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LIST OF ABBREVIATION:

ACAS	Airborne Collision Avoidance System
ACJ	Aircraft class jet
ACT	Aircraft class turboprop
ACP	Aircraft class piston
AFM	Aircraft fly manual
AOC	Air Operator Certificate
APAPI	Abbreviated Precision Approach Path Indicator
ASDA	Accelerate−stop distance available
ATM	Air Traffic Management
ATS	Air traffic services
CAS	Calibrated airspeed
CFR	Code of Federal Regulations
CS	Certification specification
CVR	Cockpit voice recorder
EASA	European Aviation Safety Agency
ELT	Emergency locator transmitter
ETOPS	Extended-range Twin-engine Operational
EU	European Union
EU-OPS	European Union - Operations
FAR	Federal Acquisition Regulation
FDR	Flight data recorder
GA	General Aviation
ICAO	International Civil Aviation Organization
IFR	Instrument flight rules
IMC	Instrument meteorological conditions
LD	Landing distance
LDA	Landing distance available
LIFUS	Line flying under supervision
MDH	Minimum descent height
MEL	Minimum equipment list
MNPS	Minimum navigation performance specifications
MSpecs	Management Specifications
MTOW	Maximum Take Off Weight
NM	Nautical miles
PAPI	Precision approach path indicator
PAX	Passenger(s)
PDP	Pre-determined point
RWY	Runway
SAT	Small aircraft in the air transport system
SE-IMC	Single engine - Instrument meteorological conditions
SET	Single engine turbine
SSR	Secondary surveillance radar
TCAS	Traffic alert & collision avoidance system
TOD	Take-off distance
TODA	Take−off distance available
TORA	Take−off run available
TSO	Technical Standard Order
VFR	Visual flight rules
VMC	Visual meteorological conditions
USA	United state of America

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EXECUTIVE SUMMARY

Purpose of this task is identification of basic regulations which are needed for correct operation of individual systems of SAT-Rdmp project and suggestion of new potential innovative approaches in questions of more effective application these regulations into SAT-Rdmp project.

Aim of SAT-Rdmp is designed new mode of small aircraft air transport so-called door-to-door system. Scheduled and unscheduled transport of GA aircraft has increase access of communities with poor transport infrastructure with using of local airports acceptable for this mean of transport.

Task D1.4 is part of WP1 Small Air Transport System – Common Vision and Technological Requirements defining elementary requirements of this system.

Project SAT-Rdmp may be divided into three systems.

The first system include aircraft manufacturer, the second, system of aircraft operator and the third system include ground areas designed for taking off and landing of aircraft.
The first system compares of **EASA CS-23, Amdt 23-2 regulation** and **14 CFR PART 23, Amdt 23-59 Normal, Utility, Aerobatic and Commuter Airplanes regulation** which are designed for fabrication of SAT aircraft.

The second, system of aircraft operator, analyse of European operational regulation **EU-OPS** and recommendation of document **Risk Assessment for European Public Transport Operations using Single Engine Turbine Aircraft at Night and in IMC**. EU-OPS is compared with **FAA14 CFR Part 135 Operating requirements: Commuter and on demand operations and rules governing persons on board such aircraft** regulation.
Further, the second system analyse and compare regulations which are designed for certification of training organizations and certification of persons apply for the issuance of an aircraft maintenance licence which are **Commission regulation (EC) No 2042/2003 (Part 66 and Part147)** and **FAA 14 CFR Part 65 – Certification: Airmen other than flight crewmembers, FAA 14 CFR Part 147 - Aviation maintenance technician schools**.

The third system briefly analyse of elementary design features of regulation **ICAO Annex 14 Airport** in connection with the operation of SAT-Rdmp aircraft and structure of **future Air Traffic Management and Air Navigation Service** regulations in EU.

1. Description of Task T1.4 Identification of existing regulation requirements, regulatory difficulties and innovative approach

Regulatory issues to be addressed by Authorities will be identified. Existing regulation area will be identified and evaluate from in view of future Small Air Transport system stakeholders regulatory burden. Regulatory requirements for large air transport aircraft and its operation will be evaluate in view of mitigation and tailoring of such requirement to Small Air Transport system.
Will take into account the risk assessment that EASA has made for commercial single engine IFR and night operations considering the necessity and assumptions of Small Air Transport ***aircraft and operations category***. Furthermore, in a Workshop dedicated to collecting requirements EASA will provide further input.

2. Classes of SAT aircraft

According to information presented in the document number "*SAT-Rdmp T1.2.1 Small air transport aircraft characteristics to be used for demand calculation*" the following classes of Small Air Transport aircraft exist:

ID	Aircraft Class Description
ACP	Piston engine powered airplanes with a passenger seating 9 or fewer and a maximum weight up to 5670 kg,
ACT	Turboprop airplanes with a passenger seating of 19 or less and a maximum weight up to 8618 kg,
ACJ	Jet airplanes with a passenger seating 11 or less and a maximum weight up to 7600 kg.

SAT aircraft specifications (Average specifications values are counted according to specifications values of reference aircraft mentioned in the document SAT-Rdmp_WP1_InputDataT1_2-V0):

Average values:

MTOW	4656 kg
Take off distance (50 ft)	847 m
Landing distance (50 ft)	768 m
Wheel span	3.98 m
Wing span	14.19 m
Overall length	12.76 m
Max. fuselage width	1.50 m

3. Analysis of certification specification

3.1 Analysis and comparison of Airworthiness and Environmental of Certification specification EASA CS-23, Amdt 23-2 and PART 23, Amdt 23-59 Normal, Utility, Aerobatic and Commuter Airplanes

The following comparison describes the requirements in FAR Part 23 and CS-23 **which differ from each other**. Labelling the references as "Non-Significant" indicates formal changes or changes that present small differences between both regulations.
Significant Standard Differences are changes that usually lead to additional fulfilment of compliance requirements and are usually subject to a separate evaluation during the validation activities.
Text highlighted with yellow shading indicates non-significant standard differences.
Text highlighted with red shading indicates Significant Standard Differences.

Part 23 is applicable for multi-engined aircraft while CS-23 is applicable only for twin-engined aircraft it means that 14 CFR, Part 23, has rules in Sections 23.57, 23.61, and 23.1309 for more than two engines airplanes that are not in EASA CS-23. These are standards differences but are not considered Significant.

14 CFR, Part 23 thru Amdt. 23-59	CS 23, Amdt. 2
Sec. 23.1 Applicability (a) This Part prescribes airworthiness standards for the issue of type certificates, and changes to those certificates, for airplanes in the normal, utility, acrobatic and commuter categories. (b) Each person who applies under Part 21 for such a certificate or change must show compliance with the applicable requirements of this Part.	**CS 23.1 Applicability** (a) This airworthiness code is applicable to – (1) Aeroplanes in the normal, utility and aerobatic categories that have a seating configuration, excluding the pilot seat(s), of nine or fewer and a maximum certificated take-off weight of 5670 kg (12 500 lb) or less; and (2) Propeller-driven twin-engined aeroplanes in the commuter category that have a seating configuration, excluding the pilot seat(s), of nineteen or fewer and a maximum certificated take-off weight of 8618 kg (19 000 lb) or less.
Sec. 23.2 Special retroactive requirements (a) Notwithstanding Secs. 21.17 and 21.101 of this chapter and irrespective of the type certification basis, each normal, utility, and acrobatic category airplane having a passenger seating configuration, excluding pilot seats, of nine or less, manufactured after December 12, 1986, or any such foreign airplane for entry into the United States must provide a safety belt and shoulder harness for each forward- or aft-facing seat which will protect the occupant from serious head injury when subjected to the inertia loads resulting from the ultimate static load factors prescribed in Sec. 23.561(b)(2) of this part, or which will provide the occupant protection specified in Sec. 23.562 of this part when that section is applicable to the airplane. For other seat orientations, the seat/restraint system must be designed to provide a level of occupant protection equivalent to that provided for forward- or aft-facing seats with a safety belt and shoulder harness installed. (b) Each shoulder harness installed at a flight crewmember station, as required by this section, must allow the crewmember, when seated with the safety belt and shoulder harness fastened, to perform all	**No CS requirements**

functions necessary for flight operations. (c) For the purpose of this section, the date of manufacture is: (1) The date the inspection acceptance records, or equivalent, reflect that the airplane is complete and meets the FAA approved type design data; or (2) In the case of a foreign manufactured airplane, the date the foreign civil airworthiness authority certifies the airplane is complete and issues an original standard airworthiness certificate, or the equivalent in that country.	
Sec. 23.23 Load distribution limits (a) Ranges of weights and centers of gravity within which the airplane may be safely operated must be established. If a weight and center of gravity combination is allowable only within certain lateral load distribution limits that could be inadvertently exceeded, these limits must be established for the corresponding weight and center of gravity combinations. (b) The load distribution limits may not exceed any of the following: (1) The selected limits; (2) The limits at which the structure is proven; or (3) The limits at which compliance with each applicable flight requirement of this subpart is shown.	**CS 23.23 Load distribution limits** (a) Ranges of weight and centres of gravity within which the aeroplane may be safely operated must be established and must include the range for lateral centres of gravity if possible loading conditions can result in significant variation of their positions. (b) The load distribution must not exceed – (1) The selected limits; (2) The limits at which the structure is proven; or (3) The limits at which compliance with each applicable flight requirement of this subpart is shown.
Sec. 23.45 General (a) Unless otherwise prescribed, the performance requirements of this part must be met for— (1) Still air and standard atmosphere; and (2) Ambient atmospheric conditions, for commuter category airplanes, for reciprocating engine-powered airplanes of more than 6,000 pounds maximum weight, and for turbine engine-powered airplanes. (b) Performance data must be determined over not less than the following ranges of conditions— (1) Airport altitudes from sea level to 10,000 feet; and (2) For reciprocating engine-powered airplanes of 6,000 pounds, or less, maximum weight, temperature from standard to 30° C above standard; or (3) For reciprocating engine-powered airplanes of more than 6,000 pounds maximum weight and turbine engine-powered airplanes, temperature from standard to 30° C above standard, or the maximum ambient atmospheric temperature at which compliance with the cooling provisions of Sec. 23.1041 to Sec. 23.1047 is shown, if lower. (c) Performance data must be determined with the cowl flaps or other means for controlling the engine cooling air supply in the position used in the cooling tests required by Sec. 23.1041 to Sec. 23.1047. (d) The available propulsive thrust must correspond to engine power, not exceeding the approved power, less— (1) Installation losses; and (2) The power absorbed by the accessories and services appropriate to the particular ambient atmospheric conditions and the particular flight condition.	**CS 23.45 General** (a) Unless otherwise prescribed, the performance requirements of this subpart must be met for – (1) Still air and standard atmosphere; (2) Ambient atmospheric conditions, for commuter category aeroplanes, for reciprocating engine-powered aeroplanes of more than 2 722 kg (6 000 lb) maximum weight and for turbine engine-powered aeroplanes. (b) Performance data must be determined over not less than the following ranges of conditions – (1) Aerodrome altitude from sea-level to 3048 m (10 000 ft); and (2) For reciprocating engine-powered aeroplanes of 2 722 kg (6 000 lb) or less maximum weight, temperatures from standard to 30°C above standard; or (3) For reciprocating engine-powered aeroplanes of more than 2 722 kg (6 000 lb) maximum weight and turbine engine-powered aeroplanes, temperature from standard to 30°C above standard, or the maximum ambient atmospheric temperature at which compliance with the cooling provisions of CS 23.1041 to 23.1047 is shown, if lower. (c) Performance data must be determined with the cowl flaps or other means for controlling the engine cooling air supply in the position used in the cooling tests required by CS 23.1041 to 23.1047. (d) The available propulsive thrust must correspond to engine power, not exceeding the approved power, less – (1) Installation losses; and (2) The power absorbed by the accessories and services appropriate to the particular ambient

(e) The performance, as affected by engine power or thrust, must be based on a relative humidity: (1) Of 80 percent at and below standard temperature; and (2) From 80 percent, at the standard temperature, varying linearly down to 34 percent at the standard temperature plus 50° F. (f) Unless otherwise prescribed, in determining the takeoff and landing distances, changes in the airplane's configuration, speed, and power must be made in accordance with procedures established by the applicant for operation in service. These procedures must be able to be executed consistently by pilots of average skill in atmospheric conditions reasonably expected to be encountered in service. (g) The following, as applicable, must be determined on a smooth, dry, hard-surfaced runway— (1) Takeoff distance of Sec. 23.53(b); (2) Accelerate-stop distance of Sec. 23.55; (3) Takeoff distance and takeoff run of Sec. 23.59; and (4) Landing distance of Sec. 23.75. NOTE: The effect on these distances of operation on other types of surfaces (for example, grass, gravel) when dry, may be determined or derived and these surfaces listed in the Airplane Flight Manual in accordance with Sec. 23.1583(p). (h) For commuter category airplanes, the following also apply: (1) Unless otherwise prescribed, the applicant must select the takeoff, enroute, approach, and landing configurations for the airplane. (2) The airplane configuration may vary with weight, altitude, and temperature, to the extent they are compatible with the operating procedures required by paragraph (h)(3) of this section. (3) Unless otherwise prescribed, in determining the critical engine-inoperative takeoff performance, takeoff flight path, the accelerate-stop distance, changes in the airplane's configuration, speed, and power must be made in accordance with procedures established by the applicant for operation in service. (4) Procedures for the execution of discontinued approaches and balked landings associated with the conditions prescribed in Secs. 23.67(c)(4) and 23.77(c) must be established. (5) The procedures established under paragraphs (h)(3) and (h)(4) of this section must— (i) Be able to be consistently executed by a crew of average skill in atmospheric conditions reasonably expected to be encountered in service; (ii) Use methods or devices that are safe and reliable; and (iii) Include allowance for any reasonably expected time delays in the execution of the procedures.	atmospheric conditions and the particular flight condition. (e) The performance as affected by engine power must be based on a relative humidity of – (1) 80% at and below standard temperature; and (2) 34% at and above standard temperature plus 28°C (plus 50°F). Between the two temperatures listed in subparagraphs (e) (1) and (e) (2) the relative humidity must vary linearly. (f) Unless otherwise prescribed in determining the take-off and landing distances, changes in the aeroplane's configuration, speed and power must be made in accordance with procedures established by the applicant for operation in service. These procedures must be able to be executed consistently by pilots of average skill in atmospheric conditions reasonably expected to be encountered in service. (g) The following, as applicable, must be determined on a smooth, dry, hard-surfaced runway – (1) Take-off distance of CS 23.53 (b); (2) Accelerate-stop distance of CS 23.55; (3) Take-off distance and take-off run of CS 23.59; and (4) Landing distance of CS 23.75. The effect on these distances of operation on other types of surface (e.g. grass, gravel) when dry, may be determined or derived and these surfaces listed in accordance with CS 23.1583 (p). (h) For commuter category aeroplanes, the following also apply: (1) Unless otherwise prescribed, the take-off, en-route, approach and landing configurations for the aeroplane must be selected; (2) The aeroplane configuration may vary with weight, altitude and temperature, to the extent that they are compatible with the operating procedures required by sub-paragraph (h) (3); (3) Unless otherwise prescribed, in determining the critical-engine-inoperative take-off performance, take-off flight path and accelerate-stop distance, changes in the aeroplane's configuration, speed and power must be made in accordance with procedures established by the applicant for operation in service. (4) Procedures for the execution of discontinued approaches and balked landings associated with the conditions prescribed in CS 23.67 (c) (4) and 23.77 (c) must be established; and (5) The procedures established under sub-paragraphs (h) (3) and (h) (4) must – (i) Be able to be consistently executed by a crew of average skill in atmospheric conditions reasonably expected to be encountered in service; (ii) Use methods or devices that are safe and reliable; and (iii) Include allowances for any reasonably expected time delays in the execution of the procedures.
Sec.23.55 Accelerate-stop distance. For normal, utility, and acrobatic category multiengine jets of more than 6,000 pounds maximum weight and commuter category airplanes, the accelerate-stop	**CS 23.55 Accelerate-stop distance** For each commuter category aeroplane, the accelerate-stop distance must be determined as follows:

distance must be determined as follows: (a) The accelerate-stop distance is the sum of the distances necessary to— (1) Accelerate the airplane from a standing start to V_{EF} with all engines operating; (2) Accelerate the airplane from V_{EF} to V_1, assuming the critical engine fails at V_{EF}; and (3) Come to a full stop from the point at which V_1 is reached. (b) Means other than wheel brakes may be used to determine the accelerate-stop distances if that means— (1) Is safe and reliable; (2) Is used so that consistent results can be expected under normal operating conditions; and (3) Is such that exceptional skill is not required to control the airplane.	(a) The accelerate-stop distance is the sum of the distances necessary to – (1) Accelerate the aeroplane from a standing start to VEF with all engines operating; (2) Accelerate the aeroplane from VEF to V1, assuming the critical engine fails at VEF; and (3) Come to a full stop from the point at which V1 is reached. (b) Means other than wheel-brakes may be used to determine the accelerate-stop distances if that means – (1) Is safe and reliable; and (2) Is used so that consistent results can be expected under normal operating conditions.
Sec. 23.59 Takeoff distance and takeoff run For normal, utility, and acrobatic category multiengine jets of more than 6,000 pounds maximum weight and commuter category airplanes, the takeoff distance and, at the option of the applicant, the takeoff run, must be determined. (a) Takeoff distance is the greater of— (1) The horizontal distance along the takeoff path from the start of the takeoff to the point at which the airplane is 35 feet above the takeoff surface as determined under §23.57; or (2) With all engines operating, 115 percent of the horizontal distance from the start of the takeoff to the point at which the airplane is 35 feet above the takeoff surface, determined by a procedure consistent with §23.57. (b) If the takeoff distance includes a clearway, the takeoff run is the greater of— (1) The horizontal distance along the takeoff path from the start of the takeoff to a point equidistant between the liftoff point and the point at which the airplane is 35 feet above the takeoff surface as determined under §23.57; or (2) With all engines operating, 115 percent of the horizontal distance from the start of the takeoff to a point equidistant between the liftoff point and the point at which the airplane is 35 feet above the takeoff surface, determined by a procedure consistent with §23.57.	**CS 23.59 Take-off distance and take-off run** For each commuter category aeroplane, the take-off distance must be determined. The determination of the take-off run is optional. (a) The take-off distance is the greater of – (1) The horizontal distance along the take-off path from the start of the take-off to the point at which the aeroplane is 11 m (35 ft) above the take-off surface, determined under CS 23.57; or (2) 115% of the horizontal distance, with all engines operating, from the start of the take-off to the point at which the aeroplane is 11 m (35 ft) above the take-off surface, determined by a procedure consistent with CS 23.57. (b) The take-off run is the greater of – (1) The horizontal distance along the take-off path from the start of the take-off to a point equidistant between the lift off point and the point at which the aeroplane is 11 m (35 ft) above the take-off surface, determined under CS 23.57; or (2) 115% of the horizontal distance, with all engines operating, from the start of the take-off to a point equidistant between the lift off point and the point at which the aeroplane is 11 m (35 ft) above the take-off surface,determined by a procedure consistent with CS 23.57.
Sec. 23.63 Climb: general (a) Compliance with the requirements of Secs. 23.65, 23.66, 23.67, 23.69, and 23.77 must be shown— (1) Out of ground effect; and (2) At speeds that are not less than those at which compliance with the powerplant cooling requirements of Secs. 23.1041 to 23.1047 has been demonstrated; and (3) Unless otherwise specified, with one engine inoperative, at a bank angle not exceeding 5 degrees. (b) For normal, utility, and acrobatic category	**CS 23.63 Climb: general** (a) Compliance with the requirements of CS 23.65, 23.66, 23.67, 23.69 and 23.77 must be shown – (1) Out of ground effect; and (2) At speeds which are not less than those at which compliance with the powerplant cooling requirements of CS 23.1041 to 23.1047 has been demonstrated. (3) Unless otherwise specified, with one engine inoperative, at a bank angle not exceeding 5 degrees. (b) For normal, utility and aerobatic category reciprocating engine-powered aeroplanes of 2 722 kg

reciprocating engine-powered airplanes of 6,000 pounds or less maximum weight, compliance must be shown with Sec. 23.65(a), Sec. 23.67(a), where appropriate, and Sec. 23.77(a) at maximum takeoff or landing weight, as appropriate, in a standard atmosphere. (c) For normal, utility, and acrobatic category reciprocating engine-powered airplanes of more than 6,000 pounds maximum weight, and turbine engine-powered airplanes in the normal, utility, and acrobatic category, compliance must be shown at weights as a function of airport altitude and ambient temperature, within the operational limits established for takeoff and landing, respectively, with— (1) Sections 23.65(b) and 23.67(b)(1) and (2), where appropriate, for takeoff, and (2) Section 23.67(b)(2), where appropriate, and Sec. 23.77(b), for landing. (d) For commuter category airplanes, compliance must be shown at weights as a function of airport altitude and ambient temperature within the operational limits established for takeoff and landing, respectively, with— (1) Sections 23.67(c)(1), 23.67(c)(2), and 23.67(c)(3) for takeoff; and (2) Sections 23.67(c)(3), 23.67(c)(4), and 23.77(c) for landing.	(6 000 lb) or less maximum weight, compliance must be shown with CS 23.65 (a), 23.67 (a), where appropriate and CS 23.77 (a) at maximum take-off or landing weight, as appropriate in a standard atmosphere. (c) For normal, utility and aerobatic category reciprocating engined aeroplanes of more than 2722 kg (6 000 lb) maximum weight and turbine engine-powered aeroplanes in the normal, utility and aerobatic category, compliance must be shown, at weights, as a function of airport altitude and ambient temperature, within the operational limits established for take-off and landing respectively, with – (1) CS 23.65 (b) and 23.67 (b) (1) and (2), where appropriate, for take-off; and (2) CS 23.67 (b) (2), where appropriate, and CS 23.77 (b), for landing. (d) For commuter category aeroplanes, compliance must be shown, at weights as a function of airport altitude and ambient temperature within the operational limits established for take-off and landing respectively, with – (1) CS 23.67 (c) (1), 23.67 (c) (2) and 23.67 (c) (3) for take-off; and (2) CS 23.67 (c) (3), 23.67 (c) (4) and 23.77 (c) for landing.
Sec. 23.66 Takeoff climb: one engine inoperative (c) The landing gear extended, except that if the landing gear can be retracted in not more than seven seconds, the test may be conducted with the gear retracted; (d) The wing flaps in the takeoff position(s); (e) The wings level; and (f) A climb speed equal to that achieved at 50 feet in the demonstration of Sec. 23.53.	**CS 23.66 Take-off climb: one-engine inoperative** (3) The landing gear extended except that, if the landing gear can be retracted in not more than 7 seconds, it may be assumed to be retracted; (4) The wing flaps in the take-off position(s); (5) The wings level; and (6) A climb speed equal to that achieved at 15 m (50 ft) in the demonstration of CS 23.53.
Sec. 23.145 Longitudinal control (a) With the airplane as nearly as possible in trim at 1.3 V_{S1}, it must be possible, at speeds below the trim speed, to pitch the nose downward so that the rate of increase in airspeed allows prompt acceleration to the trim speed with— (1) Maximum continuous power on each engine; (2) Power off; and (3) Wing flap and landing gear— (i) retracted, and (ii) extended. (b) Unless otherwise required, it must be possible to carry out the following maneuvers without requiring the application of single-handed control forces exceeding those specified in §23.143(c). The trimming controls must not be adjusted during the maneuvers: (1) With the landing gear extended, the flaps retracted, and the airplanes as nearly as possible in trim at 1.4 V_{S1}, extend the flaps as rapidly as possible and allow the airspeed to transition from 1.4$V_{S1}$to 1.4 V_{SO}: (i) With power off; and (ii) With the power necessary to maintain level flight in	**CS 23.145 Longitudinal control** (a) With the aeroplane as nearly as possible in trim at 1·3 VS1, it must be possible, at speeds below the trim speed, to pitch the nose downward so that the rate of increase in airspeed allows prompt acceleration to the trim speed with – (1) Maximum continuous power on each engine; (2) Power off; and (3) Wing flaps and landing gear – (i) Retracted; and (ii) Extended. (b) It must be possible to carry out the following manoeuvres without requiring the application of single handed control forces exceeding those specified in CS 23.143 (c), unless otherwise stated. The trimming controls must not be adjusted during the manoeuvres: (1) With landing gear extended and flaps retracted and the aeroplane as nearly as possible in trim at 1·4 VS1, extend the flaps as rapidly as possible and allow the airspeed to transition from 1·4 VS1 to 1·4 VS0, with – (i) Power off; and (ii) Power necessary to maintain level flight in the initial

the initial condition. (2) With landing gear and flaps extended, power off, and the airplane as nearly as possible in trim at 1.3 V_{SO}: quickly apply takeoff power and retract the flaps as rapidly as possible to the recommended go around setting and allow the airspeed to transition from 1.3 $V_{SO}$to 1.3 V_{S1}. Retract the gear when a positive rate of climb is established.	condition. (2) With landing gear and flaps extended, power off and the aeroplane as nearly as possible in trim at 1·3 VSO, quickly apply take-off power and retract the flaps as rapidly as possible to the recommended go-around setting and allow the airspeed to transition from 1·3 VSO to 1·3 VS1. Retract the gear when a positive rate of climb is established.
(3) With landing gear and flaps extended, in level flight, power necessary to attain level flight at 1.1 V_{SO}, and the airplane as nearly as possible in trim, it must be possible to maintain approximately level flight while retracting the flaps as rapidly as possible with simultaneous application of not more than maximum continuous power. If gated flat positions are provided, the flap retraction may be demonstrated in stages with power and trim reset for level flight at 1.1 V_{S1}, in the initial configuration for each stage— (i) From the fully extended position to the most extended gated position; (ii) Between intermediate gated positions, if applicable; and (iii) From the least extended gated position to the fully retracted position. (4) With power off, flaps and landing gear retracted and the airplane as nearly as possible in trim at 1.4 V_{S1}, apply takeoff power rapidly while maintaining the same airspeed. (5) With power off, landing gear and flaps extended, and the airplane as nearly as possible in trim at V_{REF}, obtain and maintain airspeeds between 1.1 V_{SO}, and either 1.7 V_{SO}or V_{FE}, whichever is lower without requiring the application of two-handed control forces exceeding those specified in §23.143(c). (6) With maximum takeoff power, landing gear retracted, flaps in the takeoff position, and the airplane as nearly as possible in trim at V_{FE}appropriate to the takeoff flap position, retract the flaps as rapidly as possible while maintaining constant speed. (c) At speeds above V_{MO}/M_{MO}, and up to the maximum speed shown under §23.251, a maneuvering capability of 1.5 g must be demonstrated to provide a margin to recover from upset or inadvertent speed increase. (d) It must be possible, with a pilot control force of not more than 10 pounds, to maintain a speed of not more than V_{REF}during a power-off glide with landing gear and wing flaps extended, for any weight of the airplane, up to and including the maximum weight. (e) By using normal flight and power controls, except as otherwise noted in paragraphs (e)(1) and (e)(2) of this section, it must be possible to establish a zero rate of descent at an attitude suitable for a controlled landing without exceeding the operational and structural limitations of the airplane, as follows: (1) For single-engine and multiengine airplanes, without the use of the primary longitudinal control system. (2) For multiengine airplanes—	(3) With landing gear and flaps extended, power for and in level flight at 1·1 VSO and the aeroplane as nearly as possible in trim, it must be possible to maintain approximately level flight while retracting the flaps as rapidly as possible with simultaneous application of not more than maximum continuous power. If gated flap positions are provided, the flap retraction may be demonstrated in stages with power and trim reset for level flight at 1·1 VS1 in the initial configuration for each stage – (i) From the fully extended position to the most extended gated position; (ii) Between intermediate gated positions, if applicable; and (iii) From the least extended gated position to the fully retracted position. (4) With power off, flaps and landing gear retracted and the aeroplane as nearly as possible in trim at 1·4 VS1, apply take-off power rapidly while maintaining the same airspeed. (5) With power off, landing gear and flaps extended and the aeroplane as nearly as possible in trim at VREF, obtain and maintain airspeeds between 1·1 VS0 and either 1·7 VS0 or VFE, whichever is lower, without requiring the application of two-handed control forces exceeding those specified in CS 23.143 (c). (6) With maximum take-off power, landing gear retracted, flaps in the take-off position and the aeroplane as nearly as possible in trim at VFE appropriate to the take-off flap position, retract the flaps as rapidly as possible while maintaining speed constant. (c) At speeds above VMO/MMO and up to the maximum speed shown under CS 23.251, a manoeuvring capability of 1·5g must be demonstrated to provide a margin to recover from upset or inadvertent speed increase. (d) It must be possible, with a pilot kontrol force of not more than 44·5 N (10 lbf), to maintain a speed of not more than VREF during a power-off glide with landing gear and wing flaps extended. (e) By using normal flight and power controls, except as otherwise noted in subparagraphs (e) (1) and (e) (2) it must be possible to establish a zero rate of descent at an attitude suitable for a controlled landing without exceeding the operational and structural limitations of the aeroplane, as follows: (1) For single-engined and twin-engined aeroplanes, without the use of the primary longitudinal control system;

(i) Without the use of the primary directional control; and (ii) If a single failure of any one connecting or transmitting link would affect both the longitudinal and directional primary control system, without the primary longitudinal and directional control system.	(2) For twin-engined aeroplanes; (i) Without the use of the primary directional control; and (ii) If a single failure of any one connecting or transmitting link would affect both the longitudinal and directional primary control system, without the primary longitudinal and directional control system.
Sec. 23.149 Minimum control speed met for the landing configuration with — (1) Maximum available takeoff power initially on each engine; (2) The airplane trimmed for an approach, with all engines operating, at VREF, at an approach gradient equal to the steepest used in the landing distance demonstration of Sec. 23.75; (3) Flaps in the landing position; (4) Landing gear extended; and (5) All propeller controls in the position recommended for approach with all engines operating. (d) A minimum speed to intentionally render the critical engine inoperative must be established and designated as the safe, intentional, one-engine-inoperative speed, VSSE. (e) At VMC, the rudder pedal force required to maintain control must not exceed 150 pounds and it must not be necessary to reduce power of the operative engine(s). During the maneuver, the airplane must not assume any dangerous attitude and it must be possible to prevent a heading change of more than 20°. (f) At the option of the applicant, to comply with the requirements of Sec. 23.51(c)(1), VMCG may be determined. VMCG is the minimum control speed on the ground, and is the calibrated airspeed during the takeoff run at which, when the critical engine is suddenly made inoperative, it is possible to using the rudder control alone (without the use of nose wheel steering), as maintain control of the airplane limited by 150 pounds of force, and using the lateral control to the extent of keeping the wings level to enable the takeoff to be safely continued. In the determination of VMCG, assuming that the path of the airplane accelerating with all engines operating is along the centerline of the runway, its path from the point at which the critical engine is made inoperative to the point at which recovery to a direction parallel to the centerline is completed may not deviate more than 30 feet laterally from the centerline at any point. VMCG must be established with— (1) The airplane in each takeoff configuration or, at the option of the applicant, in the most critical takeoff configuration; (2) Maximum available takeoff power on the operating engines; (3) The most unfavorable centre of gravity; (4) The airplane trimmed for takeoff; and (5) The most unfavorable weight in the range of take off weights.	**CS 23.149 Minimum control speed** met for the landing configuration with – (1) Maximum available take-off power initially on each engine; (2) The aeroplane trimmed for and approach with all engines operating at VREF at an approach gradient equal to the steepest used in the landing distance demonstration of CS 23.75; (3) Flaps in the landing position; (4) Landing gear extended; and (5) All propeller controls throughout in the position recommended for approach with all engines operating. (d) A minimum speed to intentionally render the critical engine inoperative must be established and designated as the safe, intentional, one-engine inoperative speed, VSSE. (e) At VMC, the rudder pedal force required to maintain control must not exceed 667 N (150 lbf) and it must not be necessary to reduce power of the operative engine . During the manoeuvre the aeroplane must not assume any dangerous attitude and it must be possible to prevent a heading change of more than 20°. (f) VMCG, the minimum control speed on the ground, is the calibrated airspeed during the takeoff run, at which, when the critical engine is suddenly made inoperative and with its propeller, if applicable, in the position it automatically achieves, it is possible to maintain control of the aeroplane with the use of the primary aerodynamic controls alone (without the use of nose-wheel steering) to enable the take-off to be safely continued using normal piloting skill. The rudder control force may not exceed 667 N (150 lbf) and, until the aeroplane becomes airborne, the lateral control may only be used to the extent of keeping the wings level. In the determination of VMCG, assuming that the path of the aeroplane accelerating with all engines operating is along the centreline of the runway, its path from the point at which the critical engine is made inoperative to the point at which recovery to a direction parallel to the centreline is completed, may not deviate more than 9·1m (30ft) laterally from the centreline at any point. VMCG must be established, with:- (1) The aeroplane in each take-off configuration or, at the option of the applicant, in the most critical take-off configuration; (2) Maximum available take-off power or thrust on the operating engines; (3) The most unfavourable centre of gravity; (4) The aeroplane trimmed for takeoff; and (5) The most unfavourable weight in the range of take-off weights.

