selected mass (the lowest mass at which compliance with each applicable requirement is shown) must be established so that it is not less than:

(1) the lowest mass selected by the applicant;

(2) the design minimum mass (the lowest mass at which compliance with each structural loading condition is shown); or

(3) the lowest mass at which compliance with each applicable flight requirement is shown.

TAR 27 Centre of gravity limits

The horizontal, vertical and lateral centre of gravity limitations must be established for each practicably separable operating condition.

TAR 29 Empty mass and corresponding centre of gravity

(a) The empty mass and corresponding centre of gravity must be determined from the mass of all items, including the structure, and:

(1) the mass of the deflated gas cells and envelope;

(2) Fixed ballast;

(3) Unusable fuel determined under TAR 959; and:

(4) Full operating fluids, including

(i) Oil;

(ii) Hydraulic fluid;

(iii) other fluids required for normal operation of the airship systems.

(b) The condition of the airship at the time of determining empty mass must be one that is well defined and repeatable.

TAR 31 Removable ballast

Removable ballast may be used in showing compliance with the flight requirements of this subpart, if:

(a) the place for carrying ballast is properly designed and installed, and is marked under TAR 1557;

(b) instructions are included in the Airship Flight Manual, approved manual material, or markings and placards, for the proper placement of the removable ballast under each loading condition for which removable ballast is necessary.

(c) distribution of removable ballast in terms of inertia must be considered, beside basic mass and centre of gravity effects, as this may be a significant factor on handling characteristics such as oscillatory behaviour and/or stabilities.

TAR 33 Propeller speed and pitch limits

(a) General: The propeller speed and pitch must be limited to values that will assure safe operation under normal operating conditions.

(b) Propellers not controllable in flight: for each propeller, the pitch of which cannot be controlled in flight, during take-off and initial climb at best rate of climb speed, the propeller must limit the engine r.p.m., at full throttle or at maximum allowable take-off manifold pressure, to a speed not greater than the maximum allowable take-off r.p.m.

(c) Controllable pitch propellers without constant speed controls: each propeller that can be controlled in flight, but that does not have constant speed controls, must have a means to limit the pitch range or an indication of the propeller pitch angle or thrust so that the lowest possible pitch allows compliance with subparagraph (b) of this paragraph.

(d) The means used to limit the low pitch position of the propeller blades must be set so that the engine does not exceed 103% of the maximum allowable engine rpm or 99% of an approved maximum overspeed, whichever is greater, with:

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

(2) the airship stationary under standard atmospheric conditions with no wind; and

(3) the engines operating at the maximum take-off torque limit for turboprop engine-powered airships.

(e) controllable pitch propellers with constant speed controls: each controllable pitch propeller with constant speed controls must have:

(1) with the speed control in operation, a means at the speed control to limit the maximum engine speed to the maximum allowable take-off r.p.m.;

(2) with the speed control inoperative, a means to limit the maximum engine speed to 103% of the maximum allowable take-off r.p.m. with the propeller blades at the lowest possible pitch and with take-off manifold pressure, the airship stationary, and no wind.

PROCEDURES

TAR 40 General

(a) The applicant has, were applicable, to establish and schedule appropriate techniques for masting and unmasting, take-off and landing, en-route, hovering, cargo and/or passenger loading and unloading under the conditions for which certification is requested. The techniques shall be such that the manoeuvres can be conducted safely without requiring exceptional skills and, when they are used in tests to establish performance data, the results of the tests are reasonable repeatable.

(b) The established techniques shall, were appropriate, include the procedures to be followed by all required crew including ground handling crew and shall specify the composition and duty of the minimum crew. The minimum crew shall be specified in relation to the selected conditions and limitations.

(c) The techniques established must be published in the Airship Flight Manual.

PERFORMANCE

TAR 45 General

(a) Unless otherwise prescribed, the performance requirements of this subpart must be met for still air; and ambient atmospheric conditions defined by the applicant.

(b) The performance data must correspond to the vectored, propulsive thrust available under the particular ambient atmospheric conditions, the particular flight condition, and the relative humidity specified in subparagraph (d) of this paragraph.

(c) The available propulsive thrust must correspond to engine power or thrust, not exceeding the approved power or thrust, less:

(1) installation losses;

(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) The performance, also as affected by engine power or thrust, must be based on a relative humidity selected by the applicant or as a minimum of:

(1) 80% at or below standard temperature;

(2) 34% at and above standard temperature plus 28°C (50°F);

(3) Between the two temperatures listed in subparagraphs (d)(1) and (d)(2) of this paragraph, the relative humidity must vary linearly.

(e) The following also apply:

(1) Unless otherwise prescribed, the applicant must select the take-off or unmasting, en route, approach, and landing or masting configurations for the airship;

(2) The airship configuration may vary with mass, static heaviness and lightness, altitude, and temperature, to the extent they are compatible with the operating procedures required by subparagraph (e)(3) of this paragraph;

(3) Unless otherwise prescribed, in determining the critical-engine(s)-inoperative take-off performance, take-off flight path, take-off distance, and landing distance, changes in the airship's configuration, speed, power, and thrust must be made in accordance with procedures established by the applicant for operation in service;

(4) Procedures for the execution of missed approaches and balked landings associated with the conditions prescribed in TAR 65, 67 and 77 must be established;

(5) The procedures established under subparagraphs (e)(3) and (e)(4) of this paragraph must:

(i) be such that they can be executed consistently by a crew of average skill,

(ii) use methods or devices that are safe and reliable,

(iii) include allowance for any reasonably expected time delays in the execution of the procedures.

TAR 51 Take-off

(a) The take-off performance data and procedures for airships, equipped with landing gears and requiring a horizontal take-off when operating statically heavy, the distance*) required to take-off and clear a 50-ft obstacle must be determined and included in the Airship Flight Manual:

(1) For each appropriate combination of total mass, static heaviness and the most unfavourable centre of gravity within the range of loading conditions for which certification is requested, and for ambient atmospheric temperature and wind conditions within the operational limits selected by the applicant;

(2) For the selected configuration for take-off;

(3) For the most unfavourable centre of gravity position;

(4) With the engines and vectored thrusters (if so equipped) operated within approved operating limits.

*)The take-off distance shall include the distance from the Spatial Reference Point to the tailpoint of the airship.

(b) Take-offs made to determine the data required by this paragraph must not require exceptional piloting skill or favourable conditions.

TAR 65 Climb: all engines operating

(a) Each airship, at maximum mass, static heaviness and at ambient atmospheric temperature within the operational limits established for the airship and with the most unfavourable centre of gravity for each configuration, must have a steady rate of climb at sea level of at least 1.5 m/s (300 ft/min) and a steady angle of climb of at least 1:12 with:

(1) thrust and lift controls in their normal position for climb;

(2) the landing gear or device retracted, if applicable; and

(3) not more than continuous power set on each engine.

(b) The maximum rates of climb and descent, to be used for all operations, must be established for all conditions using maximum continuous forward thrust. It must be demonstrated that envelope and gas cell pressures remain within the maximum and minimum approved pressures during climbs and descents at maximum rates of ascent and descent of at least 7 m/s (1200 ft/min).

(c) Performance data must be determined for variations in mass, static heavines, altitude and temperature at the most unfavourable centre of gravity for which approval is requested.

TAR 67 Climb: critical engine(s) inoperative

(a) Each airship, with the most critical engine(s) inoperative and with and without vectored thrust, at various combinations of mass, static heaviness and at ambient atmospheric temperature within the operational limits established for the airship and with the most unfavourable centre of gravity for each configuration, must have a steady rate of climb at sea level of at least 0.5 m/s (100 ft/min) with:

(1) thrust and lift controls in their normal position for climb;

(2) the landing gear or device retracted, if applicable; and

(3) not more than continuous power set on each engine.

(b) Performance data must be determined for variations in mass, static heavines, altitude and temperature at the most unfavourable centre of gravity for which approval is requested.

TAR 68 En-route flight path

(a) For the en-route configuration, the flight paths prescribed in (b) and (c) of this paragraph must be determined at each mass, altitude, and ambient temperature, within the operating limits established for the airship. The variation of mass along the flight path, accounting for the progressive consumption of fuel and oil by the operating engines, and also accounting for accumulation of water or snow onto the envelope of the airship may be included in the computation. The flight path must be determined at any selected speed, with:

(1) the most unfavourable centre of gravity;

(2) the critical engine(s) 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 be established;

(c) For three- or more-engined airships, a minimum of two engines inoperative net flight path data must be established

TAR 75 Landing

(a) For airships equipped with landing gears and capable of making horizontal landings the horizontal distance*) necessary to land and come to a complete stop from clearing a point 50 ft (15 m) above the landing surface must be determined for each scheduled technique, with the airship in the most critical configuration for landing. If any device is used that depends on the operation of any engine(s), and if the landing distance would be noticeably increased when a landing is made with engine(s) inoperative, the landing distance must be determined with that (those) engine(s) inoperative unless the use of compensating means will result in a landing distance not more than that with all engines operating.

*)The distance shall be measured from the obstacle to the bow of the stopped airship.

(b) For airships not equipped with a landing gear and for which landings are essentially vertical, performance data must be established for each scheduled technique with the airship in the most critical configuration for landing.

(c) Landing performance and data must be determined and included in the Airship Flight Manual:

(1) for standard temperatures at each mass and static heaviness, altitude and and wind condition within the operational limits established by the applicant;

(2) for the selected configuration for landing;

(3) for the most unfavourable centre of gravity position;

(4) with the engines operated within approved operating limits

TAR 76 Engine failure

The airship must be capable of maintaining level flight and zero rate of descent following failure of one or more critical engine(s). Ballast may be dropped or helium valved to achieve these conditions. Only disposable ballast may be dropped.

TAR 77 Balked landing

Each airship must demonstrate the ability to transition to a balked landing climb from a descent and approach to landing in accordance with established procedures in the Airship Flight Manual, at maximum landing mass and static heaviness without excessive sink or requiring excessive pilot skill. The airship configuration will include:

(a) the airship trimmed for descent and landing;

(b) the landing gear extended; and

(c) thrust and lift controls initially in the position normally used for landing.

TAR 80 Loading/Unloading

(a) For airships intended to load and unload cargo or other ballast when the airship is in flight, hovering, or on the ground but not masted, performance data must be established with the airship in the most critical configuration.

(b) Loading/Unloading performance and data must be determined and included in the Airship Flight Manual:

(1) for standard temperatures at each weight and static heaviness, altitude, and wind condition within the operational limits established by the applicant;

(2) for the selected configuration for loading/ unloading;

(3) for the most unfavourable centre of gravity position;

(4) with the engines operated within approved operating limits.

(c) During any cargo exchange or reballasting operation the airship must be capable of achieving a safe free flight condition within a time period short enough to recover from a potentially hazardous condition.

FLIGHT CHARACTERISTICS

TAR 141 General

The airship must meet the requirements of TAR 143 through 261 at all approved operating altitudes and ambient atmospheric conditions without exceptional piloting skill, alertness, or strength.

CONTROLLABILITY AND MANOEUVRABILITY

TAR 143 General

(a) The airship must be safely controllable and manoeuvrable during:

(1) Take-off;

(2) Climb;

(3) Level flight;

(4) Descent;

(5) Landing;

(6) Level flight with the critical engine(s) inoperative and remaining engines vectored in any allowable position.

(7) in flight cargo exchange and reballasting operations and during passenger or cargo loading and unloading with the airship on the ground but off the mast.

Dynamic response due to modes of motion must be considered to ascertain that no abnormal modes of motion, flight attitudes and accelerations will occur on account of the manoeuvres induced.

(b) It must be shown that without engine power descent and landing under the conditions of TAR 561 can be made.

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

(1) for airships with three or more engines the sudden failure of the second critical engine when the airship is in the en-route, approach, or landing configuration and is trimmed with the critical engine(s) inoperative; and:

(2) configuration changes, including use of deceleration devices.

(d) If, during the testing required by subparagraph (c) of this paragraph, marginal conditions exist with regard to required pilot strength, the pilot forces may not exceed the limits prescribed in Table 6 of Appendix A. For the purpose of complying with prolonged control force limitations the airship must be trimmed as neutrally as possible.

TAR 145 Longitudinal control

With all engines operating at maximum continuous power, appropriate lift control settings, the airship trimmed and without exceeding the pilot forces of Table 6 in Appendix A, it must be possible to produce a reasonably sudden:

(a) nose-down pitch change out of a stabilised climb with 30° nose-up deck angle at the most critical airspeed.

(b) nose-up pitch change out of a stabilised descent with 30° nose-down deck angle at the most critical airspeed.

TAR 147 Directional control

There must be enough rudder control to enter and recover any turns appropriate to the conditions for which certification is requested with pilot forces not exceeding the values given in Table 6 of the Appendix A. Additionally it must be demonstrated that directional control can be maintained with and against asymmetric engine thrust due to the failure of the critical engine.

TAR 149 Minimum control speed

(a) V_{MC} is the calibrated airspeed at which, when the critical engine(s) is (are) suddenly made inoperative, it is possible to maintain control of the airship, with that (the) engine(s) still inoperative, and thereafter maintain straight flight at the same speed. The method used to simulate critical engine(s) failure must represent the most critical mode of powerplant failure with respect to controllability expected in service.

(b) For airships equipped with landing gears and capable of making horizontal landings the requirements of sub-paragraph (a) must also be met for the landing configuration with:

(1) Maximum available take-off power initially on each engine;

(2) The airship trimmed for an approach with all engines operating at an approach gradient equal to the steepest used in the landing distance demonstration of TAR 75;

(3) Landing gear (if applicable) extended; and

(4) All propeller controls throughout in the position recommended for approach with all engines operating.

(c) At V_{MC}, the rudder pedal force required to maintain control must not exceed 668 N (150 lb) and it must not be necessary to reduce power of the operative engine. During the manoeuvre the airship must not assume any dangerous attitude and it must be possible to prevent a heading change of more than 20°.

TAR 150 Minimum aerodynamic control speed

The minimum aerodynamic control speed V_{AM} is the minimum airspeed at which it is possible to maintain directional and longitudinal control and zero rate of descent of the airship with aerodynamic means for various combinations of mass and static heaviness during take-off, flight and landing.

TAR 153 Control during landings

Sufficient pitch and yaw control authority must exist under all appropriate approach and landing conditions defined in the Airship Flight Manual to permit the pilot to achieve the desired attitude and position. The means, technique and limits for such control must be published in the Airship Flight Manual.

TRIM

TAR 161 Trim

It shall be demonstrated that the airship, when in static trim and equilibrium, can be flown in horizontal flight at all airspeeds in still air with the elevator controls approximately neutral.

STABILITY

TAR 171 General

It shall be demonstrated that the airship is sufficiently stable in both pitch and yaw axes in steady unaccelerated flight during climb, descent, and level flight when trimmed at the appropriate operating speeds and with consistent use of auxiliary thrust and lift controls to ensure that the crew will not be unduly fatigued and distracted from their normal duties.

TAR 181 Dynamic stability

Any oscillation within the operating envelope of the airship must be controllable with normal use of the primary flight controls without requiring exceptional pilot skills.

MISCELLANEOUS FLIGHT REQUIREMENTS

TAR 201 Stall demonstration

Stall characteristics shall be investigated in straight flight and turns.

TAR 203 Stall characteristics

It must be possible to produce and to correct pitch and yaw by unreversed use of the control surfaces, up to the time the airship is stalled. No abnormal pitching may occur. The longitudinal control force must be positive up to and throughout the stall. In addition, it must be possible to prevent stalling promptly and to recover from a stall by normal use of the controls.

TAR 207 Stall warning

A stall warning must be installed:

(a) if the airship can be stalled; and,

(b) the stall of the airship cannot be detected by the inherent aerodynamic qualities of the airship.

TAR 237 Wind velocities

A maximum wind speed in which the airship is allowed to operate shall be established and scheduled in the Flight Manual and in the Ground Handling Manual. This speed shall not be greater than the lesser of:

(a) 75% of the maximum still air speed of which the airship is capable with the critical engine inoperative and the remaining engines operating at not more than maximum continuous power, or,

(b) The maximum surface winds in which the airship may be handled by the established minimum ground handling crew.

TAR 251 Vibration and buffeting

Each part of the airship must be free from excessive vibration under any appropriate speed and power condition up to V_{CD} as defined in TAR 311(c). In addition, buffeting must not occur in any normal flight condition severe enough to interfere with the satisfactory control of the airship, cause excessive fatigue to the crew, or result in loading beyond the limit load.

TAR 253 Envelope pressure and distortion

It must be shown that envelope or hull distortion and/or deflection will not interfere with flight path control throughout the range of speed, power and envelope pressure, if applicable, to be used in normal flight.

For non-rigid and semi-rigid airships the following apply:

(a) A means must be provided for the pilot to determine and control the envelope pressure within the design pressure range if applicable.

(b) An operational procedure must be provided and set forth in the Airship Flight Manual to comply with (a).

(c) Improper use of the procedure and the controls necessary to comply with paragraph (a) must not damage the envelope or the structure attached to it.

TAR 255 Ground handling characteristics

(a) Satisfactory ground handling procedures must be developed assuming the specified minimum flight and ground crew, all anticipated airship mass, buoyancy, failure and wind conditions.

(b) Mooring procedures must be developed.

(c) Towing with mechanical means such as tractors and/or winches must strictly avoid line snapping or whipping by using appropriate means of pre-tensioning and controlled yield in case of suddenly incurred forces.

(d) Ground handling equipment must be able to counteract ground gust conditions and wind shifts safely.

(e) The Ground Handling Manual shall define the wind conditions addressed in (d)

AC 255 Ground handling characteristics

The ground handling of airships is a classical problem area that needs to be notified with high importance. As airships of this category have to deal with large numbers of passengers and/or considerable cargo weights, the definition of procedures and the necessary minimum-crew should also consider failure conditions (for example: engine failure and/or loss of control).

Further issues, that should be considered, are:

Ground crew coordination: ground crew chief and responsibility sharing/hand over between ground crew chief and pilot, airship tie down or ballast procedure for loading and unloading, on-mast/off-mast responsibility, ground pressure control/ surveillance.

Ground handling personnel and equipment must be able to safely counteract ground gust conditions and wind shifts. Therefore appropriate wind limitations should be determined.

TAR 261 Flight in rough air

(a) Procedures and performance information of the airship at various levels of turbulence must be established for combinations of mass and static heaviness and and be incorporated in the Airship Flight Manual.

(b) The lifting gas pressure must remain within its limits during flight in rough air.

Subpart C - Structure

GENERAL

TAR 301 Loads

(a) Strength requirements are specified in terms of limit loads (the maximum loads 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 lifting gas-, air- and ground loads must be placed in equilibrium with inertia forces and moments, considering each item of mass in the airship, and, where appropriate, taking into account the effects of virtual inertia of the airship. Methods used to determine load intensities and distribution must be validated by flight load measurements unless the methods used for determining those loading conditions are shown to be conservatively approximate to or to closely represent actual conditions.

(c) Compliance with the structural requirements must be shown at any combination of static lift and mass, from the design minimum to the design maximum and the most adverse combination of centre of static lift and centre of gravity position within the range for which certification is sought.

(d) An enhancement factor of 1.33 must be used to establish limit loads where aerodynamic loads or load distributions are not reliably predictable, for example, empennages.

(e) If deflections under load would significantly change the distribution of external or internal loads, this redistribution must be taken into account.

(f) Loads and deflections as a function of static lift and mass distribution throughout the airship's structure shall be considered. Procedures and placarding shall be used when necessary to prevent static lift and load distributions which would cause deflections and stresses above the maxima allowed.

TAR 303 Factors of safety

Unless otherwise specified, a factor of safety of 1.5 must be used.

TAR 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 must not interfere with safe operation.

(b) The structure must be able to support ultimate loads without failure for at least 3 seconds. However, when proof of strength is shown by dynamic tests simulating actual load conditions, the 3 second limit does not apply.

TAR 307 Proof of structure

(a) Compliance with the strength and deformation requirements must be shown for each critical load 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. Where substantiating load tests are made these must cover loads up to ultimate load, unless it is agreed with the Authority that in the circumstances of the case, equivalent substantiation can be obtained from tests to agreed lower levels. Dynamic tests, including structural flight tests, are acceptable if the design load conditions have been simulated

(b) Certain parts of the structure must be tested as specified in Subpart D of this TAR.

TAR 309 Design mass

The mass of the airship is equivalent to its maximum design static lift plus any additional mass which may be carried by dynamic lift (distributed over the envelope and empennage in an acceptable manner) or by vectored thrust.

(a) Maximum design masses: the maximum masses at which compliance is shown with each applicable structural and flight requirement are defined below:

(1) Maximum design equilibrium mass W_0;

(2) Maximum static heaviness W_{sh} (the amount by which the mass of an airship exceeds the displacement buoyancy);

(3) Maximum landing mass W_l;

(4) Maximum take-off mass $W_t = W_0 + W_{toh}$;

(5) Maximum take-off static heaviness W_{toh}, (the amount by which the weight of the airship exceeds the displacement buoyancy during take-off);

(6) Maximum operating mass $W_{m0}=W_0+W_{sh}$.

(b) Minimum design masses: the minimum masses at which compliance is shown with each applicable requirement are defined below:

(1) Minimum design equilibrium mass W_m;

(2) Maximum static lightness W_{sl} (The amount by which the mass of an airship is less than the displacement buoyancy);

(3) Minumum design operating mass W_{m0}.

(c) Static lift is lift generated by the lifting gas, equalling the displacement buoyancy.

TAR 311 Design airspeeds

The selected design airspeeds are equivalent airspeeds (EAS) except as provided in specific requirements.

(a) Design maximum level flight airspeed V_H is the maximum speed obtainable in level flight with all engines operating at maximum continuous power and the airship loaded to equilibrium buoyancy or to loading which will produce minimum drag, whichever is greater.

(b) Design airspeed for maximum gust intensity V_B shall not be less than 35 knots or 0.65 V_H, whichever is higher.

(c) Design climb/dive airspeed V_{CD} may not be less than the greater of:

(1) V_H; or the

(2) maximum airspeed obtainable in a climb with all (forward thrust) engines at maximum take-off power and the airship in the minimum drag configuration and with maximum static lightness, or the

(3) maximum airspeed obtainable in a dive with all engines at maximum continuous power and the airship in the minimum drag configuration and with maximum static heaviness.

(d) Design manoeuvring speed V_A: (*reserved*)

(e) Design wind speed V_{WG} is the maximum wind speed expected to occur during take-off, landing, ground handling and masting. It is selected by the applicant but may not be less than 10 knots.

(f) Design wind speed V_{WT} is the maximum wind speed to be expected with the airship tethered to the ground during freight loading and unloading and passenger boarding and unboarding.

(g) Design wind speed V_{WM} for moored airship should meet the expected values but may not be less than specified in Table 4 of Appendix A.

FLIGHT LOADS

TAR 321 General

Compliance with the flight load requirements of this Subpart must be shown:

(a) at each lift from the minimum design lift to the maximum design lift (static lift, aerodynamic lift, vectored thrust);

(b) at each mass from the minimum design mass to the maximum design mass, also taking into account static heaviness as well as lightness;

(c) at each critical altitude within the range in which the airship may be selected to operate;

(d) at each critical temperature at which the airship is selected (see JAR 1 Fig. 1 Standard climates) to be operated;

(e) for each required lift, mass, altitude and temperature, at any practicable distribution of disposable load within the operating limitations specified in TAR 1583 through 1589;

(f) when determining the loads, the influence of rain, snow, hail and ice has to be accounted for.

TAR 333 Design manoeuvring loads

(a) The airship, including control surfaces, is considered to be subjected to the loads resulting from the manoeuvring conditions listed in Table 1 of Appendix A. Steady state and transient effects during checked and unchecked manoeuvre must be taken into account.

(b) Consideration of the manoeuvring conditions must include the investigation of both the separate and the combined effects of the rudder and elevator control surfaces plus other related means of control as (but not limited to) lift- and mass-shift.

(c) Consideration of the manoeuvring conditions must include the investigation of the effect of the vectored thrust.

TAR 341 Gust and turbulence loads

The loads resulting from gusts and turbulence may either be determined by an analytical simulation of flight through random turbulence and discrete gusts with the results compared with values derived from the equation in subparagraph (c); or by applying subparagraph (a) and (b).

(a) The airship is assumed to be subjected to the loads resulting from encounters with the following atmospheric gusts in level flight:

(1) discrete gust of U_m=25 ft/s (7.6 m/s) while flying at speed $v=V_H$ (ft/s);

(2) discrete gust of U_m=35 ft/s (10.6 m/s) while flying at speed $v=V_B$ (ft/s).

Gust shapes and intensities u are defined as follows:

$$u = \frac{U_m}{2}\left[1 - \cos\left(\pi \cdot \frac{X}{H}\right)\right] \left[\frac{ft}{s}\right]$$

where:

U_m	gust velocity specified above (ft/s),
X	penetration distance (ft), 0 < X < 2 H,
H	gust gradient length (ft), L/4 < H < 800 ft (244 m), (a sufficient number of gust gradient length must be investigated to find the critical response of the airship)
L	length of the airship (ft).

The dynamic response of the airship to the design gusts as well as the steady state loads must be taken into account.

(b) The gusts are applied in any direction, including parallel to the airship longitudinal axis, with the control surfaces in both the neutral position and the maximum effective angles required to counteract the gust.

(c) In the absence of a more rational analysis, the maximum aerodynamic bending moment M (lb×ft), applied to the envelope, must be computed as follows:

$$M = 0.058 \cdot V \cdot \left(\frac{L}{2}\right)^{\frac{1}{4}} \left[1 + (f-4)\left(0.5624 \cdot L^{0.02} - \frac{1}{2}\right)\right] q \cdot \frac{U_m}{v} \quad [\text{lb ft}]$$

where:

f	envelope ratio, f=L/D, f≥4,
U_m	gust velocity from subparagraph (a) of this paragraph (ft/s),
q	dynamic pressure (lb/ft^2) at the velocity v (ft/s) under consideration, $q=rv^2/2$,
L	length of the airship (ft),
D	maximum envelope diameter (ft),
r	density of air (slugs/ft^3),
v	airship equivalent speed (ft/s) from subparagraph (a) of this paragraph,
V	total envelope volume (ft^3).

(d) The empennage is assumed to be subjected to the discrete gusts defined in subparagraph (a) applied under the following conditions.

(1) The airship is in straight and level flight;

(2) The gust is applied at 90° to either side of tail surfaces;

(3) Control surfaces must be considered to be in both the neutral position and at the maximum effective angles required to counteract the gust;

(4) The effective angle of attack is assumed to be:

$$\alpha = 1.25 \cdot \arctan^{-1}\left(\frac{U_m}{v}\right) \; [°]$$

(5) Control surface loads plus stern aerodynamic forces in the hull induced by the empennage must be placed in equilibrium with opposing inertia forces and/or mooring point forces in a rational or conservative manner with the airship at its design mass.

TAR 361 Engine and APU torque

(a) Each engine mount and its supporting structure must be designed for the effects of:

(1) A limit engine torque corresponding to maximum power and propeller speed acting simultaneously with 75% of the limit loads from the design manoeuvre conditions of TAR 333, or from the design gust conditions of TAR 341;

(2) A limit engine torque corresponding to the maximum continuous power and propeller speed acting simultaneously with the limit loads from the design manoeuvre conditions of TAR 333, or the limit loads from the design gust conditions of TAR 341;

(3) For turbopropeller installations: in addition to the conditions specified in subparagraphs (a)(1) and (a)(2) of this paragraph, a limit engine torque corresponding to maximum power and propeller speed, multiplied by a factor accounting for propeller control system malfunction, including quick feathering, acting simultaneously with 1 g level flight loads. In the absence of a rational analysis, a factor of 1.6 must be used.

(b) For turbopropeller installations, the engine mounts and supporting structure must be designed to withstand each of the following.

(1) A limit engine torque load imposed by sudden engine stoppage due to malfunction or structural failure (such as compressor jamming);

(2) A limit engine torque load imposed by the maximum acceleration of the engine.

(c) The limit engine torque, to be considered under subparagraph (a) of this paragraph, must be obtained by multiplying the mean torque by a factor of:

(1) 1.25 for turbopropeller installations, unless power transients can cause a higher limit torque;

(2) 1.33 for engines with five or more cylinders;

(3) 2, 3, or 4 for engines with 4, 3, or 2 cylinders, respectively

(d) When the airflow through the propeller is not symmetrical, due to airship yawing and pitching, engine vectoring or interaction from other thruster flow fields, the additional forces must be considered.

TAR 363 Side load on engine and APU mounts

(a) Each propulsive engine and auxiliary power unit 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 in the yawing or gust condition but not less than

(1) 1.33; or:

(2) One-third of the limit vertical load factor for design manoeuvre conditions specified in TAR 333.

(b) The side load prescribed in subparagraph (a) of this paragraph may be assumed to be independent of other flight conditions.

TAR 367 Unsymmetrical loads due to engine failure

For turbopropeller powered airships, the engine mount and support structure must be designed for the loads resulting from the failure of any one engine in combination with a single malfunction of the propeller drag limiting system. The following conditions apply.

(a) The loads resulting from power failure because of fuel flow interruption are considered to be limit loads.

(b) 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.

TAR 371 Gyroscopic loads

Each engine mount and its supporting structure must be designed for the gyroscopic loads resulting from the manoeuvre or gust loads whichever is higher, combined with the maximum rate of angular change in vectored thrust with the engines at maximum continuous r.p.m.

CONTROL SURFACE AND SYSTEM LOADS

TAR 391 Control surface loads: general

(a) Control surfaces must be designed for the control surface loads resulting from the conditions described in TAR 333 and 341.

(b) In the flight loading conditions, the airloads 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 TAR 397(b). However, these pilot forces may not be less than the actual maximum pilot forces determined when complying with TAR 143(c). In applying this requirement, the effects of control system boost and servo-mechanisms, and the effects of control surface inertia moments must be considered. The automatic pilot effort or any powered control system effort must be used for design if it alone can produce higher control surface loads than the human pilot.

(c) Loads due to the accumulation of snow or ice have to be taken into account.

TAR 395 Control system

(a) Each flight control system and its supporting structure must be designed for limit loads corresponding to at least 1.25 of the computed hinge moments of the movable control surface in the conditions prescribed in TAR 333 and 341. However, these loads except the loads resulting from ground gusts need not exceed the higher of the loads that can be produced by the pilot, by the autopilot or any powered control system.

(b) The system must be designed for the maximum effort of the pilot or autopilot, whichever is higher. In addition, the system should be designed for the case that the pilot and the autopilot act in opposition. Pilot forces used for design need not exceed the maximum forces prescribed in TAR 397(b).

(c) The design must, in any case, provide a rugged system for service use. Compliance with this paragraph may be shown by designing for loads resulting from application of the minimum forces prescribed in TAR 397(b).

TAR 397 Control system loads

(a) Pilot forces used for design are assumed to act at the appropriate control grips or pads as they would in flight, and to be reacted at the attachments of the control system to the control surface horns.

(b) The pilot forces and torques to be applied are presented in Table 2 of the Appendix A.

TAR 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 TAR 391; or

(2) The minimum forces specified in TAR 397(b).

(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 TAR 391.

TAR 405 Secondary control system

Secondary controls, such manually operated air or lifting gas valves as well as freight loading system controls, must be designed for the maximum forces that a pilot or crew member is likely to apply to those controls. The required design forces for one-hand operation of secondary controls are as listed in Table 2 (c) of Appendix A. If two hands are needed the forces must be increased to 150%. The forces must be multiplied by the number of the people necessary for the operation, if applicable. If the actual forces for the operation of secondary controls are lower, they may be reduced, but not to be less than 200% of the actual forces.

TAR 407 Trim tabs 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.

TAR 409 Tabs

Control surface tabs must be designed for the most severe combination of airspeed and tab deflection likely to be obtained.

TAR 411 Supplementary conditions for control surfaces

For airships with control surfaces having appreciable angles with respect to the horizontal and vertical axes or having inter surface supports, the surfaces and supporting structure must be designed for the combined surface loads prescribed for the separate systems.

TAR 415 Tail-to-wind loads

(a) The control system from the control surfaces to the stops, or when installed, the gust locks must be designed for limit loads corresponding to hinge moments calculated from the expression:

$$M_R = k \cdot l_R \cdot S_R \cdot q \quad [\mathrm{Nm}]$$

where:

- M_R limit hinge moment [Nm],
- l_R mean chord of control surface aft of the hinge line [m],
- S_R area of the control surface aft of the hinge line [m²],
- q dynamic pressure corresponding to an air speed of 13 m/s (42,7 ft/s),
- k limit hinge moment factor due to ground gust 1.40.

(b) In the absence of a more rational analysis, the load distribution on the movable control surface must be computed as varying linearly from zero at the hinge to a maximum value at the trailing edge.

GROUND LOADS

TAR 471 General

For airships designed for horizontal take-off and landing, the limit ground loads in this Subpart are considered to be external loads which must be placed in equilibrium with static lift and linear and angular inertia forces in a rational and conservative manner and the requirements and definitions of TAR 473, 477 and 479 apply.

TAR 473 Ground load conditions and assumptions

(a) The ground load requirements of this subpart must be complied with at the mass and landing gear shock absorber extensions shown in Table 3 of Appendix A.

(b) The selected limit vertical inertia load factor at the centre of gravity of the airship for the landing load conditions prescribed in this subpart may not be less than that which would be obtained when landing with the maximum descent velocity expected to occur in service but may not be less than 3 ft/sec (0.914 m/sec). Proper consideration may be given to the distribution of the landing energy on the envelope and/or the surrounding structure. No allowance shall be made for dynamic lift throughout the landing impact. The limit vertical inertia load factor n represents the ratio of the externally applied vertical forces to the mass of the airship.

(c) Energy absorption tests (to determine the limit load factor n corresponding to the required limit descent velocities) must be made under TAR 723(a).

(d) Except for airships for which the structural flexibility effects are neglectable, the effect of dynamic response of the structure must be covered by an analysis for the complete flight structure. The method of analysis must take into account at least the following elements:

(1) the structural flexibility;

(2) the aerodynamic conditions assumed to be constant, and;

(3) an analytical model of the landing gear dynamic characteristics substantiated by drop test.

TAR 477 Landing gear arrangement

For the purpose of these requirements landing gears are considered conventional if they consist of:

(a) a single wheel, or;

(b) twin co-axial wheels, or;

(c) laterally separated wheels

with or without shock absorbers, wheels and brakes located at the bottom of the airships hull or keel or car structure.

TAR 479 Landing gear loading condition

The landing gear and airship structure are considered to be subjected to the loads resulting from the take-off and landing conditions listed in Table 3 of the Appendix A. In determining the ground loads at the landing gear and affected support structure, the following apply:

(a) When investigating landing conditions, the drag components simulating the forces required to accelerate the tyres and wheels up to the landing speed must be properly combined with the corresponding instantaneous vertical ground reactions assuming a tyre sliding coefficient of friction of 0.8. The contact speed must be appropriate to landing the airship at the maximum selected forward landing speed. In determining wheel spin-up loads, the method set forth in JAR 23 Appendix D23.1, may be used.

(b) If a swivel (without lock, steering device or shimmy damper) is used, in addition to the above requirements, the gear is assumed to be swivelled 90° to the airship longitudinal axis, with the resultant ground load passing through the axle.

(c) Auxiliary landing gear and surrounding structure (e.g. wheels mounted on tail fin) must be designed to withstand the loads resulting from expected service.

TAR 481 Mooring and handling conditions

The limit loads specified in this paragraph are considered to be external loads that act upon the airship structure and handling lines. These loads are those resulting from the mooring and handling conditions listed in Table 4 of Appendix A. For these conditions, the airship is considered in the landing configuration. In addition the following has to be shown:

(a) A head-over of the moored airship has to be considered, except a device or procedure is provided to prevent the airship from doing so;

(b) If tether points on the ground are used all values necessary for their design must be listed in the Ground Handling or Operating Manual. All static and dynamic loads must be determined considering the wind conditions to be expected during mooring and handling. These values must be listed in the Airship Flight Manual. The determination by analytical means is only acceptable if a procedure is used warranting reliable results. Otherwise appropriate ground tests have to be performed. Loads provided to the airship by other ground support equipment, such as a tail down retaining ring, lateral guidance equipment or maintenance platforms need to be considered;

(c) It has to be specified, at which maximum speed the airship may contact the mast. The resulting loads on the airship are to be determined;

(d) The investigation of service conditions must include validated field weather conditions while the airship is moored during various gust and ambient conditions.

(e) Limit loads must be established for load exchange phase of flight when cargo, fuel and ballast are exchanged with the airship in a hovering mode wherein its position is or is not maintained by combinations of vectored thrust and tethering to the ground.

OTHER LOADS

TAR 505 Snow loads

(a) The limit load of precipitated snow on the moored airship's surface must be established.

(b) It must be shown by analysis that snow layers and partially sliding snow areas do not result in structural damage and/or uncontrollable conditions during flight.

(c) Fine snow crystals penetrating into the airship through crevices and openings must not accumulate to an extent that renders mechanisms or other parts of the airship inoperative.

TAR 507 Jacking loads

The airship must be designed for loads developed when supported by jacks or suspended from the hangar ceiling. Jacking points for the cars or the keel and attachment points for hangar ceiling suspension must be identified. The maximum mass and configuration of the airship structure that can be supported in this manner must be determined. Appropriate load factors must be applied in the design and substantiated.

TAR 509 Servicing access loads

(a) Parts of the structure that may be used for supporting a person during the rigging procedure, loading/unloading, boarding/unboarding, inspection, maintenance or repair on the ground must be designed to withstand a limit load of 1.1 kN and a load factor of 1.35 in addition to factor of safety.

(b) If the parts mentioned under (a) must support a person for servicing access in flight the inflight n-factors must be applied.

EMERGENCY LANDING CONDITIONS

TAR 561 General

(a) The airship, including its propulsion system, although it may be damaged in emergency landing conditions, must be designed as prescribed in this paragraph 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 seat belts provided for in the design for desgnated flight seats;

(2) the occupant experiences the ultimate inertia forces shown in Table 7 of the Appendix A.

(c) The supporting structure must be designed to restrain, under loads up to those specified in subparagraph (b)(2) of this paragraph , each item of mass that could injure an occupant if it came loose in a minor crash landing.

FATIGUE EVALUATION

TAR 571 General

The structure must be designed, as far as practible, to avoid points of stress concentration where variable stresses above the fatigue limit are likely to occur in normal service. An evaluation of the strength, detail design, and fabrication must show that catastrophic failure due to fatigue, corrosion, or accidental damage, will be avoided throughout the operational life of the airship. This evaluation must be conducted in accordance with the provisions of subparagraphs (a)(1), (b) and (d) of TAR 573, except as specified in subparagraph (a)(2) of this TAR 573, for each part of the structure which could contribute to a catastrophic failure (such as structure, the failure of which could affect buoyancy and dynamic lift, structure supporting aerodynamic form of envelope, empennage, control surfaces and their systems, the car or keel, cabin and cargo system structure, engine mounting, landing gear or device and their related primary attachments). For turbopropeller powered airships those parts which could contribute to a catastrophic failure must also be evaluated under TAR 573(c).
In addition, the following apply:

(a) Each evaluation required by this paragraph must include:

(1) The typical loading spectra, temperatures, humidities and harmful material expected in service;

(2) The identification of principal structural elements and detail design points, the failure of which could cause catastrophic failure of the airship; and

(3) An analysis, supported by test evidence, of the principal structural elements and detail design points identified in TAR 573(a)(2).

(b) The service history of airships of similar structural design, taking due account of differences in operating conditions and procedures, may be used in the evaluations required by this paragraph.

(c) Based on the evaluations required by this paragraph, inspections or other procedures must be established as necessary to prevent catastrophic failure, and must be included in the "Airworthiness Limitations Section of the Instructions for Continued Airworthiness" required by TAR 1529.

TAR 573 Damage tolerance and fatigue evaluation

(a) Metallic structures:

(1) Damage-tolerance (fail-safe) evaluation: the evaluation must include a determination of the probable locations and modes of damage due to fatigue, corrosion, or accidental damage. The determination must be shown by analysis supported by test evidence and (if available) service experience. Damage at multiple sites due to prior fatigue exposure must be included where the design is such that this type of damage can be expected to occur. The evaluation must incorporate repeated load and static analysis supported by test evidence. The extent of damage for residual strength evaluation at any time within the operational life must be consistent with the initial detectability and subsequent growth under repeated loads. The residual strength evaluation must show that the remaining structure is able to withstand loads (considered as static ultimate loads) corresponding to the following conditions:

(i) The limit symmetrical manoeuvring conditions specified in TAR 333 up to V_H.

(ii) The limit gust conditions specified in TAR 341 at the specified speeds up to V_H

(iii) The limit asymmetrical conditions specified in TAR 367 at speeds up to V_H

(iv) The limit yaw manoeuvring conditions specified in TAR 333 at the specified speeds up to V_H.

