Total Aviation System
Safety Standards Improvements

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This deliverable D3.5b is a complement of D3.5a, and contains a set of methods for automatic precursor detection and coding in accordance with safety barrier failure oriented taxonomy related to ASCOS CATS safety model.

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Acronyms

Acronym	Definition
APU	Auxiliary Power Unit
CMCF	Central Maintenance Computing Function
AoC	Angle Of Attack sensors
ASCOS	Aviation Safety and Certification of new operations and Systems
ATM	Air Traffic Management
CATS	Causal Model for Air Transport Safety
CICTT	CAST/ICAO Common Taxonomy Team
CMC	Central Maintenance Computer
CMS	Centralized Maintenance System
DAR	Direct Access Recorder
ESD	Event Sequence Diagram
FDE	Flight Deck Effect
FDM	flight data monitoring
FDR	flight data recorder
FOQA	Flight Operational Quality Assurance
GDRAS	Ground Data Replay and Analysis Station
LLR	Lessons Learned Requirement
MCDU	Multifunction Control Display Unit
MOQA	Maintenance Operational Quality Assurance
PCL	Precursor Criticality Level
TAS	Total Aviation system
IVHMS	Integrated Vehicle Health Monitoring system

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Executive Summary

This document contains set of methods for automatic precursor detection and coding in accordance with safety barrier failure oriented taxonomy related to ASCOS CATS safety model.

As it is defined in deliverable D3.5_1 Total Aviation System Safety Standards Improvements the aim of this document D3.5_2 is to propose feasible methods for implementation of safety barrier failure (precursor) oriented approach to safety in Total Aviation System. It is dedicated to improvement of safety standards by application of Lessons Learned Requirements (LLR) derived from operation events. It is realized in the following steps:

1. Description of the existing recording process of system malfunctions in the maintenance computer of the aircraft.

2. Definition a generic taxonomy safety barriers failure oriented

3. Definition of methods to detect and code automatically system malfunctions with a taxonomy “safety barrier oriented” and record them in the maintenance computer.

4. Identification of possible methods for automatic relation of the malfunctions detected in a system with the risk models and their identified safety barriers (using on board or ground facilities)

5. Extend the methodology to each player of the total aviation system (Airlines, ATM, Airports, Airworthiness and Crew licensing with taking into consideration its specification).

6. Besides that in the first part of the section all necessary assumptions and definitions concerning precursors, risk, safety barrier as well as Lessons Learned Requirement issues were included

This document corresponds to steps 2 to 4. For more information on the methodology please refer to D3.5_1 §5.5

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1 Possible methods for automatic precursors detection and coding in accordance with safety barrier failure oriented taxonomy

Table 1 ASCOS ESD 1 Aircraft system failure

Barrier	Description	Possibilities for braking the barrier – Base event	Code	Possible occurrence (CICTT)	Designation (CICTT)	Flight phase indicator	Proposed method for failure detection (trigger logic)
1.Aircraft System Integrity during take-off roll	Proper working of critical aircraft Systems during take-off roll	Autoflight Failure	TO01B11	Autopilot mode change annunciation failure during take-off	**TO-SCF-NP-AFC-APMCFL**	Phase 1: At least 2 from: 1. Speed above ~35kts and not decreasing 2. Altitude: 0 - 50ft AGL, 3. Application of take-off power	TO thrust not achieved AND / OR incorrect configuration AND autopilot status – activated AND Engines work parameters - correct
				Automatic thrust control unavailable or loss during take-off	**TO-SCF-NP-AFC-ATLS**		
				Automatic thrust control error during take-off	**TO-SCF-NP-AFC-ATERR**		
		Communications Failure	TO01B12	Communication with ATC loss during take-off	**TO-SCF-NP-AVION-COMMLS**		OR Incomplete pilot-controller communication loop (e.g. lack of controller hearback)
		Electrical Power Failure	TO01B13	Electrical generating capability loss during take-off	**TO-SCF-NP-ELEC-GENLS**		OR Loss of part of or all components powered by the same bus or energy source
				Electrical system malfunction during take-off	**TO-SCF-NP-ELEC-SYSMALF**		
		Fire Protection Failure	TO01B14	Warning error – fire on board during take-off	**TO-SCF-NP-AVION-WRNERR-FIRE**		OR Fire warning or extinguishing system activation AND lack of other symptoms of fire on board
				Fire extinguishing system failure during take-off	**TO-SCF-NP-MISC-FIREEXTFL**		

		Hydraulic Power Failure	TO01B15	Hydraulic System Failure during take-off	**TO-SCF-NP-MISC-HYDFL**		OR Warning about hydraulic system failure
		Indicating and Recording System Failure	TO01B16	Automatic protection functions failures – indicating and recording failure during take-off	**TO-SCF-NP-AFC-AUTOPROTFL-IRECF**		OR Warning about indicating and recording functions failure
		Navigation System Failure	TO01B17	Heading information loss during take-off	**TO-SCF-NP-AVION-HDGLS**		OR Incorrect functioning or loss of any navigation related system (e.g. due to power supply failure or component failure) OR Warning about navigation system failure
				Heading information error during take-off	**TO-SCF-NP-AVION-HDGERR**		
				Navigational information loss during take-off	**TO-SCF-NP-AVION-NAVLS**		
				Navigational information error during take-off	**TO-SCF-NP-AVION-NAVERR**		
		Auxiliary Power Unit Failure	TO01B18	Auxiliary Power Unit failure during take-off	**TO-SCF-NP-MISC-APUFL**		OR APU failure warning AND/OR incorrect parameters of air conditioning system (in case when engine bleed air is turned off during take-off)
		Flap Systems Failure	TO01B19	Uncommanded flight control movement – flap - during take-off	**TO-SCF-NP-FC-UNCMV-FLAP**		OR Excessive bank angle AND/OR asymmetric lift AND/OR excessive vibration level in aircraft wing components (other than resulting with directional problems)
				Flight control surface failure to move as commanded – flap - during take-off	**TO-SCF-NP-FC-MVFL-FLAP**		
				Other flight control system malfunction or failure – flap movement - during take-off	**TO-SCF-NP-FC-OTHR-FLAP**		

		Drag Control Systems Failure	TO01B110	Uncommanded flight control movement – drag control surface - during take-off	**TO-SCF-NP-FC-UNCMV-DRAGC**		OR Acceleration and attitude related parameters of aircraft different than expected (calculated for current conditions). Directional control problems excluded from this case (see ESD 4)
				Flight control surface failure to move as commanded – drag control surface - during take-off	**TO-SCF-NP-FC-MVFL-DRAGC**		
				Other flight control system malfunction or failure – drag control surface during take-off	**TO-SCF-NP-FC-OTHR-DRAGC**		
				Reverser / beta malfunction - in-flight deploy during take-off	**TO-SCF-PP–RMID**		
		Landing Gear Systems Failure	TO01B111	Indication failure – landing gear - during take-off	**TO-SCF-NP-LG-INDFL**		OR Acceleration parameters lower than expected (calculated for current conditions) AND/OR excessive vibration level of landing gear components.
				Tire failure - during take-off	**TO-SCF-NP-LG-TIREFL**		
				Wheel failure - during take-off	**TO-SCF-NP-LG-WHLFL**		
				Brake system failure - during take-off	**TO-SCF-NP-LG-BRKFL**		
				Landing gear vibration - during take-off	**TO-SCF-NP-LG-VIB**		
				Floatation system failure - during take-off	**TO-SCF-NP-LG-FLOTFL**		
				Other landing gear malfunction or failure - during take-off	**TO-SCF-NP-LG-OTHR**		

		Pneumatic Systems Failure	TO01B112	Pneumatic system failure - during take-off	**TO-SCF-NP-MISC-PNEUFL**		OR Warning about pneumatic system failure
		Door Systems Failure	TO01B113	Other cabin systems malfunction or failure - door - during take-off	**TO-SCF-NP-CABIN-OTHR-DOOR**		OR Warning about cabin door unlocked
		Other Systems Failures	TO01B114	Other fuel systems malfunction or failure - during take-off	**TO-SCF-NP–FUEL-OTHR**		OR Warning about fuel system failure (e.g. leak) displayed on ECAM or equivalent system
				Other miscellaneous malfunction or failure - during take-off	**TO-SCF-NP-MISC-OTHR**		
				Other environmental control system malfunction or failure - during take-off	**TO-SCF-NP-ECS-OTHR**		
				Cabin window problem - during take-off	**TO-SCF-NP-STRUCT-CABINWDW**		
2.Execution of take-off rejection being a result of aircraft system failure during take-off roll	Proper decision of the crew concerning termination of take-off procedure	Pilot Misdiagnosis	TO01B211	FCE – misdiagnose the failure detected problem occurred during take-off and rejected take-off above V1	**RTO-FCE-MISD-RTOABV1-SCF-NP**	Phase 2a: Following Phase 1 AND Braking application and at least two from: 1. Speed above V1 and not increasing, 2. Altitude – 0ft AGL, 3. thrust idle or reverse mode	Take-off rejection after reaching the V1 speed
		Pilot Misjudgement	TO01B212	FCE – misjudgement in terms of necessity of rejected take-off above V1	**RTO-FCE-MISJ-RTOABV1**		

		Take-off rejected correctly when below V1	TO01B22	Rejected take-off below V1 resulted from failure detected	**RTO-SCF-NP**	Phase 3. Following Phase 1 AND Braking application and at least two from: 1. Speed below V1 and not increasing and at least one from: 1. Altitude – 0ft AGL, 2. thrust idle or in reverse mode	OR Take-off rejection at speed below v1
3.Effective braking after execution of take-off rejection being a result of aircraft system failure during take-off roll	Parameters of braking systems and devices included into assumed / expected range	Insufficient Runway Length	TO01B31	Runway too short due to poor surface condition (ice or wet) following RTO	**RTO-ADRM-INSRWYL**		Runway excursion AND braking devices work correctly AND braking performed correctly AND deceleration parameters lower than expected indicating on incorrect surface friction factor.
		Brakes not functioning correctly	TO01B32	Automatic braking loss following RTO	**RTO-SCF-NP-AFC-ABRKLS**		OR Deceleration parameters lower than expected (calculated for current conditions) AND/OR braking asymmetry AND all braking devices applied on time and correctly
				Automatic braking operation error following RTO	**RTO-SCF-NP-AFC-ABRKERR**		
				Brake system failure following RTO	**RTO-SCF-NP-LG-BRKFL**		
				Reverser / beta malfunction - failure to deploy following RTO	**RTO-SCF-PP-RFD**		OR thrust reverser not deployed
		Brakes not applied correctly	TO01B33	FCE – brake application error following RTO	**RTO-FCE-BRAKAPP**		OR execution of braking procedure conducted by the flight crew differs significantly from the assumed as reference model.

Table 2 ASCOS ESD 2 - Air traffic related event

Barrier	Description	Possibilities for braking the barrier – Base event	Code	Possible occurrence (CICTT)	Designation (CICTT)	Flight phase indicator	Proposed method for failure detection (trigger logic)
1. Air Traffic Hazard Avoidance during aircraft take-off roll	Adherence of ATM or Flight crew to set of procedures and standards during aircraft take-off roll	Take-off instruction error by ATCO	TO02B11111	ATCOER (ATCO error) - Incorrect take-off clearance	**TO-ATM-ATCOER-TOINSTRER**	Phase 1: At least 2 from: 1. Speed above ~35kts and not decreasing, 2. Altitude: 0 - 50ft AGL, 3. Application of take-off power	ATM system or aircraft computer indicate on separation infringement risk during take-off (e.g. on base of shared information concerning traffic)
		Inadequate communication with pilot	TO02B11112	ATCOER - Incorrect communication between flight crew and ATCO during take-off	**TO-ATM-ATCOER-FCCOM**		OR Negative cabin voice record analysis for key words AND/OR Incomplete pilot-controller communication loop
				FCE – (flight crew error) - Incorrect communication between flight crew and ATCO during take-off	**TO-ATM-FCE-ATCOCOM**		
		Pilot failure to follow take-off instructions	TO02B1112	FCE -not following ATCO instructions during take-off	**TO-ATM-FCE-ATMINST**		OR ultrasonic sensors (or other distance sensors measuring distance to obstacle or aircraft location on the airsite) indicate on separation infringement with other aircraft AND/OR ATM system or aircraft computer on base of shared information concerning traffic indicate on separation infringement during take-off
		Separation Infringement with Departing Aircraft caused by other a/c	TO02B11211	FCE - Separation infringement with other aircraft during take-off	**TO-ATM-FCE-SEPINFR**		
		Separation Infringement with Landing Aircraft caused	TO02B11212	FCE - Separation infringement with other aircraft during take-off	**TO-ATM-FCE-SEPINFR**		

		by other a/c					
		Separation Infringement with a/c on missed approach	TO02B11213	FCE - Separation infringement with other aircraft during take-off	**TO-ATM-FCE-SEPINFR**		
				ATCOER - Separation infringement with other aircraft during take-off	**TO-ATM-ATCOER-LSEPREC**		
		Separation Infringement with departing a/c caused by aircraft taking off	TO02B11214	FCE - Separation infringement with other aircraft during take-off	**TO-ATM-FCE-SEPINFR**		
		Separation Infringement with landing a/c caused by aircraft taking off	TO02B11215	FCE - Separation infringement with other aircraft during take-off	**TO-ATM-FCE-SEPINFR**		
		Illegal A/C infringement	TO02B11216	FCE - Separation infringement with other aircraft during take-off	**TO-ATM-FCE-SEPINFR**		OR aircraft computer did not receive clearance message from ATCO
		Traffic density too high	TO02B1122	Too high traffic density	**TO-ATM-ATD**		OR traffic density calculated by ATM computer or aircraft computer (e.g. on base of shared traffic information indicate on too high traffic density values)
		Aircraft not ready to take-off	TO02B1123	FCE - Take-off delay in preparing for take-off	**TO-ATM-FCE-DTO**		OR the validity of take-off clearance messages received by aircraft computer expired before
				ATCOER - Take-off	**TO-ATM-**		

