Guidance for functions and subjective evaluation of an airplane FSTD

Primary reference document (**PRD, such as CS-FSTD(A)**) gives a list of required functions and subjective tests that must be performed. The following documents should be used to make the testing more effective:

- **RAeS 'Aeroplane Flight Simulator Evaluation Handbook vol II'** should be used. It gives clear guidance on how to effectively check each item.
- **Flight manuals (AFM, FCOM, etc.)** should be used to ensure that the FSTD's systems and performance match the simulated aircraft.
- **Training requirements** give information on what training is required. When the FSTD is used for that training, it should fulfill the training need. So training requirements give good items what to check during the functions and subjective testing of an FSTD.
- **OSD reports** list specific training requirements for each aircraft type. That information should be used and checked that the FSTD can be used for that specific training.

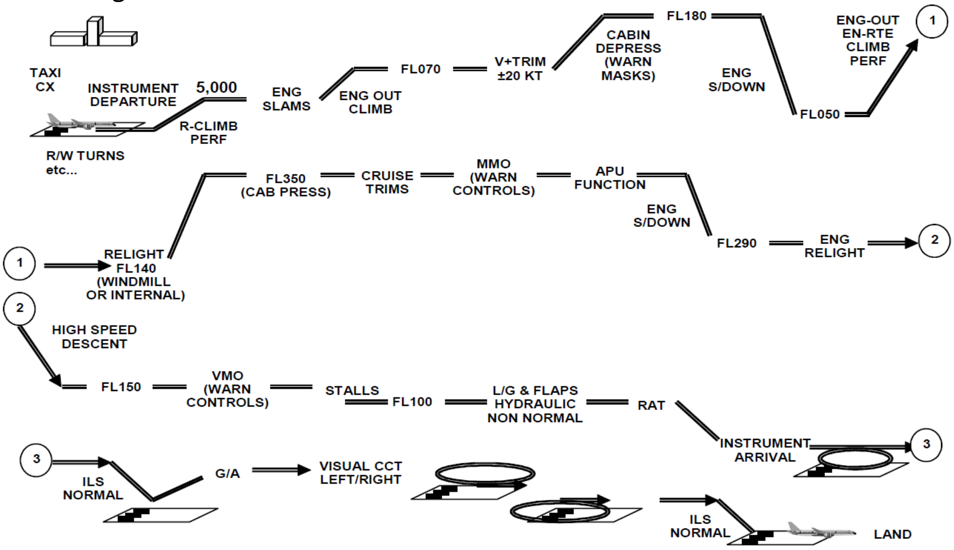
The table below summarizes many aspects that could and should be checked. However, this table is not a complete list for any device, so it is not usable alone. Also, the table focuses only light on system simulation since that is always unique for each aircraft type. The FSTD should be compared to the manuals (AFM, FCOM, etc.) whenever possible.

So functions and subjective test flight should always be tailored for each FSTD and aircraft type. The table below should be used as guidance to raise further ideas on what and how to check during functions and subjective testing.

It is important that the test team remember these points for every tested item:

- How much different is the FSTD from real aircraft? How and where do you notice it?
- Has the handling of FSTD changed since last time?
- Is the device suitable for the training task in question?
- Does the device and its systems match the flight manual?
- Is the integration of the device good, i.e. are all the cues (control loading, flight dynamics, visual, motion, instruments, sounds…) given in correct sequence in a realistic manner?

The table below is not too usable alone because of its length. Therefore, it is recommended to prepare a customized and abbreviated 'working checklist' for each evaluation. Also note that AMC1 ARA.FSTD.100(a)(3) gives a typical profile for the flight:



Item	TEST	DETAILS	REMARKS
A.	**Documents, walk-around, safety items**	See Traficom FSTD Form F17	
B.	**Cockpit**	• Replica of aircraft • Cockpit system panels • Limit placards • Buttons, switches and levers should have same look & feel as in real A/C • Controls: feel, free-play, break-out force, force vs. position, friction, return to center when released • Seats / harness • Headsets • Chart holder • Flash lights • Fire extinguisher, dummy or inspection date…………….) • Cut-off switch / switches • Check no disturbing intrusion of outside light	Included also in Traficom FSTD Form F17
C.	**Cockpit power off check**	Check that systems are not powered when electrical power is OFF → Only systems powered by hot battery bus should be powered.	
D.	**Electrical power supply**	Battery Master ON → Check: • Battery, voltage …………. EXT electrical power ON • Check voltage …………. • Check power distribution • Check synoptic APU start • Normal start → Check power distribution • Fire during start → Auto shutdown	
E.	**Pre-flight checks**	Check cockpit lights and dimming **Pre-start checklists as per normal check lists.** → Check different self-tests of systems. **Sampling check of all sub-systems:** • Cockpit lights & dimming • Annunciator lights • Circuit breakers • Display failure → Display composite format	