(v) For landing gear and directly-affected airframe structure, the limit ground loading conditions specified in TAR 473, 479 and 481. If significant changes in structural stiffness or geometry, or both, follow from a structural failure, or partial failure, the effect on damage tolerance must be further investigated. The residual strength requirements of this subparagraph (a) apply, where the critical damage is not readily detectable. On the other hand, in the case of damage which is readily detectable within a short period, smaller loads than those of subparagraphs (1)(i) to (1)(v) inclusive may be used by agreement with the Authority. A probability approach may be used in these latter assessments, substantiating that catastrophic failure is extremely improbable.

(2) Fatigue (safe-life) evaluation: Compliance with the damage-tolerance requirements of subparagraph (1) of this TAR 573 (a) is not required if the applicant establishes that their application for particular structure is impractical. This structure must be shown by analysis, supported by test evidence, to be able to withstand the repeated loads of variable magnitude expected during its service life without detectable cracks. Appropriate safe-life scatter factors must be applied.

(b) Non-metallic structures: composite airframe structures must be evaluated under this subparagraph instead of TAR 573 (a). The applicant must evaluate the composite airframe structure, the failure of which would result in catastrophic loss of the airship, in each structure related to buoyancy and static lift, empennage, their carry through and attaching structure, movable control surfaces and their attaching structure, car or keel, cabin, cargo system, engine mounting, landing gear and their related primary structures, using the damage-tolerance criteria prescribed in subparagraphs (1) to (4) of this paragraph unless shown to be impractical. If the applicant establishes that damage-tolerance criteria are impractical for a particular structure, the structure must be evaluated in accordance with subparagraphs (1) and (6) of this paragraph. Where bonded joints are used, the structure must also be evaluated in accordance with subparagraph (5) of this paragraph. The effects of material variability and environmental conditions on the strength and durability properties of the composite materials must be accounted for in the evaluations required by this paragraph .

(1) It must be demonstrated by test, or by analysis supported by tests or, if available, service experience that the structure is capable of carrying ultimate load with damage up to the threshold of detectability of the inspection procedures employed.

(2) The growth rate or no-growth of damage that may occur from fatigue, corrosion, manufacturing flaws or impact damage under repeated loads expected in service, must be established by tests or analysis supported by tests.

(3) The structure must be shown by residual strength tests, or analysis supported by residual strength tests, to be able to withstand critical limit flight loads (considered as ultimate loads) with the extent of detectable damage consistent with the results of the damage tolerance evaluations.

(4) The damage growth, between initial detectability and the value selected for residual strength demonstrations, factored to obtain inspection intervals, must allow development of an inspection programme suitable for application by operation and maintenance personnel.

(5) The limit load capacity of each bonded joint, the failure of which would result in catastrophic loss of the airship, must be substantiated by one of the following methods:

(i) The maximum disbonds of each bonded joint consistent with the capability to withstand the loads in subparagraph (3) of this paragraph must be determined by analysis, tests, or both. Disbonds of each bonded joint greater than this must be prevented by design features; or

(ii) Proof testing must be conducted on each production article that will apply the critical limit design load to each critical bonded joint; or

(iii) Repeatable and reliable non-destructive inspection techniques must be established which assure the strength of each joint.

(6) Structural components for which the damage tolerance method is shown to be impractical must be shown by component fatigue tests or analysis supported by tests to be able to withstand the repeated loads of variable magnitude expected in service. Sufficient component, sub-component, element, or coupon tests must be done to establish the fatigue scatter factor and the environmental effects. Damage up to the threshold of detectability and ultimate load residual strength capability must be considered in the demonstration.

(c) Sonic fatigue strength: it must be shown by analysis, supported by test evidence, or by the service history of airships of similar structural design and sonic excitation environment, that:

(1) Sonic fatigue cracks are not probable in any part of the flight structure subject to sonic excitation; or:

(2) Catastrophic failure caused by sonic cracks is not probable assuming that the loads prescribed in subparagraph (a)(1) of this paragraph are applied to all areas affected by those cracks.

d) Damage-tolerance (discrete source) evaluation: the airship must be capable of continuing safe flight and landing after likely single structural damage occurs during a flight as a result of separately either one of:

(1) Lightning (see also TAR 581)

(2) Icing

(3) Hail

(4) Propeller and uncontained fan blade impact,

(5) Uncontained engine failure,

(6) Uncontained high energy rotating machinery failure

(7) Whiplashing of cables breaking under load

(8) The damaged structure must be able to withstand the static loads (considered as ultimate loads) which are reasonably expected to occur at the time of the occurrence and during the completion of the flight. Dynamic effects on these static loads need not be considered. Corrective action to be taken by the pilot following the incident, such as limiting manoeuvres, avoiding

turbulence, and reducing speed, may be considered. If significant changes in structural stiffness or geometry, or both, follow from a structural failure or partial failure, the effect on damage tolerance must be further investigated.

(e) Envelope fatigue: *(reserved)*

LIGHTNING PROTECTION

TAR 581 Lightning protection

a) The airship must be protected against catastrophic effects from lightning.

b) For metallic components, compliance with subparagraph (a) of this paragraph may be shown by bonding the components properly to the airframe.

c) For non-metallic components, compliance with subparagraph (a) of this paragraph may be shown by incorporating acceptable means of diverting the resulting electrical current.

d) All components should be designed to minimise the effects of a strike such, that a strike will not endanger the airship.

Subpart D - Design and Construction

GENERAL

TAR 601 General

The airship 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 having an important bearing on safety must be established by tests.

TAR 603 Materials

The suitability and durability of materials used for parts, the failure of which could adversely affect safety, must:

(a) be established on the basis of experience or test;

(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; and take into account the effects of environmental conditions, such as temperature, UV-light and humidity, expected in service.

TAR 605 Fabrication methods

(a) The methods of fabrication employed in the Primary Structure must be such as to produce a consistently sound structure which must also be reliable with respect to maintenance of the original strength under reasonable service conditions. Processes and process control must ensure that it is unlikely that a major defect will remain in any primary structural component after manufacture (for example in complex forgings)

(b) Each new airship fabrication method must be substantiated by a test programme.

TAR 607 Fasteners

(a) Each removable bolt, screw, nut, pin or other removable fastener must incorporate two separate locking devices if:

(1) its loss could preclude continued flight and landing within the design limitations of the airship using normal pilot skill and strength; or

(2) its loss could result in reduction in pitch or yaw control capability or response below that required by Subpart B of this TAR.

(b) The fasteners specified in subparagraph (a) of this paragraph and their locking devices may not be adversely affected by the environmental conditions associated with the particular installation.

(c) No self-locking nut may be used on any bolt subject to rotation in operation unless a non-friction locking device is used in addition to the self-locking device.

TAR 609 Protection of structure

Each part of the airship 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

(b) have adequate provisions for ventilation and drainage where necessary for protection against the hazards listed at subparagraphs (a)(1) and (a)(2).

TAR 611 Accessibility provisions

Means must be provided to allow inspection (including inspection of principal structural elements, control systems, envelope and ballonets, gas cells), replacement of parts normally requiring replacement, adjustment, and lubrication as necessary for continued airworthiness. The inspection means for each item must be practicable for the inspection interval for the item. Non-destructive inspection aids may be used to inspect structural elements where it is impracticable to provide means for direct visual inspection if it is shown that the inspection is effective and the inspection procedures are specified in the maintenance manual required by TAR 1529.

TAR 613 Material strength properties and design values

(a) Material strength properties must be based on enough tests of material meeting specifications to establish design values on a statistical basis.

(b) The design values must be chosen to minimise the probability of structural failure due to material variability. Except as provided in subparagraph (e) of this paragraph, compliance with this subparagraph must be shown by selecting design values which assure material strength with the following probability:

(1) Where applied loads are eventually distributed through a single member within an assembly, the failure of which would result in loss of structural integrity of the component; 99% probability with 95% confidence.

(2) For redundant structure, in which the failure of individual elements would result in applied loads being safely distributed to other load carrying members; 90% probability with 95% confidence.

(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. Accumulation of humidity in composite parts and ageing of fabric materials under UV light have to be taken into account for the same reason.

(d) The strength, detail design, and fabrication of the structure must minimise the probability of disastrous fatigue failure, particularly at points of stress concentration.

(e) Greater design values may be used 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.

AC 613 Acceptable means of compliance

Design values could be those contained in or determined from the following publications (obtainable from the Superintendent of Documents, Government Printing Office, Washington, DC 20402) or other values approved by the Authority: 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'; MIL-HDBK-23, 'Composite construction for Flight Vehicles'; and Federal Requirement 191-A, 'Textile Test Methods'.

(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) when listed in MIL-HDBK-5 must be met.

(2) Redundant structures in which the partial 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 '0.90 probability' ('B' values) when listed in MIL-HDBK-5. Examples of these items are sheet-stiffener combinations and multi-rivet or multiple-bolt connections.

(b) Design values greater than the guaranteed minima required by paragraph (a) of this paragraph may be used 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.

(c) Material correction factors for structural items such as sheets, sheet-stringer combinations, and riveted joints, may be omitted if sufficient test data are obtained to allow a probability analysis showing that 90% or more of the elements will equal or exceed allowable selected design values.

TAR 619 Special factors

The factor of safety prescribed in TAR 303 must be multiplied by the highest pertinent special factors of safety determined in TAR 621 through 628 for each part of the structure, the strength of which is:

(a) Uncertain; or

(b) Likely to deteriorate in service before normal replacement; or

(c) Subject to appreciable variability because of uncertainties in manufacturing processes or inspection methods.

TAR 621 Casting factors

(a) General: the factors, tests, and inspections specified in paragraphs (b) through (d) of this paragraph 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 paragraph 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 paragraph:

(1) need not exceed 1.25 with respect to bearing stresses, regardless of the method of inspection used;

(2) need not be used with respect to the bearing surfaces of a part, the bearing factor of which is larger than the applicable casting factor.

(c) Critical castings: for each casting, the failure of which, would preclude continued safe flight and landing of the airship or result in serious injury to occupants, the following apply.

(1) Each critical casting must either

(i) Have a casting factor of not less than 1.25 and receive 100% inspection by visual, radiographic, and either magnetic particle penetrant or other approved equivalent non-destructive inspection method or

(ii) Have a casting factor of nor less than 2.0 and receive 100 % visual inspection and 100 % approved non-destructive inspection methods. When an approved quality control procedure is established and an acceptable statistical analysis supports reduction, non-destructive inspection may be reduced from 100%, and applied on a sampling basis.

(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 TAR 305 at an ultimate load corresponding to a casting factor of 1.25, and,

(ii) the deformation requirements of TAR 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 mass attachments, seat, berth, safety belt, and fuel and oil tank supports and attachments, and cabin pressure valves.

(d) Non-critical castings: for each casting other than those specified in subparagraph (c) of this paragraph , the following apply:

(1) Except as provided in subparagraphs (2) and (3) of this paragraph, the casting factors and corresponding inspections must meet the Table 8 of Appendix A.

(2) The percentage of castings inspected by non-visual 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;

(ii) The casting must be inspected as provided in subparagraph (1) of this paragraph for casting factors of 1.25 through 1.50, and tested under subparagraph (c)(2) of this paragraph.

TAR 623 Bearing factors

(a) Except as provided in subparagraph (b) of this paragraph, 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

TAR 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, the strength of which, 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 needs to be used 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).

(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.

(d) For each designated flight seat, berth and safety belt and harness, its attachment to the structure must be shown, by analysis, tests or both, to be able to withstand the inertia forces prescribed in TAR 561 multiplied by a fitting factor of 1.33.

TAR 627 Welding factors

For each loadcarrying welded joint the applicable welding factor has to be established in respect to the kind of welding seam and according to the state of the art. It has to be considered as a reduction factor for strength.

TAR 628 Rope, wire and cable factors

(a) For tethers and mooring ropes, wires or cables that are not passed through pulleys, the following factors apply for limit loads:

(1) 3 for calculated breaking strength;

(2) 2.5 for breaking strength established by tests.

(b) For ropes, wires or cables of hoists and winches etc. the factors must be established in accordance with TAR 603. Load collectives and kinds of operation are to be considered.

(c) For ropes, wires or cables which are stressed at low level as shown by calculation and for which the factors are not established in (b), a factor of 3.4 against tested ultimate load applies.

TAR 631 Birdstrike

The airship must be designed to assure capability of continued safe flight and landing after impact with a 2 kg bird, when the velocity of the airship (relative to the bird along the flight path of the airship) is equal to V_H. Compliance may be shown by analysis based on tests carried out on sufficiently representative structures of similar design.

CONTROL SURFACES

TAR 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) In structural analyses, rigging loads due to wire bracing must be accounted for in a rational or conservative manner.

TAR 655 Installation

(a) Movable tail surfaces must be installed so that there is no interference between any surfaces or their bracing when one surface 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 that allowing safe flight and landing.

TAR 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.

TAR 659 Mass balance

The supporting structure and the attachment of concentrated mass balance mass used on control surfaces must be designed for

(a) 24 g normal to the plane of the control surface;

(b) 12 g fore and aft;

(c) 12 g parallel to the hinge line.

CONTROL SYSTEMS

TAR 671 General

(a) Each control and control system must operate with ease, smoothness and positiveness appropriate to its functions.

(b) Controls must be arranged and identified to provide for convenience in operation and to prevent the possibility of confusion and subsequent inadvertent operation.

(c) The airship must be shown by analysis, test, or both, to be capable of continued safe flight and landing after any of the following failures or jamming in the flight control system and surfaces (including trim, lift, drag and artificial feel systems) within the normal flight envelope, without requiring exceptional piloting skill or strength. Probable malfunctions must have only minor effects on control system operation and must be capable of being readily counteracted by the pilot:

(1) Any single failure not shown to be extremely improbable, excluding jamming, (for example, disconnection or failure of mechanical elements, or structural failure of hydraulic components, such as actuators, control spool housing, and valves).

(2) Any combination of failures not shown to be extremely improbable, excluding jamming (for example dual electrical or hydraulic system failures, or any single failure in combination with any probable hydraulic or electrical failure).

(3) Any jam in a control position normally encountered during cargo loading/unloading, passenger boarding/unboarding, take-off, climb, cruise, normal turns, descent and landing unless the jam is shown to be extremely improbable or can be alleviated. A runaway of a flight control to an adverse position and jam must be accounted for if such runaway and subsequent jamming is not extremely improbable.

(d) As required by TAR 143 the airship must be capable of maintaining a statically stable condition and have sufficient control of attitude and altitude to allow a safe descent if all propulsive engines fail. Compliance with this requirement may be shown by analysis where that method has been shown to be reliable.

TAR 672 Stability augmentation and automatic power-operated systems

If the functioning of stability augmentation or other automatic or power-operated system is necessary to show compliance with flight characteristics requirements, the system must comply with TAR 671 and the following:

(a) A warning which is clearly distinguishable to the pilot under expected flight conditions must be provided for any failure in the stability augmentation system or in any other automatic or power-operated system which could result in an unsafe condition if the pilot is unaware of the failure. Warning systems must not activate the control systems.

(b) The design of the stability augmentation system or of any other automatic or power-operated system must allow initial counteraction of failures without requiring exceptional pilot skill or strength, by overriding the failure by moving the flight controls in the normal sense, and by deactivating the failed system.

(c) It must be shown that after any single failure of the stability augmentation system or any other automatic or power-operated system:

(1) The airship is safely controllable when the failure or malfunction occurs at any speed or altitude within the approved operating limitations; and:

(2) The controllability and manoeuvrability requirements are met within a practical operational flight envelope (for example, speed, altitude and normal acceleration configurations) which is described in the flight manual.

TAR 675 Stops

(a) Each control system must have stops that positively limit the range of motion of each movable aerodynamic surface controlled by the system.

(b) Each stop must be located so that wear, slackness, or take-up adjustments will not adversely affect the control characteristics of the airship 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.

TAR 677 Trim Systems

(a) Trim systems include ballonets, ballast transfer, trim tabs on aerodynamic control surfaces or any other system which directly affects the long-term, in-flight, attitude of the airship. Proper precautions must be taken to prevent inadvertent, improper, or abrupt trim operation.

(b) Static trim

(1) When ballonets are used for trimming, the pilot must have means for determining the fullness of all ballonets. In addition a means in accordance with TAR 1322 must be provided, alerting if the ballonets are completely empty or full. There must be means to determine the intermediate conditions of the ballonets.

(2) When ballast transfer is used for trimming, the pilot must be capable of determining any intermediate condition of the ballast transfer system.

(c) Aerodynamic trim:

(1) When trim tabs are used, there must be means near the trim control to indicate to the pilot the direction of trim control movement relative to airship motion. In addition, there must be means to indicate to the pilot the position of the trim device with respect to the range of adjustment. This means must be visible to the pilot and must be located and designed to prevent confusion.

(2) Tab controls must be irreversible unless the tab is properly balanced and has no unsafe flutter characteristics. Irreversible tab systems must have adequate rigidity and reliability in the portion of the system from the tab to the attachment of the irreversible unit to the airship structure.

TAR 679 Control system gust locks

If there is a device to prevent damage to the control surfaces (including tabs), and to the control system, from gusts striking the airship while it is on the ground and moored and if the device, when engaged, prevents normal operation of the control surfaces by the pilot, it must:

(a) Give unmistakable warning to the pilot when the lock is engaged;

(b) Prevent the lock from inadvertently engaging in flight.

TAR 681 Limit load static tests

(a) Compliance with the limit load requirements of this TAR 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 analysis or individual load tests) with the special factor requirements for control system joints subject to angular motion.

TAR 683 Operation tests

(a) It must be shown by operation tests that, when the controls are operated from the crew compartment or another control station with the system loaded as prescribed in subparagraph (b) of this paragraph, the system is free from:

(1) Jamming;

(2) Excessive friction;

(3) Excessive deflection.

(b) The prescribed test loads are:

(1) For the entire system, loads corresponding to the limit airloads on the appropriate surface, or the limit pilot forces, whichever are less;

(2) For secondary controls, loads not less than those corresponding to the maximum pilot effort established under TAR 405.

TAR 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, loose objects, or the freezing of moisture.

(b) There must be means to prevent the entry of foreign objects into places where they would jam a control system.

(c) There must be means to prevent the rubbing of cables or tubes against other parts.

(d) Each element of a control system must have design features, or, where impractical, must be distinctively and permanently marked, to minimise the possibility of incorrect assembly that could result in malfunctioning of the control system.

TAR 687 Spring devices

The reliability of any spring device used in the control system must be established by tests simulating service conditions unless failure of the spring will not cause flutter or unsafe flight characteristics.

TAR 689 Cable systems

(a) Each cable, cable fitting, turnbuckle, splice, and pulley must be approved. In addition:

(1) No cable smaller than 3.2 mm (0.125 in) diameter may be used in the control system, 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.

TAR 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 may not be exceeded.

LANDING GEAR

TAR 721 General

(a) For airships equipped with landing gears and designed for running take-off and landing the requirements of this subparagraph and TAR 723 to735 for the landing gear apply:

(1) The main landing gear system must be designed so that if it fails due to overloads during take-off and landing (assuming the overloads to act in the upward and aft directions), the failure mode is not likely to cause the spillage of enough fuel from any part of the fuel system to constitute a fire hazard.

(2) Each airship must be designed so that, with the airship under control, it can be landed with any one or more landing gear legs not extended without sustaining a structural component failure that is likely to cause the spillage of enough fuel to constitute a fire hazard

(b) For airships not designed for running take-off and landing and not equipped with landing gears or equipped only with suspending gears or other device for occasional ground contact or as an aid for ground movement, the requirements of this subparagraph apply:

(1) provision must be made to protect the lower extremities of the airship from damage due to ground contact during take-off and landing and normal ground handling operations.

(2) Airships equipped with belly fuel stowage must be designed to avoid spillage of fuel in the event of failure of the protective system.

(c) Compliance with the provisions of this paragraph may be shown by analysis or tests, or both.

TAR 723 Shock absorption tests

(a) It must be shown that the limit load factors selected for design in accordance with TAR 473 will not be exceeded. This must be shown by energy absorption tests except that analysis based on tests conducted on a landing gear system with identical energy absorption characteristics may be used for increases in previously approved take-off and landing mass.

(b) The landing gear must not fail, but may yield, in the test showing its reserve energy absorption capacity, simulating a descent velocity of 1.2 times the limit descent velocity. The elastic behaviour of the airship may be taken into account.

TAR 725 Limit drop tests

(a) If compliance with TAR 723(a) is shown by free drop tests, these tests must be made on the complete airship, or on units consisting of a wheel, tyre, and shock absorber, in their proper positions, from free drop heights not less than:

(1) 18.7 in (0.475 m) for the design landing mass conditions; and

(2) 6.7 in (0.170 m) for the design take-off mass conditions.

(b) If airship lift is simulated by air cylinders or by other mechanical means, the mass used for the drop must be equal to W. If the effect of airship lift is represented in free drop tests by an equivalent reduced mass, the landing gear must be dropped with an effective mass equal to:

$$W_e = W \cdot \left(\frac{h + (1 - L) \cdot d}{h + d} \right) \; [\mathrm{lb}]$$

where:

W_e = the effective mass to be used in the drop test (lb);

h = specified free drop height (in);

d = deflection under impact of the tyre (at the approved inflation pressure) plus the vertical component of the axle travel relative to the drop mass (in);

W = W_M for main gear units (lb), equal to the static mass on that unit with the airship in the level attitude (with the nose wheel clear in the case of nose wheel type airships);

W = W_T for tail gear units (lb), equal to the static mass on the tail unit with the airship in the tail-down attitude;

W = W_N for nose wheel units (lb), equal to the vertical component of the static reaction that would exist at the nose wheel, assuming that the mass of the airship acts at the centre of gravity and exerts a force of 1.0 g downward and 0.25 g forward; and

L = the ratio of the assumed airship lift to the airship mass, but not more than 1.0.

(c) The drop test attitude of the landing gear unit and the application of appropriate drag loads during the test must simulate the airship landing conditions in a manner consistent with the development of a rational or conservative limit load factor value.

(d) The value of d used in the computation of W_e in subparagraph (b) of this paragraph must 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 subparagraph (b) of this paragraph according to the following formula:

$$n = n_j \cdot \left(\frac{W_e}{W} \right) + L \; [-]$$

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 subparagraph (e) of this paragraph may not be more than the limit inertia load factor used in the landing conditions in TAR 473.

TAR 729 Retraction mechanism

(a) General: for airships designed for running take-off and landing and equipped with retractable landing gear, the following apply.

(1) Each landing gear retracting mechanism and its supporting structure must be designed for maximum flight-load factors with the gear retracted and must be designed for the combination of friction, inertia, brake torque and air loads, occurring during retraction at any airspeed up to V_{LO}, selected by the applicant;

(2) The landing gear and retracting mechanism, including the wheel well doors, must withstand flight loads, including loads resulting from all yawing conditions specified in the structure subpart with the landing gear extended at any speed up to V_{LO}.

(b) Landing gear lock: there must be positive means (other than the use of the power source for the landing gear extension) to keep the landing gear extended.

(c) Emergency operation: unless it can be demonstrated that a safe landing can be made with the gear retracted, there must be a means to extend the landing gear in the event of either:

(1) Any reasonably probable failure in the normal landing gear operation system; or

(2) Any reasonably probable failure in a power source that would prevent the operation of the normal landing gear operation system.

(d) Operation test: the proper functioning of the retracting mechanism must be shown by operation tests.

(e) Position indicator: there must be a landing gear position indicator (as well as necessary devices to actuate the indicator) or other means to inform the pilot that the gear is secured in the extended (or retracted) position. If switches are used, they must be located and coupled to the landing gear mechanical system in a manner that prevents an erroneous indication of either 'down and locked' if the landing gear is not in the 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. The switches must be of a type and location which cannot be affected by the freezing of atmospheric water vapour on to the switch system.

(f) Landing gear warning: an aural or equally effective device that functions continuously when the landing gear is not fully extended and locked and the altitude of the airship is less than 100 ft above ground level. If the altitude sensor portion of the warning system fails, the warning system must be designed to activate until the landing gear is fully extended and locked.

(g) Equipment located in the landing gear bay: if the landing gear bay is used as the location for equipment other than the landing gear, that equipment must be designed and installed to minimise damage.

TAR 731 Wheels

For airships equipped with landing gears and designed for running take-off and landing, the following apply:

(a) *(reserved)*

(b) The maximum static load rating of each wheel may not be less than the corresponding static ground reaction with the maximum take-off mass.

(c) The maximum limit load rating of each wheel must equal or exceed the maximum radial limit load determined under the loading conditions prescribed in TAR 471.

(d) Means must be provided in each wheel to prevent wheel failure and tyre burst that may result from excessive pressurisation of the wheel and tyre assembly.

(e) Each braked wheel must meet the applicable requirements of TAR 735.

TAR 733 Tyres

For airships equipped with landing gears and designed for running take-off and landing, the following apply:

(a) *(reserved)*

(b) Tyres must be such that, when fitted to the airship wheels and inflated to the recommended pressure, they will be capable of withstanding the permitted operation of the airship.

(c) If specially constructed tyres are used, the wheel(s) must be plainly and conspicuously marked to the effect, the markings must include the make, size, number of plies, and identification marking of the proper tyre.

TAR 735 Brakes and braking systems

(Corresponding advisory material is provided in AMJ 25.735)

For airships equipped with landing gears and designed for running take-off and landing, the following apply:

(a) Approval. Each assembly consisting of a wheel(s) and brake(s) must be approved.

(b) Brake system capability. The brake system, associated systems and components must be designed and constructed so that:

(1) If any electrical, pneumatic, hydraulic, or mechanical connecting or transmitting element fails, or if any single source of hydraulic or other brake operating energy supply is lost, it is possible to bring the airship to rest with a braked roll stopping distance of not more than twice that obtained in determining the landing distance as prescribed in TAR 75.

(2) Fluid lost from a brake hydraulic system following a failure in, or in the vicinity of, the brakes is insufficient to cause or support a hazardous fire on the ground or in flight.

(c) Brake controls: the brake controls must be designed and constructed so that:

(1) Excessive control force is not required for their operation.

(2) If an automatic braking system is installed, means are provided to:

(i) arm and disarm the system, and

(ii) allow the pilot(s) to override the system by use of manual braking.

(d) Parking brake: the airship must have a parking brake control that, when selected on, will, without further attention, prevent the airship from rolling on a dry and level paved runway when the most adverse combination of maximum thrust on one engine and up to maximum ground idle thrust on any, or all, other engine(s) is applied. The control must be suitably located or be adequately protected to prevent inadvertent operation. There must be indication in the cockpit when the parking brake is not fully released.

(e) Antiskid system: if an antiskid system is installed:

(1) It must operate satisfactorily over the range of expected runway conditions, without external adjustment.

(2) It must, at all times, have priority over the automatic braking system, if installed.

(f) Kinetic energy capacity: the design landing stop, the maximum kinetic energy accelerate-stop, and the most severe landing stop brake kinetic energy absorption requirements of each wheel and brake assembly must be determined. It must be substantiated by dynamometer testing that, at the declared fully worn limit(s) of the brake heat sink, the wheel and brake assemblies are capable of absorbing not less than these levels of kinetic energy. Energy absorption rates defined by the airship manufacturer must be achieved. These rates must be equivalent to mean decelerations not less than 3.05 m/s^2 (10 fps^2) for the design landing stop and 1.83 m/s^2 (6 fps^2) for the maximum kinetic energy accelerate stop. The most severe landing stop need not be considered for extremely improbable failure conditions or if the maximum kinetic energy accelerate-stop energy is more severe. Design landing stop is an operational landing stop at maximum landing mass. Maximum kinetic energy accelerate-stop is a rejected take-off for the most critical combination of airship take-off mass and speed. Most severe landing stop is a stop at the most critical combination of airship landing mass and speed.

(g) Brake condition after high kinetic energy dynamometer stop(s): following the high kinetic energy stop demonstration(s) required by subparagraph (f) of this paragraph, with the parking brake promptly and fully applied for at least three (3) minutes, it must be demonstrated that for at least five (5) minutes from application of the parking brake, no condition occurs (or has occurred during the stop), including fire associated with the tyre or wheel and brake assembly, that could prejudice the safe and complete evacuation of the airship.

(h) Stored energy systems: an indication to the flightcrew of the usable stored energy must be provided if a stored energy system is used to show compliance with subparagraph (b)(1) of this paragraph. The available stored energy must be sufficient for:

(1) At least six (6) full applications of the brakes when an antiskid system is not operating; and

(2) Bringing the airship to a complete stop when an antiskid system is operating, under all runway surface conditions for which the airship is certificated.

(i) Brake wear indicators: means must be provided for each brake assembly to indicate when the heat sink is worn to the permissible limit. The means must be reliable and readily visible.

(j) Overtemperature burst prevention: means must be provided in each braked wheel to prevent wheel failure and tyre burst that may result from elevated brake temperatures. Additionally, all wheels must meet the requirements of TAR 731(d).

(k) Compatibility: compatibility of the wheel and brake assemblies with the airship and its systems must be substantiated.

TAR 745 Wheel steering

For airships equipped with landing gears and designed for running take-off and landing, the following apply:

(a) The wheel steering system, unless it is restricted in use to low-speed manoeuvring, must be so designed that exceptional skill is not required for its use during take-off and landing, including the case of cross-wind, and in the event of sudden power-unit failure at any stage during the take-off run. This must be shown by tests. (Corresponding advisory material is provided in ACJ 25X745 (a).)

(b) It must be shown that, in any practical circumstances, movement of the pilot's steering control (including movement during retraction or extension or after retraction of the landing gears) cannot interfere with the correct retraction or extension of the landing gears.

(c) Under failure conditions the system must comply with TAR 1309 (b), (c). The arrangement of the system must be such that no single failure will result in a steered-wheel position which will lead to a hazardous effect. Where reliance is placed on wheel steering in showing compliance with directional stability and control requirements (TAR 255), the wheel steering system must be shown to comply with TAR 1309. (Corresponding advisory material is provided in ACJ 25X745 (c)).

(d) The design of the attachment for towing the airship on the ground must be such as to preclude damage to the steering system.

(e) Unless the steered-wheel(s), when retractable and lowered, are automatically in the fore-and-aft attitude successful landings must be demonstrated with the steered wheel(s) initially in all possible off-centre positions.

PERSONNEL AND CARGO ACCOMMODATIONS

TAR 771 Pilot compartment

(a) The compartment and its equipment must allow each pilot to perform his duties without unreasonable concentration or fatigue;

(b) Where the flight crew is separated from the passengers there must be means for communication between flight crew and the passengers;

(c) The controls referenced in TAR 779, excluding cables and control rods, must be located with respect to propellers so that no member of the minimum flightcrew (established under TAR 1523) or part of the controls is in the region between the plane of rotation of any propeller and the surface generated by a line passing through the centre of the propeller hub making an angle of 5° forward or aft of the plane of rotation of the propeller.

(d) If provision is made for a second pilot, the airship must be controllable with equal safety from either pilot seat.

(e) 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.

(f) Vibration and noise characteristics of the flightdeck equipment may not interfere with safe operation of the airship.

TAR 772 Flight crew compartment doors

For an airship that has a maximum passenger seating configuration of 20 seats or more and that has lockable doors installed between the flight crew compartment or stations and the passenger compartment:

(a) the emergency exit configuration must be designed so that neither crew members nor passengers need to use these doors in order to reach the emergency exits provided for them, and;

(b) means must be provided to enable flight crew members to directly enter the passenger compartment from the flight crew compartment or stations if these doors become jammed.

TAR 773 Pilot compartment view

(a) Non-precipitation conditions: for non-precipitation 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 manoeuvres within the operating limitations of the airship, including ground manoeuvring, take-off, approach and landing.

(2) Each pilot compartment must be free of glare and reflection that could interfere with the normal duties. This must be shown in day and night flight tests under non-precipitation conditions.

(b) Precipitation conditions: for precipitation conditions, the following apply:

(1) The airship must have a means to maintain a clear portion of the windshield during precipitation conditions, sufficient for the crew to have a sufficiently extensive view along the flight path in normal flight attitudes of the airship. This means must be designed to function, without continuous attention on the part of the crew, in:

(i) Heavy rain at speeds up to V_H

(ii) The icing conditions specified in TAR 1419 if certification with ice protection provisions is requested.

(2) No single failure of the systems used to provide the view required by sub-paragraph (b)(1) of this paragraph must cause the loss of that view by the crew in the specified precipitation conditions.

(3) The pilot must have a window that is openable under the conditions prescribed in sub-paragraph (b)(1) of this paragraph and gives sufficient protection from the elements against impairment of the pilot's vision;

(4) The openable window specified in sub-paragraph (b)(3) of this paragraph need not be provided if it is shown that an area of the transparent surface will remain clear sufficient for at least one pilot to land the airship safely in the event of any system failure or combination of failures which is not extremely improbable under the precipitation conditions specified in sub-paragraph (b)(1) of this paragraph.

(c) Internal windshield and window fogging: the airship must have a means to prevent fogging to the internal portions of the windshield and window panels over an area which would provide the visibility specified in sub-paragraph (a) of this paragraph under all internal and external ambient conditions, including precipitation conditions, in which the airship is intended to be operated.

(d) On airships designed for running take-off and landing fixed markers or other guides must be installed at each pilot station to enable the pilots to position themselves in their seats for an optimum combination of outside visibility and instrument scan. If lighted markers or guides are used they must comply with the requirements specified in TAR 1381.

TAR 775 Windshields and windows

(a) Windshields and windows must be made of non-splintering material.

(b) Windshields and windows must have a luminous transmittance value of not less than 70% when used for:

(1) Operating crews view when seated in the normal flight position

(2) Propeller and empennage inspection during flight

(3) Loading or unloading

(4) Mooring

(5) Rigging

(c) An openable window at the pilot and co-pilot station must be provided.

TAR 777 Cockpit controls

(a) Each cockpit control must be located and (except where its function is obvious) identified to provide convenient operation and to prevent confusion and inadvertent operation.

(b) The controls must be located and arranged so that the pilots, when seated and wearing harness, have full and unrestricted movement of each control without interference from either his clothing or the cockpit structure.

(c) Identical engine and thruster controls for each engine/thruster must be located to prevent confusion as to the engines/thrusters they control. Grouped controls per engine/thruster must be clearly distinguishable and recognisable by size, shape and colour.

(d) On airships designed for running take-off and landing, the landing gear control must be located forward of the throttles.

(e) Identical controls for gas (cells), ballast, ballonets and fuel must be located and arranged so that the pilot can see and reach it without moving any seat or primary flight control when his seat is at any position in which it can be placed.

(f) Control knobs must be so shaped as to prevent confusion. The knobs must be of the same colour and this colour must contrast with the colour of control knobs for other purposes and the surrounding cockpit. (See corresponding ACJ 25.777(g).)

TAR 779 Motion and effect of cockpit controls

Cockpit controls must be designed so that they operate in accordance with the movement and actuation in Table 9 of Appendix A. 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 airship or upon the part operated.

TAR 783 Doors

(a) External doors must not be located with respect to any propeller disc or any other potential hazard so as to endanger persons using that door.

(b) There must be a means to lock and safeguard each external door, including cargo and service type doors, against inadvertent opening in flight, by persons, by cargo or failure of a single structural element, either during or after closure.

(c) Each external passenger or crew door must comply with the following requirements:

(1) there must be a provision for direct visual inspection of the locking mechanism to determine, if the external door is fully closed and locked;

(2) the provisions must be discernible, under operating lighting conditions, by a crew member using a flashlight or an equivalent lighting source.

(d) There must be a visual means to signal a flight crew member if an external door is not fully closed and locked. This means must be designed so that any failure, or combination of failures, that would result in an erroneous closed and locked indication is improbable for doors for which the initial opening movement is not inward.

(e) All lavatory doors must be designed to preclude anyone from becoming trapped inside the lavatory, and if a locking mechanism is installed, it must be capable of being unlocked from the outside without the aid of special tools.

TAR 784 Passenger compartment windows

Each openable passenger compartment window must comply with the following requirements:

(a) there must be a means to lock and safeguard each openable window against inadvertent opening in flight, by persons or failure of a single structural element, either during or after closure; and:

(b) there must be adequate provisions to prevent persons falling out or items being thrown out an opened window.

TAR 785 Seats, berths, safety belts and harnesses

(a) Each seat, berth, designated as occupiable during take-off, landing, taxiing and mooring and emergency situations, its supporting structure, its safety belt, and harness must be designed for occupants weighing at least 77 kg (170 pounds) and for the maximum load factors corresponding to the specified flight and ground load conditions, including emergency landing conditions.

(b) Each seat, berth, safety belt and harness must be approved against appropriate requirements depending on function.

(c) Each pilot seat must be designed for the reactions resulting from the application of pilot forces to the primary flight controls prescribed in Table 2 of Appendix A.

(d) Each crew member seat at a flight compartment station and each passenger compartment crew member seat designated for use during take-off and landing must have a shoulder harness.

(e) Each berth installed parallel to the longitudinal axis of the airship 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 the occupant is subjected to the forward inertia forces prescribed in TAR 561. In addition each berth must have an approved safety belt and may not have corners or other parts likely to cause serious injury to a person occupying it during emergency conditions.

(f) Proof of compliance with the strength and deformation requirements of this paragraph for seats, berths, and safety belts, approved as part of the type design and for their installation, may be shown by

(1) Structural analysis, if the structure conforms to conventional aircraft types for which existing methods of analysis are known to be reliable; or

(2) A combination of structural analysis and static load tests to limit loads; or

(3) Static load tests to ultimate loads.

(g) Each occupant must be protected from serious head injury when subjected to the inertia loads resulting from these load factors by a safety belt.

(h) Each seat located in the passenger compartment and designated for use during take-off and landing by a flight attendant must be:

(1) Near a required floor level emergency exit, except that another location is acceptable if the emergency egress of passengers would be enhanced with that location. A flight attendant seat must be located adjacent to each floor level exit. Other flight attendant seats must be evenly distributed among the required floor level emergency exits to the extent feasible.

(2) To the extent possible, without compromising proximity to a required floor level emergency exit, located to provide a direct view of the cabin area for which the flight attendant is responsible.

(3) Positioned so that the seat will not interfere with the use of a passageway or exit when the seat is not in use.

(4) Located to minimise the probability that occupants would suffer injury by being struck by items dislodged from service areas, stowage compartments, or service equipment.

(5) Either forward or rearward facing with an energy absorbing rest that is designed to support the arms, shoulders, head and spine.

(6) Equipped with a restraint system consisting of a combined safety belt and shoulder harness unit with a single point release. There must be means to secure each restraint system when not in use to prevent interference with rapid egress in an emergency.

(i) There must be a means to secure each safety belt, when not in use, so as to prevent interference with the operation of the airship and with rapid egress in an emergency.

(j) The compartment area surrounding each seat, bed or bunk, including the structure, interior walls, instrument panel, control wheel, pedals, and seats, within striking distance of the occupants head or torso (with the safety belt fastened), must be free of potentially injurious objects, sharp edges, protuberances, and hard surfaces. If energy absorbing designs or devices are used to meet this requirement, they must protect the occupant from serious injury when the occupant experiences the ultimate inertia forces prescribed in TAR 561.

(k) Each seat track must be fitted with stops to prevent the seat from sliding off the track.

(l) All compartments and areas accessible in flight must be free of potentially injurious objects, sharp edges, protuberances and hard surfaces. If energy absorbing designs or devices are used to meet this requirement, they must protect the occupant from serious injury when the occupant experiences inertia forces due to normal gusts.

(m) In turbulence conditions it must be impossible for an unrestrained person to fall through large openings in the structure (e.g. sight seeing windows).

(n) There must be means installed for crew members acting in areas not accessible to untrained persons to carry out their tasks safely. During internal/external inspection, maintenance or repair catwalks, rails, hatches and ladders it must be possible to become quickly linked-up to a restrain system.

(o) When stressing seat attachments, seat rails etc. the mass of the seat in addition to that of the passengers shall be taken into account. The fitting factors of TAR 625 shall be applied.

(p) All other seats and compartment areas must be equipped with retention means (seat belts, seat back handholds, grips, rails) to ensure that persons be retained during reasonably expectable in-flight occurrences (refer to AFM), unless it can be shown that persons can steady themselves without difficulty.

TAR 786 Areas accessible during flight

For crew members patrolling the interior of the airship and working outside the passenger or flight compartments, even outside the hull, safety provisions must be provided, such as access (doors, safe catwalks and ladders), handrails and grips, escape routes, fire detection and extinguishers, emergency lighting, axes, knives and onboard communication.

TAR 787 Baggage and cargo compartment

Each compartment for the stowage of cargo, baggage, ballast, carry-on articles and equipment (such as life rafts) and any other stowage compartment:

(a) must be designed for its placarded maximum mass of contents and for the maximum load factors corresponding to the flight and ground conditions specified in the TAR.

(b) must contain provisions to prevent shifting of contents and to protect any controls, wiring lines, equipment or accessories during flight and ground conditions.