Sec. 23.155 Elevator control force in maneuvers (a) The elevator control force needed to achieve the positive limit maneuvering load factor may not be less than— (1) For wheel controls, (where W is the maximum weight) or 20 pounds, whichever is greater, except that it need not be greater than 50 pounds; or (2) For stick controls, (where W is the maximum weight) or 15 pounds, whichever is greater, except that it need not be greater than 35 pounds. (b) The requirement of paragraph (a) of this section must be met at 75 percent of maximum continuous power for reciprocating engines, or the maximum continuous power for turbine engines, and with the wing flaps and landing gear retracted— (1) In a turn, with the trim setting used for wings level flight at VO; and (2) In a turn with the trim setting used for the maximum wings level flight speed, except that the speed may not exceed VNE or VMO/MMO, whichever is appropriate. (c) There must be no excessive decrease in the gradient of the curve of stick force versus maneuvering load factor with increasing load factor.	**CS 23.155 Elevator control force in manoeuvres** (a) The elevator control force needed to achieve the positive limit manoeuvring load factor may not be less than – (1) For wheel controls, W/10N (where W is the maximum weight in kg) (W/100 lbf (where W is the maximum weight in lb)) or 89 N (20 lbf), whichever is greater, except that it need not be greater than 222 N (50 lbf); or (2) For stick controls, W/14N (where W is the maximum weight in kg) (W/140 lbf where W is the maximum weight in lb)) or 66·8 N (15 lbf), whichever is greater, except that it need not be greater than 156 N (35 lbf). (b) The requirement of sub-paragraph (a) must be met with wing flaps and landing gear retracted under each of the following conditions – (1) At 75% of maximum continuous power for reciprocating engines or maximum continuous power for turbine engines. (2) In a turn, after the aeroplane is trimmed with wings level, at the minimum speed at which the required normal acceleration can be achieved without stalling, and at the maximum level flight trim speed except that the speed may not exceed VNE or VMO/MMO, whichever is appropriate. (c) There must be no excessive decrease in the gradient of the curve of stick force versus manoeuvring load factor with increasing load factor.
Sec. 23.181 Dynamic stability (a) Any short period oscillation not including combined lateral-directional oscillations occurring between the stalling speed and the maximum allowable speed appropriate to the configuration of the airplane must be heavily damped with primary controls— (1) Free; and (2) In a fixed position. (b)Any combined lateral-directional oscillations ("Dutch roll") occurring between the stalling speed and the maximum allowable speed appropriate to the configuration of the airplane must be damped to amplitude in 7 cycles with the primary controls— (1) Free; and (2) In a fixed position. (c) If it is determined that the function of a stability augmentation system, reference Sec. 23.672, is needed to meet the flight characteristic requirements of this part, the primary control requirements of paragraphs (a)(2) and (b)(2) of this section are not applicable to the tests needed to verify the acceptability of that system. (d) During the conditions as specified in Sec. 23.175, when the longitudinal control force required to maintain speeds differing from the trim speed by at least ±15 percent is suddenly released, the response of the airplane must not exhibit any dangerous characteristics nor be excessive in relation to the magnitude of the	**CS 23.181 Dynamic stability** (a) Any short period oscillation not including combined lateral-directional oscillations occurring between the stalling speed and the maximum allowable speed appropriate to the configuration of the aeroplane must be heavily damped with the primary controls – (1) Free; and (2) In a fixed position, except when compliance with CS 23.672 is shown. (b) Any combined lateral–directional oscillations ("Dutch roll") occurring between the stalling speed and the maximum allowable speed appropriate to the configuration of the aeroplane must be damped to 1 10 amplitude in 7 cycles with the primary controls – (1) Free; and (2) In a fixed position, except when compliance with CS 23.672 is shown. (c) Any long-period oscillation of the flight path (phugoid) must not be so unstable as to cause an unacceptable increase in pilot workload or otherwise endanger the aeroplane. When, in the conditions of CS 23.175, the longitudinal control force required to maintain speeds differing from the trimmed speed by at least plus or minus 15% is suddenly released, the response of the aeroplane must not exhibit any dangerous characteristics nor be excessive in relation to the magnitude of the control force released.

control force released. Any long-period oscillation of flight path, phugoid oscillation, that results must not be so unstable at to increase the pilot's workload or otherwise endanger the airplane.	
Sec. 23.201 Wings level stall demonstrated in flight as follows. Starting from a speed at least 10 knots above the stall speed, the elevator control must be pulled back so that the rate of speed reduction will not exceed one knot per second until a stall is produced, as shown by either: (1) An uncontrollable downward pitching motion of the airplane; (2) A downward pitching motion of the airplane that results from the activation of a stall avoidance device (for example, stick pusher); or (3) The control reaching the stop. (c) Normal use of elevator control for recovery is allowed after the downward pitching motion of paragraphs (b)(1) or (b)(2) of this section has unmistakably been produced, of after the control has been held against the stop for not less than the longer of two seconds or the time employed in the minimum steady slight speed determination of Sec. 23.49. (d) During the entry into and the recovery from the maneuver, it must be possible to prevent more than 15 degrees of roll or yaw by the normal use of controls. (e) Compliance with the requirements of this section must be shown under the following conditions: (1) *Wing Flaps:* Retracted, fully extended, and each intermediate normal operating position. (2) *Landing Gear:* Retracted and extended. (3) *Cowl Flaps:* Appropriate to configuration. (4) *Power:* (i) Power off; and (ii) 75 percent maximum continuous power. However, if the power-to-weight ratio at 75 percent of maximum continuous power result in extreme nose-high attitudes, the test may be carried out with the power required for level flight in the landing configuration at maximum landing weight and a speed of 1.4 , except that the power may not be less than 50 percent of maximum continuous power. (5) *Trim:* The airplane trimmed at a speed as near 1.5 VS1 as practicable. (6) *Propeller:* Full increase r.p.m. position for the power off condition.	**CS 23.201 Wings level stall** demonstrated in flight as follows. Starting from a speed at least 18.5 km/h (10 knots) above the stall speed, the elevator control must be pulled back so that the rate of speed reduction will not exceed 1.9 km/h (one knot) per second until a stall is produced, as shown by either – (1) An uncontrollable downward pitching motion of the aeroplane; or (2) A downward pitching motion of the aeroplane which results from the activation of a device (e.g. stick pusher); or (3) The control reaching the stop. (c) Normal use of elevator control for recovery is allowed after the downward pitching motion of (b) (1) or (b) (2) has unmistakably been produced, or after the control has been held against the stop for not less than the longer of 2 seconds or the time employed in the minimum steady flight speed determination of CS 23.49. (d) During the entry into and the recovery from the manoeuvre, it must be possible to prevent more than 15° of roll or yaw by the normal use of controls. (e) Compliance with the requirements must be shown under the following conditions: (1) *Wing flaps*. Retracted, fully extended and each intermediate normal operating position; (2) *Landing gear*. Retracted and extended; (3) *Cowl flaps*. Appropriate to configuration; (4) *Power* (i) Power off; and (ii) 75% maximum continuous power. If the power-to-weight ratio at 75% of maximum continuous power results in extreme nose-up attitudes, the test may be carried out with the power required for level flight in the landing configuration at maximum landing weight and a speed of 1·4 VS0, but the power may not be less than 50% maximum continuous power. (5) *Trim*. The aeroplane trimmed at a speed as near 1·5 VS1 as practicable. (6) *Propeller*. Full increase rpm position for the power off condition.
Sec. 23.221 Spinning (a) *Normal category airplanes.* A single-engine, normal category airplane must be able to recover from a one-turn spin or a three-second spin, whichever takes longer, in not more than one additional turn after initiation of the first control action for recovery, or demonstrate compliance with the optional spin resistant requirements of this section. (1) The following apply to one turn or three-second spins:	**CS 23.221 Spinning** (a) *Normal Category aeroplanes.* A single engined, normal category aeroplane must be able to recover from a one-turn spin or a three-second spin, whichever takes longer, in not more than one additional turn, after initiation of the first control action for recovery. In addition – (1) For both the flaps-retracted and flaps-extended conditions, the applicable airspeed limit and positive limit manoeuvring load factor must not be exceeded;

(i) For both the flaps-retracted and flaps-extended conditions, the applicable airspeed limit and positive limit maneuvering load factor must not be exceeded; (ii) No control forces or characteristic encountered during the spin or recovery may adversely affect prompt recovery; (iii) It must be impossible to obtain unrecoverable spins with any use of the flight or engine power controls either at the entry into or during the spin; and (iv) For the flaps-extended condition, the flaps may be retracted during the recovery but not before rotation has ceased. (2) At the applicant's option, the airplane may be demonstrated to be spin resistant by the following: (i) During the stall maneuvers contained in Sec. 23.201, the pitch control must be pulled back and held against the stop. Then, using ailerons and rudders in the proper direction, it must be possible to maintain wings-level flight within 15 degrees of bank and to roll the airplane from a 30 degree bank in one direction to a 30 degree bank in the other direction; (ii) Reduce the airplane speed using pitch control at a rate of approximately 1 knot per second until the pitch control reaches the stop; then, with the pitch control pulled back and held against the stop, apply full rudder control in a manner to promote spin entry for a period of 7 seconds or through a 360 degree heading change, whichever occurs first. If the 360 degree heading change is reached first, it must have taken no fewer than 4 seconds. This maneuver must be performed first with the ailerons in the neutral position, and then with the ailerons deflected opposite the direction of turn in the most adverse manner. Power and airplane configuration must be set in accordance with Sec. 23.201(e) without change during the maneuver. At the end of 7 seconds or a 360 degree heading change, the airplane must respond immediately and normally to primary flight controls applied to regain coordinated, un-stalled flight without reversal of control effect and without exceeding the temporary control forces specified by Sec. 23.143(c); and (iii) Compliance with Secs. 23.201 and 23.203 must be demonstrated with the airplane in uncoordinated flight, corresponding to one ball width displacement on a slip-skid indicator, unless one ball width displacement cannot be obtained with full rudder, in which case the demonstration must be with full rudder applied. (b) *Utility category airplanes.* A utility category airplane must meet the requirements of paragraph (a) of this section. In addition, the requirements of paragraph (c) of this section and Sec. 23.807(b)(7) must be met if approval for spinning is requested. (c) *Acrobatic category airplanes.* An acrobatic category airplane must meet the spin requirements of paragraph (a) of this section and Sec. 23.807(b)(6). In addition, the following requirements must be met in each configuration for which approval for spinning is requested: (1) The airplane must recover from any point in a spin up to and including six turns, or any greater number of	(2) No control forces or characteristic encountered during the spin or recovery may adversely affect prompt recovery; (3) It must be impossible to obtain unrecoverable spins with any use of the flight or engine power controls either at the entry into or during the spin; and (4) For the flaps extended condition, the flaps may be retracted during the recovery but not before rotation has ceased. (b) *Utility category aeroplanes*. A utility category aeroplane must meet the requirements of sub-paragraph (a) . In addition, the requirements of sub-paragraph (c) and CS 23.807 (b) (6) must be met if approval for spinning is requested. (c) *Aerobatic category aeroplanes*. An aerobatic category aeroplane must meet the requirements of sub-paragraph (a) and CS 23.807 (b) (5). In addition, the following requirements must be met in each configuration for which approval for spinning is requested – (1) The aeroplane must recover from any point in a spin up to and including six turns, or any greater number of turns for which certification is requested, in not more than one and one-half additional turns after initiation of the first control action for recovery. However, beyond three turns, the spin may be discontinued if spiral characteristics appear; (2) The applicable airspeed limits and limit manoeuvring load factors must not be exceeded. For flaps-extended configurations for which approval is requested, the flaps must not be retracted during the recovery; (3) It must be impossible to obtain unrecoverable spins with any use of the flight or engine power controls either at the entry into or during the spin; and (4) There must be no characteristics during the spin (such as excessive rates of rotation or extreme oscillatory motion) which might prevent a successful recovery due to disorientation or incapacitation of the pilot. [Amdt No: 23/2]

turns for which certification is requested, in not more than one and one-half additional turns after initiation of the first control action for recovery. However, beyond 3 turns, the spin may be discontinued if spiral characteristics appear. (2) The applicable airspeed limits and limit maneuvering load factors must not be exceeded. For flaps-extended configurations for which approval is requested, the flaps must not be retracted during the recovery. (3) It must be impossible to obtain unrecoverable spins with any use of the flight or engine power controls either at the entry into or during the spin. (4) There must be no characteristics during the spin (such as excessive rates of rotation or extreme oscillatory motion) that might prevent a successful recovery due to disorientation or incapacitation of the pilot. **SAT note**: it may be demonstrated compliance with the optional spin resistant requirements.	
Sec. 23.237 Operation on water A wave height, demonstrated to be safe for operation, and any necessary water handling procedures for seaplanes and amphibians must be established.	**CS 23.237 Operation on water** Allowable water surface conditions and any necessary water handling procedures for seaplanes and amphibians must be established.
Sec. 23.251 Vibration and buffeting (a) There must be no vibration or buffeting severe enough to result in structural damage, and each part of the airplane must be free from excessive vibration, under any appropriate speed and power conditions up to V_D/M_D or V_{DF}/M_{DF} for turbojets. In addition, there must be no buffeting in any normal flight condition, including configuration changes during cruise, severe enough to interfere with the satisfactory control of the airplane or cause excessive fatigue to the flight crew. Stall warning buffeting within these limits is allowable. (b) There must be no perceptible buffeting condition in the cruise configuration in straight flight at any speed up to V_{MO}/M_{MO}, except stall buffeting, which is allowable. (c) For airplanes with $M_D$greater than M 0.6 or a maximum operating altitude greater than 25,000 feet, the positive maneuvering load factors at which the onset of perceptible buffeting occurs must be determined with the airplane in the cruise configuration for the ranges of airspeed or Mach number, weight, and altitude for which the airplane is to be certificated. The envelopes of load factor, speed, altitude, and weight must provide a sufficient range of speeds and load factors for normal operations. Probable inadvertent excursions beyond the boundaries of the buffet onset envelopes may not result in unsafe conditions.	**CS 23.251 Vibration and buffeting** There must be no vibration or buffeting severe enough to result in structural damage and each part of the aeroplane must be free from excessive vibration, under any appropriate speed and power conditions up to at least the minimum value of VD allowed in CS 23.335. In addition there must be no buffeting in any normal flight condition severe enough to interfere with the satisfactory control of the aeroplane or cause excessive fatigue to the flight crew. Stall warning buffeting within these limits is allowable.
Sec. 23.301 Loads (a) Strength requirements are specified in terms of limit loads (the maximum loads to be expected in service)	**CS 23.301 Loads** (a) Strength requirements are specified in terms of limit loads (the maximum loads to be expected in service)

and ultimate loads (limit loads multiplied by prescribed factors of safety). Unless otherwise provided, prescribed loads are limit loads. (b) Unless otherwise provided, the air, ground, and water loads must be placed in equilibrium with inertia forces, considering each item of mass in the airplane. These loads must be distributed to conservatively approximate or closely represent actual conditions. Methods used to determine load intensities and distribution on canard and tandem wing configurations must be validated by flight test measurement unless the methods used for determining those loading conditions are shown to be reliable or conservative on the configuration under consideration. (c) If deflections under load would significantly change the distribution of external or internal loads, this redistribution must be taken into account. (d) Simplified structural design criteria may be used if they result in design loads not less than those prescribed in Secs. 23.331 through 23.521. For airplane configurations described in appendix A, Sec. 23.1, the design criteria of appendix A of this part are an approved equivalent of Secs. 23.321 through 23.459. If appendix A of this part is used, the entire appendix must be substituted for the corresponding sections of this part.	and ultimate loads (limit loads multiplied by prescribed factors of safety). Unless otherwise provided, prescribed loads are limit loads. (b) Unless otherwise provided, the air, ground and water loads must be placed in equilibrium with inertia forces, considering each item of mass in the aeroplane. These loads must be distributed to conservatively approximate or closely represent actual conditions. Methods used to determine load intensities and distribution on canard and tandem wing configurations must be validated by flight test measurement unless the methods used for determining those loading conditions are shown to be reliable or conservative on the configuration under consideration. (c) If deflections under load would significantly change the distribution of external or internal loads, this redistribution must be taken into account. (d) Simplified structural design criteria may be used if they result in design loads not less than those prescribed in CS 23.331 to 23.521. For aeroplanes described in appendix A, paragraph A23.1, the design criteria of Appendix A of CS-23 are an approved equivalent of CS 23.321 to 23.459. If Appendix A is used, the entire Appendix must be substituted for the corresponding paragraphs of this CS-23.
Sec. 23.333 Flight envelope (a) General. Compliance with the strength requirements of this subpart must be shown at any combination of airspeed and load factor on and within the boundaries of a flight envelope (similar to the one in paragraph (d) of this section) that represents the envelope of the flight loading conditions specified by the maneuvering and gust criteria of paragraphs (b) and (c) of this section respectively. (b) Maneuvering envelope. Except where limited by maximum (static) lift coefficients, the airplane is assumed to be subjected to symmetrical maneuvers resulting in the following limit load factors: (1) The positive maneuvering load factor specified in Sec. 23.337 at speeds up to VD; (2) The negative maneuvering load factor specified in Sec. 23.337 at VC; and (3) Factors varying linearly with speed from the specified value at VC to 0.0 at VD for the normal and commuter category, and -1.0 at VD for the acrobatic and utility categories. (c) Gust envelope. (1) The airplane is assumed to be subjected to symmetrical vertical gusts in level flight. The resulting limit load factors must correspond to the conditions determined as follows: (i) Positive (up) and negative (down) gusts of 50 f.p.s. at VC must be considered at altitudes between sea level and 20,000 feet. The gust velocity may be reduced linearly from 50 f.p.s. at 20,000 feet to 25 f.p.s. at 50,000 feet. (ii) Positive and negative gusts of 25 f.p.s. at VD must	**CS 23.333 Flight envelope** (a) General. Compliance with the strength requirements of this subpart must be shown at any combination of airspeed and load factor on and within the boundaries of a flight envelope (similar to the one in sub-paragraph (d)) that represents the envelope of the flight loading conditions specified by the manoeuvring and gust criteria of sub-paragraphs (b) and (c) respectively. (b) Manoeuvring envelope. Except where limited by maximum (static) lift coefficients, the aeroplane is assumed to be subjected to symmetrical manoeuvres resulting in the following limit load factors: (1) The positive manoeuvring load factor specified in CS 23.337 at speeds up to VD; (2) The negative manoeuvring load factor specified in CS 23.337 at VC; and (3) Factors varying linearly with speed from the specified value at VC to 0·0 at VD for the normal and commuter category, and -1·0 at VD for the aerobatic and utility categories. (c) Gust envelope (1) The aeroplane is assumed to be subjected to symmetrical vertical gusts in level flight. The resulting limit load factors must correspond to the conditions determined as follows. (i) Positive (up) and negative (down) gusts of 50 fps at VC must be considered at altitudes between sea level and 6096 m (20 000 ft). The gust velocity may be reduced linearly from 50 fps at 6096 m (20 000 ft) to 25 fps at 15240 m (50 000 ft); and (ii) Positive and negative gusts of 25 fps at VD must be

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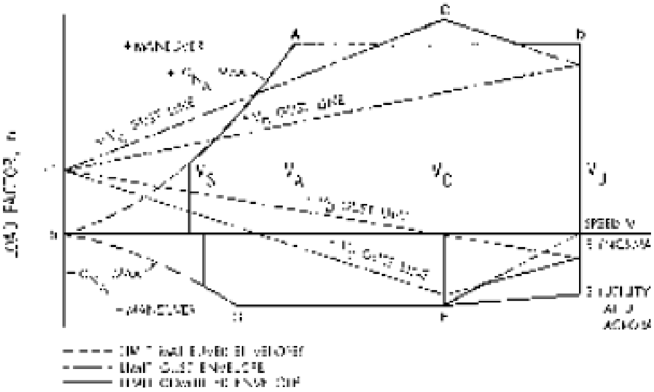
<td>be considered at altitudes between sea level and 20,000 feet. The gust velocity may be reduced linearly from 25 f.p.s. at 20,000 feet to 12.5 f.p.s. at 50,000 feet.
(iii) In addition, for commuter category airplanes, positive (up) and negative (down) rough air gusts of 66 f.p.s. at VB must be considered at altitudes between sea level and 20,000 feet. The gust velocity may be reduced linearly from 66 f.p.s. at 20,000 feet to 38 f.p.s. at 50,000 feet.
(2) The following assumptions must be made:
(i) The shape of the gust is—

$$U = \frac{U_{de}}{2}\left(1 - \cos\frac{2\pi s}{25\bar{C}}\right)$$

where—
s = Distance penetrated into gust (ft.);
C= Mean geometric chord of wing (ft.); and
Ude = Derived gust velocity referred to in subparagraph (1) of this section.
(ii) Gust load factors vary linearly with speed between VC and VD.
(d) Flight envelope.



Note: Point G need not be investigated when the supplementary condition specified in Sec. 23.369 is investigated.</td>
<td>considered at altitudes between sea level and 6096 m (20 000 ft). The gust velocity may be reduced linearly from 25 fps at 6096 m (20 000 ft) to 12·5 fps at 15240 m (50 000 ft).
(iii) In addition, for commuter category aeroplanes, positive (up) and negative (down) rough air gusts of 66 fps at VB must be considered at altitudes between sea level and 6096 m (20 000 ft). The gust velocity may be reduced linearly from 66 fps at 6096 m (20 000 ft) to 38 fps at 15240 m (50 000 ft).
(2) The following assumptions must be made:
(i) The shape of the gust is –

$$U = \frac{U_{de}}{2}\left(1 - \cos\frac{2\pi s}{25\bar{C}}\right)$$

where –
s = Distance penetrated into gust (ft.);
C= Mean geometric chord of wing (ft.); and
Ude= Derived gust velocity referred to in sub-paragraph (1) linearly with speed between VC and VD.
(ii) Gust load factors vary linearly with speed between VC and VD.
(d) Flight envelope

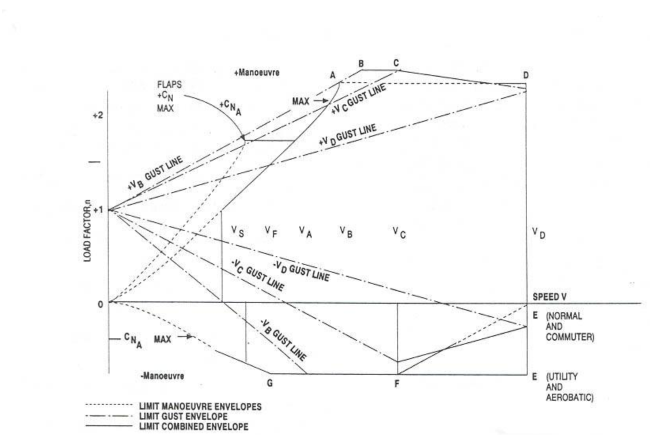
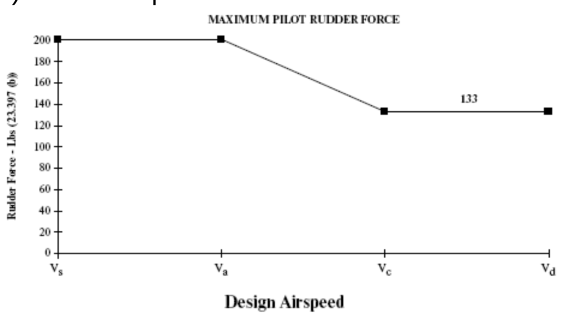
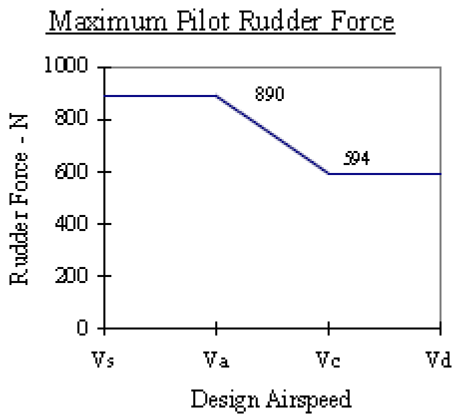


Figure has VF and +/-VB Gust Lines not in Part 23 Figure.

Note: Point G need not be investigated when the supplementary condition specified in CS 23.369 is investigated.</td>
</tr>
<tr>
<td>Sec. 23.341 Gust load factors
(a) Each airplane must be designed to withstand loads on each lifting surface resulting from gusts specified in Sec. 23.333(c).
(b) The gust load for a canard or tandem wing configuration must be computed using a rational analysis, or may be computed in accordance with paragraph
(c) of this section, provided that the resulting net loads are shown to be conservative with respect to the gust criteria of Sec. 23.333(c). (c) In the absence of a more rational analysis, the gust load factors must be computed as follows-- where—</td>
<td>CS 23.341 Gust load factors
(See AMC 23.341 (b))
(a) Each aeroplane must be designed to withstand loads on each lifting surface resulting from gusts specified in CS 23.333(c).
(b) The gust load for a canard or tandem wing configuration must be computed using a rational analysis, or may be computed in accordance with sub-paragraph (c) provided that the resulting net loads are shown to be conservative with respect to the gust criteria of CS 23.333(c).
(c) In the absence of a more rational analysis the gust load factors must be computed as follows:
$n = 1 \pm \frac{k_g \rho_o U_{de}}{2(W/S)}$</td>
</tr>
</table>

$$n = 1 + \frac{K_g U_{de} V a}{498(W/S)}$$ *K* g=0.88µg/5.3+µg=gust alleviation factor; µg=2(W/S)/ρ Cag=airplane mass ratio; *Ude* = Derived gust velocities referred to in Sec. 23.333(c) (f.p.s.); ρ = Density of air (slugs/cu. ft.); *W/S* = wing loading (p.s.f.) due to the applicable weight of the airplane in the particular load case. *C* = Mean geometric chord (ft.); *g* = Acceleration due to gravity (ft./sec.2); *V* = airplane equivalent speed (knots); and *a* = Slope of the airplane normal force coefficient curve CNA per radian if the gust loads are applied to the wings and horizontal tail surfaces simultaneously by a rational method. The wing lift curve slope CL per radian may be used when the gust load is applied to the wings only and the horizontal tail gust loads are treated as a separate condition.	where – kg = 0.88 µg = gust alleviation factor; 5.3+ µg µg =2(W/ S)/ ρ Cag = aeroplane mass ratio; Ude **=** Derived gust velocities referred to in CS 23.333 (c) (m/s); ρo = Density of air at sea-level (kg/m3) ρ = Density of air (kg/m3) at the altitude considered; W/S = Wing loading due to the applicable weight of the aeroplane in the particular load case (N/m2); C = Mean geometric chord (m); g = Acceleration due to gravity (m/sec2); V = Aeroplane equivalent speed (m/s); and a = Slope of the aeroplane normal force coefficient curve CNA per radian if the gust loads are applied to the wings and horizontal tail surfaces simultaneously by a rational method. The wing lift curve slope CL per radian may be used when the gust load is applied to the wings only and the horizontal tail gust loads are treated as a separate condition.
Sec. 23.367 Unsymmetrical loads due to engine failure (a) Turbo-propeller airplanes must be designed for the unsymmetrical loads resulting from the failure of the critical engine including the following conditions in combination with a single malfunction of the propeller drag limiting system, considering the probable pilot corrective action on the flight controls: (1) At speeds between VMC and VD, the loads resulting from power failure because of fuel flow interruption are considered to be limit loads. (2) At speeds between VMC and VC, the loads resulting from the disconnection of the engine compressor from the turbine or from loss of the turbine blades are considered to be ultimate loads. (3) The time history of the thrust decay and drag build-up occurring as a result of the prescribed engine failures must be substantiated by test or other data applicable to the particular engine-propeller combination. (4) The timing and magnitude of the probable pilot corrective action must be conservatively estimated, considering the characteristics of the particular engine propeller airplane combination. (b) Pilot corrective action may be assumed to be initiated at the time maximum yawing velocity is reached, but not earlier than 2 seconds after the engine failure. The magnitude of the corrective action may be based on the limit pilot forces specified in Sec. 23.397 except that lower forces may be assumed where it is shown by analysis or test that these forces can control the yaw and roll resulting from the prescribed engine failure conditions.	**CS 23.367 Unsymmetrical loads due to engine failure** (a) Turbopropeller aeroplanes must be designed for the unsymmetrical loads resulting from the failure of the critical engine including the following conditions in combination with a single malfunction of the propeller drag limiting system, considering the probable pilot corrective action on the flight controls. (1) At speeds between VMC and VD, the loads resulting from power failure because of fuel flow interruption are considered to be limit loads; (2) At speeds between VMC and VC, the loads resulting from the disconnection of the engine compressor from the turbine or from loss of the turbine blades are considered to be ultimate loads; (3) The time history of the thrust decay and drag build-up occurring as a result of the prescribed engine failures must be substantiated by test or other data applicable to the particular engine-propeller combination; and (4) The timing and magnitude of the probable pilot corrective action must be conservatively estimated, considering the characteristics of the particular engine propeller- aeroplane combination. (b) Pilot corrective action may be assumed to be initiated at the time maximum yawing velocity is reached, but not earlier than 2 seconds after the engine failure. The magnitude of the corrective action may be based on the limit pilot forces specified in CS 23.397 except that lower forces may be assumed where it is shown by analyses or test that these forces can control the yaw and corresponding device positions that the mechanism allows.
Sec. 23.395 Control system loads (a) Each flight control system and its supporting structure must be designed for loads corresponding to	**CS 23.395 Control system loads** (a) Each flight control system and its supporting structure must be designed for loads corresponding to

at least 125 percent of the computed hinge moments of the movable control surface in the conditions prescribed in Secs. 23.391 through 23.459. In addition, the following apply: (1) The system limit loads need not exceed the higher of the loads that can be produced by the pilot and automatic devices operating the controls. However, autopilot forces need not be added to pilot forces. The system must be designed for the maximum effort of the pilot or autopilot, whichever is higher. In addition, if the pilot and the autopilot act in opposition, the part of the system between them may be designed for the maximum effort of the one that imposes the lesser load. Pilot forces used for design need not exceed the maximum forces prescribed in Sec. 23.397(b). (2) The design must, in any case, provide a rugged system for service use, considering jamming, ground gusts, taxiing downwind, control inertia, and friction. Compliance with this subparagraph may be shown by designing for loads resulting from application of the minimum forces prescribed in Sec. 23.397(b). (b) A 125 percent factor on computed hinge moments must be used to design elevator, aileron, and rudder systems. However, a factor as low as 1.0 may be used if hinge moments are based on accurate flight test data, the exact reduction depending upon the accuracy and reliability of the data. (c) Pilot forces used for design are assumed to act at the appropriate control grips or pads as they would in flight, and to react at the attachments of the control system to the control surface horns.	at least 125% of the computed hinge moments of the movable control surface in the conditions prescribed in CS 23.391 to 23.459. In addition, the following apply: (1) The system limit loads need not exceed the higher of the loads that can be produced by the pilot and automatic devices operating the controls. However, autopilot forces need not be added to pilot forces. The system must be designed for the maximum effort of the pilot or autopilot, whichever is higher. In addition, if the pilot and the autopilot act in opposition, the part of the system between them may be designed for the maximum effort of the one that imposes the lesser load. Pilot forces used for design need not exceed the maximum forces prescribed in CS 23.397 (b). (2) The design must, in any case, provide a rugged system for service use, considering jamming, ground gusts, taxing downwind, control inertia and friction. Compliance with this sub-paragraph may be shown by designing for loads resulting from application of the minimum forces prescribed in CS 23.397 (b). (b) A 125% factor on computed hinge movements must be used to design elevator, aileron and rudder systems. However, a factor as low as 1·0 may be used if hinge moments are based on accurate flight test data, the exact reduction depending upon the accuracy and reliability of the data. (c) Pilot forces used for design are assumed to act at the appropriate control grips or pads as they would in flight and to react at the attachments of the control system to the control surface horns.
Sec. 23.425 Gust loads (a) Each horizontal surface, other than a main wing, must be designed for loads resulting from - (1) Gust velocities specified in Sec. 23.333(c) with flaps retracted; and (2) Positive and negative gusts of 25 f.p.s. nominal intensity at VF, corresponding to the flight conditions specified in Sec. 23.345(a)(2). (b) Reserved. (c) When determining the total load on the horizontal surfaces for the conditions specified in paragraph (a) of this section, the initial balancing loads for steady unaccelerated flight at the pertinent design speeds VF, VC, and VD must first be determined. The incremental load resulting from the gusts must be added to the initial balancing load to obtain the total load. (d) In the absence of a more rational analysis, the incremental load due to the gust must be computed as follows only on airplane configurations with aft-mounted, horizontal surfaces, unless its use elsewhere is shown to be conservative: $\Delta L_{ht} = \frac{K_g U_{de} V a_{ht} S_{ht}}{498}\left(1 - \frac{d_\varepsilon}{d_\alpha}\right)$ where = Incremental horizontal tail load (lbs.); Kg = Gust alleviation factor defined in Sec. 23.341; Ude = Derived gust velocity (f.p.s.); V = Airplane equivalent speed (knots);	**CS 23.425 Gust loads** (a) Each horizontal surface other than a main wing, must be designed for loads resulting from – (1) Gust velocities specified in CS 23.333 (c) with flaps retracted; and (2) Positive and negative gusts of 7.62 m/s (25 fps) nominal intensity at VF corresponding to the flight conditions specified in CS 23.345 (a) (2). (b) Reserved. (c) When determining the total load on the horizontal surfaces for the conditions specified in sub-paragraph (a) , the initial balancing loads for steady unaccelerated flight at the pertinent design speeds, VF, VC and VD must first be determined. The incremental load resulting from the gusts must be added to the initial balancing load to obtain the total load. (d) In the absence of a more rational analysis, the incremental load due to the gust must be computed as follows only on aeroplane configurations with aft-mounted, horizontal surfaces, unless its use elsewhere is shown to be conservative: $\Delta L_{ht} = \frac{K_g U_{de} V a_{ht} S_{ht}}{2}\left(1-\frac{d_e}{d_a}\right)$ where – Δ Lht = Incremental horizontal tail load (N);

aht = Slope of aft horizontal tail lift curve (per radian); *Sht* = Area of aft horizontal lift surface (ft2); and where – ρo = Density of air at sea-level (kg/m3) $\left(1-\frac{d_e}{d_a}\right)$ = Downwash factor.	ρo = Density of air at sea-level (kg/m3) Kg = Gust alleviation factor defined in CS 23.341; Ude = Derived gust velocity (m/s); V = Aeroplane equivalent speed (m/s); aht = Slope of aft horizontal tail lift curve (per radian); Sht = Area of aft horizontal tail (m2); And $\left(1-\frac{d_e}{d_a}\right)$ = Downwash factor.
Sec. 23.441 Maneuvering loads steady state sideslip angle, with the rudder at maximum deflection caused by any one of the following: (i) Control surface stops; (ii) Maximum available booster effort; (iii) Maximum pilot rudder force as shown below:  (2) The rudder must be suddenly displaced from the maximum deflection to the neutral position. (c) The yaw angles specified in paragraph (a)(3) of this section may be reduced if the yaw angle chosen for a particular speed cannot be exceeded in— (1) Steady slip conditions; (2) Uncoordinated rolls from steep banks; or (3) Sudden failure of the critical engine with delayed corrective action.	**CS 23.441 Manoeuvring loads** steady state sideslip angle, with the rudder at maximum deflection caused by any one of the following: (i) Control surface stops; (ii) Maximum available booster effort; (iii) pilot rudder force as shown below:- Figure has rudder force in Newtons.  (2) The rudder must be suddenly displaced from the maximum deflection to the neutral position. (c) The yaw angles specified in subparagraph (a)(3) may be reduced if the yaw angle chosen for a particular speed cannot be exceeded in – (1) Steady slip conditions; (2) Uncoordinated rolls from steep banks; or (3) Sudden failure of the critical engine with delayed corrective action.
Sec. 23.443 Gust loads (a) Vertical surfaces must be designed to withstand, in unaccelerated flight at speed VC, lateral gusts or the values prescribed for VC in Sec. 23.333(c). (b) In addition, for commuter category airplanes, the airplane is assumed to encounter derived gusts normal to the plane of symmetry while in unaccelerated flight at VB, VC, VD, and VF. The derived gusts and airplane speeds corresponding to these conditions, as determined by Secs. 23.341 and 23.345, must be investigated. The shape of the gust must be as specified in Sec. 23.333(c)(2)(i). (c) In the absence of a more rational analysis, the gust load must be computed as follows:	**CS 23.443 Gust loads** (See AMC 23.443) (a) Vertical surfaces must be designed to withstand, in unaccelerated flight at speed VC, lateral gusts of the values prescribed for VC in CS 23.333 (c). (b) In addition, for commuter category aeroplanes, the aeroplane is assumed to encounter derived gusts normal to the plane of symmetry while in unaccelerated flight at VB, VC, VD and VF. The derived gusts and aeroplane speeds corresponding to these conditions, as determined by CS 23.341 and 23.345, must be investigated. The shape of the gust must be as specified in CS 23.333 (c) (2) (i). (c) In the absence of a more rational analysis, the gust load must be computed as follows:

$L_{vt} = \frac{K_{gt} U_{de} V a_{vt} S_{vt}}{498}$ where – *Lvt* = Vertical surface loads (lbs.); $K_{gt} = \frac{0.88\, \mu_{gt}}{5.3 + \mu_{gt}}$ = gust alleviation factor; $\mu_{gt} = \frac{2W}{\rho \bar{c}_t g a_{vt} S_{vt}} \frac{K^2}{1_{vt}}$ = lateral mass ratio; *Ude*= Derived gust velocity (f.p.s.); ρ = Air density (slugs/cu.ft.); *W* = the applicable weight of the airplane in the particular load case (lbs.); *Svt* = Area of vertical surface (ft.2); Ct = Mean geometric chord of vertical surface (ft.); *avt* = Lift curve slope of vertical surface (per radian); *K* = Radius of gyration in yaw (ft.); *1vt* = Distance from airplane c.g. to lift centre of vertical surface (ft.); *g* = Acceleration due to gravity (ft./sec.2); and *V* = Equivalent airspeed (knots).	$L_{vt} = \frac{\rho_0 K_{gt} U_{de} V a_{vt} S_{vt}}{2}$ where: Lvt = Vertical surface loads (N); $K_{gt} = \frac{0.88\, \mu_{gt}}{5.3 + \mu_{gt}}$ = gust alleviation factor; $\mu_{gt} = \frac{2W}{\rho \bar{c}_t g a_{vt} S_{vt}} \frac{K^2}{1_{vt}}$ = lateral mass ratio; Ct = Mean geometric chord of vertical surface (m); avt = Lift curve slope of vertical surface (per radian); ρo = Density of air at sea-level (kg/m3); Ude = Derived gust velocity (m/s); ρ = Air density (Kg/m3); W = the applicable weight of the aeroplane in the particular load case (N); Svt = Area of vertical surface (m2); K = Radius of gyration in yaw (m); 1v t = Distance from aeroplane c.g. to lift centre of vertical surface (m); g = Acceleration due to gravity (m/sec2); and V = Aeroplane equivalent speed (m/s)
Sec. 23.473 Ground load conditions and assumptions (a) The ground load requirements of this subpart must be complied with at the design maximum weight except that Secs. 23.479, 23.481, and 23.483 may be complied with at a design landing weight (the highest weight for landing conditions at the maximum descent velocity) allowed under paragraphs (b) and (c) of this section. (b) The design landing weight may be as low as— (1) 95 percent of the maximum weight if the minimum fuel capacity is enough for at least one-half hour of operation at maximum continuous power plus a capacity equal to a fuel weight which is the difference between the design maximum weight and the design landing weight; or (2) The design maximum weight less the weight of 25 percent of the total fuel capacity. (c) The design landing weight of a multiengine airplane may be less than that allowed under paragraph (b) of this section if— (1) The airplane meets the one-engine-inoperative climb requirements of Sec. 23.67(b)(1) or (c); and (2) Compliance is shown with the fuel jettisoning system requirements of Sec. 23.1001. (d) The selected limit vertical inertia load factor at the centre of gravity of the airplane for the ground load conditions prescribed in this subpart may not be less than that which would be obtained when landing with a descent velocity (V), in feet per second, equal to 4.4 (W/S) except that this velocity need not be more than 10 feet per second and may not be less than seven	**CS 23.473 Ground load conditions and assumptions** (a) The ground load requirements of this subpart must be complied with at the design maximum weight except that CS 23.479, 23.481 and 23.483 may be complied with at a design landing weight (the highest weight for landing conditions at the maximum descent velocity) allowed under sub-paragraphs (b) and (c) . (b) The design landing weight may be as low as – (1) 95% of the maximum weight if the minimum fuel capacity is enough for at least one-half hour of operation at maximum continuous power plus a capacity equal to a fuel weight which is the difference between the design maximum weight and the design landing weight; or (2) The design maximum weight less the weight of 25% of the total fuel capacity. (c) The design landing weight of a twin engine aeroplane may be less than that allowed under sub-paragraph (b) if – (1) The aeroplane meets the one engine- inoperative climb requirements of CS 23.67; and (2) Compliance is shown with the fuel jettisoning system requirements of CS 23.1001 (d) The selected limit vertical inertia load factor at the centre of gravity of the aeroplane for the ground load conditions prescribed in this subpart may not be less than that which would be obtained when landing with a descent velocity (V), in feet per second, equal to 4·4 (W/S) ¼, except that this velocity need not be more than 3.0 m (10 ft) per second and may not be less than 2.1 m (7 ft) per second.

feet per second. (e) Wing lift not exceeding two-thirds of the weight of the airplane may be assumed to exist throughout the landing impact and to act through the center of gravity. The ground reaction load factor may be equal to the inertia load factor minus the ratio of the above assumed wing lift to the airplane weight. (f) If energy absorption tests are made to determine the limit load factor corresponding to the required limit descent velocities, these tests must be made under §23.723(a). (g) No inertia load factor used for design purposes may be less than 2.67, nor may the limit ground reaction load factor be less than 2.0 at design maximum weight, unless these lower values will not be exceeded in taxiing at speeds up to takeoff speed over terrain as rough as that expected in service.	(e) Wing lift not exceeding two-thirds of the weight of the aeroplane may be assumed to exist throughout the landing impact and to act through the centre of gravity. The ground reaction load factor may be equal to the inertia load factor minus the ratio of the above assumed wing lift to the aeroplane weight. (f) If energy absorption tests are made to determine the limit load factor corresponding to the required limit descent velocities, these tests must be made under CS 23.723 (a). (g) No inertia load factor used for design purposes may be less than 2·67, nor may the limit ground reaction load factor be less than 2·0 at design maximum weight, unless these lower values will not be exceeded in taxing at speeds up to take-off speed over terrain as rough as that expected in service.
Sec. 23.525 Application of loads (a) Unless otherwise prescribed, the seaplane as a whole is assumed to be subjected to the loads corresponding to the load factors specified in Sec. 23.527. (b) In applying the loads resulting from the load factors prescribed in Sec. 23.527, the loads may be distributed over the hull or main float bottom (in order to avoid excessive local shear loads and bending moments at the location of water load application) using pressures not less than those prescribed in Sec. 23.533(c). (c) For twin float seaplanes, each float must be treated as an equivalent hull on a fictitious seaplane with a weight equal to one-half the weight of the twin float seaplane. (d) Except in the takeoff condition of Sec. 23.531, the aerodynamic lift on the seaplane during the impact is assumed to be of the weight of the seaplane.	**CS 23.525 Application of loads** (a) Unless otherwise prescribed, the seaplane as a whole is assumed to be subjected to the loads corresponding to the load factors specified in CS 23.527. (b) In applying the loads resulting from the load factors prescribed in CS 23.527, the loads may be distributed over the hull or main float bottom (in order to avoid excessive local shear loads and bending moments at the location of water load application) using pressures not less than those prescribed in CS 23.533 (b). (c) For twin float seaplanes, each float must be treated as an equivalent hull on a fictitious seaplane with a weight equal to one-half the weight of the twin float seaplane. (d) Except in the take-off condition of CS 23.531, the aerodynamic lift on the seaplane during the impact is assumed to be $^2/3$ of the weight of the seaplane.
Sec. 23.533 Hull and main float bottom pressures ….. These pressures are uniform and must be applied simultaneously over the entire hull or main float bottom. The loads obtained must be carried into the sidewall a fore and aft direction as shear and bending loads.	**CS 23.533 Hull and main float bottom pressures.** …… These pressures are uniform and must be applied simultaneously over the entire hull or main float bottom. The loads obtained must be carried into the sidewall structure of the hull proper, but need not be transmitted in a fore and aft direction as shear and bending loads.
Sec. 23.535 Auxiliary float loads …… (d) *Unsymmetrical step loading.* The resultant water load consists of a component equal to 0.75 times the load specified in paragraph (a) of this section and a side component equal to 0.025 tan β times the load specified in paragraph (b) of this section. The side load must be applied perpendicularly to the plane of symmetry of the float at a point midway between the keel and the chine.	**CS 23.535 Auxiliary float loads** …. (d) *Unsymmetrical step loading.* The resultant water load consists of a komponent equal to 0·75 times the load specified in subparagraph (a) and a side component equal to 3·25 tan β times the load specified in sub-paragraph (b). The side load must be applied perpendicularly to the plane of symmetry of the float at a point midway between the keel and the chine.