				delay due to lack of aircraft readiness resulted from ATCO inefficient traffic management	**ATCOER-INTM**		take-off power application by flight crew
		Animals in vicinity of runway	TO02B1124	Animals in vicinity of runway	**TO-WILD-RWY**		OR aircraft computer received message about warning concerning the animal in RWY vicinity (coupled with ATCO voice warning)
		Weather Related Problem	TO02B1125	ATCOER - in taking into consideration the current weather conditions	**TO-ATM-ATCOER-WSTRW**		OR received and processed data concerning current weather conditions indicates on safety risk during take-off
				Adverse weather conditions	**TO-WSTRW**		
		Effective Hazard Avoidance	TO02B12	ATCO instructs flight crew to stop during take-off roll	**TO-ATM-EFHZAV**		OR aircraft computer or flight crew receive the ATCO message to stop take-off roll
2. Execution of take-off rejection being a result of air traffic hazard avoidance during aircraft take-off roll	Proper decision of the crew concerning termination of take-off procedure	Pilot Misdiagnosis	TO02B211	FCE – misdiagnose the ATM problem occurred during take-off and rejected take-off above V1	**RTO-FCE-MISD-RTOABV1-ATM**	Phase 2a: Following Phase 1 AND Braking application and at least two from: 1. Speed above V1 and not increasing, 2. Altitude – 0ft AGL, 3. thrust idle or reverse mode	Take-off rejection after reaching the V1 speed
		Pilot Misjudgement	TO02B212	FCE – misjudgement in terms of necessity of rejected take-off above V1	**RTO-FCE-MISJ-RTOABV1**		
		Take-off rejected	TO02B22	Rejected take-off below V1 resulted	**RTO-ATM**	Phase 3. Following Phase	OR Take-off rejection at speed below v1

		correctly when below V1		from ATM problem		1 AND Braking application and at least two from: 1. Speed below V1 and not increasing and at least one from: 1. Altitude – 0ft AGL, 2. thrust idle or in reverse mode	
3. Effective braking after execution of take-off rejection being a result of air traffic hazard avoidance during aircraft take-off roll	Parameters of braking systems and devices included into assumed / expected range	Insufficient Runway Length	TO02B31	Runway too short due to poor surface condition (ice or wet) following RTO	**RTO-ADRM-INSRWYL**		Runway excursion AND braking devices work correctly AND braking performed correctly AND deceleration parameters lower than expected indicating on incorrect surface friction factor.
		Brakes not functioning correctly	TO02B32	Automatic braking loss following RTO	**RTO-SCF-NP-AFC-ABRKLS**		OR Deceleration parameters lower than expected (calculated for current conditions) AND/OR braking asymmetry AND all braking devices applied on time and correctly
				Automatic braking operation error following RTO	**RTO-SCF-NP-AFC-ABRKERR**		
				Brake system failure following RTO	**RTO-SCF-NP-LG-BRKFL**		
				Reverser / beta malfunction - failure to deploy following RTO	**RTO-SCF-PP-RFD**		OR thrust reverser not deployed
		Brakes not applied correctly	TO02B33	FCE – brake application error following RTO	**RTO-FCE-BRAKAPP**		OR execution of braking procedure conducted by the flight crew differs significantly from the assumed as reference model.

Table 3 ASCOS ESD 3 – Aircraft handling by flight crew inappropriately.

Barrier	Description	Possibilities for braking the barrier – Base event	Code	Possible occurrence (CICTT)	Designation (CICTT)	Flight phase indicator	Proposed method for failure detection (trigger logic)
Take-off Roll Handling	Proper aircraft handling during take-off roll	Unsuccessful handling due to lack of training	TO03B111	FCE in aircraft handling during take-off roll – skills deficiency (V<=V1)	**TO-LOC-G-FCE-AHAN**	Phase 1: At least 2 from: 1. Speed above ~35kts and not decreasing, 2. Altitude: 0 - 50ft AGL, 3. Application of take-off power	Pilot's input to the aircraft control during take-off roll classified as incorrect AND all systems work correctly
		Unsuccessful Handling	TO03B112	FCE in aircraft handling during take-off roll (V<=V1)	**TO-LOC-G-FCE-AHAN**		
		Adverse Weather Conditions	TO03B12	FCE in aircraft handling during take-off roll – induced by weather (V<=V1)	**TO-LOC-G-FCE-AHAN-WSTRW**		OR Pilot's input to the aircraft control during take-off roll classified as incorrect AND all systems work correctly AND weather conditions classified as highly unfavorable for take-off
2. Execution of take-off rejection after take-off roll handling problems	Proper decision of the crew concerning termination of take-off procedure	Pilot Misdiagnosis	TO03B211	FCE – misdiagnose the handling problem occurred during take-off and rejected take-off above V1	**RTO-FCE-MISD-RTOABV1-AHAN**	Phase 2a: Following Phase 1 AND Braking application and at least two from: 1. Speed above V1 and not increasing, 2. Altitude – 0ft AGL, 3. thrust idle or reverse mode	Take-off rejection after reaching the V1 speed
		Pilot Misjudgement	TO03B212	FCE – misjudgement in terms of necessity of rejected take-off above V1	**RTO-FCE-MISJ-RTOABV1**		

		Take-off rejected correctly when below V1	TO03B22	Rejected take-off below V1 resulted from handling problem	**RTO-AHAN**	Phase 3. Following Phase 1 AND Braking application and at least two from: 1. Speed below V1 and not increasing and at least one from: 1. Altitude – 0ft AGL, 2. thrust idle or in reverse mode	OR Take-off rejection at speed below v1
3.Maintain control (V <= V1) after execution of take-off rejection after take-off roll handling problems	Proper aircraft handling by the crew after rejected take-off with V lower than V1	Uncontrollable	TO03B31	Loss of control on ground after rejecting take-off	**RTO-LOC-G**		Aircraft configuration, attitude and flight parameters classified as unrecoverable
		Lack of control	TO03B32	Loss of control on ground after rejecting take-off as a result of lack of pilot input to aircraft control	**RTO-LOC-G-FCE-LCTRL**		OR Aircraft configuration, attitude and flight parameters classified as recoverable AND lack of pilot input to aircraft control
		Incorrect Control	TO03B33	Loss of control on ground after rejecting take-off as a result of incorrect pilot input to aircraft control	**RTO-LOC-G-FCE-INCTRL**		OR Aircraft configuration, attitude and flight parameters classified as recoverable AND pilot input to aircraft control classified as incorrect in given situation
		Insufficient control	TO03B34	Loss of control on ground after rejecting take-off as a result of insufficient pilot input to aircraft control	**RTO-LOC-G-FCE-INSCTRL**		OR Aircraft configuration, attitude and flight parameters classified as recoverable AND pilot input to aircraft control classified as insufficient in given situation (too low extend, too short input time etc.)
4. Effective braking after execution of take-off rejection being a resolution	Parameters of braking systems and devices included into assumed / expected	Insufficient Runway Length	TO03B41	Runway too short due to poor surface condition (ice or wet) following RTO	**RTO-ADRM-INSRWYL**		Runway excursion AND braking devices work correctly AND braking performed correctly AND deceleration parameters lower than expected indicating on incorrect surface friction factor.
		Brakes not functioning	TO03B42	Automatic braking loss following RTO	**RTO-SCF-NP-AFC-ABRKLS**		OR Deceleration parameters lower than expected (calculated for

for take-off roll handling problems	range	correctly		Automatic braking operation error following RTO	**RTO-SCF-NP-AFC-ABRKERR**		current conditions) AND/OR braking asymmetry AND all braking devices applied on time and correctly
				Brake system failure following RTO	**RTO-SCF-NP-LG-BRKFL**		
				Reverser / beta malfunction - failure to deploy following RTO	**RTO-SCF-PP-RFD**		OR thrust reverser not deployed
		Brakes not applied correctly	TO03B43	FCE – brake application error following RTO	**RTO-FCE-BRAKAPP**		OR execution of braking procedure conducted by the flight crew differs significantly from the assumed as reference model.
5. Maintain control during take-off after experiencing take-off roll handling problems	Proper aircraft handling by the crew after continuation of take-off	Uncontrollable	TO03B51	Loss of control on ground during take-off resulted from pilot handling error (V>V1)	**TO-LOC-G-AHAN**	Phase 2b. Following Phase 1. AND Speed above V1 and not increasing, and at least two from: 1. Altitude above 0ft AGL, 2. landing gear not compressed, 3. thrust in take-off mode.	Aircraft configuration, attitude and flight parameters classified as unrecoverable
		Lack of control	TO03B52	Loss of control on ground during take-off as a result of lack of pilot input to aircraft control (V>V1)	**TO-LOC-G-FCE-LCTRL**		OR Aircraft configuration, attitude and flight parameters classified as recoverable AND lack of pilot input to aircraft control
		Incorrect Control	TO03B53	Loss of control on ground during take-off as a result of incorrect pilot input to aircraft control (V>V1)	**TO-LOC-G-FCE-INCTRL**		OR Aircraft configuration, attitude and flight parameters classified as recoverable AND pilot input to aircraft control classified as incorrect in given situation
		Insufficient control	TO03B54	Loss of control on ground during take-off as a result of insufficient pilot input to aircraft control (V>V1)	**TO-LOC-G-FCE-INSCTR**		OR Aircraft configuration, attitude and flight parameters classified as recoverable AND pilot input to aircraft control classified as insufficient in given situation (too low extend, too short input time etc.)

Table 4 ASCOS ESD 4 – Directional control system failure.

Barrier	Description	Possibilities for braking the barrier – Base event	Code	Possible occurrence (CICTT)	Designation (CICTT)	Flight phase indicator	Proposed method for failure detection (trigger logic)
Directional Control Systems Integrity	Integrity of systems responsible for directional controllability of the aircraft during take-off roll	Main Gear Failure	TO04B111	Landing gear structural failure – main gear – during take-off roll	**TO-SCF-NP-LG-STRUCTFL-MAING**	Phase 1: Landing gear compression longer than 10min and at least 1 from: 1. Altitude equal 0ft AGL, 2. Thrust taxiing mode.	- Acceleration and attitude related parameters of aircraft different than expected (calculated for current conditions) AND transverse acceleration value in both directions, higher than expected (calculated /estimated for current conditions) AND engine parameters correct AND / OR increased vibration level in main gear
				Floatation system failure – main gear– during take-off roll	**TO-SCF-NP-LG-FLOTFL-MAING**		
				Other main landing gear malfunction or failure– during take-off roll	**TO-SCF-NP-LG-OTHR-MAING-DIR**		
		Nose Gear Failure	TO04B112	Landing gear structural failure resulting with directional control problems– during take-off roll	**TO-SCF-NP-LG-STRUCTFL-DIR**		- OR Acceleration and attitude related parameters of aircraft different than expected (calculated for current conditions) AND transverse acceleration value in both directions, higher than expected (calculated /estimated for current conditions) AND engine parameters correct AND / OR increased vibration level in nose gear
				Steering system failure	**TO-SCF-NP-LG-STEERFL**		
				Floatation system failure resulted with directional control problems– during take-off roll	**TO-SCF-NP-LG-FLOTFL-DIR**		

		Brake system failure	TO04B121	Automatic braking operation error resulted with directional control problem– during take-off roll	**TO-SCF-NP-AFC-ABRKERR-DIR**		- OR Acceleration and attitude related parameters of aircraft different than expected (calculated for current conditions) AND transverse acceleration value in both directions, higher than expected (calculated /estimated for current conditions) AND engine parameters correct AND / OR increased vibration level in landing gear components
				Brake system failure resulted with directional control problem– during take-off roll	**TO-SCF-NP-LG-BRKFL-DIR**		
		Tire Failure	TO04B122	Tire failure resulting with directional control problem– during take-off roll	**TO-SCF-NP-LG-TIREFL-DIR**		- OR Lack of pressure in tire AND Acceleration and attitude related parameters of aircraft different than expected (calculated for current conditions) AND transverse acceleration value in both directions, higher than expected (calculated /estimated for current conditions) AND engine parameters correct AND / OR increased vibration level in landing gear components