(c) under the emergency landing conditions of TAR 561, baggage and cargo compartments must:

(1) Be positioned such that if the contents break loose they are unlikely to cause injury to the occupants or restrict any of the escape facilities provided for use after an emergency landing; or:

(2) Have sufficient strength to withstand the conditions specified in TAR 561, including the means of restraint and their attachments required by subparagraph (b) of this paragraph. Sufficient strength must be provided for the maximum authorised mass of cargo and baggage at the critical loading distribution.

(d) If cargo compartment lamps are installed, each lamp must be installed so as to prevent contact between lamp bulb and cargo.

TAR 789 Retention of items of mass in passenger and crew compartments and galleys

(a) Means must be provided to prevent each item of mass (that is part of the airship type design) in a passenger or crew compartment or galley from becoming a hazard by shifting under the appropriate maximum load factors corresponding to the specified flight and ground load conditions, and to the emergency landing conditions of TAR 561(b).

(b) Each interphone restraint system must be designed so that when subjected to the load factors specified in TAR 561 (b), the interphone and megaphone, if installed, will remain in its stowed position.

TAR 791 Passenger information signs and placards

(a) If smoking is to be prohibited, there must be at least one placard so stating that is legible to each person seated in the cabin. If smoking is to be allowed, and if the crew compartment is separated from the passenger compartment, there must be at least one sign notifying when smoking is prohibited. Signs which notify when smoking is prohibited must be installed so as to be operable from either pilot's seat and, when illuminated, must be legible under all probable conditions of cabin illumination to each person seated in the cabin.

(b) Signs that notify when occupants are to return to their designated flight seats and seat belts are to be fastened must be installed so as to be operable from either pilot's seat and, when illuminated, must be legible under all probable conditions of cabin illumination to each person in the cabin or working station. A placard must be located on or adjacent to the door of each receptacle used for the disposal of flammable waste materials to indicate that use of the receptacle for disposal of cigarettes, etc., is prohibited.

(c) Lavatories must have "NO SMOKING" or "NO SMOKING IN LAVATORY" placards positioned adjacent to each ashtray. The placards must have red letters at least 0.5 in (12.7 mm) high on a white background of at least 1 in (25.4 mm) high. (a "NO SMOKING" symbol may be included on the placard.)

TAR 793 Floor surfaces

The floor surface of all areas which are likely to become wet in service must have slip resistant properties.

TAR 801 Ditching

(a) If certification with ditching provisions is requested, the airship must meet the requirements of this paragraph and TAR 1411 and 1415(a).

(b) Each practicable design measure, compatible with the general characteristics of the airship, must be taken to minimise the probability that in an emergency landing on water, the behavior of the airship would cause immediate injury to the occupants or would make it impossible for them to escape.

(c) The probable behavior of the airship in a water landing must be investigated in a model test or by comparison with similar configurations for which the ditching characteristics are known. Different configurations, heaviness and centre of gravity have to be considered.

(d) It must be shown that under reasonably probable water conditions, the flotation time of the airship will allow the occupants to leave the airship and enter the liferafts required by TAR 1415. If compliance with this provision is shown by buoyancy and trim computations, appropriate allowances must be made for probable structural damage and leakage.

TAR 803 Emergency evacuation

(a) Each crew and passenger compartment must have easy access to at least two independent means to allow rapid evacuation in emergency such as crash landings, with the landing gear (if applicable) extended or retracted, considering the possibility of the airship on fire.

(b) A technique shall be established and included in the Airship Flight Manual for rapid evacuation of the airship on land and on water by all occupants in such an emergency, considering the possibility of (still) running engines/propellers.

(c) The technique shall include the crew procedures for controlling passenger evacuation.

(d) When following this technique, the operation of the airship's controls, including the emergency deflation means shall be such that, during the evacuation, the airship will not leave the ground to an extent that would prevent the occupants leaving the airship, and the envelope must not deflate at a rate that would permit the envelope to entrap any occupant.

(e) The technique shall include any special precautions to be taken in surface wind speeds between zero and the maximum in which operation is permitted.

(f) If the occurrence of fire hazard for the passenger and crew compartments in crash landings cannot be considered extremely improbable, it must be shown that the maximum passengers capacity, including the number of crew members required by the operating rules for which certification is requested, can be evacuated from the airship to the ground under simulated emergency conditions within 90 seconds. Compliance with this requirement must be shown by actual demonstration under simulated night conditions using only the emergency exits on the most critical side of the airship. The participants must be representative of average airline passengers with no prior practice or rehearsal for the demonstration, although standard briefings are permissible.

TAR 807 Emergency exits

Emergency exits must be provided in such size and number that rapid and unimpeded evacuation is possible in the moored position, a minor crash landing and in a water landing. Lengthy exit paths allowing a more rapid evacuation are acceptable in favour of nearer exits that easily become overcrowded. An acceptable means of compliance is provided under AC 807.

AC 807 Acceptable means of compliance

(a) Types: for the purpose of this code the types of exits are defined as follows:

- *(1) Type I: This type is a floor level exit with a rectangular opening of not less than 24 in (609.6mm) wide by 48 in (1.219 m) high, with corner radii not greater than one-third the width of the exit.*
- *(2) Type II: This type is a rectangular opening of*

not less than 20 in (508 mm) wide by 44 in (1.12 m) high, with corner radii not greater than one-third the width of the exit. Type II exits must be floor level.

(3) Type III: This type is a rectangular opening of not less than 20 in (508 mm) wide by 36 in (914.4 mm) high, with corner radii not greater than one-third the width of the exit, and with a step-up inside the airship of not more than 20 in (508 mm).

(4) Type IV: This type is a rectangular opening of not less than 19 in (482.6 mm) wide by 26 in (660.4 mm) high, with corner radii not greater than one-third the width of the exit.

(5) Type A: This type is a floor level exit with a rectangular opening of not less than 42 in (1.067 m) wide by 72 in (1.829 m) high with corner radii not greater than one-sixth of the width of the exit.

(b) Operation: Each emergency exit must

(1) Be readily accessible, requiring no exceptional agility when used in emergencies;

(2) Have a method of opening that is simple and obvious;

(3) Be arranged and marked for easy location and operation, even in darkness;

(4) Have reasonable provisions against jamming by car, compartment or cabin deformation

(c) The proper function of each emergency exit must be shown by tests.

(d) Step down distance: Step down distance, as used in this paragraph, means the actual distance between the bottom of the required opening and a usable foot hold, extending out from the gondola, car or passenger compartment, that is large enough to be effective without searching by sight or feel.

(e) Over-sized exits: Openings larger than those specified in this paragraph, whether or not of rectangular shape, may be used if the specified rectangular opening can be inscribed within the opening and the base of the inscribed rectangular opening meets the specified step-up and step-down heights.

(f) Passenger emergency exits: Except as provided in subparagraphs (f)(3) to (5) of this paragraph, the minimum number and type of passenger emergency exits is as follows:

(1) For passenger seating configurations of 1 to 299 seats:

Passenger seating (crewmember seats not included)	*Emergency exits for each side*			
	Type I	*Type II*	*Type III*	*Type IV*
1 to 9				*1*
10 to 19			*1*	
20 to 39		*1*	*1*	
40 to 79	*1*		*1*	
80 to 109	*1*		*2*	
110 to 139	*2*		*1*	
140 to 179	*2*		*2*	

Additional exits are required for passenger seating configurations greater than 179 seats in accordance with the following table:

Additional emergency exits for each side	*Increase in passenger seating configuration allowed*
Type A	*110*
Type I	*45*
Type II	*40*
Type III	*35*

(2) For passenger seating configurations greater than 299 seats, each emergency exit in the side of the gondola, car or passenger compartment must be either a Type A or a Type I. A passenger seating configuration of 110 seats is allowed for each pair of Type A exits and a passenger seating configuration of 45 seats is allowed for each pair of Type I exits.

(3) An alternate emergency exit configuration may be approved in lieu of that specified in subparagraph (f)(1) or (2) of this paragraph provided the overall evacuation capability is shown to be equal to or greater than that of the specified emergency exit configuration.

(4) The following must also meet the applicable emergency exit requirements of TAR 809 to 813:

(i) Each emergency exit in the passenger compartment in excess of the minimum number of required emergency exits.

(ii) Any other floor level door or exit that is accessible from the passenger compartment and is as large or larger than a Type II exit, but less than 46 in (1.168 m) wide.

(5) For an airship that is required to have more than one passenger emergency exit for each side of the gondola, car or passenger compartment, no passenger emergency exit shall be more than 18 m (60 ft) from any adjacent passenger emergency exit on the same side of the same deck, as measured parallel to the airship's longitudinal axis between the nearest exit edges.

(g) Location: Emergency exits must be located to allow escape without crowding in any probable crash attitude.

(1) If the pilot compartment is separated from the passenger compartment with a door that is

likely to block the pilot's escape in a minor crash, there must be an exit in the pilot's compartment;

(2) The number of exits required by subparagraph (1) must then be separately determined for the passenger compartment, using the seating capacity of that compartment.

(3) Every area which is accessible for the crew in flight must be equipped with an openable window, which meets the criteria for type IV emergency exits.

TAR 809 Emergency exit arrangement

(a) Each emergency exit must be openable from the inside and the outside.

(b) Each emergency exit must be openable under all probable airship attitudes to be encountered in the moored position, a minor crash landing and a water landing.

(c) The means of opening emergency exits must be simple and obvious and must 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 crew members trained in their use.

(d) Each emergency exit must be shown by tests, or by a combination of analysis and tests, to meet the requirements of subparagraphs (b) of this paragraph.

(e) There must be provisions to minimise the probability of jamming of the emergency exits resulting from structural deformation in a minor crash landing.

TAR 810 Emergency egress assist means and escape routes

Each emergency must have an approved means to assist the occupants in descending to the ground under all probable airship attitudes to be encountered in the moored position and in a minor crash landing. An acceptable means of compliance is provided under AC 810.

AC 810 Acceptable means of compliance

Each emergency exit more than 1.8 m (6 ft) from the ground with the airship on the ground and the landing gear extended must have an approved means to assist the occupants in descending to the ground.

(a) The assisting means for each passenger emergency exit must be a self-supporting slide or equivalent; and, in the case of a Type A exit, it must be capable of carrying simultaneously two parallel lines of evacuees. In addition, the assisting means must be designed to meet the following requirements.

(1) It must be automatically deployed and deployment must begin during the interval between the time the exit opening means is actuated from inside the airship and the time the exit is fully opened. However, each passenger emergency exit which is also a passenger entrance door or a service door must be provided with means to prevent deployment of the assisting means when it is opened from either the inside or the outside under non-emergency conditions for normal use.

(2) It must be automatically erected within 10 seconds after deployment is begun.

(3) It must be of such length after full deployment that the lower end is self-supporting on the ground and provides safe evacuation of occupants to the ground after collapse of one or more legs of the landing gear.

(4) It must have the capability, in 25-knot winds directed from the most critical angle, to deploy and, with the assistance of only one person, to remain usable after full deployment to evacuate occupants safely to the ground.

(5) For each system installation (mock-up or airship installed), five consecutive deployment and inflation tests must be conducted (per exit) without failure, and at least three tests of each such five-test series must be conducted using a single representative sample of the device. The sample devices must be deployed and inflated by the system's primary means after being subjected to the inertia forces specified in Table 7 of Appendix A If any part of the system falls or does not function properly during the required tests, the cause of the failure or malfunction must be corrected by positive means and after that, the full series of five consecutive deployment and inflation tests must be conducted without failure.

(b) The assisting means for flight crew emergency exits may be a rope or any other means demonstrated to be suitable for the purpose. If the assisting means is a rope, or an approved device equivalent to a rope, it must be:

(1) attached to the structure at or above the top of the emergency exit opening, or, for a device at a crew's emergency exit window, at another approved location if the stowed device, or its attachment, would reduce the pilot's view in flight.

(2) *able (with its attachment) to withstand a 1785 N static limit load.*

TAR 811 Emergency exit marking

(a) Each 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 recognisable from a distance equal to the width of the cabin.

(c) Means must be provided to assist the occupants in locating the exits in conditions of dense smoke.

(d) The location of each passenger emergency exit must be indicated by a sign visible to occupants approaching along the main passenger aisle (or aisles). There must be:

(1) a passenger emergency exit locator sign above the aisle (or aisles) near each passenger

emergency exit, or at another overhead location if it is more practical because of low headroom, except that one sign may serve more than one exit if each exit can be seen readily from the sign;

(2) a passenger emergency exit marking sign next to each passenger emergency exit, except that one sign may serve two such exits if they both can be seen readily from the sign; and

(3) a sign on each bulkhead or divider that prevents fore and aft vision along the passenger compartment to indicate emergency exits beyond and obscured by the bulkhead or divider, except that if this is not possible the sign may be placed at another appropriate location.

(e) The location of the operating handle and instructions for opening exits from the inside of the airship must be shown in the following manner:

(1) Each passenger emergency exit must have, on or near the exit, a marking that is readable from a distance of 30 inches (0.76 m).

(2) Each Type A, Type B, Type C, Type 1, or Type II passenger emergency exit operating handle must:

(i) Be self-illuminated with an initial brightness of at least 160 microlamberts; or

(ii) Be conspicuously located and well illuminated by the emergency lighting even in conditions of occupant crowding at the exit.

(3))*(reserved)*

(4) Each Type A, Type B, Type C, Type I, or Type II passenger emergency exit with a locking mechanism released by rotary motion of the handle must be marked by a red arrow with a shaft at least ¾ inch (19 mm) wide adjacent to the handle, that indicates the full extend and direction of the unlocking motion required. The word "OPEN" must be horizontally situated adjacent to the arrow head and must be in red capital letters at least 1 inch (25 mm) high. The arrow and word "OPEN" must be located on a background which provides adequate contrast. (See corresponding ACJ 25.811 (e)(4)).

(f) Each emergency exit and its means of opening, must be marked on the outside of the airship. In addition, the following apply:

(1) The outside marking for each passenger emergency exit in the side of the passenger compartment must include a 2-inch coloured band outlining the exit.

(2) Each outside marking including the band, must have colour contrast to be readily distinguishable from the surrounding compartment surface. The contrast must be such that if the reflectance of the darker colour is 15% or less, the reflectance of the lighter colour must be at least 45%. 'Reflectance' is the ratio of the luminous flux reflected by a body to the luminous flux it receives. When the reflectance of the darker colour is greater than 15%, at least a 30% difference between its reflectance and the reflectance of the lighter colour must be provided.

(3) In the case of exits other than those in the side of the passenger compartment, such as ventral exits, the external means of opening, including instructions if applicable, must be conspicuously marked in red, or bright chrome yellow if the background colour is such that red is inconspicuous. When the opening means is located on only one side of the compartment, a conspicuous marking to that effect must be provided on the other side.

(g) Each sign required by sub-paragraph (d) of this paragraph may use the word 'EXIT' in its legend in place of the term 'EMERGENCY EXIT'.

TAR 812 Emergency lighting

(a) An emergency lighting system, independent of the main lighting system, must be installed. However, the sources of general passenger compartment illumination may be common to both the emergency and the main lighting systems if the power supply to the emergency lighting system is independent of the power supply to the main lighting system. The emergency lighting system must include:

(1) illuminated emergency exit marking and locating signs, sources of general passenger compartment illumination, interior lighting in emergency exit areas, and floor proximity escape path marking.

(2) crew areas and all other areas accessible in flight.

(3) exterior emergency lighting.

(b) Emergency exit signs: airships that have a passenger seating configuration, excluding pilot seats, of 20 seats or more must meet the following requirements:

(1) Each passenger emergency exit locator sign and each internal passenger emergency exit marking sign must have red letters at least 1.5 inch (38 mm) high on an illuminated white background, and must have an area of at least 21 square inch (135.5 cm²) excluding the letters. The lighted background-to-letter contrast must be at least 10:1. The letter height to stroke-width ratio may not be more than 7:1 nor less than 6:1. These signs must be internally electrically illuminated with a background brightness of at least 25 foot-lamberts and a high-to-low background contrast no greater than 3:1.

(2) Each passenger emergency exit sign required by TAR 811 (d)(3) must have red letters at least 1.5 inch (38 mm) high on a white background having an area of at least 21 square inch (135.5 cm²) excluding the letters. These signs must be internally electrically illuminated or self-illuminated by other than electrical means and must have an initial brightness of at least 400 microlamberts. The colours may be reversed in the case of a sign that is self-illuminated by other than electrical means.

(c) General illumination in the passenger compartment must be provided so that when measured along the centreline of main passenger aisle(s), and cross aisle(s) between main aisles, at seat armrest height and at 40-inch (1016 mm) intervals, the average illumination is not less than 0.05 foot-candle and the illumination at each 40-inch (1016 mm) interval is not less than 0.01 foot-candle. A main passenger aisle(s) is considered to extend along the passenger compartment from the most forward passenger emergency exit or cabin occupant seat, whichever is farther forward, to the most rearward passenger emergency exit or cabin occupant seat, whichever is farther aft.

(d) The floor of the passageway leading to each floor-level passenger emergency exit, between the main aisles and the exit openings, must be provided with illumination that is not less than 0.02 foot-candle measured along a line that is within 6 inch of and parallel to the floor and is centred on the passenger evacuation path.

(e) Floor proximity emergency escape path marking must provide emergency evacuation guidance for passengers when all sources of illumination more than 1.2 m (4 ft) above the cabin aisle floor are totally obscured. In the dark of the night, the floor proximity emergency escape path marking must enable each passenger to:

(1) After leaving the passenger seat, visually identify the emergency escape path along the passenger compartment aisle floor to the first exits or pair of exits forward and aft of the seat; and

(2) Readily identify each exit from the emergency escape path by reference only to markings and visual features not more than 1.2 m (4 ft) above the compartment floor.

(f) Except for sub-systems provided in accordance with subparagraph (i) of this paragraph that serve no more than one assist means, are independent of the airship's main emergency lighting system, and are automatically activated when the assist means is erected, the emergency lighting system must be designed as follows:

(1) The lights must be operable manually from the flight crew station and from a point in the passenger compartment that is readily accessible to a normal flight attendant seat.

(2) There must be a flight crew warning light which illuminates when power is on in the airship and the emergency lighting control device is not armed.

(3) The cockpit control device must have an 'ON', "OFF" and "ARMED" position so that when armed in the cockpit or turned on at either the cockpit or flight attendant station the lights will either light or remain lighted upon interruption (except an interruption caused by a transverse separation of the flight compartment from the passenger compartment after crash landing) of the airship's normal electric power. There must be a means to safeguard against inadvertent operation of the control device from the 'armed' or 'on' positions.

(g) Exterior emergency lighting must be provided at each emergency exit to have descent assist means the illumination must be not less than 0·03 foot-candle (measured normal to the direction of the incident light) on the ground surface with the landing gear extended where an evacuee is likely to make his first contact with the ground outside the cabin.

(h) The means required in TAR 810 to assist the occupants in descending to the ground must be illuminated so that the erected assist means is visible from the airship. In addition:

(1) If the assist means is illuminated by exterior emergency lighting, it must provide illumination of not less than 0.03 foot-candle (measured normal to the direction of the incident light) at the ground end of the erected assist means where an evacuee using the established escape route would normally make first contact with the ground (with the airship on mooring mast or in loading position).

(2) If the emergency lighting sub-system illuminating the assist means serves no other assist means, is independent of the airship's main emergency lighting system, and is automatically activated when the assist means is erected, the lighting provisions:

(i) may not be adversely affected by stowage; and

(ii) must provide illumination of not less than 0.03 foot-candle (measured normal to the direction of the incident light) at the ground end of the erected assist means where an evacuee would normally make first contact with the ground (with the airship on mooring mast or in loading position).

(i) The energy supply to each emergency lighting unit must provide the required level of illumination 10 minutes at the critical ambient conditions during flight to enable occupants to reach their (required) flight seats in an emergency and for at least another 10 minutes at the critical ambient conditions after emergency landing.

(j) If storage batteries are used as the energy supply for the emergency lighting system, they may be recharged from the airship's main electric power system: Provided, that the charging circuit is designed to preclude inadvertent battery discharge into charging circuit faults.

(k) Components of the emergency lighting system, including batteries, wiring relays, lamps, and switches must be capable of normal operation after having been subjected to the inertia forces listed in mentioned in TAR 561 (b).

(l) The emergency lighting system must be designed so that after any single transverse separation of the flight compartment from the passenger compartment after crash landing:

(1) not more than 25% of all electrically illuminated emergency lights required by this paragraph are rendered inoperative, in addition to the lights that are directly damaged by the separation;

(2) each electrically illuminated exit sign required under TAR 811(b) remains operative

exclusive of those that are directly damaged by the separation; and

(3) at least one required exterior emergency light for each side of the airship remains operative exclusive of those that are directly damaged by the separation.

TAR 813 Emergency exit access

Each required emergency exit (see AC 807) must be accessible to the passengers and located where it will afford an effective means of evacuation. Emergency exit distribution must be as uniform as practical, taking passenger distribution into account; however, the size and location of exits on both sides of the passenger compartment need not be symmetrical. Where more than one floor level exit per side is prescribed, at least one floor level exit per side must be located near each end of the passenger compartment. In addition:

(a) There must be a passageway leading from the nearest main aisle to each Type A, Type B, Type C, Type I, or Type II emergency exit and between individual passenger areas. Each passageway leading to a Type A or Type B exit must be unobstructed and at least 36 inches (914.4 mm) wide. Passageways between individual passenger areas and those leading to Type I, Type II or Type C emergency exits must be unobstructed and at least 20 inches (508 mm) wide. Unless there are two or more main aisles, each Type A or B exit must be located so that there is passenger flow along the main aisle to that exit from both the forward and aft directions. If two or more main aisles are provided, there must be unobstructed cross-aisles at least 20 inches (508 mm) wide between main aisles. There must be:

(1) A cross-aisle which leads directly to each passageway between the nearest main aisle and a Type A or B exit; and

(2) A cross-aisle which leads to the immediate vicinity of each passageway between the nearest main aisle and a Type I, Type II, or Type III exit; except that when two Type III exits are located within three passenger rows of each other, a single cross-aisle may be used if it leads to the vicinity between the passageways from the nearest main aisle to each exit.

(b) Adequate space to allow crew member(s) to assist in the evacuation of passengers must be provided as follows:

(1) The assist space must not reduce the unobstructed width of the passageway below that required for the exit.

(2) For each type A or Type B exit, assist space must be provided at each side of the exit regardless of whether a means is required by TAR 810(a) to assist passengers in descending to the ground from that exit.

(3) Assist space must be provided at one side of any other type exit required by TAR 810(a) to have a means to assist passengers in descending to the ground from that exit.

(c) There must be access from each aisle to each Type III or Type IV exit, and:

(1) For airships that have a passenger seating configuration, excluding pilot's seats, of 20 or more, the projected opening of the exit provided may not be obstructed and there must be no interference in opening the exit by seats, berths, or other protrusions (including seatbacks in any position) for a distance from that exit not less than the width of the narrowest passenger seat installed on the airship.

(2) For airships that have a passenger seating configuration, excluding pilots seats, of 19 or less, there may be minor obstructions in this region, if there are compensating factors to maintain the effectiveness of the exit.

(d) If it is necessary to pass through a passageway between passenger compartments to reach any required emergency exit from any seat in the passenger compartment, the passageway must be unobstructed. However, curtains may be used if they allow free entry through the passageway.

(e) No door may be installed in any partition between passenger compartments. However, privacy cabin doors are accepted, when designed so as to preclude anyone from becoming trapped inside the cabin, and if a locking mechanism is installed, it must be capable of being unlocked from the outside without the aid of special tools.

(f) If it is necessary to pass through a doorway separating the passenger compartment from other areas to reach any required emergency exit from any passenger seat, the door must have a means to latch it in open position. The latching means must be able to withstand the loads imposed upon it when the door is subjected to the ultimate inertia forces, relative to the surrounding structure, required in TAR 561(b).

TAR 815 Width of aisle

The passenger aisle width at any point between seats must equal or exceed the values in the following table:

Passenger seating capacity	Minimum passenger aisle width (in)	
	Less than 25 in (635 mm) from floor	25 in (635 mm) and more from floor
10 or less	12*	15
11 to 19	12	20
20 or more	15	20

* A narrower width not less than 9 in (229 mm) may be approved when substantiated by tests found necessary by the Authority.

TAR 831 Ventilation

(a) Each passenger and crew compartment must be ventilated and each crew compartment must have enough fresh air (but not less than 0.283 m^3 (10 cubic ft) per minute per crew member) to enable crew members to perform their duties without undue discomfort or:

(b) Air in crew and passenger compartments and all areas accessible in flight must be free from harmful or hazardous concentrations of gases or vapours. In meeting this requirement, the following apply:

(1) Carbon monoxide concentrations in excess of one part in 20000 parts of air are considered hazardous. For test purposes, any acceptable carbon monoxide detection method may be used.

(2) Carbon dioxide in excess of 3% by volume (sea-level equivalent) is considered hazardous in the case of crew members. Higher concentrations of carbon dioxide may be allowed in crew compartments and all areas accessible in flight if appropriate protective breathing equipment is available.

(3) Helium concentrations must be established that are considered non-hazardous for occupants. Higher concentrations of Helium may be allowed in crew compartments and all areas accessible during flight if appropriate protective breathing equipment is available.

c) There must be provisions made to ensure that the conditions prescribed in subparagraph (b) of this paragraph are met after reasonably probable failures or malfunctioning of the ventilating, heating, 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.

e) Except as provided in subparagraph (f) of this paragraph, means must be provided to enable the occupants of the following compartments and areas to control the temperature and quantity of ventilating air supplied to their compartment or area independently of the temperature and quantity of air supplied to other compartments and areas:

(1) The flight-crew compartment.

(2) Crew-member compartments and areas other than the flight-crew compartment unless the crew-member compartment or area is ventilated by air interchange with other compartments or areas under all operating conditions.

(f) Means to enable the flight crew to control the temperature and quantity of ventilating air supplied to the flight-crew compartment independently of the temperature and quantity of ventilating air supplied to other compartments are not required if all of the following conditions are met:

(1) The total volume of the flight-crew and passenger compartments is 22,7 m^3 (800 cubic ft) or less.

(2) The air inlets and passages for air to flow between flight-crew and passenger compartments are arrange to provide compartment temperatures within 2,8°C (5°F) of each other and adequate ventilation to occupants in both compartments.

(3) The temperature and ventilation controls are accessible to the flight crew.

FIRE PROTECTION AND LIGHTNING EVALUATION

TAR 833 Combustion heating systems

Combustion heaters must be approved.

TAR 851 Fire extinguishers

(a) Hand fire extinguishers

(1) The following minimum number of hand fire extinguishers must be conveniently located and evenly distributed in passenger compartments:

Passenger capacity			Number of extinguishers
7	to	30	1
31	to	60	2
61	to	200	3
201	to	300	4
301	to	400	5
401	to	500	6
501	to	600	7
601	to	700	8

(2) At least one hand fire extinguisher must be conveniently located in the pilot compartment.

(3) At least one readily accessible hand fire extinguisher must be available for use in each Class A or Class B cargo or baggage compartment and in each Class E cargo or baggage compartment that is accessible to crew members in flight.

(4) At least one hand fire extinguisher must be located in, or readily accessible for use in, each galley located above or below the passenger compartment.

(5) Each hand fire extinguisher must be approved.

(6) Hand fire extinguishers are required in all areas accessible in flight where fires are likely to occur.

(7) The type of extinguishing agent used in the extinguishers required by this paragraph must be appropriate for the kinds of fires likely to occur where used.

(8) The quantity of extinguishing agent used in each extinguisher required by this paragraph must be appropriate for the kinds of fires likely to occur where used.

(9) Each extinguisher intended for use in a personnel compartment must be designed to minimise the hazard of toxic gas concentration.

(b) Built-in fire extinguishers: If a built-in fire extinguisher is provided:

(1) Each built in fire extinguishing 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.

(2) The capacity of each required built-in fire extinguishing system must be adequate for any fire likely to occur in the compartment where used,

considering the volume of the compartment and the ventilation rate.

TAR 853 Compartment interiors

For each compartment occupied by the crew or passengers, the following apply:

(a) Materials (including finishes or decorative surfaces applied to the materials) must meet the applicable test criteria prescribed in JAR 25, Part I of Appendix F or other approved equivalent methods.

(b) In addition to meeting the requirements of subparagraph (a) of this paragraph, seat cushions, except those on flight crew member seats, must meet the test requirements of JAR 25 Part II of Appendix F, or equivalent.

(c) For airships with passenger capacities of 20 or more, interior ceiling and wall panels (other than lighting lenses), partitions, and the outer surfaces of galleys, large cabinets and stowage compartments (other than underseat stowage compartments and compartments for stowing small items, such as magazines and maps) must also meet the test requirements of Parts IV and V of Appendix F, or other approved equivalent method, in addition to the flammability requirements prescribed in subparagraph (a) of this paragraph.

(d) Smoking is not to be allowed in lavatories. If smoking is to be allowed in any compartment occupied by the crew or passengers, an adequate number of self-contained, removable ashtrays must be provided for all seated occupants; and:

(e) Regardless of whether smoking is allowed in any other part of the airship, lavatories must have self-contained removable ashtrays located conspicuously both inside and outside each lavatory. One ashtray located outside a lavatory door may serve more than one lavatory door if the ashtray can be seen readily from the cabin side of each lavatory door served.

(f) Each receptacle used for the disposal of flammable waste material must be fully enclosed, constructed of at least fire resistant materials and must contain fires likely to occur in it under normal use. The ability of the receptacle to contain those fires under all probable conditions of wear, misalignment, and ventilation expected in service must be demonstrated by test.

TAR 854 Lavatory fire protection

For airships with a passenger capacity of 20 or more:

(a) Each lavatory must be equipped with a smoke detector system or equivalent that provides a warning light in the cockpit, or provides a warning light or audible warning in the passenger cabin that would be readily detected by a flight attendant; and

(b) Each lavatory must be equipped with a built-in fire extinguisher for each disposal receptacle for towels, paper, or waste, located within the lavatory. The extinguisher must be designed to discharge automatically into each disposal receptacle upon occurrence of a fire in that receptacle.

TAR 855 Cargo or baggage compartments

For each cargo or baggage compartment not occupied by crew or passengers, the following apply:

(a) The compartment must meet one of the class requirements of TAR 857.

(b) Class B through Class E cargo or baggage compartments, as defined in TAR 857, must have a liner, and the liner must be separate from (but may be attached to the airship structure.

(c) Ceiling and sidewall liner panels of Class C and D compartments must meet the test requirements of JAR 25 Part III of Appendix F or other approved equivalent methods.

(d) All other materials used in the construction of the cargo or baggage compartment must meet the applicable test criteria prescribed in JAR 25 Part I of Appendix F, or other approved equivalent methods.

(e) No compartment may contain any controls, wiring, lines, equipment, or accessories, the damage or failure of which 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.

(f) There must be means to prevent cargo or baggage from interfering with the functioning of the fire protective features of the compartment.

(g) Sources of heat within the compartment must be shielded and insulated to prevent igniting the cargo or baggage.

(h) Flight tests must be conducted to show compliance with the provisions of TAR 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 the above 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 other compartment, either during or after extinguishment, unless the extinguishing system floods each such compartment simultaneously.

TAR 857 Cargo compartment classification

(a) Class A: A Class A cargo or baggage compartment (refer to corresponding AC 25-17) is one in which:

(1) The presence of a fire would be easily discovered by a crew member 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 (refer to corresponding FAA AD 93-07-15) 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; and

(3) There is a separate approved smoke detector or fire detector system to give warning to the pilot or flight engineer station.

(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; and

(4) There are means to control ventilation and draughts within the compartment so that the extinguishing agent used can control any fire that may start within the compartment.

TAR 858 Cargo compartment fire detection systems

If certification with cargo compartment fire detection provisions is requested, the following must be met for each cargo compartment with those provisions:

(a) The detection system must provide a visual indication to the flight crew within one minute after the start of a fire.

(b) The system must be capable of detecting a fire at a temperature significantly below that at which the structural integrity of the airship is substantially decreased.

(c) There must be means to allow the crew to check in flight, the functioning of each fire detector circuit.

(d) The effectiveness of the detection system must be shown for all approved operating configurations and conditions.

TAR 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 TAR 1181 to 1191 and TAR 1195 to 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 vapours 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 vapours 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 vapours 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) Means independent of the components provided for the normal continuous control of air temperature, airflow, and fuel flow must be provided, for each heater, to automatically shut-off the ignition and fuel supply to that heater at a point remote from that heater when any of the following occurs:

(i) The heat exchanger temperature exceeds safe limits.

(ii) The ventilating air temperature exceeds safe limits.

(iii) The combustion airflow becomes inadequate for safe operation.

(iv) The ventilating airflow becomes inadequate for safe operation.

(2) The means of complying with subparagraph (e) (1) of this paragraph for any individual heater must:

(i) Be independent of components serving any other heater, the heat output of which is essential for safe operation; and

(ii) Keep the heater off until restarted by the crew.

(3) There must be means to warn the crew when any heater, the heat output of which is essential for safe operation has been shut-off by the automatic means prescribed in subparagraph (e) (1) of this paragraph.

(f) Air intakes: Each combustion and ventilating air intake must be located so that no flammable fluids or vapours 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 TAR 1121 and 1123. In addition, there must be provisions in the design of the heater 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 heater 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 conditions.

TAR 863 Flammable fluid fire protection

(a) In each area where inflammable fluids or vapours might escape by leakage of a fluid system, there must be means to minimise the probability of ignition of the fluids and vapours, and the resultant hazard if ignition does occur. (See corresponding ACJ 25.863 (a)).

(b) Compliance with subparagraph (a) of this paragraph must be shown by analysis or tests, and the following factors must be considered:

(1) Possible sources and paths of fluid leakage, and means of detecting leakage;

(2) Flammability characteristics of fluids, including effects of any combustible or absorbing materials;

(3) Possible ignition sources, including electrical faults, overheating of equipment, and malfunctioning of protective devices;

(4) Means available for controlling or extinguishing a fire, such as stopping flow of fluids, shutting down equipment, fireproof containment, or use of extinguishing agents;

(5) Ability of airship components that are critical to safety of flight to withstand fire and heat.

(c) If action by the flight crew is required to prevent or counteract a fluid fire (e.g., equipment shutdown or actuation of a fire extinguisher), quick acting means must be provided to alert the crew.

(d) Each area where flammable fluids or vapours might escape by leakage of a fluid system must be identified and defined.

TAR 865 Fire protection of flight controls, engine mounts and other flight structure

Essential flight controls, engine mounts, and other flight structures located in designated fire zones or in adjacent areas which would be subjected to the effects of fire in the fire zone must be constructed of fireproof material or shielded so that they are capable of withstanding the effects of fire.

TAR 869 Fire protection: systems

(a) Electrical system components:

(1) Components of the electrical system must meet the applicable fire and smoke protection requirements of TAR 831(b) and 863.

(2) Electrical cables, terminals, and equipment in designated fire zones, that are used during emergency procedures, must be at least fire resistant.

(3) Main power cables (including generator cables) must be designed to allow a reasonable degree of deformation and stretching without failure and must be:

(i) Isolated from flammable fluid lines; or

(ii) Shrouded by means of electrically insulated, flexible conduit, or equivalent, which is in addition to the normal cable insulation.

(4) Insulation on electrical wire and electrical cable installed in any area of the airship must be self-extinguishing when tested in accordance with the applicable portions of JAR 25 Part I of Appendix F.

(b) Each vacuum air system line and fitting on the discharge side of the pump that might contain flammable vapours or fluids must meet the requirements of TAR 1183 if the line or fitting is in a designated fire zone. Other vacuum air systems components in designated fire zones must be at least fire resistant.

(c) Oxygen equipment and lines must:

(1) Not be located in any designated fire zone.

(2) Be protected from heat that may be generated in, or escape from, any designated fire zone, and

(3) Be installed so that escaping oxygen cannot cause ignition of grease, fluid, or vapour accumulations that are present in normal operation or as a result of failure or malfunction of any system.

MISCELLANEOUS

TAR 871 Levelling means

There must be means for determining when the airship is in a level position on the ground.

TAR 875 Protection near propellers

(a) Design precautions must be taken to avoid damage to the airship by the effect of vibration induced by passing propeller tips and to minimise the hazards to the airship in the event of ice thrown from unducted propellers. The hazards which must be considered include damage to structure and critical systems.

(b) For vectored thrusters every possible inclination must be considered under (a).

(c) No window may be near the propeller tips unless it can withstand the most severe ice impact likely to occur.

AIRSHIP SPECIFICS

TAR 881 Rigid airship outer cover

For the outer cover of rigid airships the following shall apply:

(a) it must be demonstrated by analysis and test that the cover will maintain the (aerodynamic) shape assumed in performance calculations of the airship, without flutter in individual panels, at all operational airspeeds. The effects of all local aerodynamic pressures (including thrust slipstream impingement) and pitch angles must be investigated.

(b) Ventilation means must be provided in the hull and fins to control air pressure and temperature within the cover and to remove gas and vapours.

(c) In strength requirements it must be considered whether the cover contributes to strength and/or stiffness of the airship's frame. The outer cover must have sufficient strength to withstand the maximum load resulting from any of the requirements specified herein and taking into account the effects of environmental conditions such as temperature and humidity, expected in service.

(d) It must be demonstrated by test in accordance with the section Tearing Strength of the Appendix B that the envelope fabric (in both the warp and woof (fill) directions) can withstand limit design loads without further tearing.

(e) The cover shall be protected from:

(1) heat emanating from engines, heaters and the sun;

(2) off-limit air pressures within the airship cover;

(3) ice thrown by propeller or debris.

(f) Fire hazard to the outer cover has to be investigated and must be minimised; and:

(1) it has to be demonstrated that the outer cover has self-extinguishing capabilities, or;

(2) the outer cover material have self-extinguishing properties according to JAR 25, Appendix F, Part I (a)(1)(iv).

TAR 883 Non- and semi-rigid airship envelope

For the envelope of non-rigid and semi-rigid airships the following shall apply:

(a) The envelope must be designed to be pressurised and maintain sufficient superpressure (amount of envelope pressure in excess of ambient pressure) to remain in tension while supporting the limit design loads for all flight conditions and ground conditions, except for mooring and handling conditions, where wrinkling at the ends of the nose battens is permitted under loads larger than limit but should not occur to a level were damage to the envelope can happen. The effects of all local aerodynamic pressures (including thrust slipstream impingement) and pitch angles must be included in the determination of stresses to arrive at the limit-strength requirements for the envelope fabric. In determine limit design loads of the envelope the most critical areas with maximum envelope pressure-, aerodynamic-, structure- and suspension system loads must be considered if applicable.

(b) The envelope fabric must have an ultimate strength not less than 4 times the limit load determined by the maximum design internal pressure combined with the maximum load resulting from any of the requirements specified herein and taking into account the effects of environmental conditions such as temperature and humidity, expected in service.

(c) Suspension system components made of fabric or non-metallic material must have an ultimate strength of not less than four times the prescribed limit loads. A minimum pitch angle of ±30° must be used in determining system suspension loads.

(d) It must be demonstrated by test in accordance with the section Tearing Strength of the Appendix B that the envelope fabric (in both the warp and woof (fill) directions) can withstand limit design loads without further tearing.

(e) Metalcad hull material *(reserved)*

(f) Ballonets must be designed and installed such that their centre of gravity of their combined volume will coincide longitudinally, within approved limits determined in TAR 27, with the centre of buoyancy of the envelope. The ballonet system must be designed so that the static trim capabilities of the system about the centre of buoyancy of the airship are equally divided between the fore and aft ballonets, if provided. The effective trim capabilities of the ballonets must be maintained approximately equal between the limits of 0 to 100% ballonet fullness. Sufficient means must be provided to prevent trapping of air when partially deflated.

(g) Unless it is demonstrated that breaking away from the mast is extremely improbable provisions must be installed to permit rapid envelope deflation should the airship break away from the mast during mooring. If the airship is to be left unattended, automatic deflation must be provided. The system must be protected against inadvertent use and must be properly identified and available to crew members.

(h) A means must be provided to permit emergency deflation of the envelope on the ground during emergency evacuation of the occupants. Normal valving of lifting gas may be considered in meeting this requirement.

(i) Internal and/or external suspension systems for supporting components and connecting them to the envelope, such as a keel, crew and passenger compartments and propulsion units, must be designed to transmit and distribute the resulting loads to the envelope in a uniform manner for all flight conditions. Fabric parts of such systems and their connection to the envelope must be designed and constructed such that the bonds are not subjected to peeling loads. Provisions must be made to prevent chafing between suspension system components and air system components.

(j) The nose of the envelope must be designed to prevent wrinkling due to high speed flight.

(k) Gas tight sleeves must be provided at locations where suspension cables penetrate the envelope. These must be of sufficient length to allow for envelope stretch and other dimensional changes and uncertainties. If suspension system cables must be adjustable to ensure proper load distribution throughout the service life of the airship, the adjustable part must be located on the air side of the suspension system.

