These features provide a high degree of tolerance to failures, malfunctions, and human error. Paragraph CS 25.783 intends that the latching system be designed so that it is inherently or specifically restrained from being back-driven from the latches; but even so, the latches are designed to eliminate, as much as possible, all forces from the latch side that would tend to unlatch the latches. In addition to these features that prevent the latches from inadvertently opening, a separate locking system is required for doors that could be a hazard if they become unlatched. Notwithstanding these safety features, it could still be possible for the door operator to make errors in closing the door, or for mechanical failures to occur during or after closing; therefore, an indicating system is required that will signal to the flight crew if the door is not fully closed, latched, and locked. However, since it is still possible for the indication to be missed or unheeded, a separate system is required that prevents pressurisation of the aeroplane to an unsafe level if the door is not fully closed, latched, and locked.

**The following material restates the requirements of CS 25.783 in italicised text and, immediately following, provides a discussion of acceptable compliance criteria**.

CS 25.783(a) **General Design Considerations**

This paragraph applies to fuselage doors, which includes all doors, hatches, openable windows, access panels, covers, etc., on the exterior of the fuselage that do not require the use of tools to open or close. This also applies to each door or hatch through a pressure bulkhead, including any bulkhead that is specifically designed to function as a secondary bulkhead under the prescribed failure conditions of CS-25. These doors must meet the requirements of this paragraph, taking into account both pressurised and unpressurised flight, and must be designed as follows:

(a)(1) Each door must have means to safeguard against opening in flight as a result of mechanical failure, or failure of any single structural element.

Failures that should be considered when safeguarding the door against opening as a result of mechanical failure or failure of any single structural element include those caused by:

— wear;

— excessive backlash;

— excessive friction;

— jamming;

— incorrect assembly;

— incorrect adjustment;

— parts becoming loose, disconnected, or unfastened;

— parts breaking, fracturing, bending or flexing beyond the extent intended.

(a)(2) Each door that could be a hazard if it unlatches must be designed so that unlatching during pressurised and unpressurised flight from the fully closed, latched, and locked condition is extremely improbable. This must be shown by safety analysis.

All doors should incorporate features in the latching mechanism that provide a positive means to prevent the door from opening as a result of such things as:

— vibrations;

— structural loads and deflections;

— positive and negative pressure loads, positive and negative 'g' loads;

— aerodynamic loads etc.

The means should be effective throughout the approved operating envelope of the aeroplane including the unpressurised portions of flight.

The safety assessment required by this regulation may be a qualitative or quantitative analysis, or a combination as appropriate to the design. In evaluating a failure condition that results in total failure or inadvertent opening of the door, all contributing events should be considered, including:

— failure of the door and door supporting structure;

— flexibility in structures and linkages;

— failure of the operating system;

— erroneous signals from the door indication systems;

— likely errors in operating and maintaining the door.

(a)(3) Each element of each door operating system must be designed or, where impracticable, distinctively and permanently marked, to minimise the probability of incorrect assembly and adjustment that could result in a malfunction.

Experience has shown that the level of protection against mechanical failure can be significantly improved by careful attention to detail design. The following points should therefore be taken into account:

(a) To minimise the risk of incorrect assembly and adjustment, parts should be designed to prevent incorrect assembly if, as a result of such incorrect assembly, door functioning would be adversely affected. "Adverse effects" could be such things as preventing or impeding the opening of the door during an emergency, or reducing the capability of the door to remain closed. If such designs are impracticable and marking is used instead, the marking should remain clearly identifiable during service. In this respect, markings could be made using material such as permanent ink, provided it is resistant to typical solvents, lubricants, and other materials used in normal maintenance operations.

(b) To minimise the risk of the door operating mechanism being incorrectly adjusted in service, adjustment points that are intended for "in-service" use only should be clearly identified, and limited to a minimum number consistent with adequate adjustment capability. Any points provided solely to facilitate adjustment at the initial build and not intended for subsequent use, should be made non-adjustable after initial build, or should be highlighted in the maintenance manual as a part of the door mechanism that is not intended to be adjusted.