		Wheel Sub-Assembly Failure	TO04B123	Wheel failure resulting with directional control problem– during take-off roll	**TO-SCF-NP-LG-WHLFL-DIR**		- OR Acceleration and attitude related parameters of aircraft different than expected (calculated for current conditions) AND transverse acceleration value in both directions, higher than expected (calculated /estimated for current conditions) AND engine parameters correct AND / OR increased vibration level in landing gear components
2. Execution of take-off rejection being a consequence of directional controllability problems	Proper decision of the crew concerning termination of take-off procedure	Pilot Misdiagnosis	TO04B211	FCE – misdiagnose the directional control problem occurred during take-off and rejected take-off above V1	**RTO-FCE-MISD-RTOABV1-SCF-NP-LG-DIR**	Phase 2a: Following Phase 2 AND Braking application and at least two from: 1. Speed above V1 and not increasing, 2. Altitude – 0ft AGL, 3. thrust idle or reverse mode	
		Pilot Misjudgement	TO04B212	FCE – misjudgement in terms of necessity of rejected take-off above V1	**RTO-FCE-MISJ-RTOABV1**		- Take-off rejection after reaching the V1 speed
		Take-off rejected correctly when below V1	TO04B22	Take-off rejected below V1 (as a result of directional control problem)	**RTO-SCF-NP-LG-DIR**	Phase 3. Following Phase 2 AND Braking application and at least two from: 1.	- OR Take-off rejection at speed below v1
3.Maintain control (V <= V1)	Proper aircraft handling by	Uncontrollable	TO04B31	Loss of control on ground after rejecting take-off	**RTO-LOC-G-LG**		- Aircraft configuration, attitude and flight parameters classified as unrecoverable

after execution of take-off rejection after directional controllability problems	the crew after rejected take-off with V lower than V1	Lack of control	TO04B32	Loss of control on ground after rejecting take-off as a result of lack of pilot input to aircraft control	**RTO-LOC-G-FCE-LCTRL**	Speed below V1 and not increasing and at least one from: 1. Altitude – 0ft AGL, 2. thrust idle or in reverse mode	- OR Aircraft configuration, attitude and flight parameters classified as recoverable AND lack of pilot input to aircraft control
		Incorrect Control	TO04B33	Loss of control on ground after rejecting take-off as a result of incorrect pilot input to aircraft control	**RTO-LOC-G-FCE-INCTRL**		- OR Aircraft configuration, attitude and flight parameters classified as recoverable AND pilot input to aircraft control classified as incorrect in given situation
		Insufficient control	TO04B34	Loss of control on ground after rejecting take-off as a result of insufficient pilot input to aircraft control	**RTO-LOC-G-FCE-INSCTRL**		- OR Aircraft configuration, attitude and flight parameters classified as recoverable AND pilot input to aircraft control classified as insufficient in given situation (too low extend, too short input time etc.
4. Effective braking after execution of take-off rejection being a consequence of directional controllability problems	Parameters of braking systems and devices included into assumed / expected range	Insufficient Runway Length	TO04B41	Runway too short due to poor surface condition (ice or wet) following RTO	**RTO-ADRM-INSRWYL**		- Runway excursion AND braking devices work correctly AND braking performed correctly.
		Brakes not functioning correctly	TO04B42	Automatic braking loss following RTO	**RTO-SCF-NP-AFC-ABRKLS**		- OR Deceleration parameters lower than expected (calculated for current conditions) AND/OR braking asymmetry AND all braking devices applied on time and correctly
				Automatic braking operation error following RTO	**RTO-SCF-NP-AFC-ABRKERR**		
				Brake system failure following RTO	**RTO-SCF-NP-LG-BRKFL**		
				Reverser / beta malfunction - failure to deploy following RTO	**RTO-SCF-PP-RFD**		- OR thrust reverser not deployed

		Brakes not applied correctly	TO04B43	FCE – brake application error following RTO	**RTO-FCE-BRAKAPP**		- OR execution of braking procedure conducted by the flight crew differs significantly from the assumed as reference model (classified as executed incorrectly).
5. Maintain control during take-off after noticing directional control systems integrity problems during take-off roll	Flight crew avoid aircraft stall resulted with unrevealed incorrect take-off configuration	Uncontrollable	TO04B51	Loss of control on ground during take-off resulted from pilot handling error (V>V1)	**TO-LOC-G-SCF-NP-LG-DIR**	Phase 2b. Following Phase 1. AND Speed above V1 and not increasing, and at least two from: 1. Altitude above 0ft AGL, 2. landing gear not compressed, 3. thrust in take-off mode.	- Aircraft configuration, attitude and flight parameters classified as unrecoverable
		Lack of control	TO04B52	Loss of control on ground during take-off as a result of lack of pilot input to aircraft control (V>V1)	**TO-LOC-G-FCE-LCTRL**		- OR Aircraft configuration, attitude and flight parameters classified as recoverable AND lack of pilot input to aircraft control
		Incorrect Control	TO04B53	Loss of control on ground during take-off as a result of incorrect pilot input to aircraft control (V>V1)	**TO-LOC-G-FCE-INCTRL**		- OR Aircraft configuration, attitude and flight parameters classified as recoverable AND pilot input to aircraft control classified as incorrect in given situation
		Insufficient control	TO04B54	Loss of control on ground during take-off as a result of insufficient pilot input to aircraft control (V>V1)	**TO-LOC-G-FCE-INSCTR**		- OR Aircraft configuration, attitude and flight parameters classified as recoverable AND pilot input to aircraft control classified as insufficient in given situation (too low extend, too short input time etc.

Table 5 ASCOS ESD 5 - Take-off with incorrect configuration

Barrier	Description	Possibilities for braking the barrier – Base event	Code	Possible occurrence (CICTT)	Designation (CICTT)	Flight phase indicator	Proposed method for failure detection (trigger logic)
1.Correct configuration of aircraft for take-off	Proper conducting of procedure concerning setting of appropriate aircraft configuration for take-off	Unsuccessful TO configuration checklist	TO05B111	FCE - Lack of configuration checklist before take-off	**TO-FCE-LCNFCHCK**	Phase 1: Landing gear compression longer than 10min and at least 1 from: 1. Altitude equal 0ft AGL, 2. Thrust in taxiing mode.	Negative cabin voice record analysis for key words (configuration checklist)
		Unsuccessful Checklist Verification	TO05B112	FCE – unsuccessful configuration checklist before take-off	**TO-FCE-LCHCKLVER**		
		Flap & slat positions entered into FMC incorrectly	TO05B12	FCE – incorrect operation of FMC - flaps and slats position entering before take-off	**TO-FCE-FMC-INCOPER-INCFLSLENT**		OR Indicated flaps & slats positions differ than expected / suggested (calculated for current aircraft specifications and external conditions)
		Verification not conducted	TO05B21	FCE – lack of verification of flaps and slats position entered into FMC before take-off	**TO-FCE-LVRFER-FMC-FLSLSET**		
		Verification unsuccessful	TO05B22	FCE – unsuccessful verification of flaps and slats positions entered into FMC before take-off	**TO-FCE-VRFERF-FMC-FLSLSET**		OR Negative cabin voice record analysis for key words (verification of FMC input)
2.Take-off configuration warning	The flight crew is provided with the	Unsuccessful Manufacture	TO05B311	Warning loss – TOCW - manufacture findings	**TO-SCF-NP-AVION-WRNLS-TOCW-MFF**	Phase 2: At least 2 from: 1. Speed above ~35kts	Take-off roll acceleration values different than expected (calculated for current aircraft specification and applied engine power as well as external conditions) for

	alert concerning incorrect aircraft configuration for take-off			Automatic protection functions failures – TOCW - manufacture findings prior to take-off	**TO-SCF-NP-AFC-AUTOPROTFL-TOCW-MFF**	and not decreasing 2. Altitude: 0 - 50ft AGL, 3. Application of take-off power	take-off roll AND analysis of work/flight parameters considered as influencing functioning of TOCW system indicate on failure originating from incorrect manufacturing (failure appeared for the given conditions before or on other aircraft of given type) AND precursors for given event identified during component manufacturing)
		Unsuccessful Maintenance	TO05B312	Warning loss – TOCW - maintenance findings prior to take-off	**TO-SCF-NP-AVION-WRNLS-TOCW-MF**		Take-off roll acceleration values different than expected (calculated for current aircraft specification and applied engine power as well as external conditions) for take-off roll AND analysis of work/flight parameters considered as influencing functioning of TOCW system indicate on failure originating from incorrect maintenance (failure not appeared for the given conditions before or on other aircraft of given type) AND precursors for given event identified during component maintenance)
				Automatic protection functions failures – TOCW - maintenance findings prior to take-off	**TO-SCF-NP.-AFC-AUTOPROTFL-TOCW-MF**		
		Unsuccessful Operation	TO05B313	FCE – unsuccessful operation of TOCW System prior to take-off	**TO-FCE-INCOPER-TOCW**		OR TOCWS not active OR not reset
		Unsuccessful Manufacture	TO05B321	Electrical power system failure - TOCWS related – manufacture findings prior to take-off	**TO-SCF-NP-ELEC-TOCW-MFF**		OR TOCWS not active AND other aircraft system not active (dividing the same bus) AND analysis of work/flight parameters considered as influencing functioning of TOCW system indicate on failure originating from incorrect manufacturing (failure appeared for the given conditions

							before or on other aircraft of given type) AND precursors for given event identified during component manufacturing)
		Unsuccessful Maintenance	TO05B322	Electrical power system failure - TOCWS related – maintenance findings prior to take-off	**TO-SCF-NP-ELEC-TOCW-MF**		OR TOCWS not active AND other aircraft system not active (dividing the same bus) AND analysis of work/flight parameters considered as influencing functioning of TOCW system indicate on failure originating from incorrect maintenance (failure not appeared for the given conditions before or on other aircraft of given type) AND precursors for given event identified during component maintenance)
		Aircraft takes-off with incorrect configuration	TO05B33	Warning loss - TOCW prior to take-off	**TO-SCF-NP-AVION-WRNLS-TOCW**		OR TO roll and flight parameters indicate on not optimal aircraft configuration
3.Execution of take-off rejection being a consequence of TOC problems	Proper decision of the crew concerning termination of take-off procedure	Pilot Misdiagnosis	TO05B411	FCE – misdiagnose the incorrect configuration problem occurred during take-off and rejected take-off above V1	**RTO-FCE-MISD-RTOABV1-INCTOC**	Phase 3a: Following Phase 2 AND Braking application and at least two from: 1. Speed above V1 and not increasing, 2. Altitude – 0ft AGL, 3. thrust idle or reverse mode	Take-off rejection after reaching the V1 speed
		Pilot Misjudgement	TO05B412	FCE – misjudgement in terms of necessity of rejected take-off above V1	**RTO-FCE-MISJ-RTOABV1**		

		Take-off rejected correctly when below V1	TO05B42	Take-off rejected below V1	**RTO-INCTOC**	Phase 4. Following Phase 2 AND Braking application and at least two from: 1. Speed below V1 and not increasing and at least one from: 1. Altitude – 0ft AGL, 2. thrust idle or in reverse mode	OR Take-off rejection at speed below v1
4.Effective braking after execution of take-off rejection being a consequence of TOC problems	Parameters of braking systems and devices included into assumed / expected range	Insufficient Runway Length	TO05B51	Runway too short due to poor surface condition (ice or wet) following RTO	**RTO-ADRM-INSRWYL**		Runway excursion AND braking devices work correctly AND braking performed correctly.
		Brakes not functioning correctly	TO05B52	Automatic braking loss following RTO	**RTO-SCF-NP-AFC-ABRKLS**		OR Deceleration parameters lower than expected (calculated for current conditions) AND/OR braking asymmetry AND all braking devices applied on time and correctly
				Automatic braking operation error following RTO	**RTO-SCF-NP-AFC-ABRKERR**		
				Brake system failure following RTO	**RTO-SCF-NP-LG-BRKFL**		
				Reverser / beta malfunction - failure to deploy following RTO	**RTO-SCF-PP-RFD**		OR thrust reverser not deployed
		Brakes not applied correctly	TO05B53	FCE – brake application error following RTO	**RTO-FCE-BRAKAPP**		OR execution of braking procedure conducted by the flight crew differs significantly from the assumed as reference model.
5.Stall avoidance after take-off with unrevealed incorrect take-off configuration	Flight crew avoid aircraft stall resulted with unrevealed incorrect take-off configuration	Stall Unavoidable	TO05B61	Loss of control in flight during take-off in result of incorrect configuration	**TO-LOC-I-INCTOC**	Phase 3b. Following Phase 2. AND Speed above V1 and not decreasing, and at least two from: 1. Altitude	Flight parameters indicate on near stall AND lack of icing conditions
		Pilot ignores stickshaker	TO05B622	FCE – ignoring of stickshaker warning during take-off	**TO-FCE-IGN-STICSHKRWRN**		OR Actions taken by the flight crew do not cover procedure assumed as optimal for given conditions
		Stick shaker failure	TO05B6211	Warning loss – stickshaker failure during take-off	**TO-SCF-NP-AVION-WRNLS-**		OR Flight parameters (speed, configuration, AoA) indicate on near stall conditions AND lack of stickshaker

					STICSHKR	above 0ft AGL, 2. landing gear not compressed, 3. thrust in take-off mode.	warning AND lack of icing conditions
				Automatic protection functions failures – stickshaker failure during take-off	**TO-SCF-NP-AFC-AUTOPROTFL-STICSHKR**		
		Stall AOA too low	TO05B6212	Automatic protection functions failures during take-off	**TO-SCF-NP-AFC-AUTOPROTFL-STICSHKR**		OR Flight parameters indicate on stall AND AoA lower that necessary for stickshaker activation AND lack of icing conditions
6. Recovery of control after stalling being a result of unrevealed incorrect configuration	Flight crew recover the aircraft after stall being a result of unrevealed incorrect take-off configuration	Uncontrollable	TO05B71	Aircraft incontrollable in result of stall	**TO-LOC-I-STALL**		Aircraft configuration, attitude and flight parameters classified as unrecoverable (in result of stall)
		Lack of control	TO05B72	FCE – lack of reaction of flight crew on aircraft stall	**TO-LOC-I-FCE-LCTRL**		OR Aircraft configuration, attitude and flight parameters classified as recoverable AND lack of pilot input to aircraft control
		Incorrect Control	TO05B73	FCE – incorrect flight crew input to aircraft control	**TO-LOC-I-FCE-INCTRL**		OR Aircraft configuration, attitude and flight parameters classified as recoverable AND pilot input to aircraft control classified as incorrect in given situation
		Insufficient control	TO05B74	FCE – insufficient flight crew input to aircraft control	**TO-LOC-I-FCE-INSCTRL**		OR Aircraft configuration, attitude and flight parameters classified as recoverable AND pilot input to aircraft control classified as insufficient in given situation (too low extend, too short input time etc.