(l) The envelope and ballonets must be protected from chafing with the suspension system cables and/or other solid elements.

(m) Fire hazard to the envelope have to be investigated and must be minimised; and:

(1) it has to be demonstrated that the gas filled envelope or gas cell has self-extinguishing capabilities, or;

(2) the envelope material have self-extinguishing properties according to JAR 25, Appendix F, Part I (a)(1)(iv).

(m) Acceptable envelope leakage rates and purity degradation values have to be established and published in the Airship Flight Manual.

(n) For multi-cell envelopes it must be shown by analysis that in the case of any deflated cell:

(1) no emergency landing is required

(2) proper trim can be assured

(3) no excessive shear will become effective in the hull structure.

(p) The envelope shall be protected from:

(1) heat emanating from engines, heaters and the sun;

(2) off-limit air pressures within the airship cover;

(3) ice thrown by propeller or debris.

TAR 885 Gas cells

(a) Gas cells and suspension system components of rigid airships must be designed to support the limit design loads from:

(1) all flight and ground conditions up to the maximum pitch angles expected in service;

(2) deflation of a cell adjacent to a full cell;

(3) full cells at maximum pressures.

(b) Unless otherwise substantiated gas cell fabric must have an ultimate strength not less than 4 times the limit load specified herein and taking into account the effects of environmental conditions, such as temperature and humidity, expected in service.

(c) Suspension system components made of fabric or non-metallic material must have an ultimate strength of not less than four times the prescribed limit loads.

(d) It must be demonstrated by test in accordance with the section Tearing Strength of the Appendix B that the gas cell fabric (in both the warp and woof (fill) directions) can withstand limit design loads without further tearing.

(e) Gas cells must be designed and installed such that their centre of displacement during operation is within the allowed lateral centre of gravity limits determined under TAR 27.

(f) Provisions must be maintained to permit rapid gas cells deflation should the airship break away from the mast during mooring. If the airship is to be left unattended, automatic deflation must be provided. The system must be protected against inadvertent use and must be properly identified and available to crew members or it can be demonstrated that breaking away from the mast is extremely improbable.

(g) A means must be provided to permit emergency deflation of an appropriate number of gas cells on the ground during emergency evacuation of the occupants. Normal valving of lifting gas may be considered in meeting this requirement

(h) Systems for connecting the gas cells to the airship frame must be designed to transmit and distribute the resulting loads to the frame in a uniform manner for all flight conditions. Fabric parts of such systems and their connection to the frame must be designed and constructed such that the bonds are not subjected to peeling loads. Provisions must be made to prevent chafing between suspension system components and gas cell components.

(i) *(reserved)*

(j) Gas tight sleeves must be provided at locations where cables penetrate gas cells. These sleeves must be of sufficient length to allow for gas cell dimensional changes. If the cables must be adjustable to ensure proper load distribution throughout the service life of the airship, the adjustable part must be located on the air side of the cable.

(k) Gas cells shall be contained and supported in such a manner as to prevent dislocation and chafing against the hull or envelope.

(l) Fire hazard to the gas cells have to be investigated and must be minimised and:

(1) it has to be demonstrated that the gas filled envelope or gas cell has self extinguishing capabilities, or;

(2) gas cell material have self-extinguishing properties according to JAR 25, Appendix F, Part I (a)(1)(iv)

(m) Gas cell leakage rates and purity degradation values have to be established and published in the Airship Flight Manual

(n) *(reserved)*

(o) It must be shown by analysis that in the case of any deflated cell:

(1) no emergency landing is required

(2) proper trim can be assured

(3) no excessive shear will become effective in the hull structure.

(p) Gas cells shall be protected from:

(1) heat emanating from engines, heaters and the sun;

(2) ice thrown by propeller or debris.

TAR 887 Lifting gas pressure system

Non- and semi-rigid airships: a means shall be provided to control the internal pressure of the envelope and to provide air to the ballonets and must contain at least the following components:

(a) Lifting gas Valves: at least two valves must be provided. The valves may be located either on or near the envelope but not higher than 10° above the equator. They must be designed for both manual and automatic operation, be operable at specified pressure settings at all attainable air speeds, and be designed to open and close positively and be prevented from sticking and/or freezing. The valves must not discharge lifting gas into spaces normally accessible to occupants, the engine intake system, or the ballonets. The valves must be of sufficient capacity to permit ascent above pressure height at the maximum design rate-of-climb but not less than 15 m/s without exceeding lifting gas pressure of 1.25 times maximum operating pressure.

(b) Air Valve(s): at least one air valve must be provided to discharge air from each ballonet. The valves may be located in the envelope or connected to it by a suitable duct. The valve(s) must be capable of manual and automatic operation and be capable of operating at appropriate pressure settings at all attainable air speeds and must be designed to open and close positively and be prevented from sticking and/or freezing. The valve(s) must be of sufficient capacity to permit ascent below pressure height at the maximum design rate-of-climb without exceeding lifting gas pressure of 1.15 times maximum operating pressure. It must not be possible for the pilot to manually and simultaneously to lock all air valves closed to prevent envelope overpressure in the climb and a resultant automatic release of helium. If the airship has only one valve per ballonet, then a system must be provided to prevent both fore and aft ballonet valves from being manually locked closed simultaneously. If the airship has multiple valves per ballonet, then it must not be possible to manually lock one particular valve closed. This would normally be valve #1, the highest pressure valve, in the forward ballonet.

(c) Ballonet Air Induction System: scoops, ducts, blowers and dampers (air inlet valves) or combinations of these must be of sufficient capacity to permit descent at the maximum design rate but not less than 7.5 m/sec with sufficient pressure to maintain envelope shape and control system functions. The effects of single or multiple engine failure if the system is dependent on engine functioning must be determined.

(d) Air supply source: A reliable means of supplying air to the ballonet, must be provided, and must have adequate capacity to enable the pressure in the envelope to be maintained during flight at low engine powers and forward speeds, and, if appropriate, when thrust vectoring reduces the effectiveness of the engines in supplying air. The means shall also be able to maintain envelope shape to permit operation of systems dependent upon that shape following the failure of all engines for a sufficient time to permit a landing to be made.

(e) Provisions must be made to blow air into the lifting gas space to supplement the ballonet in case of excessive lifting gas loss. The control(s) for this system must be readily accessible and quickly operable by the crew. A lifting gas pressure sufficient to prevent wrinkling of the envelope at a forward speed of 0.25 V_H must be maintained with a descent rate of 1.5 m/s.

(f) Rigid airships: for each gas cell at least two lifting gas valves must be provided. The valves must be located not higher than 10° above the equator. They must be designed for both manual and automatic operation, be operable at specified pressure settings at all attainable air speeds, and be designed to open and close positively and be prevented from sticking and/or freezing. The valves must not discharge lifting gas into spaces normally accessible to occupants or the engine intake system. The valves must be of sufficient capacity to permit ascent above pressure height at the maximum design rate-of-climb but not less than 15 m/s without exceeding lifting gas pressure of 1.25 times maximum operating pressure.

(g) The lifting gas system must, apart from replenishing the cells, allow positive and controlled transfer of gas between selected gas cells for trimming purposes in TAR 885(o)(2) and to prevent critical load distribution in the airship.

(h) Controls and instruments necessary for controlled release or transfer of lifting gas by the crew must be provided. Such controls and instruments shall be located and arranged so that they may be operated by the crew in the correct manner without undue concentration or fatigue. If remotely actuated lifting gas valves are used, a mechanical backup system must be provided.

TAR 889 Ground handling provisions

Provisions for ground handling must be provided as required by TAR 255. All fabric patches and fittings of ground handling lines must be designed with a breaking strength of 1.15 the specified breaking strength of the attached cable or line assembly strength.

TAR 891 Flutter

The envelope and all fixed and movable control surfaces must be shown to be free from flutter, up to V_H plus U_m, V_{CD} or V_M whichever is greater, by analysis supported by flight test.

TAR 893 Lifting gas

The lifting gas must be non-flammable, non-toxic and non-irritant.

TAR 895 Ballast system

If a system is installed using disposable ballast according to Appendix C the following applies:

(a) General: the disposable ballast system, including all controls and related components, must be designed and installed so as to ensure positive, controlled disposal or transfer of the disposable ballast by the crew under all normal operating conditions. Disposal or transfer of disposable ballast shall be controllable by the flight crew to prevent critical load distributions in the airship.

(b) Capacity: the airship must contain sufficient disposable ballast capacity, to restore itself to a condition of equilibrium at any time during normal flight operations. Adequate provisions for safe storage of the disposable ballast under all design loading conditions must be provided.

(c) Ballast material: disposable ballast may be in the form of water or other transferable and disposable material such as sand or shot. It must be easily dissipated without causing injury to persons or property on the ground. Means must be provided to prevent freezing and/or blocking of the ballast material.

(d) Discharge rate: means must be provided to discharge disposable ballast in a controlled manner at a rate that must comply with the safety requirements in the course of near-ground manoeuvres:

(1) if non-liquid ballast is used, gates must be installed to enable this discharge rate.

(2) if liquid ballast is used tank vents must be installed to accommodate this discharge rate. Leakage from the tank or vents is not permitted in normal flight attitudes. The liquid discharge valve must be designed to allow the crew to close the valve during any part of the discharge operation.

(e) Location of ballast ports: the disposable ballast discharge ports or vents must not be located in the immediate vicinity of the engines, air scoops, or so as to cause impingement on the airship or to impair/endanger engine operation.

(f) Controls and instruments: controls and instruments necessary for controlled release or transfer of disposable ballast by the crew must be provided. Such controls and instruments shall be located and arranged so that they may be operated by the crew in the correct manner without undue concentration or fatigue. If remotely actuated dump valves are used, a mechanical backup system must be provided.

TAR 897 External load means of attachment

For airships carrying external loads or ballast the following apply:

(a) The external load must not interfere with the airship's ability to maintain safe flight and to be controllable during take-off, landing, taxiing, mooring and the load exchange process.

(b) The mechanism for handling external loads must be designed for the maximum predicted inertia factors.

(c) Loads must be applied to the load support structure in the directions and angles produced by pitch and roll of the airship during all flight phases while carrying an external load. Angles of ±30° pitch and ±20° roll are required by the Authority as minimum values.

(d) It must be shown by analysis or test or both that the load cannot be unintentionally released during flight.

TAR 899 Hoists and suspended loads

(a) It must be shown by analysis and test that the hoisting system is designed for static limit loads derived from the maximum suspended masses, for which authorization is sought, multiplied by a factor of 2. The load is applied in the vertical direction and in any direction making an angle of 30° relative to the vertical.

(b) It must be shown by analysis and test that the airship mooring provisions and their supports are designed for static limit static loads induced by the loading and unloading operation multiplied by a load factor of 3.

(c) It must be shown by analysis and simulation, supported by test, that oscillations of masses suspended from the hovering airship will be manageable and will not damage the airship.

(d) It must be shown by analysis supported by test that - during the cargo transfer - the kinetic energy of the suspended mass due to oscillations in combination with the dynamics of the hovering airship and the lowering speed of the cargo hoist does not endanger the airship's controllability.

(e) Ropes, cables and/or other devices attached to the lowered suspended mass for longitudinal and lateral adjustment of the precise settling and positioning of the mass must be designed to absorb all inertial forces due to the dynamics addressed in (c). The rope, wire and cable factors in TAR 628 apply.

(f) For the hoisting system, including all cables, winches, control equipment and ancillary components, proof must be furnished of the suitability, durability and reliability of the entire device. TAR 1309 as well as ACJ 25.1309 No. 2, 3, 4, 6, 7, 8, and AMJ 25.1309 apply.

AC 899 (f)

Compliance with the requirement of TAR 899(f) can be proved by a certificate from an expert body. This certificate also contains the conditions for safe operation of the device.

Subpart E - Powerplant

GENERAL

TAR 901 Installation

(a) For the purpose of this code, airship powerplant installations include each component that:

(1) Is necessary for propulsion in any direction;

(2) Affects the safety and control of the major propulsion unit(s); or:

(3) Affects the safety of the major propulsive units between normal inspections or overhauls.

(b) For each powerplant:

(1) The installation must comply with:

(i) The installation instructions provided under JAR-E, section 4, paragraph 7 or equivalent instructions; and:

(ii) The applicable provisions of this Subpart (see also JAR 25 AMJ 20X-1).

(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 airship.

(c) The powerplant installation must comply with TAR 1309.

(d) *(reserved)*

(e) The satisfactory functioning of the power unit must be demonstrated by ground and flight tests over the range of operating conditions for which certification is required and must include tests under hot climatic conditions, unless equivalent evidence cam be produced (see ACJ 25.901(e).

TAR 903 Engines

(a) Engine type certification:

(1) Each engine must be approved and either

(i) Have a type certificate; or

(ii) Be certificated as a part of the airship. JAR-E or equivalent shall be used as a guide for the certification basis.

(2) Each turbine engine not certificated to JAR-E 790 and 800 must be shown to comply with JAR-E 790 and JAR-E 800 or be shown to have a foreign object ingestion service history in similar installation locations which has not resulted in any unsafe condition or that the particular installation excludes ingestion.

(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 the failure or malfunction (including destruction by fire in the engine compartment) of any system that can affect an engine (other than a fuel tank, if only one fuel tank for two engines is installed), will not:

(1) Prevent the continued safe operation of the remaining engines; or

(2) Require immediate action by a crew member for continued safe operation of the remaining engines.

(c) Control of engine rotation: There must be a means for stopping the rotation of any engine individually in flight, except that means for stopping the rotation of any engine need to be provided only where continued rotation could jeopardise the safety of the airship:

(1) In particular, where no means are provided to prevent continued rotation, the safety of the airship must be shown in the event of failure of the engine oil supply. (See JAR-E 710 and ACJ E 710)

(2) Each component of the stopping system on the engine side of the firewall that might be exposed to fire must be at least fire resistant.

(3) 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: For turbine engine installations

(1) Design precautions must be taken to minimise the hazards to the airship in the event of an engine-rotor failure or a fire originating inside the engine which burns through the engine casing;

(2) The powerplant systems associated with engine control devices, systems, and instrumentation must be designed to give reasonable assurance that those operating limitations that adversely affect turbine rotor structural integrity will not be exceeded in service.

(e) Restart capability.

(1) Means to restart any engine in flight must be provided.

(2) An altitude and airspeed envelope must be established for the airship for in-flight engine

restarting, and each installed engine must have a restart capability within that envelope.

(f) Starting and stopping (piston engine): the design of the installation must be such that risk of fire or mechanical damage to the engine or airship, as a result of starting is reduced to a minimum. Any techniques and associated limitations for engine starting must be established and included in the Airship Flight Manual, approved manual material, or applicable operating placards. Means must be provided for stopping and restarting each engine in flight. In addition the following apply:

(1) Each component of the stopping system on the engine side of the firewall that might be exposed to fire must be at least fire resistant;

(2) 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.

TAR 905 Propellers

(a) Each propeller must be approved and either

(1) Have a type certificate; or

(2) Be certificated as a part of the airship. JAR-P or equivalent shall be used as a guide for the certification basis.

(b) Engine power and propeller shaft rotational speed must not exceed the limits for which the propeller is certificated (See JAR-P 80).

(c) Each component of the propeller blade pitch control system must meet the requirements of JAR-P 200.

(d) Design precautions must be taken to minimise the hazards to the airship and occupants in the event a propeller blade fails or is released by a hub failure. The hazards which must be considered include damage to structure, gas cells, load carrying parts of envelope, suspensions and catenary (if installed) and critical systems due to impact of a failed or released blade and the unbalance created by such failure or release.

(e) If a vectoring system is installed the combination of swiveling speed, airspeed, and engine power may not exceed the limits for which the propeller is designed for.

TAR 907 Vibration

(a) Propeller vibration: (See JAR-P 190)

(b) Engine vibration: each engine must be installed to prevent the harmful vibration of any part of the engine or airship.

(c) Thrust vectoring: the thruster drive system and vectored operation of the thruster may not subject the propeller/gearbox and/or the principal rotating parts of the engine to excessive vibration stresses. This must be shown by a vibration investigation.

TAR 908 Cooling fans

For cooling fans that are a part of a powerplant installation the following apply:

(a) For cooling fans installed in airships, it must be shown that a fan blade failure will not prevent continued safe flight either because of damage caused by the failed blade or loss of cooling air.

(b) Fatigue evaluation: Unless a fatigue evaluation under TAR 571 is conducted, it must be shown that cooling fan blades are not operating at resonant conditions within the operating limits of the airship.

TAR 909 Turbochargers

(a) Each turbocharger must be approved under the engine type certificate, or it must be shown that the turbocharger system

(1) Can withstand, without defect, an endurance test of 150 hours that meets the applicable requirements of JAR-E 440;

(2) Will have no adverse effect upon the engine.

(b) Control system malfunctions, vibrations, and abnormal speeds and temperatures expected in service may not damage the turbocharger compressor or turbine.

(c) Each turbocharger case must be able to contain fragments of a compressor or turbine that fails at the highest speed that is obtainable with normal speed control devices inoperative.

(d) Each intercooler installation, where provided, must comply with the following.

(1) The mounting provisions of the intercooler must be designed to withstand the loads imposed on the system;

(2) It must be shown that, under the installed vibration environment, the intercooler will not fail in a manner allowing portions of the intercooler to be ingested by the engine;

(3) Airflow through the intercooler must not discharge directly on any airship component (e.g. windshield) unless such discharge is shown to cause no hazard to the airship under all operating conditions.

(e) Engine power, cooling characteristics, operating limits, and procedures affected by the turbocharger system installations must be evaluated. Turbocharger operating procedures and limitations must be included in the Airship Flight Manual in accordance with TAR 1581.

TAR 917 Thruster drive system

(a) General: the thruster drive system includes any part necessary to transmit power from the engines to the thruster or propeller. This includes gearboxes, shafting, universal joints, couplings, thruster brake assemblies, clutches, supporting bearings for shafting, any attendant accessory pads or drives, and any cooling fans that are a part of, attached to, or mounted on the thruster drive system. The TAR 918 to 924 must apply.

(b) Arrangement: *(reserved)*

TAR 918 Shafting critical speed

(a) The critical speeds of any shafting must be determined by demonstration except that analytical methods may be used if reliable methods of analysis are available for the particular design.

(b) If any critical speed lies within, or close to, the operating ranges for idling, power-on, and autorotative conditions, the stresses occurring at that speed must be within safe limits. This must be shown by tests.

(c) If analytical methods are used and show that no critical speed lies within the permissible operating ranges, the margins between the calculated critical speeds and the limits of the allowable operating ranges must be adequate to allow for possible variations between the computed and actual values.

TAR 919 Shafting joints

Each universal joint, slip joint and other shafting joints, the lubrication of which is necessary for operation must have provision for lubrication.

TAR 921 Thruster brake

If there is a means to control the rotation of the thruster drive system independently of the engine, any limitations on the use of that means must be specified, and the control for that means must be guarded to prevent inadvertent operation.

TAR 923 Thruster drive system and control mechanism tests

(a) Endurance tests, general: each thruster drive system and thruster control mechanism must be tested, as prescribed in subparagraphs (b) to (j) and (m) of this paragraph, for at least 50 hours. These tests must be conducted as follows:

(1) Five-hour test cycles must be used.

(2) The tests must be conducted on the airship or may be conducted on a representative bench test facility. The load, the frequency, and the methods of application to the affected thruster drive system components must be representative of airship conditions. Test components must be those used for showing compliance with the remainder of this paragraph.

(3) The test torque and rotational speed must be:

(i) determined by the powerplant limitations; and

(ii) absorbed by the thruster to be approved for the airship.

(b) Endurance tests, maximum thrust run: the maximum thrust run must be conducted as follows: The maximum thrust torque run must consist of 0,5 hour of alternate runs of 5 minutes at maximum thrust torque and the maximum speed for use with maximum thrust torque, and 5 minutes at as low an engine idle speed as practicable. The engine must be declutched from the thruster drive system, and the thruster brake, if furnished and so intended, must be applied during the first minute of the idle run. During the remaining 4 minutes of the idle run, the clutch must be engaged so that the engine drives the thruster at the minimum practical rpm. Acceleration of the engine and the thruster drive system must be done at the maximum rate. When declutching the engine, it must be decelerated rapidly enough to allow the operation of the overrunning clutch.

(c) Endurance tests, maximum continuous vector thrust: 1.5 hours of continuous operation at maximum continuous torque and the maximum speed for use with maximum continuous torque must be conducted. The main thruster controls must be operated at a minimum of 15 times each hour through the main thruster pitch positions of maximum thrust and minimum thrust, except that the control movements need not produce loads or blade flapping motion exceeding the maximum loads of motions encountered in flight.

(d) Endurance tests: 90% of maximum continuous run: 1 hour of continuous operation at 90% of maximum continuous torque and the maximum speed for use with 90% of maximum continuous torque must be conducted.

(e) Endurance tests: 80% of maximum continuous run: 1 hour of continuous operation at 80% of maximum continuous torque and the minimum speed for use with 80% of maximum continuous torque must be conducted.

(f) Endurance tests: 60% of maximum continuous run: 1 hour of continuous operation at 60% of maximum continuous torque and the minimum speed for use with 60% of maximum continuous torque must be conducted.

(g) Endurance tests: engine malfunctioning run: It must be determined whether malfunctioning of components, such as the engine fuel or ignition systems, or whether unequal engine power can cause dynamic conditions detrimental to the drive system. If so, a suitable number of hours of operation must be accomplished under those conditions.

(h) Endurance tests: overspeed run: One hour of continuous operation must be conducted at maximum continuous torque and the maximum power-on overspeed expected in service, assuming that speed and torque limiting devices, if any, function properly.

(i) Endurance tests, clutch and brake engagements: A total of at least 100 clutch and brake engagements, including the engagements of subparagraph (b) of this paragraph, must be made during the take-off torque runs and, if necessary, at each change of torque and speed throughout the test. The clutch engagements must be accomplished at the speed and by the method prescribed by the applicant.

(j) Any components that are affected by manoeuvring and gust loads must be investigated for the same flight conditions as are the thrusters, and their service lives must be determined by fatigue tests or by other acceptable methods. In addition, a level of safety equal to that of the thrusters must be provided for each component in the thruster drive system, the failure of which would cause an uncontrolled hover or landing.

(k) Each part tested as prescribed in this paragraph must be in a serviceable condition at the end of the tests. No intervening disassembly which might affect test results may be conducted.

(l) Endurance tests; operating lubricants: To be approved for use in thruster drive and control systems, lubricants must meet the specifications of lubricants used during the tests prescribed by this paragraph. Additional or alternate lubricants may be qualified by equivalent testing or by comparative analysis of lubricant specifications and thruster drive and control system characteristics. In addition:

(1) At least one 10-hour cycle required by this paragraph must be conducted with transmission and gearbox lubricant temperatures, at the location prescribed for measurement, not lower than the maximum operating temperature for which approval is requested;

(2) For pressure lubricated systems, at least one 10-hour cycles required by this paragraph must be conducted with the lubricant pressure, at the location prescribed for measurement, not higher than the minimum operating pressure for which approval is requested.

(m) The manufacturer may propose an alternate endurance test procedure if the thruster system differs in character from that in this part. This test plan must be approved by the authority.

TAR 924 Additional tests

(a) Any additional dynamic, endurance, and operational tests, and vibratory investigations necessary to determine that the thruster drive mechanism is safe, must be performed.

(b) Lubrication system failure. For lubrication systems required for proper operation of thruster drive systems, it must be shown that the thruster drive system is capable of operating under 75% of max. continuous power conditions for at least 15 minutes.

(c) The tests prescribed in subparagraphs (a) and (b) of this paragraph must be conducted on the airship and the torque must be absorbed by the thrusters to be installed, except that other ground or flight test facilities with other appropriate methods of torque absorption may be used if the conditions of support and vibration closely simulate the conditions that would exist during a test on the airship.

TAR 925 Propeller clearance

(a) Ground clearance:

Propellers and shrouds must have positive ground clearance under most adverse conditions expected under normal operation.

(b) Structural clearance: There must be:

(1) sufficient clearance between the propeller blades or cuffs and stationary parts of the airship, including radial clearance to prevent harmful vibration;

(2) positive clearance between other rotating parts of the propeller or spinner and stationary parts of the airship;

(3) sufficient clearance between the propeller and the airship envelope so as to minimise damage from debris or ice thrown by the propellers unless propeller shrouds or equivalent protective means are provided.

(4) positive clearance between propellers and shrouds under all flight and ground conditions specified in these regulations.

(c) Hazards from propeller and shroud interference for minor crash landings must be considered in the design for each propeller vectoring position.

(d) Ducted propellers:

(1) (a) and (c) apply.

(2) Structural clearance: *(reserved)*.

TAR 929 Propeller de-icing

(a) Propeller and other complete engine installations must be protected against the accumulation of ice as necessary to enable satisfactory functioning without appreciable loss of power when operated in the icing conditions for which certification is requested.

(b) If combustible fluid is used for propeller de-icing, TAR 1181 to 1185 and TAR 1189 apply.

TAR 933 Reversing systems

(a) *(reserved)*

(b) Reversing systems 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 airship including ground operation. Failure of structural elements need not be considered if the probability of this kind of failure is extremely remote.

TAR 937 Turbopropeller - drag limiting systems

Turbopropeller-powered airship 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 airship was designed under TAR 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.

TAR 939 Powerplant operating characteristics

(a) 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 airship and of the engine.

(b) Turbocharged reciprocating engine operating characteristics must be investigated in flight to assure that no adverse characteristics, as a result of an inadvertent overboost, surge, flooding, or vapour lock, are present during normal or emergency operation of the engine(s) throughout the range of operating limitations of both airship and engine.

(c) For turbine engines, the air inlet system must not, as a result of airflow distortion during normal operation, cause vibration harmful to the engine.

(d) It must be established over the range of operating conditions for which certification is required that the powerplant installation does not induce engine carcass vibration in excess of the acceptable levels established during engine type certification under JAR-E 650(e).

(e) For governor-controlled engines, it must be shown that there exists no hazardous torsional instability of the drive system associated with critical combinations of power, rotational speed, and control displacement.

TAR 943 Negative acceleration

No hazardous malfunction of an engine or any component or system associated with the powerplant unit may occur when the airship is operated at the negative accelerations within the flight envelopes prescribed in TAR 333. This must be shown for the greatest duration expected for the acceleration.

TAR 945 Thrust or power augmentation system

(reserved)

FUEL SYSTEM

TAR 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 manoeuvre 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.

(c) Each fuel system for a turbine engine must be capable of sustained operation throughout its flow and pressure range with fuel initially saturated with water at 27°C (80°F) and having 0.2 cm^3 of free water per litre added and cooled to the most critical condition for icing likely to be encountered in operation.

(d) Each fuel system for a turbine engine powered airship must meet the applicable fuel venting requirements of JAR 34.

TAR 952 Fuel system analysis and test

(a) Proper fuel system functioning under all probable operating conditions must be shown by analysis and those tests found necessary by the Authority. Tests, if required, must be made using the airship fuel system or a test article that reproduces the operating characteristics of the portion of the fuel system to be tested.

(b) The likely failure of any heat exchanger using fuel as one of its fluids may not result in a hazardous condition.

(c) Each fuel heat exchanger must be able to withstand without failure any vibration, inertia and fuel pressure load to which it may be subjected in operation.

TAR 953 Fuel system independence

Each fuel system must meet the requirements of TAR 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.

TAR 954 Fuel System lightning protection

The fuel system must be designed and arranged to prevent the ignition of fuel vapour within the system (see corresponding JAR 25 ACJ 25.954 and 25X899) by:

(a) direct lightning strikes to areas having a high probability of stroke attachment;

(b) swept lightning strokes on areas where swept strokes are highly probable;

(c) corona or streamering at fuel vent outlets.

TAR 955 Fuel Flow

(a) Each fuel system must provide at least 100% of the fuel flow required under each intended operating condition and manoeuvre. Compliance must be shown as follows:

(1) Fuel must be delivered to each engine at a pressure, corrected for accelerations (load factors), 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 quantity for that tank under the requirements of TAR 959 plus that necessary to show compliance with this paragraph.

(3) Each main pump must be used that is necessary for each operating condition and attitude for which compliance with this paragraph 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.

(5) The fuel head between the tank and the engine must be critical with respect to airship flight attitudes.

(b) If an engine can be supplied with fuel from more than one tank, the fuel system must for each engine, in addition to having appropriate manual switching capability, be designed to prevent interruption of fuel flow to that engine, without attention by the flight crew, when any tank supplying fuel to that engine is depleted of usable fuel during normal operation, and any other tank, that normally supplies fuel to that engine alone, contains usable fuel.

TAR 957 Flow between interconnected tanks

(a) Where tank outlets are interconnected and allow fuel to flow between them due to gravity or flight accelerations, it must be impossible for fuel to flow between tanks in quantities great enough to cause overflow from the tank vent in any sustained flight condition.

(b) If fuel can be pumped from one tank to another in flight:

(1) The design of the vents and the fuel transfer system must prevent structural damage to tanks from overfilling; and

(2) There must be means to warn the crew before overflow through the vents occurs.

TAR 959 Unusable fuel supply

The unusable fuel supply for each fuel tank and its fuel system components must be established as not less than that quantity at which the first evidence of engine malfunctioning occurs under the most adverse fuel-feed condition occurring under each intended operation and flight manoeuvre involving fuel feeding from that tank. Fuel system component failures need not be considered.

TAR 961 Fuel system hot weather operation

(a) The fuel system must perform satisfactorily in hot weather operation. This must be shown by demonstrating that the fuel system from the tank outlets to each engine is pressurised, under all intended operations, so as to prevent vapour formation, or must be shown by climbing from the altitude of the airport elected by the applicant to the maximum altitude established as an operating limitation under TAR 1527. If a climb test is elected, there must be no evidence of vapour lock or other malfunctioning during the climb test conducted under the following conditions:

(1) For piston engine powered airships, the power settings should be maintained at the maximum approved levels for take-off and climb to provide for the maximum fuel flow. The climb should be continued to the maximum operating altitude approved for the airship. If a lower altitude is substantiated, appropriate limitations should be noted in the Airship Flight Manual.

(2) For turbine engine powered airships, the engines must operate at take-off power/ maximum thrust for the time interval selected for showing the take-off flight path, and at maximum continuous power for the rest of the climb.

(3) The mass of the airship must be with full fuel tanks, minimum crew, and the ballast necessary to maintain the centre of gravity within allowable limits or other combinations approved by the authority.

(4) The climb airspeed may not exceed the maximum airspeed established for climbing from take-off to the maximum operating altitude.

(5) The fuel temperature must be at least 43°C (110ºF).

(b) The test prescribed in subparagraph (a) of this paragraph 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.

TAR 963 Fuel tanks: general

(See corresponding AC 25-8)

(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) Each integral fuel tank must have adequate facilities for interior inspection and repair.

(d) Fuel tanks must, so far as it is practicable, be designed, located and installed so that no fuel is released in or near the airship or near the engines in quantities sufficient to start a serious fire in otherwise survivable crash conditions.

(e) Fuel tanks within the airship must be able to resist rupture, and to retain fuel, under the inertia forces prescribed for the emergency landing conditions in TAR 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.

(f) For pressurised fuel tanks, a means with failsafe features must be provided to prevent the build-up of an excessive pressure difference between the inside and the outside of the tank.

(g) Fuel tank access covers must comply with the following criteria in order to avoid loss of hazardous quantities of fuel: All covers located in an area where experience or analysis indicates a strike is likely, must be shown by analysis or tests to minimise penetration and deformation by tyre fragments, low energy engine debris, or other likely debris.

TAR 965 Fuel tank tests

(a) It must be shown by tests that the fuel tanks mounted in the airship can withstand, without failure or leakage, the more critical of the pressures resulting from the conditions specified in subparagraphs (a)(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 conditions of subparagraphs (a)(3) and (4) of this paragraph, are able to withstand the following pressures:

(1) An internal pressure of 24.14 kPa (3.5 psi).

(2) 125% of the maximum air pressure developed in the tank from ram effect.

(3) Fluid pressures developed during maximum limit accelerations, and deflections, of the airship with a full tank.

(4) Fluid pressures developed during the most adverse combination of airship pitch, yaw and roll and fuel load.

(b) Each metallic tank with large unsupported or unstiffened flat surfaces, the failure or deformation of hich, 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 (b)(4) of this paragraph, the tank assembly must be vibrated for 25 hours at an amplitude of not less than 0.8 mm (0.03125 in) (unless another amplitude is substantiated) while two-thirds 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 rpm within the normal operating range of engine speeds is critical, the test frequency of vibration must be 2000 cycles per minute.

(ii) If only one frequency of vibration resulting from any rpm 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 rpm within the normal operating range of engine speeds is critical, the most critical of these frequencies must be the test frequency.

(4) Under subparagraph (b)(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 (b)(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 15º on both sides of the horizontal (30º 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 12.5 hours.

(c) Except where satisfactory operating experience with a similar tank in a similar installation is shown, non-metallic tanks must withstand the test specified in subparagraph (b)(5) of this paragraph, with fuel at a temperature of 43°C (110ºF). During this test, a representative specimen of the tank must be installed in a supporting structure simulating the installation in the airship.

(d) For pressurised fuel tanks, it must be shown by analysis or tests that the fuel tanks can withstand the maximum pressure likely to occur on the ground or in flight taking the additional pressures of (a)(3) and (a)(4) of this subparagraph into account.

TAR 967 Fuel tank installation

(a) Each fuel tank must be supported so that tank loads are not concentrated. In addition:

(1) There must be pads, if necessary, to prevent chafing between each tank and its supports;

(2) Padding must be non-absorbent, or treated to prevent the absorption of fuel;

(3) If a flexible tank liner is used, it must be supported so that it is not required to withstand fluid loads;

(4) Interior surfaces adjacent to the liner must be smooth and free from projections that could cause wear of the liner, unless

(i) Provisions are made for protection of the liner at those points, or

(ii) The liner construction itself provides such protection;

(5) A positive pressure must be maintained within the vapour space of each bladder cell under all conditions of operation except for particular condition for which it is shown that a zero or negative pressure will not cause the bladder cell to collapse;

(6) Siphoning of fuel (other than minor spillage) or collapse of bladder fuel cells must be possible as a result of being improperly secured or the loss of the fuel filler cap.

(b) Each tank compartment must be ventilated and drained to prevent the accumulation of flammable fluids or vapours. Each compartment adjacent to a tank that is an integral part of the airship structure must also be ventilated and drained. 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 TAR 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.

(f) Fuel tanks must be designed, located (as practicable away from occupants compartments) and installed so as to retain fuel under the inertia forces prescribed for the emergency landing conditions in TAR 561.

TAR 969 Fuel tank expansion space

Each fuel tank must have an expansion space of not less than 2% of the tank capacity. It must be impossible to fill the expansion space inadvertently with the airship in the normal ground attitude. For pressure fuelling systems, compliance with this paragraph may be shown with the means provided to comply with TAR 979(b).

TAR 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 0.10% of the tank capacity unless operating limitations are established to ensure that the accumulation of water in service will not exceed the sump capacity.

(b) The capacity prescribed in subparagraph (a) of this paragraph must be effective with the airship in any normal attitude, and must be located so that the sump contents cannot escape through the tank outlet opening. Each fuel tank must allow drainage of any hazardous quantity of water from any part of the tank to its sump with the airship 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 airship; and

(3) Has manual or automatic means for positive locking in the closed position.

TAR 973 Fuel tank filler connection

(a) Each fuel tank filler connection must be marked as prescribed in TAR 1557(c).

(b) Spilled fuel must be prevented from entering the fuel tank compartment or any part of the airship other than the tank itself.

(c) Each filler cap must provide a fuel-tight seal for the main filler opening.

(d) Each fuel-filling point must have a provision for electrically bonding the airship to ground fuelling equipment.

(e) Each recessed filler connection that can retain any appreciable quantity of fuel must have a drain that discharges clear of each part of the airship.

(f) Filler caps must be designed to minimise the probability of incorrect installation or in flight loss.

(g) For airships with engines requiring gasoline as the only permissible fuel, the inside diameter of the fuel filler opening must be no larger than 59.9 mm (2.36 inch).

(h) For airships with turbine engines, the inside diameter of the fuel filler opening must be no smaller than 74.9 mm (2.95 inch).

TAR 975 Fuel tank vents and carburettor vapour vents

(a) 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 outlet must be located and constructed in a manner that minimises the possibility of being obstructed by ice or other foreign matter;

(2) Each vent must be constructed to 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) Refuelling and defuelling (where applicable);

(4) Airspaces of tanks with interconnected outlets must be interconnected;

(5) There may be no undrainable points in any vent line where moisture can accumulate with the airship in either the ground or level flight attitudes;

(6) No vent or drainage provision may terminate at a point where the discharge of fuel from the vent outlet will constitute a fire hazard or from which fumes could enter crew and passenger compartments.

(b) Each carburettor with vapour elimination connections and each fuel injection engine employing vapour return provisions must have a separate vent line to lead vapours back to the top of a fuel tank. If there is more than one fuel tank, and it is necessary to use these tanks in a definite sequence for any reason, the vapour vent return line must lead back to the fuel tank to be used first, unless the relative capacities of the tanks are such that return to another tank is preferable.

TAR 977 Fuel tank outlet

(a) There must be a fuel strainer for the fuel tank outlet or for the booster pump. This strainer must

(1) For reciprocating engine-powered airships, have 3 to 6 meshes per cm (8 to 16 meshes per inch);

(2) For turbine engine-powered airships, prevent the passage of any object that could restrict fuel flow or damage any fuel-system component.

(b) The clear area of each fuel tank outlet strainer must be at least five times the area of the outlet line.

(c) The diameter of each strainer must be at least that of the fuel tank outlet.

(d) Each finger strainer must be accessible for inspection and cleaning.

TAR 979 Pressure fuelling system

For pressure fuelling systems, the following apply.

(a) Each pressure fuelling system fuel manifold connection must have means to prevent the escape of hazardous quantities of fuel from the system if the fuel entry valve fails.

(b) An automatic shutoff means must be provided to prevent the quantity of fuel in each tank from exceeding the maximum quantity approved for that tank. This means must:

(1) allow checking for proper shutoff operation before each fuelling of the tank, and

(2) Provide indication, at each fuelling station, of failure of the shut-off means to stop the fuel flow at the maximum quantity approved for that tank.

(c) A means must be provided to prevent damage to the fuel system in the event of failure of the automatic shutoff means prescribed in subparagraph (b) of this paragraph.

(d) The airship pressure fuelling system (not including fuel tanks and fuel tank vents) must withstand an ultimate load that is 2.0 times the load arising from the maximum pressures, including surge, that is likely to occur during fuelling. The maximum surge pressure must be established with any combination of tank valves being either intentionally or inadvertently closed.

(e) The airship defuelling system (not including fuel tanks and fuel tank vents) must withstand an ultimate load that is 2.0 times the load arising from the maximum permissible defuelling pressure (positive or negative) at the airship fuelling connection.

TAR 981 Fuel tank ignition prevention

(a) No ignition source may be present at each point of the fuel tank or fuel tank system where catastrophic failure could occur due to ignition of fuel or vapours. This must be shown by:

(1) Determining the highest temperature allowing a safe margin below the lowest expected auto-ignition temperature of the fuel in the fuel tanks.

(2) Demonstrating that no temperature at each place inside each fuel tank where fuel ignition is possible will exceed the temperature determined under sub-paragraph (a)(1) of this paragraph. This must be verified under all probable operating, failure and malfunction conditions of each component, the operation, failure or malfunction of which could increase the temperature inside the tank.

(b) Based on the evaluations required by this paragraph, critical design configuration control limitations, inspections or other procedures must be established as necessary to prevent development of ignition sources within the fuel tank system and must be included in the Airworthiness Limitations Section of the ICA required by TAR 1529. Placards, decals or other visible means must be placed in areas of the airship where maintenance, repairs or alterations may violate the critical design configuration limitations.

(c) The fuel tank installation must include:

(1) Means to minimise the development of flammable vapours in the fuel tanks; or

(2) Means to mitigate the effects of an ignition of fuel vapours within fuel tanks such that no damage caused by an ignition will prevent continued safe flight and landing.

FUEL SYSTEM COMPONENTS

TAR 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 subparagraph (b) of this paragraph), is a main pump. For each main pump, provision must be made to allow the bypass of each positive displacement fuel pump 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.

(c) Warning means: If both the normal pump and emergency pump operate continuously, there must be a means to indicate to the appropriate flight crewmember a malfunction of either pump.

(d) Operation of any fuel pump may not affect engine operation so as to create a hazard, regardless of the engine power or thrust setting or functional status of any other fuel pump.

TAR 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 airship 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) Each 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 shutdown.

(f) Each fuel line must be designed and installed to allow a reasonable degree of deformation and stretching without leakage.

TAR 994 Fuel system components

Fuel system components must be protected from damage which could result in spillage of enough fuel to constitute a fire hazard as a result of a wheels-up landing.

