## Annex 1 (Relating to Articles 12-3, 14 and 56-2 and Appended Table 2)

# Standards for Strength, Structure and Performance to Ensure Safety of Aircraft and Equipment

### Chapter 1 General Provisions

1-1 These standards specify the strength, structure and performance standards needed to ensure the safety of aircraft and equipment.

1-2 These standards shall be applied by taking into consideration the airworthiness categories specified in 1-3.

1-3 The airworthiness categories of aircraft are as shown in the following table:

| Airworthiness category | Description |
|---|---|
| Airplane, normal N | An airplane with a maximum takeoff weight of 8,618kg or less and passenger seats of 19 or less |
| Airplane, transport T | An airplane suitable for air transport services |
| Rotorcraft, normal N | A rotorcraft with a maximum takeoff weight of 3,175kg or less |
| Rotorcraft, transport T Category A | A multi-engine rotorcraft suitable for air transport services that is capable of safe operation even when the critical engine stops |
| Rotorcraft, transport T Category B | A rotorcraft with a maximum takeoff weight of 9,080kg or less that is suitable for air transport services |
| Glider, acrobatic A | A glider with a maximum takeoff weight of 750kg or less that is suitable for normal flights and acrobatic flights |
| Glider, utility U | A glider with a maximum takeoff weight of 750kg or less that is suitable for normal flights or, in addition to normal flights, acrobatic flights, such as stall turns, steep turns, spins, lazy eights, chandelles and positive loops |
| Motor glider, acrobatic A | A glider with a maximum takeoff weight of 850kg or less that has a powerplant and is suitable for normal flights and acrobatic flights |
| Motor glider, utility U | A glider with a maximum takeoff weight of 850kg or less that has a powerplant and is suitable for normal flights or acrobatic flights including stall turns, steep turns, spins, lazy eights, chandelles and positive loops in addition to normal flights |
| Special aircraft X | Any aircraft not classified in any of the above categories |



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## Chapter 2 Flight

2-1 General

2-1-1 The performance and flying characteristics of an aircraft must be demonstrated through flight tests and other tests or calculations based on those tests. In this regard, calculation-based results must certainly be accurate to the same degree as or on the safer side than results based directly on tests.

2-1-2 The demonstration specified in 2-1-1 must be performed for all possible combinations of weight and center of gravity under expected operating conditions.

2-1-3 The determination of performance and the evaluation of flying characteristics at various flight stages must be performed under an appropriate configuration setup.

2-2 Performance

2-2-1 General

The performance of an aircraft must comply with the provisions of 2-2 under calm standard atmospheric conditions without requiring special skills or an excessive attentiveness for operation.

2-2-2 Takeoff

2-2-2-1 An aircraft must be capable of taking off safely with the engines which are operated within the limit of takeoff power or thrust.

2-2-2-2 An airplane whose airworthiness category is transport category airplane (hereinafter referred to as "airplane, transport T") and a specified airplane, normal N (limited to multi-engine airplane) must exhibit the following performance:

a. To be able to safely take off even if one of the critical engines stops after the aircraft speed reaches the critical speed or above.

b. To be able to climb to an altitude where the airplane is able to make one circling flight around the airport while maintaining that altitude under the condition that one of the critical engines remain inoperative even after the allowable operation time of takeoff power or thrust elapses and the remaining engines operating within the limit of the maximum continuous power or thrust.

c. To be able to climb at a gradient equal to or above the lowest limit required for safe operation at any point on the takeoff flight path.

2-2-2-3 A rotorcraft whose airworthiness category is transport category rotorcraft (hereinafter referred to as "rotorcraft, transport T") must be capable of safe landing at any point on the takeoff flight path even if the critical engine (one engine for a single-engine rotorcraft) stops.

2-2-3 Climb

An aircraft must exhibit climb performance that is equal to or above the lowest limit required for safe operation.

2-2-4 Landing

2-2-4-1 An aircraft must be able to continue flying up to the point where an approach can be commenced even after a missed approach while the critical engine is inoperative and the aircraft is in approach configuration.

2-2-4-2 An aircraft must be capable of safely re-climbing for a go-around while all engines are in operation and the aircraft is in approach configuration.