Table 6 ASCOS ESD 6 -Aircraft takes off with contaminated wing

Barrier	Description	Possibilities for braking the barrier – Base event	Code	Possible occurrence (CICTT)	Designation (CICTT)	Flight phase indicator	Proposed method for failure detection (trigger logic)
1. Pre-Service De-icing Procedure	Proper conducting of pre-service de-icing and de-contaminating of aircraft surfaces	Icing conditions	TO06B11	Icing conditions at the level of airport	**TO-ICE**	Phase 1: Landing gear compression longer than 10min and at least 1 from: 1. Altitude equals to 0ft AGL, 2. All engines are off or in idle mode.	Weather conditions indicate on serious risk of aircraft surface icing.
		Aircraft already in service	TO06B121	Aircraft during turnaround phase	**TO-ICE-GSE**		OR Weather conditions indicates on serious risk of aircraft surface icing AND aircraft in service (during turnaround phase)
		Aircraft entering service	TO06B1221	Pre-service deicing ineffective due to extreme icing conditions	**TO-ICE-EXTRWTHR-PSDICINEF**		OR Weather conditions indicates on serious risk of aircraft surface icing AND weather conditions indicate on the risk of reaccumulation of ice on aircraft surfaces (after pre-service deicing)
		Pre-Service de-icing failure	TO06B1222	Pre-service deicing procedure conducted incorrectly	**TO-ICE-GSE-PSDICEF**		OR Weather conditions indicates on serious risk of aircraft surface icing AND aircraft computer did not detect all steps indicating on correctly conducted pre-service deicing (procedure should be carried in manner enabling its detection by the aircraft computer and / or aircraft should be equipped with sensors enabling identification of correctly/incorrectly conducted deicing pre-service procedure)
2. Pre-Flight De-icing Procedure	Proper conducting of pre-service de-icing and de-contaminating of aircraft surfaces	Lack of pre-flight ice inspection	TO06B211	FCE – lack of pre-flight ice inspection.	**TO-ICE-FCE-LPFICINS**		Weather conditions indicates on serious risk of aircraft surface icing AND aircraft computer did not detect all indicators indicating on correctly conducted pre-flight ice inspection (e.g. seat compression or key words in flight crew conversation)
		Unsuccessful pre-flight ice inspection	TO06B212	FCE – incorrect flight crew pre-flight ice inspection	**TO-ICE-FCE-PFICINSF**		
		De-icing Failure	TO06B22	Pre-flight deicing procedure conducted incorrectly	**TO-ICE-GSE-PFDICE**		OR Weather conditions indicate on serious risk of aircraft surface icing AND aircraft computer detects all indicators indicating on correctly conducted pre-flight ice inspection AND aircraft

							computer did not detect all steps indicating on correctly conducted pre-flight deicing.
		ATC Delay	TO06B231	ATCOER – resulting with delayed take-off when icing conditions	**TO-ICE-ATM-ATCOER-FDELAY**		OR Weather conditions indicates on serious risk of aircraft surface icing AND time of expiration of pre-flight deicing for given weather condition does not reach the aircraft take-off (due to delayed take-off)
		Holdover properties inadequate	TO06B232	Incorrect HOT of deicing fluid	**TO-ICE-GSE-INCHOT**		OR aircraft computer detects inconsistency between HOT of applied deicing fluid and programmed time necessary for start for given airport.
		Severe Weather	TO06B233	Extreme icing conditions on the airport level	**TO-ICE-EXTRWTHR**		OR Weather conditions indicates on serious risk of ice accumulation exceeding the capacity of all available de-icing and anti-icing systems and means (both located on aircraft and available by airport services)
3. Post Push-Back De-icing Procedure	Proper conducting of pre-service de-icing and de-contaminating of aircraft surfaces	Lack of observation	TO06B311	FCE – lack of post-pushback ice inspection.	**TO-ICE-FCE-LPPBICINS**	Phase 2: Following phase 1 AND At least 4 from: 1. Speed above 0 and below ~35kts, 2. Altitude: 0ft AGL, 3. Landing gear compression, 4. Thrust in taxi mode, 5. Take-off configuration.	Weather conditions indicates on serious risk of aircraft surface icing AND aircraft computer did not detect all indicators indicating on correctly conducted post-pushback ice inspection (e.g. seat compression or key words in flight crew conversation)
		Unsuccessful Observation	TO06B312	FCE – incorrect flight crew post-pushback ice inspection	**TO-ICE-FCE-PPBICINSF**		
		De-icing Failure	TO06B32	GSE (Ground service error) - Post-pushback deicing procedure conducted incorrectly	**TO-ICE-GSE-PPBDICE**		OR Weather conditions indicate on serious risk of aircraft surface icing AND aircraft computer did not detect all signals indicating on correctly conducted post-pushback deicing.
		ATC Delay	TO06B331	ATCOER – resulting with delayed take-off when icing conditions	**TO-ICE-ATM-ATCOER-FDELAY**		OR Weather conditions indicates on serious risk of aircraft surface icing AND time of expiration of post-pushback deicing for given weather conditions does not reach the aircraft take-off

							(due to delayed take-off)
		Holdover properties inadequate	TO06B332	Incorrect HOT of deicing fluid	**TO-ICE-GSE-INCHOT**		OR aircraft computer detects inconsistency between HOT of applied deicing fluid and programmed time necessary for start for given airport.
		Severe Weather	TO06B333	Extreme icing conditions on the airport level	**TO-ICE-EXTRWTHR**		OR Weather conditions indicates on serious risk of ice accumulation exceeding the capacity of all available de-icing and anti-icing systems and means (both located on aircraft and available by airport services)
4. Stall avoidance after take-off with unrevealed incorrect take-off configuration	Flight crew avoid aircraft stall during take-off resulted with unrevealed incorrect take-off configuration	Stall Unavoidable	TO06B41	Loss of control in flight during take-off in result of aircraft surface icing	**TO-ICE-LOC-I**	Phase 3. Following Phase 2. AND Speed above V1 and not decreasing, and at least two from: 1. Altitude above 0ft AGL, 2. landing gear not compressed, 3. thrust in take-off mode.	Flight parameters indicate on near stall AND weather conditions indicates on serious risk of aircraft surface icing
		Stick shaker failure	TO06B4211	Warning loss – stickshaker failure during take-off	**TO-ICE-SCF-NP-AFC-AUTOPROTFL-STICSHKR**		OR Flight parameters (speed, configuration, AoA) indicate on near stall conditions AND lack of stickshaker warning AND weather conditions indicates on serious risk of aircraft surface icing
				Automatic protection functions failures – stickshaker during take-off	**TO-ICE-SCF-NP-AVION-WRNLS-STICSHKR**		
		Stall AOA too low	TO06B4212	Automatic protection functions failures – stickshaker during take-off	**TO-ICE-SCF-NP-AFC-AUTOPROTFL-STICSHKR**		OR Flight parameters (speed, configuration, AoA) indicate on near stall conditions AND lack of stickshaker warning AND weather conditions indicates on serious risk of aircraft surface icing
		Pilot ignores stickshaker	TO06B422	FCE – ignoring of stickshaker warning during take-off	**TO-ICE-FCE-STICSHKRWRN-IGN**		OR Actions taken by the flight crew do not cover procedure assumed as optimal for given conditions

Table 7 ASCOS ESD 8 - Aircraft encounters performance decreasing windshear after rotation

Barrier	Description	Possibilities for braking the barrier – Base event	Code	Possible occurrence (CICTT)	Designation (CICTT)	Flight phase indicator	Proposed method for failure detection (trigger logic)
1. Windshear detection	Flight crew detect the windshear with use of available supporting systems, ATM or own competence and skills	LLWAS not installed	TO08B111	Lack of LLWAS system at the airport	**TO-WSTRW-ADRM-LLLWAS**	Phase 1: Speed near to V1and increasing and at least 4 from: 1. Altitude equals to 0ft AGL and increasing, 2. Take-off power application, 3. Nose gear not compressed and main gear compressed, 4. Angle of attack optimal for take-off configuration, 5. Take-off	- ATCO system is not equipped with LLWAS
		LLWAS not activated	TO08B112	LLWAS system failure	**TO-WSTRW-ATM-WRNLS-LLWAS**		- OR LLWAS system not active
		Failure of ATC to advise pilot	TO08B113	ATCOER – alerting the flight crew about the windshear during take-off	**TO-WSTRW-ATM-ATCOER-FCADV**		- OR aircraft computer did not detect the message from ATCO warning about windshear AND receive automatic message from ATM system equipped with LLWAS
		PWS not installed	TO08B121	Lack of PWS installed on aircraft	**TO-WSTRW-LPWS**		- OR PWS not available
		PWS not activated	TO08B122	Failure of the PWS during take-off	**TO-SCF-NP-AVION-WRNLS-PWS**		- OR PWS not activated AND aircraft computer receive warning from ATM system AND/ OR detected the alert warning communicated by the ATCO
		Crew fail to recognize windshear	TO08B13	FCE – lack of windshear symptoms detection in case of lack of automatic systems.	**TO-WSTRW-FCE-WSHRREC**		- OR weather conditions as well as programmed airport specifications indicate on risk of windshear

2. Windshear Management	Flight crew executes the WEM	Failure to avoid windshear	TO08B21	Windshear unavoidable	**TO-WSTRW-WSHRAF**	configuration.	- Aircraft computer detected ATCO alert about windshear appearing AND/OR received message from ATM system about detected windshear by the LLWAS AND/OR detected with PWS windshear followed by aircraft flight parameters indicating on windshear encounter by the aircraft AND windshear unavoidable(e.g. due to too short time distance between windshear detection and experiencing)
		Aircraft too low	TO08B221	Windshear unavoidable due to too low altitude	**TO-WSTRW-WSHRAF**		- OR Aircraft computer detected ATCO alert about windshear appearing AND/OR received message from ATM system about detected windshear by the LLWAS AND/OR detected with PWS windshear followed by aircraft flight parameters indicating on windshear encounter by the aircraft AND windshear unavoidable(due to too low altitude)
		Pilot fails to execute a WEM	TO08B222	FCE-incorrect WEM execution	**TO-WSTRW-FCE-WSHRDAF**		- OR Aircraft computer detected ATCO alert about windshear appearing AND/OR received message from ATM system about detected windshear by the LLWAS AND/OR detected with PWS windshear followed by aircraft flight parameters indicating on windshear encounter by the aircraft AND Actions taken by the flight crew do not cover WEM procedure assumed as optimal for given conditions.
3. Maintaining of control	Flight crew maintain control	Uncontrollable	TO08B31	Aircraft incontrollable in result of stall	**TO-WSTRW-LOC-I-WSHR**	Phase 2. Following Phase 1.	- Aircraft attitude and flight parameters classified as unrecoverable

after experiencing unrevealed windshear and / or unsuccessful WEM	under the aircraft after experiencing unrevealed windshear and / or unsuccessful WEM	Lack of control	TO08B32	FCE – lack of reaction of flight crew on aircraft configuration after windshear encounter	**TO-WSTRW-LOC-I-FCE-LCTRL**	AND at least 4 from: 1. Altitude above 0ft AGL and not increasing, 2. Take-off power application, 3. Landing gear not compressed, 4. Angle of attack not optimal for take-off, 5. Speed above V1 and changing rapidly	- OR Aircraft configuration, attitude and flight parameters classified as recoverable AND lack of pilot input to aircraft control
		Incorrect control	TO08B33	FCE – incorrect flight crew input to aircraft control after windshear encounter	**TO-WSTRW-LOC-I-FCE-INCTRL**		- OR Aircraft configuration, attitude and flight parameters classified as recoverable AND pilot input to aircraft control classified as incorrect in given situation
		Insufficient control	TO08B34	FCE – insufficient flight crew input to aircraft control after windshear encounter	**TO-WSTRW-LOC-I-FCE-INSCTRL**		- OR Aircraft configuration, attitude and flight parameters classified as recoverable AND pilot input to aircraft control classified as insufficient in given situation (too low extend, too short input time etc.)

Table 8 ASCOS ESD 9 - Single engine failure

Barrier	Description	Possibilities for braking the barrier – Base event	Code	Possible occurrence (CICTT)	Designation (CICTT)	Flight phase indicator	Proposed method for failure detection (trigger logic)
1. Engine Integrity during take-off roll	Proper working of engine during take-off roll	Unsuccessful Manufacturing	TO09B11	In-flight shutdown during take-off in result of unsuccessful manufacturing	**TO-SCF–PP–IFSD-MFF**	Phase 1: At least 2 from: 1. Speed above ~35kts and not decreasing, 2. Altitude: 0 - 50ft AGL, 3. Application of take-off power	- Engine shutdown AND experiences gathered during engine development and testing compared with current work conditions indicate on strong possibility of failure resulted from manufacturing error AND lack of precursors related to maintenance detected before.
				Other engine malfunction during take-off in result of unsuccessful manufacturing	**TO-SCF-PP-OTHEM-MFF**		- OR Deviation from proper engine work parameters indicating on malfunction AND experiences gathered during engine development and testing compared with current work conditions indicate on strong possibility of failure resulted from manufacturing error AND lack of precursors related to maintenance detected before.
		Unsuccessful Maintenance	TO09B12	In-flight shutdown during take-off in result of unsuccessful maintenance	**TO-SCF-PP-IFSD-MF**		- OR Engine shutdown AND during last maintenance precursors for engine failure were detected AND / OR experiences gathered during engine development and testing compared with current work conditions indicate on strong possibility of failure resulted from maintenance error
				Other engine malfunction during take-off in result of unsuccessful maintenance	**TO-SCF-PP-OTHEM-MF**		- OR Deviation from proper engine work parameters indicating on malfunction AND during last maintenance precursors for engine failure were detected AND / OR experiences gathered during engine development and testing compared with