TAR 995 Fuel valves

There must be a means to allow appropriate flight crew members rapidly to shut off the fuel to each engine individually in flight. In addition to the requirements of TAR 1189 for shut-off means, each fuel valve must:

(a) *(reserved)*

(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.

TAR 997 Fuel strainer or filter

(This paragraph does not apply to fuel strainers or filters already approved as part of an engine type certificated under JAR-E.)

There must be a fuel strainer or filter between the fuel tank outlet and the inlet of either the fuel metering device or an engine-driven positive displacement pump, whichever is nearer the fuel tank outlet. This fuel strainer or filter must

(a) Be accessible for draining and cleaning and must incorporate as screen or element which is easily removable;

(b) Have a sediment trap and drain except that it need not have a drain if the strainer or filter is easily removable for drain purposes;

(c) Be 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;

(d) Have the capacity (with respect to operating limitations established for the engine) and the mesh to ensure that engine fuel system functioning is not impaired, with the fuel contaminated to a degree (with respect to particle size and density) that is greater than the established for the engine in JAR E, or equivalent regulations.

(e) In addition, unless means are provided in the fuel system to prevent the accumulation of ice on the filter, a means must be provided to automatically maintain the fuel flow if ice clogging of the filter occurs.

TAR 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 required by subparagraph (a) of this paragraph and TAR 971 must

(1) discharge clear of all parts of the airship;

(2) Have manual or automatic means for positive locking in the closed position;

(3) Have a drain valve that is readily accessible and which can be easily opened and closed.

TAR 1001 Fuel jettisoning system

If a fuel jettisoning system is installed, the following applies:

(a) Fuel jettisoning must be safe during all flight regimes for which jettisoning is to be authorised.

(b) In showing compliance with subparagraph (a) of this paragraph, 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 airship;

(3) fuel or fumes do not enter any part of the airship;

(4) the jettisoning operation does not adversely affect the controllability of the airship.

(c) The fuel jettisoning valve must be designed to allow the crew (minimum crew) to safely interrupt fuel jettisoning and to close the valve during any part of the jettisoning operation.

(d) Unless it is shown that using any means and any engine operation (including engine vectoring or operation of auxiliary power units) does not adversely affect fuel jettisoning, there must be a placard, adjacent to the jettisoning control, to warn crew members against jettisoning during operations that adversely affect fuel jettisoning.

(e) 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 the inability to jettison fuel.

OIL SYSTEM

TAR 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 tank capacity may not be less than the product of the endurance of the airship under critical operating conditions and the maximum oil consumption of the engine under the same conditions, plus a suitable margin to ensure adequate circulation and cooling.

(c) For an oil system without an oil transfer system, only the usable oil tank capacity may be considered. The amount of oil in the engine oil lines, the oil radiator, and the feathering reserve, may not be considered.

(d) If an oil transfer system is used, the amount of oil in the transfer lines that can be pumped by the transfer pump must be included in the oil capacity.

TAR 1013 Oil tanks

(This paragraph does not apply to oil tanks already approved as part of an engine type certificated under JAR-E.)

(a) Installation: each oil tank must be installed to:

(1) meet the requirements of TAR 967;

(2) withstand any vibration, inertia, and fluid loads expected in operation.

(b) Expansion space: oil tank expansion space must be provided so that

(1) Each oil tank used with a reciprocating engine has an expansion space of not less than the greater of 10% of the tank capacity or 1.9 litre (0.5 US-gallons), and each oil tank used with a turbine engine has an expansion space of not less than 10% of the tank capacity;

(2) It is impossible to fill the expansion space inadvertently with the airship in the normal ground attitude.

(3) Each reserve oil tank not directly connected to any engine may have an expansion space of not less than 2% of the tank capacity.

(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 airship. In addition:

(1) Each oil tank filler cap must provide an oil tight seal;

(2) Each oil tank filler must be marked as prescribed in TAR 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 the vent connection is not covered by oil under any normal flight condition;

(2) Oil tank vents must be arranged so that condensed water vapour that might freeze and obstruct the line cannot accumulate at any point.

(e) Outlet: 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. No oil tank outlet diameter may be less than the diameter of the engine oil pump inlet. Each oil tank used with a turbine engine must have 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. There must be a shutoff valve at the outlet of each oil tank used with a turbine engine, unless the external portion of the oil system (including of tank supports) is fireproof.

(f) Flexible liners: each flexible oil tank liner must be approved or must be shown to be suitable for the particular application.

(g) Each filler cap of an oil tank that is used with a turbine engine must provide an oil tight seal.

TAR 1015 Oil tank tests

(This paragraph does not apply to oil tanks already approved as part of an engine type certificated under JAR-E.)

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 TAR 965, except:

(1) The test pressure:

(i) For pressurised tanks used with a turbine engine, may not be less than 34.45 kPa (5 psi) plus the maximum operating pressure of the tank instead of the pressure specified in TAR 965(a); and

(ii) For all other tanks, may not be less than 34.45 kPa (5 psi) instead of the pressure specified in TAR 965(a); and

(2) The test fluid must be oil at 120°C (250ºF) instead of the fluid specified in TAR 965(c).

TAR 1017 Oil lines and fittings

(a) Oil lines: oil lines must meet TAR 993, and each oil line and fitting in any designated fire zone must meet the requirements of TAR 1183. Oil lines must accommodate a flow of oil at a rate and pressure adequate for proper engine functioning under any normal operating condition.

(b) Breather lines: breather lines must be arranged so that

(1) condensed water vapour or oil that might freeze and obstruct the line cannot accumulate at any point;

(2) the breather discharge will not constitute a fire hazard if foaming occurs, or cause emitted oil to strike the pilot's windshield;

(3) the breather does not discharge into the engine air-induction system;

(4) the breather outlet its protected against blockage by ice or foreign matter.

TAR 1019 Oil strainer or filter

(This paragraph does not apply to oil strainers or filters already approved as part of an engine type certificated under JAR-E.)

(a) Each turbine engine installation must incorporate an oil strainer or filter through which all of the engine oil flows and which meets the following requirements.

(1) Each oil strainer or filter that has a bypass, 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 completely blocked.

(2) The oil strainer or filter must have the capacity (with respect to operating limitations established for the engine) and the mesh to ensure that engine oil system functioning is not impaired when the oil is contaminated to a degree (with respect to particle size and density) that is greater than that established for the engine in JAR E or equivalent regulations.

(3) The oil strainer or filter, unless it is installed at an oil tank outlet, must incorporate an indicator that will indicate contamination of the screen before it reaches the capacity established in accordance with subparagraph (2) of this paragraph.

(4) The bypass of a strainer or filter must be constructed and installed so that the release of collected contaminants is minimised by appropriate location of the bypass to ensure that collected contaminants are not in the bypass flow path.

(5) An oil strainer or filter that has no bypass, except on that is installed at an oil tank outlet, must have a means to connect it to the warning system required in subparagraph 1305(c)(7).

(b) Each oil strainer or filter in a powerplant installation using reciprocating engines 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.

TAR 1021 Oil system drains

A drain (or drains) must be provided to allow safe drainage of the oil system. Each drain must:

(a) Be accessible; and

(b) Have manual or automatic means for positive locking in the closed position.

TAR 1023 Oil radiators

If installed:

(a) each oil radiator and its supporting structures must be able to withstand the vibration, inertia, and oil pressure loads 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.

TAR 1025 Oil valves

(a) Each oil shut-off must meet the requirements of TAR 1189.

(b) The closing of oil shut-off 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.

TAR 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 feathering 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.

(d) Provisions must be made to prevent sludge or other foreign matter from affecting the safe operation of the propeller feathering system.

COOLING

TAR 1041 General

The powerplant cooling provisions must be able to maintain the temperatures of powerplant components and engine fluids, within the temperature limits established during ground and flight operations to the maximum altitude for which approval is requested and after normal engine shutdown.

TAR 1043 Cooling tests

(a) General: compliance with TAR 1041 must be shown under critical ground and flight operating conditions (including loiter, hover, climb, and descent) to the maximum altitude for which approval is requested. For turbocharged engines, each turbocharger must be operated through that part of the climb profile for which operation with the turbocharger is requested and in a manner consistent with its intended operation. For these tests, the following apply.

(1) If the tests are conducted under conditions deviating from the maximum ambient atmospheric temperature specified in subparagraph (b), of this paragraph, the recorded powerplant temperature must be corrected under paragraphs (c) and (d) of this paragraph, unless a more rational correction method is applicable.

(2) No corrected temperature determined under subparagraph (1) of this paragraph may exceed established limits.

(3) The fuel used during the cooling tests must be of the minimum grade approved for the engines, and for reciprocating engines the mixture settings must be the leanest recommended for flight.

(b) Maximum ambient atmospheric temperature: a maximum ambient atmospheric temperature corresponding to sea level conditions of at least 38°C (100°F) must be established. The assumed temperature lapse rate is 2°C (3.6 °F) per thousand feet of altitude above sea level. However, for winterization installations, the applicant may select a maximum ambient atmospheric temperature corresponding to sea level conditions of less than 38°C (100 °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: 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.

TAR 1045 Cooling test procedures

(a) General: Compliance with TAR 1041 must be shown for the take-off, climb, en-route, and landing stages of flight that correspond to the applicable performance requirements. For each stage of flight, the cooling test must be conducted with the airship

(1) In the configuration most critical for cooling (including cowl flap settings selected by the applicant for reciprocating engine powered airships, if applicable, and where vectored thrust is provided, including vectoring procedures established by the applicant);

(2) Under the operational conditions most critical for cooling.

(b) Temperature stabilisation: For the purpose of the cooling tests, a temperature is 'stabilised' when its rate of change is less than 1.1°C (2°F) per minute. The following stabilisation rules apply for each stage of flight:

(1) The temperatures must be stabilised under the conditions from which entry is made into the stage of flight being investigated; or

(2) If the entry condition normally does not allow temperatures to stabilise, operation through the full entry condition must be conducted before entry into the stage of flight being investigated in order to allow the temperatures to have attained their natural levels at the time of entry.

(c) Duration of test: For each stage of flight the test must be continued until

(1) The component and engine-fluid temperatures stabilise; or

(2) The stage of flight is completed; or

(3) An operating limitation is reached.

(d) Turbine engine powered airships: The following additional requirement applies: The take-off cooling test must be preceded by a period during which the powerplant component and engine-fluid temperatures are stabilised with the engines at ground idle.

(e) For reciprocating engine-powered airships, engine-cooling tests during climb must be conducted as follows:

(1) The critical engines are inoperative;

(2) Engine temperature must be stabilised in level flight with the engine at not less than 75% of maximum continuous power.

(3) The climb must begin at the lowest practicable altitude with the engine at take-off power for the specified duration of take-off power and thence with maximum continuous power.

(4) The climb must be conducted at a speed not more than the best rate of climb speed with maximum continuous power unless the slope of the flight path at the speed chosen for the cooling test is equal to or greater than the minimum required angle of climb determined under TAR 65 and the airship has a cylinder head temperature indicator.

(5) The climb must be continued at maximum continuous power for at least 5 minutes after the occurrence of the highest temperature recorded (or pressure height).

(f) The hovering cooling provisions must be shown:

(1) For vectoring procedures established by the applicant.

(2) With the vector thrust controls operated through the (pitch) positions of maximum and minimum horizontal thrust.

(3) With maximum continuous power or a power which corresponds with (2) and maximum heaviness for this configuration, until at least 5 minutes after the occurrence of the highest temperature recorded.

LIQUID COOLING

TAR 1061 Installation

(a) General: Each liquid-cooled engine must have an independent cooling system (including coolant tank) installed so that:

(1) Each coolant tank is supported so that tank loads are distributed over a large part of the tank surface;

(2) There are pads or other isolation means between the tank and its supports to prevent chafing; and

(3) Pads or any other isolation means that is used must be non-absorbent or must be treated to prevent absorption of flammable fluids; and

(4) No air or vapour can be trapped in any part of the system, except the coolant tank expansion space, during filling or during operation.

(b) Coolant tank: The tank capacity must be at least 3.8 litres (1 US-gallon), plus 10% of the cooling system capacity. In addition:

(1) Each coolant tank must be able to withstand the vibration, inertia and fluid loads to which it may be subjected in operation;

(2) Each coolant tank must have an expansion space of at least 10% of the total cooling system capacity; and

(3) It must be impossible to fill the expansion space inadvertently with the airship in the normal ground attitude.

(c) Filler connection: Each coolant tank filler connection must be marked as specified in TAR 1557 In addition:

(1) Spilled coolant must be prevented from entering the coolant tank compartment or any part of the airship other than the tank itself; and

(2) Each recessed coolant filler connection must have a drain that discharges clear of the entire airship.

(d) Lines and fittings: Each coolant system line and fitting must meet the requirements of TAR 993, except that the inside diameter of the engine coolant inlet and outlet lines may not be less than the diameter of the corresponding engine inlet and outlet connections.

(e) Radiators: Each coolant radiator must be able to withstand any vibration, inertia and coolant pressure load to which it may normally be subjected. In addition:

(1) Each radiator must be supported to allow expansion due to operating temperatures and prevent the transmittal of harmful vibration to the radiator; and

(2) If flammable coolant is used, the air intake duct to the coolant radiator must be located so that (in case of fire) flames from the nacelle cannot strike the radiator.

(f) Drains: There must be an accessible drain that:

(1) Drains the entire cooling system (including the coolant tank, radiator and the engine) when the airship is in the normal ground attitude;

(2) Discharges clear of the entire airship; and

(3) Has means to lock it closed positively.

TAR 1063 Coolant tank tests

Each coolant tank must be tested under TAR 965, except that:

(a) The test required by TAR 965 (a) (1) must be replaced with a similar test using the sum of the pressure developed during the maximum ultimate acceleration with a full tank or a pressure of 24.12 kPa (3.5 psi), whichever is greater, plus the maximum working pressure of the system; and:

(b) For a tank with a non-metallic liner the test fluid must be coolant rather than fuel as specified in TAR 965 (c) and the slosh test on a specimen liner must be conducted with the coolant at operating temperature.

INDUCTION SYSTEM

TAR 1091 Air intake

(a) The air intake system for each engine must supply:

(1) the air required by that engine under the operating conditions for which certification is requested, and:

(2) The air for proper fuel metering and mixture distribution with the air intake system valves in any position.

(b) Each reciprocating gasoline engine installation must have at least two separate air intake sources and must meet the following.

(1) Primary air intakes may open within the cowling if that part of the cowling is isolated from the engine accessory section by a fire-resistant diaphragm or if there are means to prevent the emergence of backfire flames.

(2) Each alternate air intake must be located in a sheltered position and may not open within the cowling if the emergence of backfire flames will result in a hazard.

(3) The supplying of air to the engine through the alternate air intake system may not result in a loss of excessive power in addition to the power loss due to the rise in air temperature.

(4) Each automatic alternate air door must have an override means accessible to the flight crew.

(5) Each automatic alternate air door must have a means to indicate to the flight crew when it is not closed

(c) For air intakes for turbine engine-powered installations the following apply:

(1) Air intakes may not open within the cowling, unless that part of the cowling is isolated from the engine accessory section by means of a fireproof diaphragm;

(2) 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;

(3) The air inlet ducts must be located or protected so as to minimise the ingestion of foreign matter during take-off, landing, mooring and taxiing;

(4) If the engine air intake system contains parts or components that could be damaged by foreign objects entering the air intake, it must be shown by tests or, if appropriate, by analysis that the air intake system design can withstand the foreign object ingestion test conditions of JAR-E 790 and JAR-E 800 without failure of parts or components that could create a hazard.

(d) Reciprocating diesel engines installation *(reserved)*

TAR 1093 Air intake system de-icing and anti-icing provisions

(a) Reciprocating gasoline engines: Each reciprocating gasoline 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 -1.1°C (30°F):

(1) Each airship with altitude engines using fuel metering devices tending to prevent icing has a preheater that, with the engines at 60% of maximum continuous power, can provide a temperature rise of:

(i) 56°C (100°F); or

(ii) 22°C (40°F), if a fluid de-icing system meeting the requirements of JAR 23.1095 through 23.1099 is installed;

(2) Each airship with sea level engine(s) using a fuel metering device tending to prevent icing has a sheltered alternate source of air with a preheat temperature rise of not less than 33°C (60°F) with the engines at 75% of maximum continuous power;

(3) Each airship with sea level or altitude engine(s) using fuel injection systems having metering components on which impact ice may accumulate has a preheater capable of providing a temperature rise of 42°C (75°F) when the engine is operating at 75% of its maximum continuous power; and:

(4) Each airship with sea level or altitude engine(s) using fuel injection systems not having fuel metering components projecting into the airstream on which ice may form, and introducing fuel into the air induction system downstream of any components or other obstruction on which ice produced by fuel evapouration may form, has a sheltered alternate source of air with a preheat temperature rise of not less than 33°C (60°F) with the engines at 75% of its maximum continuous power.

(b) Turbine engines

(1) Each turbine engine and its air-inlet system must operate throughout the flight-power range of the engine (including idling), within the limitations established for the airship, without the accumulation of ice on engine or inlet system components that would adversely affect engine operation or cause a serious loss of power or.

(i) Under the icing conditions specified in JAR 25 Appendix C;

(ii) In snow, both falling and blowing.

(2) Each turbine engine must idle for 30 minutes on the ground, with the air bleed available for engine icing protection at its critical condition, without adverse effect, in an atmosphere that is at a temperature between -9°C and -1°C (15°F and 30°F) and has a liquid water content not less than 0.3 grams per cubic metre in the form of drops having a mean effective diameter not less than 20 µm, followed by momentary operation at take-off power or thrust. During the 30 minutes of idle operation, the engine may be run up periodically to a moderate

power or thrust setting in a manner acceptable to the Authority.

(c) For airships with reciprocating engines having superchargers to pressurise the air before it enters the carburettor, the temperature rise in the air caused by that supercharging at any altitude may be utilised in determining compliance with subparagraph (a) of this paragraph if the heat rise utilised is that which will be available, automatically, for the applicable altitudes and operating condition because of supercharging.

(d) Reciprocating diesel engines *(reserved)*

TAR 1101 Carburettor air preheater design

Each exhaust-heated, induction air preheater must be designed and constructed to:

(a) Ensure ventilation of the preheater when the induction air preheater is not being used during engine operation.

(b) Allow inspection of the exhaust manifold parts that it surrounds; and

(c) Allow inspection of critical parts of the preheater itself.

TAR 1103 Induction system ducts

(a) Each induction system duct must have a drain to prevent the accumulation of fuel or moisture in the normal ground and flight attitudes. No drain may discharge where it will cause a fire hazard.

(b) Each air intake system must be:

(1) Strong enough to prevent structural failure resulting from engine surging; 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.

(d) For bleed air systems no hazard may result if a duct rupture or failure occurs at any point between the engine port and the airship unit served by the bleed air.

(e) For reciprocating engine installations, each induction system duct must be:

(1) Strong enough to prevent induction system failures resulting from normal backfire conditions; and

(2) Fire resistant in any compartment for which a fire extinguishing system is required.

TAR 1105 Air intake system screens

If induction system screens are used:

(a) Each screen must be upstream of the fuel metering device;

(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

(1) The available preheat temperature rise is at least 55.6°C (100°F), and

(2) The screen can be de-iced by heated air;

(c) No screen may be de-iced by alcohol alone; and

(d) It must be impossible for fuel to strike any screen

TAR 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.

TAR 1108 Induction system filters

If an air filter, is used to protect the engine against foreign material particles in the induction air supply, it must be capable of withstanding the effects of temperature extremes, rain, fuel, oil, and solvents to which it is expected to be exposed in service and maintenance.

TAR 1109 Turbocharger bleed air system

The following applies to turbocharged bleed air systems used for cabin air systems:

(a) The cabin air system may not be subject to hazardous contamination following any probable failure of the turbocharger or its lubrication system.

(b) The turbocharger supply air must be taken from a source where it cannot be contaminated by harmful or hazardous gases or vapours following any probable failure or malfunction of the engine exhaust, hydraulic, fuel or oil system.

TAR 1111 Turbine engine bleed-air system

For turbine engine bleed-air systems, the following apply.

(a) No hazard may result if duct rupture or failure occurs anywhere between the engine port and the airship unit served by the bleed air.

(b) The effect on airship and engine performance of using maximum bleed air must be established.

(c) Hazardous contamination of cabin air systems may not result from failures of the engine lubricating system.

(d) Bleed air must not discharge directly on any airship component (e.g. windshield) unless such discharge is shown to cause no hazard to the airship under all operating conditions.

EXHAUST SYSTEM

TAR 1121 General

(a) Each exhaust system must ensure safe disposal of exhaust gases without fire hazard or carbon monoxide contamination in any crew or passenger compartment. For test purposes, any acceptable carbon monoxide detection method may be used to show the absence of carbon monoxide.

(b) Each exhaust system part with a surface hot enough to ignite flammable fluids or vapours must be located or shielded so that leakage from any system carrying flammable fluids or vapours will not result in a fire caused by impingement of the fluids or vapours on any part of the exhaust system including shields for the exhaust system.

(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 airship that are outside the engine compartment.

(d) No exhaust gases may discharge near any flammable fluid, vent, or drain that may cause a fire hazard.

(e) Each exhaust shroud must be ventilated or insulated to avoid, during normal operation, a temperature high enough to ignite any flammable fluids or vapours external to the shroud.

(f) No exhaust gases my be discharged where they will cause a glare seriously affecting pilot vision at night.

(g) If significant traps exist, each turbine engine exhaust system must have drains discharging clear of the airship, in any normal ground and flight attitude, to prevent fuel accumulation after the failure of an attempted engine start.

(h) Each exhaust heat exchanger must incorporate means to prevent blockage of the exhaust port after any internal heat exchanger failure.

TAR 1123 Exhaust piping

(a) Each exhaust piping must be fireproof and corrosion-resistant, and must have means to prevent failure due to expansion caused by operating temperatures.

(b) Each exhaust piping must be supported to withstand the vibration and inertia loads to which it may be subjected in operation.

(c) Parts of the exhaust system connected to components between which relative motion could exist must have means for flexibility.

TAR 1125 Exhaust heat exchangers

For reciprocating engine-powered airships, the following apply:

(a) Each exhaust heat exchanger must be constructed and installed to withstand the vibration, inertia, and other loads to which it will be subject in normal 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 inspection of the critical parts of each exchanger;

(3) Each exchanger must be ventilated wherever it is subject to contact with exhaust gases.

(4) No exhaust heat exchanger or muffler may have any stagnant areas or liquid traps that would increase the probability of ignition of flammable fluids or vapours 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.

TAR 1126 Water recovery systems

(reserved)

POWERPLANT CONTROLS AND ACCESSORIES

TAR 1141 Powerplant controls: general

Each powerplant control must be located, arranged, and designed under TAR 777 and 779 and marked under TAR 1555. In addition, it must meet the following requirements:

(a) Each control must be located so that it cannot be operated inadvertently 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-crew members and without creep due to control loads or vibration.

(e) The portion of each powerplant control located in a designated fire zone that is required to be operated in the event of fire must be at least fire resistant. (See TAR 903(c)(2).)

(f) Powerplant valve controls located in the cockpit must have

(1) For manual valves, positive stops or in the case of fuel valves suitable index provisions, in the open and closed positions; and

(2) In the case of valves controlled from the cockpit other than by mechanical means, where the correct functioning of such a valve is essential for the safe operation of the airship, a valve position indicator operated by a system which senses directly that the valve has attained the position selected, unless other indications in the cockpit give the flight crew a clear indication that the valve has moved to the selected position. (See ACJ 25.1141(f).)

TAR 1143 Engine controls

(a) There must be a separate and independent power or thrust control for each engine, and a separate control for each supercharger that requires a control.

(b) The controls must be grouped and arranged to allow:

(1) separate control, and

(2) simultaneous control of all functionally related engines.

(c) Each power, thrust, and supercharger control must give a positive and immediately respone in controlling its engine, thruster or supercharger.

(d) *(reserved)*

(e) If a power or thrust control incorporates a fuel-shutoff feature, the control must have a means to prevent the inadvertent movement of the control into the shut-off position. The control must

(1) Have a positive lock or stop at the idle position;

(2) Require a separate and distinct operation to place the control in the shut-off position.

TAR 1145 Ignition switches

(a) Ignition switches must control each ignition circuit on each engine.

(b) There must be means to shut off quickly all ignition either by a group of switches or by a master ignition control.

(c) Each group of ignition switches, except ignition switches for turbine engines for which continuous ignition is not required, and each master ignition control must have a means to prevent its inadvertent operation.

(d) Pre-glow switches for Diesel engines are to be treated the same as ignition switches.

TAR 1147 Mixture controls

(a) If there are mixture controls, each engine must have a separate control and each mixture control must have guards or must be shaped or arranged to prevent confusion by feel with other controls.

(1) The controls must be grouped and arranged to allow:

(i) Separate control of each engine; and:

(ii) Simultaneous control of all functionally related engines.

(2) The control must require a separate and distinct operation to move the control towards lean or shut-off position.

(b) Each manual engine mixture control must be designed so that, if the control separates at the engine fuel metering device, the airship is capable of continuing safe flight.

TAR 1149 Propeller speed and pitch controls

(a) If there are propeller speed or pitch controls, they must be grouped and arranged to allow

(1) Separate control of each propeller;

(2) Simultaneous control of all functionally related propellers.

(b) The controls must allow ready synchronization of all propellers on airships.

(c) The propeller speed and pitch controls must be to the right of, and at least 25.4 mm (1 inch) below, the pilot's throttle controls.

TAR 1153 Propeller feathering controls

(a) If there are propeller feathering controls, each propeller must have a separate control. Each control must have means to prevent inadvertent operation.

(b) If feathering is accomplished by movement of the propeller pitch or speed control lever, there must be means to prevent the inadvertent movement of this lever to the feathering position during normal operation.

TAR 1157 Carburettor air temperature controls

If there is a carburettor air temperature control, it must be separate for each engine.

TAR 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 any other control used to combat fire.

TAR 1163 Powerplant accessories

(a) Each engine-driven accessory must:

(1) Be approved for mounting on the engine involved;

(2) Use the provisions on the engine for mounting;

(3) Be sealed to prevent contamination of the engine oil system and the accessory system.

(b) Electrical equipment subject to arcing or sparking must be installed to minimise the probability of contact with any flammable fluids or vapours that might be present in a free state.

(c) Each generator rated at or more than 6 kW must be designed and installed to minimise the probability of a fire hazard in the event it malfunctions.

(d) If the continued rotation of any accessory remotely driven by the engine is hazardous when malfunctioning occurs, a means to prevent rotation without interfering with the continued operation of the engine must be provided.

(e) The generator cooling provisions must be able to maintain the temperatures of generator components within the established temperature limits during ground and flight operations.

(f) Each accessory driven by a gearbox that is not approved as part of the powerplant driving the gearbox must:

(1) Have torque limiting means to prevent the torque limits established for the affected drive from being exceeded;

(2) Use the provisions on the gearbox for mounting; and

(3) Be sealed to prevent contamination of the gearbox oil system and the accessory system.

TAR 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) There must be means to warn appropriate crew members if malfunctioning of any part of the electrical system is causing the continuous discharge of any battery used for engine ignition.

(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 assisting, controlling, or analysing the operation of that system.

(g) There must be means to warn appropriate flight-crew members if the malfunctioning of any part of the electrical system is causing the continuous discharge of any battery necessary for engine ignition.

(h) Each engine ignition system must be considered an essential electrical load.

TAR 1167 Vectored thrust controls

If thrust vectoring is provided, the following requirements must be met:

(a) each vectoring control must be independent of all other controls, if appropriate, and must provide a positive and immediate response.

(b) the vector controls must be readily available to the pilot, and must be such that the pilot can readily and positively select each appropriate vectored thrust unit.

(c) if separate vector controls are provided for each propulsive unit:

(1) they must be arranged to allow:

(i) separate control and

(ii) simultaneous control of all functionally related units;

(2) the airship must be demonstrated to have safe flight characteristics when the vectored thrust units are in the normal flight position on one side and in the fully vectored position on the other, with engines operating at maximum take-off power.

(d) in the event of a vectoring-system failure, an auxiliary means must be provided to return the system to a normal-operating position, if failures are harmful.

POWERPLANT FIRE PROTECTION

TAR 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 fuel-burning heater and other combustion equipment installation described in TAR 859;

(5) The compressor and accessory sections of turbine engines; and

(6) 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 TAR 869, 1185 to 1203.

(c) Each airship 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 (e) (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 section.

TAR 1182 Nacelle areas behind firewalls, and engine pod attaching structures containing flammable fluid lines

(a) Each nacelle area immediately behind the firewall, and each portion of any engine pod attaching structure containing flammable fluid lines, must meet each requirement of TAR 1103, 1165 (e), 1183, 1185 (c), 1187, 1189 and TAR 1195 to 1203, including those concerning designated fire zones. However, engine pod attaching structures need not contain fire detection or extinguishing means.

(b) For each area covered by subparagraph (a) of this paragraph that contains a retractable landing gear, compliance with that subparagraph need only be shown with the landing gear retracted.

TAR 1183 Flammable fluid-carrying components

(a) Except as provided in subparagraph (b) of this paragraph, each line, fitting, and other component carrying flammable fluid in any area subject to engine fire conditions, and each component which conveys or contains flammable fluid in a designated fire zone must be fire resistant, except that flammable fluid tanks and supports in a designated fire zone must be fireproof or be enclosed by a fireproof shield unless damage by fire to any non-fireproof part will not cause leakage or spillage of flammable fluid. Components must be shielded or located to safeguard against the ignition of leaking flammable fluid.

(b) Subparagraph (a) of this paragraph does not apply to:

(1) Lines, fittings and components which are already approved as part of a type certificated engine; and:

(2) Vent and drain lines, and their fittings, the failure of which will not result in, or add to, a fire hazard.

(c) All components, including ducts, within a designated fire zone must be fireproof if, when exposed to or damaged by fire, they could:

(1) Result in fire spreading to other regions of the airship, or

(2) Cause unintentional operation of, or inability to operate, essential services or equipment.

TAR 1185 Flammable fluids

(a) Except for the integral oil sumps specified in TAR 1013 (a), no tank or reservoir that is a 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 shut-off means, and all connections, lines and controls 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 13 mm (0.5 in) 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.

TAR 1187 Drainage and ventilation of fire zones

(a) There must be complete drainage of each part of each designated fire zone to minimise 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 discharge fluid will cause an additional fire hazard.

(b) Each designated fire zone must be ventilated to prevent the accumulation of flammable vapours.

(c) No ventilation opening may be where it would allow the entry of flammable fluids, vapours, or flame from other zones.

(d) Each ventilation means must be arranged so that no discharged vapours 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 a 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.

TAR 1188 Ventilation

Each compartment containing any part of the powerplant installation must have provision for ventilation to prevent the accumulation of flammable vapours.

TAR 1189 Shut-off means

(a) Each engine installation and each fire zone specified in TAR 1181 (a)(5) and (a)(6) must have means to shut-off or otherwise prevent hazardous quantities of fuel, oil, and other flammable liquids from flowing into, within, or through any engine compartment, except that shut-off means are not required for:

(1) Lines, fittings, and components forming an integral part of an engine; and

(2) Oil systems in which all components of the system in a designated fire zone, including the oil tanks, are fireproof or located in areas not subject to engine fire conditions.

(b) The closing of the fuel shutoff valve for any engine may not make fuel unavailable to the remaining engines.

(c) Operation of any shutoff means may not interfere with the later emergency operation of other equipment such as propeller feathering devices.

(d) Each flammable fluid shut-off means and control must be fireproof or must be located and protected so that any fire in a fire zone will not affect its operation.

(e) No hazardous amount of flammable fluid may drain into the engine compartment after shutoff.

(f) There must be means to guard against inadvertent operations of each shutoff means, and to make it possible for the crew to reopen the shutoff means in flight after it has been closed.

(g) Each tank-to-engine shut-off valve must be located so that the operation of the valve will not be affected by powerplant or engine mount structural failure.

(h) Each shut-off valve must have a means to relieve excessive pressure accumulation unless a means for pressure relief is otherwise provided in the system.

TAR 1191 Firewalls

(a) Each engine, fuel-burning heater and 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 airship by firewalls, shrouds, or other equivalent means.

(b) Each firewall or shroud must be constructed so that no hazardous quantity of liquid, gas, or flame can pass from the engine compartment to other part of the airship.

(c) Each opening in the firewall or shroud must be sealed with close-fitting, fireproof grommets, bushings, or firewall fittings.

(d) Each firewall and shroud must be fireproof and protected against corrosion.

(e) Compliance with the criteria for fireproof materials or components, must be shown as follows.

(1) The flame to which the materials or components are subjected must be 1100 ± 65°C (2000 ± 150°F);

(2) Sheet materials approximately 10 sq in must be subjected to the flame from a suitable burner;

(3) The flame must be large enough to maintain the required test temperature over an area approximately 5 sq in.

(f) Firewall materials and fittings must resist flame penetration for at least 15 minutes.

(g) The following materials may be used in firewalls or shrouds without being tested as required by this paragraph:

(1) Stainless steel sheet, 0.38 mm (0·015 in) thick.

(2) Mild steel sheet (coated with aluminium or otherwise protected against corrosion) 0.45 mm (0.018 in) thick.

(3) Terne plate, 0.45 mm (0.018 in) thick.

(4) Monel metal, 0.45 mm (0.018 in) thick.

(5) Steel or copper base alloy firewall fittings.

TAR 1192 Engine accessory compartment diaphragm

For air-cooled radial engines, the engine power section and all portions of the exhaust system must be isolated from the engine accessory compartment by a diaphragm that meets the firewall requirements of TAR 1191.

TAR 1193 Engine cowling

(a) The cowling must be constructed and supported so that it can resist the vibration, inertia, and air loads to which it may be subjected in operation.

(b) Cowling must meet the drainage and ventilation requirements of TAR 1187.

(c) On airships 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 TAR 1191.

(d) Each part of the cowling subjected to high temperatures due to its nearness to exhaust-system parts or exhaust gas impingement must be fireproof.

TAR 1195 Fire extinguishing systems

Fire extinguishing systems must be installed and compliance shown with the following.

(a) Except for combustor, turbine, and tailpipe sections of turbine engine installations that contain lines or components carrying flammable fluids or gases for which a fire originating in these sections is shown to be controllable, a fire extinguisher system must serve each engine compartment.

(b) The fire extinguishing system, the quantity of the extinguishing agent, the rate of discharge, and the discharge distribution must be adequate to extinguish fires. It must be shown by either actual or simulated flight tests that under critical airflow conditions in flight the discharge of the extinguishing agent in each designated fire zone specified in subparagraph (a) of this paragraph will provide an agent concentration capable of extinguishing fires in that zone and of minimizing the probability of re-ignition. An individual 'one-shot' system may be used for fuel burning heaters, and other combustion equipment. For each other designated fire zone, two discharges must be provided each of which produces adequate agent concentration.

(c) The fire extinguishing system for a nacelle must be able to protect simultaneously each compartment of the nacelle for which protection is provided.

TAR 1197 Fire extinguishing agents

(a) Fire extinguishing agents must:

(1) Be capable of extinguishing flames emanating from any burning fluids or other combustible materials in the area protected by the fire extinguishing system; and

(2) Have thermal stability over the temperature range likely to be experienced in the compartment in which they are stored.

(b) If any toxic extinguishing agent is used, provisions must be made to prevent harmful concentrations of fluid vapours (which could occur from leakage during normal airship operation or as a result of discharging the fire extinguisher on the ground or in flight) from entering any personnel compartment, even if a defect may exist in the extinguishing system. This must be shown by test except for extinguishing systems built into the personnel compartment where:

(1) 2.3 kg (5 lb) or less of carbon dioxide is available for discharge into personnel compartments under established extinguishing procedures, or

(2) Protective breathing equipment is available for each flight crew member on flight deck duty.

TAR 1199 Extinguishing agent containers

The following applies:

(a) Each extinguishing agent container must be fitted with a pressure relief device to prevent the container from bursting through excessive internal pressures.

(b) The discharge end of each discharge line from a pressure relief connection must be located so that discharge of the fire extinguishing agent does not damage the airship. The line must also be located or protected to prevent clogging caused by ice or other foreign matter.

(c) A means must be provided for each fire extinguishing agent container to indicate that the container has discharged or that the charging pressure is below the established minimum necessary for proper functioning.

(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.

(e) If a pyrotechnic capsule is used to discharge the extinguishing agent, each container must be installed so that temperature conditions will not cause hazardous deterioration of the pyrotechnic capsule.

TAR 1201 Fire extinguishing system materials

The following apply:

(a) No material in any fire extinguishing system shall be capable of reacting chemically with any extinguishing agent so as to create a hazard.

(b) Each system component in an engine compartment must be fireproof.

TAR 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 so that-

(1) It will withstand the vibration, inertia, and other loads to which it may be subjected in operation and

(2) There is a means to warn the crew in the event that the sensor or associated wiring within a designated fire zone is severed at one point, unless the system continues to function as a satisfactory detection system after the severing; and

(3) There is a means to warn the crew in the event of a short circuit in the sensor or associated wiring within a designated fire zone, unless the system continues to function as a satisfactory detection system after the short circuit

(c) No fire or overheat 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 an engine compartment must be at least fire resistant.

(f) No fire or overheat 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 it passes; or

(2) Each zone involved is simultaneously protected by the same detector and extinguishing system.

(g) Each fire detector system must be constructed so that when it is in the configuration for installation it will not exceed the alarm activation time approved for the detectors using the response time criteria specified in the appropriate Technical Standard Order.

TAR 1205 Vectored thrust

For airships utilizing vectored-thrust systems, the engine exhaust impingement effect on the airship must not cause an increase in the temperature of airship materials or components beyond safe limits.

TAR 1207 Compliance

Unless otherwise specified, compliance with the requirements of TAR 1181 to 1205 must be shown by a full scale fire test or by one or more of the following methods:

(a) Tests of similar powerplant configurations;

(b) Tests of components;

(c) Service experience of airships or aircraft with similar powerplant configurations;

(d) Analysis.

Subpart F - Equipment

GENERAL

TAR 1301 Function and installation

Each item of installed equipment must:

(a) Be of a kind and design appropriate to its intended function;

(b) Be labelled as to its identification, function, or operating limitations, or any applicable combination of these factors (see ACJ 25.1301 (b)).

(c) Be installed according to limitations specified for that equipment.

TAR 1303 Flight and navigation instruments

All flight and navigation instruments must have characteristics suitable for use in the particular airship considered. The presentation must be clear and unambiguous. The following instruments are required:

(a) at each pilot station:

(1) airspeed indicator;

(2) ground speed indicator;

(3) altimeter (sensitive);

(4) rate-of-climb indicator;

(5) pitch attitude indicator;

(6) gyroscopic rate-of-turn indicator;

(7) gyroscopically stabilised direction indicator (magnetic or non-magnetic).

(b) to be visible from each pilots station:

(1) free air temperature indicator;

(2) magnetic direction indicator;

(3) clock;

(4) Means to indicate pressure:

(i) for rigid airships: in the gas cells;

(ii) for semi-rigid and non-rigid airships: in the envelope, ballonets or gas cells, and the outside air;

(iii) lights to indicate to the pilot that lifting gas valves are open. The applicant has to demonstrate if this may be hazardous and requires immediate pilot corrective action (red alert).

(5) means for measuring the temperature differential between the lifting gas and the outside air;

(6) Position indicators for the flight controls, engines/propellers and adjustable propeller blades.

TAR 1305 Powerplant instruments

(a) The following are required powerplant instruments for all airships:

(1) 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.

(2) Fuel-quantity indicator for each fuel tank;

(3) Oil-quantity indicator for each oil tank;

(4) 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.

(5) *(reserved)*

(6) Oil-temperature indicator for each engine and for each turbocharger oil system that is separate from other oil systems;

(7) Fire-warning devices that provide visual and audible warning;

(8) *(reserved)*

(9) Any other instrumentation or warning means as listed in the Engine Type Certificate Data Sheet or in equivalent Installation Instructions which is necessary to ensure safe operation of the airship.

(10)If the engine compartment is accessible during flight for maintenance, essential engine indicators are to be installed also in the engine compartments.

(11)Instrumentation to indicate the functioning of the propeller ice-protection- and/or de-icing-system;

(12)Position indicating means to indicate to the flight crew the propeller blade angle and the thrust direction;

(13)Instrumentation for water recovery system (if installed) *(reserved)*.

(b) For reciprocating engine-powered airships in addition to the powerplant instruments required by subparagraph (a) of this paragraph, the following powerplant instruments are required.

(1) Tachometer for each engine;

(2) Cylinder head temperature indicator;

(3) Fuel-pressure or fuel flow indicator (to indicate the pressure or flow at which the fuel is supplied) for each pump-fed engine;

(4) Manifold-pressure indicator for each altitude engine and for each engine with a controllable propeller.

(5) Induction system air temperature indicator for each engine equipped with a preheater and having induction air temperature limitations that can be exceeded with preheat.