2-2-4-3 A rotorcraft must be capable of safely making an approach and landing by an autorotation while all engines are inoperative.

2-3 Flying Characteristics

2-3-1 Controllability

2-3-1-1 An aircraft must exhibit smooth, reliable, easy and quick controllability in vertical, horizontal and directional ways under all expected operating conditions (including taxiing on the ground or water).

2-3-1-2 An airplane, transport T, a specified airplane, normal N (limited to multi-engine airplane) and a rotorcraft, transport T must comply with the standards set in 2-3-1-1 even if the critical engine (one engine for single-engine rotorcraft) stops during a takeoff.

2-3-1-3 An aircraft must allow a shift to other operating conditions (including a change in engine power or thrust and a change in configuration) without requiring special skills, an excessive attentiveness or inordinate piloting skills for operation.

2-3-1-4 A multi-engine aircraft must comply with the standards set in 2-3-1-3 even if one or two engines (one engine for two-engine aircraft) stop.

2-3-2 Trim

2-3-2-1 An aircraft must, under all expected operating conditions, keep the attention and piloting skills required to maintain the vertical, horizontal and directional trim from becoming excessive in contrast to the flight stages and duration.

2-3-2-2 A multi-engine aircraft must comply with the standards set in 2-3-2-1 even if one or two engines (one engine for two-engine aircraft) stop.

2-3-3 Stability

An aircraft must, under all expected operating conditions, keep the attention and piloting skills required to maintain adequate vertical, horizontal and directional stability from becoming excessive in contrast to the flight stages and duration.

2-3-4 Stalling

2-3-4-1 An airplane or glider must be capable of safely and quickly recovering from a stall.

2-3-4-2 An airplane must be capable of clearly alerting the pilot upon entering stall conditions using a stall warning system.

2-3-5 Flutter and vibration

All part of an aircraft must be so designed that they do not cause flutter, violent buffeting or other excessive vibration under expected operating conditions.

## Chapter 3 Strength

### 3-1 General

3-1-1 The strength of an aircraft must be demonstrated through load tests or calculations. In this regard, calculation-based results must certainly be accurate to the same degree as or on the safer side than results based on tests.

3-1-2 An aircraft must comply with the standards set in this chapter for all possible combinations of weight and center of gravity and the most disadvantageous weight distribution under expected operating conditions.

3-1-3 An aircraft must comply with the standards set in this chapter under such load conditions as to be derived from the distribution of aerodynamic forces, inertial forces and other forces that fairly closely resembles the actual distribution under expected operating conditions or is on the safer side.

### 3-2 Flight Loads

3-2-1 An aircraft must not sustain harmful deformation if subjected to the following loads up to limit load levels and must withstand them at ultimate load levels:

a. Dynamic loads that are determined on the basis of maneuvering load factors corresponding to maneuvering movements allowed within the operating limitations and exceed values considered appropriate under expected operating conditions

b. Gust loads determined on the basis of vertical gust velocities, horizontal gust velocities and gust velocity gradients considered reasonable under expected operating conditions according to statistical and other data.

### 3-3 Ground Loads

3-3-1 An aircraft must not sustain harmful deformation if subjected to ground loads up to limit load levels and must withstand them at ultimate load levels. In this regard, landing conditions that determine ground loads shall include the aircraft attitude during a touchdown, symmetric landing conditions, asymmetric landing conditions and the descent rate, as well as causative factors that loads have on the structure under expected operating conditions.

### 3-4 Other Loads

3-4-1 An aircraft must not sustain harmful deformation if subjected to other loads that potentially occur under expected operating conditions (e.g. control loads, cabin pressurization load, engine torque load, configuration change load, winch towing load

and airplane towing load) up to limit load levels and must withstand them at ultimate load levels.

3-5 Flutter, Divergence and Vibration

3-5-1 An aircraft must be safe against flutter, structural divergence and structural deformation that decreases controllability at all speeds under expected operating conditions.

3-5-2 An aircraft must have adequate strength against vibration and buffeting that potentially occur under expected operating conditions.

3-6 Fatigue Strength

3-6-1 An aircraft must have adequate safety to prevent it from causing a fatal fatigue destruction due to repetitive loads and vibration loads that potentially occur under expected operating conditions.