(a)(4) All sources of power that could initiate unlocking or unlatching of each door must be automatically isolated from the latching and locking systems prior to flight and it must not be possible to restore power to them during flight.

For doors that use electrical, hydraulic, or pneumatic power to initiate unlocking or unlatching, those power sources must be automatically isolated from the latching and locking systems before flight, and it should not be possible to restore power to them during flight. It is particularly important for doors with powered latches or locks to have all power removed that could power these systems or that could energise control circuits

to these systems in the event of electrical short circuits. This does not include power to the door indicating system, auxiliary securing devices if installed, or other systems not related to door operation. Power to those systems should not be sufficient to cause unlocking or unlatching unless each failure condition that could result in energising the latching and locking systems is extremely improbable.

(a)(5) Each removable bolt, screw, nut, pin, or other removable fastener must meet the locking requirements of CS 25.607. [Fasteners]

Refer to AMC 25.607 for guidance on complying with CS 25.607.

(a)(6) Certain fuselage doors, as specified by 25.807(h), must also meet the applicable requirements of CS 25.809 through 25.812 for emergency exits.

CS 25.783(b) **Opening by persons**

There must be means to safeguard each door against opening during flight due to inadvertent action by persons.

The door should have inherent design features that achieve this objective. It is not considered acceptable to rely solely on cabin pressure to prevent inadvertent opening of doors during flight, because there have been instances where doors have opened during unpressurised flight, such as during landing. Therefore all doors should incorporate features to prevent the door from being opened inadvertently by persons on board.

In addition, for each door that could be a hazard, design precautions must be taken to minimise the possibility for a person to open a door intentionally during flight. If these precautions include the use of auxiliary devices, those devices and their controlling systems must be designed so that:

(1) no single failure will prevent more than one exit from being opened, and

(2) failures that would prevent opening of any exit after landing must not be more probable than remote.

The intentional opening of a door by persons on board while the aeroplane is in flight should be considered. This rule is intended to protect the aircraft and passengers but not necessarily the person who intentionally tries to open the door. Suitable design precautions should therefore be taken; however, the precautions should not compromise the ability to open an emergency exit in an emergency evacuation. The following precautions should be considered:

(a) For doors in pressurised compartments: it should not normally be possible to open the door when the compartment differential pressure is above 13.8 kPa (2 psi). The ability to open the door will depend on the door operating mechanism and the handle design, location and operating force. Operating forces in excess of 136 kg (300 pounds) should be considered sufficient to prevent the door from being opened. During approach, take-off and landing when the compartment differential pressure is lower, it is recognised that intentional opening may be possible; however, these phases are brief and all passengers are expected to be seated with seat belts fastened. Nevertheless flight experience has shown that cabin staff may cycle door handles during take-off in an attempt to ensure that the door is closed, resulting in door openings in flight. For hazardous doors CS 25.783(e)(2) intends to provide a positive means to indicate to the door operator after closure of the door on the ground, that the door is not properly closed, latched and locked. CS

25.783(e)(2) will minimise, but can not prevent the deliberate cycling of the door handle by the cabin staff during take-off.

(b) For doors that cannot meet the guidance of (a) above, and for doors in non-pressurised aeroplanes: The use of auxiliary devices (for example, a speed-activated or barometrically-activated means) to safeguard the door from opening in flight should be considered. The need for such auxiliary devices should depend upon the consequences to the aeroplane and other occupants if the door is opened in flight.

(c) Auxiliary devices installed on emergency exits: The failure of an auxiliary device should normally result in an unsecured position of the device. Failures of an auxiliary device that would prevent opening of the exit after landing should not be more probable than Remote (1x10-5/flight hour). Where auxiliary devices are controlled by a central system or other more complex systems, a single failure criterion for opening may not be sufficient. The criteria for failure of the auxiliary device to open after landing should include consideration of single failures and all failure conditions that are more probable than remote. In the assessment of single failures, no credit should be given to dormant functions.