	SAT note: Probably mistake in coefficient tan β
Sec. 23.562 Emergency landing dynamic conditions (a) Each seat/restraint system for use in a normal, utility, or acrobatic category airplane must be designed to protect each occupant during an emergency landing when— (1) Proper use is made of seats, safety belts, and shoulder harnesses provided for in the design; and (2) The occupant is exposed to the loads resulting from the conditions prescribed in this section. (b) Except for those seat/restraint systems that are required to meet paragraph (d) of this section, each seat/restraint system for crew or passenger occupancy in a normal, utility, or acrobatic category airplane, must successfully complete dynamic tests or be demonstrated by rational analysis supported by dynamic tests, in accordance with each of the following conditions. These tests must be conducted with an occupant simulated by an anthropomorphic test dummy (ATD) defined by 49 CFR Part 572, subpart B, or an FAA-approved equivalent, with a nominal weight of 170 pounds and seated in the normal upright position. (1) For the first test, the change in velocity may not be less than 31 feet per second. The seat/restraint system must be oriented in its nominal position with respect to the airplane and with the horizontal plane of the airplane pitched up 60°, with no yaw, relative to the impact vector. For seat/restraint systems to be installed in the first row of the airplane, peak deceleration must occur in not more than 0.05 seconds after impact and must reach a minimum of 19g. For all other seat/restraint systems, peak deceleration must occur in not more than 0.06 seconds after impact and must reach a minimum of 15g. (2) For the second test, the change in velocity may not be less than 42 feet per second. The seat/restraint system must be oriented in its nominal position with respect to the airplane and with the vertical plane of the airplane yawed 10°, with no pitch, relative to the impact vector in a direction that results in the greatest load on the shoulder harness. For seat/restraint systems to be installed in the first row of the airplane, peak deceleration must occur in not more than 0.05 seconds after impact and must reach a minimum of 26g. For all other seat/restraint systems, peak deceleration must occur in not more than 0.06 seconds after impact and must reach a minimum of 21g. (3) To account for floor warpage, the floor rails or attachment devices used to attach the seat/restraint system to the airframe structure must be preloaded to misalign with respect to each other by at least 10° vertically (i.e., pitch out of parallel) and one of the rails or attachment devices must be preloaded to misalign by 10° in roll prior to conducting the test defined by paragraph (b)(2) of this section. (c) Compliance with the following requirements must	**CS 23.562 Emergency landing dynamic conditions** (See AMC 23.562) (a) Each seat/restraint system must be designed to protect each occupant during an emergency landing when – (1) Proper use is made of seats, safety belts, and shoulder harnesses provided for the design; and (2) The occupant is exposed to the loads resulting from the conditions prescribed in this paragraph. (b) Each seat/restraint system, for crew or passenger occupancy during take off and landing, must successfully complete dynamic tests or be demonstrated by rational analysis supported by dynamic tests, in accordance with each of the following conditions. These tests must be conducted with an occupant simulated by an anthropomorphic test dummy (ATD), as specified in Appendix J or an approved equivalent with a nominal weight of 77 kg (170 lb) and seated in the normal upright position. (1) For the first test, the change in velocity may not be less than 9.4 m (31 ft) per second. The seat/restraint system must be oriented in its nominal position with respect to the aeroplane and with the horizontal plane of the aeroplane pitched up 60°, with no yaw, relative to the impact vector. For seat/restraint systems to be installed in the first row of the aeroplane, peak deceleration must occur in not more than 0·05 seconds after impact and must reach a minimum of 19g. For all other seat/restraint systems, peak deceleration must occur in not more than 0·06 seconds after impact and must reach a minimum of 15g. (2) For the second test, the change in velocity may not be less than 12.8 m (42 ft) per second. The seat/restraint system must be oriented in its nominal position with respect to the aeroplane and with the vertical plane of the aeroplane yawed 10°, with no pitch, relative to the impact vector in a direction that results in the greatest load on the shoulder harness. For seat/restraint systems to be installed in the first row of the aeroplane, peak deceleration must occur in not more than 0·05 seconds after impact and must reach a minimum of 26g. For all other seat/restraint systems, peak deceleration must occur in not more than 0·06 seconds after impact and must reach a minimum of 21g. (3) To account for floor warpage, the floor rails of attachment devices used to attach the seat/restraint system to the airframe structure must be preloaded to misalign with respect to each other by at least 10° vertically (i.e. pitch out of parallel) and one of the rails or attachment devices must be preloaded to misalign by 10° in roll prior to conducting the test defined by sub-paragraph (b)(2) . (c) Compliance with the following requirements must be shown during the dynamic tests conducted in accordance with subparagraph (b) . (1) The seat/restraint system must restrain the ATD

be shown during the dynamic tests conducted in accordance with paragraph (b) of this section:

(1) The seat/restraint system must restrain the ATD although seat/restraint system components may experience deformation, elongation, displacement, or crushing intended as part of the design.

(2) The attachment between the seat/restraint system and the test fixture must remain intact, although the seat structure may have deformed.

(3) Each shoulder harness strap must remain on the ATD's shoulder during the impact.

(4) The safety belt must remain on the ATD's pelvis during the impact.

(5) The results of the dynamic tests must show that the occupant is protected from serious head injury.

(i) When contact with adjacent seats, structure, or other items in the cabin can occur, protection must be provided so that the head impact does not exceed a head injury criteria (HIC) of 1,000.

(ii) The value of HIC is defined as—

$$HIC = \left\{ (t_2 - t_1) \left[\frac{1}{(t_2 - t_1)} \int_{t_1}^{t_2} a(t)dt \right]^{2.5} \right\}_{Max}$$

where—

t1 is the initial integration time, expressed in seconds,

t2 is the final integration time, expressed in seconds,

(t2-t1) is the time duration of the major head impact, expressed in seconds, and

a(t) is the resultant deceleration at the center of gravity of the head form expressed as a multiple of g (units of gravity).

(iii) Compliance with the HIC limit must be demonstrated by measuring the head impact during dynamic testing as prescribed in paragraphs (b)(1) and (b)(2) of this section or by a separate showing of compliance with the head injury criteria using test or analysis procedures.

(6) Loads in individual shoulder harness straps may not exceed 1,750 pounds. If dual straps are used for retaining the upper torso, the total strap loads may not exceed 2,000 pounds.

(7) The compression load measured between the pelvis and the lumbar spine of the ATD may not exceed 1,500 pounds.

(d) For all single-engine airplanes with a VSO of more than 61 knots at maximum weight, and those multiengine airplanes of 6,000 pounds or less maximum weight with a VSO of more than 61 knots at maximum weight that do not comply with Sec. 23.67(a)(1);

(1) The ultimate load factors of Sec. 23.561(b) must be increased by multiplying the load factors by the square of the ratio of the increased stall speed to 61 knots. The increased ultimate load factors need not exceed the values reached at a VSO of 79 knots. The upward ultimate load factor for acrobatic category airplanes need not exceed 5.0 g.

(2) The seat/restraint system test required by

although seat/restraint system components may experience deformation, elongation, displacement, or crushing intended as part of the design.

(2) The attachment between the seat/ restraint system and the test fixture must remain intact, although the seat structure may have deformed.

(3) Each shoulder harness strap must remain on the ATD's shoulder during the impact.

(4) The safety belt must remain on the ATD's pelvis during the impact.

(5) The results of the dynamic tests must show that the occupant is protected from serious head injury.

(i) When contact with adjacent seats, structure or other items in the cabin can occur, protection must be provided so that head impact does not exceed a head injury criteria (HIC) of 1 000

(ii) The value of HIC is defined as –

$$HIC = \left\{ (t_2 - t_1) \left[\frac{1}{(t_2 - t_1)} \int_{t_1}^{t_2} a(t)dt \right]^{2.5} \right\}_{Max}$$

Where –

t1 is the initial integration time, expressed in seconds,

t2 is the final integration time, expressed in seconds,

(t2 − t1) is the time duration of the major head impact, expressed in seconds, and

a(t) is the resultant deceleration at the centre of gravity of the head form expressed as a multiple of g (units of gravity).

(iii) Compliance with the HIC limit must be demonstrated by measuring the head impact during dynamic testing as prescribed in subparagraphs (b) (1) and (b) (2) or by a separate showing of compliance with the head injury criteria using test or analysis procedures.

(6) Loads in individual shoulder harness straps may not exceed 794 kg (1 750 lb). If dual straps are used for retaining the upper torso, the total strap loads may not exceed 907 kg (2 000 lb).

(7) The compression load measured between the pelvis and the lumbar spine of the ATD may not exceed 680 kg (1 500 lb).

(d) For all single engined aeroplanes with a VSO of more than 113 km/h (61 knots) at maximum weight, and those twinengined aeroplanes of 2722 kg (6000 lb) or less maximum weight with a VSO of more than 113 km/h (61 knots) at maximum weight that do not comply with CS 23.67(a)(1);

(1) The ultimate load factors of CS 23.561(b) must be increased by multiplying the load factors by the square of the ratio of the increased stall speed to 113 km/h (61 knots). The increased ultimate load factors need not exceed the values reached at a VSO of 146 km/h (79 knots). The upward ultimate load factor for aerobatic category aeroplanes need not exceed 5·0g.

(2) The seat/restraint system test required by subparagraph (b)(1) of this paragraph must be conducted in accordance with the following criteria:

(i) The change in velocity may not be less than 9·4 m

paragraph (b)(1) of this section must be conducted in accordance with the following criteria: (i) The change in velocity may not be less than 31 feet per second. (ii) (A) The peak deceleration (gp) of 19g and 15g must be increased and multiplied by the square of the ratio of the increased stall speed to 61 knots: $g_p = 19.0\left(V_{S_0}/61\right)^2$ or $g_p = 15.0\left(V_{S_0}/61\right)^2$ (B) The peak deceleration need not exceed the value reached at a of 79 knots. (iii) The peak deceleration must occur in not more than time (tr), which must be computed as follows: $t_r = \frac{31}{32.2(g_p)} = \frac{.96}{g_p}$ where— gp = The peak deceleration calculated in accordance with paragraph (d)(2)(ii) of this section; and tr = The rise time (in seconds) to the peak deceleration. (e) An alternate approach that achieves an equivalent, or greater, level of occupant protection to that required by this section may be used if substantiated on a rational basis.	(31 feet) per second. (ii) (A) The peak deceleration (gp) of 19g and 15g must be increased and multiplied by the square of the ratio of the increased stall speed to 113 km/h (61 knots): $g_p = 19{\cdot}0\,(V_{SO}/113)^2$ or $gp = 15{\cdot}0\,(V_{SO}/113)^2$ (B) The peak deceleration need not exceed the value reached at a VSO of 146 km/h (79 knots). (iii) The peak deceleration must occur in not more time than time (tr) which must be computed as follows: tr = 31/32·2 (gp) = 0·96/ gp Where gp = the peak deceleration calculated in accordance with paragraph (d)(2)(ii) of this section and tr = the rise time (in seconds) to the peak deceleration. (e) An alternate approach that achieves an equivalent, or greater, level of occupant protection to that required by this paragraph may be used if substantiated on a rational basis. [Amdt No: 23/1]
Sec. 23.573 Damage tolerance and fatigue evaluation of structure *(a) Composite airframe structure*. Composite airframe structure must be evaluated under this paragraph instead of Secs. 23.571 and 23.572. The applicant must evaluate the composite airframe structure, the failure of which would result in catastrophic loss of the airplane, in each wing (including canards, tandem wings, and winglets), empennage, their carrythrough and attaching structure, moveable control surfaces and their attaching structure, fuselage, and pressure cabin using the damage-tolerance criteria prescribed in paragraphs (a)(1) through (a)(4) of this section unless shown to be impractical. If the applicant establishes that damage-tolerance criteria is impractical for a particular structure, the structure must be evaluated in accordance with paragraphs (a)(1) and (a)(6) of this section. Where bonded joints are used, the structure must also be evaluated in accordance with paragraph (a)(5) of this section. 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 section. (1) It must be demonstrated by tests, or by analysis supported by tests, that the structure is capable of carrying ultimate load with damage up to the threshold of delectability considering 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	**CS 23.573 Damage tolerance and fatigue evaluation of structure** (See AMC 23.573 (a) (1) & (3) and AMC 23.573 (b)) *(a) Composite airframe structure.* Composite airframe structure must be evaluated under this paragraph instead of CS paragraphs 23.571 and 23.572. The composite airframe structure, the failure of which would result in catastrophic loss of the aeroplane, in each wing (including canards, tandem wings, and winglets), empennage, their carrythrough and attaching structure, moveable control surfaces and their attaching structure, fuselage, and pressure cabin must be evaluated using the damage-tolerance criteria prescribed in sub-paragraphs (a)(1) through (a)(4) unless shown to be impractical. If the applicant establishes that damage-tolerance criteria is impractical for a particular structure, the structure must be evaluated in accordance with sub-paragraphs (a)(1) and (a)(6). Where bonded joints are used, the structure must also be evaluated in accordance with sub-paragraph (a)(5) .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 tests, or by analysis supported by tests, that the structure is capable of carrying ultimate load with damage up to the threshold of detectability considering 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

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. For pressurized cabins, the following loads must be withstood: (i) Critical limit flight loads with the combined effects of normal operating pressure and expected external aerodynamic pressures. (ii) The expected external aerodynamic pressures in 1g flight combined with a cabin differential pressure equal to 1.1 times the normal operating differential pressure without any other load. (4) The damage growth, between initial delectability and the value selected for residual strength demonstrations, factored to obtain inspection intervals, must allow development of an inspection program suitable for application by operation and maintenance personnel. (5) For any bonded joint, the failure of which would result in catastrophic loss of the airplane, the limit load capacity 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 paragraph (a)(3) of this section 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 that ensure 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, subcomponent, element, or coupon tests must be done to establish the fatigue scatter factor and the environmental effects. Damage up to the threshold of delectability and ultimate load residual strength capability must be considered in the demonstration. *(b) Metallic airframe structure*. If the applicant elects to use Sec. 23.571(a)(3) or Sec. 23.572(a)(3), then the damage tolerance evaluation must include a determination of the probable locations and modes of damage due to fatigue, corrosion, or accidental damage. The determination must be by analysis supported by test evidence and, if available, service experience. Damage at multiple sites due to fatigue 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 analyses supported by test evidence. The extent of	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. For pressurised cabins, the following loads must be withstood: (i) Critical limit flight loads with the combined effects of normal operating pressure and expected external aerodynamic pressures. (ii) The expected external aerodynamic pressures in 1g flight combined with a cabin differential pressure equal to 1.1 times the normal operating differential pressure without any other load. (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 program suitable for application by operation and maintenance personnel. (5) For any bonded joint, the failure of which would result in catastrophic loss of the aeroplane, the limit load capacity 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 (a)(3) must be determined by analysis, test, or both. Disbonds of each bonded joint greater than this must beprevented 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 nondestructive inspection techniques must be established that ensure 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, subcomponent, 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. *(b) Metallic airframe structure*. If the applicant elects to use CS 23.571(c) or CS 23.572(a)(3), then the damage tolerance evaluation must include a determination of the probable locations and modes of damage due to fatigue, corrosion, or accidental damage. The determination must be by analysis supported by test evidence and, if available, service experience. Damage at multiple sites due to fatigue 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

damage for residual strength evaluation at any time within the operational life of the airplane must be consistent with the initial delectability and subsequent growth under repeated loads. The residual strength evaluation must show that the remaining structure is able to withstand critical limit flight loads, considered as ultimate, with the extent of detectable damage consistent with the results of the damage tolerance evaluations. For pressurized cabins, the following load must be withstood: (1) The normal operating differential pressure combined with the expected external aerodynamic pressures applied simultaneously with the flight loading conditions specified in this part, and (2) The expected external aerodynamic pressures in 1g flight combined with a cabin differential pressure equal to 1.1 times the normal operating differential pressure without any other load. (c) Removed.	analyses supported by test evidence. The extent of damage for residual strength evaluation at any time within the operational life of the aeroplane 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 critical limit flight loads, considered as ultimate, with the extent of detectable damage consistent with the results of the damage tolerance evaluations. For pressurised cabins, the following load must be withstood: (1) The normal operating differential pressure combined with the expected external aerodynamic pressures applied simultaneously with the flight loading conditions specified in this subpart, and (2) The expected external aerodynamic pressures in 1g flight combined with a cabin differential pressure equal to 1.1 times the normal operating differential pressure without any other load.
	CS 23.685 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 in the cockpit to prevent the entry of foreign objects into places where they would jam the system. (c) There must be means to prevent the slapping of cables or tubes against other parts. (d) Each element of the flight control system must have design features, or must be distinctively and permanently marked, to minimise the possibility of incorrect assembly that could result in malfunctioning of the control system.
Sec. 23.691 Artificial stall barrier system If the function of an artificial stall barrier, for example, stick pusher, is used to show compliance with Sec. 23.201(c), the system must comply with the following: (a) With the system adjusted for operation, the plus and minus airspeeds at which downward pitching control will be provided must be established. (b) Considering the plus and minus airspeed tolerances established by paragraph (a) of this section, an airspeed must be selected for the activation of the downward pitching control that provides a safe margin above any airspeed at which any unsatisfactory stall characteristics occur. (c) In addition to the stall warning required by Sec. 23.207, a warning that is clearly distinguishable to the pilot under all expected flight conditions without requiring the pilot's attention, must be provided for faults that would prevent the system from providing the required pitching motion. (d) Each system must be designed so that the artificial stall barrier can be quickly and positively disengaged by the pilots to prevent unwanted downward pitching of the airplane by a quick release (emergency) control	**No CS**

that meets the requirements of Sec. 23.1329(b). (e) A preflight check of the complete system must be established and the procedure for this check made available in the Airplane Flight Manual (AFM). Preflight checks that are critical to the safety of the airplane must be included in the limitations section of the AFM. (f) For those airplanes whose design includes an autopilot system: (1) A quick release (emergency) control installed in accordance with Sec. 23.1329(b) may be used to meet the requirements of paragraph (d), of this section, and (2) The pitch servo for that system may be used to provide the stall downward pitching motion. (g) In showing compliance with Sec. 23.1309, the system must be evaluated to determine the effect that any announced or unannounced failure may have on the continued safe flight and landing of the airplane or the ability of the crew to cope with any adverse conditions that may result from such failures. This evaluation must consider the hazards that would result from the airplane's flight characteristics if the system was not provided, and the hazard that may result from unwanted downward pitching motion, which could result from a failure at airspeeds above the selected stall speed.	
Sec. 23.725 Limit drop tests (a) If compliance with Sec. 23.723(a) is shown by free drop tests, these tests must be made on the complete airplane, or on units consisting of wheel, tire, and shock absorber, in their proper relation, from free drop heights not less than those determined by the following formula: *h* (inches) = 3.6 (W/S) ½ However, the free drop height may not be less than 9.2 inches and need not be more than 18.7 inches. (b) If the effect of wing lift is provided for in free drop tests, the landing gear must be dropped with an effective weight equal to— $W_e = W\frac{[h+(1-L)d]}{(h+d)}$ where— *We* = the effective weight to be used in the drop test (lbs.); *h* = specified free drop height (inches); *d* = deflection under impact of the tire (at the approved inflation pressure) plus the vertical component of the axle travel relative to the drop mass (inches); *W* = *WM* for main gear units (lbs.), equal to the static weight on that unit with the airplane in the level attitude (with the nose wheel clear in the case of the nose wheel type airplanes); *W* = *WT* for tail gear units (lbs.), equal to the static weight on the tail unit with the airplane in the tail-down attitude; *W* = *WN* for nose wheel units (lbs.), equal to the vertical component of the static reaction that would exist at the nose wheel, assuming that the mass of the	**CS 23.725 Limit drop tests** (a) If compliance with CS 23.723 (a) is shown by free drop tests, these tests must be made on the complete aeroplane, or on units consisting of wheel, tyre and shock absorber, in their proper relation, from free drop heights not less than those determined by the following formula: h (m) = . 0.0132 (Mg/S) ½ However, the free drop height may not be less than 0.234 m (9·2 inches) and need not be more than 0.475 m (18·7 inches). (b) If the effect of wing lift is provided for in free drop tests, the landing gear must be dropped with an effective weight equal to – $M_e = M\frac{h+(1-L)d}{h+d}$ where – Me = the effective weight to be used in the drop test (kg); h = Specified free drop height (m); 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 (m); M = MM for main gear units (kg), equal to the static weight on that unit with the aeroplane in the level attitude (with the nose wheel clear in the case of the nose wheel type aeroplanes); M = MT for tail gear units (kg), equal to the static weight on the tail unit with the aeroplane in the tail-down attitude; M = MN for nose wheel units (kg), equal to the vertical component of the static reaction that would exist at the nose wheel, assuming that the mass of the aeroplane

airplane acts at the centre of gravity and exerts a force of 1.0*g* downward and 0.33*g* forward; and *L* = the ratio of the assumed wing lift to the airplane weight, but not more than 0.667. (c) The limit inertia load factor must be determined in a rational or conservative manner, during the drop test, using a landing gear unit attitude, and applied drag loads, that represent the landing conditions. (d) The value of *d* used in the computation of *We* in paragraph (b) of this section may not exceed the value actually obtained in the drop test. (e) The limit inertia load factor must be determined from the drop test in paragraph (b) of this section according to the following formula: $n = n_j \frac{W_e}{W} + L$ where— *nj* = 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 *We*, *W*, and *L* are the same as in the drop test computation. (f) The value of *n* determined in accordance with paragraph (e) may not be more than the limit inertia load factor used in the landing conditions in Sec. 23.473.	acts at the centre of gravity and exerts a force of 1·0g downward and 0·33g forward; and L = the ratio of the assumed wing lift to the aeroplane weight, but not more than 0·667. g = The acceleration due to gravity (m/s2) (c) The limit inertia load factor must be determined in a rational or conservative manner, during the drop test, using a landing gear unit attitude and applied drag loads, that represent the landing conditions. (d) The value of d used in the computation of Me in sub-paragraph (b) may not exceed the value actually obtained in the drop test. (e) The limit inertia load factor must be determined from the drop test in sub-paragraph (b) according to the following formula: $n = n_j \frac{M_e}{M} + L$ where – nj = 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 Me, M and L are the same as in the drop test computation. (f) The value of n determined in accordance with sub-paragraph (e) may not be more than the limit inertia load factor used in the landing conditions in CS 23.473.
Sec. 23.727 Reserve energy absorption drop tests (a) If compliance with the reserve energy absorption requirement in Sec. 23.723(b) is shown by free drop tests, the drop height may not be less than 1.44 times that specified in Sec. 23.725. (b) If the effect of wing lift is provided for, the units must be dropped with an effective mass equal to, $W_e = W\left(\frac{h}{h+d}\right)$ when the symbols and other details are the same as in Sec. 23.725.	**CS 23.727 Reserve energy absorption drop tests** (a) If compliance with the reserve energy absorption requirements in CS 23.723 (b) is shown by free drop tests, the drop height may not be less than 1·44 times that specified in CS 23.725. (b) If the effect of wing lift is provided for, the units must be dropped with an effective mass equal to $M_e = M\left(\frac{h}{h+d}\right)$ when the symbols and other details are the same as in CS 23.725.
Sec. 23.735 Brakes (a) Brakes must be provided. The landing brake kinetic energy capacity rating of each main wheel brake assembly must not be less than the kinetic energy absorption requirements determined under either of the following methods: (1) The brake kinetic energy absorption requirements must be based on a conservative rational analysis of the sequence of events expected during landing at the design landing weight. (2) Instead of a rational analysis, the kinetic energy absorption requirements for each main wheel brake assembly may be derived from the following formula: $KE = \frac{0.0443WV^2}{N}$ where—	**CS 23.735 Brakes** (See AMC 23.735 (c)) (a) Brakes must be provided. The landing brake kinetic energy capacity rating of each main wheel brake assembly must not be less than the kinetic energy absorption requirements determined under either of the following methods: (1) The brake kinetic energy absorption requirements must be based on a conservative rational analysis of the sequence of events expected during landing at the design landing weight. (2) Instead of a rational analysis, the kinetic energy absorption requirements for each main wheel brake assembly may be derived from the following formula: KE = ½MV2/N where – KE = Kinetic energy per wheel (Joules);

KE = Kinetic energy per wheel (ft.-lb.); *W* = Design landing weight (lb.); *V* = Airplane speed in knots. *V* must be not less than, VSO the poweroff stalling speed of the airplane at sea level, at the design landing weight, and in the landing configuration; and *N* = Number of main wheels with brakes. (b) Brakes must be able to prevent the wheels from rolling on a paved runway with takeoff power on the critical engine, but need not prevent movement of the airplane with wheels locked. (c) During the landing distance determination required by Sec. 23.75, the pressure on the wheel braking system must not exceed the pressure specified by the brake manufacturer. (d) If antiskid devices are installed, the devices and associated systems must be designed so that no single probable malfunction or failure will result in a hazardous loss of braking ability or directional control of the airplane. (e) In addition, for commuter category airplanes, the rejected takeoff brake kinetic energy capacity rating of each main wheel brake assembly must not be less than the kinetic energy absorption requirements determined under either of the following methods— (1) The brake kinetic energy absorption requirements must be based on a conservative rational analysis of the sequence of events expected during a rejected takeoff at the design takeoff weight. (2) Instead of a rational analysis, the kinetic energy absorption requirements for each main wheel brake assembly may be derived from the following formula— $KE = 0.0443 WV^2 / N$ where- *KE* = Kinetic energy per wheel (ft.-lbs.); *W* = Design takeoff weight (lbs.); *V* = Ground speed, in knots, associated with the maximum value of V1 selected in accordance with Sec. 23.51(c)(1); *N* = Number of main wheels with brakes.	M = Mass at design landing weight (kg); V = Aeroplane speed in m/s. V must be not less than VSO, the power off stalling speed of the aeroplane at sea level, at the design landing weight, and in the landing configuration; and N = Number of main wheels with brakes. (b) Brakes must be able to prevent the wheels from rolling on a paved runway with take-off power in the critical engine, but need not prevent movement of the aeroplane with wheels locked. (c) During the landing distance determination required by CS 23.75, the pressure in the wheel braking system must not exceed the pressure specified by the brake manufacturer. (d) If anti-skid devices are installed, the devices and associated systems must be designed so that no single probable malfunction or failure will result in a hazardous loss of braking ability or directional control of the aeroplane. (e) In addition, for commuter category aeroplanes, the rejected take-off brake kinetic energy capacity rating of each mainwheel brake assembly must not be less than the kinetic energy absorption requirements determined under either of the following methods: (1) The brake kinetic energy absorption requirements must be based on a conservative rational analysis of the sequence of events expected during a rejected take-off at the design take-off weight. (2) Instead of a rational analysis, the kinetic energy absorption requirements for each mainwheel brake assembly may be derived from the following formula: KE = ½ MV2/N where – KE = Kinetic energy per wheel (Joules) M = Mass at design take-off weight (kg) V = Ground speed in m/s associated with the maximum value of V1 selected in accordance with CS 23.51 (c) (1) N = Number of main wheels with brakes
Sec. 23.785 Seats, berths, litters, safety belts, and shoulder harnesses There must be a seat or berth for each occupant that meets the following: (a) Each seat/restraint system and the supporting structure must be designed to support occupants weighing at least 215 pounds when subjected to the maximum load factors corresponding to the specified flight and ground load conditions, as defined in the approved operating envelope of the airplane. In addition, these loads must be multiplied by a factor of 1.33 in determining the strength of all fittings and the attachment of— (1) Each seat to the structure; and (2) Each safety belt and shoulder harness to the seat or structure. (b) Each forward-facing or aft facing seat/restraint	**CS 23.785 Seats, berths, litters, safety belts and shoulder harnesses** There must be a seat or berth for each occupant that meets the following: (a) Each seat/restraint system and the supporting structure must be designed to support occupants weighing at least 98 kg (215 lb) when subjected to the maximum load factors corresponding to the specified flight and ground load conditions, as defined in the approved operating envelope of the aeroplane. In addition, these loads must be multiplied by a factor of 1·33 in determining the strength of all fittings and the attachment of – (1) Each seat to the structure; and (2) Each safety belt and shoulder harness to the seat or structure. (b) Each forward-facing or aft-facing seat/ restraint

system in normal, utility, or acrobatic category airplanes must consist of a seat, a safety belt, and a shoulder harness, with a metal-to-metal latching device, that are designed to provide the occupant protection provisions required in Sec. 23.562. Other seat orientations must provide the same level of occupant protection as a forward-facing or aft-facing seat with a safety belt and a shoulder harness, and must provide the protection provisions of Sec. 23.562. (c) For commuter category airplanes, each seat and the supporting structure must be designed for occupants weighing at least 170 pounds when subjected to the inertia loads resulting from the ultimate static load factors prescribed in Sec. 23.561(b)(2) of this part. Each occupant must be protected from serious head injury when subjected to the inertia loads resulting from these load factors by a safety belt and shoulder harness, with a metal-to-metal latching device, for the front seats; and a safety belt, or a safety belt and shoulder harness, with a metal-to metal latching device, for each seat other than the front seats. (d) Each restraint system must have a single-point release for occupant evacuation. (e) The restraint system for each crewmember must allow the crewmember, when seated with the safety belt and shoulder harness fastened, to perform all functions necessary for flight operations. (f) Each pilot seat must be designed for the reactions resulting from the application of pilot forces to the primary flight controls as prescribed in Sec. 23.395 of this part. (g) There must be a means to secure each safety belt and shoulder harness, when not in use, to prevent interference with the operation of the airplane and with rapid occupant egress in an emergency. (h) Unless otherwise placarded, each seat in a utility and acrobatic category airplane must be designed to accommodate an occupant wearing a parachute. (i) The cabin area surrounding each seat, including the structure, interior walls, instrument panel, control wheel, pedals, and seats within striking distance of the occupant's head or torso (with the restraint system 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 is subjected to the inertia loads resulting from the ultimate static load factors prescribed in Sec. 23.561(b)(2) of this part, or they must comply with the occupant protection provisions of Sec. 23.562 of this part, as required in paragraphs (b) and (c) of this section. (j) Each seat track must be fitted with stops to prevent the seat from sliding off the track. (k) Each seat/restraint system may use design features, such as crushing or separation of certain components, to reduce occupant loads when showing compliance with the requirements of Sec. 23.562 of this part; otherwise, the system must remain intact. (l) For the purposes of this section, a front seat is a seat located at a flight crewmember station or any seat located alongside such a seat. (m) Each berth, or	system in normal, utility, or aerobatic category aeroplanes must consist of a seat, safety belt and shoulder harness with a metal-to-metal latching device that are designed to provide the occupant protection provisions required in CS 23.562. Other seat orientations must provide the same level of occupant protection as a forward facing or aft-facing seat with a safety belt and shoulder harness, and must provide the protection provisions of CS 23.562. (c) For commuter category aeroplanes each seat and the supporting structure must be designed for occupants weighing at least 77 kg (170 lb) when subjected to the inertia loads resulting from the ultimate static load factors prescribed in CS 23.561 (b) (2), and each seat/restraint system must be designed to provide the occupant protection provisions required in CS 23.562; and each occupant must be protected from serious head injury when subjected to the inertia loads resulting from the emergency landing dynamic conditions by a safety belt and shoulder harness with a metal to- metal latching device for the front seats; and a safety belt, or a safety belt and shoulder harness, for each seat other than the front seats. (d) Each restraint system must have a single point release for occupant evacuation. (e) The restraint system for each crew member must allow the crew member, when seated with the safety belt and shoulder harness fastened, to perform all functions necessary for flight operations. (f) Each pilot seat must be designed for the reactions resulting from the application of pilot forces to the primary flight controls as prescribed in CS 23.395. (g) There must be a means to secure each safety belt and shoulder harness, when not in use, to prevent interference with the operation of the aeroplane and with rapid occupant egress in an emergency. (h) Unless otherwise placarded, each seat in a utility or aerobatic category aeroplane must be designed to accommodate an occupant wearing a parachute. (i) The cabin area surrounding each seat, including the structure, interior walls, instrument panel, control wheel, pedals, and seats, within striking distance of the occupant's head or torso (with the restraint system 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 is subjected to the inertia loads resulting from the ultimate static load factors prescribed in CS 23.561 (b) (2), or they must comply with the occupant protection provisions of CS 23.562, as required in subparagraphs (b) and (c) . (j) Each seat track must be fitted with stops to prevent the seat from sliding off the track. (k) Each seat/restraint system may use design features, such as crushing or separation of certain components, to reduce occupant loads when showing compliance with the requirements of CS 23.562; otherwise, the system must remain intact. (l) For the purposes , a front seat is a seat located at a