## Chapter 4 Structure

4-1 General

4-1-1 The structure of an aircraft must be designed and manufactured in such a way that the effective and reliable functioning of all parts of the aircraft under expected operating conditions is convincingly guaranteed.

4-1-2 The guarantee described in 4-1-1 must be based on tests or appropriate research and investigation or deemed empirically reasonable. However, tests are mandatory for movable parts that are important for the safe operation of an aircraft.

4-1-3 All materials used for parts that are important for the safe operation of an aircraft must comply with standards approved by the Minister of Land, Infrastructure, Transport and Tourism.

4-1-4 Working and assembling methods must be reliable. In this regard, gluing, welding, heat treatment and other working processes that require precise control must be based on methods approved by the Minister of Land, Infrastructure, Transport and Tourism.

4-1-5 The structure of an aircraft must be protected against degradation or strength deterioration resulting from weathering, corrosion, wear and other causes.

4-1-6 The structure of an aircraft must accommodate inspections, replacements, adjustments and lubrication of movable parts required periodically and after expected severe operations.

4-2 Pilot Compartment

4-2-1 Control devices and operating devices must be so designed that they minimize confusion and operation errors.

4-2-2 The pilot compartment must be so designed that it minimizes the risk of the inaccurate or restricted control or operation actions of pilots due to fatigue, confusion, or hindrance presented by other flight crew. In this regard, consideration must be given to the arrangement of control devices, operating devices and instruments, identification thereof, identification of emergency equipment, control feel, ventilation, heating, noise, and so on.

4-2-3 The pilot compartment must be so designed that it provides a sufficiently wide, clear and undistorted field of vision and prevents exposure to direct or indirect light that obstructs the pilot's vision to ensure the safe operation of the aircraft.

4-2-4 The pilot compartment must be so designed that it secures an adequate field of vision even under precipitation conditions, both during normal flights and while making an approach and landing.

4-3 Emergency Devices

4-3-1 An aircraft must have devices designed to prevent the occurrence of emergency situations arise from predictable serious failures of its equipment or their associated systems.

4-3-2 An aircraft must have the necessary devices to allow it to continue flying or being controlled in the event of a failure of the critical engine.

4-4 Fire Protection

4-4-1 An aircraft must be designed in such a way as to minimize the occurrence of a fire either in flight or on the ground.

4-4-2 An aircraft must be enabled to seal off the site of a fire or detect and extinguish a fire.

4-5 Protection of Aircraft Occupants

4-5-1 An aircraft must be so designed that it is able to protect its occupants in the event of a loss of cabin pressure or the generation of smoke or toxic gas.

4-5-2 Low cabin pressure warning device - A low cabin pressure warning device must be so designed that it reliably operates when the air pressure in aircraft falls below the safety limit.

4-6 Emergency Landing Equipment

4-6-1 An aircraft must be so designed that it is able to protect its occupants from an impact and fire caused by an emergency landing.

4-6-2 An aircraft must have a system that allows its occupants to swiftly evacuate upon an emergency landing.

4-7 Consideration for Ground Operations

4-7-1 An aircraft must be so designed that there is no risk of damaging aircraft parts that are important for the safe operation of the aircraft caused by towing, maintenance, lubrication and other ground operations.

## Chapter 5 Powerplant

5-1 General

5-1-1 The powerplant installation must be capable of allowing the safe operation of the aircraft under expected operating conditions.

5-1-2 In the case of an aircraft for which allowing an engine or propeller that has developed a failure to continue rotating may increase the risk of a fire or serious structural destruction, the powerplant installation must be so designed that the flight crew can stop the rotation of the engine or reduce its rotating speed to safe levels during flight.

5-1-3 The powerplant installation must be capable of restarting the engines at all altitudes under expected operating conditions.

5-2 Independence, etc. of Powerplant

5-2-1 The powerplant must be arranged and installed in such a way that each powerplant can be operated and controlled independently.

5-2-2 The powerplant and associated systems must be installed in such a way that, with any normally predictable failure, the reduction in engine power or thrust due to the occurrence of a failure is not greater than the reduction in engine power or thrust due to the complete failure of the critical engine.