The opening of exits on the ground should also be considered in the design, relative to the effects of differential pressure. While it is desirable and required to be able to open exits under normal residual differential pressure, opening of the exit with significant differential pressure can be a hazard to the person opening the exit. Clearly, emergency conditions may dictate that the exit be opened regardless of the differential pressure. Devices that restrict opening of the door, or affect the pressurization system, can have failure modes that create other safety concerns. However, the manufacturer should consider this issue in the design of the door and provide warnings where necessary, if it is possible to open a door under differential pressure that may be hazardous to the exit operator.

CS 25.783(c) **Pressurisation prevention means**

There must be a provision to prevent pressurisation of the aeroplane to an unsafe level if any door subject to pressurisation is not fully closed, latched, and locked.

(c)(1) The provision must be designed to function after any single failure, or after any combination of failures not shown to be extremely improbable.

(a) The provisions for preventing pressurisation must monitor the closed, latched and locked condition of the door. If more than one lock system is used, each lock system must be monitored. Examples of such provisions are vent panels and pressurisation inhibiting circuits. Pressurisation to an unsafe level is considered to be prevented when the pressure is kept below 3.447 kPa (1/2 psi). These systems are not intended to function to depressurise the aeroplane once the fully closed latched and locked condition is established and pressurisation is initiated.

(b) If a vent panel is used, it should be designed so that, in normal operation or with a single failure in the operating linkage, the vent panel cannot be closed until the door is latched and locked. The vent panel linkage should monitor the locked condition of each door lock system.

(c) If automatic control of the cabin pressurisation system is used as a means to prevent pressurisation, the control system should monitor each lock. Because

inadvertent depressurisation at altitude can be hazardous to the occupants, this control system should be considered in showing compliance with the applicable pressurisation system reliability requirements. Normally, such systems should be automatically disconnected from the aeroplane's pressurisation system after the aeroplane is airborne, provided no prior unsafe condition was detected.

(d) It should not be possible to override the pressurisation prevention system unless a procedure is defined in the Master Minimum Equipment List (MMEL) that confirms a fully closed, latched and locked condition. In order to prevent the override procedure from becoming routine, the override condition should not be achievable by actions solely on the flight deck and should be automatically reset at each door operational cycle.

(c)(2) Doors that meet the conditions described in sub-paragraph (h) of this paragraph are not required to have a dedicated pressurisation prevention means if, from every possible position of the door, it will remain open to the extent that it prevents pressurisation or safely close and latch as pressurisation takes place. This must also be shown with any single failure and malfunction except that:

(i) with failures or malfunctions in the latching mechanism, it need not latch after closing, and

(ii) with jamming as a result of mechanical failure or blocking debris, the door need not close and latch if it can be shown that the pressurisation loads on the jammed door or mechanism would not result in an unsafe condition.

As specified in CS 25.783(d)(7), each door for which unlatching would not result in a hazard is not required to have a locking mechanism; those doors also may not be required to have a dedicated pressurisation prevention means. However, this should be determined by demonstrating that an unsafe level of pressurisation cannot be achieved for each position that the door may take during closure, including those positions that may result from single failures or jams.

— Excluding jamming and excluding failures and malfunctions in the latching system, for every possible position of the door, it must either remain open to the extent that it prevents pressurisation, or safely close and latch as pressurisation takes place;

— With single failures of the latching system or malfunctions in the latching system the door may not necessarily be capable of latching, but it should either remain open to the extent that it prevents pressurisation, or safely move to the closed position as pressurisation takes place; and

— With jamming as a result of mechanical failure in the latching system or blocking debris, the pressurisation loads on the jammed door or mechanism may not result in damage to the door or airframe that could be detrimental to safe flight (both the immediate flight or future flights). In this regard, consideration should be given to jams or non-frangible debris that could hold the door open just enough to still allow pressurisation, and then break loose in flight after full pressurisation is reached.