							current work conditions indicate on strong possibility of failure resulted from maintenance error
		Unsuccessful Manufacture and Maintenance	TO09B13	In-flight shutdown during take-off in result of unsuccessful manufacture or maintenance	**TO-SCF-PP-IFSD-MF**		- OR Engine shutdown AND / OR experiences gathered during engine development and testing compared with current work conditions indicate on strong possibility of failure resulted from maintenance OR manufacture error AND during last maintenance precursors for engine failure were detected OR during manufacturing precursors for engine failure were detected
					TO-SCF-PP-IFSD-MFF		
				Other engine malfunction during take-off in result of unsuccessful manufacture or maintenance	**TO-SCF-PP-OTHEM-MF**		
					TO-SCF-PP-OTHEM-MFF		
		Foreign Object Damage	TO09B14	In-flight shutdown during take-off in result of bird impact	**TO-BIRD-SCF-PP-IFSD**		- OR Engine shutdown AND engine work parameters indicate on foreign object ingestion AND/OR sound of impact detected (e.g. with use of engine noise spectrum analysis)
				Other engine malfunction during take-off in result of bird impact	**TO-BIRD-SCF-PP-OTHEM**		- OR Deviation from proper engine work parameters AND engine work parameters indicate on foreign object ingestion AND/OR sound of impact detected (e.g. with use of engine noise spectrum analysis)
				In-flight shutdown during take-off in result of foreign object impact	**TO-ADRM-SCF-PP-IFSD**		- OR Engine shutdown AND engine work parameters indicate on foreign object ingestion AND/OR sound of impact detected (e.g. with use of engine noise spectrum analysis) AND main gear compressed
				Other engine malfunction during	**TO-ADRM-SCF-PP-**		- OR Deviation from proper engine work parameters AND engine work parameters

				take-off in result of foreign object impact	**OTHEM**		indicate on foreign object ingestion AND sound of impact detected (e.g. with use of engine noise spectrum analysis) AND main gear compressed
2.Execution of take-off rejection being a consequence of engine problems	Proper decision of the crew concerning termination of take-off procedure	Pilot Misdiagnosis	TO09B211	FCE – misdiagnose the engine problem occurred during take-off and rejected take-off above V1	**RTO-FCE-MISD-RTOABV1-SCF-PP**	Phase 2a: Following Phase 1 AND Braking application and at least two from: 1. Speed above V1 and not increasing, 2. Altitude – 0ft AGL, 3. thrust idle or reverse mode	- Take-off rejection after reaching the V1 speed
		Pilot Misjudgement	TO09B212	FCE – misjudgement in terms of necessity of rejected take-off above V1 resulted from engine problem during ta	**RTO-FCE-MISJ-RTOABV1**		
		Take-off rejected correctly when below V1	TO09B22	Take-off rejected correctly below V1 (as a result of engine problems)	**RTO-SCF-PP**	Phase 3. Following Phase 2 AND Braking application and at least two from: 1. Speed below V1 and not	- Take-off rejection before reaching the V1 speed
3. Maintain control after execution of take-off	Flight crew maintains control after executio	Uncontrollable	TO09B31	Loss of control on aircraft after rejected take-off in result of propulsion failure	**RTO-LOC-G-SCF-PP**		- Aircraft attitude and flight parameters classified as unrecoverable
		Lack of	TO09B3	FCE – lack of	**RTO-LOC-**		- OR Aircraft configuration, attitude and

rejection being a consequence of single engine failure	n of take-off rejection being a consequence of single engine failure	control	2	reaction of flight crew on incorrect flight parameters of aircraft	**G-FCE-LCTRL**	increasing and at least one from: 1. Altitude – 0ft AGL, 2. Thrust: idle or in reverse mode	flight parameters classified as recoverable AND lack of pilot input to aircraft control
		Incorrect control	TO09B33	FCE – incorrect flight crew input to aircraft control	**RTO-LOC-G-FCE-INCTRL**		- OR Aircraft configuration, attitude and flight parameters classified as recoverable AND pilot input to aircraft control classified as incorrect in given situation
		Insufficient control	TO09B34	FCE – insufficient flight crew input to aircraft control	**RTO-LOC-G-FCE-INSCTRL**		- OR Aircraft configuration, attitude and flight parameters classified as recoverable AND pilot input to aircraft control classified as insufficient in given situation (too low extend, too short input time etc.)
4. Effective braking after execution of take-off rejection being a consequence of single engine failure	Parameters of braking systems and devices included into assumed / expected range	Insufficient Runway Length	TO09B41	Runway too short due to poor surface condition (iced or wet) following RTO	**RTO-ADRM-INSRWYL**		- Runway excursion AND braking devices work correctly AND braking performed correctly.
		Brakes not functioning correctly	TO09B42	Automatic braking loss following RTO	**RTO-SCF-NP-AFC-ABRKLS**		- OR Deceleration parameters lower than expected (calculated for current conditions) AND/OR braking asymmetry AND all braking devices applied on time and correctly
				Automatic braking operation error following RTO	**RTO-SCF-NP-AFC-ABRKERR**		
				Brake system failure following RTO	**RTO-SCF-NP-LG-BRKFL**		
				Reverser / beta malfunction - failure to deploy following RTO	**RTO-SCF-PP-RFD**		- OR thrust reverser not deployed
		Brakes not applied correctly	TO09B43	FCE – brake application error following RTO	**RTO-FCE-BRAKAPP**		- OR execution of braking procedure conducted by the flight crew differs significantly from the assumed as reference

							model for given conditions.
5. Maintain control during continued take-off with single engine failure	Flight crew maintains control during not aborted take-off due to single engine failure.	Uncontrollable	TO09B51	Aircraft uncontrollable in result of engine in-flight shutdown	**TO-LOC-G-SCF-PP-IFSD**	Phase 2b. Following Phase 1. AND Speed above V1 and not increasing, and at least two from: 1. Altitude above 0ft AGL, 2. landing gear not compressed, 3. thrust in take-off mode.	- Aircraft configuration, attitude and flight parameters classified as unrecoverable
		Lack of control	TO09B52	FCE – lack of recovery action	**TO-LOC-G-FCE-LCTRL**		- OR Aircraft configuration, attitude and flight parameters classified as recoverable AND lack of pilot input to aircraft control
		Incorrect Control	TO09B53	FCE – incorrect recovery action	**TO-LOC-G-FCE-INCTRL**		- OR Aircraft configuration, attitude and flight parameters classified as recoverable AND pilot input to aircraft control classified as incorrect in given situation
		Insufficient control	TO09B54	FCE – insufficient recovery action	**TO-LOC-G-FCE-INSCTRL**		- OR Aircraft configuration, attitude and flight parameters classified as recoverable AND pilot input to aircraft control classified as insufficient in given situation (too low extend, too short input time etc.)

Table 9 ASCOS ESD 10 - Pitch control problem

Barrier	Description	Possibilities for braking the barrier – Base event	Code	Possible occurrence (CICTT)	Designation (CICTT)	Flight phase indicator	Proposed method for failure detection (trigger logic)
1.Aircraft pitch under control	Trim and speed setting and / or pitch control input correctly determined and entered by the flight crew into FMC. Integrity of integral components of FMC as well as FMC as system.	Trim settings incorrectly determined	TO10B11 11	FCE - trim setting determination during take-off	**TO-FCE-INCTRIMS**	Phase 1: At least 2 from: 1. Speed above ~35kts and not decreasing, 2. Altitude: 0 - 50ft AGL, 3. Application of take-off power	Trim and speed settings determined by the flight crew differ than expected/suggested (calculated for current aircraft specifications and external conditions)
		Speed settings incorrectly determined	TO10B11 12	FCE - speed settings determination during take-off	**TO-FCE-INCSPEEDS**		
		Trim settings incorrectly entered into FMC	TO10B11 2	FCE - entering the trim settings to FMC during take-off	**TO-FCE-FMC-INCTRIMENT**		OR Trim and speed settings did not introduced into FMS AND/OR Trim and speed settings determined by the flight crew differ than expected/suggested (calculated for current aircraft specifications and external conditions)
		Speed settings incorrectly entered into FMC	TO10B11 3	FCE - entering the speed setting to FMC during take-off	**TO-FCE-FMC-INCSPDENT**		
		Unsuccessful Pitch Control Inputs	TO10B12	FCE - inappropriate inputs to the flight controls during take-off	**TO-FCE-INCPCIN**		OR Flight crew input to aircraft control classified as incorrect
		Unsuccessful Design	TO10B13 11	Pitch control problem during take-off resulted from unsuccessful design of FCS components	**TO-FMC-DF-PITCHC**		OR pitch control problem detected AND did not origin from flight crew error AND current combination of all considered as significant (for pitch control ability) flight parameters and external conditions concurrent with detected pitch problem appeared before in the aircraft/aircraft component indicating on design related

							error AND precursor for given occurrence were identified during aircraft/aircraft component design process
		Unsuccessful Manufacture	TO10B1312	Pitch control problem during take-off resulted from unsuccessful manufacture of FCS components	**TO-SCF-NP-AFC-OTHR-PITHCC-MFF**		OR pitch control problem detected AND did not origin from flight crew error AND current combination of all considered as significant (for pitch control ability) flight parameters and external conditions concurrent with detected pitch problem appeared before in the aircraft/aircraft component series indicating on manufacturing related error (in other aircraft of the same type but other series given combination of conditions did not result with similar pitch problems) AND precursor for given occurrence were identified during aircraft/aircraft component manufacturing process.
		Unsuccessful Maintenance	TO10B1313	Pitch control problem during take-off resulted from unsuccessful maintenance of FCS components	**TO-SCF-NP-AFC-OTHR-PITCHC-MF**		OR pitch control problem detected AND did not origin from flight crew error AND current combination of all considered as significant (for pitch control ability) flight parameters and external conditions concurrent with detected pitch problem did not meet the requirement for design or manufacture related failure AND / OR during last maintenance appropriate precursors for FCS failure were detected
		Foreign Object Damage	TO10B1314	Pitch control problem during take-off resulted from impact of foreign object (bird	**TO-BIRD-SCF-NP-AFC-PITCHC**		OR Deviation from proper FCS work parameters AND FCS work parameters indicate on foreign object impact AND sound of impact detected (e.g. with use of noise spectrum analysis)

				or debris)	**TO-ADRM-SCF-NP-AFC-PITCHC**		OR Deviation from proper FCS work parameters AND FCS work parameters indicate on foreign object impact AND sound of impact detected (e.g. with use of noise spectrum analysis) AND main gear compressed
		Severe Flight Control System Failure	TO10B132	Pitch control problem during take-off resulted from FCS failure	**TO-SCF–NP-AFC-OTHR-PITCHC**		OR Deviation from proper FCS work parameters (other than pitch control FCS functionalities)
2. Execution of take-off rejection being a consequence of pitch control problems	Proper decision of the crew concerning termination of take-off procedure	Pilot Misdiagnosis	TO10B211	FCE – misdiagnose the problem occurred during take-off and rejected take-off above V1 resulted from pitch control problems	**RTO-FCE-MISD-RTOABV1-PITCHC**	Phase 2a: Following Phase 1 AND Braking application and at least two from: 1. Speed above V1 and not increasing, 2. Altitude – 0ft AGL, 3. thrust idle or reverse mode	Take-off rejection after reaching the V1 speed
		Pilot Misjudgement	TO10B212	FCE – misjudgement in terms of necessity of rejected take-off above V1	**RTO-FCE-MISJ-RTOABV1**		
		Take-off rejected correctly when below V1	TO10B22	Take-off rejected below V1 (as result of pitch control problems)	**RTO-PITCHC**	Phase 3. Following Phase 2 AND Braking application and at least two from: 1. Speed below V1 and not increasing and at least one from: 1. Altitude – 0ft	Take-off rejection before reaching the V1 speed
3. Effective braking after execution	Parameters of braking systems and	Insufficient Runway Length	TO10B31	Runway too short due to poor surface condition (iced or wet) following RTO	**RTO-ADRM-INSRWYL**		Runway excursion AND braking devices work correctly AND braking performed correctly.

of take-off rejection being a consequence of single engine failure	devices included into assumed / expected range	Brakes not functioning correctly	TO10B32	Automatic braking loss following RTO	**RTO-SCF-NP-AFC-ABRKLS**	AGL, 2. Thrust: idle or in reverse mode	OR Deceleration parameters lower than expected (calculated for current conditions) AND/OR braking asymmetry AND all braking devices applied on time and correctly
				Automatic braking operation error following RTO	**RTO-SCF-NP-AFC-ABRKERR**		
				Brake system failure following RTO	**RTO-SCF-NP-LG-BRKFL**		
				Reverser / beta malfunction - failure to deploy following RTO	**RTO-SCF-PP-RFD**		OR thrust reverser not deployed
		Brakes not applied correctly	TO10B33	FCE – brake application error following RTO	**RTO-FCE-BRAKAPP**		OR execution of braking procedure conducted by the flight crew differs significantly from the assumed as reference model.
4. Rotation and lift off after not aborted take-off due to pitch control problems detected	Flight crew overcome problems related with pitch control after not aborted take-off	Pitch Control Misdiagnosed	TO10B41	FCE-diagnose of pitch problem incorrect	**TO-FCE-MISD-PITCHC**	Phase 2b. Following Phase 1. AND Speed above V1 and not increasing, and at least two from: 1. Altitude above 0ft AGL, 2. landing gear not compressed, 3. thrust in take-off mode.	Aircraft configuration, attitude and flight parameters classified as incorrect AND pilot input to aircraft controls differs from programmed as optimal for given situation
		Unsuccessful Pitch Control Rectification	TO10B42	FCE-incorrect flight crew actions in order to rectify the situation	**TO-FCE-RECF-PITCHC**		