F.	**FMS programming**	Check FMS software version …………………….. Check NAV database validity …………………….. Insert planned route → Save flight plan to IOS Sample different features, such as: • temporary/secondary flight plan • changes to flight plan (e.g. delete waypoint, select direct-to…) • ETA & optimum level for different CI • When OAT is higher, the optimum flight level should be lower • optimum level for different winds • exclude NAV aids such as VOR • RAIM prediction (automatic / manual?) • change of take-off runway • change flex temperature to min/max • create a new waypoint • add manual holding pattern	
G.	**Normal flight preparation and ground checks**	Use normal checklists Check time for IRS alignment ………………… Perform all pre-flight checks. List major items in remarks-column and/or tick them below: • stall warning, stick shaker/pusher • fire detection • annunciators • autopilot system • EFIS Sample checks that are not included in normal checklists. For example: • EGPWS • TCAS • WXR	
H.	**Engine starts**	Sample different cases: • normal start • start in very cold OAT (expect oil pressure rise and slow warm up) • hung start • hot start → Check EGT rise and cracking to cool engine • start by X-bleed • start with battery power only (i.e. no external power) • start with rotor brake (if installed, e.g. ATR) • start valve fault • manual / automatic start cycle Check: • All engine parameters and their acceleration (N1, N2, RPM, FF…) • EGT → FF vs. EGT for malfunction cases • associated systems (e.g. hydraulics) • motion and sound cues • time to reach engine running stable • warnings associated to start malfunctions • do not react to malfunction (e.g. let EGT rise too high for hot start)	

I.	**Pushback or powerback**	Check: • Check final position after pushback • Indication on gate guidance or marshaller at stand • Parking brake ON before/during pushback	
J.	**Taxi and thrust**	Check: • Power response vs. weight to start moving → Engine power at which A/C start moving: …………………..… → Repeat this for using asymmetric power (OEI): …………………..… • Required power to maintain stable taxi speed: …………………..… • Repeat for multiple different weights and CGs • Power lever friction • Asymmetric thrust vs. turning momentum • Pitch attitude changes vs. engine power (depending on type due to oleo strut deflection)	
K.	**Taxi handling**	Check: • Brake operation: → varying amount → normal & alternate braking systems → test from left/right pilot pedals → observe FSTD latency (i.e. motion & visual cues together) • Nosewheel scuffing: threshold speed left/right, dry/wet, slow/quick tiller turns • Different runway frictions & conditions • Runway rumble • Effect of heavy cross wind • Minimum radius turn (e.g. 180˚) • Motion cues for turns: if cue for initial acceleration (for a taxiing turn) is too strong, the motion cue for engine failure might be way too much	
L.	**Visual system on ground**	Check: • Visual database (terminals, runways, taxiway signs, lights, stop bars…) • Day, twilight, night • CAT I, CAT II, CAT III, LVTO • Check correspondence with taxi charts • Record perceived RVR on runway • Weather effects: rain, snow, blowing snow, thunderstorm • Moving ground traffic/hazard	
M.	**Take-off configuration warning**	Select wrong configuration (see FCOM) and use take-off thrust or push-button to activate take-off configuration test. Check for correct caution or warning.	
N.	**Take-off power against brakes**	Select take-off power (different flex temperatures and TOGA) against brakes: • record engine parameters (see separate table) and compare to FCOM • check motion vibration • check sounds	

<table>
<tr><td>O.</td><td>Take-off</td><td>Flap setting ………………..… → Check different flap settings for take-off
Take-off power ………………..…… → Check different thrust ratings (e.g. flex, TOGA) for take-off

Weather conditions / effects: …………………………

Check:
engine take-off thrust (N1, EPR, TRQ…) vs. FCOM/AFM
nose-wheel and rudder steering
acceleration characteristics (visual and motion cueing)
sounds
FMA & flight director indications & modes
systems (e.g. engine power, FD, FMA, EFIS, autothrust, sequencing)
take-off runway ILS alignment
handling (e.g. runway tracking, rotation) & control inputs
short field take-off procedure
flight control system failure (e.g. control jam, fly-by-wire inop…)
gear retraction cues
motion cues
Check simulation & fidelity by varying these:
different T/O flaps → compare sensitiveness
different weight (MTOW, medium, light)
different CG (even out of limits)
deliberately wrong stabilizer trim value
max flex temp / TOGA
different OAT
contaminated runway
LVTO (this highlights the motion cues!)
Check special cases:
tail strike due to too early rotation → check motion cue
pod strike due to excessive bank during rotation → check motion cue</td><td>Flight director modes to be found in FCOM page ………………..…

Autothrust description for take-off to be found in FCOM page ………………..…</td></tr>
<tr><td>P.</td><td>Climb</td><td>Climb to FL………………..…

Check sequencing of flap/slats.
→ Check pitch changes due to configuration changes.
→ Check drag/acceleration due to configuration changes.