CS 25.783(d) **Latching and locking**

The latching and locking mechanisms must be designed as follows:

(d)(1) There must be a provision to latch each door.

(a) The definitions of latches and locks are redefined in Chapter 3 [Definitions of Terms], particularly in regard to mechanical and structural elements of inward-opening plug doors. In this regard, fixed stops are not considered latches. The movable elements that hold the door in position relative to the fixed stops are considered latches. These movable elements prevent the door from opening and will support some loads in certain flight conditions, particularly when the aeroplane is unpressurised.

(b) For all doors, sub-paragraph CS 25.783(d)(2) requires that the latching system employ a securing means other than the locking system. The separate locking system may not be necessary for certain doors with an initial inward movement (see CS 25.783(d)(4)).

(d)(2) The latches and their operating mechanism must be designed so that, under all aeroplane flight and ground loading conditions, with the door latched, there is no force or torque tending to unlatch the latches. In addition, the latching system must include a means to secure the latches in the latched position. This means must be independent of the locking system.

The latches of doors for which the initial opening movement is outward are typically subject to vibrations; structural loads and deflections; positive and negative pressure loads; positive and negative 'g' loads; aerodynamic loads; etc. The latches of doors for which the initial opening movement is inward typically share some of these same types of loads with fixed stops. Doors for which the initial opening movement is inward tend to be resistant to opening when the aircraft is pressurised since a component of the pressure load tends to hold the door closed.

(a) Latch design. The design of the latch should be such that with the latch disconnected from its operating mechanism, the net reaction forces on the latch should not tend to unlatch the latch during both pressurised and unpressurised flight throughout the approved flight envelope. The effects of possible friction in resisting the forces on the latch should be ignored when considering reaction forces tending to unlatch the door. The effects of distortion of the latch and corresponding structural attachments should be taken into account in this determination. Any latch element for which 'g' loads could result in an unlatching force should be designed to minimise such forces.

(b) Latch securing means. Even though the principal back-driving forces should be eliminated by design, it is recognised that there may still be ratcheting forces that could progressively move the latches to the unlatched position. Therefore, each latch should be positively secured in the latched position by its operating mechanism, which should be effective throughout the approved flight envelope. The location of the operating system securing means will depend on the rigidity of the system and the tendency for any forces (such as ratcheting, etc.) at one latch to unlatch other latches.

(c) Over-centre features in the latching mechanism are considered to be an acceptable securing means, provided that an effective retaining feature that functions automatically to prevent back-driving is incorporated. If the design of the latch is such that it could be subject to ratcheting loads which might tend to unlatch it, the securing means should be adequate to resist such loads.

(d) Back-driving effect of switches. In those designs that use the latch to operate an electrical switch, any back-driving effect of the switch on the latch is permissible, provided that the extent of any possible movement of the switch

— is insufficient to unlatch it; and

— will not result in the latch being subjected to any other force or torque tending to unlatch it.

(e) The latch securing means must be independent of the locking means. However, the latching and locking functions may be fulfilled by a single operating means, provided that it is not possible to back-drive the locks via the latch mechanism when the door locks are engaged with the latch mechanism.

(d)(3) Each door subject to pressurisation, and for which the initial opening movement is not inward must:

(i) have an individual lock for each latch;

(ii) have the lock located as close as practicable to the latch; and

(iii) be designed so that during pressurised flight, no single failure in the locking system would prevent the locks from restraining the latches necessary to secure the door.