5-3 Propeller Vibration

5-3-1 The powerplant of an airplane must be installed in such a way that the vibration stress of the propellers does not exceed levels considered operationally safe under expected operating conditions of the airplane.

5-4 Cooling System

5-4-1 The cooling system must be capable of keeping the temperature of the powerplant compliant with the standard specified in 5-1-1 at all atmospheric temperatures up to the maximum expected atmospheric temperature during operation.

5-5 Other systems

5-5-1 The fuel system, lubrication system, air intake system and all other systems associated with the powerplant must be so designed that they are collectively capable of enabling the engines to suitably operate under all conditions expected during aircraft operation (e.g. in terms of engine power or thrust, altitude, acceleration, atmospheric conditions, fuel temperature and lubricating oil temperature). In this regard, the fuel (including water and alcohol) and lubricating oil used must comply with standards approved by the Minister of Land, Infrastructure, Transport and Tourism.

5-6 Fire Protection System

5-6-1 Firewall - An area accommodating such parts of the powerplant as to be of particularly great fire risk due to the proximity of a fire source and combustible materials (hereinafter referred to as a “fire zone”) must be isolated from areas that potentially endanger the continuous flight in the event of catching fire using a firewall by taking into consideration potential fire sources and fire propagation paths.

5-6-2 Fire protection for combustible fluid system

5-6-2-1 The structure of a combustible fluid system in a fire zone must be such that leakage of the combustible fluid does not occur if exposed to flames.

5-6-2-2 The combustible fluid system must be equipped with a device to stop the inflow of combustible fluid into a fire zone if a fire occurs in that area.

5-6-3 Fire detector - A fire zone must be equipped with a fire detector that is sufficient to detect a fire quickly and reliably.

5-6-4 Fire extinguishing system - A fire zone must be equipped with a fire extinguishing system capable of reliably extinguishing any fire occurring in that area. However, a fire extinguishing system may be omitted if there is no risk of a fire occurring in such an area endangering the flight depending on the degree of isolation, quantities of combustible materials, fire resistance of the structure and other factors.

## Chapter 6 Equipment

6-1 General

6-1-1 An aircraft must be furnished with the necessary equipment to allow expected operations to be carried out safely.

6-1-2 Equipment specified in 6-1-1 must be so designed that they are capable of functioning effectively and reliably.

6-1-3 Equipment specified in 6-1-1 must carry suitable signs indicating their types, functions and operational limits.

6-1-4 Aircraft equipment and their associated systems must be installed in such a manner as to not hinder safe aircraft operation.

6-2 Instrumental Equipment

6-2-1 Layout of instruments

6-2-1-1 The flight instruments, navigation instruments and powerplant instruments used by each flight crew must be laid out in such a manner as to be easily viewable to them.

6-2-1-2 In the case of a multi-engine aircraft, powerplant instruments must be laid out in such a manner as to prevent misidentification of instruments with regard to their corresponding engines.

6-2-2 Vibration characteristics of instrument panel - The instrument panel must not have such vibration characteristics as to spoil the accuracy of instruments or lead to their destruction.

6-2-3 Error of instruments - Instruments must be so designed that they operate with an error range that does not hinder the safe operation of the aircraft.

6-3 Electrical System and Electrical Equipment

6-3-1 Electrical system installation - The electrical system must be installed in such a way as not to endanger the occupants of the aircraft.

6-3-2 Storage batteries - The storage batteries must be capable of supplying the electric power needed to allow all the equipment connected thereto to suitably operate during expected aircraft operation.

6-3-3 Power generator system - The power generator system must be capable of supplying the electric power needed to allow all the equipment connected to it to suitably operate during expected aircraft operation.

6-3-4 Power shutdown device

6-3-4-1 The electrical system must be fitted with power shutdown devices so that each power source can be cut off from the corresponding power distribution system at a point adjacent to it.

6-3-4-2 A power shutdown device must be so designed that it can be easily operated by the flight crew during flight.

6-3-5 Safety devices - The electric circuit to each equipment must be fitted with a re-connectable safety device.

6-3-6 Electric cable - Electric cables must comply with standards approved by the Minister of Land, Infrastructure, Transport and Tourism.