Check FMS and AP modes (e.g. select HDG mode during SID and then re-couple to NAV mode)</td><td></td></tr>
<tr><td>Q.</td><td>Communications</td><td>Check communications (VHF, HS, SELCAL, SATCOM) through loudspeaker, hand mike, headsets between pilots and instructor
Check both transmit and receive functions and volume control
Check use of all radios
Check intercom
Check idents of nav aids
Check ATIS (if simulated)</td><td></td></tr>
<tr><td>R.</td><td>Visual system in air</td><td>Check:
FEW, SCT, BKN and OVC clouds at different altitudes
scud clouds
visibility 10 km, 30 km, unlimited
ground fog and slant visibility
patchy fog
day, twilight, night
reflection of aircraft light from cloud</td><td></td></tr>
</table>

S.	**Engine failure**	Select engine flame-out. Check: • autopilot OFF: free response with/without yaw damper • autopilot ON: autopilot should have no problem in controlling at cruise speeds • engine and system indications (e.g. loss of elec & hyd systems) • APU start (while airborne) to give elec & hyd power	
T.	**Performance checks**	See separate tables for recording data. Sample different cases: Check OEI cruise performance (or drift down) at different flight levels and compare to FCOM. Check OEI climb performance and compare to FCOM. Check AEO cruise performance at different flight levels and compare to FCOM. → Compare fuel flow at high altitude to fuel flow at low altitude. The fuel flow is the amount of chemical energy, so it is basically an indication of thrust. At high altitude the thrust and fuel flow should be only perhaps 1/3 of the value at sea level. Check AEO climb performance and compare to FCOM. In case of 3-4 engine aircraft, repeat test also for 2 engines inoperative.	
U.	**Engine restart**	Check FCOM for the windmill restart envelope. Perform windmill restart.	
V.	**TCAS**	Simulated version of TCAS is: …………………………… Use separate guidance at the end of this checklist. Check: • Correct pilot actions • Wrong pilot actions (to see that RA changes accordingly) • TA only mode (should not give RA) • Targets in visual (day, twilight, night) • Different QNH vs. intruder's altitude • RA's at different altitudes • See more at: GM1 CAT.OP.MPA.295	
W.	**Storm front**	Check • visual presentation (day, twilight, night) • use of weather radar functions (e.g. tilt) • weather radar presentation of storm vs. IOS image • penetrate storm and check visual, sound and motion cues • check turbulence within the storm	

X.	**Flight director, autopilot and autothrust systems**	Check: • use all available autopilots (e.g. AP1 & AP2) • FMA indications for all flight phases • coupling of flight director to different NAV sources (e.g. VOR & GPS) • sensitivity of flight director (e.g. too aggressive vs. too sluggish) for different altitudes and airspeeds • operation of all lateral modes • operation of all vertical modes • go-around mode • couple AP with no FD modes selected → what mode (e.g. wings level, pitch hold) is activated? (see FCOM) • very high cross-wind vs. ability to maintain track • intercepting/capturing track at different angles • roll angles (i.e. lower bank angle at higher altitudes?) • CWS • autopilot disengagement criteria (see FCOM, e.g. pushbutton, use of trim, AoA limit, hight pitch…) • malfunctions and integration to other systems (e.g. when attitude source is failed, AP should not be able to be coupled in that mode) • For generic devices, see criteria of operation in CS 23.1329 (“Automatic pilot system”).	Any other special FD/AP/AT feature to be evaluated? → FCOM reference: ………………………..

Y.	**Manual flying characteristics**	Evaluate at two (or more) different altitudes (low and high, e.g. 5000 ft and FL350). → Evaluated at FL………….. and FL………….. Check: • Turns (30˚ / 45˚ / 60˚) → Check how easily the aircraft rolls. → Check how easy it is to maintain bank angle. → Check need for pulling yoke for high bank angles. → Check IAS decrease or need for more power. • How easy it is to trim for straight level flight • Very slow flight (1.1Vs) → Check stability vs. airspeed (AoA increase creates more drag and IAS lowers quickly) → Check control forces • Stick force gradient ('sensitivity') for different flaps (at low altitude) → Pull/push out of trim IAS and release slowly → IAS returns to ±10% of original (CS 23.173, 25.173) • Deceleration / acceleration response (power, pitch, IAS) • Spiral stability (see QTG case for reference): establish bank angle and release controls to see if return to wings level. • Sideslip: For swept wing aircraft, sideslip results in more rolling moment than on straight-wing aircraft → Check drag effect (IAS decrease) for sideslip • Short period oscillations heavily damped (controls free or in a fixed position, CS 23.181, 25.181) • Oscillations: Dutch roll initiated by pedals (YD on/off), Phugoid initiated by stick (CS 23.181, 25.181) • Rate of climb (RoC) proportionality to TAS: → For a given attitude change, the RoC depends on TAS. → Test a 3˚ pitch change <u>at the same IAS</u> at low and high altitude. At high altitude, the RoC change should be noticeably greater (e.g. ≈2x higher) due to higher TAS. • Roll rate (CS 23.157): → Flaps T/O, gear UP, a roll from 30º to opposite 60º may take 5 sec (<2722kg) or 10 sec (>2722kg) → Flaps LDG, gear DN, a roll from 30º to opposite 60º may take 4 sec (<2722kg) or 7 sec (>2722kg)	Compare flying characteristics between low/high altitudes. Describe observations below:

Z.	**Manual flying characteristics for computer controlled aircraft (fly-by-wire)**	Evaluated at FL…………… → Check: • Flight envelope protection functions (e.g. high AoA, bank angle and overspeed protection) • For non-normal control state (e.g. 'alternate/direct law'): → Check associated indications (e.g. PFD & synoptic) → Check loss of associated systems (e.g. AP) → Check loss of protections → Check handling characteristics: stability and sensitivity **→ Test this for all flight phases (e.g. approach & landing)!** **→ Test for example go-around!** • Rudder input: → Max rudder deflection is controlled depending on IAS and altitude. → Test max pedal input for different situations (IAS / ALT) and compare rudder deflection (e.g. on synoptics).	Write selected malfunctions and FCOM reference below:
AA.	**High altitude & high speed maneuvering specific features**	Evaluated at FL…………… Check: • At high altitude the aerodynamic damping decreases. Can this be felt in maneuvering (high vs. low alt) as increased sensitiveness? • Bank angle vs. buffet cues (see data on FCOM) • Check high altitude handling with/without yaw damper. • Descent to exceed Mmo / Vmo → Check required pitch attitude. → Check pitch / roll sensitivity and control forces. → Check overspeed warning. • Mach tuck (if type is sensitive to it) Climb close to '**coffin corner**' (i.e. altitude where Vs = Vmo) and check (FL……………): • Maneuvering 'window'. → Any maneuvering should result in buffet (low or high speed buffet) and stall/overspeed warning. • Engine thrust vs. OAT → Increase OAT slowly from the IOS. → Engine thrust decreases and forces to a descent.	
BB.	**Manual power/thrust management**	Check: • Sensitivity of power levers vs. engine parameter • Symmetry of power levers (i.e. are they side by side when engine parameters are identical?) • Power reserve vs. altitude: → Record time (sec) to accelerate through certain speeds (e.g. 50 kts change). Compere low/high altitude.	

CC.	**Navigation**	Check: • All NAV sources → Cross-check bearing to a station e.g. by using VOR and GPS • Use of all modes on navigation displays (e.g. rose mode, HSI, etc.) • Holding pattern • Use of stand-by instruments (e.g. RMI vs. different VOR stations) • FMS/GPS flight plan changes & prediction functions • Enroute / terminal navigation accuracy ('actual navigation accuracy' ANP or 'estimated position uncertainty' EPU) vs. RNP • Vertical profile (e.g. top of descent vs. cost index) • Speed → increase of TAS vs. IAS → cross-over altitude above which IAS reference is changed with Mach (depending on OAT) • Select malfunction to use data from another system → Check indications (e.g. color codes) • Cone of confusion of NAV beacons	
DD.	**System normal operation**	• Sampling of all systems (e.g. normal mode, manual mode, back-up mode, etc.). Check indications, features and functions. • Compare to FCOM, AFM, etc. • For generic devices, see CS 23 Subpart F ("Equipment") for requirements.	
EE.	**System failures**	Sample malfunctions of different systems / emergencies. Write the selected malfunctions below: • Electrical, hydraulic, instrumentation, etc… → Select malfunctions & check reference from FCOM • Navigation: multiple system failures (e.g. GPS & DMEs) → Check IR drift vs. time. → Check warning for when actual navigation performance (ANP/EPU) exceeds the required navigation performance (RNP) • Cabin rapid depressurization or smoke: → Check use & condition of oxygen masks → Check communications with oxygen masks → Emergency descent to FL80. Check altitude where pressurization warning goes off (≈FL130-100). • Alternative gear extension → Check malfunction 'triggering' from the IOS at certain IAS, ALT, etc.	

FF.	**Stall**	Check <u>approach to stall</u>. → Record data (see separate table) and compare to FCOM: • different flap configurations • bank angle (e.g. 35°) • different GW and CG • accelerated approach to stall (i.e. pull-up) • after ice accumulation in icing conditions • fly manually and with AP (e.g. ALT HLD and reduce power) Check also <u>full stall</u>, but understand that (at the moment) the simulation is *validated* only to stall warning and not below that. Check: • Subjectively assess the level of buffet/vibration associated to stall (generally it is too low). • Stall warning comes minimum of 5 kts before stall (CS 23.207) and continue until stall • Acceptable indications of stall: a) nose down pitch moment, b) buffeting, c) pitch controller fully aft and no increase in pitch attitude (CS 23/25.201) • Stall characteristics: a) controls may not be reversed, b) roll for stall & recovery must be below about 20°, c) no excessive bank angle for turning stall (CS 25.203), d) roll and yaw controlling must be possible down to Vs (CS 25.203 & 23.201) Check stall at <u>high altitude</u>. → Stall should happen at a lower AoA due to shock waves. → Also there can be more nose down momentum due to shock waves. Check also <u>ballistic trajectory</u>: → Fly a ballistic trajectory. Airplane should go *below Vs* speed. → Pitch control is then not available. Stall recovery is possible only after gravity accelerates A/C enough.	
GG.	**Upsets - UPRT**	Check recovery from unusual attitudes. • See a separate Traficom's UPRT / CS-FSTD(A) issue 2 (Form F10) checklist at https://www.traficom.fi/en/transport/aviation/flight-simulators-and-other-fstds • See other possible test scenarios in UPRT training guides at: http://flightsafety.org/archives-and-resources/airplane-upset-recovery-training-aid https://www.icao.int/safety/LOCI/AUPRTA/index.html	