Table 10 ASCOS ESD 11 - Fire on-board aircraft

Barrier	Description	Possibilities for braking the barrier – Base event	Code	Possible occurrence (CICTT)	Designation (CICTT)	Flight phase indicator	Proposed method for failure detection (trigger logic)
1. All conditions assuring safety in area of fire are met.	In case of all potential sources of fire safe conditions are kept.	Cargo in Heightened Flammable State	ER11B11	Cargo restraint system failure during en route	**ER-F-NI-SCF-NP-MISC-CARGRSTFL**	Phase 1. Following phase 0 (take-off) and at least 2 from: 1. Speed above V2, 2. Altitude above 1000ft AGL, 3. Thrust cruise mode.	- Flight parameters during climb or manoeuvring indicate on CG movement resulted from cargo movement AND cargo transported classified as DGR
				Ground service error (GSE) in cargo securing on-board during en route	**ER-F-NI-GSE-CARGRSTFL**		
		Foreign Object Damage results in fuel leak	ER11B1211	Fuel leak during en route resulted with bird impact during take-off or initial climb	**ER-BIRD-F-NI-SCF-NP-FUEL-LK**		- OR Fuel leak detected AND sound of impact detected during take-off roll or initial climb indicating on foreign object impact (e.g. detected with use of noise spectrum analysis)
				Fuel leak during en route resulted with debris impact during take-off roll	**ER-ADRM-F-NI-SCF-NP-FUEL-LK**		
		Unsuccessful Maintenance Revealed	ER11B1212	Fuel leak during en route resulted from unsuccessful maintenance of fuel system	**ER-F-NI-SCF-NP-FUEL-LK-MF**		- OR Fuel leak detected AND appropriate precursor(s) detected during last maintenance of the system
				Flammable fluid leak during en route resulted from unsuccessful maintenance	**ER-F-NI-SCF-PP-FFL-MF**		- OR flammable fluid leak detected AND appropriate precursor(s) detected during last maintenance of the system

				Engine failure during en route resulting with fire caused by incorrect maintenance	**ER-F-NI-SCF-PP-MF**		- OR Deviation in engine component work parameters indicating on failure able to result with fire AND appropriate precursor(s) detected during last maintenance of system
		Unsuccessful Fuel Transfer	ER11B1213	Fuel control system failure possible to cause a fire during en route	**ER-F-NI-SCF-NP-FUEL-CTRL**		- OR Inconsistency between expected and transferred amount of fuel detected indicating on fuel leak and risk of fire AND/OR deviation from modelled and real data related to the fuel transfer process (e.g. fuel flow characteristic)
				GSE – error during transferring fuel to the aircraft prior to flight	**ER-F-NI-GSE-FUELTR**		- OR precursors for fire events detected during operation of fuel equipment by ground service worker (detected by aircraft systems, fuel car system or e.g. airsite CCTV)
		Flammable Vapor in Fuel Tank	ER11B122	Incorrect fuel tank atmosphere parameters during en route	**ER-F-NI-SCF-NP-FUEL-TNKPR**		- OR parameters of fuel tank atmosphere classified as dangerous and possibly fire generating
		Hydraulic Fluids in Heightened Flammable State	ER11B13	Hydraulic system failure with potential for causing fire during en route	**ER-F-NI-SCF-NP-MISC-HYDFL**		- OR Work parameters of hydraulic system indicated on flammable state
		Aircraft Equipment in Heightened Flammable State	ER11B14	Risk fire during en route resulted with equipment installation error during manufacturing	**ER-F-NI-SCF-NP-MFF**		- OR temperature and heat transfer analysis for aircraft components during operation indicate on increased risk of causing a fire unusual for given aircraft type (indicating on manufacture error)

							(Such analysis should be conducted every some time period) AND appropriate precursor(s) for given failure detected during manufacturing of the component
				Risk fire during en route resulted with equipment installation error during maintenance	**ER-F-NI-SCF-NP-MF**		- OR temperature and heat transfer analysis for aircraft components during operation indicate on increased risk of causing a fire unusual for given aircraft (indicating on maintenance error)(Such analysis should be conducted every some time period) AND appropriate precursor(s) for given failure detected during installation of the component
				Risk fire during en route resulted with equipment installation error during design	**ER-F-NI-SCF-NP-DF**		- OR temperature and heat transfer analysis for aircraft components during operation indicate on increased risk of causing a fire appropriate precursor(s) for given failure detected during design of the component
		Engine Overheats	ER11B15	Case burnthrough being a result of engine overheat during en route	**ER-F-NI-SCF-PP-CB**		- OR Engine components ultimate temperature exceeded AND possibility for case burnthrough detected
				Other engine malfunction during en route	**ER-F-NI-SCF-PP-OTHEM**		- OR Engine components temperature exceeded AND deviation in engine components work parameters detected.
				Propulsion system fire during en route	**ER-F-NI-SCF-PP-**		- OR Engine components temperature exceeded AND possibility of

					PSF		outbreak of fire.
				Propulsion system fume event during en route	**ER-F-NI-SCF-PP-PSFE**		- OR Engine components temperature exceeded AND deviation in exhaust gas parameters.
				Compartment overheat/Air leak during en route	**ER-F-NI-SCF-PP-COAL**		- OR Engine components temperature exceeded AND air leak detected.
		APU Overheats	ER11B16	APU overheat during en route possible to turn into a fire	**ER-F-NI-SCF-NP-MISC-APUFL-OVHT**		- OR APU work parameters indicate on overheat possible to turn into a fire
		Electrical Event results in Ignition	ER11B21	Arcing during en route	**ER-F-NI-SCF-NP-ELEC-ARC**		- OR electric system failure / deviation in work parameters detected AND failure classified as being able to result in fire
		Excessive Heat Transfer results in Ignition	ER11B22	Excessive Heat Transfer overheat during en route resulted in Ignition	**ER-F-NI-OVHT**		- OR aircraft components temperature exceeded AND classified as being able to turn into a fire
2. Fire detection by flight crew	Flight crew successfully overcome the situation	Fire Detection System Failure	ER11B31	Fire not detected	**ER-F-NI-SCF-NP-AVION-WRNLS-FIRDET**		- Aircraft components temperature exceeded (must be measured by more than one instrument) indicated on strong risk of fire AND lack of fire detection system warning
		Fire Warning System Failure	ER11B32	Lack of warning from fire detection system	**ER-F-NI-SCF-NP-AVION-WRNLS-FIRWARN**		
		No Detection /Warning System	ER11B33	Lack of fire detection / warning system	**ER-F-NI-LFIREWARN**		- OR Aircraft components temperature exceeded (must be measured in every aircraft

		Available					component which can be potentially touched by fire
		Fire Detection Impractical	ER11B34	Explosion during en route	**ER-F-NI-EXPL**		- OR measured parameters indicate on explosion in some part of aircraft (detected e.g. through sound analysis and flight parameters analysis)
3. Fire extinction by the flight crew	Flight crew successfully overcome the situation	No System Installed at Point of Fire	ER11B411	Lack of fire extinguishing system at the location of fire	**ER-F-NI-LFIREEXT**		- Fire detected beyond the range of fire extinguishing system
		Fire Extinction System Failure	ER11B412	Failure of the fire extinguishing system in cabin during en route	**ER-F-NI-SCF-NP-CABIN-OTHR-FIREEXT**		- OR Fire detected AND aircraft computer detect that flow of extinguishing fluid is below the value classified as correct /necessary
				Failure of the fire extinguishing system in place of fire during en route	**ER-F-NI-SCF-NP-MISC-FIREEXTFL**		
		Fire Extinction System not Activated	ER11B42	Fire Extinction System not active	**ER-F-NI-FCE-FIREEXT**		- OR Fire detected AND fire extinguish system not active
		Flight Crew misinterpret Systems Warning	ER11B431	FCE – misdiagnose the situation concerning fire during en route	**ER-F-NI-FCE-MISD-FIRE**		- OR Fire detected AND flight crew actions do not cover the model procedure coded/established in aircraft computer for given situation
		Flight Crew misinterpret Sensory Warnings	ER11B432	FCE - Flight Crew misinterpret fire sensory warnings	**ER-F-NI-FCE-MISJ-FIRE**		
		Incorrect Operation of Fire Extinction	ER11B44	Fire extinction system failure during en route	**ER-F-NI-FCE-INCOP-**		- OR Fire detected AND flight crew actions cover the model procedure for given situation AND fire

		System			**FIREEXT**		extinction system execution parameters differ from optimal for given situation.
		Fire Extinction System Insufficient	ER11B45	Fire scale exceeds the capacity of fire extinction system	**ER-F-NI-OVFIRE**		- OR Fire detected AND flight crew actions cover the model procedure for given situation AND fire extinction system execution parameters correct AND fire propagates.
		Fire Extinction Impractical	ER11B46	Explosion during en route	**ER-F-NI-EXPL**		- OR Fire detected AND flight crew actions cover the model procedure for given situation AND fire extinction system execution parameters correct AND measured parameters indicate on explosion in some part of aircraft (detected e.g. through sound analysis and flight parameters analysis)
4.Fire containment	Flight crew inhibits propagation of fire	Fire fed by Original Flammable Source	ER11B51	Fuel leak being a source of fire during en route	**ER-F-NI-SCF-NP-FUEL-LK**		- Fire propagates AND fuel leak detected
				Flammable fluid leak being a source of fire during en route	**ER-F-NI-SCF-PP-FFL**		- OR Fire propagates AND flammable fluid leak detected
		Fire fed by Secondary Flammable Sources	ER11B52	Fuel leak being a source of fire during en route	**ER-F-NI-SCF-NP-FUEL-LK**		- OR Fire propagates AND fuel leak detected
				Flammable fluid leak being a source of fire during en route	**ER-F-NI-SCF-PP-FFL**		- OR Fire propagates AND flammable fluid leak detected
		Fire has Catastrophic Explosive	ER11B53	Explosion during en route	**ER-F-NI-EXPL**		- OR fire propagates AND measured parameters indicate on explosion in some part of aircraft (detected e.g.

		Effects					through sound analysis and flight parameters analysis)
5. Maintaining Control after appearing uncontrollable fire onboard	Flight crew maintain control under uncontrollable fire onboard	Flight Control Surfaces Inoperable	ER11B611	Loss of control in flight resulted with inoperable flight surface	**ER-F-NI-LOC-I-FCSUN**	Phase 1. Following phase 0 (take-off) and at least 2 from: 1. Speed above V2, 2. Altitude above 1000ft AGL, 3. Thrust cruise mode.	- Fire detected and propagates AND inconsistencies between flight crew input to the aircraft controls and aircraft answer detected
		Aircraft Structural Integrity Failure	ER11B612	Aircraft structural integrity failure resulted with fire	**ER-F-NI-LOC-I-STRUCTF**		- OR Fire detected and propagates AND inconsistencies between flight crew input to the aircraft controls and aircraft answer detected AND flight parameters data analysis indicate on aircraft integrity failure (e.g. weight and balance data or cabin pressure decrease)
		Flight Crew Incapacitated	ER11B613	Flight crew incapacitation being a consequence of fire	**ER-F-NI-FCINCAP**		- OR Fire detected and propagates AND lack of flight crew activity detected
		Lack of Control	ER11B62	FCE – lack of reaction on fire	**ER-F-NI-FCE-LCTRL**		- OR Fire detected and propagates AND flight crew actions do not cover the procedure programmed in aircraft computer AND other not related to fire events occurred
		Incorrect Control	ER11B63	FCE – incorrect reaction on fire	**ER-F-NI-FCE-INCTRL**		- OR Fire detected and propagates AND flight crew actions do not cover the procedure programmed in aircraft computer.

Table 11 ASCOS ESD 12 - Flight crew member spatially disorientated

Barrier	Description	Possibilities for braking the barrier – Base event	Code	Possible occurrence (CICTT)	Designation (CICTT)	Flight phase indicator	Proposed method for failure detection (trigger logic)
1. Attitude guidance	Proper functioning of Attitude Director Indicator which is used and continuously crosschecked with other indicators by flight crew	ADI failure in flight	ER12B311	Altitude information error during en route leading to pilot disorientation	**ER-SCF-NP-AVION-ALTERR-ADI**	Phase 1. Following phase 0 (take-off) and at least 2 from: 1. Speed above V2, 2. Altitude above 1000ft AGL, 3. Thrust cruise mode.	- Inconsistency between ADI indication and output values from other sources (calculated on base of other data or received from other instruments)
				Airspeed information error during en route leading to pilot disorientation	**ER-SCF-NP-AVION-ASERR-ADI**		
				Attitude information error during en route leading to pilot disorientation	**ER-SCF-NP-AVION-ATTERR-ADI**		
				AoA information error during en route leading to pilot disorientation	**ER-SCF-NP-AVION-AOAERR-ADI**		
		No ADI cross-check by pilot	ER12B3121	FCE – no ADI crosscheck by pilot	**ER-FCE-LCRSSCHCK-ADI**		- OR Inconsistency between ADI indication and output values from other sources (calculated on base of other data or received from other instruments) AND not all indicators failed (failure classified as detectable by flight crew) AND lack of flight crew reaction indicating on problem

							detection
		Multiple ADI failure	ER12B3122	Altitude information error during en route leading to pilot disorientation	**ER-SCF-NP-AVION-ALTERR-ADI**		- OR Inconsistency between ADI indication and output values from other sources (calculated on base of other data or received from other instruments)
				Airspeed information error during en route leading to pilot disorientation	**ER-SCF-NP-AVION-ASERR-ADI**		
				Attitude information error during en route leading to pilot disorientation	**ER-SCF-NP-AVION-ATTERR-ADI**		
				AoA information error during en route leading to pilot disorientation	**ER-SCF-NP-AVION-AOAERR-ADI**		
		Disorientating maneuver	ER12C1	ATCOER - Potentially disorientating manoeuvre commanded	**ER-ATM-ATCOER-DISMAN**		- OR executed manoeuvre classified as potentially disorientating AND/OR ATM message containing necessary manoeuvre classified as potentially disorientating
		ADI not used by pilot	ER12B321	FCE – not using ADI by the pilot during disorientating manoeuvre	**ER-FCE-LADIUSE**		- OR executed manoeuvre classified as potentially disorientating AND/OR ATM message containing necessary manoeuvre classified as potentially disorientating AND analysis of pilot input to the aircraft controls indicate on not using of ADI
2. Visual	Flight crew	Instrument	ER12B41	Lack of visibility	**ER-IMC**		- OR executed manoeuvre classified as