provisions for a litter, installed parallel to the longitudinal axis of the airplane, must be designed so that the forward part has a padded end-board, canvas diaphragm, or equivalent means that can withstand the load reactions from a 215 pound occupant when subjected to the inertia loads resulting from the ultimate static load factors of Sec. 23.561 (b)(2) of this part. In addition-- (1) Each berth or litter must have an occupant restraint system and may not have corners or other parts likely to cause serious injury to a person occupying it during emergency landing conditions; and (2) Occupant restraint system attachments for the berth or litter must withstand the inertia loads resulting from the ultimate static load factors of Sec. 23.561 (b)(2) of this part. (n) Proof of compliance with the static strength requirements of this section for seats and berths approved as part of the type design and for seat and berth installations may be shown by-- (1) Structural analysis, if the structure conforms to conventional airplane types for which existing methods of analysis are known to be reliable; (2) A combination of structural analysis and static load tests to limit load; or (3) Static load tests to ultimate loads.	flight crew member station or any seat located alongside such a seat. (m) Each berth, or provisions for a litter, installed parallel to the longitudinal axis of the aeroplane, must be designed so that the forward part has a padded end-board, canvas diaphragm, or equivalent means that can withstand the load reactions from a 98 kg (215 lb) occupant when subjected to the inertia loads resulting from the ultimate static load factors of CS 23.561 (b) (3). In addition – (1) Each berth or litter must have an occupant restraint system and may not have corners or other parts likely to cause serious injury to a person occupying it during emergency landing conditions; and (2) Occupant restraint system attachments for the berth or litter must withstand the inertia loads resulting from the ultimate static load factors of CS 23.561 (b) (3). (n) Proof of compliance with the static strength requirements for seats and berths approved as part of the type design and for seat and berth installations may be shown by – (1) Structural analysis, if the structure conforms to conventional aeroplane types for which existing methods of analysis are known to be reliable; (2) A combination of structural analysis and static load tests to limit load; or (3) Static load tests to ultimate loads.
Sec. 23.855 Cargo and baggage compartment fire protection (a) Sources of heat within each cargo and baggage compartment that are capable of igniting the compartment contents must be shielded and insulated to prevent such ignition. (b) Each cargo and baggage compartment must be constructed of materials that meet the appropriate provisions of Sec. 23.853(d)(3). (c) In addition, for commuter category airplanes, each cargo and baggage compartment must: (1) Be located where the presence of a fire would be easily discovered by the pilots when seated at their duty station, or it must be equipped with a smoke or fire detector system to give a warning at the pilots' station, and provide sufficient access to enable a pilot to effectively reach any part of the compartment with the contents of a hand held fire extinguisher, or (2) Be equipped with a smoke or fire detector system to give a warning at the pilots' station and have ceiling and sidewall liners and floor panels constructed of materials that have been subjected to and meet the 45 degree angle test of appendix F of this part. The flame may not penetrate (pass through) the material during application of the flame or subsequent to its removal. The average flame time after removal of the flame source may not exceed 15 seconds, and the average glow time may not exceed 10 seconds. The compartment must be constructed to provide fire	**CS 23.855 Cargo and baggage compartment fire protection** (a) Sources of heat within each cargo and baggage compartment that are capable of igniting the compartment contents must be shielded or insulated to prevent such ignition. (b) For normal, utility and aerobatic category aeroplanes, each cargo and baggage compartment must be constructed of materials which are at least flame resistant. (c) In addition, for commuter category aeroplanes, each cargo and baggage compartment must meet the provisions of CS 23.853 (d) (3), and either – (1) Be located where the presence of a fire would easily be discovered by a pilot while at his station, or be equipped with a separate smoke detector or fire detector system to give warning at the pilot station, and provide sufficient access in flight to enable a pilot to reach any part of the compartment with the contents of a hand-held fire extinguisher, or (2) Be equipped with a separate smoke detector or fire detector system to give warning at the pilot station and have floor panels and ceiling and sidewall liner panels constructed of materials which have been tested at a 45° angle in accordance with the applicable portions of Appendix F of CS-23. The flame must not penetrate (pass through) the material during application of the flame or subsequent to its removal. The average flame time after removal of the flame source must not exceed

protection that is not less than that required of its individual panels; or (3) Be constructed and sealed to contain any fire within the compartment.	15 seconds and the average glow time must not exceed 10 seconds. The compartment must be so constructed as to provide fire protection not less than that required of its individual panels, or (3) Be constructed and sealed to contain any fire within the compartment.
Sec. 23.901 Installation (a) For the purpose of this part, the airplane powerplant installation includes each component that — (1) Is necessary for propulsion; and (2) Affects the safety of the major propulsive units. (b) Each powerplant installation must be constructed and arranged to- (1) Ensure safe operation to the maximum altitude for which approval is requested. (2) Be accessible for necessary inspections and maintenance. (c) Engine cowls and nacelles must be easily removable or openable by the pilot to provide adequate access to and exposure of the engine compartment for pre-flight checks. (d) Each turbine engine installation must be constructed and arranged to— (1) Result in carcass vibration characteristics that do not exceed those established during the type certification of the engine. (2) Ensure that the capability of the installed engine to withstand the ingestion of rain, hail, ice, and birds into the engine inlet is not less than the capability established for the engine itself under Sec. 23.903(a)(2). (e) The installation must comply with— (1) The instructions provided under the engine type certificate and the propeller type certificate. (2) The applicable provisions of this subpart. (f) Each auxiliary power unit installation must meet the applicable portions of this part.	**CS 23.901 Installation** (a) For the purpose of CS-23, the aeroplane powerplant installation includes each component that – (1) Is necessary for propulsion; and (2) Affects the safety of the major propulsive units. (b) Each powerplant installation must be constructed and arranged to – (1) Ensure safe operation to the maximum altitude for which approval is requested. (2) Be accessible for necessary inspections and maintenance. (c) Engine cowls and nacelles must be easily removable or openable by the pilot to provide adequate access to and exposure of the engine compartment for pre-flight checks. (d) Each turbine engine installation must be constructed and arranged to – (1) Result in carcass vibration characteristics that do not exceed those established during the type certification of the engine. (2) Provide continued safe operation without a hazardous loss of power or thrust while being operated in rain for at least 3 minutes with the rate of water ingestion being not less than 4% by weight, of the engine induction airflow rate at the maximum installed power or thrust approved for take-off and at flight idle. (e) The powerplant installation must comply with – (1) The installation instructions provided under – (i) The engine type certificate, and (ii) The propeller type certificate or equivalent approval. (2) The applicable provisions of this subpart. (f) Each auxiliary power unit installation must meet the applicable portions of CS-23.
Sec. 23.903 Engines (a) *Engine type certificate.* (1) Each engine must have a type certificate and must meet the applicable requirements of Part 34 of this chapter. (2) Each turbine engine must either-- (i) Sections 33.76, 33.77 and 33.78 of this chapter in effect on December 13, 2000, or as subsequently amended; or (ii) Comply with Sec. 33.77 of this chapter in effect on October 31, 1974, or as subsequently amended prior to April 30, 1998, and must have a foreign object ingestion service history that has not resulted in any unsafe condition; or (iii) Be shown to have a foreign object ingestion service history in similar installation locations which has not resulted in any unsafe condition. **Note**: *Sec. 33.77 of this chapter in effect on October*	**CS 23.903 Engines and auxiliary power units** (See AMC 23.903 (a) (1) and AMC 23.903 (f)) (a) Each turbine engine must either – (1) Comply with CS E-790 and CS E-800, or (2) Be shown to have a foreign object ingestion service history in similar installation locations which has not resulted in any unsafe condition. (b) *Turbine engine installations*. For turbine engine installations – (1) Design precautions must be taken to minimise the hazards to the aeroplane in the event of an engine rotor failure or of a fire originating inside the engine which burns through the engine case. (See AMC 20-128A) (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

31, 1974, was published in 14 CFR parts 1 to 59, Revised as of January 1, 1975. See 39 FR 35467, October 1, 1974.] (b) *Turbine engine installations.* For turbine engine installations-- (1) Design precautions must be taken to minimize the hazards to the airplane in the event of an engine rotor failure or of a fire originating inside the engine which burns through the engine case. (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. (c) *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 (g) *Restart capability.* For turbine engine powered airplanes, if the minimum windmilling speed of the engines, following the in-flight shutdown of all engines, is insufficient to provide the necessary electrical power for engine ignition, a power source independent of the engine-driven electrical power generating system must be provided to permit in-flight engine ignition for restarting.	structural integrity will not be exceeded in service. (c) *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 will not – (1) Prevent the continued safe operation of the remaining engines; or (2) Require immediate action by any crew member for continued safe operation of the remaining engine. (d) *Starting and stopping (piston engine)* (1) The design of the installation must be such that risk of fire or mechanical damage to the (g) *Restart capability.* For turbine engine powered aeroplanes, if the minimum windmilling speed of the engines, following the in-flight shutdown of all engines, is insufficient to provide the necessary electrical power for engine ignition, a power source independent of the engine-driven electrical power generating system must be provided to permit in-flight engine ignition for restarting. (h) *Auxiliary power units*. Each APU must meet the requirements of CS-APU.
Sec. 23.905 Propellers (a) Each propeller must have a type certificate. (b) Engine power and propeller shaft rotational speed may not exceed the limits for which the propeller is certificated. (c) Each featherable propeller must have a means to unfeather it in flight. (d) The propeller blade pitch control system must meet the requirements of Secs. 35.21, 35.23, 35.42 and 35.43 of this chapter. (e) All areas of the airplane forward of the pusher propeller that are likely to accumulate and shed ice into the propeller disc during any operating condition must be suitably protected to prevent ice formation, or it must be shown that any ice shed into the propeller disc will not create a hazardous condition. (f) Each pusher propeller must be marked so that the disc is conspicuous under normal daylight ground conditions. (g) If the engine exhaust gases are discharged into the pusher propeller disc, it must be shown by tests, or analysis supported by tests, that the propeller is capable of continuous safe operation. (h) All engine cowling, access doors, and other removable items must be designed to ensure that they will not separate from the airplane and contact the pusher propeller.	**CS 23.905 Propellers** (a) *(reserved)* (b) Engine power and propeller shaft rotational speed may not exceed the limits for which the propeller is certificated. (c) Each featherable propeller must have a means to unfeather it in flight. (d) Each component of the propeller blade pitch control system must meet the requirements of CS-P-210. (e) All areas of the aeroplane forward of the pusher propeller that are likely to accumulate and shed ice into the propeller disc during any operating condition must be suitably protected to prevent ice formation, or it must be shown that any ice shed into the propeller disc will not create a hazardous condition. (See AMC 23.905 (e)) (f) Each pusher propeller must be marked so that the disc is conspicuous under normal daylight ground conditions. (g) If the engine exhaust gases are discharged into the pusher propeller disc, it must be shown by tests, or analysis supported by tests, that the propeller is capable of continuous safe operation. (See AMC 23.905 (g)) (h) All engine cowlings, access doors, and other removable items must be designed to ensure that they will not separate from the aeroplane and contact the pusher propeller.
Sec. 23.907 Propeller vibration	**CS 23.907 Propeller vibration**

This section does not apply to fixed-pitch wood propellers of conventional design. (a) The applicant must determine the magnitude of the propeller vibration stresses or loads, including any stress peaks and resonant conditions, throughout the operational envelope of the airplane by either: (1) Measurement of stresses or loads through direct testing or analysis based on direct testing of the propeller on the airplane and engine installation for which approval is sought; or (2) Comparison of the propeller to similar propellers installed on similar airplane installations for which these measurements have been made. (b) The applicant must demonstrate by tests, analysis based on tests, or previous experience on similar designs that the propeller does not experience harmful effects of flutter throughout the operational envelope of the airplane. (c) The applicant must perform an evaluation of the propeller to show that failure due to fatigue will be avoided throughout the operational life of the propeller using the fatigue and structural data obtained in accordance with part 35 of this chapter and the vibration data obtained from compliance with paragraph (a) of this section. For the purpose of this paragraph, the propeller includes the hub, blades, blade retention component and any other propeller component whose failure due to fatigue could be catastrophic to the airplane. This evaluation must include: (1) The intended loading spectra including all reasonably foreseeable propeller vibration and cyclic load patterns, identified emergency conditions, allowable overspeeds and overtorques, and the effects of temperatures and humidity expected in service. (2) The effects of airplane and propeller operating and airworthiness limitations.	(See AMC 23.907 (a)) (a) Each propeller other than a conventional fixed pitch wooden propeller must be shown to have vibration stresses, in normal operating conditions, that do not exceed values that have been shown by the propeller manufacturer to be safe for continuous operation. This must be shown by – (1) Measurement of stresses through direct testing of the propeller; (2) Comparison with similar installations for which these measurements have been made; or (3) Any other acceptable test method or service experience that proves the safety of the installation. (b) Proof of safe vibration characteristics for any type of propeller, except for conventional, fixed-pitch, wood propellers must be shown where necessary.
Sec. 23.909 Turbocharger systems (a) Each turbocharger must be approved under the engine type certificate or it must be shown that the turbocharger system, while in its normal engine installation and operating in the engine environment- (1) Can withstand, without defect, an endurance test of 150 hours that meets the applicable requirements of Sec. 33.49 of this subchapter; and (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;	**CS 23.909 Turbo charger systems** (See AMC 23.909 (d) (1)) (a) Each turbo charger must be approved under the engine type certificate or it must be shown that the turbo charger system, while in its normal engine installation and operating in the engine environment- (1) Can withstand, without defect, an endurance test of 150 hours that meets the applicable requirements of CS-E 440, and (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 turbo charger compressor or turbine. (c) Each turbo charger 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 in-operative. (d) Each intercooler installation, where provided, must comply with the following: (1) The mounting provisions of the intercooler must be

(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; and (3) Airflow through the intercooler must not discharge directly on any airplane component (e.g., windshield) unless such discharge is shown to cause no hazard to the airplane 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 Airplane Flight Manual in accordance with §23.1581.	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, and (3) Airflow through the intercooler must not discharge directly on any aeroplane component (e.g. windshield) unless such discharge is shown to cause no hazard to the aeroplane 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 aeroplane flight manual in accordance with CS 23.1581.
Sec. 23.925 Propeller clearance Unless smaller clearances are substantiated, propeller clearances with the airplane at maximum weight, with the most adverse centre of gravity, and with the propeller in the most adverse pitch position, may not be less than the following: (a) *Ground clearance.* There must be a clearance of at least seven inches (for each airplane with nose wheel landing gear) or nine inches (for each airplane with tail wheel landing gear) between each propeller and the ground with the landing gear statically deflected and in the level, normal takeoff, or taxing attitude, whichever is most critical. In addition, for each airplane with conventional landing gear struts using fluid or mechanical means for absorbing landing shocks, there must be positive clearance between the propeller and the ground in the level takeoff attitude with the critical tire completely deflated and the corresponding landing gear strut bottomed. Positive clearance for airplanes using leaf spring struts is shown with a deflection corresponding to 1.5*g*. (b) *Aft-mounted propellers.* In addition to the clearances specified in paragraph (a) of this section, an airplane with an aft mounted propeller must be designed such that the propeller will not contact the runway surface when the airplane is in the maximum pitch attitude attainable during normal takeoffs and landings**.** (c) *Water clearance.* There must be a clearance of at least 18 inches between each propeller and the water, unless compliance with Sec. 23.239 can be shown with a lesser clearance. (d) *Structural clearance.* There must be— (1) At least one inch radial clearance between the blade tips and the airplane structure, plus any additional radial clearance necessary to prevent harmful vibration; (2) At least one-half inch longitudinal clearance between the propeller blades or cuffs and stationary parts of the airplane; and (3) Positive clearance between other rotating parts of the propeller or spinner and stationary parts of the airplane.	**CS 23.925 Propeller clearance** Propeller clearances with the aeroplane at the most adverse combination of weight and centre of gravity and with the propeller in the most adverse pitch position, may not be less than the following: (a) *Ground clearance*. There must be a clearance of at least 18 cm (7 in) (for each aeroplane with nose wheel landing gear) or 23 cm (9 in) (for each aeroplane with tail wheel landing gear) between each propeller and the ground with the landing gear statically deflected and in the level, normal take-off, or taxing attitude, whichever is the most critical. In addition, for each aeroplane with conventional landing gear struts using fluid or mechanical means for absorbing landing shocks, there must be positive clearance between the propeller and the ground in the level take-off attitude with the critical tyre completely deflated and the corresponding landing gear strut bottomed. Positive clearance for aeroplanes using leaf spring struts is shown with a deflection corresponding to 1·5g. (b) *Aft mounted propellers*. In addition to the clearance specified in sub-paragraph (a) an aeroplane with an aft mounted propeller must be designed such that the propeller will not contact the runway surface when the aeroplane is in the maximum pitch attitude attainable during normal take-off and landings. (c) *Water clearance*. There must be a clearance of at least 46 cm (18 in) between each propeller and the water, unless compliance with CS 23.239 can be shown with a lesser clearance. (d) *Structural clearance*. There must be – (1) At least 25 mm (1 in) radial clearance between the blade tips and the aeroplane structure, plus any additional radial clearance necessary to prevent harmful vibration; (2) At least 12·7 mm (½ in) longitudinal clearance between the propeller blades or cuffs and stationary parts of the aeroplane; and (3) Positive clearance between other rotating parts of the propeller or spinner and stationary parts of the aeroplane.

Sec. 23.929 Engine installation ice protection Propellers (except wooden propellers) and other components of complete engine installations must be protected against the accumulation of ice as necessary to enable satisfactory functioning without appreciable loss of thrust when operated in the icing conditions for which certification is requested.	**CS 23.929 Engine installation ice protection** Propellers and other components of complete engine installations must be protected against the accumulation of ice as necessary to enable satisfactory functioning without appreciable loss of thrust when operated in the icing conditions fo which certification is requested.
Sec. 23.933 Reversing systems (a) For turbojet and turbofan reversing systems-- (1) Each system intended for ground operation only must be designed so that, during any reversal in flight, the engine will produce no more than flight idle thrust. In addition, it must be shown by analysis or test, or both, that-- (i) Each operable reverser can be restored to the forward thrust position; or (ii) The airplane is capable of continued safe flight and landing under any possible position of the thrust reverser. (2) Each system intended for inflight use must be designed so that no unsafe condition will result during normal operation of the system, or from any failure, or likely combination of failures, of the reversing system under any operating condition including ground operation. Failure of structural elements need not be considered if the probability of this kind of failure is extremely remote. (3) Each system must have a means to prevent the engine from producing more than idle thrust when the reversing system malfunctions; except that it may produce any greater thrust that is shown to allow directional control to be maintained, with aerodynamic means alone, under the most critical reversing condition expected in operation. (b) For propeller reversing systems— (1) Each system must be designed so that no single failure, likely combination of failures or malfunction of the system will result in unwanted reverse thrust under any operating condition. Failure of structural elements need not be considered if the probability of this type of failure is extremely remote. (2) Compliance with paragraph (b)(1) of this section must be shown by failure analysis, or testing, or both, for propeller systems that allow the propeller blades to move from the flight low-pitch position to a position that is substantially less than the normal flight, low-pitch position. The analysis may include or be supported by the analysis made to show compliance for the type certification with Sec. 35.21 for the type certification of the propeller and associated installation components. Credit will be given for pertinent analysis and testing completed by the engine and propeller manufacturers.	**CS 23.933 Reversing systems** (a) *For turbojet and turbofan reversing systems –* (1) Each system intended for ground operation only must be designed so that during any reversal in flight the engine will produce no more than flight idle thrust. In addition, it must be shown by analysis or test, or both, that – (i) Each operable reverser can be restored to the forward thrust position; or (ii) The aeroplane is capable of continued safe flight and landing under any possible position of the thrust reverser. (2) Each system intended for in-flight use must be designed so that no unsafe condition will result during normal operation of the system, or from any failure (or likely combination of failures) of the reversing system, under any operating condition including ground operation. Failure of structural elements need not be considered if the probability of this kind of failure is extremely remote. (3) Each system must have means to prevent the engine from producing more than idle thrust when the reversing system malfunctions, except that it may produce any greater thrust that is shown to allow directional control to be maintained, with aerodynamic means alone, under the most critical reversing condition expected in operation. (b) *For propeller reversing systems –* (1) Each system must be designed so that no single failure (or reasonably likely combination of failures) or malfunction of the system will result in unwanted reverse thrust under any expected operating condition. Failure of structural elements need not be considered if this kind of failure is extremely remote. (2) Compliance with sub-paragraph (b) (1) may be shown by failure analysis or testing, or both, for propeller systems that allow propeller blades to move from the flight low pitch position to a position that is substantially less than that at the normal flight low-pitch position. The analysis may include or be supported by the analysis made to show compliance with the requirements of CS-P for the propeller and associated installation components. (3) For turbopropeller-powered, commuter category aeroplanes the requirements of sub-paragraph (a) (2) apply. Compliance with this paragraph must be shown by failure analysis, testing, or both, for propeller systems that allow the propeller blades to move from the flight low-pitch position to a position thatis substantially less than that at normal flight, low pitch

	stop position. The analysis may include, or be supported by, the analysis made to show compliance for the type certification of the propeller and associated installation components.
Sec. 23.934 Turbojet and turbofan engine thrust reverser systems tests Thrust reverser systems of turbojet or turbofan engines must meet the requirements of Sec. 33.97 of this chapter or it must be demonstrated by tests that engine operation and vibratory levels are not affected.	**CS 23.934 Turbojet and turbofan engine thrust reverser system tests** Thrust reverser systems of turbojet or turbofan engines must meet the appropriate requirements of CS-E 650 and CS-E 890.
Sec. 23.951 General (a) Each fuel system must be constructed and arranged to ensure fuel flow at a rate and pressure established for proper engine and auxiliary power unit functioning under each likely operating condition, including any maneuver for which certification is requested and during which the engine or auxiliary power unit is permitted to be in operation. (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 80° F. and having 0.75cc of free water per gallon 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 airplane must meet the applicable fuel venting requirements of part 34 of this chapter.	**CS 23.951 General** (a) Each fuel system must be constructed and arranged to ensure fuel flow at a rate and pressure established for proper engine and auxiliary power unit functioning under each likely operating condition, including any manoeuvre for which certification is requested and during which the engine or auxiliary power unit is permitted to be in operation. (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 0·75cc of free water per 3.8 l (US-gallon) added and cooled to the most critical condition for icing likely to be encountered in operation.
Sec. 23.953 Fuel system independence (a) Each fuel system for a multiengine airplane must be arranged so that, in at least one system configuration, the failure of any one component (other than a fuel tank) will not result in the loss of power of more than one engine or require immediate action by the pilot to prevent the loss of power of more than one engine. (b) If a single fuel tank (or series of fuel tanks interconnected to function as a single fuel tank) is used on a multiengine airplane, the following must be provided: (1) Independent tank outlets for each engine, each incorporating a shutoff valve at the tank. This shutoff valve may also serve as the firewall shutoff valve required if the line between the valve and the engine compartment does not contain more than one quart of fuel (or any greater amount shown to be safe) that can escape into the engine compartment. (2) At least two vents arranged to minimize the probability of both vents becoming obstructed simultaneously. (3) Filler caps designed to minimize the probability of incorrect installation or in-flight loss. (4) A fuel system in which those parts of the system from each tank outlet to any engine are independent of	**CS 23.953 Fuel system independence** (a) Each fuel system for a twin-engine aeroplane must be arranged so that, in at least one system configuration, the failure of any one component will not result in the loss of power of more than one engine or require immediate action by the pilot to prevent the loss of power of more than one engine.

each part of the system supplying fuel to any other engine.	
Sec. 23.967 Fuel tank installation (e) Fuel tanks must be designed, located, and installed so as to retain fuel— (1) When subjected to the inertia loads resulting from the ultimate static load factors prescribed in Sec. 23.561 (b)(2) of this part; and (2) Under conditions likely to occur when an airplane lands on a paved runway at a normal landing speed under each of the following conditions: (i) The airplane in a normal landing attitude and its landing gear retracted. (ii) The most critical landing gear leg collapsed and the other landing gear legs extended. In showing compliance with paragraph (e)(2) of this section, the tearing away of an engine mount must be considered unless all the engines are installed above the wing or on the tail or fuselage of the airplane.	**CS 23.967 Fuel tank installation** (e) Fuel tanks must be designed, located and installed – (1) So as to retain fuel when subjected to the inertia loads resulting from the ultimate static load factors prescribed in CS 23.561 (b) (2); and (2) So as to retain fuel under conditions likely to occur when an aeroplane lands on a paved runway at a normal landing speed under each of the following conditions: (i) The aeroplane in a normal landing attitude and its landing gear retracted. (ii) The most critical landing gear leg collapsed and the other landing gear legs extended. In showing compliance with subparagraph (e) (2), the tearing away of an engine mount must be considered unless all the engines are installed above the wing or on the tail or fuselage of the aeroplane. (3) For commuter category aeroplanes, fuel tanks within the fuselage contour must be able to resist rupture and be in a protected position so that exposure of the tanks to scraping action with the ground is unlikely.
Sec. 23.1093 Induction system icing protection (a) *Reciprocating engines.* Each reciprocating engine air induction system must have means to prevent and eliminate icing. Unless this is done by other means, it must be shown that, in air free of visible moisture at a temperature of 30° F.— (1) Each airplane with sea level engines using conventional venturi carburetors has a preheated that can provide a heat rise of 90° F. with the engines at 75 percent of maximum continuous power; (2) Each airplane with altitude engines using conventional venturi carburetors has a preheated that can provide a heat rise of 120° F. with the engines at 75 percent of maximum continuous power; (3) Each airplane with altitude engines using fuel metering device tending to prevent icing has a preheated that, with the engines at 60 percent of maximum continuous power, can provide a heat rise of-- (i) 100° F.; or (ii) 40° F., if a fluid de-icing system meeting the requirements of Secs. 23.1095 through 23.1099 is installed; (4) Each airplane with a sea level engine(s) using a fuel metering device tending to prevent icing has a sheltered alternate source of air with a preheat of not less than 60°F with the engines at 75 percent of maximum continuous power; (5) Each airplane with sea level or altitude engine(s) using fuel injection systems having metering component on which impact ice may accumulate has a preheater capable of providing a heat rise of 75° F. with the engine is operating at 75 percent of its	**CS 23.1093 Induction system icing protection** (a) *Reciprocating engines*. Each reciprocating engine air induction system must have means to prevent and eliminate icing. Unless this is done by other means, it must be shown that, in air free of visible moisture at a temperature of -1°C (30°F) – (1) Each aeroplane with sea-level engines using conventional venturi carburetors has a preheated that can provide a heat rise of 50°C (90°F) with the engines at 75% of maximum continuous power; (2) Each aeroplane with altitude engines using conventional venturi carburettors has a preheated that can provide a heat rise of 67°C (120°F) with the engines at 75% of maximum continuous power; (3) Each aeroplane with altitude engines using carburettors tending to prevent icing has a preheated that, with the engines at 60% of maximum continuous power, can provide a heat rise of – (i) 56°C (100°F); or (ii) 22°C (40°F), if a fluid de-icing system meeting the requirements of CS 23.1095 to 23.1099 is installed; (4) Each single-engine aeroplane with a sea-level engine using a carburettor tending to prevent icing has a sheltered alternate source of air with a preheat of not less than that provided by the engine cooling air downstream of the cylinders; and (5) Each twin-engined aeroplane with sea-level engines using a carburettor tending to prevent icing has a preheater that can provide a heat rise of 50°C (90°F) with the engines at 75% of maximum continuous power. (6) Each aeroplane with sea level or altitude engine(s)

maximum continuous power; and (6) Each airplane 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 evaporation may form, has a sheltered alternate source of air with a preheat of not less than 60°F with the engines at 75 percent of 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), 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 thrust-- (i) Under the icing conditions specified in appendix C of part 25 of this chapter; and (ii) In snow, both falling and blowing, within the limitations established for the airplane for such operation. (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 15° F and 30° F (between -9° and -1°C) and has a liquid water content not less than 0.3 grams per cubic meter in the form of drops having a mean effective diameter not less than 20 microns, followed by momentary operation at takeoff 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 Administrator. (c) *Reciprocating engines with superchargers.* For airplanes with reciprocating engines having superchargers to pressurize the air before it enters the fuel metering device, the heat rise in the air caused by that supercharging at any altitude may be utilized in determining compliance with paragraph (a) of this section if the heat rise utilized is that which will be available, automatically, for the applicable altitudes and operating condition because of supercharging.	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 of not less than 16ºC (60ºF) with the engines at 75 percent 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), 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 thrust – (i) Under the icing conditions specified in CS Definitions; and (ii) In snow, both falling and blowing, within the limitations established for the aeroplane for such operation. (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° and -1°C (between 15° 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 microns, 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 Agency. (c) *Reciprocating engines with superchargers*. For aeroplanes with reciprocating engines having superchargers to pressurise the air before it enters the carburettor, the heat rise in the air caused by that supercharging at any altitude may be utilised in determining compliance with sub-paragraph (a) if the heat rise utilised is that which will be available, automatically, for the applicable altitudes and operating condition because of supercharging.
Sec. 23.1105 Induction system screens If induction system screens are used— (a) Each screen must be upstream of the carburetor or fuel injection system. (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 is at least 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.	**CS 23.1105 Induction system screens** If induction system screens are used on reciprocating engines – (a) Each screen must be upstream of the carburettor or fuel injection system; (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 is at least 56°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.
Sec. 23.1107 Induction system filters If an air filter is used to protect the engine against foreign material particles in the induction air supply- (a)	**CS 23.1107 Induction system filters** On reciprocating-engine installations, if an air filter is used to protect the engine against foreign

Each air filter 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; and (b) Each air filter shall have a design feature to prevent material separated from the filter media from interfering with proper fuel metering operation.	material particles in the induction air supply-- (a) Each air filter 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; and (b) Each air filter must have a design feature to prevent material separated from the filter media from interfering with proper fuel metering operation.
Sec. 23.1189 Shutoff means (a) For each multiengine airplane, the following apply: (1) Each engine installation must have means to shut off or otherwise prevent hazardous quantities of fuel, oil, de-icing fluid, and other flammable liquids from flowing into, within, or through any engine compartment, except in lines, fittings, and components forming an integral part of an engine. 2) The closing of the fuel shutoff valve for any engine may not make any fuel unavailable to the remaining engines that would be available to those engines with that valve open. (3) Operation of any shutoff means may not interfere with the later emergency operation of other equipment such as propeller feathering devices. (4) Each shutoff must be outside of the engine compartment unless an equal degree of safety is provided with the shutoff inside the compartment. (5) Not more than one quart of flammable fluid may escape into the engine compartment after engine shutoff. For those installations where the flammable fluid that escapes after shutdown cannot be limited to one quart, it must be demonstrated that this greater amount can be safely contained or drained overboard. (6) 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. (b) Turbine engine installations need not have an engine oil system shutoff if— (1) The oil tank is integral with, or mounted on, the engine; and (2) All oil system components external to the engine are fireproof or located in areas not subject to engine fire conditions. (c) Power operated valves must have means to indicate to the flight crew when the valve has reached the selected position and must be designed so that the valve will not move from the selected position under vibration conditions likely to exist at the valve location.	**CS 23.1189 Shut-off means** (See AMC 23.1189 (a) (5)) (a) For each twin-engined aeroplane the following apply: (1) Each engine installation must have means to shut off or otherwise prevent hazardous quantities of fuel, oil, de-icing fluid and other flammable liquids from flowing into, within, or through any engine compartment, except in lines, fittings and components forming an integral part of an engine. (2) The closing of the fuel shut-off valve for any engine may not make any fuel unavailable to the remaining engine that would be available to that engine with that valve open. (3) Operation of any shut-off means may not interfere with the later emergency operation of other equipment such as propeller feathering devices. (4) Each shut-off must be outside of the engine compartment unless an equal degree of safety is provided with the shut-off inside the compartment. (5) No hazardous amount of flammable fluid may drain into the engine compartment after shut-off. (6) There must be means to guard against inadvertent operations of each shut-off means and to make it possible for the crew to reopen the shut-off means in flight after it has been closed. (b) Turbine engine installations need not have an engine oil system shut-off if – (1) The oil tank is integral with, or mounted on, the engine; and (2) All oil system components external to the engine are fireproof or located in areas not subject to engine fire conditions. (c) Power-operated valves must have means to indicate to the flight crew when the valve has reached the selected position and must be designed so that the valve will not move from the selected position under vibration conditions likely to exist at the valve location.
Sec. 23.1193 Cowling and nacelle (f) Each nacelle of a multiengine airplane with supercharged engines must be designed and constructed so that with the landing gear retracted, a fire in the engine compartment will not burn through a cowling or nacelle and enter a nacelle area other than the engine compartment. (g) In addition, for commuter category airplanes, the airplane must be designed so that no fire originating in	**CS 23.1193 Cowling and nacelle** (f) Each nacelle of a twin-engine aeroplane with turbocharged engines must be designed and constructed so that with the landing gear retracted, a fire in the engine compartment will not burn through a cowling or nacelle and enter a nacelle area other than the engine compartment. (g) In addition for commuter category aeroplanes, the aeroplane must be designed so that no fire originating

any engine compartment can enter, either through openings or by burn through, any other region where it would create additional hazards.	in any engine compartment can enter, either through openings or by burn-through, any other region where it would create additional hazards.
Sec. 23.1195 Fire extinguishing systems (a) For commuter category airplanes, fire extinguishing systems must be installed and compliance shown with the following: (1) 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; (2) 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 may be used. (3) The fire extinguishing system for a nacelle must be able to simultaneously protect each compartment of the nacelle for which protection is provided. (b) If an auxiliary power unit is installed in any airplane certificated to this part, that auxiliary power unit compartment must be served by a fire extinguishing system meeting the requirements of paragraph (a)(2) of this section.	**CS 23.1195 Fire extinguishing systems** (a) For commuter category aeroplanes, fire extinguishing systems must be installed and compliance shown with the following: (1) 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, there must be a fire extinguisher system serving each designated fire zone. (2) 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 may be used. (3) The fire extinguishing system for a nacelle must be able to simultaneously protect each zone of the nacelle for which protection is provided. (b) If an auxiliary power unit is installed in any aeroplane certificated to CS-23, that auxiliary power unit compartment must be served by a fire extinguishing system meeting the requirements of sub-paragraph (a) (2).
Sec. 23.1203 Fire detector system (a) There must be means that ensure the prompt detection of a fire in— (1) An engine compartment of— (i) Multiengine turbine powered airplanes; (ii) Multiengine reciprocating engine powered airplanes incorporating turbochargers; (iii) Airplanes with engine(s) located where they are not readily visible from the cockpit; and (iv) All commuter category airplanes. (2) The auxiliary power unit compartment of any airplane incorporating an auxiliary power unit. (b) Each fire detector must be constructed and installed to withstand the vibration, inertia, and other loads to which it may be subjected in operation. (c) No fire detector may be affected by any oil, water, other fluids, or fumes that might be present. (d) There must be means to allow the crew to check, in flight, the functioning of each fire detector electric circuit. (e) Wiring and other components of each fire detector system in a designated fire zone must be at least fire resistant.	**CS 23.1203 Fire detector system** (a) There must be means that ensures the prompt detection of a fire in – (1) Each designated fire zone of – (i) Twin-engine turbine powered aeroplanes; (ii) Twin-engine reciprocating engine powered aeroplanes incorporating turbochargers; (iii) Aeroplanes with engine(s) located where they are not readily visible from the cockpit; and (iv) All commuter category aeroplanes. (2) The auxiliary power unit compartment of any aeroplane incorporating an auxiliary power unit. (b) Each fire detector system must be constructed and installed to withstand the vibration, inertia and other loads to which it may be subjected in operation. (c) No fire detector may be affected by any oil, water, other fluids, or fumes that might be present. (d) There must be means to allow the crew to check, in flight, the functioning of each fire detector electric circuit. (e) Wiring and other components of each fire detector system in a designated fire zone must be at least fire-resistant.
Sec. 23.1305 Powerplant instruments (b) *For reciprocating engine-powered airplanes.* In addition to the powerplant instruments required by paragraph (a) of this section, the following powerplant instruments are required: (1) An induction system air temperature indicator for each engine equipped with a preheated and having induction air temperature limitations that can be	**CS 23.1305 Powerplant instruments** (b) *For reciprocating engine-powered aeroplanes.* In addition to the powerplant instruments required by sub-paragraph (a), the following powerplant instruments are required: (1) An induction system air temperature indicator for each engine equipped with a preheated and having induction air temperature limitations that can be

exceeded with preheat. (2) A tachometer indicator for each engine. (3) A cylinder head temperature indicator for— (i) Each air-cooled engine with cowl flaps; (ii) Removed and reserved. (iii) Each commuter category airplane. (4) For each pump-fed engine, a means: (i) That continuously indicates, to the pilot, the fuel pressure or fuel flow; or (ii) That continuously monitors the fuel system and warns the pilot of any fuel flow trend that could lead to engine failure. (5) A manifold pressure indicator for each altitude engine and for each engine with a controllable propeller. (6) For each turbocharger installation: (i) If limitations are established for either carburetor (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.	exceeded with preheat. (2) A tachometer indicator for each engine. (3) A cylinder head temperature indicator for- (i) Each air-cooled engine with cowl flaps; (ii) Removed and reserved. (iii) Each commuter category aeroplane. (4) A fuel pressure indicator for pump fed engines. (5) A manifold pressure indicator for each altitude engine and for each engine with a controllable propeller. (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.
Sec. 23.1307 Miscellaneous equipment The equipment necessary for an airplane to operate at the maximum operating altitude and in the kinds of operations and meteorological conditions for which certification is requested and is approved in accordance with Sec. 23.1559 must be included in the type design.	No CS requirement.
Sec. 23.1308 High-Intensity Radiated Fields (HIRF) Protection (a) Except as provided in paragraph (d) of this section, each electrical and electronic system that performs a function whose failure would prevent the continued safe flight and landing of the airplane must be designed and installed so that— (1) The function is not adversely affected during and after the time the airplane is exposed to HIRF environment I, as described in appendix J to this part. (2) The system automatically recovers normal operation of that function, in a timely manner, after the airplane is exposed to HIRF environment I, as described in appendix J to this part, unless the system's recovery conflicts with other operational or functional requirements of the system; and (3) The system is not adversely affected during and after the time the airplane is exposed to HIRF environment II, as described in appendix J to this part. (b) Each electrical and electronic system that performs a function whose failure would significantly reduce the capability of the airplane or the ability of the flightcrew	No CS requirement.