HH.	**PBN operations**	Check:
		
		• GPS functions:
		  • GPS requires 4 satellites to calculate 3D position.
		  • RAIM requires 5 satellites.
		  • Fault detection and exclusion (FDE) requires 6 satellites.
		
		• Insert STAR and **RNAV/RNP approach** to flight plan.
		
		• Check AP flying the STAR and vertical profile.
		
		• Check sequencing of waypoints. Compare to chart.
		
		• Check terminal area navigation accuracy (RNAV 1 capability if AFM refers to AC90-100, see GM2 CAT.IDE.A.345)
		→ Check that AP flies STAR with AP / FD
		→ Check navaid exclusion (FMS function)
		
		• RNAV (GNSS) or RNAV (RNP) approach (manual / autocoupled)
		→ Check that GPS is primary nav system
		→ Compare approach procedure (RNP value, fixes, speed & alt constraints) on EFIS/FMS to approach chart
		
		• Check VNAV capabilities & indications (if applicable)
		• Check APC (Baro/VNAV or SBAS) if applicable
		
		• Set freezing outside air temperature
		→ Check VNAV approach profile
		
		• Check go-around and RNAV navigation
		
		• For RNAV (RNP) approach:
		→ Check transition from cruise phase to RNP AR app
		→ Set strong **<u>crosswind</u>** and check navigation accuracy on RF leg
		→ Set strong **<u>tailwind</u>** and check that flies correct <u>RF leg radius</u> (see ICAO Doc 9905 Table 3-2 b: 38 kts for turns at 1000 ft AGL, 50 kts for turns at 1500 ft AGL, 60 kts for turns at 4000 ft AGL)
		→ Check max bank angle is 20˚ (see ICAO Doc 9905 Table 3-3)
		→ Check aural advisories / warnings
		→ Check TOGA to LNAV transition
		→ Check go-around during RF leg
		→ Check engine failure at any stage of approach
		
		• Select a GNSS related malfunction
		→ Check caution/warning
		→ Check NAV indications & RAIM
		→ Compare GPS and IRU coordinates to see that there is a difference
		→ Check warning for **ANP > RNP**	

II.	**Descent**	Check: • Turns with/without speed brake while descending → Does the speed brake affect the roll rate in this type? • Optimum vertical path (CDFA) • Autocoupled • Maximum rate descent (clean and with speed brake) → Check sound cues.	

JJ.	**Precision approach**	Check: • Check FD modes and indications • Check different LOC interception angles (e.g. 30˚ / 60˚) and speeds • CAT I, CAT II, CAT III, high/low OAT • Autocoupled approach → Check trimming need when AP is disconected • Manual approach with/without FD • Autothrust on/off • System operation (e.g. ILS, RA, call-outs…) as in FCOM • Visual contact at selected height • Autoland operation (critical X-wind, weight or CG or engine failure at any point of approach) → Check roll-out • Select very cold OAT (e.g. -30˚C) and fly ILS. Check that altimeter temperature error is simulated. → Glideslope is captured closer to THR (see DME) than in ISA. Check also associated malfunctions: • FMS failure for autoland above/below alert height • GEN failure for autoland • Anti-skid failure	
KK.	**Non-precision approach**	Perform non-precision approach (e.g. VOR, NDB, LOC) Check indications and system operations.	
LL.	**Go-around / missed approach**	Check engine failure at any stage of the approach Check go-around: • Soon after IAF → How does FD sequencing function when G/A altitude is very close? • Close to minima • After touch-and-go landing Check • Warning of AP decoupling • TOGA thrust • **Check FD go-around mode** • Motion cue Check different cases: • Manual flight / autocoupled • **All engines** operating go-around • **Engine failure** during go-around → Sample multiple different engine failures, like **<u>engine structural damage and simultaneous fire</u>**	