Orientation by flight crew	is able to spatially orient on base of visible horizon or objects on terrain	meteorological conditions		due to weather conditions during ADI failure and execution of disorientating manoeuvre (during en route)			potentially disorientating AND/OR ATM message containing necessary manoeuvre classified as potentially disorientating AND inconsistency between ADI indication and output values from other sources (calculated on base of other data or received from other instruments) AND analysis of weather conditions indicates on lack of visibility (due to clouds)
		Dark sky and terrain	ER12B42	Darkness during ADI failure and execution of disorientating manoeuvre (during en route)	**ER-DARKNSS**		- OR executed manoeuvre classified as potentially disorientating AND/OR ATM message containing necessary manoeuvre classified as potentially disorientating AND Inconsistency between ADI indication and output values from other sources (calculated on base of other data or received from other instruments) AND darkness
3. Proper use of autopilot	Flight crew properly uses autopilot and is aware of its capabilities	Autopilot not capable of required maneuver	ER12B51	Autopilot function loss due to ADI failure during disorientating manoeuvre	**ER-SCF-NP-AFC-APLS-ADI**		- OR executed manoeuvre classified as potentially disorientating AND/OR ATM message containing necessary manoeuvre classified as potentially disorientating AND inconsistency between ADI indication and output values from other sources (calculated on base of other data or received from other instruments) AND autopilot failure warning
		Flight crew training in manual flight	ER12B521	FCE – manual flight training during ADI failure (during en route)	**ER-FCE-MANFL**		- OR executed manoeuvre classified as potentially disorientating AND/OR ATM message containing necessary manoeuvre classified as potentially

		Flight crew preference for manual flight	ER12B522	FCE – manual flight due to preferences (during en route)	**ER-FCE-MANFL**		disorientating AND inconsistency between ADI indication and output values from other sources (calculated on base of other data or received from other instruments) AND flight crew flies manually
		Crew unaware of how to use autopilot	ER12B523	FCE – incorrect use of autopilot during undiagnosed ADI failure and disorientating maneuver (during en route)	**ER-FCE-INCOPER-AUPT**		- OR executed manoeuvre classified as potentially disorientating AND/OR ATM message containing necessary manoeuvre classified as potentially disorientating AND Inconsistency between ADI indication and output values from other sources (calculated on base of other data or received from other instruments) AND flight crew operate the autopilot incorrectly (pilot actions compared to suggested in appropriate manual)
		Autopilot incorrectly used by flight crew	ER12B53		**ER-FCE-INCOPER-AUPT**		
4. Attitude monitoring by PNF	PNF monitor the aircraft attitude and corrects the PF if necessary	Lack of attitude monitoring	ER12B21	FCE - Lack of attitude monitoring during en route	**ER-FCE-CRMF-PNFE-LAM**	Phase 2 following phase 1 and at least 1 from: 1. Altitude above 1000ft AGL, 2. Thrust cruise mode.	- Aircraft attitude classified as extreme AND recognizable on base of cockpit instrument indication AND lack of PNF activity detected towards incorrect aircraft attitude warning to PF (analysis of cabin voice for key words or PNF activity analysis)
		Failure of attitude monitoring	ER12B22	FCE - Failure of attitude monitoring during en route	**ER-FCE-CRMF-PNFE-AMF**		
		Failure to communicate warning	ER12B23	FCE - Failure to communicate warning during en route	**ER-FCE-CRMF-PNFE-FCOM**		
		Lack of response to warning	ER12B24	FCE - Lack of response to warning during en	**ER-FCE-CRMF-PFE-PNFWRN-**		- OR Aircraft attitude classified as extreme AND PNF warning message to PF detected AND lack of PF input to the

				route	**IGN**		aircraft control related to the PNF suggestion.
5. Control Recovery by flight crew after spatial disorientation	Flight crew or PF recovers the control after spatial disorientation	Recovery impractical	ER12B11	Aircraft uncontrollable in result of engine in-flight shutdown	**ER-LOC-I-SPATDISR**	Phase 3. Following Phase 2. AND Speed below V1 and not increasing, and at least 1 from: 1. Altitude above 1000ft AGL, 2. thrust in cruise mode.	- Aircraft configuration, attitude and flight parameters classified as unrecoverable
		Lack of recovery action	ER12B12	FCE – lack of recovery action	**ER-LOC-I-FCE-LCTRL**		- OR Aircraft configuration, attitude and flight parameters classified as recoverable AND lack of pilot input to aircraft control
		Incorrect recovery action	ER12B13	FCE – incorrect recovery action	**ER-LOC-I-FCE-INCTRL**		- OR Aircraft configuration, attitude and flight parameters classified as recoverable AND pilot input to aircraft control classified as incorrect in given situation
		Insufficient recovery action	ER12B14	FCE – insufficient recovery action	**ER-LOC-I-FCE-INSCTRL**		- OR Aircraft configuration, attitude and flight parameters classified as recoverable AND pilot input to aircraft control classified as insufficient in given situation (too low extend, too short input time etc.)

Table 12 ASCOS ESD 13 - Flight control system failure

Barrier	Description	Possibilities for braking the barrier – Base event	Code	Possible occurrence (CICTT)	Designation (CICTT)	Flight phase indicator	Proposed method for failure detection (trigger logic)
1. Flight Control System Integrity	Proper functioning of systems responsible for flight control. It includes control surfaces, autopilot, autothrottle system and thrust reverser.	Rudder failure	ER13F311	Flight control surface failure to move as commanded during en route - rudder	**ER-SCF-NP-FC-MVFL-RDR**	Phase 1. Following phase 0 (take-off) and at least 2 from: 1. Speed above V2, 2. Altitude above 1000ft AGL, 3. Thrust cruise mode.	- Inconsistence between pilot input to the aircraft control and rudder deflection
				Other flight control system malfunction or failure during en route - rudder	**ER-SCF-NP-FC-OTHR-RDR**		
		Uncommanded rudder deflection	ER13F312	Uncommanded flight control movement during en route - rudder	**ER-SCF-NP-FC-UNCMV-RDR**		- OR rudder deflection without adequate pilot input to the aircraft controls
		Horizontal stabilizer failure	ER13F321	Flight control surface failure to move as commanded during en route – horizontal stabilizer	**ER-SCF-NP-FC-MVFL-HORSF**		- OR Inconsistence between pilot input to the aircraft control and stabiliser deflection
				Other flight control system malfunction or failure during en route – horizontal stabilizer	**ER-SCF-NP-FC-OTHR-HORSF**		
		Uncommanded stabilizer deflection	ER13F322	Uncommanded flight control movement during en route – horizontal stabilizer	**ER-SCF-NP-FC-UNCMV-HORSF**		- OR stabiliser deflection without adequate pilot input to the aircraft controls
		Wing control surface failure	ER13F331	Flight control surface failure to move as commanded during en route – horizontal	**ER-SCF-NP-FC-MVFL-WINGCSF**		- OR Inconsistence between pilot input to the aircraft control and wing control surface deflection

				stabilizer			
				Other flight control system malfunction or failure	**ER-SCF-NP-FC-OTHR-WINGCSF**		
		Uncommanded wing CS deflection	ER13F332	Uncommanded flight control movement during en route – wing control surface	**ER-SCF-NP-FC-UNCMV-WINGSCF**		- OR wing control surface deflection without adequate pilot input to the aircraft controls
		Autopilot failure	ER13F41	Autopilot function loss during en route	**ER-SCF-NP-AFC-APLS**		- OR loss of autopilot function without flight crew command
		Uncommanded autopilot action	ER13F42	Autopilot mode change annunciation failure during en route	**ER-SCF-NP-AFC-APMCFL**		- OR autopilot actions not proceeded by flight crew appropriate control input AND / OR inconsistency between flight crew input to autopilot and actions performed by autopilot
		Autothrottle failure	ER13F51	Automatic thrust control unavailable or loss during en route	**ER-SCF-NP-AFC-ATLS**		- OR loss of autothrottle function without flight crew command
		Uncommanded thrust	ER13F52	Automatic thrust control error during en route	**ER-SCF-NP-AFC-ATERR**		- OR autothrottle actions not proceeded by flight crew appropriate control input
		Thrust reverser failure	ER13F61	Reverser / beta malfunction - in-flight deploy during en route	**ER-SCF-PP-RMID**		- OR thrust decrease AND / OR thrust asymmetry detected
		Uncommanded deployment	ER13F62	Reverser / beta malfunction - in-flight deploy during en route	**ER-SCF-PP-RMID**		
2. Control Recovery by flight crew	Flight crew recovers the control after FCS failure	Recovery impractical	ER13B11	Aircraft uncontrollable in result of engine in-flight shutdown	**ER-LOC-I-FCSF**	Phase 2. Following Phase 2. AND Speed	- Aircraft configuration, attitude and flight parameters classified as unrecoverable
		Lack of recovery	ER13B12	FCE – lack of recovery action	**ER-LOC-I-FCE-LCTRL**		- OR Aircraft configuration, attitude and flight parameters classified as

after FCS failure		action				below V1 and not increasing, and at least 1 from: 1. Altitude above 1000ft AGL, 2. thrust in cruise mode.	recoverable AND lack of pilot input to aircraft control
		Incorrect recovery action	ER13B13	FCE – incorrect recovery action	**ER-LOC-I-FCE-INCTRL**		- OR Aircraft configuration, attitude and flight parameters classified as recoverable AND pilot input to aircraft control classified as incorrect in given situation
		Insufficient recovery action	ER13B14	FCE – insufficient recovery action	**ER-LOC-I-FCE-INSCTRL**		- OR Aircraft configuration, attitude and flight parameters classified as recoverable AND pilot input to aircraft control classified as insufficient in given situation (too low extend, too short input time etc.)

Table 13 ASCOS ESD 14 - Flight crew incapacitation

Barrier	Description	Possibilities for braking the barrier – Base event	Code	Possible occurrence (CICTT)	Designation (CICTT)	Flight phase indicator	Proposed method for failure detection (trigger logic)
1. Crew capability to perform its duties	Aircraft is free of failures or malfunctions, which can affect crew capabilities to perform its duties.	Medical incapacitation of pilot	ER14F3	Medical incapacitation of one pilot during en route	**ER-MED-FC**	Phase 1. Following phase 0 (take-off) and at least 2 from: 1. Speed above V2, 2. Altitude above 1000ft AGL, 3. Thrust cruise mode.	- Prolonged lack of one pilot activity (cab be also detected with some dedicated cockpit sensors e.g. monitoring of life symptoms)
		Unsuccessful depressurization response	ER14B2	Flight crew incapacitation caused by depressurization during en route	**ER-MED-ALLFC**		- OR Indication of incorrect interior air pressure leading to serious risk of flight crew incapacitation
				Cabin pressurization failure resulted with flight crew incapacitation	**ER-SCF-NP-ECS-PRFL**		- OR Indication of incorrect interior air pressure leading to serious risk of flight crew incapacitation AND warning about ECS failure
		Toxic gas in flight deck	ER14F51	Toxic gas emission in flight deck during en route	**ER-F-NI-TOXCAB**		- OR toxic gas in cabin detected
		Unsuccessful flight deck smoke procedures	ER14B3	FCE – anti smoke actions	**ER-F-NI-FCE-TOXGASREM**		- OR toxic gas concentration not decrease AND flight crew input to aircraft control do not cover the reference procedure programmed in aircraft computer for given conditions
				Inability to clear smoke from flight desk during en route	**ER-F-NI-SCF-NP-ECS-SMKPERSIS**		- OR toxic gas concentration not decrease
		CPCS failure in flight	ER14F41111	Other avionics failure or malfunction	**ER-SCF-NP-AVION-OTHR-CPCS**		- OR lack of activity of CPCS system AND / OR CPCS decisions are classified as incorrect for given

				resulting with CPCS failure in flight			conditions
				Cabin pressurization failure resulted from CPCS failure in flight	**ER-SCF-NP-ECS-PRFL**		
		Depressurization	ER14F41112	Cabin decompression during en route	**ER-SCF-NP-ECS-DECOMP**		- OR lack of activity of CPCS system AND indicated aircraft cabin pressure is incorrect
				Cabin pressurization failure during en route	**ER-SCF-NP-ECS-PRFL**		
		Depressurization due to incorrect CPCS operation	ER14F4112	FCE – CPCS operation during en route	**ER-FCE-INCOP-CPCS**		- OR Inconsistency between CPCS manual and suggested procedures and pilot input to CPCS control panel AND indicated aircraft cabin pressure is incorrect
		Door failure in flight	ER14F41211	Uncommanded door operation during en route	**ER-SCF-NP-CABIN-OTHR-DOOR**		- OR warning about door failure AND indicated aircraft cabin pressure is incorrect
		Depressurization	ER14F41212	Cabin decompression caused by door failure in flight	**ER-SCF-NP-STRUCT-DECOMP-DOOR**		- OR warning about door failure AND decreased pressure inside the aircraft cabin AND indicated aircraft cabin pressure is incorrect
		Window failure in flight	ER14F41221	Window failure in flight	**ER-SCF-NP-STRUCT-CABINWDW**		- OR warning about window failure (need for new sensors detecting fuselage leaktightness) AND indicated aircraft cabin pressure is incorrect
		Depressurization	ER14F41222	Cabin decompression resulted from window failure	**ER-SCF-NP-STRUCT-CABINWDW**		- OR warning about window failure (need for new sensors detecting fuselage leaktightness) AND decreased pressure inside the aircraft cabin

		Fuselage failure due to deterioration	ER14F41231	Cabin decompression resulting from fuselage deterioration	**ER-SCF-NP-STRUCT-DECOMP-FUSLG**		- OR decreased cabin pressure AND no warning concerning specific component or system (door, window or CPCS) AND presence of precursors in maintenance process indicating on increased risk of structure failures resulted from structure deterioration
				Breach of pressurized fuselage skin caused by fuselage deterioration	**ER-SCF-NP-STRUCT-PRFSBR-FUSLG**		
		Fuselage failure due to bird strike	ER14F41232	Bird strike leading to fuselage structural failure	**TO-BIRD-SCF-NP-STRUCT**		- OR Analysis of noise registered around the aircraft indicates on impact during take-off or previous landing roll
		Fuselage failure due to tail strike	ER14F41323	Abnormal runway contact leading to breach of pressurized fuselage skin during en route	**ER-ARC-SCF-NP-STRUCT-PRFSBR**		- OR Analysis of noise registered around the aircraft indicates on tail strike AND / OR aircraft attitude (pitch) during take-off or landing exceeded acceptable values
		Fuselage failure due to impact while on ground	ER14F41324	Ground collision leading to breach of pressurized fuselage skin during en route	**ER-GCOL-SCF-NP-STRUCT-PRFSBR**		- OR ultrasonic distance measure system indicated on collision on ground AND / OR analysis of noise registered around the aircraft indicates on impact
2. Maintain Control by the crew after failure affecting crew capabilitie	Flight crew is able to maintain control aver the aircraft after failures or	Simultaneous incapacitation of all flight crew	ER14B11	Al flight crew members incapacitated during en-route	**ER-MED-ALLFC**	Phase 2. Following Phase 1. AND Speed below V1 and not increasing, and at least 1 from: 1.	- Total lack of flight crew activity
		Lack of response to pilot incapacitation	ER14B12	FCE - Lack of flight crew activity aimed at recovery	**ER-MED-FCE-LRESP**		- OR Inconsistency between pilot input to aircraft controls and procedure coded as reference in aircraft computer for given conditions
		Incorrect	ER14B13	FCE - Incorrect flight	**ER-MED-**		

s to perform its duties	malfunctions affecting capabilities to perform its duties.	response to pilot incapacitation		crew actions in terms of situation recovery	**FCE-INCRESP**	Altitude above 1000ft AGL, 2. thrust in cruise mode.	