(6) For each turbocharger installation:

(i) If limitations are established for either carburettor (or manifold) air inlet temperature or exhaust gas or turbocharger turbine inlet temperature, indicators must be furnished for each temperature for which the limitation is established unless it is shown that the limitation will not be exceeded in all intended operations.

(ii) If its oil system is separate from the engine oil system, oil pressure and oil temperature indicators must be provided.

(7) A coolant temperature indicator for each liquid-cooled engine.

(c) For turbine engine-powered airships in addition to the powerplant instruments required by subparagraph (a) of this paragraph, the following powerplant instruments are required.

(1) Gas-temperature indicator for each engine;

(2) Fuel flowmeter for each engine;

(3) Tachometer (to indicate the speed of the rotors with established limiting speeds) for each engine;

(4) A means to indicate, to the flight crew, the operation of each engine starter that can be operated continuously but that is neither designed for continuous operation nor designed to prevent hazard if it has failed;

(5) An indicator for the functioning of the powerplant ice protection system for each engine; this applies only to a system which is selectable or contains some means of regulation.

(6) An indicator for the fuel strainer or filter required by TAR 997 to indicate the occurrence of contamination of the strainer or filter before it reaches the capacity established in accordance with subparagraph 997(d);

(7) A warning means for the oil strainer or filter required by TAR 1019, if it has no bypass, to warn the crew of the occurrence of contamination of the strainer or filter screen before it reaches the capacity established in accordance with subparagraph 1019(a)(2);

(8) An indicator for the proper functioning of any heater used to prevent ice clogging of fuel-system components.

(d) For turbopropeller-powered airships a torque indicator for each engine is required in addition to the powerplant instruments required by paragraphs (a) and (c) of this paragraph.

(e) *(reserved)*

(f) *(reserved)*

(g) Thruster system:

(1) For both fixed and variable angle thrusters the following is required:

(i) Oil pressure indicator for each pressure-lubricated gearbox;

(ii) Oil pressure warning device for each pressure-lubricated gearbox to indicate when the oil pressure falls below a safe value;

(iii) Oil quantity indicator for each oil tank and each rotor drive gearbox, if lubricant is self-contained;

(iv) Oil temperature warning device to indicate unsafe oil temperatures in each thruster drive gearbox.

(v) thrust direction indicator

(vi) thrust magnitude indicator

(2) For each variable angle thruster a thrust vector angle position indicator is required.

TAR 1306 Miscellaneous equipment instruments

The following are additional required instruments for auxiliary systems, if installed:

(a) Electrical power generating systems:

(1) Volt/load meter for each DC generating system;

(2) Volt/frequency meter for each AC generating system.

(b) *(reserved)*

(c) *(reserved)*

(d) Hydraulic systems:

(1) Hydraulic-quantity gauge for each system (dipstick or sight gauge);

(2) Hydraulic-pressure gauge for each system.

(e) Fly-by-wire / Fly-by-light flight control system: a means to indicate control surface position to the crew relative to commanded position

(f) Indicators for disposable ballast and disposable cargo mass and distribution.

(g) Indicators for the position of the locks for disposable ballast or cargo:

(h) A means to indicate computed mass and balance changes in the mass exchange system (if a mass exchange system is installed, such as a water system).

TAR 1307 Miscellaneous equipment

The following miscellaneous equipment is required:

(a) A seat or berth for each occupant or watch;

(b) *(reserved)*;

(c) Electrical protective devices, as prescribed in these regulations.

(d) Two systems for two-way radio communications, with controls for each accessible from each pilot station, designed and installed so that failure of one system will not preclude operation of the other system. The use of a common antenna system is acceptable if adequate reliability is shown.

(e) Two systems for radio navigation, with controls for each accessible from each pilot station designed and installed so that failure of one system will not preclude operation of the other system. The use of a common antenna system is acceptable if adequate reliability is shown.

(f) A public address system that can be made audible for all occupants;

(g) An emergency location transmitter;

(h) A cockpit voice recorder (CVR);

(i) A flight data recorder (FDR);

(j) A mode S transponder.

TAR 1309 Equipment, systems, and installations

(See AMJ 25.1309-1) The requirements of this paragraph, except as identified below, are applicable, in addition to specific design requirements of the TAR, to any equipment or system installed in the airship. Although this paragraph does not apply to the performance and flight characteristic requirements of Subpart B and the structural requirements of Subparts C and D, it does apply to any system on which compliance with any of those requirements is dependent. Certain single failures or jams covered by TAR 671(c)(1) and TAR 671(c)(3) are excepted from the requirements of TAR 1309(b)(1)(ii). Certain single failures covered by TAR 735(b)(1) are excepted from the requirements of TAR 1309(b). The failure effects covered by AC 810(a)(5) and TAR 812 are excepted from the requirements of TAR 1309(b). The requirements of TAR 1309(b) apply to powerplant installations as specified in TAR 901.

(a) The airship equipment and systems must be designed and installed so that:

(1) Those required for type certification or by operating rules, or improper functioning of which would reduce safety, perform as intended under the airship's operating and environmental conditions.

(2) Other equipment and systems are not a source of danger in themselves and do not adversely affect the proper functioning of those covered by sub-paragraph (a)(1) of this paragraph.

(b) The airship systems and associated components, considered separately and in relation to other systems, must be designed so that:

(1) Any catastrophic failure condition

(i) is extremely improbable; and

(ii) does not result from a single failure; and

(2) Any hazardous failure condition is extremely remote; and

(3) Any major failure condition is remote.

(c) Information concerning unsafe system operating conditions must be provided to the crew to enable them to take appropriate corrective action. A warning indication must be provided if immediate corrective action is required. Systems and controls, including indications and annunciations must be designed to minimise crew errors which could create additional hazards.

TAR 1310 Power source capacity and distribution

(a) Each installation, the functioning of which is required for type certification or by operating rules 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 (Corresponding advisory material is provided in ACJ 25.1310(a)):

(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-engined airships; and

(ii) Any two engines on three engined airships; and

(iii) Any number of engines but two on four-or-more engined airships.

After the failure of any two engines on a three-engined airship or after the failure of any number of engines but two on a four-or-more engined airship, those services essential to airworthiness must continue to function and perform adequately within the limits of operation implied by the emergency conditions. (Corresponding advisory material is provided in ACJ 25.1310(a)(3).)

(4) Essential loads for which an alternate source of power is required, after any failure or malfunction in any one power supply system, distribution system, or other utilisation system.

(b) In determining compliance with sub-paragraphs (a)(2) and (3) of this paragraph, the power loads may be assumed to be reduced under a monitoring procedure consistent with safety in the kinds of operation authorised. Loads not required in controlled flight need not be considered for the two-engine-inoperative condition on airships with three engines or the any-number-but-two-engine-inoperative condition on airships with four-or-more engines.

TAR 1316 System lightning protection

(a) For functions, the failure of which would contribute to or cause a condition that would prevent the continued safe flight and landing of the airship, each electrical and electronic system that performs these functions must be designed and installed to ensure that the operation and operational capabilities of the systems to perform these functions are not adversely affected when the airship is exposed to lightning.

(b) For functions, the failure of which would contribute to or cause a condition that would reduce the capability of the airship or the ability of the flightcrew to cope with adverse operating conditions, each electrical and electronic system that performs these functions must be designed and installed to ensure that these functions can be recovered in a timely manner after the airship is exposed to lightning.

(c) Compliance with the lightning protection criteria prescribed in paragraphs (a) and (b) of this paragraph must be shown. The applicant must design for and verify that airship electrical/electronic systems are protected against the effects of lightning by:

(1) Determining to lightning strike zones for the airship;

(2) Establishing the external lightning environment for the zones;

(3) Establishing the internal environment;

(4) Identifying all the electrical and electronic systems that are subject to the requirements of this paragraph, and their locations on or within the airship;

(5) Establishing the susceptibility of the systems to the internal and external lightning environment;

(6) Designing protection;and

(7) Verifying that protection is adequate.

TAR 1317 Protection from the effects of HIRF

The airship's electrical and electronic systems, equipment and installatons considered separately and in relation to other systems, must be designed and installed so that:

(a) each function, the failure of which would prevent the continued safe flight and landing of the airship:

(1) is not adversely affected when the airship is exposed to the certification HIRF environment.

(2) Following airship exposure to the certification HIRF environment, each affected system that performs such a function automatically recovers to normal opeartion unless this conflicts with other operational or functional requirements of that system.

(3) Each system that performs a function, the failure of which would prevent the continued safe flight and landing of the airship, is not adversely affected when the airship is exposed to the normal HIRF environment.

(b) Each system that performs a function, the failure of which would cause large reductions in the capability of the airship or the ability of the crew to cope with adverse operating conditions, is not adversely affected when the equipment providing these functions is qualified using an acceptable method.

INSTRUMENTS: INSTALLATION

TAR 1321 Arrangement and visibility

Instruments and indicating devices shall be located so that they can be read easily by the appropriate crew member.

(a) Each flight-, navigation-, envelope-, gas cell or envelope and ballonet pressure- (whichever is installed) and powerplant-instrument and warning device for use by any flight crew member shall be so arranged as to be convenient for their purpose and must be plainly visible to him/her from his/her pilot station with the minimum practicable deviation from his/her normal position and line of vision when looking forward along the flight path.

(b) Identical power-plant instruments must be conveniently grouped on instrumentpanels in such a manner that the appropriate crew member(s) may see them readily. Power-plant instruments for each engine shall be so located that the engine to which they relate is indicated with certainty.

(c) Instrument panel vibration may not damage or impair the accuracy of any instrument.

(d) For each airship the flight instruments required by TAR 1303 and, as applicable, by the operating rules must be grouped on the instrument panel and centred as near as practicable about the vertical plane of the crew's forward vision. In addition the following is required:

(1) the instrument that most effectively indicates the attitude must be on the panel in the top centre position;

(2) the instrument that most effectively indicates airspeed must be adjacent to and directly to the left of the instrument in the top centre position;

(3) The instrument that most effectively indicates altitude must be adjacent to and directly to the right of the instrument in the top centre position; and;

(4) The instrument that most effectively indicates direction of flight, other than the magnetic direction indicator required by TAR 1303 (b)(2), must be adjacent to and directly below the instrument in the top centre position.

(5) Electronic display indicators may be used for compliance with sub-paragraphs (d)(1) to (d)(4) of this paragraph when such displays comply with requirements in TAR 1330.

(6) A gauge or equivalent to indicate envelope and ballonet pressure on rigid and semi-rigid airships should be located near the main flight instruments.

(e) If a visual indicator is provided to indicate malfunction of an instrument, it must be effective under all probable cockpit lighting conditions.

TAR 1322 Warning, caution and advisory lights

(See AMJ 25.1322)
If warning, caution, or advisory lights are installed in the cockpit, they must, unless otherwise approved by the Authority, be:

(a) Red, for warning lights (lights indicating a hazard which requires immediate corrective action);

(b) Amber, for caution lights (lights indicating the possible need for future corrective action);

(c) Green, for safe operation lights;

(d) Any other colour, including white, for lights not described in paragraphs (a) through (c) of this paragraph, provided the colour differs sufficiently from the colours prescribed in paragraphs (a) through (c) of this paragraph to avoid possible confusion.

TAR 1323 Airspeed indicating system

(a) Each airspeed indicating instrument 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 pressure are applied.

(b) Each airspeed system must be calibrated in flight to determine the system error. The system error, including position error, but excluding the airspeed indicator instrument calibration error, must not exceed 5% of the maximum airspeed attainable as defined in TAR 1505.

(c) 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.

TAR 1325 Static pressure systems

(a) Each instrument provided with static pressure case connections must be so vented that the influence of airship speed, the opening and closing of windows, airflow variations, moisture, or other foreign matter will least affect the accuracy of the instruments except as noted in subparagraph (b)(3) of this paragraph.

(b) If a static pressure system is necessary for the functioning of instruments, systems, or devices, it must comply with the following:

(1) The design and installation of a static pressure system must be such that

(i) Positive drainage of moisture is provided;

(ii) Chafing of the tubing, and excessive distortion or restriction at bends in tubing, is avoided;

(iii) The materials used are durable and suitable for the purpose intended, and protected against corrosion.

(2) A proof test must be conducted to demonstrate the integrity of the static pressure system in the following manner: Evacuate the static pressure system to a pressure differential of approximately 34 Pa or to a reading on the altimeter, 1000 ft above the airship elevation at the time of the test. Without additional pumping for a period of 1 minute, the loss of indicated altitude must not exceed 100 ft on the altimeter.

(3) For those airships intended for operation under Instrument Flight Rules or in known icing conditions, and if a static pressure system is provided for any instrument, device, or system required by the operating rules applicable, each static pressure port must be located in such a manner that the correlations between air pressure in the static pressure are not altered when the airship encounters icing conditions. An anti-icing means or an alternate source of static pressure may be used in showing compliance with this requirement. If the reading of the altimeter, when on the alternate static pressure system differs from the reading of the altimeter when on the primary static system by more than 50 ft, a correction card must be provided for the alternate static system.

(c) Except as provided in subparagraph (d) of this paragraph, if the static pressure system incorporates both a primary and an alternate static pressure source, the means for selecting one or the other source must be designed so that

(1) When either source is selected, the other is blocked off;

(2) Both sources cannot be blocked off simultaneously.

(d) Subparagraph (c)(1) of this paragraph does not apply if it can be demonstrated that the static pressure system calibration, when either static pressure source is selected, is not changed by the other static pressure source being open or blocked.

(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 ft in the speed range between V_{AM} and V_{MO}.

TAR 1326 Pitot heat indication systems

If a flight instrument pitot heating system is installed, an indication system must be provided to indicate to the flight crew when that pitot heating system is not operating. The indication system must comply with the following requirements:

(a) The indication provided must incorporate an amber light that is in clear view of a flight-crew member.

(b) The indication provided must be designed to alert the flight crew if either of the following conditions exist:

(1) The pitot heating system is switched 'off'.

(2) The pitot heating system is switched 'on' and any pitot tube heating element is inoperative.

TAR 1327 Magnetic direction indicator

(a) Except as provided in subparagraph (b) of this paragraph

(1) Each magnetic direction indicator must be installed so that its accuracy is not excessively affected by the airships vibration or magnetic fields;

(2) The compensated installation may not have a deviation, in level flight, greater than 10° on any heading.

(b) A magnetic nonstabilised direction indicator may deviate more than 10° due to the operation of electrically-powered system such as electrically-heated windshields if either a magnetic stabilised direction indicator, which does not have a deviation in level flight greater than 10° on any heading, or a gyroscopic direction indicator, is installed. Deviations of a magnetic nonstabilised-direction indicator of more than 10° must be placarded in accordance with TAR 1547(e).

TAR 1329 Automatic pilot system

If an automatic pilot system is installed, it must meet the following (equivalent guidance material provided in ACJ 25.1329):

(a) Each system must be designed so that it can be quickly and positively disengaged by the crew to prevent it from interfering with the control of the airship.

(b) Unless there is automatic synchronization, each system must have a means to indicate readily to the crew the alignment of the actuating device in relation to the control system it operates.

(c) Each manually operated control for the system's operation must be readily accessible to the flight crew. Each control must operate in the same plane and sense of motion as the corresponding primary flight control. The direction of motion must be plainly indicated on or near each control.

(d) Each system must be designed and adjusted so that, within the range of adjustment available to the flight crew, it cannot produce hazardous loads on the airship or create hazardous deviations in the flight path, under any flight condition appropriate to its use, either during normal operation or in the event of a malfunction, assuming that correction action begins within a reasonable period of time (e.g. recognition plus 5 seconds).

(e) Each system must be designed so that a single malfunction will not produce a hardover signal in more than one control axis. If the automatic pilot integrates signals from auxiliary controls or furnishes signals for operation of other equipment, positive interlocks and sequencing of engagement to prevent improper operation are required.

(f) There must be protection against adverse interaction of integrated components, resulting from a malfunction.

(g) Means must be provided to indicate to the flight crew the current mode of operation and any modes armed by the flight crew. Selection switch position is not acceptable as a means of indication.

(h) Vectored thrusters or bow/tail thrusters shall not be connected to the autopilot system, unless safe integration with the functioning of the normal flight controls can be demonstrated.

(i) An automatic station keeping system or hovering system must meet the requirements (a) through (h), if applicable.

TAR 1330 Electronic flight instrument system (EFIS)

Electronic display systems may be installed provided:

(a) they are easily legible under all lighting conditions encountered in the cockpit, including direct sunlight;

(b) the requirements in TAR 1303, 1305 and 1321 are met;

(c) they incorporate sensory cues for the crew that are equivalent to those in the instruments being replaced by the electronic display units;

(d) they incorporate visual display of instrument markings required by TAR 1541 through 1553, or visual display that alert the crew to abnormal operational values, or approaches to unsafe values, of any parameter required to be displayed by these regulations.

TAR 1331 Instruments using a power supply

For each instrument required by TAR 1303 (b) that uses a power supply, the following apply:

(a) Each instrument must have a visual means integral with 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.

(b) Each instrument must, in the event of the failure of one power source, be supplied by another power source. This may be accomplished automatically or by manual means. The failure of one power source must not affect the instruments of all crew stations.

(c) If an instrument presenting flight and/or navigation data receives information from sources external to that instrument and loss of that information would render the presented data unreliable, a clear and unambiguous visual warning must be given to the crew when such loss of information occurs that the presented data cannot be relied upon.

TAR 1333 Instrument systems

For systems that operate the instruments required by TAR 1303 (a) which are located at each pilot's station:

(a) Means must be provided to connect the required instruments at the first pilot's station to operating systems which are independent of the operating systems at other flight crew stations, or other equipment;

(b) The equipment, systems, and installations must be designed so that sufficient information is available to assure control of the airship in speed, altitude, heading and pitch by one of the pilots without immediate crew action after any single failure or combination of failures that is not assessed to be extremely improbable (equivalent guidance material provided in ACJ 25.1333 (b)) and

(c) Additional instruments, systems, or equipment may not be connected to the operating systems for the required instruments, unless provisions are made to ensure the continued normal functioning of the required instruments in the event of any malfunction of the additional instruments, systems, or equipment which is not shown to be extremely improbable.

TAR 1335 Flight director systems

If a flight director system is installed, means must be provided to indicate to the flight crew its current mode of operation and any modes armed by the flight crew. Selector switch position is not acceptable as a means of indication.

TAR 1337 Powerplant instruments

(a) Instruments and instrument lines:

(1) each powerplant instrument line must meet the requirements of TAR 993 and 1183.

(2) each line carrying flammable fluids under pressure must:

(i) have restricting orifices or other safety devices at the source of pressure to prevent the escape of excessive fluid if the line fails;

(ii) be installed and located so that the escape of fluids would not create a hazard.

(3) Each powerplant instrument that utilises flammable fluids must be installed and located so that the escape of fluid would not create a hazard.

(b) Fuel quantity indicator: There must be a means to indicate to the flight crew members the quantity of fuel in each tank during flight. An indicator, calibrated in litres, kilogrammes or equivalent units and clearly marked to indicate which scale is being used, may be used. 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 quantity determined under TAR 959;

(2) Each exposed sight gauge used as a fuel-quantity indicator must be protected against damage;

(3) Tanks with interconnected outlets and airspaces may be considered as one tank and need not have separate indicators;

(4) No fuel-quantity indicator is required for a small auxiliary tank that is used only to transfer fuel to other tanks if the relative size of the tank, the rate of fuel transfer, and operating instructions are adequate to

(i) Guard against overflow;

(ii) Give the flight crew members prompt warning if transfer is not proceeding as planned.

(c) Fuel flow meter system: If a fuel flow meter system is installed, each metering component must have a means to bypass the fuel supply if malfunctioning of that component severely restricts fuel flow.

(d) Oil-quantity indicator: There must be a means to indicate the quantity of oil in each tank:

(1) on the ground;

(2) in flight, to the flight crew members, if there is an oil transfer system, or a reserve oil-supply system.

ELECTRICAL SYSTEMS AND EQUIPMENT

TAR 1351 General

(a) Electrical system capacity: the required generating capacity, and number and types of power sources must:

(1) Be determined by an electrical load analysis; and

(2) Meet the requirements of TAR 1309 and 1310.

(b) Generating system: the generating system includes electrical power sources, main power buses, 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 shall 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 is maintained within the limits for which the equipment is designed, during any probable operating condition;

(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 where necessary, in flight, to appropriate crew members for the individual and rapid disconnection of each electrical power source; and:

(6) There are means to indicate to appropriate crew members the generating system capacities essential for the safe operation of the system, such as the voltage and current supplied by each generator.

(c) External power: If provisions are made for connecting external power to the airship, and that external power can be electrically connected to equipment other than that used for engine starting, means must be provided to ensure that no external power supply having a reverse polarity, a reverse phase sequence (including crossed phase and neutral), open circuit line, incorrect frequency or voltage, can supply power to the airship's electrical system.

(d) Operation without normal electrical power. The following apply:

(1) Unless it can be shown that the loss of the normal electrical power generating system(s) is extremely improbable, alternate high integrity electrical power system(s), independent of the normal electrical power generating system(s), must be provided to power those services necessary to complete a flight and make a safe landing.

(2) The services to be powered must include:

(i) Those required for immediate safety and which must continue to operate following the loss of the normal electrical power generating system(s), without the need for flight crew action;

(ii) Those required for continued controlled flight; and

(iii) Those required for descent, approach and landing.

(3) Failures, including junction box, control panel or wire bundle fires, which would result in the loss of the normal and alternate systems must be shown to be extremely improbable.

TAR 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. Any electrical interference likely to be present in the airship must not result in hazardous effects upon the airship or its systems except under extremely remote conditions.

(b) Cables must be grouped, routed and spaced so that damage to essential circuits will be minimised if there are faults in cables, particularly 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 or power;

(ii) During a flight of maximum duration; and

(iii) Under the most adverse cooling condition likely to occur in service.

(2) Compliance with subparagraph (c)(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 airship.

(4) No corrosive fluids or gases that may escape from the battery may damage surrounding airship structures or adjacent essential equipment.

(5) Each nickel-cadmium battery installation must have provisions to prevent any hazardous effect on structure or essential systems that may be caused by the maximum amount of heat the battery can generate during a short circuit of the battery or of its individual cells.

(6) Nickel-cadmium battery installations that are not provided with low-energy charging means must have:

(i) A system to control the charging rate of the battery automatically so as to prevent battery overheating;

(ii) A battery temperature sensing and over-temperature warning system with a means for disconnecting the battery from its charging source in the event of an over-temperature condition; or

(iii) A battery failure sensing and warning system with a means for disconnecting the battery from its charging source in the event of battery failure.

(d) Electrical cables and cable installations must be designed and installed as follows:

(1) The electrical cables used must be compatible with the circuit protection devices required by TAR 1357, such that a fire or smoke

hazard cannot be created under temporary or continuous fault conditions.

(2) Means of permanent identification must be provided for electrical cables, connectors and terminals.

(3) Electrical cables must be installed such that the risk of mechanical damage and/or damage caused by fluids, vapours, sources of heat or ageing is minimised.

(4) Each electric connecting cable must be of adequate capacity.

(5) Each cable and associated equipment that would overheat in the event or circuit overload or fault must be at least flame resistant and may not emit dangerous quantities of toxic fumes.

(e) Electrical bonding must provide an adequate electrical return path under both normal and fault conditions, on airships having earthed electrical systems (see TAR 581).

TAR 1355 Distribution system

(a) The distribution system includes the distribution buses, their associated feeders, and each control protective device.

(b) *(reserved)*

(c) If two independent sources of electrical power for particular equipment or systems are required by this TAR, in the event of the failure of one power source for such equipment or system, another power source (including its separate feeder) must be automatically provided or be manually selectable to maintain equipment or system operation. Corresponding advisory material is provided in ACJ 25.1355(c).

TAR 1357 Circuit protective devices

(a) Automatic protective devices must be used to minimise distress to the electrical system and hazard to the airship 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-energise and disconnect faulty power sources and power transmission equipment from their associated buses with sufficient rapidity to provide protection from hazardous over-voltage and other malfunctios.

(c) Each resetable 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. Where fuses are used, there must be spare fuses for use in-flight equal to at least 50% of the number of fuses of each rating required for complete circuit protection.

(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) *(reserved)*

(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.

TAR 1360 Precautions against injury

(See ACJ25X1360(a) and (b))

(a) Shock: the electrical system must be designed to minimise the risk of electric shock to crew, passengers and servicing personnel and also to maintenance personnel using normal precautions.

(b) Burns: the temperature rise of any part which has to be handled during normal operation by the flight crew, must not be such as to cause dangerous inadvertent movement, or injury to the crew member.

TAR 1361 Master switch arrangement

(a) There must be a master switch to allow ready disconnection of electric power sources from the main bus. The point of disconnection must be adjacent to the sources controlled by the switch.

(b) Load circuits may be connected so that they remain energised after switched off, if:

(1)The circuits are isolated, or physically shielded, to prevent their igniting flammable fluids or vapours that might be liberated by the leakage or rupture of any flammable fluid systems; and

(2)The circuits are required for continued operation of the engines; or

(3)The circuits are protected by circuit protective devices, rated at 5 ampères or less, located near the electric power source.

(c) The master switch or its controls must be so installed that the switch is easily discernible and accessible to a crew member in flight.

(d) Additional local circuit breakers should be installed in the airship if the system is accessible to the crew during flight, ground handling or maintenance.

TAR 1362 Electricity supplies for emergency conditions

A suitable electricity supply must be maintained to those services which are required, either by this TAR (e.g. TAR 1195) or in order for emergency procedures to be carried out, after an emergency landing or ditching. The circuits to these services must be designed and protected to minimise the risk of their causing a fire under these conditions.

TAR 1363 Electrical system tests

(a) Tests must be made to determine that the performance of the electrical supply systems meets the requirements of this code under all the appropriate normal and failure conditions. 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 airship;

(2) The equipment must simulate the electrical characteristics and length 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 airship 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 airship, flight tests must be made.

TAR 1367 Switches

Each switch must be:

(a) Able to carry its rated current;

(b) Constructed with sufficient distance or insulating material between current carrying parts and the housing that vibration in flight will not cause short circuit:

(c) Accessible to appropriate flight crew members;

(d) Labelled as to operation and the circuit controlled.

LIGHTS

TAR 1381 Instrument lights

(a) The instrument lights must:

(1) Provide sufficient illumination to make each instrument, switch and other device necessary for safe operation easily readable unless sufficient illumination is available from another source; 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.

TAR 1383 Ground proximity and landing lights

(a) Each ground proximity and landing light must be approved, and must be installed so that:

(1) No objectionable glare is visible to the crew;

(2) The pilots are not adversely affected by halation; and

(3) It provides enough light for the intended night operation including landing.

(4) A landing light must be installed. For IFR operation two lamps or double filament seperately energised must be installed.

(5) If a rear landing gear is provided, a light for downward landing area illumination must be installed.

(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) If external lighting is provided for crew members other than the pilots, switching should be possible:

(1) locally from the crew station, and

(2) centrally from the pilot's seats.

(d) If lights are retractable there must be a means to indicate to the crew when the lights are extended.

TAR 1385 Position light system installation

General: each part of each position light system must meet the applicable requirements of this TAR and each system as a whole must meet the requirements of TAR 1387 through TAR 1397. Position lights must be distributed in such a way that no aircraft crossing the airships flight path might endeavour to fly between bow and stern position lights.

(a) Bow position light: the bow position light must be a white light mounted as far forward as possible on the envelope and must be approved.

(b) Forward position lights: forward position lights must consist of a red and green light spaced laterally as far apart as practicable and installed on the widest forward part of the airship so that, with the airship in the normal flying position, the red light is on the left side and the green light in on the right side. Each light must be approved.

(c) Rearward position lights: rearward position lights must consist of a red and green light spaced laterally as far apart as practicable and installed on the widest rearward part of the airship so that, with the airship in the normal flying position, the red light is on the left side and the green light in on the right side. Each light must be approved.

(d) Stern position light: the stern position light must be a white light mounted as far aft a practicable on the tail and must be approved.

(e) Circuit: the bow position light, the two forward and rearward position lights and the stern position light must make a single circuit.

(f) Light covers and colour filters: each light cover or colour filter must be at least flame resistant and may not change colour or shape or lose any appreciable light transmission during normal use.

TAR 1387 Position light system dihedral angles

(a) Except as provided in subparagraph (f) of this paragraph, each bow, forward, rearward and stern position light must, as installed, show unbroken light within the dihedral angles described in this paragraph.

(b) Dihedral angle F (forward) is formed by two intersecting vertical planes making angles of 110° to the right and to the left, respectivly, to a vertical plane passing through the longitudinal axis, as viewed when looking forward along the longitudinal axis.

(c) Dihedral angle L (left) is formed by two intersecting vertical planes, the first parallel to the longitudinal axis of the airship, and the other at 110° to the left of the first, as viewed when looking forward along the longitudinal axis.

(d) Dihedral angle R (right) is formed by two intersecting vertical planes, the first parallel to the longitudinal axis of the airship, and the other at 110° to the right of the first, as viewed when looking forward along the longitudinal axis.

(e) Dihedral angle A (aft) is formed by two intersecting vertical planes making angles of 70° to the right and to the left, respectivly, to a vertical plane passing through the longitudinal axis, as viewed when looking aft along the longitudinal axis.

(f) If the stern position light, when mounted as far aft a practicable in accordance with TAR 1385(d), cannot show unbroken light within dihedral angle A (as defined in subparagraph (d) of this paragraph), a solid angle or angles of obstructed visibility totalling not more than 0.04 steradians is allowable within that dihedral angle, if such solid angle is within a cone, the apex of which is at the rear position light and the elements of which make an angle of 30° with a vertical line passing through the rear position light.

TAR 1389 Position light distribution and intensities

(a) General: the intensities prescribed in this paragraph must be provided by new equipment with each light cover and colour filter 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 airship's electricity supply. The light distribution and intensity of each position light must meet the requirements of subparagraph (b) of this paragraph.

(b) Bow, forward, rearward and stern position lights: the light distribution and intensities of bow, forward, rearward and stern 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 F, L, R, and A, and must meet the following requirements:

(1) Intensities in the horizontal plane: Each intensity in the horizontal plane (a plane containing the longitudinal axis of the airship and perpendicular to the plane of symmetry of the airship) must equal or exceed the values in TAR 1391.

(2) Intensities in any vertical plane: Each intensity in any vertical plane (a plane perpendicular to the horizontal plane) must equal or exceed the appropriate value in TAR 1393, where I is the minimum intensity prescribed in TAR 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 in TAR 1395, except that higher intensities in overlaps may be used with main beam intensities substantially greater than the minimum specified in TAR 1391 and 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 and rearward position lights is more than 100 candles, the maximum overlap intensities between them may exceed the values in TAR 1395 if the overlap intensity in Area A is not more than 10% of peak position light intensity and the overlap intensity in Area B is not more than 2.5% of peak position light intensity.

(c) Bow or stern position light installation: a single-position light may be installed in a position displaced laterally from the plane of symmetry of an airship if:

(1) The axis of the maximum cone of illumination is parallel to the flight path in level flight;

(2) There is no obstruction aft of the light and between planes 70° to the right and left of the axis of maximum illumination.

TAR 1391 Minimum intensities in the horizontal plane of bow, forward, rearward and stern position lights

Each position light intensity must equal or exceed the applicable values in Table 10 of Appendix A.

TAR 1393 Minimum intensities in any vertical plane of bow, forward, rearward and stern position lights

Each position light intensity must equal or exceed the applicable values in Table 11 of Appendix A.

TAR 1395 Maximum intensities in overlapping beams of bow and forward, forward and stern, respectively rearward and stern position light

No position light intensity may exceed the applicable values in the Table 12 of Appendix A, except as provided in TAR 1389(b)(3).

TAR 1397 Colour specifications

Each position light colour must have the applicable International Commission on Illumination chromaticity coordinates as follows, where y_0 is the y-coordinate of the Planckian radiator for the value of x considered

(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 - 0.320 y;
x is not greater than y - 0.170; and
y is not less than 0.390 - 0.170 x.

(c) Aviation white

x is not less than 0.300 and not greater than 0.540;
y is not less than x - 0.040 or y_0 - 0.010, whichever is the smaller; and
y is not greater than x + 0.020 nor 0.636 - 0.400 x.

TAR 1401 Anticollision light system

(a) General: the airship 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 flight crew members vision or detract from the conspicuity of the position lights;

(2) Is distributed in such a way that no aircraft crossing the airships flight path might endeavour to fly between bow and stern lights.

(3) Meets the requirements of subparagraphs (b) through (f) of this paragraph.

(b) Field of coverage: the system must consist of enough lights to illuminate the vital areas around the airship, considering the physical configuration and flight characteristics of the airship. The field of coverage must extend in each direction within at least 75° above and 75° below the horizontal plane of the airship, except that there may be solid angles of obstructed visibility totalling not more than 0.5 steradians.

(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 airship'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) Colour: Each anticollision light must be either aviation red or aviation white and must meet the applicable requirements of TAR 1397.

(e) Light intensity: the minimum light intensities in any vertical plane, measured with the red filter (if used) and expressed in terms of 'effective' intensities, must meet the requirements of subparagraph (f) of this paragraph. 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 Table 13 of Appendix A.

SAFETY EQUIPMENT

TAR 1411 General

(a) Accessibility: required safety equipment to be used by the crew in an emergency must be readily accessible at all crew stations throughout the airship:

(b) Stowage provisions: Stowage provisions for required safety equipment must be furnished and must:

(1) be arranged so that the equipment is directly accessible and its location obvious; and

(2) protect the safety equipment from inadvertent damage caused by being subjected to the inertia loads specified in TAR 561.

(c) Emergency exit descent device: The stowage provisions for the emergency exit descent device required by TAR 810 must be at the exits for which they are intended.

(d) Liferafts:

(1) The stowage provisions for the liferafts described in TAR 1415 must accommodate sufficient number of rafts for the maximum number of occupants for which certification is requested.

(2) Liferafts must be stowed near exits through which the rafts can be launched during an unplanned ditching.

(3) Rafts automatically or remotely released outside the airship must be attached to the airship by means of the static line prescribed in TAR 1415.

(4) The stowage provisions for each portable liferaft must allow rapid detachment and removal of the raft for use at other than the intended exits.

(e) Long-range signalling device: the stowage provisions for the long-range signalling device required by TAR 1415 must be near an exit available during an unplanned ditching.

(f) Life-preserver stowage provisions: the stowage provisions for life preservers described in TAR 1415 must accommodate one life preserver for each occupant: Each life preserver must be within easy reach.

(g) Life line stowage provisions: there must be provisions to store the life lines. These provisions must allow one life line to be attached to each side of the passenger/crew compartments.

TAR 1413 Safety belts

(a) The rated strength of safety belts may not be less than that corresponding with the ultimate load factors specified in TAR 561 considering the dimensional characteristics of the belt installation for the specific seat or berth arrangement.

(b) For safety belts for berths parallel to the longitudinal axis of the airship, the forward load factor specified in TAR 561 need not be applied.

(c) Each safety belt must be equipped with a metal to metal latching device.

TAR 1414 Electrostatic discharge equipment

A means must be provided for electrostatic discharge during landing and ground handling and while the airship is on the ground.

TAR 1415 Ditching equipment

(a) Ditching equipment used in airships, required by the National Operating Rules, must meet the requirements of this paragraph.

(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 airship 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 airship but to release it if the airship becomes totally submerged.

(c) Approved survival equipment must be attached to, or stored adjacent to, each liferaft.

(d) Survival type emergency locator transmitters for use in liferafts must meet the applicable requirements of the relevant JTSO or an acceptable equivalent.

(e) There must be life preservers or other approved flotation means within easy reach of each seated occupant and must be readily removable from the airship.

TAR 1417 Icing Detection

A means must be provided for illuminating or otherwise determining the formation of ice on the parts that are critical from the standpoint of ice accumulation. Any illumination that is used must be of a type that will not cause glare or reflection that would handicap crew members in the performance of their duties.

TAR 1419 Ice and snow protection

If certification for flight in icing and snowing conditions is desired, the airship must be capable of safe operation in the continuous maximum and intermittent maximum icing conditions of JAR 25, Appendix C. To establish that the airship can operate within the continuous maximum and intermittent maximum conditions:

(a) An analysis must be performed to establish that the ice and snow protection for the various components of the airship is adequate, taking into account the various airship operational configurations and tests.

(b) To verify the ice and snow protection analysis, to check for icing anomalies, and to demonstrate that the ice protection system and its components are effective, the airship or its components must be flight tested in the various operational configurations, in measured natural atmospheric icing conditions, and as found necessary to be demonstrated by adaquate flight and/or laboratory

TAR 1421 Megaphones

If a megaphone is installed, a restraining means must be provided that is capable of restraining it when subjected to the ultimate inertia forces specified in TAR 561 (b)(2).

MISCELLANEOUS EQUIPMENT

TAR 1423 Public address system

A public address system required by this TAR must:

(a) Be powerable when the airship is in flight or stopped on the ground, after the shutdown or failure of all engines and auxiliary power units, or the disconnection or failure of all power sources dependent on their continued operation, for:

(1) A time duration of at least 30 minutes, including an aggregate time duration of at least 10 minutes of announcements made by flight and cabin crew members, considering all other loads which may remain powered by the same source when all other power sources are inoperative; and

(2) An additional time duration in its standby state appropriate or required for any other loads that are powered by the same source and that are essential to safety of flight or required during emergency conditions.

(b) The system must be dual redundant and be capable of operation within 3 seconds from the time a microphone is removed from its stowage by a flight attendant at those stations in the passenger compartment from which its use is accessible.

(c) Be intelligible at all locations where passengers might be expected including crew seats, lavatories, flight attendant seats and crew work stations.

(d) Be designed so that no unused, unstowed microphone will render the system inoperative.

(e) Be capable of functioning independently of any required crew member interphone system.

(f) Be accessible for immediate use from each of two flight-crew member stations in the pilot compartment.

(g) For each required floor-level passenger emergency exit which has an adjacent flight attendant seat, have a microphone which is readily accessible to the seated flight attendant, except that one microphone may serve more than one exit, provided the proximity of the exits allows unassisted verbal communications between seated flight attendants.

TAR 1431 Electronic equipment

(a) In showing compliance with TAR 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 TAR 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 any applicable aviation rule or regulation.

(d) Electronic equipment must be designed and installed such that it does not cause essential loads to become inoperative, as a result of electrical power supply transients or transients from other causes.

TAR 1435 Hydraulic systems

(See AMJ 25.1435)

(a) Element design: each element of the hydraulic system must be designed to:

(1) withstand the proof pressure without permanent deformation that would prevent it from performing its intended function, and the ultimate pressure without rupture. The proof and ultimate

pressures are defined in terms of the design operating pressure (DOP) as follows:

	Element	Proof (x DOP)	Ultimate (x DOP)
1.	Tubes and fittings	1.5	3.0
2.	Pressure vessels containing gas:		
	high pressure (e.g. accumulators)	3.0	4.0
	low pressure (e.g. reservoirs)	1.5	3.0
3.	Hoses	2.0	4.0
4.	All other elements	1.5	2.0

(2) withstand, without deformation that would prevent it from performing its intended function, the design operating pressure in combination with limit structural loads that may be imposed;

(3) withstand, without rupture, the design operating pressure multiplied by a factor of 1.5 in combination with ultimate structural loads that can reasonably occur simultaneously;

(4) Withstand the fatigue effects of all cyclic pressures, including transients, and associated externally induced loads, taking into account the consequences of element failure; and

(5) Perform as intended under all environmental conditions for which the airship is certificated.

(b) System design: each hydraulic system must:

(1) have means located at a flight crew member station to indicate appropriate system parameters if,

(i) it performs a function necessary for continued safe flight and landing; or

(ii) in the event of hydraulic system malfunction, corrective action by the crew to ensure continued safe flight and landing is necessary;

(2) have means to ensure that system pressures, including transient pressures and pressures from fluid volumetric changes in elements that are likely to remain closed long enough for such changes to occur, are within the design capabilities of each element, such that they meet the requirements defined in TAR 1435(a)(1) to TAR 1435(a)(5) inclusive;

(3) have means to minimise the release of harmful or hazardous concentrations of hydraulic fluid or vapours into the crew and passenger compartments during flight;

(4) meet the applicable requirements of TAR 863, 1183, 1185 and 1189 if a flammable hydraulic fluid is used; and:

(5) be designed to use any suitable hydraulic fluid specified by the airship manufacturer, which must be identified by appropriate markings as required by TAR 1541.

(c) Tests: tests must be conducted on the hydraulic system(s), and/or subsystem(s) and elements, except that analysis may be used in place of or to supplement testing where the analysis is shown to be reliable and appropriate. All internal and external influences must be taken into account to an extent necessary to evaluate their effects, and to assure reliable system and element functioning and integration. Failure or unacceptable deficiency of an element or system must be corrected and be sufficiently retested, where necessary.

(1) The system(s), subsystem(s), or elements must be subjected to performance, fatigue, and endurance tests representative of airship ground and flight operations.