to respond to an adverse operating condition must be designed and installed so the system is not adversely affected when the equipment providing the function is exposed to equipment HIRF test level 1 or 2, as described in appendix J to this part. (c) Each electrical and electronic system that performs a function whose failure would reduce the capability of the airplane or the ability of the flight crew to respond to an adverse operating condition must be designed and installed so the system is not adversely affected when the equipment providing the function is exposed to equipment HIRF test level 3, as described in appendix J to this part. (d) Before December 1, 2012, an electrical or electronic system that performs a function whose failure would prevent the continued safe flight and landing of an airplane may be designed and installed without meeting the provisions of paragraph (a) provided— (1) The system has previously been shown to comply with special conditions for HIRF, prescribed under § 21.16, issued before December 1, 2007; (2) The HIRF immunity characteristics of the system have not changed since compliance with the special conditions was demonstrated; and (3) The data used to demonstrate compliance with the special conditions is provided.	
Sec. 23.1309 Equipment, systems, and installations (a) Each item of equipment, each system, and each installation: (1) When performing its intended function, may not adversely affect the response, operation, or accuracy of any-- (i) Equipment essential to safe operation; or (ii) Other equipment unless there is a means to inform the pilot of the effect. (2) In a single-engine airplane, must be designed to minimize hazards to the airplane in the event of a probable malfunction or failure. (3) In a multiengine airplane, must be designed to prevent hazards to the airplane in the event of a probable malfunction or failure. (4) In a commuter category airplane, must be designed to safeguard against hazards to the airplane in the event of their malfunction or failure. (b) The design of each item of equipment, each system, and each installation must be examined separately and in relationship to other airplane systems and installations to determine if the airplane is dependent upon its function for continued safe flight and landing and, for airplanes not limited to VFR conditions, if failure of a system would significantly reduce the capability of the airplane or the ability of the crew to cope with adverse operating conditions. Each item of equipment, each system, and each installation identified by this examination as one upon which the airplane is dependent for proper functioning to ensure continued safe flight and landing, or whose failure would significantly reduce the capability of the airplane or the ability of the crew to cope with adverse operating conditions, must be designed to comply with	**CS 23.1309 Equipment, systems and installations** (a) Each item of equipment, each system, and each installation – (1) When performing its intended function, may not adversely affect the response, operation, or accuracy of any – (i) Equipment essential to safe operation; or (ii) Other equipment unless there is a means to inform the pilot of the effect. (2) In a single-engine aeroplane, must be designed to minimise hazards to the aeroplane in the event of a probable malfunction or failure. (3) In a twin-engine aeroplane, must be designed to prevent hazards to the aeroplane in the event of a probable malfunction or failure. (4) In a commuter category aeroplane, must be designed to safeguard against hazards to the aeroplane in the event of their malfunction or failure. (b) The design of each item of equipment, each system, and each installation must be examined separately and in relationship to other aeroplane systems and installations to determine if the aeroplane is dependent upon its function for continued safe flight and landing and, for aeroplanes not limited to VFR conditions, if failure of a system would significantly reduce the capability of the aeroplane or the ability of the crew to cope with adverse operating conditions. Each item of equipment, each system, and each installation identified by this examination as one upon which the aeroplane is dependent for proper functioning to ensure continued safe flight and landing,

the following additional requirements: (1) It must perform its intended function under any foreseeable operating condition. (2) When systems and associated components are considered separately and in relation to other systems-- (i) The occurrence of any failure condition that would prevent the continued safe flight and landing of the airplane must be extremely improbable; and (ii) The occurrence of any other failure condition that would significantly reduce the capability of the airplane or the ability of the crew to cope with adverse operating conditions must be improbable. (3) Warning information must be provided to alert the crew to unsafe system operating conditions and to enable them to take appropriate corrective action. Systems, controls, and associated monitoring and warning means must be designed to minimize crew errors that could create additional hazards. (4) Compliance with the requirements of paragraph (b)(2) of this section may be shown by analysis and, where necessary, by appropriate ground, flight, or simulator test. The analysis must consider— (i) Possible modes of failure, including malfunctions and damage from external sources; (ii) The probability of multiple failures and the probability or undetected faults; (iii) The resulting effects of the airplane and occupants, considering the stage of flight and operating conditions; and (iv) The crew warning cues, corrective action required, and the crew's capability of determining faults. (c) Each item of equipment, each system, and each installation whose functioning is required by this chapter and that requires a power supply is an "essential load" on the power supply. The power sources and the system must be able to supply the following power loads in probable operating combinations and for probable durations: (1) Loads connected to the power distribution system with the system functioning normally. (2) Essential loads after failure of— (i) Any one engine on two-engine airplanes; or (ii) Any two engines on an airplane with three or more engines; or (iii) Any power converter or energy storage device. (3) Essential loads for which an alternate source of power is required, as applicable, by the operating rules of this chapter, after any failure or malfunction in any one power supply system, distribution system, or other utilization system. (d) In determining compliance with paragraph (c)(2) of this section, the power loads may be assumed to be reduced under a monitoring procedure consistent with safety in the kinds of operations authorized. Loads not required in controlled flight need not be considered for the two-engine-inoperative condition on airplanes with three or more engines. (e) In showing compliance with this section with regard to the electrical power system and to equipment design and installation, critical environmental and atmospheric	or whose failure would significantly reduce the capability of the aeroplane or the ability of the crew to cope with adverse operating conditions, must be designed to comply with the following additional requirements: (1) It must perform its intended function under any foreseeable operating condition. (2) When systems and associated components are considered separately and in relation to other systems – (i) The occurrence of any failure condition that would prevent the continued safe flight and landing of the aeroplane must be extremely improbable; and (ii) The occurrence of any other failure condition that would significantly reduce the capability of the aeroplane or the ability of the crew to cope with adverse operating conditions must be improbable. (3) Warning information must be provided to alert the crew to unsafe system operating conditions and to enable them to take appropriate corrective action. Systems, controls, and associated monitoring and warning means must be designed to minimize crew errors that could create additional hazards. (4) Compliance with the requirements of sub-paragraph (b) (2) may be shown by analysis and, where necessary, by appropriate ground, flight, or simulator test. The analysis must consider – (i) Possible modes of failure, including malfunctions and damage from external sources; (ii) The probability of multiple failures, and the probability of undetected faults; (iii) The resulting effects on the aeroplane and occupants, considering the stage of flight and operating conditions; and (iv) The crew warning cues, corrective action required, and the crew's capability of determining faults. (c) Each item of equipment, each system, and each installation whose functioning is required for certification and that requires a power supply, is an "essential load" on the power supply. The power sources and the system must be able to supply the following power loads in probable operating combinations and for probable durations: (1) Loads connected to the power distribution system with the system functioning normally. (2) Essential loads after failure of – (i) Any one engine on two-engine aeroplanes; or (ii) Any power converter or energy storage device. (3) Essential loads for which an alternate source of power is required by the operating rules, after any failure or malfunction in any one power supply system, distribution system, or other utilisation system. (d) In determining compliance with subparagraph (c) (2) , the power loads may be assumed to be reduced under a monitoring procedure consistent with safety in the kinds of operations authorised. (e) In showing compliance with this paragraph with regard to the electrical power system and to equipment design and installation, critical environmental and atmospheric conditions, including radio frequency

conditions, including radio frequency energy and the effects (both direct and indirect) of lightning strikes, must be considered. For electrical generation, distribution, and utilization equipment required by or used in complying with this chapter, the ability to provide continuous, safe service under foreseeable environmental conditions may be shown by environmental tests, design analysis, or reference to previous comparable service experience on other airplanes. (f) As used in this section, "systems" refers to all pneumatic systems, fluid systems, electrical systems, mechanical systems, and powerplant systems included in the airplane design, except for the following: (1) Powerplant systems provided as part of the certificated engine. (2) The flight structure (such as wing, empennage, control surfaces and their systems, the fuselage, engine mounting, and landing gear and their related primary attachments) whose requirements are specific in subparts C and D of this part.	energy and the effects (both direct and indirect) of lightning strikes, must be considered. For electrical generation, distribution, and utilisation equipment required by or used in complying with this subpart, the ability to provide continuous, safe service under foreseeable environmental conditions may be shown by environmental tests, design analysis, or reference to previous comparable service experience on other aeroplanes. (f) As used in this paragraph, “systems” refers to all pneumatic systems, fluid systems, electrical systems, mechanical systems, and powerplant systems included in the aeroplane design, except for the following: (1) Powerplant systems provided as part of the certificated engine. (2) The flight structure (such as wing, empennage, control surfaces and their systems, the fuselage, engine mounting, and landing gear and their related primary attachments) whose requirements are specific in Subparts C and D of CS-23.
Sec. 23.1311 Electronic display instrument systems (a) Electronic display indicator … (5) Have an independent magnetic direction indicator and either an independent secondary mechanical altimeter, airspeed indicator, and attitude instrument or individual electronic display indicators for the altitude, airspeed, and attitude that are independent from the airplane's primary electrical power system. These secondary instruments may be installed in panel positions that are displaced from the primary positions specified by Sec. 23.1321(d), but must be located where they meet the pilot's visibility requirements of Sec. 23.1321(a).	**CS 23.1311 Electronic display instrument systems** (a) Electronic display indicator … (5) Have an independent magnetic direction indicator and an independent secondary mechanical altimeter, airspeed indicator, magnetic direction indicator, and attitude instrument, or individual electronic display indicators for the altimeter, airspeed, and attitude that are independent from the aeroplane’s primary electrical power system. These secondary instruments may be installed in panel positions that are displaced from the primary positions specified by CS 23.1321 (d), but must be located where they meet the pilot’s visibility requirements of CS 23.1321(a).
Sec. 23.1321 Arrangement and visibility (a) Each flight, navigation, and powerplant instrument for use by any required pilot during takeoff, initial climb, final approach, and landing must be located so that any pilot seated at the controls can monitor the airplane's flight path and these instruments with minimum head and eye movement. The powerplant instruments for these flight conditions are those needed to set power within powerplant limitations. (b) For each multiengine airplane, identical powerplant instruments must be located so as to prevent confusion as to which engine each instrument relates. (c) Instrument panel vibration may not damage, or impair the accuracy of, any instrument. (d) For each airplane, the flight instruments required by Sec. 23.1303, and, as applicable, by the operating rules of this chapter, must be grouped on the instrument panel and centered as nearly as practicable about the vertical plane of each required pilot's forward vision. In addition: (1) The instrument that most effectively indicates the	**CS 23.1321 Arrangement and visibility** (a) Each flight, navigation and powerplant instrument for use by any required pilot during take-off, initial climb, final approach, and landing must be located so that any pilot seated at the controls can monitor the aeroplane’s flight path and these instruments with minimum head and eye movement. The powerplant instruments for these flight conditions are those needed to set power within powerplant limitations. (b) For each twin-engined aeroplane, identical powerplant instruments must be located so as to prevent confusion as to which engine each instrument relates. (c) Instrument panel vibration may not damage, or impair the accuracy of, any instrument. (d) For each aeroplane the flight instruments required by CS 23.1303 and, as applicable, by the Operating Rules must be grouped on the instrument panel and centred as nearly as practicable about the vertical plane of the pilot’s forward vision. In addition – (1) The instrument that most effectively indicates the

attitude must be on the panel in the top center position; (2) The instrument that most effectively indicates airspeed must be adjacent to and directly to the left of the instrument in the top center position; (3) The instrument that most effectively indicates altitude must be adjacent to and directly to the right of the instrument in the top center position; and (4) The instrument that most effectively indicates direction of flight, other than the magnetic direction indicator required by Sec. 23.1303(c), must be adjacent to and directly below the instrument in the top center position; and (5) Electronic display indicators may be used for compliance with paragraphs (d)(1) through (d)(4) of this section when such displays comply with requirements in Sec. 23.1311. (e) If a visual indicator is provided to indicate malfunction of an instrument, it must be effective under all probable cockpit lighting conditions.	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 CS 23.1303(c), 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) when such displays comply with requirements in CS 23.1311. (e) If a visual indicator is provided to indicate malfunction of an instrument, it must be effective under all probable cockpit lighting conditions.
Sec. 23.1325 Static pressure system ….. (g) For airplanes prohibited from flight in instrument meteorological or icing conditions, in accordance with Sec. 23.1559(b) of this part, paragraph (b)(3) of this section does not apply.	**CS 23.1325 Static pressure system** ….. (g) For aeroplanes prohibited from flight under instrument flight rules (IFR) or known icing conditions in accordance with CS 23.1525, subparagraph (b) (3) does not apply.
Sec. 23.1327 Magnetic direction indicator (a) Except as provided in paragraph (b) of this section- (1) Each magnetic direction indicator must be installed so that its accuracy is not excessively affected by the airplane's vibration or magnetic fields; and (2) The compensated installation may not have a deviation, in level flight, greater than ten degrees on any heading. (b) A magnetic nonstabilized direction indicator may deviate more than ten degrees due to the operation of electrically powered systems such as electrically heated windshields if either a magnetic stabilized direction indicator, which does not have a deviation in level flight greater than ten degrees on any heading, or a gyroscopic direction indicator, is installed. Deviations of a magnetic nonstabilized direction indicator of more than 10 degrees must be placarded in accordance with Sec. 23.1547(e).	**CS 23.1327 Magnetic direction indicator** (a) Except as provided in sub-paragraph (b): (1) Each magnetic direction indicator must be installed so that its accuracy is not excessively affected by the aeroplane's vibration or magnetic fields; and (2) The compensated installation may not have a deviation, in level flight, greater than 10° on any heading. (b) A magnetic non-stabilised direction indicator may deviate more than 10° due to the operation of electrically powered systems 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 non-stabilised direction indicator of more than 10° must be placarded in accordance with CS 23.1547 (c)
Sec. 23.1351 General ….. (f) *External power.* If provisions are made for connecting external power to the airplane, 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, or a reverse phase sequence, can supply power to the airplane's electrical system.	**CS 23.1351 General** ….. (f) *External power.* If provisions are made for connecting external power to the aeroplane 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, or a reverse phase sequence, can supply power to the aeroplane's electrical system. The external power connection must be located so that its use will not result in a hazard to the aeroplane or ground personnel.

Sec. 23.1389 Position light distribution and intensities (a) *General.* The intensities prescribed in this section 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 airplane. The light distribution and intensity of each position light must meet the requirements of paragraph (b) of this section. (b) *Position lights.* The light distribution and intensities of position lights must be expressed in terms of minimum intensities in any vertical plane, and maximum intensities in overlapping beams, with dihedral angles *L, R,* and *A*, and must meet the following requirements: …..	**CS 23.1389 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 aeroplane. The light distribution and intensity of each position light must meet the requirements of subparagraph (b). (b) *Position lights.* The light distribution and intensities of position lights must be expressed in terms of minimum intensities in the horizontal plane, minimum intensities in any vertical plane and maximum intensities in over-lapping beams, within dihedral angles L, R and A, must meet the following requirements: …..
Sec. 23.1415 Ditching equipment (a) Emergency flotation and signalling equipment required by any operating rule in this chapter must be installed so that it is readily available to the crew and passengers. (b) Each raft and each life preserver must be approved. (c) Each raft released automatically or by the pilot must be attached to the airplane by a line to keep it alongside the airplane. This line must be weak enough to break before submerging the empty raft to which it is attached. (d) Each signalling device required by any operating rule in this chapter, must be accessible, function satisfactorily, and must be free of any hazard in its operation.	**CS 23.1415 Ditching equipment** (a) Emergency flotation and signalling equipment required by the operating rules must be installed so that it is readily available to the crew and passengers. (b) Each raft and each life preserver must be approved. (c) Each raft released automatically or by the pilot must be attached to the aeroplane by a line to keep it alongside the aeroplane. This line must be weak enough to break before submerging the empty raft to which it is attached. (d) Each signalling device required by the operating rules, must be accessible, function satisfactorily and must be free of any hazard in its operation.
Sec. 23.1419 Ice protection If certification with ice protection provisions is desired, compliance with the requirements of this section and other applicable sections of this part must be shown: (a) An analysis must be performed to establish, on the basis of the airplane's operational needs, the adequacy of the ice protection system for the various components of the airplane. In addition, tests of the ice protection system must be conducted to demonstrate that the airplane is capable of operating safely in continuous maximum and intermittent maximum icing conditions as described in Appendix C of part 25 of this chapter. As used in this section, "Capable of operating safely," means that airplane performance, controllability, maneuverability, and stability must not be less than that required in part 23, subpart B. (b) Except as provided by paragraph (c) of this section, in addition to the analysis and physical evaluation prescribed in paragraph (a) of this section, the effectiveness of the ice protection system and its components must be shown by flight tests of the airplane or its components in measured natural	**CS 23.1419 Ice protection** (See AMC 23.1419) If certification with ice protection provisions is desired, compliance with the following requirements must be shown: (a) The recommended procedures for the use of the ice protection equipment must be set forth in the Aeroplane Flight Manual or in approved manual material. (b) An analysis must be performed to establish, on the basis of the aeroplane's operational needs, the adequacy of the ice protection system for the various components of the aeroplane. In addition, tests of the ice protection system must be conducted to demonstrate that the aeroplane is capable of operating safely in continuous maximum and intermittent maximum icing conditions as described in AMC-1. (c) Compliance with all or portions may be accomplished by reference, where applicable because of similarity of the designs to analysis and tests performed for the type certification of a type certificated aircraft.

atmospheric icing conditions and by one or more of the following tests, as found necessary to determine the adequacy of the ice protection system— (1) Laboratory dry air or simulated icing tests, or a combination of both, of the components or models of the components. (2) Flight dry air tests of the ice protection system as a whole, or its individual components. (3) Flight test of the airplane or its components in measured simulated icing conditions. (c) If certification with ice protection has been accomplished on prior type certificated airplanes whose designs include components that are thermodynamically and aerodynamically equivalent to those used on a new airplane design, certification of these equivalent components may be accomplished by reference to previously accomplished tests, required in Sec. 23.1419(a) and (b), provided that the applicant accounts for any differences in installation of these components. (d) A means must be identified or provided for determining the formation of ice on the critical parts of the airplane. Adequate lighting must be provided for the use of this means during night operation. Also, when monitoring of the external surfaces of the airplane by the flight crew is required for operation of the ice protection equipment, external lighting must be provided that is adequate to enable the monitoring to be done at night. Any illumination that is used must be of a type that will not cause glare or reflection that would handicap crewmembers in the performance of their duties. The Airplane Flight Manual or other approved manual material must describe the means of determining ice formation and must contain information for the safe operation of the airplane in icing conditions.	(d) When monitoring of the external surfaces of the aeroplane by the flight crew is required for proper operation of the ice protection equipment, external lighting must be provided which is adequate to enable the monitoring to be done at night. **SAT note:** FAR and CS are organized in different way.
Sec. 23.1457 Cockpit voice recorders (5) And that as far as is practicable all sounds received by the microphone listed in paragraphs (c)(1), (2), and (4) of this section must be recorded without interruption irrespective of the position of the interphone-transmitter key switch. The design shall ensure that sidetone for the flight crew is produced only when the interphone, public address system, or radio transmitters are in use. (6) If datalink communication equipment is installed, all datalink communications, using an approved data message set. Datalink messages must be recorded as the output signal from the communications unit that translates the signal into usable data. (d) Each cockpit voice recorder must be installed so that: (1) It receives its electrical power from the bus that provides the maximum reliability for operation of the cockpit voice recorder without jeopardizing service to essential or emergency loads. The cockpit voice recorder must remain powered for as long as possible without jeopardizing emergency operation of the	**CS 23.1457 Cockpit voice recorders** (5) And that as far as is practicable all sounds received by the microphone listed in sub-paragraph (c) (1), (2) and (4) must be 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 of the cockpit voice recorder without jeopardising service to essential or emergency loads. (2) There is an automatic means to simultaneously stop 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

airplane; (2) There is an automatic means to simultaneously stop 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 preflight checking of the recorder for proper operation; (4) Any single electrical failure external to the recorder does not disable both the cockpit voice recorder and the flight data recorder; (5) It has an independent power source— (i) That provides 10 1 minutes of electrical power to operate both the cockpit voice recorder and cockpit-mounted area microphone; (ii) That is located as close as practicable to the cockpit voice recorder; and (iii) To which the cockpit voice recorder and cockpit-mounted area microphone are switched automatically in the event that all other power to the cockpit voice recorder is interrupted either by normal shutdown or by any other loss of power to the electrical power bus; and (6) It is in a separate container from the flight data recorder when both are required. If used to comply with only the cockpit voice recorder requirements, a combination unit may be installed. (e) The recorder container must be located and mounted to minimize the probability of rupture of the container as a result of crash impact and consequent heat damage to the recorder from fire. (1) Except as provided in paragraph (e)(2) of this section, the recorder container must be located as far aft as practicable, but need not be outside of the pressurized compartment, and may not be located where aft-mounted engines may crush the container during impact. (2) If two separate combination digital flight data recorder and cockpit voice recorder units are installed instead of one cockpit voice recorder and one digital flight data recorder, the combination unit that is installed to comply (f) If the cockpit voice recorder has a bulk erasure device, the installation must be designed to minimize the probability of inadvertent operations 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 of this chapter, on or adjacent to the container which is secured in such manner that they are not likely to be separated during crash impact.	to minimise the probability of rupture of the container as a result of crash impact and consequent heat damage to the record from fire. In meeting this requirement, the record container must be as far aft as practicable, but may not be where aft mounted engines may crush the container during impact. However, it need not be outside of the pressurised compartment. (f) If the cockpit voice recorder has a bulk erasure device, the installation must be designed to minimise the probability of inadvertent operations 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 manner that they are not likely to be separated during crash impact.
Sec. 23.1459 Flight recorders (a) Each flight recorder required by the operating rules of this chapter must be installed so that— (1) It is supplied with airspeed, altitude, and directional data obtained from sources that meet the accuracy requirements of Secs. 23.1323, 23.1325, and 23.1327,	**CS 23.1459 Flight recorders** (See AMC 23.1459 (b)) (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

as appropriate; (2) The vertical acceleration sensor is rigidly attached, and located longitudinally either within the approved center of gravity limits of the airplane, or at a distance forward or aft of these limits that does not exceed 25 percent of the airplane's mean aerodynamic chord; (3)It receives its electrical power from the bus that provides the maximum reliability for operation of the flight data recorder without jeopardizing service to essential or emergency loads. The flight data recorder must remain powered for as long as possible without jeopardizing emergency operation of the airplane; (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; (6) Any single electrical failure external to the recorder does not disable both the cockpit voice recorder and the flight data recorder; and (7) It is in a separate container from the cockpit voice recorder when both are required. If used to comply with only the flight data recorder requirements, a combination unit may be installed. If a combination unit is installed as a cockpit voice recorder to comply with Sec. 23.1457(e)(2), a combination unit must be used to comply with this flight data recorder requirement. (b) Each nonejectable record container must be located and mounted so as to minimize the probability of container rupture resulting from crash impact and subsequent damage to the record from fire. In meeting this requirement the record container must be located as far aft as practicable, but need not be aft of the pressurized compartment, and may not be where aft-mounted engines may crush the container upon impact. (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 airplane is to be operated, the range of altitude to which the airplane is limited, and 360 degrees 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; and (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 aircraft shall be evaluated to determine if any dedicated parameters must be	requirements of CS 23.1323, 23.1325 and 23.1327, as appropriate; (2) The vertical acceleration sensor is rigidly attached, and located longitudinally either within the approved centre of gravity limits of the aeroplane, or at a distance forward or aft of these limits that does not exceed 25% of the aeroplane's mean aerodynamic chord; (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 pre-flight 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 (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. In meeting this requirement the record container must be located as far aft as practicable, but need not be aft of the pressurized compartment, and may not be where aft-mounted engines may crush the container upon impact. (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 aeroplane is to be operated, the range of altitude to which the aeroplane is limited, and 360° 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; 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. (e) Any novel or unique design or operational characteristics of the aeroplane must be evaluated to determine if any dedicated parameters must be recorded on flight recorders in addition to or in place of existing requirements.

recorded on flight recorders in addition to or in place of existing requirements.	
Sec. 23.1513 Minimum control speed The minimum control speed VMC, determined under §23.149, must be established as an operating limitation.	**CS 23.1513 Minimum control speed** The minimum control speed(s) VMC, determined under CS 23.149 (b), must be established as an operating limitation(s).
Sec. 23.1529 Instructions for Continued Airworthiness The applicant must prepare Instructions for Continued Airworthiness in accordance with appendix G to this part that are acceptable to the Administrator. The instructions may be incomplete at type certification if a program exists to ensure their completion prior to delivery of the first airplane or issuance of a standard certificate of airworthiness, whichever occurs later. **SAT note:** The difference is that according to FAR Instructions for Continued Airworthiness may be incomplete at type certification but the completion must be ensure prior to delivery of first airplane or issuance of a standard CoA.	**CS 23.1529 Instructions for continued Airworthiness** Instructions for continued airworthiness in accordance with Appendix G must be prepared.

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3.2 Analysis of EU-OPS, Risk Assessment for European Public Transport Operations using Single Engine Turbine Aircraft at Night and in IMC and comparison with regulation FAR 135 Operating requirements

The following chapter analyse and compare operational requirements of regulations EU-OPS and FAR135 on classes of SAT aircraft that are mentioned in chapter 2 hereof document.

Note: *Once the new EASA Regulatory System of Implementing Regulations (IRs) under **Part-OPS** has been developed, **EU-OPS** will be repealed. The target date for this further and final transition has been set in 2012. Part-OPS will cover the air operation of all aircraft except tilt-rotor, airships and UAVs.*

3.2.1 EU-OPS

EU-OPS regulation defines aircraft performance subsequently:

Subpart G - Performance class A

An operator shall ensure that multi-engine aeroplanes powered by turbo propeller engines with a maximum approved passenger seating configuration of more than 9 or a maximum take-off mass exceeding 5700 kg, and all multi-engine turbojet powered aeroplanes are operated in accordance with Subpart G (Performance Class A).
Aircraft according to SAT-Rdmp: ACT and ACJ

Subpart H – Performance class B

An operator shall ensure that propeller driven aeroplanes with a maximum approved passenger seating configuration of nine or less, and a maximum take-off mass of 5700 kg or less are operated in accordance with Subpart H (Performance Class B).
Aircraft according to SAT-Rdmp: ACP and ACT

Subpart I – Performance class C

An operator shall ensure that aeroplanes powered by reciprocating engines with a maximum approved passenger seating configuration of more than nine or a maximum take-off mass exceeding 5700 kg are operated in accordance with Subpart I (Performance Class C).
Aircraft according to SAT-Rdmp: ACP

EU-OPS is an operation regulation which must be followed by all operators of commercial air transport in Europe with any aircraft fleet. The aircraft (ACJ, ACT, ACP) used for operating in SAT-Rdmp project must be operated according to individual paragraphs of EU-OPS regulation, however, for some of them there are some operation exceptions in this regulation “facilitating their operation“. The regulation was analysed for the individual aircraft according to their design parameters, which are: **number of seats, number and type of power units and MTOW.** The purpose of the information shown in the Subchapter **“EU-OPS“** is to facilitate orientation in this regulation for the operator so that he can operate individual categories of airplanes mentioned in Chapter 2 herein.

The important factors which will further influence the operation of the above mentioned aircraft classes in the SAT transport system are Subpart M – Airplane maintenance and Subpart Q – Flight and duty time limitations and rest requirements.

Subpart M – Aeroplane maintenance

An important factor influencing the operation of the above mentioned classes of airplanes is their maintenance It is very important to carry out airplane maintenance in a suitable way in given intervals which are shown in operation documentation of every airplane.

The airplane operator mustn't operate the airplane if its maintenance wasn't duly carried out in compliance with operation documentation of every airplane. After this maintenance the airplane must be released to operation, namely by organization which is duly authorized to perform maintenance or recognized according to Part-145 of such airplane type.
At the same time the requirements for maintenance of airplane airworthiness mentioned in Part-M must be met.

The so called "**Progressive methods of maintenance**" appear to be the most convenient way of aircraft maintenance in the SAT transport system. By means of these methods of maintenance it is assured that the airplane is used in the most effective way and that the minimum idle times of airplane are assured as well as the effort to minimize operation costs.

The use of various systems and diagnostic systems, which monitor actual conditions of given aircraft systems, is one of the key assumptions for utilization of these progressive methods of airplane maintenance.

This method of maintenance is divided as follows:

- Method of maintenance according to blocks
- Method of permanent maintenance
- Method of controlled reliability maintenance
    - Method of On-Condition maintenance
    - Method of Condition Monitoring maintenance

Licensing of persons for performing airplane maintenance according to Part-66 and that of organizations responsible for training these persons according to Part-147 are shown in Chapter 3.3 herein.

Subpart Q – Flight and duty time limitations and rest requirements

OPS 1.1100 - Flight and duty limitations
Cumulative duty hours
An operator shall ensure that the total duty periods to which a crew member is assigned do not exceed:
(a) 190 duty hours in any 28 consecutive days, and
(b) 60 duty hours in any seven consecutive days.

Limit on total block times
An operator shall ensure that the total block times of the flights on which an individual crew member is assigned as an operating crew member does not exceed

(a) 900 block hours in a calendar year;

(b) 100 block hours in any 28 consecutive days.

OPS 1.1105 - Maximum daily flight duty period (FDP)

- this OPS does not apply to single pilot operations
- the maximum basic daily FDP is 13 hours

- these 13 hours will be reduced by 30 minutes for each sector from the third sector onwards with a maximum total reduction of two hours
- the maximum daily FDP can be extended by up to one hour, but extensions are not allowed for a basic FDP of six sectors or more
- the maximum number of extensions is two in any seven consecutive days
- where an FDP is planned to use an extension pre and post flight minimum rest is increased by two hours or post flight rest only is increased by four hours
- when an FDP with extension starts in the period 22.00 to 04.59 the operator will limit the FDP to 11.45

OPS 1.1110 – Rest

- the minimum rest which must be provided before undertaking a flight duty period starting at home base shall be at least as long as the preceding duty period or 12 hours whichever is the greater
- the minimum rest which must be provided before undertaking a flight duty period starting away from home base shall be at least as long as the preceding duty period or 10 hours whichever is the greater; when on minimum rest away from home base, the operator must allow for an eight hour sleep opportunity taking due account of travelling and other physiological needs;

Performance Class A – SAT-Rdmp aeroplanes ACJ and ACT

Subpart D Operational procedures

OPS 1.192 – Terminology

(f) Isolated airport. If acceptable to the Authority, the destination airport can be considered as an isolated airport, if the fuel required (diversion plus final) to the nearest adequate destination alternate airport is more than:

For aeroplanes with turbine engines, fuel to fly for two hours at normal cruise consumption above the destination airport, including final reserve fuel.

OPS 1.245 – Maximum distance from an adequate airport for two-engine aeroplanes without an ETOPS approval

(a) Unless specifically approved by the Authority in accordance with OPS 1.246 (a) (ETOPS approval), an operator shall not operate a two-engine aeroplane over a route which contains a point further from an adequate airport (under standard conditions in still air) than, in the case of:

2. Performance Class A aeroplanes with:

(i) a maximum approved passenger seating configuration of 19 or less; and

(ii) a maximum take-off mass less than 45 360 kg, the distance flown in 120 minutes or, if approved by the Authority, up to 180 minutes for turbo-jet aeroplanes, at the one-engine-inoperative cruise speed determined in accordance with subparagraph (b) below;

Appendix 1 to OPS 1.255

<u>Fuel policy</u>

An operator must base the company fuel policy, including calculation of the amount of fuel to be on board for departure, on the following planning criteria:

1.5. Final reserve fuel, which shall be:

(b) for aeroplanes with turbine engines, fuel to fly for 30 minutes at holding speed at 1 500 ft (450 m) above airport elevation in standard conditions, calculated with the estimated mass on arrival at the destination alternate airport or the destination airport, when no destination alternate airport is required.

3. Pre-determined point (PDP) procedure If an operator's fuel policy includes planning to a destination alternate airport where the distance between the destination airport and the destination alternate airport is such that a flight can only be routed via a predetermined point to one of these airports, the amount of usable fuel, on board for departure, shall be the greater of 3.1 or 3.2 below:

3.1. The sum of:

(d) additional fuel if required, but not less than:

(ii) for aeroplanes with turbine engines, fuel to fly for two hours at normal cruise consumption above the destination airport. This shall not be less than final reserve fuel; and

3.2. The sum of:

(d) additional fuel if required, but not less than:

(ii) For aeroplanes with turbine engines: fuel to fly for 30 minutes at holding speed at 1 500 ft (450 m) above the destination alternate airport elevation in standard conditions. This shall not be less than final reserve fuel

Subpart J Mass and balance

OPS 1.620 - Mass values for passengers and baggage
(e) Mass values for passengers — 19 seats or less.
1. Where the total number of passenger seats available on an aeroplane is 19 or less, the standard masses in Table are applicable.

Passenger seats	1-5	6-9	10-19
Male	104 kg	96 kg	92 kg
Female	86 kg	78 kg	74 kg
Children	35 kg	35 kg	35 kg

2. On flights where no hand baggage is carried in the cabin or where hand baggage is accounted for separately, 6 kg may be deducted from the below male and female masses. Articles such as an overcoat, an umbrella, a small handbag or purse, reading material or a small camera are not considered as hand baggage for the purpose of this subparagraph.

(f) Mass values for baggage
1. For aeroplanes with 19 passenger seats or less, the actual mass of checked baggage, determined by weighing, must be used.

Appendix 1 to OPS 1.620 (g)

Procedure for establishing revised standard mass values for passengers and baggage

(c) Determination of revised standard mass values for passengers and checked Baggage
3. On smaller aeroplanes, the following increments must be added to the average passenger mass to obtain the revised standard mass values:

Number of passenger seats	Required mass increment
1-5 inclusive	16 kg
6-9 inclusive	8 kg
10-19 inclusive	4 kg

Subpart K Instruments and equipment

Aircraft must be operated according to all instruments and equipment see EU-OPS Subpart K.

Subpart L Communication and navigation equipment

The aircraft operator must operate the aircraft with:

- the radio which is prescribed for the given kind of operation and also enables connection on distress aviation frequency 121.5 MHz (OPS 1.850)
- the panelem of selector of l.f. outputs in the case of IFR flights, namely with access for each member of the crew. (OPS 1.855)
- the aircraft must have necessary radio equipment for operation according to VFR on the routs with references according to visible checking points (OPS 1.860)
- on the routes for operation according to IFR or VFR, where navigation with reference to visible checking points is not possible, the aircraft must be equipped with appropriate communication and navigation equipment. (OPS 1.865)
- The aircraft must operate with responder SSR which is able to report pressure altitude and further parameters needed for relevant routes (OPS 1.866)
- The aircraft must operate in the areas with prescribed minimum navigation performances (MNPS) with additional navigation equipment (OPS 1.870)

Subpart N Flight crew

OPS 1.940 - Composition of flight crew

(b) Minimum flight crew for operations under IFR or at night. For operations under IFR or at night, an operator shall ensure that:

1. for all turbo-propeller aeroplanes with a maximum approved passenger seating configuration of more than nine and for all turbo-jet aeroplanes, the minimum flight crew is two pilots

Subpart O Cabin crew

OPS 1.990 - Number and composition of cabin crew

(a) An operator shall not operate an aeroplane with a maximum approved passenger seating configuration of more than 19, when carrying one or more passengers, unless at least one cabin crew member is included in the crew for the purpose of performing duties, specified in the Operations Manual, in the interests of the safety of passengers.