(a) To safeguard doors subject to pressurisation and for which the initial opening movement is not inward, each latch must have an individual lock. The lock should directly lock the latch. In this regard, the lock should be located directly at the latch to ensure that, in the event of a single failure in the latch operating mechanism, the lock would continue to restrain the latch in the latched position. Even in those cases where the lock cannot be located directly at the latch, the same objective should be achieved. In some cases, a pair of integrally-connected latches may be treated as a single latch with respect to the requirement for a lock provided that:

1) the lock reliably monitors the position of at least one of the load carrying elements of the latch, and

2) with any one latch element missing, the aeroplane can meet the full requirements of CS-25 as they apply to the unfailed aeroplane, and

3) with the pair disengaged, the aeroplane can achieve safe flight and landing, and meet the damage tolerance requirements of CS 25.571 [Damage-tolerance and fatigue evaluation of structure].

(b) In some designs more latches are provided than necessary to meet the minimum design requirements. The single failure requirement for the locking system is intended to ensure that the number and combination of latches necessary to secure the door will remain restrained by the locking mechanism. Only those latches needed to meet the minimum design requirements need to remain restrained after the single failure.

(c) In meeting this requirement, the indirect locking provided through the latch system by the locks at other latches may be considered. In this case, the locking system and the latching system between the locked latch and the unlocked latch should be designed to withstand the maximum design loads discussed in sub-paragraph d.(6) of this AMC, below, as appropriate to pressurised flight.

(d)(4) Each door for which the initial opening movement is inward, and unlatching of the door could result in a hazard, must have a locking means to prevent the latches from becoming disengaged. The locking means must ensure sufficient latching to prevent opening of the door even with a single failure of the latching mechanism.

For a door to be classified as having Initial Inward Opening Movement before opening outwards, and thus be eligible for some relief regarding the locks compared with other outward opening doors, the following conditions should be fulfilled:

a) Loads on the door resulting from positive pressure differential of the fuselage should be reacted by fixed (non moveable) structural stops on the door and fuselage doorframe.

b) The stops must be designed so that, under all 1g aeroplane level flight conditions, the door to fuselage stop interfaces produce no net force tending to move the door in the opening direction.

c) If the stops are used to provide the initial inward opening movement, the stops should be designed such that they cause the door to move inwards, typically at a minimum angle of 3° relative to the mean pressure plane, opposing any positive fuselage pressure differential:

1) until the door is in a position where it is clear of the fixed stops and is free to open, or

2) until the loads required to overcome friction between the door and fuselage stops are sufficient to prevent the door moving in an opening direction when the door is subjected to loads of +/- 0.5g, or

3) if neither of the above options are appropriate, based on justified engineering judgement and agreed with the Agency.

d) If guides or other mechanisms are used to position the door such that it can move clear of the fixed stops in an opening direction, the means used should, be designed such that it causes the door to move inwards, typically at a minimum angle of 3° relative to the mean pressure plane, opposing any positive fuselage pressure differential and be sufficiently robust to function without significant loss of effectiveness when the door is subject to a differential pressure of 13.8 kPa (2 psi):

1) until the door is in a position where it is clear of the fixed stops and is free to open, or

2) until the loads required to overcome friction are sufficient to prevent the door moving in an opening direction when the door is subjected to loads of +/- 0.5g,or

3) if neither of the above options are appropriate, based on justified engineering judgement and agreed with the Agency.

On these doors, the locking means should monitor the latch securing means, but need not directly monitor and lock each latch. Additionally, the locking means could be located such that all latches are locked by locking the latching mechanism. With any single failure in the latching mechanism, the means must still lock a sufficient number of latches to ensure that the door remains safely latched.

(d)(5) It must not be possible to position the lock in the locked position if the latch and the latching mechanism are not in the latched position.

The lock should be an effective monitor of the position of the latch such that, if any latch is unlatched, the complete locking system cannot be moved to the locked position. Although an over-centre feature may be an adequate means of securing the latching mechanism, it is not considered to be the locking means for the latches.