<table>
<tr><td>MM.</td><td>AEO approach and landing</td><td>Check:
Normal approach and landing
→ Assess all the cues!
→ Check system operation (e.g. triggering of spoilers, use of reversers, braking systems, etc.)
Check that approach path and track can be maintained with small control inputs → Check that ILS sensitivity increases as distance to runway decreases
Trimming need → For a stabilized approach the need for trimming in final approach is minimal
Deliberately fly out of GS or LOC
→ Re-join approach path/track. Check operation of instruments, warnings for excessive deviation and handling characteristics.
Zero flap landing
→ Check pitch attitude and lower drag
Different gross weights, including MLW with aft CG and low weight with forward CG.</td><td></td></tr>
<tr><td>NN.</td><td>OEI approach and landing</td><td>Check:
Controlling and trimming on each axis:
power, roll, pitch, rudder
→ <u>Control one axis at the time.</u> Observe the need to adjust another axis due to that (e.g. increase power, adjust pedal input, adjust pitch & roll, trim…)
→ Check that controlling is logical and as expected.
AP coupled approach → Check AP trimming
Manual approach (FD / raw data) in CAT I/CAVOK
→ Check FSTD latency!
With varying wind velocities/vectors and gusts
Autoland (if applicable for the type)</td><td></td></tr>
<tr><td>OO.</td><td>Post landing</td><td>Check:
Spoiler operation
Reverse thrust
Directional control and ground handling
Reduction of rudder effectiveness with reverse thrust for rear pod mounted engines
Autobrake
Brake and anti-skid operation (dry, wet, contaminated)
Motion cues
Taxi to center & sides of runway to check ILS/LOC indication
Taxiing to gate → Check visual</td><td></td></tr>
</table>

PP.	**Visual system for approach**	Check that landing/go-around decision can be made at MDA/DH. Check different weather conditions (visibility/RVR and cloud height for day, twilight, night) during approach. → Check cloud-break and ground contact. → Check gradual break-out. Check distance from where different lights can be seen. CS-FSTD(A): • Runway definition, strobe lights, approach lights, and runway edge white lights from 8 km (4.3 nm) of the runway threshold • Runway centerline lights and taxiway from 5 km (2.7 nm) • Threshold lights and touchdown zone lights from 3 km (1.6 nm) • Runway markings within range of landing lights for night scenes as required by the surface resolution test on day scenes Check light intensity settings (0-5).	
QQ.	**Visual system airport model content**	For FFS level C and D from CS-FSTD(A): Airport buildings, markings, taxiway lighting, etc. may be *representative*, but approach lighting systems shall be *appropriate*. **But for the three specific airport scenes:** • accurate portrayal of airport • ramps and terminal buildings • all lights have appropriate color, directionality, behavior and spacing • terrain, geographical and cultural features • multiple ground and air hazards	
RR.	**Visual approach**	Check visual approach and visual cues Review airport visual model from 2000 ft AGL. → Check different weather conditions. Check approach with/without PAPI lights. → Check visual for attitude, sink rate and depth perception cues. Check circling at minimum weather. → Check directionality and intensity of runway lights (day, twilight, night).	

SS.	**Rejected take-off**	Reposition to T/O position. Check: • Rejected take-off with no engine failure → Check spoilers and autobrake (their use & triggering) → Check reverse thrust • Engine failure below **Vmcg** → Check controllability with aerodynamic controls only (i.e. disconnect nose wheel steering) by maintaining power and full pedal until heading can be controlled → Max pedal force 667 N (CS 23.149, 25.149) • Engine failure **before V1** → Check dry runway → Check contaminated runway → Check autobrake on/off → Check MTOW & low gross weight → Check TOGA / flex power → Check very slow pilot reactions → Check FD indications & lateral guidance → Check brake temperature and brake fade (i.e. another try) Evaluated for T/O flap settings ………………………. Check motion cueing for rejected take-off: If braking starts soon after initial acceleration (i.e. no time for motion washout), the motion cue might be too strong.	
TT.	**Continued take-off**	Reposition to T/O position. Check: • Engine failure **after V1** → Check different gross weights (MTOW & low) → Check TOGA / flex power → Check very slow pilot reactions (i.e. free response to dynamic engine failure): <u>note yaw, roll & pitch responses</u> to engine failure → Check FD indications & guidance → Check warnings & take-off inhibit functions → Check continued take-off with some cross-wind (from more critical side). Check that wind cock effect and engine failure yaw summarize correctly. → Check pitch attitude & acceleration to V2 → For turbo-props: test also failure of autofeather → Check automatic thrust increase on operative (if applicable) → Check with/without rudder pedal booster (if installed) • Climb to MSA Evaluated for T/O flap settings ………………………. and weights ……………………….	