Subpart P Manuals, logs and records

All amendments and revisions in Operations Manual must be done in comply with the Air Operator Certificate (AOC) or any applicable regulations. An operator shall ensure that the Operations Manual is amended or revised so that the instructions and information contained therein are kept up to date. Particular flight information must be saved in logbook. An operator shall ensure that all records and all relevant operational and technical information for each individual flight, are stored for the periods prescribed in Appendix 1 to OPS 1.1065.

Subpart S Security

OPS 1.1255 - Flight crew compartment security

Airplanes ACJ and ACT do not have to have pilot’s cockpit door with possibility of locking and unlocking from both pilot places.

Performance Class B – SAT-Rdmp aeroplanes ACT and ACP

Subpart B General

<u>*General*</u>

OPS 1.005 - For operations of Performance ***Class B aeroplanes***, alleviated requirements can be found in **Appendix 1 to OPS 1.005(a)**.

Appendix 1 to OPS 1.005

OPS 1.035 - Quality System: In the case of a very small operator, the post of Quality Manager may be held by a nominated postholder if external auditors are used. This applies also where the accountable manager is holding one or several of the nominated posts.

OPS 1.075 - Methods of carriage of persons: Not required for VFR operations of single engine aeroplanes.

OPS 1.100 - Admission to the flight deck:

(i) An operator must establish rules for the carriage of passengers in a pilot seat.

(ii) The commander must ensure that:

A. carriage of passengers in a pilot seat does not cause distraction and/or interference with the operation of the flight; and

B. the passenger occupying a pilot seat is made familiar with the relevant restrictions and safety procedures.

OPS 1.105 - Unauthorised Carriage: Not required for VFR operations of single engine aeroplanes.

OPS 1.135 - Additional information and forms to be carried:

(ii) For A to B VFR operations of single engine aeroplanes by day, notification of special categories of passengers as described in OPS 1.135 (a)(7) does not need to be carried.

(iii) For A to B VFR operations by day, the operational flight plan may be in a simplified form and must meet the needs of the type of operation.

OPS 1.215 - Use of Air Traffic Services: For VFR operations of single engine aeroplanes by day, non mandatory contact with ATS shall be maintained to the extent appropriate to the nature of the operation. Search and rescue services must be ensured in accordance with OPS 1.300.

OPS 1.225 - Airport Operating Minima: For VFR operations, the standard VFR operating minima will normally cover this requirement. Where necessary, the operator shall specify additional requirements taking into account such factors as radio coverage, terrain, nature of sites for take-off and landing, flight conditions and ATS capacity.

OPS 1.235 - Noise abatement procedures: Not applicable to VFR operations of single engine aeroplanes.

OPS 1.250 - Establishment of minimum flight altitudes:

For VFR operations by day, this requirement is applicable as follows. An operator shall ensure that operations are only conducted along such routes or within such areas for which a safe terrain clearance can be maintained and shall take account of such factors as temperature, terrain, unfavourable meteorological conditions (e.g. severe turbulence and descending air currents, corrections for temperature and pressure variations from standard values).

OPS 1.255 - Fuel Policy:

(ii) For A to B Flights — An operator shall ensure that the pre-flight calculation of usable fuel required for a flight includes;

(A) Taxi fuel — Fuel consumed before take-off, if significant; and

(B) Trip fuel (Fuel to reach the destination); and

(C) Reserve fuel –

1. Contingency fuel — Fuel that is not less than 5 % of the planned trip fuel or, in the event of in-flight re-planning, 5 % of the trip fuel for the remainder of the flight; and

2. Final reserve fuel — Fuel to fly for an additional period of 45 minutes (piston engines) or 30 minutes (turbine engines); and

(D) Alternate fuel — Fuel to reach the destination alternate via the destination, if a destination alternate is required; and

(E) Extra fuel — Fuel that the commander may require in addition to that required under subparagraphs (A)-(D) above.

OPS 1.265 - Carriage of inadmissible passengers, deportees or persons in custody: For VFR operations of single engine aeroplanes and where it is not intended to carry inadmissible passengers, deportees or persons in custody, an operator is not required to establish procedures for the carriage of such passengers.

OPS 1.280 - Passenger Seating: Not Applicable to VFR operations of single engine aeroplanes.

OPS 1.285 - Passenger Briefing: Demonstration and briefing shall be given as appropriate to the kind of operations. In single pilot operations, the pilot may not be allocated tasks distracting him/her from his/her flying duties.

OPS 1.290 - Flight Preparation:

(ii) A to B operations under VFR by day — An operator shall ensure that a simplified form of an operational flight plan which is relevant to the type of operation is completed for each flight.

OPS 1.295 - Selection of airports: Not applicable to VFR operations. The necessary instructions for the use of airports and sites for takeoff and landing are to be issued with reference to OPS 1.220.

OPS 1.310 - Crew members at stations:

For VFR operations, instructions on this matter are required only where two pilot operations are conducted.

OPS 1.375 - In-flight fuel management:

Appendix 1 to OPS 1.375 is not required to be applied to VFR operations of single engine aeroplanes by day.

OPS 1.405 - Commencement and continuation of approach:

Not applicable to VFR operations.

OPS 1.410 - Operating procedures — threshold crossing height:

Not applicable to VFR operations.

OPS 1.430 to 1.460, including appendices:

Not applicable to VFR operations.

OPS 1.530 - Take-off:

(i) Subparagraph (a) applies with the following addition. The Authority may, on a case-by-case basis, accept other performance data produced by the operator and based on demonstration and/or documented experience. Subparagraphs (b) and (c) apply with the following addition. Where the requirements of this paragraph cannot be complied with due to physical limitations relating to extending the runway and there is a clear public interest and necessity for the operation, the Authority may accept, on a case by-case basis, other performance data, not conflicting with the Aeroplane Flight Manual relating to special procedures, produced by the operator based on demonstration and/or documented experience.

(ii) An operator wishing to conduct operations according to subparagraph (i) must have the prior approval of the Authority issuing the AOC. Such an approval will:
(A) specify the type of aeroplane;
(B) specify the type of operation;
(C) specify the airport(s) and runways concerned;
(D) restrict the take-off to be conducted under VMC;
(E) specify the crew qualification, and
(F) be limited to aeroplanes where the first type certificate was first issued before 1 January 2005.

(iii) The operation must be accepted by the State in which the airport is located.

OPS 1.535 - Take-off Obstacle Clearance — Multi-Engined aeroplanes:

(i) Subparagraphs (a)(3), (a)(4), (a)(5), (b)(2), (c)(1), (c)(2) and the Appendix are not applicable to VFR operations by day.
(ii) For IFR or VFR operations by day, subparagraphs (b) and (c) apply with the following variations.
(A) Visual course guidance is considered available when the flight visibility is 1 500 m or more
(B) The maximum corridor width required is 300 m when flight visibility is 1 500 m or more.

OPS 1.545 - Landing — destination and alternate airports:

(i) The paragraph applies with the following addition. Where the requirements of this paragraph cannot be complied with due to physical limitations relating to extending the runway and there is a clear public interest and operational necessity for the operation, the Authority may accept, on a case-by-case basis, other performance data, not conflicting with the Aeroplane Flight Manual relating to special procedures, produced by the operator based on demonstration and/or documented experience.

(ii) An operator wishing to conduct operations according to subparagraph (I) must have prior approval of the Authority issuing the AOC. Such an approval will:

(A) specify the type of aeroplane;
(B) specify the type of operation;
(C) specify the airport(s) and runways concerned;
(D) restrict the final approach and landing to be conducted under VMC;
(E) specify the crew qualification, and
(F) be limited to aeroplanes where the type certificate was first issued before 1 January 2005.

(iii) The operation must be accepted by the State in which the airport is located.

OPS 1.550 - Landing — dry runways:

(i) The paragraph applies with the following addition. Where the requirements of this paragraph cannot be complied with due to physical limitations relating to extending the runway and there is a clear public interest and operational necessity for the operation, the Authority may accept, on a case-by-case basis, other performance data, not conflicting with the Aeroplane Flight Manual relating to special procedures, produced by the operator based on demonstration and/or documented experience.

(ii) An operator wishing to conduct operations according to subparagraph (i) must have prior approval of the Authority issuing the AOC. Such an approval will:

(A) specify the type of aeroplane;
(B) specify the type of operation;
(C) specify the airport(s) and runways concerned;
(D) restrict the final approach and landing to be conducted under VMC;
(E) specify the crew qualification; and
(F) be limited to aeroplanes where the first type certificate was issued before 1 January 2005.

(iii) The operation must be accepted by the State in which the airport is located.

OPS 1.650 - Day VFR operations:

Paragraph 1.650 is applicable with the following addition. Single engine aeroplanes, first issued with an individual certificate of airworthiness before 22 May 1995, may be exempted from the requirements of subparagraphs (f), (g), (h) and (i) by the Authority if the fulfilment would require retrofitting.

Part M, paragraph M.A.704, Continuing Airworthiness Management Exposition:

The Continuing Airworthiness Management Exposition may be adapted to the operation to be conducted;

Part M, paragraph M. A. 306, Operator's technical log system:

The Authority may approve an abbreviated form of technical log system, relevant to the type of operation conducted.

OPS 1.940 - Composition of Flight Crew:

Subparagraphs (a)(2), (a)(4), and (b) are not applicable to VFR operations by day, except that (a)(4) must be applied in full where two pilots are required by OPS 1.

OPS 1.945 - Conversion training and checking:

(i) Subparagraph (a)(7) — Line flying under supervision (LIFUS) may be performed on any aeroplane within the applicable class. The amount of LIFUS required is dependent on the complexity of the operations to be performed.

(ii) Subparagraph (a)(8) is not required.

OPS 1.955 - Nomination as commander:

Subparagraph (b) applies as follows. The Authority may accept an abbreviated command course relevant to the type of operation conducted.

OPS 1.960 - Commanders holding a Commercial Pilot Licence: Subparagraph (a)(1)(i) is not applicable to VFR operations by day.

OPS 1.968 - Pilot qualification for either pilot's seat:

Appendix 1 is not applicable to VFR operations of single engine aeroplanes by day.

OPS 1.975 - Route and airport competence:

(i) For VFR operations by day, subparagraphs (b), (c) and (d) are not applicable, except that the operator shall ensure that in the cases where a special approval by the state of the airport is required, the associated requirements are observed.
(ii) For IFR operations or VFR operations by night, as an alternative to subparagraphs (b) to (d), route and airport competence may be revalidated as follows:
(A) Except for operations to the most demanding airports, by completion of at least 10 sectors within the area of operation during the preceding 12 months in addition to any required self briefing.
(B) Operations to the most demanding airports may be performed only if:
1. the commander has been qualified at the airport within the preceding 36 months by a visit as an operating flight crew member or as an observer;
2. the approach is performed in VMC from the applicable minimum sector altitude; and
3. an adequate self briefing has been made prior to the flight

OPS 1.980 - More than one type or variant:
(i) Not applicable if operations are limited to single pilot classes of piston engine aeroplanes under VFR by day.
(ii) For IFR and VFR Night Operations, the requirement in Appendix 1 to OPS 1.980, subparagraph (d)(2)(i) for 500 hours in the relevant crew position before exercising the privileges of two licence endorsements, is reduced to 100 hours or sectors if one of the endorsements is related to a class. A check flight must be completed before the pilot is released for duties as Commander.

OPS 1.981 - Operation of helicopters and aeroplanes:
Subparagraph (a)(1) is not applicable if operations are limited to single pilot classes of piston engine aeroplanes.

OPS 1.1060 - Operational flight plan:
Not required for A to A VFR/Day operations. For A to B VFR/Day operations the requirement is applicable but the flight plan may be in a simplified form relevant to the kind of operations conducted. (see OPS 1.135).

OPS 1.1070 - Continuing Airworthiness Management Exposition:
The Continuing Airworthiness Management Exposition may be adapted to the operation to be conducted.

OPS 1.1071 - Aeroplane technical log:
Applicable as indicated for Part M, paragraph M. A. 306 Operators technical log system.

OPS 1.1240 - Training programmes:
The training programmes shall be adapted to the kind of operations performed. A self-study training programme may be acceptable for VFR operations.

OPS 1.1250 - Aeroplane search procedure checklist:
Not applicable for VFR operations by day.

Subpart D Operational procedures

OPS 1.192 – Terminology
(f) Isolated airport. If acceptable to the Authority, the destination airport can be considered as an isolated airport, if the fuel required (diversion plus final) to the nearest adequate destination alternate airport is more than:
For aeroplanes with turbine engines, fuel to fly for two hours at normal cruise consumption above the destination airport, including final reserve fuel.

OPS 1.245 - Maximum distance from an adequate airport for two-engined aeroplanes without an ETOPS approval
(a) Unless specifically approved by the Authority in accordance with OPS 1.246 (a) (ETOPS approval), an operator shall not operate a two-engined aeroplane over a route which contains a point further from an adequate airport (under standard conditions in still air) than, in the case of:
(i) The distance flown in 120 minutes at the one-engine-inoperative cruise speed determined in accordance with subparagraph (b) below; or

(ii) 300 nautical miles, whichever is less.

Appendix 1 to OPS 1.255

<u>Fuel policy</u>

An operator must base the company fuel policy, including calculation of the amount of fuel to be on board for departure, on the following planning criteria:

1.5. Final reserve fuel, which shall be:
(a) for aeroplanes with reciprocating engines, fuel to fly for 45 minutes

3.Pre-determined point (PDP) procedure If an operator's fuel policy includes planning to a destination alternate airport where the distance between the destination airport and the destination alternate airport is such that a flight can only be routed via a predetermined point to one of these airports, the amount of usable fuel, on board for departure, shall be the greater of 3.1 or 3.2 below:

3.1. The sum of:
(d) additional fuel if required, but not less than:
(i) for aeroplanes with reciprocating engines, fuel to fly for 45 minutes plus 15 % of the flight time planned to be spent at cruising level or two hours, whichever is less; or
(ii) for aeroplanes with turbine engines, fuel to fly for two hours at normal cruise consumption above the destination airport. This shall not be less than final reserve fuel; and

3.2. The sum of:
(d) additional fuel if required, but not less than:
(i) For aeroplanes with reciprocating engines: fuel to fly for 45 minutes; or
(ii) For aeroplanes with turbine engines: fuel to fly for 30 minutes at holding speed at 1 500 ft (450 m) above the destination alternate airport elevation in standard conditions. This shall not be less than final reserve fuel

Subpart J Mass and Balance

OPS 1.620 - Mass values for passengers and baggage

(e) Mass values for passengers — 19 seats or less.

1. Where the total number of passenger seats available on an aeroplane is 19 or less, the standard masses in Table are applicable.

Passenger seats	1-5	6-9	10-19
Male	104 kg	96 kg	92 kg
Female	86 kg	78 kg	74 kg
Children	35 kg	35 kg	35 kg

2. On flights where no hand baggage is carried in the cabin or where hand baggage is accounted for separately, 6 kg may be deducted from the below male and female masses. Articles such as an overcoat, an umbrella, a small handbag or purse, reading material or a small camera are not considered as hand baggage for the purpose of this subparagraph.

Appendix 1 to OPS 1.620 (g)

Procedure for establishing revised standard mass values for passengers and baggage

(c) Determination of revised standard mass values for passengers and checked Baggage
3. On smaller aeroplanes, the following increments must be added to the average passenger mass to obtain the revised standard mass values:

Number of passenger seats	Required mass increment
1-5 inclusive	16 kg
6-9 inclusive	8 kg
10-19 inclusive	4 kg

Subpart K Instruments and equipment

Except the standard equipment that is stated in EU-OPS regulation and which is obligatory for all performance classes of aircraft, this performance class (Class B) doesn´t have to be (can be) operated with certain instruments and equipment in comparison with Classes A and C:

The aircraft operator must operate the aircraft with:

- the operator must operate the aircraft in the day time with the system of anticollision lights, with lighting that ensures lighting of all instruments and passenger compartments from electrical network of the aircraft, lamp for each member of the crew. For flights at night the aircraft must be, in addition to this, equipped with position navigation lights, two landing head-lights or one head-light which has two independently powered fibres (OPS 1.640)
- autopilot with the mode of automatic maintenance of altitude and flight course at one-pilot operation under IFR conditions (OPS 1.655)
- valid certification and given equipment for operation in possible icing conditions (OPS 1.675)
- system of board phone of the flight crew in the case when there is more than one pilot in the flight crew (OPS 1.685)
- the voice recorder which must be able to record 30 minutes of flight as a minimum (OPS 1.700 b), 1.705 and 1.710)
- so that the aicraft is able to keep the length of record in the flight data recorder at least 10 hours (OPS 1.715 b) (for more details see Supplement 1 to OPS 1.715, table A2)
- in accordance with OPS 1.730, seat equipment, two-point belts, multipoint belts and children seat belts
- signalization "Fasten your safety belts" and "No smoking" in the case when it is not possible to see all the passenger seats from the pilot compartment OPS 1.731)
- at least one first aid kit (OPS 1.745)
- additional supply of oxygen and deliver prescribed quantity of oxygen at altitudes above 10 000 ft if the aircraft has an unpressurized cabin (OPS 1.775) (for more details see Supplement 1 to OPS 1.775, table 1)
- one suitably located hand extinguisher in the passenger compartmentí (OPS 1.790 e)
- marking of the places for penetrating the aircraft fuselage (OPS 1.800)
- emergency lights supplied from the independent source in the case of more than 9 passengers (emergency lighting is for easier evacuation) (OPS 1.815 a) and the aircraft mustn´t be operated at night with max number of approved seats for passengers 9 and less if it is not equipped with power source of total cabin lighting for facilitation of aircraft evacuation (OPS 1.815 b)
- one automatic position beacon ELT (applied in case of air crash) (OPS 1.820)
- the aircraft must be equipped with life jackets in the case that the landplane is operated which flies over water for the distance more than 50 NM from the coast and/or in the case when the aircraft takes off or lands at the airport where the takeoff and landing paths on RWY are directed over water so that it would be probable to land on water in case of an aircraft accident (OPS 1.825)
- The aircraft must operate under conditions OPS 1.830 in the case that it performs distance flights over water

The aircraft operator can/ doesn´t have to operate the aircraft with:

- the windshield wiper (OPS 1.645)
- the heated pitot tube, at daily VFR operation, or means preventing from incorrect activity due to condensation or icing (OPS 1.650 l 1))
- The aircraft can operate with one system of static presure, one standby source of static presure (OPS 1.652 j) and the aircraft doesn´t have to be equipped with independent standby indicator of flight position (gyro horizon), which can be used from both pilot seats (OPS 1.652 l)
- The aircraft can operate without the system of set altitude signalization (OPS 1.660)
- The aircraft can operate even without the system of dangerous ground proximity signalization GPWS and the warning system of dangerous proximity of terrain (OPS 1.665)
- The aicraft can operate without board anticollision system ACAS II (OPS 1.668)
- The aircraft doesn´t have to be equipped with board meteorological radar (OPS 1.670), system of board phone of the crew (OPS 1.690), board announcement system, (OPS 1.695)
- If the aircraft is equipped with a voice recorder in the cockpit and a flight data recorder, these can be replaced by one combined recorder (OPS 1.727)
- The aircraft doesn´t have to operate with a lockable door with the plate ”For crew only“ between the cockpit and the passenger compartment (OPS 1.735 a)
- The aircraft doesn´t have to operate with the first aid kit (OPS 1.755)
- The aircraft doesn´t have to operate with oxygen for the first aid (OPS 1.760)
- The aircraft can operate without protective equipment of eyes, nose and mouth serving for oxygen supply for at least 15 min. Namely for crew members in the pilot compartment and for stewards (OPS 1.780 a) 1, 2)
- The aircraft doesn´t have to operate with an emergency axe or a crowbar (OPS 1.795)
- The aircraft doesn´t have to operate with a megaphone (OPS 1.810)
- The aircraft can operate in areas in which searching and rescuing were especially difficult (it must be equipped at least with ELT) (OPS 1.835)

Subpart L Communication and navigation equipment

The aircraft operator must operate the aircraft with:

- the radio which is prescribed for the given kind of operation and also enables connection on distress aviation frequency 121.5 MHz (OPS 1.850)
- the panelem of selector of l.f. outputs in the case of IFR flights, namely with access for each member of the crew. (OPS 1.855)
- the aircraft must have necessary radio equipment for operation according to VFR on the routs with references according to visible checking points (OPS 1.860)
- on the routes for operation according to IFR or VFR, where navigation with reference to visible checking points is not possible, the aircraft must be equipped with appropriate communication and navigation equipment. (OPS 1.865)
- The aircraft must operate with responder SSR which is able to report pressure altitude and further parameters needed for relevant routes (OPS 1.866)
- The aircraft must operate in the areas with prescribed minimum navigation performances (MNPS) with additional navigation equipment (OPS 1.870)

Subpart N Flight crew

The aircraft can operate with the minimum flight crew for IFR operation or at night with one pilot only, if the requirements from Supplement 2, to OPS 1.940 are met. If not, the crew must consist of two pilots as a minimum (OPS 1.940 b). As for crew weight, the following is applied:
pilots 85 kg and steward 75 kg.
According to Supplement 1 to OPS 1.005 a) Operation of class B aircraft

- *para 31) to part: OPS 1.940 Structure of flight crew, for VFR operation by day the paragraphs* a) 2, a) 4 a b) from regulation OPS 1.940 are not applied, but if two pilots are required according to OPS 1, para a)4 must be applied in full wording.
- *para 32) to part OPS 1.945 Retraining and testing,* para a) 7 route flights can be carried out under supervision (LIFUS) on any aircraft of applicable class and para a) 8 isn´t required at all.

- *para 33) to part OPS 1.955 Nomination for the function of aircraft captain,* para b) is used, namely in such a way that the authority can recognize the captain course reduction. This approval must be in dependence on the kind of performed operation.
- *para 34) to part OPS 1.960 Aircraft captains with certificate of commercial pilot qualification, not applied for* VFR operation by day, para a) 1 i)
- *para 35) to part OPS 1.965 Refresher training and testing, para a*) 1, a) 3 ii), a) 4 i), b) 2, which are used in a given wording to the part of OPS 1.965 of this aircraft category.
- *para 37) to part OPS 1.975 Route and airport qualifications are paragraphs* b), c), d), which are used in a given wording to the part of OPS 1.975 of this aircraft category
- *para 38) to part OPS 1.980 Flying on more types or variants, the requirement for* IFR and VFR operation, which is shown in Supplement 1 to OPS 1.980 para d) 2 i) utilization of rights of two confirmations, two successive verifications of professional qualification by the operator and flown 500 hours in appropriate functions in the crew, namely at commercial flights at the same operator, are reduced to 100 flown hours in the case that one confirmation is related to the class. Before taking over duties it is needed to perform the check flight.

Subpart O Cabin crew

OPS 1.990 - Number and composition of cabin crew

(a) An operator shall not operate an aeroplane with a maximum approved passenger seating configuration of more than 19, when carrying one or more passengers, unless at least one cabin crew member is included in the crew for the purpose of performing duties, specified in the Operations Manual, in the interests of the safety of passengers.

Subpart P Manuals, logs and records

All amendments and revisions in Operations Manual must be done in comply with the Air Operator Certificate (AOC) or any applicable regulations. An operator shall ensure that the Operations Manual is amended or revised so that the instructions and information contained therein are kept up to date. Particular flight information must be saved in logbook. An operator shall ensure that all records and all relevant operational and technical information for each individual flight, are stored for the periods prescribed in Appendix 1 to OPS 1.1065.

According to Supplement 1 to OPS 1.005 a) Operation of Class B aircraft

- *para 42) to part OPS 1.1070 Interpretation of airworthiness maintenance management can be modified for the operation for which it should be carried out*
- *para 43) to part OPS 1.1071 Technical logbook of the aircraft, keeping the technical logbook of the operator is used as shown in part* M, para M.A. 306

Subpart S Security

OPS 1.1255 - Flight crew compartment security

Airplanes ACJ and ACT do not have to have pilot’s cockpit door with possibility of locking and unlocking from both pilot places.

- *para 46) to the part of OPS 1.1240 Training programs* must be modified according to the kind of performed operation. For VFR operation the independent training program is acceptable.
- *para 47) to the part of OPS 1.1250 Check list of procedures of aircraft searching will not be used by day for* VFR operation of the aircraft.

Performance Class C – SAT-Rdmp aeroplanes ACP

Subpart D Operational procedures

OPS 1.192 – Terminology
(f) Isolated airport. If acceptable to the Authority, the destination airport
can be considered as an isolated airport, if the fuel required (diversion plus final) to the nearest adequate destination alternate airport is more than:
For aeroplanes with reciprocating engines, fuel to fly for 45 minutes plus 15 % of the flight time planned to be spent at cruising level or two hours, whichever is less.

Appendix 1 to OPS 1.255

Fuel policy
An operator must base the company fuel policy, including calculation of the amount of fuel to be on board for departure, on the following planning criteria:

1.5. Final reserve fuel, which shall be:
(a) for aeroplanes with reciprocating engines, fuel to fly for 45 minutes

3. Pre-determined point (PDP) procedure
If an operator's fuel policy includes planning to a destination alternate airport where the distance between the destination airport and the destination alternate airport is such that a flight can only be routed via a predetermined point to one of these airports, the amount of usable fuel, on board for departure, shall be greater of 3.1 or 3.2 below:

3.1. The sum of:
(d) additional fuel if required, but not less than:
(i) for aeroplanes with reciprocating engines, fuel to fly for 45 minutes plus 15 % of the flight time planned to be spent at cruising level or two hours, whichever is less

3.2. The sum of:
(d) additional fuel if required, but not less than:
(i) For aeroplanes with reciprocating engines: fuel to fly for 45 minutes;

Subpart J Mass and balance

OPS 1.620 - Mass values for passengers and baggage
(e) Mass values for passengers — 19 seats or less.
1. Where the total number of passenger seats available on an aeroplane is 19 or less, the standard masses in Table are applicable.

Passenger seats	1-5	6-9	10-19
Male	104 kg	96 kg	92 kg
Female	86 kg	78 kg	74 kg
Children	35 kg	35 kg	35 kg

2. On flights where no hand baggage is carried in the cabin or where hand baggage is accounted for separately, 6 kg may be deducted from the below male and female masses. Articles such as an overcoat, an umbrella, a small handbag or purse, reading material or a small camera are not considered as hand baggage for the purpose of this subparagraph.

Appendix 1 to OPS 1.620 (g)

Procedure for establishing revised standard mass values for passengers and baggage

(c) Determination of revised standard mass values for passengers and checked Baggage
3. On smaller aeroplanes, the following increments must be added to the average passenger mass to obtain the revised standard mass values:

Number of passenger seats	Required mass increment

1-5 inclusive	16 kg
6-9 inclusive	8 kg
10-19 inclusive	4 kg

Subpart K Instruments and equipment

Aircraft must be operated according to all instruments and equipment see EU-OPS Subpart K.

Subpart L Communication and navigation equipment

The aircraft operator must operate the aircraft with:

- the radio which is prescribed for the given kind of operation and also enables connection on distress aviation frequency 121.5 MHz (OPS 1.850)
- the panelem of selector of l.f. outputs in the case of IFR flights, namely with access for each member of the crew. (OPS 1.855)
- the aircraft must have necessary radio equipment for operation according to VFR on the routs with references according to visible checking points (OPS 1.860)
- on the routes for operation according to IFR or VFR, where navigation with reference to visible checking points is not possible, the aircraft must be equipped with appropriate communication and navigation equipment. (OPS 1.865)
- The aircraft must operate with responder SSR which is able to report pressure altitude and further parameters needed for relevant routes (OPS 1.866)
- The aircraft must operate in the areas with prescribed minimum navigation performances (MNPS) with additional navigation equipment (OPS 1.870)

Subpart N Flight crew

OPS 1.940 - Composition of flight crew

(b) Minimum flight crew for operations under IFR or at night. For operations under IFR or at night, an operator shall ensure that:

1. for all turbo-propeller aeroplanes with a maximum approved passenger seating configuration of more than nine and for all turbo-jet aeroplanes, the minimum flight crew is two pilots

Subpart O Cabin crew

OPS 1.990 - Number and composition of cabin crew

(a) An operator shall not operate an aeroplane with a maximum approved passenger seating configuration of more than 19, when carrying one or more passengers, unless at least one cabin crew member is included in the crew for the purpose of performing duties, specified in the Operations Manual, in the interests of the safety of passengers.

Subpart P Manuals, logs and records

All amendments and revisions in Operations Manual must be done in comply with the Air Operator Certificate (AOC) or any applicable regulations. An operator shall ensure that the Operations Manual is amended or revised so that the instructions and information contained therein are kept up to date. Particular flight information must be saved in logbook. An operator shall ensure that all records and all relevant operational and technical information for each individual flight, are stored for the periods prescribed in Appendix 1 to OPS 1.1065.

Subpart S Security

OPS 1.1255 - Flight crew compartment security

Airplanes ACJ and ACT do not have to have pilot’s cockpit door with possibility of locking and unlocking from both pilot places.

3.2.2 Risk Assessment for European Public Transport Operations using Single Engine Turbine Aircraft at Night and in IMC

This document contains rules of operation of **single engine turbine aircraft at night and IMC**. Recommendation presented in this document *„Risk Assessment for European Public Transport Operations using Single Engine Turbine Aircraft at Night and in IMC“* should take into account in case of design and certification of single engine turbine aircraft so that aircraft could be operated according to mentioned above conditions. Purpose of this document is minimizing presumption of occurrence of accident in case of engine failure in whichever flight stadium.

Note: EASA has put Commercial Air transportation aeroplane operations Single Engine IMC as a part of the rulemaking programme 2012-2015.

In summary, the Working Group set up QinetiQ for risk task, proposed that the target fatal accident rate for SET operations in Europe should by $4.0x10^{-6}$ to better reflect current occupational health and safety expectations for aircrew. This should encompass SE-IMC operations if approved

Summary of engine failure or shut down events for UK GA in the period February 06 to February 07:

Aircraft category	Number of engine failure or shut down events	On airfield landings no damage	On airfield landings with damage	Off airfield landings No damage	Off airfield landings with damage
Single engine piston	24	4	2 minor injures	6	12 2 with minor injuries, 1 with serious injuries
Multi engine piston	14	14	-	-	-
Twin engine turbine	7	7	-	-	-

The conditions minimizing presumption occurrence of accident in case of engine failure are mentioned in chapter 3 “Risk Mitigation”:

- Minimising the risk of engine failure and thrust loss
  - The power plant and installation
  - Fuel system
- Maintenance of essential services following engine failure
  - Electrical
  - Flight Instrument, warning devices and checklist
  - Lighting
  - Services
  - Environmental
  - Navigation
- Demonstration that essential services can be maintained
- Navigation aids
- Aircraft handling
- Airfield facilities
- Survivability consideration
- Operational planning

Chapter 4 „Forced landing consideration” is engaged in reaching (non-reaching) of airport in any flight stadium in case of engine failure and subsequent forced landing. At the same time this chapter is engaged in presumption of pilot proper work so that the aircraft safely landing.

Chapter 6 „Crew workload“ is engaged in setting of one or two pilots during above mentioned condition (night or IMC). Probability of accident occurrence (night or IMC operation) during engine failure is higher if the aircraft is controlled by one pilot instead of two pilots. If the aircraft is controlled by one pilot and proper automatic system during night or IMC conditions pilot stress is lower.

Chapter 7 „Training“ is engaged in training of crew during a night or IMC condition one-man (or two-seat) operation. Any applicant submitting a proposal to operate must include a proposal for initial and continuity training, utilising both simulator (if one exists) and actual flight experience.

Recommendations for applicant:

- analyse of risk engine failure for every route at what aircraft will operate and increase of force landing length about 200 ft during night or IMC condition
- prove of remove icing during engine failure in case of operation of aircraft in icing condition
- show that the risk of an unsuccessful forced landing following engine failure is more remote than $1.3x10^{-6}$ per flight hour, after that it is recommended that the route and the associated weather minima be approved.
- explain how de-confliction with other traffic is to be achieved when undertaking the risk assessment for specific routes, airfields and runways
- prove stalls with propeller feathered to determine the warning and stall characteristics with no propeller slipstream present
- undertake a static test in darkened cockpit when approving an aircraft type for SE-IMC. Demonstration made that the systems are adequate for the maximum duration of descent and that the crew has the information and facilities to safely and correctly execute an emergency landing.
- assess the vertical and horizontal navigation aids in flight under simulated IMC
- show convincing reasons, e.g. automation, why the workload can be managed by one pilot
- record in order to obtain statistical data to support expansion of this type of operation with simplified acceptance criteria
- prove that stall speed SET should not exceed 70 kt CAS in landing configuration, recommended stall speed is 61 kt during MDH 500 ft and visibility 1200 m. These values would have to be increased if higher stalling speeds and hence higher approach speeds were to be approved.
- operate the aircraft with crew of 2 pilots for SE-IMC. The applicant can show convincing reasons why the workload can be managed by one pilot.

In approving operations by single-engine turbine-powered aeroplanes at night and/or in IMC, the State of the Operator shall ensure that the airworthiness certification of the aeroplane is appropriate and that the overall level of safety intended by the provisions of Annexes 6 and 8 is provided by:
a) the reliability of the turbine engine;
b) the operator’s maintenance procedures, operating practices, flight dispatch procedures and crew training programmes; and
c) equipment and other requirements provided in accordance with Appendix 3.

All single-engine turbine-powered aeroplanes operated at night and/or in IMC shall have an engine trend monitoring system, and those aeroplanes for which the individual certificate of airworthiness is first issued on or after 1 January 2005 shall have an automatic trend monitoring system.

Conclusion:

Positive:

- It has positive influence on operation safety of single engine aircraft in case of engine failure not only at night condition or in IMC

Negative:

- Potential additional time, financial and administrative load for operators in case of proving of mentioned above aircraft capabilities within the scope of single engine aircraft operation at night or in IMC of SAT transportation system.

3.2.3 Analysis of Title 14 of the Code of Federal Regulations (14 CFR) Part 135 OPERATING REQUIREMENTS: COMMUTER AND ON DEMAND OPERATIONS AND RULES GOVERNING PERSONS ON BOARD SUCH AIRCRAFT

FAR 135 is regulation of American aviation authority FAA which defines operation requirements of the aircraft operator operating the aircraft regularly between two places or when it is required. This regulation also defines rules for persons handling such aircraft. If the operator operates the aircraft in the US territory, it is necessary to follow the rules which are given in this regulation. Off the US territory it will be governed by regulation Annex 2 or by aircraft regulations of a given country (§135.3).

The regulation is divided into so called Subparts as follows:

Subpart A General
Subpart B Flight Operations
Subpart C Aircraft and Equipment
Subpart D VFR/IFR Operating Limitations and Weather Requirements
Subpart E Flight Crewmember Requirements
Subpart F Crewmember Flight Time and Duty Period Limitations and Rest Requirements
Subpart G Crewmember Testing Requirements
Subpart H Training
Subpart I Airplane Performance Operating Limitations
Subpart J Maintenance, Preventive Maintenance and Alterations
Subpart K Hazardous Materials Training Program

The information from individual parts (Subpart) relating to aircraft categories, as shown herein in Chapter 2, will be included in the analysis of this regulation.

Subpart A General

Rules for authorized operators operating on request (§135.4)

- in part a) there are requirements (experience) relating to the aircraft crew, both pilots – captain and copilot

Aircraft requirements (§135.25)

- every operator operating the aircraft according to this regulation must have this aircraft registered as US civil aircraft and must have a valid certificate of airworthiness
- the operator can use the aircraft for transport of pasengers, mail (cargo), with corrresponding crew, registered in the country having valid international agreements in civil aviation and a valid certificate of airworthiness of the given country of registration

Subpart B Flight Operations

This part of regulation prescribes rules according to part 91 (part 91 General operating and flight rules) which are related to operators operating the aircraft according to FAR135.

Requirement for pilots – using oxygen (§135.89)

- if the aircraft is designed with unpressurized cabin, then the pilot, according to this regulation part, should use oxygen, namely when the aircraft is flying at the altitude from 10 000 ft to 12 000 ft for more than 30 minutes.

Minimum altitude for autopilot using (§135.93)

- according to this regulation no person can use the autopilot at the altitude below 500 ft over terrain or depending on how it is defined in the flight manual of the aircraft

Structure of flight crew (§135.99)

- the flight crew composition must be in accordance with its category of aircraft and according to the information shown in the flight manual. If the aircraft is for 9 passengers, it can be, according to this regulation, operated without a copilot (if the aircraft is for more than 10 passengers, it must be operated with a copilot).

Requirements for stewards (§135.107)

- no stewards are necessary on the aircraft board

Occupation of the pilot seat by passenger (§135.113)

- if the aircraft has more than 8 seats for passengers (not including pilot seats) and the aircraft is certified after 15 October 1971 then no passenger may be transported on the seat of the pilot (if it is not copilot, engineer or employee of the company)

Emergency exits (135.129)

- In the case of the operator performing irregular air transport with the aircraft with less than 19 seats for passengers and the operator performing regular transport with the aircraft with less than 9 seats for passengers, such aircraft needn´t have emergency exits.

