Airworthiness Requirements

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Who sets them:

Civilian:
European Aviation Safety Agency – Certification Specifications (CS)
Federal Aviation Administration – Federal Aviation Regulations (FAR)
Civil Aviation Authority - British Civil Airworthiness Requirements (BCAR)

Military
UK Ministry of Defence – Defence Standards (Def Stan)
US Department of Defence – Military Stantadrs (Mil-Std & Mil-Spec)

Key parts – Civilian:

Part 1 – Definitions
Part 11 – General rule-making procedures

Part 21 – Certification Procedures for Products, Articles, and Parts
Part 22 – Sailplanes and powered sailplanes
Part 23 – Normal, Utility, Acrobatic, and Commuter category airplanes (merges with VLA in 2017)
Part 25 – Transport category airplanes
Part 27 – Small Rotorcraft
Part 29 – Transport Rotorcraft
Part 36 – Aircraft noise

Part E – Engines
Part P – Propellers

Also provide framework for certification of persons and organizations

Key parts – Military:

Number	Title
MIL-F-8785B	Flying Qualities of Piloted Airplanes
MIL-F-83300	Flying Qualities of Piloted V/STOL Aircraft
MIL- F- 9490	Flight Control Systems- Design, Installation and Test of Piloted Aircraft
MIL- S-8369	Stall/Post- Stall/Spin Flight Test Demonstration Requirements for Airplanes
MJL-C- 18244	Control and Stabilization Systems: Automatic, Piloted Aircraft
MIL-D- 8708	Demonstration Requirements for Airplanes
MIL-A-8860 through 8864 and 8870	Airplane Strength and Rigidity
MIL-P-26366	Propellers, Type Test of
MIL-I-8700	Installation and Test of Electronics Equipment in Aircraft
MIL-S- 18471	Seat System, Ejectable, Aircraft
MIL-W-25140	Weight and Balance Control Data
MIL-STD-850	Aircrew Station Vision Req. for Military Aircraft
MIL-STD-757	Reliability Evaluation from Demonstration Data
MIL- C- 5011	Charts; Standard Aircraft Characteristics and Performance
MIL-STD-881	Work Breakdown Structure (WBS)

Classification of Civilian Aircraft:

	Part 23		Part 25
MTOW	< 12,500 lbs	< 19,000 lbs	-
Category	normal, utility and aerobatic	commuter	transport
Min Number of Engines	1 or more	2 or more	2 or more
Types of Engines	All	Propeller	All
Flight Crew	1 or more	2	2 or more
Cabin Crew (Part 121)	None	1	< 10 pax: 0 ≥ 10 pax: 1 >50 pax: 1/50 pax
Max passengers	10	10 - 19	
Max altitude	25,000 ft (except for high speed aeroplanes)		No limit

Performance Requirements:

	Part 23		Part 25
MTOW	< 12,500 lbs	< 19,000 lbs	-
Category	normal, utility and aerobatic	commuter	transport
Engine Failure in Takeoff	no		yes
Accelerate-stop	none	limited	complete stop
Wet runway	none	none	yes
OEI Climb capability	yes for given MTOWs and if 2 engines or more		yes

Flight Characteristics Requirements:

	Part 23		Part 25
MTOW	< 12,500 lbs	< 19,000 lbs	-
Category	normal, utility and aerobatic	commuter	transport
Lateral c.g. shift	no		included
Minimum control speed	Related to stall speed at MTOW		Related to LOF and stall speed
Spin characteristics	complete	limited	none
Maneuver load factor margin in cruise	no		Avoid buffet

Structural Design & Construction Requirements:

	Part 23		Part 25
MTOW	< 12,500 lbs	< 19,000 lbs	-
Category	normal, utility and aerobatic	commuter	transport
Maneuver and gust load envelope	limited for single engine	yes	yes
Fatigue evaluation	for pressure cabin, wing and associated structure		fail-safe, safe-life fatigue evaluation of major parts
Fail-safe/safe-life	for wing and carry-through structure		specified throughout
Bird-proof windshield	no	no	no
Descent velocity limit for undercarriage loads	dependent on W_L/S max but $\leq$ 10 ft/s		10 ft/s
Max cabin pressure alt. after system failure	no	no	15,000 ft
Special emergency provisions for pax.	no	limited	yes

Systems Requirements:

	Part 23		Part 25
MTOW	< 12,500 lbs	< 19,000 lbs	-
Category	normal, utility and aerobatic	commuter	transport
Powerplants and related systems	Limited independence	Complete independence	Complete independence
System redundancy	no	Essential functions duplicated	throughout
Restarting capability of powerplant	no	yes	yes
Equipment for adverse weather flight (IFR)	no	yes	yes
Ice protection	no	limited	yes

Takeoff Specifications

	MIL-C5011A (military)	Part 23 (Civil)	Part 25 (Commercial)
Velocities	$V_{TO} \geq 1.1V_S$ $V_{CL} \geq 1.2V_S$	$V_{TO} \geq 1.1V_S$ $V_{CL} \geq 1.2V_S$	$V_{TO} \geq 1.1V_S$ $V_{CL} \geq 1.2V_S$
Climb	Gear up: 500 fpm @ S.L. (AEO) 100 fpm @ S.L. (OEI)	Gear up: 300 fpm @ SL (AEO - FAR) (SC much more stringent)	See next slide
Field-length required definition	Actual Takeoff distance over 50-ft obstacle	Actual Takeoff distance over 50-ft obstacle (35 ft for high speed or commuter)	115% of actual takeoff distance over 35-ft obstacle or balanced field length
Rolling friction coef.	$\mu = 0.025$	not defined	not defined

Landing Specifications

	MIL-C5011A (military)	Part 23 (Civil)	Part 25 (Commercial)
Velocities	$V_A \geq 1.2V_S$ $V_{TD} \geq 1.1V_S$	$V_A \geq 1.3V_S$ $V_{TD} \geq 1.15V_S$	$V_A \geq 1.3V_S$ $V_{TD} \geq 1.15V_S$
Field-length required definition	Landing distance over 50-ft obstacle	Landing distance over 50-ft obstacle	5/3 x Landing distance over 50-ft obstacle
Braking friction coef.	$\mu = 0.3$	not defined	not defined

Part 25 – Climb requirements

V_{s_0} = stall speed in landing configuration for reciprocating-engine-powered airplanes.

V_{s_1} = stall speed in a specified configuration for reciprocating-engine-powered airplanes.

V_2 = climbout speed over 35-ft obstacle. LOF: liftoff.

Turbine-Engine Aircraft: FAR 25

All segments with one engine stopped, except go-around in landing configuration, which has all engines operating. Engine power or thrust set at "maximum rated", except being "maximum continuous" for third-segment climb. Maximum thrust attained after 8 s from flight idle for go-around. AEO: all engines operating.

Operation	Speed	Flaps	Landing gear	Minimum climb gradient for aircraft with n engines, %		
				$n = 2$	$n = 3$	$n = 4$
Takeoff Climb						
First-segment	LOF	Takeoff	Down	≥ 0	0.3	0.5
Second-segment	V_2[a]	Takeoff	Up	2.4	2.7	3.0
Third-segment	$\geq 1.25V_s$[b]	Up	Up	1.2	1.4	1.5
Landing						
Go-around in approach configuration	$\leq 1.5V_s$[b]	Approach	Up	2.1	2.4	2.7
Go-around in landing configuration	$\leq 1.3V_s$[b] AEO	Landing	Down	3.2	3.2	3.2

[a]Over 35-ft obstacle. [b]Stall speed in the pertinent condition.