(2) The complete system must be tested to determine proper functional performance and relation to other systems, including simulation of relevant failure conditions, and to support or validate element design.

(3) The complete hydraulic system(s) must be functionally tested on the airship in normal operation over the range of motion of all associated user systems. The test must be conducted at the relief pressure or 1.25 times the DOP if a system pressure relief device is not part of the system design. Clearances between hydraulic system elements and other systems or structural elements must remain adequate and there must be no detrimental mutual effects.

TAR 1436 Pneumatic systems - high pressure

(a) General: pneumatic systems which are powered by, and/or used for distributing or storing, air or nitrogen, must comply with the requirements of this paragraph if the product of system pressure times system volume amounts to 30 MPa m^3 or more.

(1) Compliance with TAR 1309 for pneumatic systems must be shown by functional tests, endurance tests and analysis. Any part of a pneumatic system which is an engine accessory must comply with the relevant requirements of TAR 1163.

(2) No element of the pneumatic system which would be liable to cause hazardous effects by exploding if subject to a fire, may be mounted within an engine bay or other designated fire zone, or in the same compartment as a combustion heater.

(3) When the system is operating no hazardous blockage due to freezing must occur. If such blockage is liable to occur when the airship is stationary on the ground, a pressure relieving device must be installed adjacent to each pressure source.

(b) Design: each pneumatic system must be designed as follows:

(1) Each element of the pneumatic system must be designed to withstand the loads due to the operating pressure, P_w, in the case of elements other than pressure vessels or to the limit pressure, P_L, in the case of pressure vessels, in combination with limit structural loads which may be imposed without deformation that would prevent it from

performing its intended function, and to withstand without rupture, the working or limit pressure loads multiplied by a factor of 1.5 in combination with ultimate structural loads that can reasonably occur simultaneously.

(i) P_w: the working pressure is the maximum steady pressure in service acting on the element including the tolerances and possible pressure variations in normal operating modes but excluding transient pressures.

(ii) P_L: the limit pressure is the anticipated maximum pressure in service acting on a pressure vessel, including the tolerances and possible pressure variations in normal operating modes but excluding transient pressures.

(2) A means to indicate system pressure located at a flight-crew member station, must be provided for each pneumatic system that:

(i) performs a function that is essential for continued safe flight and landing; or

(ii) in the event of pneumatic system malfunction, requires corrective action by the crew to ensure continued safe flight and landing.

(3) There must be means to ensure that system pressures, including transient pressures and pressures from gas volumetric changes in components which are likely to remain closed long enough for such changes to occur:

(i) will be within 90% to 110% of pump average discharge pressure at each pump outlet or at the outlet of the pump transient pressure dampening device, if provided; and

(ii) except as provided in sub-paragraph (b)(6) of this paragraph, will not exceed 125% of the design operating pressure, excluding pressure at the outlets specified in sub-paragraph (b)(3)(i) of this paragraph. Design operating pressure is the maximum steady operating pressure. The means used must be effective in preventing excessive pressures being generated during ground charging of the system. (See ACJ 25X1436 (b)(3)).

(4) Each pneumatic element must be installed and supported to prevent excessive vibration, abrasion, corrosion, and mechanical damage, and to withstand inertia loads.

(5) Means for providing flexibility must be used to connect points in a pneumatic line between which relative motion or differential vibration exists.

(6) Transient pressure in a part of the system may exceed the limit specified in sub-paragraph (b)(3)(ii) of this paragraph if:

(i) a survey of those transient pressures is conducted to determine their magnitude and frequency; and

(ii) based on the survey, the fatigue strength of that part of the system is substantiated by analysis or tests, or both. (See Orange Paper Amendment 96/1)

(iii) maintenance instructions are established.

(7) The elements of the system must withstand the loads due to the pressure given in Table 14 of Appendix A, for the proof condition without leakage or permanent distortion and for the ultimate condition without rupture. Temperature must be those corresponding to normal operating conditions. Where elements are constructed from materials other than aluminium alloy, tungum, or medium-strength steel, the Authority may prescribe or agree other factors. The materials used should in all cases be resistant to deterioration arising from the environmental conditions of the installation, particularly the effects of vibration.

(8) Where any part of the system is subject to fluctuating or repeated external or internal loads, adequate allowance must be made for fatigue.

(c) Tests:

(1) a complete pneumatic system must be static tested to show that it can withstand a pressure of 1.5 times the working pressure without a deformation of any part of the system that would prevent it from performing its intended function. Clearance between structural members and pneumatic system elements must be adequate and there must be no permanent detrimental deformation. For the purpose of this test, the pressure relief valve may be made inoperable to permit application of the required pressure.

(2) The entire system or appropriate sub-systems must be tested in an airship or in a mock-up installation to determine proper performance and proper relation to other airship systems. The functional tests must include simulation of pneumatic system failure conditions. The tests must account for flight loads, ground loads, and pneumatic system working, limit and transient pressures expected during normal operation, but need not account for vibration loads or for loads due to temperature effects. Endurance tests must simulate the repeated complete flights that could be expected to occur in service. Elements which fail during the tests must be modified in order to have the design deficiency corrected and, where necessary, must be sufficiently retested. Simulation of operating and environmental conditions must be completed on elements and appropriate portions of the pneumatic system to the extent necessary to evaluate the environmental effects (see ACJ 25X1436 (c)(2)).

(3) Parts, the failure of which will significantly lower the airworthiness or safe handling of the airship must be proved by suitable testing, taking into account the most critical combination of pressures and temperatures which are applicable.

TAR 1437 Engine-driven accessories

Engine-driven accessories essential to safe operation must be distributed among two or more engines so that the failure of any one engine will not impair safe operation through the malfunctioning of these accessories.

TAR 1438 Pneumatic systems- low pressure

The following requirements apply to all pneumatic systems in the airship except those systems dedicated to the pressurization of the gas cells or the envelope and ballonets:

(a) pneumatic system elements must be burst pressure tested to 3 times and proof pressure tested to 1.5 times, the maximum normal operating pressure.

(b) an analysis, or a combination of analysis and test may be substituted for any test required by subparagraph (a) of this paragraph if the Authority finds it equivalent to the required test.

TAR 1439 Protective breathing equipment

(a) Protective breathing equipment must be installed for use of appropriate crew members. Such equipment must be located so as to be available for use in compartments accessible in flight.

(b) For protective breathing equipment required by TAR 1439 (a) or by the National Operating Regulations the following apply:

(1) The equipment must be designed to protect the appropriate crew members from smoke, carbon dioxide and other harmful gases while on flight deck duty or stations or while combating fires.

(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) Equipment, including portable equipment, while in use must allow communication with other crew members. Equipment available at flight crew assigned duty stations must enable the flight crew to use radio equipment.

(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) Each dispensing equipment must supply protective oxygen for a minimum of 15 minutes at a pressure altitude 8,000 ft with respiratory minute volume of 30 litres per minute BTPD. The equipment and system must be designed to prevent any leakage to the inside of the mask and any significant increase in the oxygen content of the local ambient atmosphere (see AC 1439)

TAR 1457 Cockpit voice recorders

(a) Each cockpit voice recorder required by the operating rules must be approved and must be installed so that it will record the following:

(1) Voice communications transmitted from or received in the airship by radio.

(2) Voice communications of flight-crew members on the flight deck.

(3) Voice communications of flight-crew members on the flight deck, using the airship interphone system.

(4) Voice or audio signals identifying navigation or approach aids introduced into a headset or speaker.

(5) Voice communications of flight-crew members using the passenger loudspeaker system, if there is such a system and if the fourth channel is available in accordance with the requirements of subparagraph (c)(1)(iv)(B) of this paragraph.

(b) The recording requirements of subparagraph (a)(2) of this paragraph must be met by installing a cockpit-mounted area microphone, located in the best position for recording voice communications originating at the first and second pilot stations and voice communications of other crew members on the flight deck when directed to those stations. The microphone must be so located and, if necessary, the pre-amplifiers and filters of the recorder must be so adjusted or supplemented, that the intelligibility of the recorded communications is 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:

(1) the part of the communication or audio signals specified in subparagraph (a) of this paragraph obtained from each of the following sources is recorded on a separate channel:

(i) for the first channel, from each boom, mask, or hand-held microphone, headset, or speaker used at the first pilot station.

(ii) for the second channel, from each boom, mask, or hand-held microphone, headset, or speaker used at the second pilot station.

(iii) for the third channel, from the cockpit-mounted area microphone.

(iv) for the fourth channel, from:

(A) each boom, mask, or hand-held microphone, headset or speaker used at the stations for the third and fourth crew members; or:

(B) if the stations specified in subparagraph (c)(1)(iv)(A) of this paragraph are not required or if the signal at such a station is picked up by another channel, each microphone on the flight deck that is used with the public address system if its signals are not picked up by another channel.

(2) As far as is practicable all sounds received by the microphones listed in subparagraphs (c)(1)(i),(ii) and (iv) of this paragraph are recorded without interruption irrespective of the position of the interphone-transmitter key switch. The design must ensure that sidetone for the flight crew is produced only when the interphone, public address system or radio transmitters are in use.

(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 without jeopardising service to essential or emergency loads;

(2) There is an automatic means to stop simultaneously the recorder and prevent each erasure feature from functioning, within 10 minutes after crash impact; and

(3) There is an aural or visual means for pre-flight checking of the recorder for proper operation.

(e) The record container must be located and mounted to minimise the probability of rupture of the container as a result of crash impact and consequent heat damage to the record from fire

(f) If the cockpit voice recorder has a bulk erasure device, the installation must be designed to minimise the probability of inadvertent operation and actuation of the device during crash impact.

(g) Each recorder container must:

(1) Be either bright orange or bright yellow;

(2) Have reflective tape affixed to its external surface to facilitate its location under water; and

(3) Have an underwater locating device, when required by the operating rules, on or adjacent to the container which is secured in such a manner that they are not likely to be separated during crash impact.

TAR 1459 Flight recorders

(a) Each flight recorder required by the operating rules must be installed so that:

(1) It is supplied with airspeed, altitude, and directional data obtained from sources that meet the accuracy requirements of TAR 1323, 1325 and 1327, as appropriate;

(2) The vertical acceleration sensor is rigidly attached and located longitudinally within the approved centre of gravity limits of the airship.

(3) It receives its electrical power from the bus that provides the maximum reliability for operation of the flight recorder without jeopardising service to essential or emergency loads;

(4) There is an aural or visual means for preflight checking of the recorder for proper recording of data in the storage medium;

(5) Except for recorders powered solely by the engine-driven electrical generator system, there is an automatic means to simultaneously stop a recorder that has a data erasure feature and prevent each erasure feature from functioning, within 10 minutes after crash impact; and:

(6) There is a means to record data from which the time of each radio transmission either to or from ATC can be determined.

(b) Each non-ejectable record container must be located and mounted so as to minimise the probability of container rupture resulting from crash impact and subsequent damage to the record from fire.

(c) A correlation must be established between the flight recorder readings of airspeed, altitude, and heading and the corresponding readings (taking into account correction factors) of the first pilot's instruments. The correlation must cover the airspeed range over which the airship is to be operated, the range of altitude to which the airship is limited, and 360º of heading. Correlation may be established on the ground as appropriate.

(d) Each recorder container must:

(1) Be either bright orange or bright yellow;

(2) Have reflective tape affixed to its external surface to facilitate its location under water;

(3) Have an underwater locating device, when required by the operating rules of this chapter, on or adjacent to the container which is secured in such a manner that they are not likely to be separated during crash impact.

(e) Any novel or unique design or operational characteristics of the airship shall be evaluated to determine if any dedicated parameters must be recorded on flight recorders in addition to or in place of existing requirements.

TAR 1461 Equipment containing high energy rotors

(a) Equipment containing high energy rotors must meet subparagraph (b), (c), or (d) of this paragraph.

(b) High energy rotors contained in equipment must be able to withstand damage caused by malfunctions, vibration, abnormal speeds, and abnormal temperatures. In addition:

(1) Auxiliary rotor cases must be able to contain damage caused by the failure of high energy rotor blades;

(2) Equipment control devices, systems, and instrumentation must ensure, to a reasonable extent, that no operating limitations affecting the integrity of high energy rotors will be exceeded in service.

(c) It must be shown by test that equipment containing high energy rotors can contain any failure of a high energy rotor that occurs at the highest speed obtainable with the normal speed control devices inoperative.

(d) Equipment containing high energy rotors must be located where rotor failure will neither endanger the occupants nor adversely affect continued safe flight.

TAR 1499 Domestic services and appliances

(a) Domestic appliances must be so designed and installed that in the event of failures of the electrical supply or control system the requirements of TAR 1309 (b), (c) and (d) will be satisfied (see AC 1499 *(reserved)*).

(b) The installation of galleys and cooking appliances must be such as to minimise the risk of fire (see AC 1499 *reserved*).

(c) Domestic appliances, particularly those in galley areas must be so installed or protected as to prevent damage or contamination of other equipment or systems from fluids or vapours which may be present during normal operation or as a result of spillage, where such damage or contamination may hazard the airship.

(d) All electric domestic appliances must be suitably bonded to earth potential.

AC 1499 Acceptable means of compliance

1. Heated Domestic Appliances (Galley Equipment)

(a) The design and installation of heated domestic appliances should be such that no single failure (e.g. welded thermostat or contactor, loss of water supply) can result in dangerous overheating and consequent risk of fire or smoke or injury to occupants. An acceptable method of achieving this is by the provision of a means independent of the normal temperature control system, which will automatically interrupt the electrical power supply to the unit in the event of an overheat condition occurring. The means adopted should be such that it cannot be reset in flight.

(b) The design and installation of microwave ovens should be such that no hazard could be caused to the occupants or the equipment of the airship under either normal operation or single failure conditions.

(c) Heated liquid containers, e.g. water boilers, coffee makers should, in addition to overheat protection, be provided with an effective means to relieve overpressure, either in the equipment itself or in its installations.

Notes: Due account should be taken of the possible effects of lime scale deposit both in the design and maintenance procedures of water heating equipment. The design of galley and cooking appliance installations should be such as to facilitate cleaning to limit the accumulation of extraneous substances which may constitute a fire risk.

2. Electric Overheat Protection Equipment, Including those Installed in Domestic Systems

Unless it can be shown that compliance with JAR 25X1499(a) is provided by the circuit protective device required by JAR 25.1357(a), electric motors and transformers etc., installed in domestic systems, should be provided with a suitable thermal protection device if necessary to prevent them overheating such as to create a smoke or fire hazard under normal operation and failure conditions.

The following should be taken into consideration:

(a) Failures of any automatic control systems, e.g. automatic timer systems, which may cause the motor to run continuously;

(b) Short circuit failures of motor windings or transformer windings to each other or to the motor or transformer frame;

(c) Open circuit of one or more phases on multi-phase motors;

(d) Motor seizures;

(e) The proximity of flammable materials or fluids;

(f) The proximity of other airship installations;

(g) Spillage of fluids, such as toilet waste;

(h) Accumulation of combustible material; and

(i) Cooling air discharge under normal operating or failure conditions.

3. Water systems

Where water is provided in the airship for consumption or use by the occupant, the associated system should be designed so as to ensure that no hazard to the airship can result from water coming into contact with electrical or other systems. Service connections (filling points) should be of a different type from those used for other services, such that water could not inadvertently be introduced into the systems for other services.

Subpart G - Operating Limitations and Information

GENERAL

TAR 1501 General

(a) Each operating limitation specified in TAR 1505 through 1528 and other limitations and information necessary for safe operation must be established.

(b) The operating limitations and other information necessary for safe operation must be made available to the crew members as prescribed in TAR 1541 through 1601.

OPERATING LIMITATIONS

TAR 1503 Airspeed limitations: general

When airspeed limitations are a function of mass, mass distribution, static heaviness, altitude, limitations corresponding to each critical combination of these factors must be published.

TAR 1505 Maximum operating speed limits

The maximum operating limit speed, V_{MO}, is a speed that may not be deliberately exceeded in any regime of flight (climb, cruise, or descent), unless a higher speed is authorised for flight test or pilot training operations. V_{MO} must be established so that it is not greater than the design maximum level flight airspeed V_H and so that it is sufficiently below V_{CD}, to make it highly improbable that the latter speed will be inadvertently exceeded in operations.

TAR 1515 Landing gear speeds

(a) The maximum landing gear operating speed, V_{LO}, may not exceed the speed determined under TAR 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

TAR 1516 Other speed limitations

Any other limitation associated with speed must be established.

TAR 1519 Mass and centre of gravity and mass distribution

The mass/static lift and centre of gravity/static lift limitations determined under TAR 23 must be established as operating limitations. This includes the maximum take-off mass, maximum landing mass and maximum permissible static heaviness and static lightness. The distribution of mass, static lift and useful load must be established as operating limitations. If a control car is used, its maximum mass must be determined. The maximum mass of all items supported by the keel or car structure, including cargo, passengers, crew, fuel and ballast must be determined for each location. A procedure for monitoring and recording the load distribution must be established and satisfy TAR 1583(c)(4).

TAR 1521 Powerplant limitations

(a) General: the powerplant limitations prescribed in this paragraph must be established so that they do not exceed the corresponding limits for which the engines or propellers are either approved or type certificated and do not exceed the values on which compliance with any other requirement of this TAR is based.

(b) Take-off operation with relation to augmented or unaugmented operation as applicable: the powerplant take-off operation must be limited by:

(1) the maximum rotational speed (r.p.m.);

(2) the maximum allowable manifold pressure (for reciprocating, altitude engines);

(3) the maximum allowable gas temperature (for turbine engines);

(4) horsepower, torque or thrust (for turbine engines)

(5) the time limit for the use of the Take-off operation corresponding to the limitations established in subparagraphs (1) through (4) of this paragraph;

(6) the maximum allowable cylinder head, liquid coolant and oil temperatures (as applicable).

(c) Continuous operation with relation to augmented or unaugmented operation as applicable: the continuous operation must be limited by

(1) the maximum rational speed;

(2) the maximum allowable manifold pressure (for reciprocating, altitude engines);

(3) the maximum allowable gas temperature (for turbine engines);

(4) horsepower, torque or thrust (for turbine engines)

(5) the maximum allowable cylinder head (as applicable), oil and liquid coolant temperatures.

(d) Fuel grade or designation: the minimum fuel grade (for reciprocating engines) or fuel designation or specification (for turbine engines) must be established so that it is not less than that required for the operation of the engines within the limitations of paragraphs (b) and (c) of this paragraph.

(e) Any other parameter for which a limitation has been established as part of the engine type certificate except that a limitation need not be established for a parameter that cannot be exceeded during normal operation due to the design of the installation or to another established limitation.

(f) Transmission (for thrusters): the transmission operation must be limited by:

(1) the maximum rotational speed, which may not be greater than -

(i) the maximum value determined by the design; or

(ii) the maximum value shown during the type tests;

(2) the maximum allowable power or torque for each engine, considering the power input limitations of the transmission with all engines operating;

(3) the time limit for the use of the power corresponding to the limitations established in subparagraphs (b) (1) and (2) of this paragraph; and

(4) the maximum allowable transmission oil temperatures.

(g) Ambient temperature limitations (including limitations for winterisation installations if applicable) must be established as the maximum ambient atmospheric temperature at which compliance with the cooling provisions of TAR 1041 to 1045 is shown.

TAR 1522 Auxiliary power unit limitations

If an auxiliary power unit (APU) is installed in the airship, limitations established for the APU, including categories of operation, must be specified as operating limitations for the airship.

TAR 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 crew members;

(b) the accessibility and ease of operation of necessary controls by the appropriate crew members;

(c) the kinds of operation authorised under TAR 1525;

(d) appropriate crew coordination for all tasks where several crew members are incorporated in the operation:

(e) adequate supervision/control when the airship is moored.

TAR 1524 Systems and equipment limitations

All limitations applicable to functional equipment and systems installations, and which are considered necessary for safe operation, must be established.

TAR 1525 Kinds of operation

The kinds of operation to which the airship is limited are established by the category in which it is eligible for certification and by the installed equipment.

TAR 1526 Maximum rates of climb and descent

The maximum rates of climb and descent determined under TAR 65(b) through 65(c) must be established.

TAR 1527 Ambient air temperature and operating altitude

The extremes of the ambient air temperature and operating altitude for which operation is allowed, as limited by flight, structural, powerplant, functional, or equipment characteristics, must be established.

TAR 1528 Envelope, lifting gas and ballonet pressures

Operating pressure differential limitations for the envelope, gas cells and ballonets, as limited by flight, structural and functional requirements, must be established.

TAR 1529 Instructions for continued airworthiness

The applicant must prepare Instructions for Continued Airworthiness in accordance with JAR 25, as appropriate, that are acceptable to the Authority. The instructions may be incomplete at type certification if a programme exists to ensure their completion prior delivery of the first airship or issuance of a standard certificate of airworthiness whichever occurs later.

TAR 1530 Engine or propeller vectoring

The maximum engine vectoring angles, to which operation is allowed, as limited by flight, structural, powerplant, and functional requirements, must be established.

TAR 1533 Additional operating limits

Maximum passenger/location configuration: the maximum number of passengers and their location must be established, considering the different flight-phases.

MARKINGS AND PLACARDS

TAR 1541 General

(a) The airship must contain

(1) The specified markings and placards;

(2) Any additional information, instrument markings, and placards required for the safe operation of the airship.

(b) Each marking and placard prescribed in subparagraph (a) of this paragraph

(1) Must be displayed in a conspicuous place;

(2) May not be easily erased, disfigured, or obscured.

TAR 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;

(b) each arc and line must be wide enough and located to be clearly visible to the pilot;

(c) when digital instruments are used the operating limitations should be shown by coloured symbology or warning lights. An analogue trend indication must be provided unless the Authority determines that the trend indicator advantages of an analogue indicator are not needed. The limiting values must then also be marked on the analogue indicator.

TAR 1544 Operating pressure limitations

The maximum operating pressures must be indicated on each gauge for the envelope, ballonets or gas cells in pressure airships and gas cells in rigid airships

TAR 1545 Airspeed limitation information

There must be a red arc or line marking for V_{MO} made at the lowest value of V_{MO} established for any altitude up to the maximum operating altitude for the airship. In addition each other airspeed limitation established in accordance with TAR 1505 to 1516 must be stated on a placard installed in clear view of each pilot unless the associated instrument has been colour coded or provided with a limit indicating device.

TAR 1547 Magnetic direction indicator

(a) A placard meeting the requirements of this paragraph must be installed on or near the magnetic direction indicator.

(b) The placard must show the calibration of the instruments 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 30° increments.

(e) If a magnetic nonstabilised direction indicator can have a deviation of more than 10° caused by the operation of electrical equipment, the placard must state which electrical loads, or combination of loads, would cause a deviation of more than 10° when turned on.

TAR 1549 Powerplant instruments

For each required powerplant instrument, as appropriate to the type of instrument

(a) Each maximum and, if applicable, minimum safe operating limit must be marked with a red radial or a red line;

(b) Each normal operating range must be marked with a green arc or green line, not extending beyond the maximum and minimum safe limits;

(c) Each take-off and precautionary range must be marked with a yellow arc or a yellow line;

(d) Each engine, propeller speed range, vectoring angle and speed and bow/tail thruster deflection that is restricted because of excessive vibration stresses must be marked with red arcs or red lines.

TAR 1551 Oil quantity indicator

Each oil quantity indicator must be marked in sufficient increments to indicate readily and accurately the quantity of oil.

TAR 1553 Fuel quantity indicator

If the unusable fuel supply for any tank exceed 4 litres or 5% 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.

TAR 1555 Control markings

(a) Each cockpit control, other than primary flight controls and controls, the function of which is obvious, must be plainly marked as to its function and method of operation.

(b) Each secondary control must be suitably marked.

(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 near the selector for those tanks;

(3) The conditions under which the full amount of usable fuel in any restricted usage fuel tank can safely be used must be stated on a placard adjacent to the selector valve for that tank;

(4) Each valve control for any engine must be marked to indicate the position corresponding to each engine controlled.

(d) Usable fuel capacity must be marked as follows.

(1) For fuel systems having no selector controls, the usable fuel capacity of the system must be indicated at the fuel quantity indicator.

(2) For fuel systems having selector controls, the usable fuel capacity available at each selector control position must be indicated near the selector control.

(e) For accessory, auxiliary, and emergency controls

(1) If retractable landing gear is used, the indicator required by TAR 729(e) must be marked so that the pilot can, at any time, ascertain that the wheels are secured in the extreme positions;

(2) Each emergency control must be red and must be marked with its method of operation.

TAR 1557 Miscellaneous markings and placards

(a) Throughout the ship, placarding shall ensure safe mass distribution. The following locations must have placards stating any limitations on contents, including mass, that are necessary under the loading requirements:

(1) each passenger compartment

(2) each location, where occupants are likely to gather

(3) each baggage and cargo compartments

(4) each ballast location

(b) Seats: if the maximum allowable mass to be carried in a seat is less than 77 kg (170 lb), a placard stating the lesser mass must be permanently attached to the seat structure.

(c) Fuel, coolant and oil filler openings: the following apply.

(1) Fuel filler openings must be marked at or near the filler cover with

(i)The wording of the required fuel (e.g. "Avgas","Diesel-Engine Oil" "Jet Fuel"); and

(ii) The minimum fuel grade, or references to the Flight Manual (AFM) for permissible fuel designations.

(iii) For pressure fuelling systems, the maximum permissible fuelling supply pressure and the maximum permissible defuelling pressure.

(2) Oil filter openings must be marked at or near the filler cover with the word 'Oil', the oil capacity, and the approved grade and specification of oil.

(d) Coolant filler openings must be marked at or near the filler cover with the word "Coolant".

(e) Augmentation fluid filler openings must be marked at or near the filler cover to identify the required fluid.

TAR 1559 Operating limitations placard

There must be a placard in clear view of the pilot that specifies the kind of operations (such as VFR, IFR, day or night) and meteorological conditions (such as icing conditions) to which the operation of the airship is limited, or from which it is prohibited, by the equipment installed.

TAR 1561 Safety equipment

(a) Safety equipment must be plainly marked with its method of operation.

(b) Stowage provisions for required safety equipment must be marked for the benefit of the occupants. Coloured arrows and pictograms shall direct occupants to the location of items of safety equipment, if they are located more than 3 m from the occupants seats, designated as occupiable during take-off, landing, taxiing and mooring and emergency situations.

TAR 1563 Airspeed/ Altitude/ Attitude placard

There must be placards for airspeed, altitude and attitude in clear view of the pilot and as close as practicable to the applicable indicators.

AIRSHIP FLIGHT MANUAL

TAR 1581 General

(a) Furnishing information: an Airship Flight Manual and an Airship Ground Handling Manual, for ground handling procedures, must be furnished with each airship, and they must contain the following.

(1) Information required by TAR 1583 through 1589;

(2) Other information that is necessary for safe operation because of design, operating, or handling characteristics.

(b) Approved information:

(1) Each part of the Airship Flight Manual containing information prescribed in TAR 1583 through 1589 must be approved, segregated, identified, and clearly distinguished from each unapproved part of that manual.

(2) *(reserved)*

(3) Each page of the Airship Flight Manual containing information prescribed in this paragraph must be of a type that is not easily erased, disfigured, or misplaced, and is capable of being inserted in a manual provided by the applicant, or in a folder, or in any other permanent binder.

(c) Each Airship Flight Manual must include a table of contents if the complexity of the manual indicates a need for it.

TAR 1583 Operating limitations

(a) Airspeed limitations: the following information must be furnished.

(1) The maximum operating limit speed, V_{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 authorised for flight test or pilot training;

(2) The landing gear operating speed or speeds, if applicable, and a statement explaining the speeds as defined in TAR 1515.

(3) (reserved)

(4) The maximum speed V_{RA} for flight in rough air

(b) Powerplant limitations: the following information must be furnished.

(1) Limitations required by TAR 1521 and 1522;

(2) Explanation of the limitations, when appropriate;

(3) Information necessary for marking the instruments required by TAR 1549 through 1553.

(c) Mass/Lift: the Airship Flight Manual must include the following mass/lift limitations.

(1) Maximum mass/lift (take-off);

(2) Maximum landing mass/lift;

(3) Maximum permissible static heaviness and static lightness;

(4) Maximum useful load and distribution;

(5) Maximum baggage compartment mass.

(6) Maximum freight loading unit mass (maximum freight inclusive)

(d) Centre of gravity: the established centre of gravity limits must be furnished.

(e) Flight crew: the minimum crew required must be stated and if more than one is required for safety, the number and functions of the minimum flight crew must be furnished.

(f) Types of operation: the types of operation (such as VFR, IFR, day, or night) and the meteorological conditions under which the airship may or may not be used, must be furnished. Installed equipment that affects any operating limitation must be listed and identified with its operational function.

(g) Maximum passenger configuration: the maximum number of passengers and their required location (plus safety precautions) during take-off and landing must be furnished.

(h) Gas cell or envelope pressure: the minimum and maximum gas cell or envelope and (when installed) ballonet pressures must be furnished.

(i) Maximum rates of ascent and descent: the maximum rates of ascent and descent must be furnished.

(j) Manoeuvres: the maximum pitch angles and turning rates for the airship must be furnished in relation to flying speed.

(k) Placards: any placards which are required by TAR 1541 through 1563 must be reproduced in the Airship Flight Manual together with a written description of the appropriate locations of each on the airship.

(l) Snow loads: the maximum loads of snow or ice and information for measuring these loads must be established and furnished in the Airship Flight Manual and Airship Ground Handling Manual.

(m) Types of surface: a statement of the types of surface of the landing fields on which operation may be conducted.

(n) System and equipment limitations established must be furnished.

(o) The extremes of the ambient air temperatures and operating altitudes must be furnished.

TAR 1585 Operating procedures

(a) For each airship, information concerning normal and emergency procedures and other pertinent information necessary for safe operation must be furnished, including

(1) The recommended climb speed and any variation with altitude;

(2) The recommended take-off and climb profiles including use of auxiliary thrust, lift, and trim controls, and power management for normal take-off and climb as well as for short field operations, if different;

(3) The recommended approach and landing speeds and profiles including use of auxiliary thrust, lift and trim controls and power management for normal approach and landing as well as for short field operations, if different;

(4) Landing and loading interruption information:

(i) the recommended balked landing climb airspeeds and procedures for transitioning from approach and landing to the balked landing climb;

(ii) the recommended procedure for interrupted cargo or ballast loading based on the requirements of TAR 80(c);

(5) The recommended procedures for transitioning from powered flight to free balloon mode and associated descent and landing procedures in the free balloon mode;

(6) Operational procedures for maintaining lifting gas pressures based on the requirements of TAR 887;

(7) Instructions covering the use of control system locks, when used;

(8) Flammable fluid fire protection instructions and procedures based on the requirements of TAR 863;

(9) The recommended procedures for starting and stopping engines as required by TAR 903(e) and (f);

(10)Ditching instructions and procedures (including the procedures based on the requirements of TAR 807(b), TAR 1411 and 1415);

(11)Instructions and procedures covering the use of fuel ice protection equipment required by TAR 1419;

(12)*(reserved)*;

(13)The recommended ground handling, mast handling, and mooring procedures required by TAR 255 (these procedures must reflect the design capabilities of the airship as required by TAR 481). Description in a separate manual is optional;

(14)Operational procedures covering ballast disposal based on the requirements of TAR 895;

(15)Operational procedures covering fuel jettisoning based on the requirements of TAR 1001;

(16)Operational procedures covering the emergency evacuation based on the requirements of TAR 803 and TAR 883(g).

(17)The maximum demonstrated values of wind for mooring, take-off and landing and procedures and information pertinent to operations in wind.

(b) The following information and procedures must also be included:

(1) normal and emergency procedures for single engine operations and all engine out operations;

(2) informations and procedures for obtaining the best performance must be furnished for various configurations of the airship for the following conditions:

(i) One or more engines inoperative

(ii) One or more auxiliary or vectored thrust systems inoperative

(3) Procedures for take-off determined in accordance with TAR 51;

(4) Information identifying each operating condition in which the fuel system independence prescribed in TAR 953 is necessary for safety must be furnished, together with instructions for placing the fuel system in a configuration used to show compliance with that paragraph.

(c) For each airship showing compliance with TAR 1353(c), the operating procedures for disconnecting the battery from its charging source must be furnished.

(d) If the unusable fuel quantity in any tank exceed 5% of the tank capacity, or 4 litres, whichever is greater, information must be furnished which indicates that when the fuel quantity indicator reads 'zero' in level flight, any fuel remaining in the fuel tank cannot be used safely in flight.

(e) Information on the total quantity of usable fuel for each fuel tank must be furnished.

(f) In addition, the procedures for restarting turbine engines in flight, including the effects of altitude, must be set forth in the Airship Flight Manual.

TAR 1587 Performance information

(a) For each airship, if applicable, the following information must be furnished:

(1) Any loss of altitude more than 100 ft (30 m), or any pitch angle greater than 30°, occurring during the recovery prescribed in TAR 76 and 203;

(2) The conditions under which the full amount of usable fuel in each tank can safely be used;

(3) The take-off distance determined under TAR 51, the airspeed at the 50 ft (15 m) height, the airship configuration (if pertinent), the kind of surface in the tests, use of flight path control devices and use of the landing gear retraction system (if installed);

(4) The landing distance determined under TAR 75, the airship configuration (if pertinent), the use of bow or tail thrusters (if installed) and the kind of surface used in the tests;

(5) The steady rate or gradient of climb determined under TAR 65 and 67, the airspeed, power, and the airship configuration;

(6) The calculated approximate effect on take-off distance (subparagraph (a)(3) of this paragraph), landing distance (subparagraph (a)(4) of this paragraph), and steady rates of climb (subparagraph (a)(5) of this paragraph), of variations in

(i) Altitude from sea level to maximum design take-off altitude;

(ii) Temperature at these altitudes from 33°C (60°F) below standard to 22°C (40°F) above standard;

(iii) Relative humidity at these altitudes from 20% to 100%;

(iv) Lifting gas purity.

(7) For reciprocating engine-powered airships, the maximum atmospheric temperature at which compliance with the cooling provisions of TAR 1041 through 1063 is shown;

(8) Maximum speed for various static conditions and turbulence levels;

(9) Maximum airspeed, pitch and yaw angle and all other relevant data, established under TAR 80, allowed during cargo exchange operations

(10)Maximum allowable wind and cross wind speeds during take-off and landing.

(11)Pressure height, or maximum allowable altitude, in relation to gas cell or ballonett fullness.

(b) The following additional information must be furnished.

(1) The best rate of climb speed with the critical engine(s) inoperative;

(2) The speed used in showing compliance with the cooling and climb requirements of TAR 1045 (e)(4), if this speed is greater that the best rate of climb speed with the critical engine inoperative;

(3) The steady rate or gradient of climb determined under TAR 67 and the airspeed, power, and airship configuration;

(4) The calculated approximate effect on the climb performance determined under TAR 67 of variations in:

(i) Altitude from sea level to maximum design altitude;

(ii) Temperature at these altitudes from 33°C (60°F) below standard (15°C) and 22°C (40°F) above standard;

(iii) Relative humidity at these altitudes from 20% to 100%;

(iv) Lifting gas purity;

(v) Effects on performance with various numbers of engines inoperative including a single operating engine.

(vi) Limits for vectored thrust positions and power settings required for take-off and landings for various static conditions.

(c) The Airship Flight Manual must contain at least the following performance information.

(1) Sufficient information so that the take-off mass limits specified in TAR 1583 can be determined for all temperatures and altitudes within the operational limitations selected by the applicant;

(2) The conditions under which the performance information was obtained including the airspeed at the 50 ft height used to determine the landing distance as required by TAR 75;

(3) The performance information (determined by extrapolation and computed for the range of mass between the maximum landing and maximum take-off mass) for

(i) Climb in the landing configuration as determined by TAR 77; and:

(ii) Landing distance as determined by TAR 75;

(4) Procedures information established in accordance with the limitations and other information for safe operation of the airship in the form of recommended procedures;

(5) An explanation of significant or unusual flight and ground handling characteristics of the airship.

TAR 1589 Loading information

The following loading information must be furnished:

(a) the mass and location of each item of equipment included in the empty mass as determined under TAR 29

(b) appropriate loading instructions for each possible loading condition between the maximum and minimum mass determined under TAR 25 that can result in a centre of gravity distribution beyond:

(1) The extremes selected by the applicant; or

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

(3) The extremes within which compliance with each functional requirement is shown.

TAR 1601 Airworthiness Airship Cabin Manual (AACM)

See AC 1601.

AC 1601 *(reserved)*

Subpart J - Gas Turbine Auxilliary Power Unit Installation

Part A - All APUs

GENERAL

TAR A901 Installation

(b) For each APU

(1) The installation must comply with:

(i) The installation instructions provided under JAR-APU or other requirements approved by the authority, and

(ii) the provisions of Part A for non-essential APUs *[(2)] and the provisions of Parts A and B for essential APUs *[(3)].

(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 (see ACJ 25A901(b)(2)).

(3) The installation must be accessible for necessary inspections and maintenance; and (4) The major components of the installations must be electrically bonded to the other parts of the airship (see ACJ 25A901 (b)(4)).

(c) The APU installation must comply with TAR 1309. Where the air-flow delivery from the APU and main engine is delivered to a common manifold system, precautions must be taken to minimise the possibility of a hazardous condition due to reverse air flow through the APU resulting from malfunctions of any component in the system.

(d) The satisfactory functioning of the APU must be demonstrated by ground and flight tests over the range of operating conditions for which certification is required and must include tests under hot climatic conditions, unless equivalent evidence can be produced (see ACJ-25A901(d)).

TAR A903 Auxiliary power unit

(a) Each APU must meet the requirements of JAR-APU for the corresponding category and class of operation intended or other requirements approved by the authority.

(c)Control of APU rotation and shut-down capability

(1) It shall be possible to shut down the APU from the flight deck in normal and emergency conditions.

(2) There must be a means for stopping the rotation of any APU individually in flight, except that the means of stopping the rotation of any APU need be provided only where continued rotation could jeopardise the safety of the airship. Each component of the stopping system on the APU side of the firewall that might be exposed to fire must be at least fire-resistant.

(3) In particular, where no means is provided to prevent continued rotation, the safety of the airship must be shown in the even of failure of the APU oil supply.

(d) For APU installations:

(1) Design precautions must be taken to minimise the hazards to the airship in the event of an APU rotor failure or of a fire originating within the APU which burns through the APU casing.

(2) The powerplant systems associated with APU control devices, systems, and instru-mentation, must be designed to give reasonable assurance that those APU operating limitations that adversely affect turbine rotor structural integrity will not be exceeded in service.

TAR A939 APU operating characteristics

(a) APU operating characteristics must be investigated in flight to determine that no adverse characteristics (such as stall, surge, or flame-out for Turbine APUs) are present, to a hazardous degree, during normal and emergency operation within the range of operation limitations of the airship and of the APU. Compliance need not be shown if operation of the APU is limited to ground use only with the airship stationary (see ACJ 25A939(a)).

(c) The APU air inlet system may not, as a result of air-flow distortion during normal operation, cause.vibration harmful to the APU.

(d) It must be established over the range of operating conditions for which certification is required, that the APU installation vibratory conditions do not exceed the critical frequencies and amplitudes established under JAR-APU, Section 1, Appendix 1, paragraph 6.18. or other requirements.

TAR A943 Negative acceleration

No hazardous malfunction of an APU or any component or system associated with the APU may occur when the airship is operated at the negative accelerations within the flight envelopes prescribed in TAR 333. This must be shown for the greatest duration expected for the acceleration. (See ACJ 25A943.)

FUEL SYSTEM

TAR A952 Fuel system analysis and test

(a) Proper fuel system functioning under all probable operating conditions must be shown by analysis and those tests found necessary by the Authority. Tests, if required, must be made using the airship fuel system or a test article that reproduces the operating characteristics of the portion of the fuel system to be tested.

(b) The likely failure of any heat exchanger using fuel as one of its fluids may not result in a hazardous condition.

FUEL SYSTEM COMPONENTS

TAR A993 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 airship between which relative motion could exist must have provisions for flexibility.

(c) Each flexible connection in fuel lines that may be under pressure and subject to axial loading must use flexible hose assemblies or equivalent means.

(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 an APU hutdown.

(f) Each fuel line within must be designed and installed to allow a reasonable degree of deformation and stretching without leakage.

TAR A994 Fuel system components

Fuel system components in an APU compartment or in the hull must be located or protected from damage which could cause the release of dangerous quantities of fuel as a result of an unintended contact with the ground.

TAR A995 Fuel valves

In addition to the requirements of TAR A1189 for shut-off means, each fuel valve must:

(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.

TAR A999 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 required by sub-paragraph (a) of this paragraph must

(1) Discharge clear of all parts of the airship;

(2) Have manual or automatic means for positive locking in the closed position; and

(3) Have a drain valve

(i) That is readily accessible and which can be easily opened and closed; and

(ii) That is either located or protected to prevent fuel spillage in dangerous quantities in the event of an unintended contact with the ground.