Subpart C Aircraft and Equipment

All equipment installed on the aircraft must be approved in advance. According to part §135.143 ATC transponder, which is installed after 1 Jan 1992, must meet performance requirements of class TSO-C112 (Mode S).

The aircraft operator must operate the aircraft with:

- switched off electronic portable devices on the board of the aircraft. This is not required for portable voice recorders, headphones, pacemakers, electric razors and others as shown in part 119 (§135.144)
- with double control if the aircraft must be controlled by two pilots
- sensitive altimeter adjustable to barometric pressure, heating or deicing of air sources and other additionally required equipment (§135.149)
- recorder of the voice from the crew compartment CVR (Cockpit voice recorders); applied for multiengine aircraft in configuration 6 and more passengers. Installation of CVR must be in accordance with §23.1457, §25.1457, §27.1457, §29.1457 (§135.151 a) 1 and 2). The gained record should be stored at least for 60 days. (§135.151)
- at least one digital recorder of flight data for aircraft in configuration for 10-19 passengers (§135.152)
- a device warning of ground proximity. The aircraft for 6 to 9 passengers must be equipped with this equipment, class B as a minimum, technical standard TSO-C151. For more than 9 passengers this equipment must have class A od thechnical standard TSO-C151 and the aircraft must have a device indicating this possible situation. (§135.154)
- manual extinguisher located in the pilot cockpit, for more than 10 passengers at least one extinguisher must be located in the compartment for passengers (§135.155)
- oxygen intended for the crew (pilots) flying at altitude of more than 10 000 ft and less than 15 000 ft. 10 % of oxygen reserve must be for passengers, namely for the time more than 30 minutes. For flights above 15 000 ft the aircraft must be equipped with oxygen for all passengers (applied for the aircraft with the unpressurized cabin). (§135.157)
- heating pitot-static system (§135.158)
- additional equipment for VFR operation at night or at its boundary conditions, namely: turn speed meter – the aircraft equipped with the third horizon, slip indicator, cross and longitudinal inclinometer, flight gyro, generator(s) feeding all electrical systems and recharging batteries, doesn´t need it. For night flights the aircraft must have anticollision light system, background illumination of all instruments and devices, flashing lights. Radio system, electrically controlled instruments and lights should be feeded continuously. (§135.159)
- Bidirectional radio system for communication in case of navigation according to pilotage, i.e. according to the map and not instruments, namely for VFR flights (§135.161)
- Equipment for IFR flights, namely with: variometer, ambient temperature indicator, heated pitot-static tube for every speed indicator, warning system indicating sufficiency of energy for all gyro devices, alternative source of static pressure for altimeters, speed indicators and variometers, at least two generators or alternators for individual engines, two independent sources of energy (one for engine and one for instruments). For single engine aircraft, the aircraft must be equipped with two independent sources of electrical energy where the standby source is capable to supply energy at least for the time of one hour. (§135.163).
- in part §135.165, specified communication and navigation equipment for extended flights over water level and IFR operation.
- in part §135.167, specified equipment for extended flights over water level.
- the so called weather radar or a device capable to detect storms for aircraft in configuration for 10 and more passengers (§135.173)

- according to the document MEL, issued by he aircraft operator, if it has non-functional instruments and equipment necessary for aircraft operation (§135.179)
- with TCAS equipment for the aircraft in configuration for 10 and more passengers (§135.180)
- in part §135.181, specified conditions for required airaraft performance over limit or under IFR conditions
- in part §135.183, specified conditions for required performance of the landplane flying over water level – the operator cannost operate such aircraft if it is not possible to operate at such latitude that allows to reach the ground in case of engine failure, if it is not necessary for takeoff and landing. It is not possible to operate multiengine aricraft with one power unit operating which doesn´t have climbing rate of at least 50 ft per minute at altitude of 1 000 ft.
- With aircraft C.G. position calculation with empty weight, not older than 36 months this is not applied, if the original certificate of air worthiness was isued at that time and if the aircraft under this system of weight and balancing was approved in operation specifications of the holder certificate.

The aircraft operator can/doesn´t have to operate the aircraft:

- No need to operate the aircraft with the board announcement system (§135.150)
- No need to operate the aircraft with configuration up to 9 passengers with the flight data recorder FDR (§135.152)
- No need to operate the aircraft with adding requirements for airworthiness described in regulation part §135.169 regardig the aircraft for 10 and more passengers
- No need to operate the aircraft with shoulder straps for the aircraft crew (§135.171)
- No need to operate the aircraft with the so called weather radar or device capable to detect storms for aircraft in configuration up to 9 passengers (§135.173)
- No need to operate the aircraft with TCAS equipment (§135.180)

Subpart D VFR/IFR Operating Limitations and Weather Requirements
Fuel reserve for VFR (135.209)

- during the day the fuel reserve must be at of 30 minutes of flight
- at night the fuel reserve must be at least for 45 minutes of flight

Fuel reserve for IFR (135.223)

- fuel reserve for IFR flights must be at least for 45 minutes of flight

Subpart I Airplane Performance Operating Limitations

Every operator (a certificate holder) operating small transport aircraft must operate the aircraft in accordance with regulation part **§135.397**. Everybody, who wants to operate small piston or turboprop aircraft according to this regulation, must operate it in accordance with part **§135.379 takeoff limitations** (except for part d) a f)) and further in accordance with regulation parts **§135.385** and **§135.387 landing**.
According to regulation part **„takeoff limitations“** the aircraft mustn´t take off if its weight and ambient temperature are higher than it is specified in the flight manual. Distance at interrupted takeoff mustn´t be longer than the length of runway including stopway. Takeoff mustn´t exceed the length of runway plus clearway.
According to regulation part **”landing**“ the aircraft musnt´t land on a chosen or standby airport if its landing weight or ambient temperature at a given altitude of the airport is higher than according to the conditions defined in the flight manual. According to part b) of this regulation every aircraft must be capable to stop completely within 60% of runway length, namely from 50 ft above the threshold of a given runway. The turboprop aircraft which cannot land on a chosen airport, can carry out landing on a chosen standby airport, namely they must fully stop within 70% of runway effective length.

Subpart J Maintenance, Preventive Maintenance and Alterations

This part of the regulation describes the rules for aircraft maintenance. Aircraft maintenance will be performed in accordance with regulation parts 91 a 43 and according to the following parts of

this regulation **§135.415**, **§135.417**, **§135.421 and §135.422** and the approved checking program according to part **§135.419**.
According to these parts every operator should report the a failure endangering safety operation of the aircraft, see part **§135.415 a)**.
Moreover, all mechanical defects (failures) should be reported, see **§135.417**, which caused interruption of flight, unplanned change of the flight plan, change of flight routes, namely till 10th day of the new months for the previous month (part §135.417). The approved checking program can be modified any time if the authority finds out that it is not in compliance with part 91. Changes are performed by the authority in accordance with §119.51.

The operator must carry out maintenance set down according to aircraft manufacturer´s procedure and approved by the authority (§135.421). Regulation part **§135.422** deals with inspections of old multiengine aircraft certified for 9 and less passengers, where the aircraft operator has to prove adequate maintenance of sensitive aircraft parts and instruments to the authority.

FAR 135 regulation is further extended by the following supplements:

Appendix A Additional Airwothiness Standarts for 10 or More Passenger Airplane

Appendix B, D, F Airplane Flight Recorder Specifications

Appendix C, E Helicopter Flight Recorder Specifications

Appendix G Extended Operations (ETOPS)

3.2.4 Comparison of regulations from the viewpoint of legislative severity on operators and aircraft categories in SAT project

If we compare the aircraft according to categories, then:

- Aircraft is exactly specified (according to given criteria) by aircraft Class A, B or C in EU-OPS regulation.
- In FAR135 regulation aircraft isn´t exactly specified by category, here it falls in category ”small transport category airplane”.
- It is possible to say that EU-OPS regulation is, as a whole, more comprehensive and isn´t focused on such general description as FAR135 regulation in total comparison of both regulations.

3.2.5 Fractional ownership program under Title 14 of the CFR Part 91 subpart K

Fractional Ownership Program is defined in FAA regulation Title 14 of the Code of Federal Regulations Part 91 General Operating and Flight Rules subpart K. Basic requirements of Fractional Ownership Program and comparison with regulation Part 135 are mentioned below.
This way of aircraft operation is not defined in Europe and it could further fulfill requirements of small aircraft transport which are main purpose of SAT-Rdmp project.

Fractional Ownership Program is a program of shared aircraft ownership that is conducted under the requirements of part 91 subpart K, a fractional ownership program must contain all of the following elements:

(1) Single program manager who provides aviation expertise and management services,

(2) Two or more airworthy aircraft,

(3) One or more fractional owners per program aircraft,

(4) Possession of at least a minimum fractional ownership interest in one or more program aircraft by each fractional owner (1/16th for airplanes / 1/32nd for helicopters),

(5) Dry-lease exchange agreements among owners, and

(6) Multiyear contracts or program agreements for management services and aircraft dry-lease exchange.

The fractional owner is ultimately responsible for safe operations and compliance with the regulations. The owner(s) may delegate the performance of tasks to the program manager and can rely on the program manager for aviation expertise and management services, but an owner cannot delegate his or her operational control responsibilities. When tasks are delegated, both the owner and the program manager are jointly and individually responsible for compliance. Enforcement of violations of the regulations could penalize the fractional owner, the program manager, or both, depending on the nature of the violation, and will be reviewed on a case-by-case basis. Enforcement could result in suspension or revocation of MSpecs, which could ultimately affect all owners in the program.

More information about Fractional Ownership you can find in document Advisory Circular 91-84.

Comparison of the CFR Part 91 Subpart K Fractional Ownership and Part 135

Part 91 Subpart K Fractional Ownership	Part 135
General	
The program is open *only* to owners in that program or affiliate programs. An air carrier must conduct leases or subleases of shares less than the minimum size. An owner cannot exceed the number of hours in excess of hours associated with a share. An owner cannot carry people or property for compensation or hire on a program flight.	A certificate holder can hold out to the public to provide transportation. No minimum or maximum hours specified.
Citizenship	
There is no citizenship requirement for program managers. Fractional owners must consider citizenship in the context of aircraft registration and reimbursement for use.	The certificate holder must be a U.S. citizen.
Contracts	
Multiple contracts are required defining operational control responsibilities, owner/ program manager responsibilities, dry-lease, etc.	There are no required contracts.
Purchase and use	
Hours may not exceed total hours associated with share. Share size may not be smaller than 1/16th for airplanes and 1/32nd for helicopters. An air carrier must conduct a sale or sublease of a share less than the minimum size.	There is no maximum or minimum purchase or utilization. Charter can be purchased on a single trip basis or block charter.
Part 91 Subpart K Fractional Ownership	**Part 135**
Operaional Control	
The owner is in operational control of a program flight when the owner has directed the	Air carrier has all responsibility for operational control.

flight and the aircraft is carrying those persons or property. The program manager has operational control on administrative flights, sales demos, positioning, ferrying, maintenance or crew training, and no passengers designated by the owner(s) are carried. If the aircraft is also used under 14 CFR part 121 or 135, that air carrier has operational control. The owner is ultimately responsible for safe operations and rule compliance. • Can delegate performance of tasks, but not the responsibility; • Can rely on the program manager for aviation expertise and aviation management services; • Signs acknowledgement of responsibilities; • Other required contracts; and • When tasks are delegated to program manager, the owner and program manager are jointly and individually responsible for compliance.	
Management Specifications (MSpecs)	
There is no certificate issued. The program manager receives MSpecs on behalf of the collective owners. Content similar to air carrier operations specifications (OpSpecs).	Certificate issued (14 CFR part 119). OpSpecs are issued to the air carrier.
Drug and Alcohol Testing Program	
Drug and alcohol misuse education program required. There is no drug and alcohol testing program required by regulation; however, may have company testing but must disclose differences between Federal Aviation Administration (FAA) and company testing programs to the owners. Must not use Federal forms.	Drug and alcohol testing program required by regulation.
Emergency Maintenance	
Can use maintenance personnel who have not received drug and alcohol misuse education. Reporting requirements apply.	Cannot use maintenance personnel who have not received drug and alcohol misuse testing. Reporting requirements apply.
Part 91 Subpart K Fractional Ownership	**Part 135**
Passenger Briefings	
Safety briefing similar to part 135. Must include name of person who has operational control.	Safety briefing required.

Part 91 Subpart K Fractional Ownership	Part 135
Load Manifest	
Required for all aircraft. Must also carry a written document that states the name of the entity having operational control on that flight and the part under which the flight is operated.	Required for multiengine aircraft.
Management Personnel	
There are no required management personnel or qualifications, but must designate points of contact/ people authorized to sign MSpecs. Certain management personnel are required for a Continuous Airworthiness Maintenance Program (CAMP).	Required management personnel (except for a single-pilot operation) • Director of Operations. • Chief Pilot. • Director of Maintenance.
Pilot Qualifications	
Must have adequate number of pilots per program aircraft to meet program needs. Two pilots required unless deviation issued. PIC must have 1,500 hours/second in command (SIC) 500 hours.	No set number of pilots. Pilot in Command (PIC) for instrument flight rules (IFR) must have 1,200 hours/airline transport pilot (ATP) or Commercial depending on type of aircraft and authorized operation. Single-pilot operations authorized. PIC for visual flight rules (VFR) must have 50 hours. PIC for IFR must have 1,200 hours. No regulatory time specified for SIC. “Eligible on-demand operator” must use two pilots—PIC 1,500 hours/SIC 500 hours.
Crew Pairing	
Crew pairing and operating limits required.	Crew pairing and operating limits required for “eligible on-demand operator” only.
Pilot Background Checks	
Check required.	Check required.
Scheduling/Flight Release	
Must have trained and qualified scheduling/ flight release personnel on duty.	Must have flight locating system. Specific personnel not specified.

Part 91 Subpart K Fractional Ownership	Part 135
Flight Duty/Rest	
Can use part 91K program or 135 or 121 flight, duty and rest program. Pilot/flight attendant schedules must be published in advance.	Part 135 flight/duty and rest requirements apply.

Performance	
Runway performance requirements specified. Can use "80 percent rule" with approved destination airport analysis program.	Runway performance requirements specified—Eligible on-demand operator can use "80 percent rule."
Proving/Validation Testing	
Proving and validation tests if applicable to aircraft and authorizations. Part 135 experience can justify deviations from proving and validation requirements.	Proving and validation tests if applicable to aircraft and authorizations. Fractional ownership experience can justify deviations from proving and validation requirements.
Maintnance Programs	
Will use part 135 program if aircraft also used in part 135 operation. Aircraft inspection program must be FAA approved. CAMP may be authorized. Maintenance training required.	Maintenance program.
Minimum Equipment List (MEL)	
Approved MEL required. If aircraft also used in part 135, must use that MEL.	Approved MEL required.
Manuals	
Manuals are required. If aircraft also used in part 135, can use part 135 manual if any differences are noted.	Manuals are required (except for single-pilot operation).
Flight Crewmember Training and Testing	
Training and testing program—can use a part 135 qualification program in lieu of part 91K program. Competency and proficiency checks (PIC and SIC). If simulator available, at least one training session per year must be in simulator.	Training program required (except for single-pilot operation). Competency (PIC and SIC). Proficiency and line checks (PIC only).

Part 91 Subpart K Fractional Ownership	Part 135
Aircraft	
There is no aircraft size limit. Aircraft size or type does not affect the minimum ownership share, but the share remains at 1/16th for airplanes and 1/32nd for helicopters.	On demand: Airplanes 30 or fewer passenger seats and 7,500 lb payload or less, and helicopters. Scheduled: Airplanes, except turbojets, 9 or fewer

	passenger seats and helicopters.
Equipment	
Applicable to aircraft size and seating capacity. Refer to air carrier rule for specific applicability requirements. If more than 30 seats or payload capacity more than 7,500 lb: Cockpit voice recorder (CVR)—Same requirement as part 121, § 121.359. Flight data recorder (FDR)—Same requirement as part 121, §§ 121.343 or 121.344. Terrain Awareness and Warning Systems (TAWS)—Same requirement as part 121, § 121.354. Traffic Alert and Collision Avoidance System (TCAS)—Same requirement as part 121, § 121.356. Weather radar—Same requirement as part 121, § 121.357. Aircraft with 30 pax seats or fewer and 7,500 lb or less payload: CVR—Same requirement as part 135, § 135.151. FDR—Same requirement as part 135, § 135.152. TAWS—Same requirement as part 135, § 135.154. TCAS—Same requirement as part 135, § 135.180. Thunderstorm detection—Same requirement as part 135, § 135.173. Weather radar—Same requirement as part 135, § 135.175.	See noted rules in part 91K column for air carrier requirements.
FAA Oversight	
Assigned principal inspectors. Subject to inspections except for line checks and en route inspections.	Assigned principal inspectors and inspection program. Subject to all types of FAA inspections.

3.3 Analysis of organizations and personnel certification according to Part-147 and Part-66 and comparison with regulation Title 14 CFR Part 65 and Part 147 (Federal Aviation Administration)

3.3.1 Part 147

Scope

This section establishes the requirements to be met by organisations seeking approval to conduct training and examination as specified in Part-66.

According to Part 147 Subpart C part 147.A.200 The approved basic training course point f) for acquiring of aircraft maintenance licence aeroplanes and helicopters according to Part 66 must be basic training course duration according to following table.

Basic Training Course Duration

Minimum duration of complete basic courses. For the purpose of this paragraph, a training hour means 60 minutes training, without pauses.

Basic Course	Duration (in hours)	Theoretical training ratio (in %)
A1	800	30-35
A2	650	30-35
A3	800	30-35
A4	800	30-35
B1.1	2400	50-60
B1.2	2000	50-60
B1.3	2400	50-60
B1.4	2400	50-60
B2	2400	50-60

3.3.2 Part 66

Scope and Privileges

Aircraft maintenance licence aeroplanes and helicopters are divided into following category and subcategory:

- **category A** – this category licence permits the holder to issue certificates of release to service following **minor scheduled line maintenance and simple defect rectification** within the limits of tasks specifically endorsed on the authorisation
  - subcategory A1 Aeroplanes Turbine
  - subcategory A2 Aeroplanes Piston
  - subcategory A3 Helicopters Turbine
  - subcategory A4 Helicopters Piston

- **category B1** – this licence shall permit the holder to issue certificates of release to service following maintenance, including **aircraft structure, powerplant and mechanical and electrical systems**. Replacement of avionic line replaceable units, requiring simple tests to prove their serviceability, shall also be included in the privileges Category B1 automatically includes corresponding subcategory A.
  - subcategory B1.1 Aeroplanes Turbine
  - subcategory B1.2 Aeroplanes Piston
  - subcategory B1.3 Helicopters Turbine
  - subcategory B1.4 Helicopters Piston

- **category B2** – this licence shall permit the holder to issue certificates of release to service following maintenance on **avionic and electrical systems**

- **category C** – licence shall permit the holder to issue certificates of release to service following **base maintenance on aircraft**

Application and Eligibility

- An applicant for an aircraft maintenance licence shall be at least 18 years of age.
- An application for an aircraft maintenance licence or amendment to such licence shall be made on EASA Form 19.

Basic knowledge requirements

An applicant for an aircraft maintenance licence or the addition of a category or subcategory to such an aircraft maintenance licence shall demonstrate, by examination, a level of knowledge in the appropriate **subject modules** in accordance with Appendix I to this Part.
The basic knowledge examinations shall be conducted by a **training organisation** appropriately approved under **Part-147** or by the **competent authority**.
Qualification on basic subjects for each Part-66 aircraft maintenance licence category or subcategory should be in accordance with the following matrix. Applicable subjects are indicated by an 'X':

Subject modules	A or B1 aeroplane with:		A or B1 helicopter with:		B2
	Turbine engine(s)	Piston engine(s)	Turbine engine(s)	Piston engine(s)	Avionics
1 – MATHEMATICS	X	X	X	X	X
2 – PHYSICS	X	X	X	X	X
3 – ELECTRICAL FUNDAMENTALS	X	X	X	X	X
4 – ELECTRONIC FUNDAMENTALS	X	X	X	X	X
5 – DIGITAL TECHNIQUES ELECTRONIC INSTRUMENT SYSTEMS	X	X	X	X	X
6 – MATERIALS AND HARDWARE	X	X	X	X	X
7 - MAINTENANCE PRACTICES	X	X	X	X	X
8 - BASIC AERODYNAMICS	X	X	X	X	X
9 - HUMAN FACTORS	X	X	X	X	X
10 - AVIATION LEGISLATION	X	X	X	X	X
11A - TURBINE AEROPLANE AERODYNAMICS, STRUCTURES AND SYSTEMS	X	X			
11B - PISTON AEROPLANE AERODYNAMICS, STRUCTURES AND SYSTEMS	X	X			
12 - HELICOPTER AERODYNAMICS, STRUCTURES AND SYSTEMS			X	X	
13 - AIRCRAFT AERODYNAMICS, STRUCTURES AND SYSTEMS					X
14 - PROPULSION					X
15 - GAS TURBINE ENGINE	X		X		
16 - PISTON ENGINE		X		X	
17 - PROPELLER	X	X			

Experience requirements

(a) An applicant for an aircraft maintenance licence shall have acquired:

1. For category A and subcategories B1.2 and B1.4:

- three years of practical maintenance experience on operating aircraft, if the applicant has no previous relevant technical training; or
- two years of practical maintenance experience on operating aircraft and completion of training considered relevant by the competent authority as a skilled worker, in a technical trade; or

- one year of practical maintenance experience on operating aircraft and completion of a Part-147 approved basic training course.

2. For category B2 and subcategories B1.1 and B1.3:

- five years of practical maintenance experience on operating aircraft if the applicant has no previous relevant technical training; or
- three years of practical maintenance experience on operating aircraft and completion of training considered relevant by the competent authority as a skilled worker, in a technical trade; or
- two years of practical maintenance experience on operating aircraft and completion of a Part -147 approved basic training course.

3. For category C with respect to large aircraft:

- three years of experience exercising category B1.1, B1.3 or B2 privileges on large aircraft or as Part-145 B1.1, B1.3 or B2 support staff, or, a combination of both; or
- five years of experience exercising category B1.2 or B1.4 privileges on large aircraft or as Part-145 B1.2 or B1.4 support staff, or a combination of both;

4. For category C with respect to non large aircraft:

- three years of experience exercising category B1 or B2 privileges on non large aircraft or as Part-145 B1 or B.2 support staff, or a combination of both; or

5. For category C obtained through the academic route:

an applicant holding an academic degree in a technical discipline, from a university or other higher educational institution recognised by the competent authority, three years of experience working in a civil aircraft maintenance environment on a representative selection of tasks directly associated with aircraft maintenance including six months of observation of base maintenance tasks.

(b) An applicant for an extension to an aircraft maintenance licence shall have a minimum civil aircraft maintenance experience requirement appropriate to the additional category or subcategory of licence applied for as defined in Appendix IV to this Part (see following table).

Experience requirements for extending a Part-66 Aircraft Maintenance Licence
The experience requirement will be reduced by 50 % if the applicant has completed an approved Part-147 course relevant to the subcategory.

From/to	A1	A2	A3	A4	B1.1	B1.2	B1.3	B1.4	B2
A1		6 months	6 months	6 months	2 years	6 months	2 years	1 year	2 years
A2	6 months		6 months	6 months	2 years	6 months	2 years	1 year	2 years
A3	6 months	6 months		6 months	2 years	1 year	2 years	6 months	2 years
A4	6 months	6 months	6 months	6 months	2 years	1 year	2 years	6 months	2 years
B1.1	None	6 months	6 months	6 months		6 months	6 months	6 months	1 year
B1.2	6 months	None	6 months	6 months	2 years		2 years	6 months	2 years
B1.3	6 months	6 months	None	6 months	6 months	6 months		6 months	1 year
B1.4	6 months	6 months	6 months	None	2 years	6 months	2 years		2 years
B2	6 months	6 months	6 months	6 months	1 year	1 year	1 year	1 year	

(c) For category A, B1 and B2 the experience must be practical which means being involved with a representative cross section of maintenance tasks on aircraft.

(d) For all applicants, at least one year of the required experience must be recent maintenance experience on aircraft of the category/subcategory for which the initial aircraft maintenance

licence is sought. For subsequent category/subcategory additions to an existing aircraft maintenance licence, the additional recent maintenance experience required may be less than one year, but must be at least three months. The required experience must be dependent upon the difference between the licence category/subcategory held and applied for. Such additional experience must be typical of the new licence category/subcategory sought.

(e) Notwithstanding paragraph (a), aircraft maintenance experience gained outside a civil aircraft maintenance environment shall be accepted when such maintenance is equivalent to that required by this Part as established by the competent authority. Additional experience of civil aircraft maintenance shall, however, be required to ensure understanding of the civil aircraft maintenance environment.

Continued validity of the aircraft maintenance licence
The aircraft maintenance licence becomes invalid five years after its last issue or amendment, unless the holder submits his/her aircraft maintenance licence to the competent authority that issued it, in order to verify that the information contained in the licence is the same as that contained in the competent authority records.

Type/task training and ratings
The holder of aircraft maintenance licence may only exercise certification privileges on a specific aircraft type following the satisfactory completion of the relevant category aircraft task training carried out by an appropriately approved Part-145 or Part-147 organisation. The training shall include practical hands on training and theoretical training as appropriate for each task authorised. Satisfactory completion of training shall be demonstrated by an examination and/or by workplace assessment carried out by an appropriately approved Part-145 or Part-147 organisation.

3.3.3 14 CFR Part 65 (Federal Aviation Administration)

<u>**Mechanics**</u>

To be eligible for a mechanic certificate and associated ratings, a person must be:

- at least 18 years of age;
- able to read, write, speak, and understand the English language,
- have passed all of the prescribed tests within a period of 24 months

§ 65.73 Ratings
The following ratings are issued under this subpart:

- Airframe
- Powerplant

§ 65.75 Knowledge requirements
Each applicant for a mechanic certificate or rating must, after meeting the applicable experience requirements of §65.77, pass a written test covering the construction and maintenance of aircraft appropriate to the rating he seeks.
The applicant must pass each section of the test before applying for the oral and practical tests.

§ 65.77 Experience requirements
Each applicant for a mechanic certificate or rating must present either an appropriate **graduation certificate** or **certificate of completion from a certificated aviation maintenance technician school** or **documentary evidence, satisfactory to the Administrator**, of:

- **At least 18 months of practical experience** with the procedures, practices, materials, tools, machine tools, and equipment generally used in constructing, maintaining, or altering **airframes, or powerplants** appropriate to the rating sought;
- **At least 30 months of practical experience** concurrently performing the duties appropriate to **both the airframe and powerplant** ratings.

§ 65.79 Skill requirements

Each applicant for a mechanic certificate or rating must pass an oral and a practical test on the rating he seeks.

Repairman

To be eligible for a repairman certificate a person must be:

- at least 18 years of age
- specially qualified to perform maintenance on aircraft or components
- employed for a specific job requiring those special qualifications by a certificated repair station, or by a certificated commercial operator or certificated air carrier
- recommended for certification by his employer
- have either at least 18 months of practical experience in the procedures, practices, inspection methods, materials, tools, machine tools, and equipment generally used in the maintenance duties
- completed formal training that is acceptable to the Administrator and is specifically designed to qualify the applicant for the job on which the applicant is to be employed; and
- able to read, write, speak, and understand the English language

§ 65.103 Repairman certificate: Privileges and limitations

- a certificated repairman may perform or supervise the maintenance, preventive maintenance, or alteration of aircraft or aircraft components appropriate to the job for which the repairman was employed and certificated, but only in connection with duties for the certificate holder by whom the repairman was employed and recommended.

3.3.4 14 CFR Part 147 (Federal Aviation Administration)

This part prescribes the requirements for issuing aviation maintenance technician school certificates and associated ratings and the general operating rules for the holders of those certificates and ratings.

According to **Subpart B—Certification Requirements** the following ratings are issued under this part:

- Airframe
- Powerplant
- Airframe and Powerplant

§ 147.21 General curriculum requirements

An applicant for an aviation maintenance technician school certificate and rating, or for an additional rating, must have an approved curriculum. The curriculum must offer at least the following number of hours of instruction for the rating shown, and the **instruction unit hour shall not be less than 50 minutes in length**.

Airframe - 1150 hours (400 hours general plus 750 hours airframe)
Powerplant - 1150 hours (400 hours general plus 750 hours powerplant)
Combined airframe and powerplant - 1900 hours (400 hours general plus 750 hours airframe and 750 powerplant)

- **Appendix B to Part 147 General Curriculum Subjects -** this appendix lists the subjects required in at least 400 hours in general curriculum subjects
- **Appendix C to Part 147 Airframe Curriculum Subjects -** this appendix lists the subjects required in at least 750 hours of each airframe curriculum, in addition to at least 400 hours in general curriculum subjects.

- **Appendix D to Part 147 Powerplant Curriculum Subjects -** this appendix lists the subjects required in at least 750 hours of each powerplant curriculum, in addition to at least 400 hours in general curriculum subjects.

§ 147.23 Instructor requirements
An applicant for an aviation maintenance technician school certificate and rating, or for an additional rating, must provide the number of instructors holding appropriate mechanic certificates and ratings that the Administrator determines necessary to provide adequate instruction and supervision of the students, including at least one such instructor for each 25 students in each shop class. However, the applicant may provide specialized instructors, who are not certificated mechanics, to teach mathematics, physics, basic electricity, basic hydraulics, drawing, and similar subjects.

According to **Subpart C—Operating Rules**

§ 147.31 Attendance and enrollment, tests, and credit for prior instruction or experience.
A certificated aviation maintenance technician school may not require any student to attend classes of instruction more than **8 hours in any day or more than 6 days or 40 hours in any 7-day period.**

3.4 Analysis of elementary design parameters of airports for SAT aircraft and structure of future Air Traffic Management and Air Navigation Service regulations in EU

The European Council adopted two regulations to improve the performance and safety of the European aviation system – the first strengthens the Single European Sky legislation regulation (EC) 1070/2004, while the second extends the tasks of the European Aviation Safety Agency (EASA) to the safety of airports, air traffic management and air navigation services (Regulation (EC) 1108/2009). Both regulations were adopted following a first-reading agreement with the European Parliament in March 2009.

Structure of future implementing rules for ATM/ANS and airports

The future implementing rules for ATM/ANS and airports are mostly annexes (blue) to EU regulations (orange) and they shall be separated into:

- Technical requirements contained in the annexes to the respective area regulations such as for example the implementing rules for Meteorology underneath the regulation on ATM/ ANS.
- Requirements applicable to organisations in the different domains contained in the annexes entitled Organisation Requirements (OR)
- Requirements for competent authorities certifying and overseeing aviation activities in the different domains contained in the annexes entitled Authority Requirements (AR)

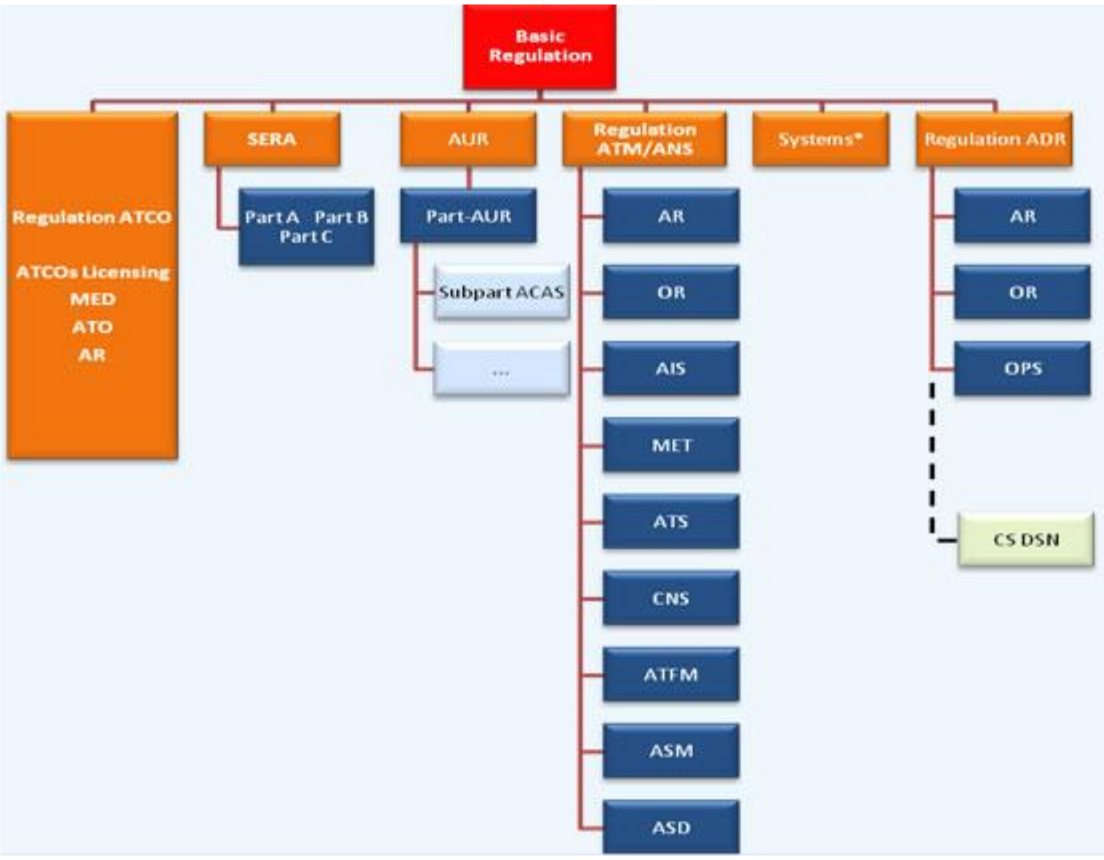


Fig. 3.1 Structure of future implementing rules for ATM/ANS and airports

It is planned to have implementing rules for air traffic management (ATM) and Air Navigation Services (ANS) to be completed by 2012. For the area of airports (ADR) it is planned to have the required rules adopted at the end of 2013.

The structure for airports:
It is foreseen to have a regulation on airport safety with three annexes that cover the implementing rules for authorities, organisations and airport operations. Linked to these, but not legally dependent are the certification specifications for airport design, called CS DSN.

Annex 14 to the Chicago Convention contains the basic provisions for airport safety, upon which the Member States of the EASA system have built their national airport regulatory systems, developed their airport industries and achieved high safety levels.
Analysis of elementary design parameters of airports for SAT aircraft was done according to ICAO Annex 14 regulation.

3.4.1 ICAO Annex 14

ICAO Annex 14 regulation is analyzed according to SAT aircraft specifications mentioned in chapter 2. Analysis purpose is provide elementary information for design of airports intended for operation of aircraft typical for project SAT.

Reference code
The intent of the reference code is to provide a simple method for interrelating the numerous specifications concerning the characteristics of airports so as to provide a series of airport facilities that are suitable for the aeroplanes that are intended to operate at the airport.
The code is not intended to be used for determining runway length or pavement strength requirements. The code is composed of two elements which are related to the aeroplane performance characteristics and dimensions. Element 1 is a number based on the aeroplane reference field length and element 2 is a letter based on the aeroplane wing span and outer main gear wheel span. A particular specification is related to the more appropriate of the two elements of the code or to an appropriate combination of the two code elements. The code letter or number within an element selected for design purposes is related to the critical aeroplane characteristics for which the facility is provided. When applying Annex 14, Volume I, the aeroplanes which the airport is intended to serve are first identified and then the two elements of the code.

The reference code will be **Code element 1 – code number 1 and 2; Code element 2 – code letter A and B (see table below)** according to SAT aircraft specification.

Code element 1		***Code element 2***		
Code number (1)	***Aeroplane reference field length (2)***	***Code letter (3)***	***Wing span (4)***	***Outer main gear wheel span (5)***
1	**Less than 800 m**	**A**	**Up to but not including 15 m**	**Up to but not including 4.5 m**
2	**800 m up to but not including 1 200 m**	**B**	**15 m up to but not including 24 m**	**4.5 m up to but not including 6 m**
3	1 200 m up to but not including 1 800 m	C	24 m up to but not including 36 m	6 m up to but not including 9 m
4	1 800 m and over	D	36 m up to but not including 52 m	9 m up to but not including 14 m
		E	52 m up to but not including 65 m	9 m up to but not including 14 m
		F	65 m up to but not including 80 m	14 m up to but not including 16 m
		G	from 80 m	to 16 m

Declared distances
The following distances shall be calculated to the nearest metre or foot for a runway intended for use by international commercial air transport:
a) take-off run available TORA;
b) take-off distance available TODA;
c) accelerate-stop distance available ASDA; and
d) landing distance available LDA.