(d)(6) It must not be possible to unlatch the latches with the locks in the locked position. Locks must be designed to withstand the limit loads resulting from:

(i) the maximum operator effort when the latches are operated manually;

(ii) the powered latch actuators, if installed; and

(iii) the relative motion between the latch and the structural counterpart.

Although the locks are not the primary means of keeping the latches engaged, they must have sufficient strength to withstand any loads likely to be imposed during all approved modes of door operation. The operating handle loads on manually-operated doors should be based on a rational human factors evaluation. However, the application of forces on the handle in excess of 136 kg (300 pounds) need not be considered. The loads imposed by the normal powered latch actuators are generally predictable; however, loads imposed by alternate drive systems are not. For this reason the locks should have sufficient strength to react the stall forces of the latch drive system. Load-limiting devices should be installed in any alternate drive system for the latches in order to protect the latches and the locks from overload conditions. If the design of the latch is such that it could be subject to ratcheting loads which might tend to unlatch it, the locks should be adequate to resist such loads with the latch operating system disconnected from the latch.

(d)(7) Each door for which unlatching would not result in a hazard is not required to have a locking mechanism meeting the requirements of sub-paragraph (d)(3) through (d)(6) of this paragraph.

See sub-paragraph CS 25.783(h) of this AMC, below, for a description of doors for which unlatching is considered not to result in a safety hazard.

(d)(8) A door that could result in a hazard if not closed, must have means to prevent the latches from being moved to the latched position unless it can be shown that a door that is not closed would be clearly evident before flight.

For door security, it is good basic design philosophy to provide independent integrity in the closing, latching, locking and indication functions. The integrity of the closing function in particular is vulnerable to human factors and experience has shown that human error can occur resulting in an unsafe condition.

Door designs should incorporate a feature that prevents the latches from moving to the latched position if the door is not closed. The importance of such a feature is that it

prevents the latched and locked functions from being completed when the door is not closed.

If the feature is provided by electronic means, the probability of failure to prevent the initiation of the latching sequence should be no greater than remote ($1x10^{-5}$/flight hour).

To avoid the potential for an unsafe condition, the means provided to indicate the closed position of the door under sub-paragraph (e) should be totally independent of the feature preventing initiation of the latching sequence.

As an alternative to providing the feature described above, reliance can be placed on trained cabin crew or flight crew members to determine that certain doors are not fully closed. This alternative is applicable only to doors that are normally operated by these crew members, and where it is visually clearly evident from within the aircraft without detailed inspection under all operational lighting conditions that the door is not fully closed.

CS 25.783(e) **Warning, caution and advisory indications**

Doors must be provided with the following indications:

(e)(1) There must be a positive means to indicate at each door operator's station that all required operations to close, latch, and lock the door(s) have been completed.

In order to minimise the probability of incomplete door operations, it should be possible to perform all operations for each door at one station. If there is more than one operator's station for a single door, appropriate indications should be provided at each station. The positive means to indicate at the door operator's station that all required operations have been completed are such things as final handle positions or indicating lights. This requirement is not intended to preclude or require a single station for multiple doors.

(e)(2) There must be a positive means, clearly visible from each operator station for each door that could be a hazard if unlatched, to indicate if the door is not fully closed, latched, and locked.

A single indication that directly monitors the door in the closed, latched and locked conditions should be provided unless the door operator has a visual indication that the door is fully closed latched and locked. This indication should be obvious to the door operator. For example, a vent door or indicator light that monitors the door locks and is located at the operator's station may be sufficient. In case of an indicator light, it should not be less reliable than the visual means in the cockpit as required per CS 25.783(e)(3). The same sensors could be used for both indications in order to prevent any discrepancy between the indications.

(e)(3) There must be a visual means on the flight deck to signal the pilots if any door is not fully closed, latched, and locked. The means must be designed such that any failure or combination of failures that would result in an erroneous closed, latched, and locked indication is remote for:

(i) each door that is subject to pressurisation and for which the initial opening movement is not inward, or

(ii) each door that could be a hazard if unlatched.