6-4 Lights

6-4-1 Instrument lights

6-4-1-1 Instrument lights must be so designed that they illuminate all the instruments, switches and the like used by the flight crew to make to easy identification and reading possible.

6-4-1-2 Instrument lights must be installed in such a way that their direct or reflected rays of light do not have an adverse effect on the flight crew.

6-4-2 Landing lights

6-4-2-1 Landing lights must comply with standards approved by the Minister of Land, Infrastructure, Transport and Tourism.

6-4-2-2 Landing lights must be installed at such locations as to make it possible to provide the necessary illumination for night landings and in such a way that their direct or reflected rays of light do not have an adverse effect on the flight crew.

6-4-3 Navigation lights (anti-collision lights, starboard lights, port side lights and tail lights)

6-4-3-1 Navigation lights must enable other aircraft and people on the ground to visually identify the aircraft's position and traveling direction with speed and accuracy by taking into consideration expected operating conditions and conditions of the surroundings at the time they are turned on.

6-4-3-2 Navigation lights must be installed in such a way that their direct or reflected rays of light do not have an adverse effect on the flight crew.

6-5 Safety Equipment

6-5-1 First-aid kit must be furnished in such a way that they can be easily handled by the flight crew member in an emergency with the methods of their use clearly indicated.

6-5-2 Safety belts, etc. - Safety belts, shoulder belts and straps must comply with standards approved by the Minister of Land, Infrastructure, Transport and Tourism.

6-5-3 Oxygen supply equipment - Oxygen supply equipment must be capable of supplying oxygen at the flow rate and for the duration necessary to protect the occupants of the aircraft under expected aircraft operating conditions.

6-5-4 Anti-ice system - The anti-ice system must be so designed that it operates reliably under expected weather conditions.

6-6 Hydraulic System

6-6-1 The hydraulic system must have an adequate level of safety under expected operating conditions. In this regard, the hydraulic oil used must comply with standards approved by the Minister of Land, Infrastructure, Transport and Tourism.

6-7 Electronic Equipment

6-7-1 Electronic instruments and their associated devices must be installed in such a way as to not endanger the occupants of the aircraft under expected aircraft operating conditions.

6-7-2 Electronic instruments must be so designed that they do not generate electric noise that adversely affects other equipment during their use.

6-8 Radio communications equipment

6-8-1 Radio communications equipment must be installed in such a way as to not endanger the occupants of the aircraft under expected aircraft operating conditions.

6-8-2 Radio communications equipment must be so designed that it does not generate electric noise that adversely impacts other equipment during its use.

6-8-3 Radio communications equipment must maintain a level of accuracy needed to ensure safe aircraft operation and function reliably under expected aircraft operating conditions.

## Chapter 7 Engines

7-1 General

7-1-1 Engines installed on an aircraft as sources of propulsion power must be designed and manufactured in such a way that their effective and reliable functioning under expected operating conditions is convincingly guaranteed.

7-2 Tests

7-2-1 The guarantee specified in 7-1-1 must be demonstrated through the following tests:

a. Performance test - A test to determine the output characteristics or thrust characteristics of an engine
b. Operation test - A test to demonstrate that the operation characteristics of an engine relating to startup, deceleration, acceleration, vibration, over-revolution and the like are appropriate and that the engine possesses an adequate margin to deal with detonation, surging and other detrimental events
c. Durability test - A test to demonstrate the durability and reliability of an engine
d. Other necessary tests

## Chapter 8 Propellers

8-1 General

8-1-1 Propellers installed on an aircraft must be designed and manufactured in such a way that their effective and reliable functioning under expected operating conditions is convincingly guaranteed.

8-2 Tests

8-2-1 The guarantee specified in 8-1-1 must be demonstrated through the following tests:

a. Operation test - A test to demonstrate that the characteristics relating to strength, vibration and over-revolution are appropriate and that the pitch changing mechanism and operation mechanism function properly

b. Durability test - A test to demonstrate the durability and reliability of a propeller

c. Other necessary tests

**Chapter 9 Special Aircraft**

9-1 Provisions of Chapter 2 through the preceding chapter do not apply to an aircraft whose airworthiness category is special aircraft X (hereinafter referred to as “a special aircraft X”).

9-2 A special aircraft X must be capable of safe operation under expected operating conditions.



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