Every airplane has specific take off distance which is adjusted of runway slope and wind direction (uphill runway slope extend TOD and headwind reduce TOD). Take off distance is extended about 5% on 1°uphill runway slope.
Take off distance is multiplied the following coefficients for types of RWY surfaces:

Surface	**Condition**	**Coefficient**
Grass to 13 cm	dry	1,2
	wet	1,25
Built-up	wet	1,05

Calculated information is compared with TORA, TODA and ASDA for which must apply according to EU-OPS following:

- for RWY without CWY and SWY Apple 1,25TOD≤TORA
- for RWY without CWY and SWY Apple TOD≤TORA
  1,15TOD≤TODA
  1,3TOD≤ASDA

Important information is landing distance available from height 50 ft and landing run distance which is adjusted of runway slope and wind direction (uphill runway slope and headwind reduce LDA).
LDA is multiplied the following coefficients for types of RWY surfaces:

Surface	Condition	Coefficient
Grass to 13 cm	dry	1,2
Built-up	wet	1,15

Calculated information is compared with LDA for which must apply according to EU-OPS following: 1,43LD= LDA

Width of runways
The width of a runway should be not less than the appropriate dimension specified in the following tabulation:

	Code letter					
Code number	**A**	**B**	C	D	E	F
1[a]	**18 m**	**18 m**	23 m	-	-	-
2[a]	**23 m**	**23 m**	30 m	-	-	-
3	30 m	30 m	30 m	45 m	-	-
4	-	-	45 m	45 m	45 m	60 m

a.) The width of a precision approach runway should be not less than 30 m where the code number is 1 or 2.

Taxiways
Taxiways should be provided to safe and expeditious surface movement of aircraft.
The design of a taxiway should be such that, when the cockpit of the aeroplane for which the taxiway is intended remains over the taxiway centre line markings, the clearance distance between the outer main wheel of the aeroplane and the edge of the taxiway should be not less than that given by the following tabulation:

Code letter	Clearance
A	**1.5 m**
B	**2.5 m**
C	3 m if the taxiway is intended to be used by aeroplanes with a wheel base less than 18 m 4.5 m if the taxiway is intended to be used by aeroplanes with a wheel base equal to or greater than 18 m
D	4.5 m
E	4.5 m
F	4.5 m
G	4.5 m

Width of taxiways
A straight portion of a taxiway should have a width of not less than that given by the following tabulation:

Code letter	Taxiway width
A	**7.5 m**
B	**10.5 m**
C	15 m if the taxiway is intended to be used by aeroplanes with a wheel base less than 18 m 18 m if the taxiway is intended to be used by aeroplanes with a wheel base equal to or greater than 18 m
D	18 m if the taxiway is intended to be used by aeroplanes with an outer main gear wheel span of less than 9 m 18 m if the taxiway is intended to be used by aeroplanes with an outer main gear wheel span equal to or greater than 9 m
E	23 m
F	25 m

Aprons
Aprons should be provided where necessary to permit the on- and off-loading of passengers, cargo or mail as well as the servicing of aircraft without interfering with the airport traffic.

Clearance distances on aircraft stands
An aircraft stand should provide the following minimum clearances between an aircraft using the stand and any adjacent building, aircraft on another stand and other objects:

Code letter	Clearance
A	**3 m**
B	**3 m**
C	4.5 m
D	7.5 m
E	7.5 m
F	7.5 m

Approach lighting systems

A - Non-instrument runway
Where physically practicable, a simple approach lighting system as specified in 5.3.4.2 to 5.3.4.9 ICAO Annex 14 should be provided to serve a non-instrument runway where the code number is 3 or 4 and intended for use at night, except when the runway is used only in conditions of good visibility, and sufficient guidance is provided by other visual aids.

B - Non-precision approach runway
Where physically practicable, a simple approach lighting system as specified in 5.3.4.2 to 5.3.4.9 ICAO Annex 14shall be provided to serve a non-precision approach runway, except when the runway is used only in conditions of good visibility or sufficient guidance is provided by other visual aids.

C - Precision approach runway category I
Where physically practicable, a precision approach category I lighting system as specified in 5.3.4.10 to 5.3.4.21 ICAO Annex 14 shall be provided to serve a precision approach runway category I.

D - Precision approach runway categories II and III
A precision approach category II and III lighting system as specified in 5.3.4.22 to 5.3.4.39 ICAO Annex 14 shall be provided to serve a precision approach runway category II or III.

Visual approach slope indicator systems
The standard visual approach slope indicator systems shall consist of the following:
PAPI or APAPI shall be provided where the code number is 1 or 2

Rescue and fire fighting
The airport category shall be determined from table below and shall be based on the longest aeroplanes normally using the airport and their fuselage width.
Airport category rescue and fire fighting according to SAT aircraft will be number 3.

Airport Category (1)	Aeroplane overall length (2)	Maximum fuselage width (3)
1	**0 m up to but not including 9 m**	**2 m**
2	**9 m up to but not including 12 m**	**2 m**
3	**12 m up to but not including 18 m**	**3 m**
4	18 m up to but not including 24 m	4 m
5	24 m up to but not including 28 m	4 m
6	28 m up to but not including 39 m	5 m
7	39 m up to but not including 49 m	5 m
8	49 m up to but not including 61 m	7 m
9	61 m up to but not including 76 m	7 m
10	76 m up to but not including 90 m	8 m

3.4.2 Regulation (EC) No 1108/2009 amending Regulation (EC) No 216/2008 in the field of airports and repealing Directive 2006/23/EC

This Regulation shall apply to:

- the design, maintenance and operation of airports, as well as personnel and organisations involved therein and, without prejudice to Community and national legislation on environment and land-use planning, the safeguarding of surroundings of airports
- the design, production and maintenance of airport equipment, as well as personnel and organisations involved therein

Airports, including equipment, located in the territory subject to the provisions of the Treaty, open to public use and which serve commercial air transport and where operations using instrument approach or departure procedures are provided, and:

(a) have a paved runway of 800 metres or above; or

(b) exclusively serve helicopters;

shall comply with this Regulation. Personnel and organisations involved in the operation of these airports shall comply with this Regulation.

Member States may decide to exempt from the provisions of this Regulation an airport which handles no more than 10 000 passengers per year, and handles no more than 850 movements related to cargo operations per year.

ESSENTIAL REQUIREMENTS FOR AERODROMES

A - Physical characteristics, infrastructure and equipment

1. Movement area

(a) Airports shall have a designated area for the landing and take-off of aircraft, which satisfies the following conditions:

(i) the landing and take-off area shall have dimensions and characteristics suitable for the aircraft intended to use the facility;

(ii) the landing and take-off area, where applicable, shall have a bearing strength sufficient to support repetitive operations of the intended aircraft. Those areas not intended for repetitive operations only need to be capable of supporting the aircraft;

(iii) the landing and take-off area shall be designed to drain water and to prevent standing water becoming an unacceptable risk to aircraft operations;

(iv) the slope and slope changes of the landing and take-off area shall not create an unacceptable risk to aircraft operations;

(v) the surface characteristics of the landing and take-off area shall be adequate for use by the intended aircraft; and

(vi) the landing and take-off area shall be free from objects which might create an unacceptable risk to aircraft operations.

(b) Where there are several designated landing and take-off areas, they shall be such that they do not create an unacceptable risk to aircraft operations.

(c) The designated landing and take-off area shall be surrounded by defined areas. These areas are intended to protect aircraft flying over them during take-off or landing operations or to mitigate the consequences of undershooting, running off the side or overrunning the take-off and landing area, and shall satisfy the following conditions:

(i) these areas shall have dimensions appropriate to the aircraft operations anticipated;

(ii) the slope and slope changes of these areas shall not create an unacceptable risk to aircraft operations;

(iii) these areas shall be free from objects which might create an unacceptable risk to aircraft operations. This should not preclude frangible equipment to be located in those areas, if required to assist aircraft operations; and

(iv) each of these areas shall have a bearing strength sufficient to serve its purpose.

(d) Those areas of an airport, with their associated immediate surroundings, that are to be used for taxiing or parking aircraft, shall be designed to permit safe operation of the aircraft expected to use the particular facility under all the conditions planned for, and shall satisfy the following conditions:

(i) these areas shall have a bearing strength sufficient to support repetitive operations of the intended aircraft, except for areas which are expected for only occasional use which only need to be capable of supporting the aircraft;

(ii) these areas shall be designed to drain water and to prevent standing water becoming an unacceptable risk to aircraft operations;

(iii) the slope and slope changes of these areas shall not create an unacceptable risk to aircraft operations;

(iv) the surface characteristics of these areas shall be adequate for use by the intended aircraft; and

(v) these areas shall be free from objects which might create an unacceptable risk to aircraft. This should not preclude parking equipment required for that area in specifically identified positions or zones.

(e) Other infrastructure intended for use by aircraft shall be so designed that use of that infrastructure does not create an unacceptable risk to aircraft using it.

(f) Constructions, buildings, equipment or storage areas shall be located and designed so as not to create an unacceptable risk for aircraft operations.

(g) Suitable means shall be provided to prevent unauthorised persons, unauthorised vehicles or animals large enough to create an unacceptable risk to aircraft operations from entering the movement area, without prejudice to national and international animal protection provisions.

2. Obstacle clearances

(a) To protect aircraft proceeding to an airport for landing, or for their departure from an airport, arrival and departure routes or areas shall be established. Such routes or areas shall provide aircraft with the required clearance from obstacles located in the area surrounding the airport taking due account of the local physical characteristics.

(b) Such obstacle clearance shall be appropriate to the phase of flight and type of operation being conducted. It shall also take into account the equipment being used for determining the position of the aircraft.

3. Visual and non-visual aids and airport equipment

(a) AIDS shall be fit for purpose, recognisable and provide unambiguous information to users under all intended operational conditions.

(b) Airport equipment shall function as intended under the foreseen operating conditions. Under operating conditions or in case of failure, airport equipment shall not cause an unacceptable risk to aviation safety.

(c) The aids and their electrical power supply system shall be so designed that failures do not result in inappropriate, misleading or insufficient information being given to users or in interruption of an essential service.

(d) Suitable means of protection shall be provided to avoid damage or disturbance to such aids.

(e) Sources of radiation or the presence of moving or fixed objects shall not interfere with or adversely affect the performance of aeronautical communications, navigation and surveillance systems.

(f) Information on operation and use of airport equipment shall be made available to relevant staff, including clear indications of the conditions which may create unacceptable risks to aviation safety.

4. Airport data

(a) Data relevant to the airport and the available services shall be established and kept up to date.

(b) The data shall be accurate, readable, complete and unambiguous. Appropriate integrity levels shall be maintained.

(c) The data shall be made available to the users and the relevant ANS providers in a timely manner, using a sufficiently secure and expeditious method of communication.

B - Operations and management

1. The airport operator is responsible for operation of the airport. The responsibilities of the airport operator are as follows:

(a) the airport operator shall have, directly or under contracts, all the means necessary to ensure safe operation of aircraft at the airport. These means shall include, but are not limited to, facilities, personnel, equipment and material, documentation of tasks, responsibilities and procedures, access to relevant data and record-keeping;

(b) the airport operator shall verify that the requirements of Section A are complied with at all times or take appropriate measures to mitigate the risks associated with non-compliance. Procedures shall be established and applied to make all users aware of such measures in a timely manner;

(c) the airport operator shall establish and implement an appropriate airport wildlife risk management programme;

(d) the airport operator shall ensure that movements of vehicles and persons in the movement area and other operational areas are coordinated with movements of aircraft in order to avoid collisions and damage to aircraft;

(e) the airport operator shall ensure that procedures to mitigate risks related to airport operations in winter operation, adverse weather conditions, reduced visibility or at night, if applicable, are established and implemented;

(f) the airport operator shall establish arrangements with other relevant organisations to ensure continuing compliance with these essential requirements for airports. These organisations include, but are not limited to, aircraft operators, air navigation service providers, ground handling service providers and other organisations whose activities or products may have an effect on aircraft safety;

(g) the airport operator, either by itself or by means of contracts with third parties, shall ensure that procedures exist to provide aircraft with fuel which is uncontaminated and of the correct specification;

(h) manuals for maintenance of airport equipment shall be available, applied in practice and cover maintenance and repair instructions, servicing information, troubleshooting and inspection procedures;

(i) the airport operator shall establish and implement an airport emergency plan, covering emergency scenarios that may occur at the airport or in its surroundings. This plan shall be coordinated, as appropriate, with the local community emergency plan;

(j) the airport operator shall ensure that adequate airport rescue and firefighting services are provided. Such services shall respond to an incident or accident with due urgency and shall include at least equipment, extinguishing agents and a sufficient number of personnel;

(k) the airport operator shall use only trained and qualified personnel for airport operations and maintenance and shall implement and maintain training and check programmes to ensure the continuing competence of all relevant personnel;

(l) the airport operator shall ensure that any person permitted unescorted access to the movement area or other operational areas is adequately trained and qualified for such access;

(m) the rescue and firefighting personnel shall be properly trained and qualified to operate in the airport environment. The airport operator shall implement and maintain training and check programmes to ensure the continuing competence of this personnel; and

(n) all rescue and firefighting personnel potentially required to act in aviation emergencies shall periodically demonstrate their medical fitness to execute their functions satisfactorily, taking into account the type of activity. In this context, medical fitness, comprising both physical and mental

fitness, means not suffering from any disease or disability which could make this personnel unable:

(i) to execute the tasks necessary to operate in aviation emergencies;

(ii) to perform their assigned duties at any time; or

(iii) to perceive their environment correctly.

2. *Management systems*

(a) The airport operator shall implement and maintain a management system to ensure compliance with these essential requirements for airports and to aim for continuous and proactive improvement of safety. The management system shall include organisational structures, accountability, responsibilities, policies and procedures.

(b) The management system shall include an accident and incident prevention programme, including an occurrence-reporting and analysis scheme. The analysis shall involve the parties listed in point 1(f) above, as appropriate.

(c) The airport operator shall develop an airport manual and operate in accordance with that manual. Such manuals shall contain all necessary instructions, information and procedures for the airport, the management system and for operations personnel to perform their duties.

C - Airport surroundings

1. The airspace around airport movement areas shall be safeguarded from obstacles so as to permit the intended aircraft operations at the airports without creating an unacceptable risk caused by the development of obstacles around the airport. Obstacle monitoring surfaces shall therefore be developed, implemented and continuously monitored to identify any infringing penetration.

(a) Any infringement of these surfaces will require an assessment to identify whether or not the object creates an unacceptable risk. Any object posing an unacceptable risk shall be removed or appropriate mitigating action shall be taken to protect aircraft using the airport.

(b) Any remaining such obstacles shall be published and, depending on the need, shall be marked and, where necessary, made visible by means of lights.

2. Hazards related to human activities and land use, such as, but not limited to, items on the following list, shall be monitored. The risk caused by them shall be assessed and mitigated as appropriate:

(a) any development or change in land use in the airport area;

(b) the possibility of obstacle-induced turbulence;

(c) the use of hazardous, confusing and misleading lights;

(d) the dazzling caused by large and highly reflective surfaces;

(e) the creation of areas that might encourage wildlife activity in the surroundings of the airport movement area;

(f) sources of non-visible radiation or the presence of moving or fixed objects which may interfere with, or adversely affect, the performance of aeronautical communications, navigation and surveillance systems.

3. A local community emergency plan shall be established for aviation emergency situations occurring in the airport local area.

D - Others

Except for aircraft emergency situations, when diverting to an alternate airport, or under other conditions specified in each case, an airport or parts thereof shall not be used by aircraft for which the airport design and operating procedures are not normally intended.

3.4.3 Regulation (EC) No 1070/2009 amending Regulations (EC) No 549/2004, (EC) No 550/2004, (EC) No 551/2004 and (EC) No 552/2004 in order to improve the performance and sustainability of the European aviation system

The objective of the Single European sky initiative is to enhance current air traffic safety standards, to contribute to the sustainable development of the air transport system and to improve the overall performance of air traffic management (ATM) and air navigation services (ANS) for general air traffic in Europe, with a view to meeting the requirements of all airspace users. This single European sky shall comprise a coherent pan-European network of routes, network management and air traffic management systems based only on safety, efficiency and technical considerations, for the benefit of all airspace users. In pursuit of this objective, this Regulation establishes a harmonised regulatory framework for the creation of the single European sky.

Functional airspace blocks
By 4 December 2012, Member States shall take all necessary measures in order to ensure the implementation of functional airspace blocks with a view to achieving the required capacity and efficiency of the air traffic management network within the single European sky and maintaining a high level of safety and contributing to the overall performance of the air transport system and a reduced environmental impact. Member States shall cooperate to the fullest extent possible with each other; in particular Member States establishing neighbouring functional airspace blocks, in order to ensure compliance with this provision. Where relevant, cooperation may also include third countries taking part in functional airspace blocks.

Relations with military authorities
Member States shall, within the context of the common transport policy, take the necessary steps to ensure that written agreements between the competent civil and military authorities or equivalent legal arrangements are established or renewed in respect of the management of specific airspace blocks.

Principles
The charging scheme shall be based on the account of costs for air navigation services incurred by service providers for the benefit of airspace users. The scheme shall allocate these costs among categories of users.

Rules of the air and airspace classification
The Commission shall, in accordance with the regulatory procedure referred to in Article 5(3) of the framework Regulation, adopt implementing rules in order to:

(a) adopt appropriate provisions on rules of the air based upon ICAO standards and recommended practices;

(b) harmonise the application of the ICAO airspace classification, with appropriate adaptation, in order to ensure the seamless provision of safe and efficient air traffic services within the single European sky.

Network management and design
The air traffic management (ATM) network functions shall allow optimum use of airspace and ensure that airspace users can operate preferred trajectories, while allowing maximum access to airspace and air navigation services. These network functions shall be aimed at supporting initiatives at national level and at the level of functional airspace block sand shall be executed in a manner which respects the separation of regulatory and operational tasks.

The implementing rules for air traffic flow management shall support operational decisions by air navigation service providers, airport operators and airspace users and shall cover the following areas:

(a) flight planning;

(b) use of available airspace capacity during all phases of flight, including slot assignment; and

(c) use of routings by general air traffic, including:

- the creation of a single publication for route and traffic orientation,
- options for diversion of general air traffic from congested areas, and
- priority rules regarding access to airspace for general air traffic, particularly during periods of congestion and crisis.

When developing and adopting the implementing rules the Commission shall, as appropriate and without prejudice to safety, take into account consistency between flight plans and airport slots and the necessary coordination with adjacent regions.

3.4.4 Regulation (EC) No 1108/2009 amending Regulation (EC) No 216/2008 in the field of air traffic management and air navigation services and repealing Directive 2006/23/EC

This Regulation shall apply to:

- the design, production and maintenance of systems and constituents for air traffic management and air navigation services (ATM/ANS), as well as personnel and organisations involved therein
- ATM/ANS, as well as personnel and organisations involved therein

ESSENTIAL REQUIREMENTS FOR ATM/ANS AND AIR TRAFFIC CONTROLLERS

1. Use of the airspace

(a) All aircraft, excluding military, customs, police, search and rescue, firefighting, coastguard or similar activities or services, in all phases of flight or on the movement area of an airport, shall be operated in accordance with common general operating rules and any applicable procedure specified for use of that airspace.

(b) All aircraft, excluding military, customs, police, search and rescue, firefighting, coastguard or similar activities or services, shall be equipped with the required constituents and operated accordingly. Constituents used in the ATM/ANS system shall also comply with the requirements in point 3.

2. Services

(a) Aeronautical information and data for airspace users for the purpose of air navigation

(i) The data used as a source for aeronautical information shall be of sufficient quality, complete, current and provided in a timely manner.

(ii) Aeronautical information shall be accurate, complete, current, unambiguous and be of adequate integrity in a suitable format for users.

(iii) The dissemination of such aeronautical information to airspace users shall be timely and use sufficiently reliable and expeditious means of communication protected from interference and corruption.

(b) Meteorological information

(i) The data used as a source for aeronautical meteorological information shall be of sufficient quality, complete and current.

(ii) To the extent possible, aeronautical meteorological information shall be precise, complete, current, be of adequate integrity and unambiguous in order to meet the needs of airspace users.

(iii) The dissemination of such aeronautical meteorological information to airspace users shall be timely and use sufficiently reliable and expeditious means of communication protected from interference and corruption.

(c) Air traffic services

(i) The data used as a source for the provision of air traffic services shall be correct, complete and current.

(ii) Air traffic services shall be sufficiently precise, complete, current, and unambiguous to meet the safety needs of users.

(iii) Automated tools providing information or advice to users shall be properly designed, manufactured and maintained to ensure that they are fit for their intended purpose.

(iv) Air traffic control services and related processes shall provide for adequate separation between aircraft and, where appropriate, assist in protection from obstacles and other airborne hazards and shall ensure prompt and timely coordination with all relevant users and adjacent volumes of airspace.

(v) Communication between air traffic services and aircraft and between relevant air traffic services units shall be timely, clear, correct and unambiguous, protected from interference and commonly understood and, if applicable, acknowledged by all actors involved.

(vi) Means shall be in place to detect possible emergencies and, when appropriate, to initiate effective search and rescue action. Such means shall, as a minimum, comprise appropriate alerting mechanisms, coordination measures and procedures, means and personnel to cover the area of responsibility efficiently.

(d) Communication services

Communication services shall achieve and maintain sufficient performance with regard to their availability, integrity, continuity and timeliness. They shall be expeditious and protected from corruption.

(e) Navigation service

Navigation services shall achieve and maintain a sufficient level of performance with regard to guidance, positioning and, when provided, timing information. The performance criteria include accuracy, integrity, availability and continuity of the service.

(f) Surveillance service Surveillance services shall determine the respective position of aircraft in the air and of other aircraft and ground vehicles on the airport surface, with sufficient performance with regard to their accuracy, integrity, continuity and probability of detection.

(g) Air traffic flow management

The tactical management of air traffic flows at Community level shall use and provide sufficiently precise and current information of the volume and nature of the planned air traffic affecting service provision and shall coordinate and negotiate re-routing or delaying traffic flows in order to reduce the risk of overloading situations occurring in the air or at the airports.

(h) Airspace management

The designation of specific volumes of airspace for a certain use shall be monitored, coordinated and promulgated in a timely manner in order to reduce the risk of loss of separation between aircraft in all circumstances.

(i) Airspace design

Airspace structures and flight procedures shall be properly designed, surveyed and validated before they can be deployed and used by aircraft.

3. Systems and constituents

(a) General

ATM/ANS systems and constituents providing related information to and from the aircraft and on the ground shall be properly designed, manufactured, installed, maintained and operated to ensure that they are fit for their intended purpose.

(b) System and constituent integrity, performance and reliability

The integrity and safety-related performance of systems and constituents whether on aircraft, on the ground or in space, shall be fit for their intended purpose. They shall meet the required level of operational performance for all their foreseeable operating conditions and for their whole operational life.

(c) Design of systems and constituents

(i) Systems and constituents shall be designed to meet applicable safety requirements.

(ii) Systems and constituents, considered collectively, separately and in relation to each other, shall be designed in such a way that an inverse relationship exists between the probability that any failure can result in a total system failure and the severity of its effect on the safety of services.

(iii) Systems and constituents, considered individually and in combination with each other, shall be designed taking into account limitations related to human capabilities and performance.

(iv) Systems and constituents shall be designed in a manner that protects them from unintended harmful interactions with external elements. (v) Information needed for manufacturing installation, operation and maintenance of the systems and constituents as well as information concerning unsafe conditions shall be provided to personnel in a clear, consistent and unambiguous manner. (d) Continuing level of service Safety levels of systems and constituents shall be maintained during service and any modifications to service.

4. Qualification of air traffic controllers

(a) General A person undertaking training as an air traffic controller or as a student air traffic controller, shall be sufficiently mature educationally, physically and mentally to acquire, retain and demonstrate the relevant theoretical knowledge and practical skill. EN 24.11.2009 Official Journal of the European Union L 309/67

(b) Theoretical knowledge

(i) An air traffic controller shall acquire and maintain a level of knowledge appropriate to the functions exercised and proportionate to the risks associated with the type of service.

(ii) Acquisition and retention of theoretical knowledge shall be demonstrated by continuous assessment during training, or by appropriate examinations.

(iii) An appropriate level of theoretical knowledge shall be maintained. Compliance shall be demonstrated by regular assessments or examinations. The frequency of examinations shall be proportionate to the level of risk associated with the type of service.

(c) Practical skill

(i) An air traffic controller shall acquire and maintain the practical skills appropriate to exercise his/her functions. Such skills shall be proportionate to the risks associated with the type of service and shall cover at least, if appropriate to the functions exercised, the following items:

i. operational procedures;

ii. task specific aspects;

iii. abnormal and emergency situations; and

iv. human factors.

(ii) An air traffic controller shall demonstrate the ability to perform the associated procedures and tasks with a level of competence appropriate to the functions exercised.

(iii) A satisfactory level of competence in practical skill shall be maintained. Compliance shall be verified by regular assessments. The frequency of these assessments shall be proportionate to the complexity and the level of risk associated with the type of service and the tasks performed.

(d) Language proficiency

(i) An air traffic controller shall demonstrate proficiency to speak and understand English to the extent he/she is able to communicate effectively in voice-only (telephone/radiotelephone) and in face-to-face situations on concrete and work-related topics, including in emergency situations.

(ii) Whenever necessary in a defined volume of airspace for ATS service provision purposes, an air traffic controller shall also have proficiency to speak and understand the national language(s) to the extent described above.

(e) Synthetic training devices (STD)

When an STD is used for practical training on situational awareness and human factors or to demonstrate that skills are acquired or maintained, it shall have a level of performance that allows adequate simulation of the working environment and operational situations appropriate to the training provided.

(f) Training course

(i) Training shall be given by a training course, which may comprise theoretical and practical instruction, including training on an STD, if applicable.

(ii) A course shall be defined and approved for each type of training.

(g) Instructors

(i) Theoretical instruction shall be given by appropriately qualified instructors. They shall:

i. have appropriate knowledge in the field where instruction is to be given; and

ii. have demonstrated the ability to use appropriate instructional techniques.

(ii) Instruction on practical skills shall be given by appropriately qualified instructors, who have the following qualifications:

i. meet the theoretical knowledge and the experience requirements appropriate to the instruction being given;

ii. have demonstrated the ability to instruct and to use appropriate instructional techniques;

iii. have practised instructional techniques in those procedures in which it is intended to provide instruction; and

iv. receive regular refresher training to ensure that the instructional competences are maintained.

(iii) Instructors on practical skills shall also be or have been entitled to act as an air traffic controller.

(h) Assessors

(i) Persons responsible for assessing the skill of air traffic controllers shall:

i. have demonstrated the ability to assess the performance of, and conduct tests and checks on air traffic controllers; and

ii. receive regular refresher training to ensure that the assessment standards are maintained up to date.

(ii) Assessors on practical skills shall also be or have been entitled to act as an air traffic controller in those areas in which assessment is to be made.

(i) Medical fitness of an air traffic controller

(i) Medical criteria

i. All air traffic controllers shall periodically demonstrate medical fitness to satisfactorily execute their functions. Compliance shall be shown by appropriate assessment taking into account the possible mental and physical degradation due to age;

ii. Demonstration of medical fitness, comprising physical and mental fitness, shall include the demonstrated absence of any disease or disability, which makes the person providing an air traffic control (ATC) service unable:

— to execute properly the tasks necessary to provide an ATC service,

— to perform assigned duties at any time, or

— to perceive correctly his/her environment.

(ii) Where medical fitness cannot be fully demonstrated, mitigation measures that provide equivalent safety may be implemented.

5. Service providers and training organisations

(a) Service provision shall not be undertaken unless the following conditions are met:

(i) the service provider shall have directly or indirectly through contracts the means necessary for the scale and scope of the service. These means shall comprise but are not limited to the following: systems, facilities, including power supply, management structure, personnel, equipment and its maintenance, documentation of tasks, responsibilities and procedures, access to relevant data and record-keeping;

(ii) the service provider shall develop and keep up-to-date management and operations manuals relating to the provision of its services and operate in accordance with those manuals. Such manuals shall contain all necessary instructions, information and procedures for the operations, the management system and for operations personnel to perform their duties;

(iii) the service provider shall implement and maintain a risk-based management system to ensure compliance with the essential requirements in this Annex and aim for continuous proactive improvement of this system;

(iv) the service provider shall use only suitably qualified and trained personnel and implement and maintain training and checking programmes for the personnel;

(v) the service provider shall establish formal interfaces with all the other contributors to the service provision to ensure compliance with these essential requirements;

(vi) the service provider shall establish and implement a contingency plan covering emergency and abnormal situations that may occur in relation to its services;

(vii) the service provider shall establish and maintain an accident and incident prevention and safety programme including an occurrence reporting and analysis programme, which shall be used by the management system in order to contribute to the aim of continuous improvement of safety; and

(viii) the service provider shall make arrangements to verify that the safety performance requirements of any system and constituent they operate are met at any time.

(b) ATC service provision shall not be undertaken unless the following conditions are met:

(i) the prevention of fatigue of personnel providing an ATC service shall be managed through a rostering system. Such a rostering system needs to address duty periods, duty time and adapted rest periods. Limitations established within the rostering system shall take into account relevant factors contributing to fatigue such as, in particular, sleep deprivation, disruption of circadian cycles, night hours, cumulative duty time for given periods of time and also the sharing of allocated tasks between personnel;

(ii) the prevention of stress of personnel providing an ATC service shall be managed through education and prevention programmes;

(iii) the ATC service provider shall have in place procedures to verify that the cognitive judgement of personnel providing ATC services is not impaired or their medical fitness insufficient;

(iv) the ATC service provider shall take into account operational and technical constraints as well as human factor principles in its planning and operations.

(c) Communication, navigation and/or surveillance service provision shall not be undertaken unless the following condition is met:

The service provider shall keep relevant airspace users and ATS units informed on a timely basis of the operational status (and changes thereof) of their services provided for ATS purposes.

(d) Training organisations

A training organisation providing training for personnel providing an ATC service shall meet the following requirements:

(i) have all the means necessary for the scope of responsibilities associated with their activity. These means comprise, but are not limited to, the following: facilities, personnel, equipment, methodology, documentation of tasks, responsibilities and procedures, access to relevant data and record-keeping;

(ii) implement and maintain a management system relating to safety and the standard of training, and aim for continuous improvement of this system; and

(iii) establish arrangements with other relevant organisations, as necessary, to ensure continuing compliance with these essential requirements.

Other related implementing rules and regulations:

ICAO Annex 4444 – Air Traffic Management

ICAO Doc 8168 – Aircraft operations

ICAO Annex 11 – Air Traffic Services

Commission Regulation (EC) No 1032/2006 laying down requirments for automatic systems for the exchange of flight data between ATC units

Commission Regulation (EC) No 1033/2006 laying down the requirments on procedures for flight plans in the pre-flight phase

Commission Regulation (EC) No 633/2007 laying down requirements for the application of a flight message transfer protocol for use by ATC units

Commisssion Regulation (EC) No 1265/2007 laying down requirements on air-ground voice channel spacing for the the Single European Sky

Commission Regulation (EC) No 29/2009 laying down requirements on data link services for the Single European Sky

Commisssion Regulation (EC) No 262/2009 laying down requirements for the coordinated allocation and use of Mode S interrogator codes for the Single European Sky

Commission Regulation (EC) No 73/2010 laying down requirements on the quality of aeronautical data and aeronautical information for the Single European Sky

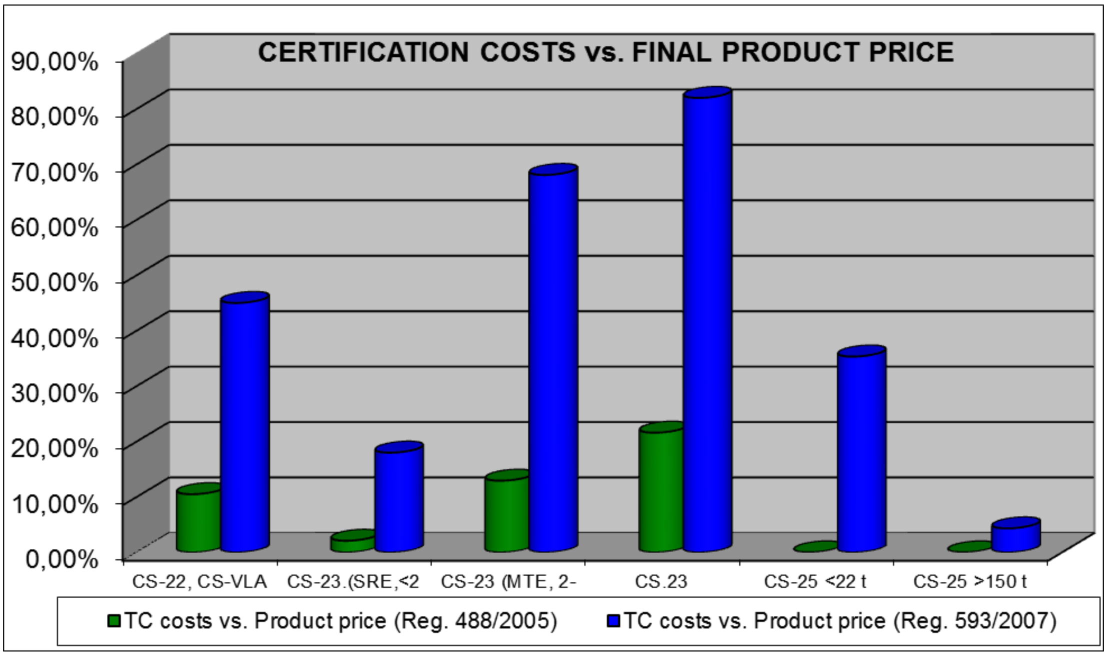
4. Conclusion

Certification of aircraft, engine, aircraft unit, aviation personnel or organization for GA is for most of companies developing, manufacturing, maintaining and operating the above mentioned products and using own licensed aviation personnel for maintenance of aircraft for GA quite a demanding activity from time, finances and administration point of view. The current aircraft regulations and directives which are issued by EASA, to a certain extent disadvantage certification, operation and maintenance of small manufacturers and operators of aircraft for GA against certification, operation and maintenance of aircraft of big European companies above all due to a higher administrative load which small aircraft operators must manage in an extent very close to big air carriers. Unfortunately, not always this increased administrative load results in enhancement of aircraft operation safety.

The above mentioned comparison of some of EASA and FAA aircraft regulations shows that the FAA regulations are in certain cases more liberal and thus they enable a larger development of this segment of aircraft transport (GA).

For a larger development of GA in Europe and in order to fulfill the idea of SAT-Rdmp project, the issue of comparing the costs of GA aircraft certification with big transport aircraft related to a ratio value (1PAX seat, person-km, etc.) should be open. Reduction of these costs will enable a larger development of GA aircraft transport segment (SAT) in Europe and it will open the way to the development of new airplanes for GA.

The below mentioned chart shows the ratio of the certification costs related to the final price of customer's airplane. From comparison it is obvious that the certification cost ratio is, owing to the product price in the SAT area, significantly higher than in the area of big airplanes and it can be supposed that with other change of the Commission Regulation on the fees and charges it will be even higher to the detriment of SAT category of aircraft. Of course, the use of new technologies in the SAT area will further increase financial costs of certification to the detriment of SAT area.
Another important aspect, which emphasizes unfavorably and insensitively set fees for initial airworthiness of aircraft in SAT system, is that in spite of the fact that the aircraft of CS-23 MTE category or CS-23 commuter category are designed by organization with full authorities of DOA holder according to Part 21, the percentage ration of certification costs is in these categories the highest in the whole assessed area.
The fees for running supervision, which such holders of DOA (DOA 1B, resp. DOA 1A category) pay, range from 20 000 € to 90 000 € depending on organization size. It is therefore obvious that the organizations designing aircraft of CS-23 MTE category or CS-23 commuter category pay considerable amounts for maintaining the system according to Part 21 usually with full authorities in the Design Assurance System area including independent verification (CVE). Such built-up system reduces involvement of EASA supervision only for the selected areas defined by certification program. All theses facts, however, are not sufficiently reflected in decreased level of certification costs for the aircraft of CS-23 MTE category or CS-23 commuter category.
In the chart the estimates of certification costs are used for the "usual" (standard) product in the given category and the usual price of such product in the given area. The carried out comparison of certification costs is made according to the original Regulation of fees and payments from the year 2005 (488/2005) and the currently valid regulation (593/2007).



In addition, the time demands and approach of national authorities and EASA organization to certification of this aircraft should be reassessed, namely in the case of certification of the aircraft staff for servicing and maintenance of this technology for GA.

The projects of Eurocontrol organization, like SESAR, etc, deal with the questions of ATM and ANS. Within the scope of these projects and suggestion of new legislative for ATM, ANS and airports, the commercial and non-commercial operation of small airplanes should also be taken into consideration within the frame of SAT project so that arrangement and control of this operation in lower and upper airspace should be just as effective in the future as the operation of airplane of higher categories than small airplanes in this airspace. In connection with the future increase of flight operation the loading of air traffic operators will be also proportionally increased. Within the scope of safe and continuous operation the fatigue of these air traffic operators and effective structure of their services and breaks during the services should be taken into consideration too.

In the case of fulfillment of the above mentioned suggestions for reassessment of European aircraft regulations issued by EASA organization and the approach to the question of aircraft certification, organizations and personnel for GA, this will have a positive influence on implementation of the ideas of SAT-Rdmp project and therefore on a possible development of this transport segment in Europe.

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