OIL SYSTEM

TAR A1011 General

(a) Each APU 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. The oil system for the APU must comply with JAR-APU or other requirements approved by the authority even if the oil system is not an integral part of the APU.

TAR A1017 Oil lines and fittings

(b) Breather lines must be arranged so that

(1) Condensed water vapour that might freeze and obstruct the line cannot accumulate at any point;

(2) The breather discharge does not constitute a hazard if foaming occurs; or

(3) The breather does not discharge into the APU air induction system.

TAR A1021 Oil drains

There must be at least one accessible drain that

(a) Allows safe drainage of the entire oil system.

TAR A1023 Oil radiators

(b) Each oil radiator air duct must be located so that, in case of fire, flames coming from normal openings of the APU compartment cannot impinge directly upon the radiator.

TAR A1025 Oil valves

(a) Each oil shut-off must meet the requirements of TAR A1189.

(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.

COOLING

TAR A1041 General

The APU cooling provisions must be able to maintain the temperatures of APU components and fluids within the temperature limits established for these components and fluids, under ground and flight operating conditions, and after normal shut down.

TAR A1043 Cooling tests

(a) General. Compliance with TAR A1041 must be shown by tests under critical ground 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 APU temperatures must be corrected under sub-paragraph (c) of this paragraph.

(2) No corrected temperatures determined under sub-paragraph (1) of this paragraph may exceed established limits.

(3) The fuel used during the cooling tests must be the grade approved for the APUs. The test procedures must be as prescribed in TAR A1045.

(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 airship. The temperature lapse rate is 3.6ºF (2.0ºC) per thousand feet of altitude above sea-level until a temperature of -69.7ºF (-56.5ºC) is reached, above which altitude, the temperature is considered constant at -69.7ºF (-56.5ºC).

(c) Correction factor. Unless a more rational correction applies, temperatures of APU fluids and components 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.

TAR A1045 Cooling test procedures

(a) For each stage of flight, the cooling test must be conducted with the airship in the configuration most critical for cooling (including cowl flap settings selected by the applicant for reciprocating engine powered airships, and where vectored thrust is provided, including vectoring procedures established by the applicant.

(b) Temperature stabilization: For the purpose of the cooling tests, a temperatures is 'stabilised' when its rate of change is less than 1.1°C (2°F) per minute.

(c) Temperatures must be stabilised 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 APU fluid temperatures would stabilise (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 take-off cooling test must be preceded by a period during which the APU component and APU fluid temperatures are stabilised with the APU operating normally.

(d) Cooling tests for each state of flight must be continued until

(1) The component and APU fluid temperatures stabilise;

(2) The stage of flight is completed; or

(3) An operating limitation is reached.

AIR INTAKE SYSTEM

TAR A1091 Air intake

(a) The air intake system for the APU must supply

(1) The air required by the APU under each operating condition for which certification is requested.

(d) Ingestion

(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 APU air intake system.

TAR A1093 Air intake system de-icing and anti-icing provisions

(b)(3) Each nonessential APU air intake system which does not comply with TAR B1093 (b)(2) must be restricted to use in non-ice conditions, unless it can be shown that the APU complete with air intake system, if subjected to icing conditions, will not affect the safe operation of the airship.

TAR A1103 Air intake system ducts

(a) Each air intake system duct upstream of the first stage of the APU compressor or FCU (for reciprocating APUs) 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 air intake system duct must be

(1) Strong enough to prevent air intake system failures resulting from reverse flow due to APU surging (for Turbine APUs); and

(2) Fireproof within the APU compartment. Outside the APU compartment the materials used to form the air intake duct and plenum chamber of the APU must be capable of resisting the maximum heat conditions likely to occur under reverse flow conditions.

(c) Each duct connected to components between which relative motion could exist must have means for flexibility.

(d) For APU bleed air systems no hazard may result if a duct rupture or failure occurs at any point between the APU port and the airship unit served by the bleed air.

(e) Each APU air intake system duct must be constructed of materials that will not absorb sufficient quantities of flammable fluids such as to create a fire hazard due to ignition caused by reverse flow during surging.

TAR A1105 Air intake system screens

If air intake system screens are used

(c) No screen may be de-iced by alcohol alone.

EXHAUST SYSTEM.

TAR A1121 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 located dangerously close to parts of any system carrying flammable fluids or vapours, 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 airship that are outside the APU 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 vapours external to the shroud.

TAR A1123 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.

APU CONTROLS AND ACCESSORIES

TAR A1141 APU controls: general

Each APU control must be located, arranged and designed to meet the objectives of TAR 777 through TAR 779 and marked in accordance with TAR 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-crew members and without creep due to control loads or vibration.

(f) Control valves:

(1) For manual valves, positive stops or, in the case of fuel valves, suitable index provisions in the open and closed positions must be provided.

(2) In the case of valves controlled from the cockpit other than by mechanical means, where the correct functioning of such a valve is essential for the safe operation of the airship, a valve position indicator which senses directly that the valve has attained the position selected must be provided, unless other indications in the cockpit give the flight crew a clear indication that the valve has moved to the selected position. A continuous indicator need not be provided.

TAR A1163 APU accessories

(a) APU mounted accessories must be approved for installation on the APU concerned and use the provisions of the APU for mounting.

(b) Electrical equipment subject to arcing or sparking must be installed to minimise the probability of contact with any flammable fluids or vapours that might be present in a free state.

APU FIRE PROTECTION

TAR A1181 Designated fire zones: regions included

(a) Designated fire zones are:

(4) Any APU compartment.

(b) Each designated fire zone must meet the requirements of TAR A1185 through A1203.

TAR A1183 Lines, fittings and components

(a) Except as provided in sub-paragraph (b) of this paragraph, each line, fitting, and other component carrying flammable fluid in any area subject to APU fire conditions, and each component which conveys or contains flammable fluid in a designated fire zone must be fire resistant, except that flammable fluid tanks and supports in a designated fire zone must be fireproof or be enclosed by a fireproof shield unless damage by fire to any non-fireproof part will not cause leakage or spillage of flammable fluid. Components must be shielded or located to safeguard against the ignition of leaking flammable fluid. An integral oil sump of less than 22 litres (20 quart) capacity need not be fireproof nor be enclosed by a fireproof shield.

(b) Subparagraph (a) of this paragraph does not apply to

(1) Lines and fittings already approved as part of an APU, and

(2) Vent and drain lines, and their fittings, the failure of which will not result in, or add to, a fire hazard.

(c) All components, including ducts, within a designated fire zone which, if damaged by fire could result in fire spreading to other regions of the airship, must be fireproof. Those components within a designated fire zone, which could cause unintentional operation of, or inability to operate essential services or equipment, must be fireproof.

TAR A1185 Flammable fluids

(a) Except for the integral oil sumps specified in TAR 1013 (a), no tank or reservoir that is a 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 shut-off means, and all connections, lines, and controls 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 12 mm (0.5 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.

TAR A1187 Drainage and ventilation of fire zones

(a) There must be complete drainage of each part of each designated fire zone to minimise 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 vapours.

(c) No ventilation opening may be where it would allow the entry of flammable fluids, vapours, or flame from other zones.

(d) Each ventilation means must be arranged so that no discharged vapours 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.

TAR A1189 Shut-off means

(a) Each APU compartment specified in TAR A1181 (a)(4) 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, except that shut-off means are not required for

(1) Lines forming an integral part of an APU and

(2) Oil systems for APU installations in which all external components of the oil system, including the oil tanks, are fireproof.

(b) The closing of any fuel shut-off valve for any

APU may not make fuel unavailable to the main engines.

(c) Operation of any shut-off may not interfere with the later emergency operation of other equipment.

(d) Each flammable fluid shut-off means and control must be fireproof or must be located and protected so that any fire in a fire zone will not affect its operation.

(e) No hazardous quantity of flammable fluid may drain into any designated fire zone after shut-off.

(f) There must be means to guard against inadvertent operation of the shut-off means and to make it possible for the crew to reopen the shut-off means in flight after it has been closed.

(g) Each tank to APU shut-off valve must be located so that the operation of the valve will not be affected by the APU mount structural failure.

(h) Each shut-off valve must have a means to relieve excessive pressure accumulation unless a means for pressure relief is otherwise provided in the system.

TAR A1191 Firewalls

(a) Each APU must be isolated from the rest of the airship 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 airship;

(3) Constructed so that each opening is sealed with close fitting fireproof grommets, bushes, or firewall fittings; and

(4) Protected against corrosion.

TAR A1193 Cowling and nacelle skin

(a) Each cowl 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 TAR A1187.

(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 airship must

(1) Be designed and constructed so that no fire originating in any APU 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 sub-paragraph (e) (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 APU compartment.

TAR A1195 Fire extinguisher systems

(a) There must be a fire extinguisher system serving the APU compartment.

(b) The fire extinguishing system, the quantity of the extinguishing agent, the rate of discharge, and the discharge distribution must be adequate to extinguish fires. An individual 'one shot' system is acceptable. (See ACJ 25A1195 (b).)

(c) The fire-extinguishing system for an APU compartment must be able to protect simultaneously each zone of the APU compartment for which protection is provided.

TAR A1197 Fire extinguishing agents

(a) Fire extinguishing agents must

(1) Be capable of extinguishing flames emanating from any burning of fluids or other combustible materials in the area protected by the fire extinguishing system; and

(2) Have thermal stability over the temperature range likely to be experienced in the compartment in which they are stored.

(b) If any toxic extinguishing agent is used, provisions must be made to prevent harmful concentrations of fluid or fluid vapours (from leakage during normal operation of the airship 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 compartment fire extinguishing systems for which

(1) 2.3 kg (5 lbs) or less of carbon dioxide will be discharged, under established fire control procedures, into any compartment; or

(2) There is protective breathing equipment for each flight-crew member on flight deck duty.

TAR A1199 Extinguishing agent containers

(a) Each extinguishing agent container must have a pressure relief to prevent bursting of the container by excessive internal pressures.

(b) The discharge end of each discharge line from a pressure relief connection must be located so that discharge of the fire extinguishing agent would not damage the airship. The line must be located or protected to prevent clogging caused by ice or other foreign matter.

(c) There must be a means for each fire extinguishing agent container to indicate that the container has discharged or that the charging pressure is below the established minimum necessary for proper functioning.

(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.

(e) If a pyrotechnic capsule is used to discharge the extinguishing agent, each container must be installed so that temperature conditions will not cause hazardous deterioration of the pyrotechnic capsule.

TAR A1201 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 APU compartment must be fireproof.

TAR A1203 Fire-detector system

(a) There must be approved, quick acting fire or overheat detectors in each APU compartment in numbers and locations ensuring prompt detection of fire.

(b) Each fire detector system must be constructed and installed so that

(1) It will withstand the vibration, inertia, and other loads to which it may be subjected in operation;

(2) There is a means to warn the crew in the event that the sensor or associated wiring within a designated fire zone is severed at one point, unless the system continues to function as a satisfactory detection system after the severing; and

(3) There is a means to warn the crew in the event of a short circuit in the sensor or associated wiring within a designated fire zone, unless the system continues to function as a satisfactory detection system after the short circuit.

(c) No fire or overheat 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 or overheat detector electric circuit.

(e) Wiring and other components of each fire or overheat detector system in a fire zone must be at least fire-resistant.

(f) No fire or overheat 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 it passes; or

(2) Each zone involved is simultaneously protected by the same detector and extinguishing system.

(g) Each fire detector system must be constructed so that when it is in the configuration for installation it will not exceed the alarm activation time approved for the detectors using the response time criteria specified in the appropriate Technical Standard Order or an acceptable equivalent.

TAR A1207 Compliance

Compliance with the requirements of TAR A1181 through TAR A1203 must be shown by one or more of the following methods:

(a) Tests of similar gas turbine installations.

(b) Tests of components.

(c) Service experience of aircraft with similar APU installations.

(d) Analysis, unless tests are specifically required.

EQUIPMENT

TAR A1305 APU instruments

(a) The following instruments are required:

(1) A fire warning indicator.

(2) Any other instrumentation necessary to ensure safe operation of the APU.

TAR A1337 APU instruments

(a) Instruments and instrument lines.

(1) Each APU instrument line must meet the requirements of TAR A993 and TAR A1183.

(2) Each line carrying flammable fluids under pressure must

(i) Have restricting orifices or other safety devices at the source of the pressure to prevent the escape of excessive fluid if the line fails; and

(ii) Be installed and located so that the escape of fluids would not create a hazard.

(3) Each APU instrument that utilises flammable fluids must be installed and located so that the escape of fluid would not create a hazard.

OPERATING LIMITATIONS

TAR A1521 APU limitations

The APU limitations must be established so that they do not exceed the corresponding approved limits for the APU and its systems.

TAR A1527 Ambient air temperature and operating altitude

The extremes of the ambient air temperature and operating altitude for which operation is allowed, as limited by flight, structural, APU installation, functional, or equipment characteristics, must be established.

MARKINGS AND PLACARDS

TAR A1549 APU instruments

For each APU instrument either a placard or colour markings or an acceptable combination must be provided to convey information on the maximum and (where applicable) minimum operating limits. Colour coding must comply with the following:

(a) Each maximum and, if applicable, minimum safe operating limit must be marked with a red radial or a red line;

(b) Each normal operating range must be marked with a green arc or green line, not extending beyond the maximum and minimum safe limits;

(c) Each precautionary operating range must be marked with a yellow arc or a yellow line; and

(d) Each APU speed range that is restricted because of excessive vibration stresses must be marked with red arcs or red lines.

TAR A1551 Oil quantity indicator
Each oil quantity indicator must be marked with enough increments to indicate readily and accurately the quantity of oil.

AIRSHIP FLIGHT MANUAL

TAR A1583 Operating limitations
(b) APU limitations. APU limitations established under TAR A1521 and information to explain the instrument markings provided under TAR A1549 and TAR A1551 must be furnished.

Subpart J - Gas Turbine Auxilliary Power Unit Installation
Part B - Essential APUs

GENERAL

TAR B903 Auxiliary power units
(e) Restart capability

(1) Means to restart any APU in flight must be provided.

(2) An altitude and airspeed envelope must be established for in-flight APU restarting, and the APU must have a restart capability within that envelope. (See ACJ 25B903(e)(2).)

FUEL SYSTEM

TAR B951 General
(a) Each fuel system must be constructed and arranged to ensure a flow of fuel at a rate and pressure established for proper auxiliary power unit functioning under each likely operating condition, including any manoeuvre for which certification is requested and during which the APU is permitted to be in operation.

(b) Each fuel system must be arranged so that any air which is introduced into the system will not result in

(2) Flameout of the APU.

See JAR-25 Orange Paper Amendment 96/1

TAR B953 Fuel system independence
Each fuel system must allow the supply of fuel to the APU

(a) through a system independent of each part of the system supplying fuel to the main engines, or

(b) by any other acceptable method. (See ACJ 25A953(b).

TAR B955 Fuel flow
(a) The fuel system must provide at least 100% of the fuel flow required under each intended operating condition and manoeuvre. Compliance must be shown as follows:

(1) Fuel must be delivered to the APU at a pressure within the limits specified in the APU type approval.

(2) The quantity of fuel in the tank may not exceed the amount established as the unusable fuel quantity for that tank under the requirements of TAR 959 plus that necessary to show compliance with this paragraph.

(3) Each main pump must be used that is necessary for each operating condition and attitude for which compliance with this paragraph 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 is bypass. (See ACJ 25.955 (a)(4).)

(b) If an APU can be supplied with fuel from more than one tank, the fuel system must:

(2) For the APU, in addition to having appropriate manual switching capability, be designed to prevent interruption of fuel flow to the APU, without attention by the flight crew, when any tank supplying fuel to the APU is depleted of usable fuel during normal operation and any other tank, that normally supplies fuel to the APU alone, contains usable fuel.

TAR B961 Fuel system hot weather operation
(a) The fuel supply of an APU must perform satisfactorily in hot weather operation. It must be shown that the fuel system from the tank outlet to the APU is pressurised under all intended operations so as to prevent vapour formation. Alternatively, it must be shown that there is no evidence of vapour lock or other malfunctioning during a climb from the altitude of the airport selected by the applicant to the maximum altitude established as an operating limitation under TAR 1527, with the APU operating at the most critical conditions for vapour formation but not exceeding the maximum essential load conditions. If the fuel supply is dependant on the same fuel pumps or fuel supply as the main engines, the main engines must be operated at maximum continuous power.

(5) The fuel temperature must be at least 110ºF (43ºC) at the start of the climb. (See ACJ 25B961(a)(5).)

(b) The test prescribed in subparagraph (a) of this paragraph 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.

TAR B977 Fuel tank outlet
(a) There must be a fuel strainer for the fuel tank outlet or for the booster pump. This strainer must

(2) For the APU, prevent the passage of any object that could restrict fuel flow or damage any fuel system component.

(c) The clear area of each fuel tank outlet strainer must be at least five times the area of the outlet line.

(d) The diameter of each strainer must be at least that of the fuel tank outlet.

(e) Each finger strainer must be accessible for inspection and cleaning.

FUEL SYSTEM COMPONENTS

TAR B991 Fuel pumps

(See ACJ 25B991)

(a) Main pumps: each fuel pump required for proper APU operation, or required to meet the fuel system requirements of this subpart (other than those in sub-paragraph (b) of this paragraph), 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 approved as part of the APU.

(b) Emergency pumps. There must be emergency pumps or another main pump to feed the APU immediately after failure of any main pump (other than a fuel injection pump approved as part of the APU).

TAR B997 Fuel strainer or filter

There must be a fuel strainer or filter between the fuel tank outlet and the inlet of either the fuel metering device or an APU driven positive displacement pump, whichever is nearer the fuel tank outlet. This fuel strainer or filter must

(a) Be accessible for draining and cleaning and must incorporate a screen or element which is easily removable;

(b) Have a sediment trap and drain except that it need not have a drain if the strainer or filter is easily removable for drain purposes;

(c) Be 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; and

(d) Have the capacity (with respect to operating limitations established for the APU) and the mesh to ensure that APU fuel system functioning is not impaired, with the fuel contaminated to a degree (with respect to particle size and density) that is greater than that established for the APU in JAR-APU, Section 1, Appendix 1, paragraph 6.6.

OIL SYSTEM

TAR B1011 General

(b) The usable oil capacity may not be less than the product of the endurance of the airship under critical operating conditions and the approved maximum allowable oil consumption of the APU under the same conditions, plus a suitable margin to ensure system circulation.

AIR INTAKE SYSTEM.

TAR B1091 Air intake

(b) For APUs

(2) The airship must be designed to prevent water or slush on the runway, taxiway, or other operating surfaces from being directed into the APU air intake duct in hazardous quantities, and the air intake duct must be located or protected so as to minimise the ingestion of foreign matter during take-off, landing, and taxiing.

TAR B1093 Air intake system de-icing and anti-icing provisions

(b) (2) Each air intake system of an essential APU must be such as to enable the APU to operate throughout its flight power range without adverse effect on its operation or serious loss of power, under the icing conditions specified in AppendixC (see ACJ 25B1093 (b)(2)).

TAR B1105 Air intake system screens

(b) No screen may be in any part of the air intake system that is the only passage through which air can reach the APU unless it can be shown that the screen does not ice up to an unacceptable degree.

APU CONTROLS AND ACCESSORIES

TAR B1163 APU accessories

(c) If continued rotation of an APU driven cabin supercharger or of any remote accessory driven by the APU is hazardous if malfunctioning occurs, there must be means to prevent rotation without interfering with the continued operation of the APU.

TAR B1165 APU ignition systems

(f) Each ignition system must be independent of any electrical circuit not used for assisting, controlling, or analysing the operation of that system.

EQUIPMENT

TAR B1305 APU instruments

(a) The following instruments are required:

(1) A gas temperature indicator (for Turbine APUs).

(2) A tachometer (to indicate the speed of the rotors or crankshaft) or overspeed warning.

(3) An oil pressure warning means, and, unless it can be shown that such instrumentation is

(4) unnecessary to ensure safe operation of the unit

(5) A fire warning indicator.

(6) Any other instrumentation necessary to ensure continued safe operation of the unit.

(c) For APUs

(5) An indicator to indicate the functioning of the ice protection system, if such a system is installed.

(8) An indicator to indicate the proper functioning of any heater used to prevent ice clogging of fuel system components.

APPENDICES

APPENDIX A Tables and data

Table 1 - Design manoeuvre conditions

No	Condition	Speed	Weight	Attitude	Thrust Direction	Control Surface Position	
						Rudder	Elevator
1	Level Flight	V_H	W_t	(2)	Forward	Neutral	(2)
2	Level Flight	0.71 V_H	W_l	(2)	Reverse	Neutral	(2)
3	Nose Down	V_H	W_0	+ 30°	Forward	Neutral	(2)
4	Nose Up	V_H	W_0	- 30°	-	Neutral	(2)
5	Descent & Pull-Up	V_H	W_t	(2)	Forward	Neutral	(2)
6	Turn Entry	V_H	W_0	Horizontal	Forward	Full Over	Neutral
7	Turn & Reverse	V_H	W_0	Horizontal	Forward	(3)	Neutral
8	Dive Entry	V_H	W_0	Horizontal	Forward	Neutral	Full Down
9	Climb Entry	V_H	W_0	Horizontal	Forward	Neutral	Full Up
10	Turn & Climb	V_H	W_0	Horizontal	Forward	Full Over	Full Up
11	Turn & Dive	V_H	W_0	Horizontal	Forward	Full Over	Full Down
12	Turn	(1)	W_0	Horizontal	Forward	Full Over	Neutral
13	Turn Recovery	(1)	W_0	Horizontal	Forward	(3)	Neutral
14	Turn Rec. & Climb	(1)	W_0	Horizontal	Forward	(3)	Full Up
15	Turn Rec. & Dive	(1)	W_0	Horizontal	Forward	(3)	Full Down
16	Light Flight	V_H	(2)	(2)	Forward	Neutral	(2)

Notes

(1) Velocity values must be determined after speed is stabilised, but not before a steady state condition.
(2) That necessary to produce maximum loading conditions.
(3) Full rudder must be applied followed by full reverse rudder after 75° of turn.

Table 2 - Pilot forces

Control	Forces or torques: Maximum	Forces or torques: Minimum
(a) Elevator		
Capstan wheel [(1)]	745 N (167 lb f)	445 N (100 lb f)
Wheel mounted on a column (Symmetrical)	900 N (200 lb f)	445 N (100 lb f)
Wheel mounted on a column (Unsymmetrical) [(2)]	-	445 N (100 lb f)
Stick	745 N (167 lb f)	445 N (100 lb f)
(b) Rudder		
Rudder pedals [(3)]	900 N (200 lb f)	580 N (130 lb f)
Wheel mounted on a column [(4)]	5,6 D Nm (5) (50 D in-lb)	4,5 D Nm (5) (40 D in-lb)
Stick	300 N (67 lb f)	180 N (40 lb)
(c) Wheels, levers and cranks operated by		
- finger or wrist forces		145 N
- hand/arm force without support (seated/standing)		340 N
- hand/arm force with support (seated/standing)		590 N
(d) Sidestick operated by one wrist (not arm)		
- for all components between and including the handle and its control stops		
- in x-direction		350 N (80 lb f)
- in y-direction		200 N (45 lb f)
- for all other components of the side stick control assy (excluding the internal components of the electrical sensor assy) to avoid damage as a result of an in-flight jam		
- in x-direction		
- in y-direction		220 N (50 lb f)
		110 N (25 lb f)

Notes

(1) When a capstan wheel is mounted beside the pilot, the fore-and-aft force is applied to the highest point on the rim of the wheel.

(2) The unsymmetrical force must be applied at one of the normal hand grip points on the control wheel.

(3) If provided, since airships may not have pedals mandatory.

(4) When the rudder operating control is a wheel mounted on a column in front of the pilot, the loads must be applied tangentially to the rim of the wheel.

(5) D is the wheel diameter (m).

Table 3 - Take-off and landing conditions

Condition	Attitude	Weight	Shock Absorber Extension	Landing Gear Loads (3)		
				Vertical (4)	Lateral (2)(4)	Longitudinal (2)(4)
Take-off	Level	W_t	static	1.5 W_{sh}	-	0.275 W_{sh}
Level Landing	Level	W_l	maximum	n W_l	-	±0.25 nW_l
Level Landing	Level	W_l	maximum	n W_l	-	(1)
Landing	Level	W_l	static	1.5 W_{sh}	0.55 W_{sh}	-
Side Drift Landing	Level	W_l	maximum	n W_l	0.55 n W_l	-

Notes

(1) This load is based upon spin-up or spring-back conditions.

(2) Lateral and longitudinal loads act in a horizontal plane.

(3) For landing gear equipped with dual wheels, use a 60/40 load distribution between wheels.

(4) n is the limit vertical inertia load factor, at the C.G. of the airship, selected under TAR 473(b).

Table 4 - Mooring and handling conditions

Conditions (6)	Weight	Wind Velocity	Wind Angle
Symmetrical Mooring	W_t	70 knots	0
Unsymmetrical Mooring	W_t	70 knots	(2)
Mast Handling-Heavy (3)	W_t	(1)	(2)
Mast Handling - Equilibrium (3)	W_0	(1)	(2)
Mast Handling - Override (4)	W_t	0	0
Line Handling (3), (5)	W_t	(1)	(2)
Line Handling (3), (5)	W_0	(1)	(2)

Notes

(1) The maximum wind velocities V_{WG} expected to occur during ground handling are selected by the designer and listed in the airship operating limitations, but may not be less than 10 knots.
(2) The wind angle must be determined from the lateral wind force and the longitudinal wind force assumed imposed on the envelope with maximum design gas pressure. These wind forces are based on an instantaneous directional change to either side. In the absence of a more rational analysis, a wind angle of 10° must be used.
(3) An envelope of ground loads must be determined based on critical effective relative wind angles.
(4) Loads must be determined based on a compressive force between mast and airship resulting from a differential speed of 3 knots.
(5) For nose lines, use wind angles determined for mooring conditions with line angles of 0°-120° laterally with respect to a vertical plane through the airship axis and at an angle of 30° below the horizontal plane through the airship axis. For tail or after quarter lines, an envelope of ground loads must be determined, using wind angles determined for mast handling. In the absence of a more rational analysis, use line angles of 60°-120° laterally to the same reference planes as for the nose lines. Line angles selected must be listed in the airship handling procedures.
(6) Compressive loads caused by elastic rebound of the airship due to a sudden change in wind velocity must be considered for all applicable mooring conditions.

Table 5 - General tolerances during flight testing

see TAR 21 (d)

Table 6 - Maximum pilot forces

	Values in N (pound force) applied to the control as specified	
	Pitch Axis	Yaw Axis
Temporary application		
Stick	265 N (60 lb f)	135 N (30 lb f)
Wheel (applied to rim)	335 N (75 lb f)	265 N (60 lb f)
Capstan wheel	265 N (60 lb f)	-
Rudder pedal	-	670 N (150 lb f)
Prolonged application		
Stick or wheel (applied to rim)	45 N (10 lb f)	22 N (5 lb f)
Capstan wheel	45 N (10 lb f)	-
Rudder pedal	-	90 N (20 lb f)

Table 7 - Ultimate inertia forces in units of gravity

Upward	1.5
Downward	4
Forward	4
Rearward	4
Sideward	4

Table 8 - Noncritical castings

Casting factor	Inspection
2.0 or more	100% visual
Less than 2.0 but more than 1.5	100% visual, and magnetic particle or penetrant, or equivalent nondestructive inspection methods
1.25 through 1.50	100% visual, magnetic particle or penetrant, and equivalent nondestructive inspection methods

Table 9 - Motion and effect of cockpit controls

Controls	Motion and effect
Elevator	Rearward for nose up
Rudder	Right pedal forward for nose right, or, for wheel or stick control, right (clockwise) for right rudder
Throttle	Forward to open
Trims control	Rotate to produce similar rotation of the airship about an axis parallel to the axis of the trim wheel
Landing gear	Down to extend
Power / Thrust	Forward to increase forward or upward thrust and rearward to increase rearward or downward thrust
Vectored thrust control	In co-ordination with power/thrust controls, the motion of the vectoring controls must clearly indicate the direction of thrust
Propellers	Forward to increase rpm

Table 10 - Minimum intensities in the horizontal plane position lights

Dihedral angle (light included)	Angle from right or left of longitudinal axis, measured from dead ahead	Intensity (cd)
F (bow white)	0° to 110°	20
L and R (forward and rearward red and green)	0° to 10°	40
	10° to 20°	30
	20° to 110°	5
A (stern white)	110° to 180°	20

Table 11 - Minimum intensities in any vertical plane position lights

Angle above or below the horizontal plane	Intensity
0°	1.00
0° to 5°	0.90
5° to 10°	0.80
10° to 15°	0.70
15° to 20°	0.50
20° to 30°	0.30
30° to 40°	0.10
40° to 90°	0.05

Table 12 - Maximum intensities in overlapping beams

Overlaps	Maximum Intensity (cd)	
	Area A	Area B
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
White in dihedral angle L	5	1
White in dihedral angle R	5	1

Note

Area A includes all directions in the adjacent dihedral angle that pass through the light source and intersect the common boundary plan at more than 10° but less than 20°. Area B includes all directions in the adjacent dihedral angle that pass through the light source and intersect the common boundary plan at more than 20°.

Table 13 - Minimum effective intensities for anticollision lights

Angle above or below the horizontal plane	Effective intensity (cd)
0° to 5°	400
5° to 10°	240
10° to 20°	80
20° to 30°	40
30° to 75°	20

Table 14 - Strenghth values for high pressure pneumatic systems

Element of System	Strength Value Proof	Ultimate	Remarks
Rigid pipes and ducts Couplings Flexible hoses Return line elements	1.5 P_W 1.5 P_W 2.0 P_W ---	3.0 P_W 3.0 P_W 4.0 P_W 1,5 P_f	P_f The maximum pressure applied during failure conditions
Components other than pipes couplings, ducts or pressure vessels	1.5 P_W	2.0 P_W	
Pressure vessels fabricated from metallic materials(For non-metallic materials see JAR 25.1435(a)(10) and JAR 25X1436(b)(7))			
Pressure vessels connected to a line source of pressure	3.0 P_L or 1.5 P_L	4.0 P_L or 2.0 P_L	The lower values are conditional upon justification by a fatigue endurance test from which a permissible fatigue life is declared, and upon the ultimate load test being made on the test specimen used for the fatigue life test.
Pressure vessels not connected to a line source of pressure e.g. emergency vessels inflated from a ground source	2.5 P_L or 1.5 P_L	3.0 P_L or 2.0 P_L	The lower values are conditional upon justification by a life endurance test of a suitably factored permissible number of inflation/deflation cycles, including temperature fluctuation results in a signficant pressure variation, and upon the ultimate load test being made on the test specimen used for the life endurance test.
			For all pressure vessels: (1) The minimum acceptable conditions for storage, handling and inspection are to be defined in the appropriate manual. See JAR 25.1529(h). (2) The proof factor is to be sustained for at least three minutes. (3) The ultimate factor is to be sustained for at least one minute. The factor having been achieved, the pressure vessel may be isolated from the pressure source for the remaining portion of the test period.

APPENDIX B Tearing strength test

Material tearing strength test

(Applicable for non-rigid and semi-rigid airships only)

Scope - This test method is intended for use in determining the tearing strength of envelope fabric required by TAR 883(d).

Specimen - The sample must consist of a 98 mm x 152 mm (4 x 6 in) sample having a 38 mm (1.25 in) wide slit made with a razor blade across the centre of the sample at right angles to the longest dimension.

Apparatus -The apparatus must be approved.

Procedures - The specimen must be placed symmetrically in the clamps of the machine with the long dimension parallel and the short dimension at right angles to the direction of application of the load. The yarn running parallel to the long dimension must be aligned parallel with one outside edge of the front jaw of each clamp to ensure the same yarns being gripped in both clamps. The clamps must be (25.4 mm) (1 in) wide and must grip the yarns that have been slit. The distance between clamps must be (76 mm) (3 in) at the start of the test, with the slit in the specimen an equal distance from each clamp jaw. Breaking force must be applied to the specimen at such a rate that the pulling clamp will travel at a uniform speed of 305 mm ±12.7 mm (12.0 ±0.5 in) per minute. After rupture of the specimen, the breaking force must be read from the dial, scale, or chart and the value recorded. Five specimens in both the warp and woof (fill) directions must be tested and results reported for each fabric type.

Result - The tearing strength value [N/mm] is the average load of the highest recorded peaks of the five specimens.

Acceptance criteria (pass - fail criteria) - The limit design loads of the envelope must not exceed the result of the tested material strength value corresponding.

APPENDIX C Definitions and abbreviations

Definitions

The following definitions apply:

(a) Types of airships:
- (1) non-rigid airships (blimps), consisting of an envelope, the shape and stiffness of which is maintained by the lifting gas contained within it pressurised above ambient;
- (2) semi-rigid airships, consisting of an envelope, the shape of which is maintained by the lifting gas contained within it pressurised above ambient, stiffened with a structure attached to it;
- (3) rigid airships, consisting of an airframe, covered with a skin or envelope determining the external shape, carrying all heavy components and useful load. The lifting gas is contained within one or more gas cells.

(b) Density of pure gases at standard sea level atmospheric condition of 1.01325 x 10^3 Pa (29.92 in Hg) pressure and 15°C (59°F) temperature:
- (1) Dry air: ρ=1.2250 kg/m^3 (0.07647 lb/ft^3);
- (2) Dry helium ρ=0.1689 kg/m^3 (0.01054 lb/ft^3).

(c) Unit lift: the value used should be identified in the analysis of the design. In the absence of a rational analysis, 9.975 N/m^3 (0.0635 lb/ft^3) should be used for helium (96% purity).

General Definitions

Aerodynamic trim	means when all aerodynamic forces plus static lift force are exactly in line vertically with the centre of gravity without control input by the pilot.
Airship	a controllable, engine-driven lighter-than-air aircraft
Back-up system	means a second system with or without reduced system capability to function as a substitute for an original system, when this fails.
Ballast, disposable	means ballast to be dropped or dumped or jettisioned during flight to adjust c.g. or lighten the airship due to a designated procedure.
Ballast, fixed	means to be intended to adjust the airships balance to achieve defined c.g. due to design tolerance in general or production tolerance on a specific production airship.
Ballast, removable	means removable on ground. Thus to prepare the airship for a certain flight mission or movable during flight within the airship to adjust c.g.
Ballonet	a flexible and collapsible air cell contained within the envelope for the purpose of compensating for gas volume changes, maintaining internal pressure in the envelope, and assisting in trimming the airship.
Car	component or structure attached to or suspended from the envelope or the structure in- or outside of the envelope for carrying crew members, passengers, cargo or propulsion systems or other devices
Cargo	means payload such as freight, bulk cargo or unit load cargo.
Centre of buoyancy	means the point within the airship where the buoyancy is assumed to be acting on.
Centre of gravity	means the point in which the mass of the airship is assumed to be concentrated.
Condition	means a failure, ambient, environmental, event condition, not a capability of the airship.
Conventional	means if similar design already approved or experienced otherwise.
Cri	means Certification Review Item
Critical function	a function, the failure of which would prevent continued safe flight and landing of the airship

Critical function	a function, the failure of which would prevent continued safe flight and landing of the airship
Defined	means defined as/or designed by the applicant
Designated	means designated as/or designed by the applicant.
Desired	means desired by the applicant
DOP	design operating pressure
Dual redundant	Parallel and independent systems. In case of failure of one system automatic detection and transition to the parallel system without action of the operator. The performed transition must be indicated by optical means
Dual system	means two similar or dissimilar systems used (not in a failure case only) as a redundant or alternative means with each system having full capability, but not a backup system. The independence will be very high
EAS	equivalent airspeed
Envelope	for a non-rigid or semi-rigid airship: the mainbody or hull of which the shape is maintained by internal pressure.
	for a rigid airship: a skin or cover around the airframe defining together the external shape of the airship
Equilibrium	Zero static heaviness. The static lift force resulting from buoyancy is equal to gravity force. All aerodynamic forces are zero.
	Near-equilibrium is the capability of achieving zero static heaviness resulting in zero vertical air speed during normal flight operations
Essential function	a function, the failure of which would reduce the capability of the airship or the ability of the crew to cope with adverse operating conditions
External load	means a load attached to the airship but not enclosed by any airship structure
Fixed thruster	means the angle of the thrust is fixed as a normal mode of operation. It comprises the thruster drive, thruster control system
Gas cell	a flexible and collapsible cell containing the lifting gas within the airframe or envelope of an airship
Ground handling	means that condition under which external loads are applied to the airship by ground crews and/ or mechanical equipment to control the movement of the airship on the ground
Ground operation	means ground handling of the airship allready moored on a mast or tied to the ground equipment. Flight crew is typically not required to perform the operation. Typical operations are hangar exit, moving the airship, airship masted or moored and maintenance
Head-over	means if the moored airship turns with the unmoored tail up vertically unintended due to gust or balance conditions.
HIRF	High Intensity Radiated Fields
ICA	instructions for continued airworthiness
Keel	component or structure attached to or suspended from the envelope or the structure in- or outside of the envelope for carrying crew members, passengers, cargo or propulsion systems or other devices
Mass	definitions are stated in TAR 25 and 29
Masting	means ground handling considered in flight until placing an airship on a mooring mast. Flight and ground crew is typically required to perform the operation
Maximum altitude	means the maximum athmospheric ceiling altitude the airship can reach pending on environmental conditions to airship and equipment.
Minor crash	emergency landing condition under which the occupant protection can be assured reliably
Mooring	means ground handling considered in flight until tying an airship to the ground. Flight and ground crew is typically required to perform the operation

Pressure height	or ceiling height means the height at which the ballonets are fully deflated or where the gas cells are inflated to limit pressure. This height is variable but not to be exceeded without over-pressure or valving of the lifting gas.
Primary structure	means the envelope and rigid structure, if provided and carries the critical and essential loads.
Privacy cabin	means a self contained cabin, which is indispensable for the occupants seclusion on long term flights
Provided	means a capability of the airship if desired or designated, but not a condition.
Redundancy	means a dual, second or back-up system with no further specification.
Secondary control	means all other controls except primary controls, i.e. also a trim system used for control of the airship.
Spatial reference point	reference point in the airship established by the designer as the point in space where the airship is located
Specified	means defined.
Static heaviness	difference between airship mass and static lift. Ship downwards means static heaviness.
Static lightness	difference between airship mass and static lift. Ship upwards means static lightness.
Static trim	means if the centre of gravity is exactly below the centre of buoyancy.
Technique	means the capability of the airship in conjunction with a practical approved procedure for crew.
Thruster drive system	means the mechanical linkage such as torque shafts, gear boxes and clutches to drive any thrust system.
Trim height	means the height at which one of the ballonets is empty and the airship is still in static trim. Above trim height, the airship is out of static trim.
Unit load device	means a unit load device to be restrained itself such as a cargo container, but not unrestrained bulk.
Variable angle thruster	or vectored thruster means the angle respective direction of the thrust is variable as a normal mode of operation. It comprises the thruster drive, the vectoring and thruster control system.
Virtual inertia	the apparent additional inertia of a body moving instationary in a fluid due to the forces exerted by accelerated fluids on the body.

Abbreviations and Symbols

Abbreviations and symbols in the TAR are in accordance with JAR-1. Symbols not specified by JAR 1 are listed below. Speeds are equivalent airspeeds (EAS) unless indicated otherwise.

V_{WG}	wind velocity on ground
V_{WT}	design wind speed for the airship tehered for loading/unloading or boarding unboarding.
V_{WM}	design wind speed for moored airship
V_B	maximum gust operating or encounter speed
V_D	maximum dive speed
V_{MO}	max. operating speed
V_{VO}	max. thrust vector operation speed
V_H	max. horizontal speed
V_{Hh}	design maximum level flight speed (heavy)
V_A	design manoeuvre speed *(reserved)*
V_{AM}	minimum aerodynamic control speed.
V_{LE}	max. speed landing gear extended
V_{LO}	max. landing gear operating speed

V_{MC}	min. control speed with critical engine(s) inoperative but maintaining control of the airship is still possible
V_{CD}	design climb/dive airspeed
W_0	max. design and equilibrium mass, equaling max.design static lift
W_{sh}	max. design static heaviness
W_{sl}	max. design static lightness
W_{toh}	max. take-off static heaviness
W_l	max. landing mass
W_t	max. take-off mass (W_0+W_{sh})
W_{flu}	max. freight loading unit weight
W_f	max. freight weight
W_{pf}	max. freight payload (W_{flu}+W_f)
W_m	min. design mass
(reserved)	unit load weight
W_{m0}	max. operating weight W_0 + W_{sh}

Airship category

The transport category is defined for multi-engined propeller driven airships that have a capacity of 20 or more passengers (excluding crew), or a maximum take-off mass of 15,000 kg or more, or a design lifting gas volume of 20,000 m³ or more, whichever is greater.