UU.	**OEI flying characteristics**	Check: • OEI flying characteristics: → Check required rudder trim setting (…………) to maintain minimum drag attitude → Check sideslip angle (i.e. HDG vs. TRK) for minimum drag attitude → Check the whole scale of rudder trim → Check rudder trim and wheel input vs. IAS and engine power • Vmca (compare to FCOM) → Test Vmca with wings level and with 5° bank towards operative engine (with slip-ball 1/2 or 1/3 towards operating engine). For wings level the Vmca is higher (≈8 kts for small twin, 30 kts for four-engine airplane) due to sideslip. → Pedal force max 667N (CS 23.149, 25.149) → With a 5° bank, Vmca is highest for these conditions: • low weight • aft CG • low altitude • low OAT • flaps up • engine failure of the critical engine → With wings level, the weight does not affect Vmca. → If Vs≈Vmca, then expect a strong rolling moment at Vmca. → For swept wings, sideslip (e.g. below Vmca) gives rolling moment. • Lateral control → It must be possible to make 20˚ banked turns to both directions in OEI, with the operative engines at MCT (steady flight at 1.3 VS, gear up/down, flaps 2nd segm) (CS 25.147)	
VV.	**Icing**	Fly straight and level. Select icing conditions (e.g. OAT -5˚ and IMC). Select anti-ice equipment OFF. Select icing accumulation ON from the IOS. Check: • Pitch angle (as well as AoA) increase • IAS reduce • Stall warning AoA is reduced • Any icing warnings if applicable to the type • Engine vibrations and/or power loss Then select anti-ice equipment ON and check if they can melt and detach ice, i.e. performance returns normal.	
WW.	**Low visibility take-off**	Set RVR to minimum allowed (below 125 m requires specific guidance). Check visual system. Check lateral guidance during take-off run.	
XX.	**Windshears**	Test multiple take-off and approach windshears and micro-bursts. Check: • FD guidance during windshear → Can AP be coupled? • warning systems and all indications • aural cues • motion cues • strong turbulence on multiple (or all) axis • power reserve (i.e. from flex T/O power to TOGA)	

YY.	**Crosswind**	Select max cross wind (90˚ left/right) It is minimum 0.2 x landing configuration stall speed (VS0), see CS 23.233, 25.237 Evaluated for T/O flap setting ………………………. <u>Take-off.</u> Check: • Motion effect of crosswind while stationary • Weathercock effect vs. IAS • Up-wind wing raises during take-off run • Lift-off: yawing into the wind & roll downwind → motion cue • Different cases: → Pilots do not control yaw at all (i.e. free pedal & wheel) → Normal pilot actions → Very light aircraft with aft CG (effects are greatest) <u>Traffic circuit.</u> Check: • Drifting with wind → Check crab angle • Ground speed (e.g. base leg length vs. wind direction) • Wind vector calculation on EFIS • Check turbulence <u>Landing.</u> Check: • With/without turbulence • Left/right hand side patterns → Check visual edge blending • Crab angle • Ground effect → Does the cross wind effect weaken? • Flare and required controls → Check motion cue • Deceleration and rudder effectiveness • Check max crosswinds for contaminated runway to stay on the runway	
ZZ.	**GPWS / EGPWS**	See separate page at the end of this checklist. Check for example: • flying towards a mountain • RA indication when flying low on mountains • descending after take-off • flying too low on approach path • terrain contour pop-up display • aural call-outs • See more at GM1 CAT.OP.MPD.290	
AAA.	**Landing in abnormal situation**	Check applicable cases. For example: • minimum flap/slats • total hydraulic failure • minimum / standby electrical power • all engine out landing • over weight landing • strong tail wind → check landing distance • with trim malfunctions • landing with no spoiler (due to a malfunction): there should be a strong pitch up moment at touchdown • tire failure or gear collapse on landing	

TCAS

See also CAT.IDE.A.155 and GM1 CAT.OP.MPA.295 and EASA ETSO-C118 and ETSO-C119.

- **TCAS II ver 7.1:** Required in Europe for all new aircrafts after 1 March 2012. Required for all aircraft after 1 Dec 2015. Same as ver 7.0 with the following changes:
  - CP112E: Aircrafts on same level. → Pilot reacts in **opposite direction** to RA, so both aircraft start climb or descent. → Situation should result in **reversal** climb/descent.
  - CP115: RA "Adjust vertical speed, adjust" is replaced with single "Level-off" (i.e. 0 ft/min). New aural alert (source Eurocontrol, 'Overview of ACAS II', version 3.0, 12 Jan 2012) is:

UPWARD SENSE			**DOWNWARD SENSE**		
RA	**Required ft/min**	**Aural**	**RA**	**Required ft/min**	**Aural**
Level off	0	Level off; level off	Level off	0	Level off; level off

- **TCAS II ver 7.0:** Based on 1000 ft separation. Required for RVSM airspace. Altitude threshold for TA is 850 ft. Altitude threshold for RA it is 300-700 ft depending on altitude. Target vertical miss distance is 300-700 ft depending on altitude. TA caution area 20-48 sec. RA warning area 15-35 sec. All RAs are inhibited below 1000 ft AGL RA. Aural alerts (source Eurocontrol, 'Overview of ACAS II', version 3.0, 12 Jan 2012):

UPWARD SENSE			**DOWNWARD SENSE**		
RA	**Required ft/min**	**Aural**	**RA**	**Required ft/min**	**Aural**
Climb	1500	Climb, climb	Descend	-1500	Descend, descend
Crossing Climb	1500	Climb, crossing climb; Climb, crossing climb	Crossing Descend	-1500	Descend, crossing descend; Descend, crossing descend
Maintain Climb	1500 to 4400	Maintain vertical speed, maintain	Maintain Descend	-1500 to -4400	Maintain vertical speed, maintain
Maintain Crossing Climb	1500 to 4400	Maintain vertical speed, crossing maintain	Maintain Crossing Descend	-1500 to -4400	Maintain vertical speed, crossing maintain
Reduce Descent → Replaced in 7.1	0, -500, -1000, -2000	Adjust vertical speed, adjust	Reduce Climb → Replaced in 7.1	0, 500, 1000, 2000	Adjust vertical speed, adjust
Reversal Climb	1500	Climb, climb NOW; Climb, climb NOW	Reversal Descent	-1500	Descend, descend NOW; Descend, descend NOW
Increase Climb	2500	Increase climb, increase climb	Increase Descent	-2500	Increase descent, increase descent
Preventive RA	No change	Monitor vertical speed	Preventive RA	No change	Monitor vertical speed
RA Removed	-	Clear of conflict	RA Removed	-	Clear of conflict

- **TCAS II ver 6.04:** This was never mandated in Europe. Based on 2000 ft separation at FL300. Not approved for RVSM airspace above FL300. Altitude threshold for TA is 1200 ft. Altitude threshold for RA it is 800 ft. RA is either preventive or corrective. Target vertical miss distance is 300-700 ft depending on altitude. All RAs are inhibited below 400 ft AGL RA. TA caution area 20-48 sec. RA warning area 15-35 sec. Aural alerts (source FAA AC 20-131A, 29 Mar 1993)
  - Climb RA "Climb, Climb, Climb"
  - Descend RA "Descend, Descend, Descend"
  - Preventive RA "Monitor Vertical Speed; Monitor Vertical Speed"
  - Reduce Climb "Reduce Climb; Reduce Climb"
  - Reduce Descent "Reduce Descent; Reduce Descent"
  - Altitude Crossing Climb "Climb, Crossing Climb; Climb, Crossing Climb"
  - Altitude Crossing Descent "Descend, Crossing Descend; Descend, Crossing Descend"
  - Increase Climb "Increase Climb; Increase Climb"
  - Increase Descent "Increase Descent; Increase Descend"
  - Reversal to a Climb "Climb, Climb Now; Climb, Climb Now"
  - Reversal to a Descent "Descend, Descend Now; Descend, Descend Now"
  - Clear of Conflict "Clear of Conflict"

- **TCAS I:** Does not provide RA. Provides TA only. TCAS I is not mandated in Europe and there are no operational rules regarding the use of TCAS I. TCAS I is intended to operate using Mode A/C interrogations only. Furthermore, it does not coordinate with other TCAS. Therefore, a Mode S transponder is not required as a part of an TCAS I installation. Aural alert is "Traffic, Traffic".

Low Visibility Operations Equipment

Sources: CS-AWO, Part-SPA and its AMCs

See AFM / FCOM for information on equipment, indications, etc. for the aircraft type in question.

Equipment for LVTO:
- Take-off guidance information for pilot who is making the take-off

Equipment for CAT II, DH 100 ft, RVR 300 m:
- 2 x ILS
- AP → May be flown either with AP or manually with FD if a HUDLS is used.
- 1 x RA with displays at each pilot's station
- Alert height of DH at each pilot's station
- Automatic or FD go-around system
- Audible warning of AP failure
- Alert of excessive deviation from approach path

Equipment for CAT III, common for all decision heights (DH) below 100 ft:
- 2 x ILS
- 1 x RA with displays at each pilot's station
- Alert height of DH at each pilot's station
- Equipment failure warning system
- Alert of excessive deviation from approach path
- Voice system which calls the approaching decision height

Equipment for CAT III, DH below 100 ft and above 50 ft:
- Fail passive automatic approach system with or without automatic landing system (see AFM)

Equipment for CAT IIIB, DH below 50 ft, RVR 125 m:
- Fail operational automatic landing system
- Automatic roll out or head-up ground roll guidance to a safe taxi speed
- Fail passive automatic go-around (even from touchdown)
- Automatic throttle / thrust control (maintaining ±5 kts)

Equipment for CAT IIIB, no DH, RVR 75 m:
- Fail operational automatic landing system → After failure in one system it must operate as fail passive system
- Automatic roll out or head-up ground roll guidance to a safe taxi speed
- Fail passive automatic go-around (even from touchdown)
- Automatic throttle / thrust control (maintaining ±5 kts)
- Anti-skid braking system

The following visual aids should be available:

(i) standard runway day markings and approach and the following runway lights: runway edge lights, threshold lights and runway end lights;

(ii) for operations in RVR below 450 m, additionally touch-down zone and/or runway centre line lights;

(iii) for operations with an RVR of 400 m or less, additionally centre line lights.

→ See standards on approach, runway and airports lights in ICAO Annex 14.