Table 14 ASCOS ESD 15 - Ice accretion on aircraft

Barrier	Description	Possibilities for braking the barrier – Base event	Code	Possible occurrence (CICTT)	Designation (CICTT)	Flight phase indicator	Proposed method for failure detection (trigger logic)
1. Anti-icing system integrity, Flight crew adheres to anti-icing procedures, Icing conditions within predicted range of severity	All possible anti-icing means are available and adequate procedures are executed. It is also assumed that icing conditions do not exceed the predicted range in terms of severity	Icing conditions not detected	ER15B31	Lack of warning concerning icing conditions during en route	**ER-ICE-SCF-NP-AVION-WRNLS-ICCOND**	Phase 1. Following phase 0 (take-off) and at least 2 from: 1. Speed above V2, 2. Altitude above 1000ft AGL, 3. Thrust cruise mode.	Lack of warning concerning icing conditions AND external conditions indicate on increased risk of ice accumulation
		Anti-icing system not used	ER15B32	FCE - Lack of activation of anti-ice system during en route	**ER-ICE-FCE-LAICSUSE-LIFTSURF**		OR Anti-icing system not active AND external conditions indicate on increased risk of ice accumulation
		Anti-icing system failure	ER15B33	Failure of the anti-icing system during en route	**ER-ICE-SCF-NP-MISC-ANTICEFL-AICE-LIFTSURF**		OR Antiicing system not active AND / OR warning about anti-icing system failure
		Anti-icing procedures not followed	ER15B34	FCE – incorrect anti-ice procedure execution	**ER-ICE-FCE-LAICPRCD**		OR Lack of flight crew activity in terms of anti-ice procedures execution detected AND external conditions indicate on increased risk of ice accumulation
		Icing exceeding anti-icing capability	ER15B35	Extreme icing conditions during en route	**ER-ICE-EXTRWTHR**		OR external ice conditions detected indicating on risk of extreme ice accumulation exceeding the anti-ice system capabilities
		Flight into icing conditions	ER15F	Icing conditions encountered during en route	**ER-ICE-FCE-EXTRWTHR**		OR external conditions indicate on increased risk of ice accumulation
2. Correct response of Flight crew to accreted	Flight crew correctly and on time	Ice accretion not detected	ER15B21	Lack of warning concerning ice accretion during en route	**ER-ICE-SCF-NP-AVION-WRNLS-ICACR**		Flight parameters analysis indicates on risk of undetected ice accretion
				Anti-ice system	**ER-ICE-SCF-NP-**		

ice.	response to accreted ice			failure resulting with undetected ice accretion during en route.	**MISC-ANTICEFL-LERTSURF**		
		Lack of response to ice accretion	ER15B 22	FCE – lack of flight crew response to ice accretion on aircraft	**ER-ICE-FCE-LRESP**		OR lack of pilot to ice accretion on aircraft
		Incorrect response to ice accretion	ER15B 23	FCE – incorrect flight crew response to ice accretion on aircraft	**ER-ICE-FCE-INCRESP**		OR pilot response to ice accretion on aircraft classified as incorrect in given situation
		Insufficient response to ice accretion	ER15B 24	FCE – insufficient response of flight crew to ice accretion on aircraft	**ER-ICE-FCE-INSRESP**		OR pilot response to ice accretion on aircraft classified as insufficient in given situation (too low extend, too short input time etc.)
3.Maintain control over the aircraft with accreted ice	Flight crew maintains control over the iced aircraft	Recovery impractical	ER15B 11	Aircraft uncontrollable in result of ice accretion on aircraft surfaces	**ER-ICE-LOC-I**	Phase 2. Following Phase 1. AND Speed below V1 and not increasing, and at least 1 from: 1. Altitude above 1000ft AGL, 2. thrust in cruise mode.	Aircraft configuration, attitude and flight parameters classified as unrecoverable
		Lack of recovery action	ER15B 12	FCE – lack of recovery action	**ER-ICE-LOC-I-FCE-LRESP**		OR Aircraft configuration, attitude and flight parameters classified as recoverable AND lack of pilot input to aircraft control
		Incorrect recovery action	ER15B 13	FCE – incorrect recovery action	**ER-ICE-LOC-I-FCE-INCRESP**		OR Aircraft configuration, attitude and flight parameters classified as recoverable AND pilot input to aircraft control classified as incorrect in given situation
		Insufficient recovery action	ER15B 14	FCE – insufficient recovery action	**ER-ICE-LOC-I-FCE-INSRESP**		OR Aircraft configuration, attitude and flight parameters classified as recoverable AND pilot input to aircraft control classified as insufficient in given situation (too low extend, too short input time etc.)

Table 15 ASCOS ESD 16 - Flight instrument failure

Barrier	Description	Possibilities for braking the barrier – Base event	Code	Possible occurrence (CICTT)	Designation (CICTT)	Flight phase indicator	Proposed method for failure detection (trigger logic)
1. Integrity of main flight control instrument (ASI, ADI, PFD), Main flight control instrument are appropriately maintained and prepared for the flight. Flying into volcanic ash is efficiently avoided.	All basic flight control instrument functioning correctly, they are also appropriately maintained and prepared for the flight. Flying into volcanic ash is efficiently avoided.	Pitot-static port covers not removed	ER16F3111	Airspeed information loss resulted from pitot-static port covered during en route	**ER-SCF-NP-AVION-ASLS-PITOT**	Phase 1. Following phase 0 (take-off) and at least 2 from: 1. Speed above V2, 2. Altitude above 1000ft AGL, 3. Thrust cruise mode.	Lack of pilot tube speed indication indicates on pitot-tube failure AND lack of icing conditions AND precursor(s) for incorrect pre-flight inspection/operations detected.
				GSE – Pitot-static tube cover not removed before flight	**ER-GSE-COVPITOT**		
		Flight into icing conditions	ER16F	Flight into icing conditions resulting with pitot tube icing.	**ER-ICE-PITOT**		OR Lack of pilot tube speed indication AND icing conditions detected indicating on pitot-tube icing.
		Pitot-static ice protection system failure	ER16B31	Altitude information error resulted from pitot-static ice protection system failure during en route	**ER-ICE-SCF-NP-AVION-ALTERR**		OR icing conditions detected AND inconsistency between pitot-tube and other flight parameters sources indicates on pitot-tube ice protection system failure.
				Airspeed information error resulted from pitot-static ice protection system failure during en route	**ER-ICE-SCF-NP-AVION-ASERR**		
				Altitude information loss resulted from pitot-static ice protection system failure during en route	**ER-ICE-SCF-NP-AVION-ALTLS-PITOT**		
				Airspeed information loss resulted from	**ER-ICE-SCF-NP-AVION-ASLS-**		

				pitot-static ice protection system failure during en route	**PITOT**		
				Anti-ice or de-ice function failure resulted from pitot-static ice protection system failure during en route	**ER-ICE-SCF-NP-MISC-ANTICEFL-PITOT**		
		Pitot-static ice protection system not used	ER16B32	FCE – activation of anti-icing system	**ER-ICE-FCE-LAICSUSE-PITOT**		OR Pitot anti-ice system not activated AND icing conditions detected
		Pitot-static system blocked by contamination	ER16F3113	Altitude information error resulted from pitot-tube contamination during en-route	**ER-SCF-NP-AVION-ALTERR-PITOT**		OR Inconsistency between indication of pilot tube and other flight parameters sources indicating on pitot tube failure AND lack of icing conditions AND lack of precursors for incorrect conducted pre-flight actions
				Airspeed information error resulted from pitot-tube contamination during en-route	**ER-SCF-NP-AVION-ASERR-PITOT**		
		Pitot-static system leak	ER16F3114	Altitude information error resulted from installation leakage	**ER-SCF-NP-AVION-ALTERR-PITOT-LEAK**		OR analysis of pitot tube indications compared to other sources indicates on leakage in pitot-tube installation (e.g. reduced system sensitivity or indication range)
				Airspeed information error resulted from installation leakage	**ER-SCF-NP-AVION-ASERR-PITOT-LEAK**		
		ASI anomaly	ER16F312	Altitude information error caused by pitot-	**ER-SCF-NP-AVION-**		OR pitot-static failure detected AND ASI indications inconsistent with the value

				tube failure in flight	**ALTERR-PITOT**		computed or received from other sources
				Airspeed information error caused by pitot-tube failure in flight	**ER-SCF-NP-AVION-ASERR-PITOT**		
		ADI failure in flight	ER16F321	Altitude information loss caused by ADI failure in flight	**ER-ICE-SCF-NP-AVION-ALTLS-ADI**		OR Lack of indication from ADI
				Airspeed information loss caused by ADI failure in flight	**ER-ICE-SCF-NP-AVION-ASLS-ADI**		
				Attitude information loss caused by ADI failure in flight	**ER-SCF-NP-AVION-ATTLS-ADI**		
				AoA information loss caused by ADI failure in flight	**ER-SCF-NP-AVION-AOALS-ADI**		
		ASI anomaly	ER16F322	Altitude information loss caused by ADI failure in flight	**ER-ICE-SCF-NP-AVION-ALTLS-ADI**		OR ADI failure detected AND Inconsistency between ASI indication and output values from other sources (calculated or received)
				Airspeed information loss caused by ADI failure in flight	**ER-ICE-SCF-NP-AVION-ASLS-ADI**		
				Attitude information loss caused by ADI failure in flight	**ER-SCF-NP-AVION-ATTLS-ADI**		
				AoA information loss caused by ADI failure in flight	**ER-SCF-NP-AVION-AOALS-ADI**		
		ASI failure in flight	ER16F331	Altitude information loss during en route	**ER-SCF-NP-AVION-ALTLS-ASI**		OR Lack of ASI indication AND monitoring of health of other subsystems indicate of ASI failure in flight
				Airspeed information loss during en route	**ER-SCF-NP-AVION-ASLS-**		

					ASI		
		ASI anomaly	ER16F332	Altitude information loss caused by ASI failure during en route	**ER-SCF-NP-AVION-ALTLS-ASI**	OR ASI failure detected AND flight information error displayed to the flight crew detected	
				Airspeed information loss caused by ASI failure during en route	**ER-SCF-NP-AVION-ASLS-ASI**		
		PFD failure in flight	ER16F341	Altitude information loss caused by PFD failure during en route	**ER-SCF-NP-AVION-ALTLS-PFD**	OR temporary lack of PFD activity or PFD malfunction detected restricting access to the displayed data	
				Airspeed information loss caused by PFD failure during en route	**ER-SCF-NP-AVION-ASLS-PFD**		
				Attitude information loss caused by PFD failure during en route	**ER-SCF-NP-AVION-ATTLS-PFD**		
				AoA information loss caused by PFD failure during en route	**ER-SCF-NP-AVION-AOALS-PFD**		
				Heading information loss caused by PFD failure during en route	**ER-SCF-NP-AVION-HDGLS-PFD**		
				Integrated display unit loss caused by PFD failure during en route	**ER-SCF-NP-AVION-DULS-PFD**		
		ASI anomaly	ER16F342	Altitude information loss caused by PFD failure during en route	**ER-SCF-NP-AVION-ALTLS-PFD**	OR Lack of PFD activity disabling access to the displayed information	
				Airspeed information loss caused by PFD failure during en route	**ER-SCF-NP-AVION-ASLS-PFD**		
				Attitude information loss caused by PFD	**ER-SCF-NP-AVION-ATTLS-**		

				failure during en route	**PFD**		
				AoA information loss caused by PFD failure during en route	**ER-SCF-NP-AVION-AOALS-PFD**		
2. Flight instrument failure is detected and all necessary correction actions are done	Flight crew detect the failure of flight instrument and correct response to the problem	Flight instrument failure not detected	ER16B21	Flight instrument failure not detectable by the flight crew	**ER-SCF-NP-AVION-NOTDETBL**		Flight instrument failure detected by the aircraft computer AND classified as undetectable by the flight crew
				FCE – flight instrument failure detection	**ER-FCE-LCRSSCHCK-FINST**		OR Flight instrument failure detected by the aircraft computer AND classified as detectable by the flight crew AND lack of flight crew reaction aiming at problem recovery
		Lack of response to flight instrument failure	ER16B22	FCE – lack of flight crew response to detected flight instrument failure	**ER-SCF-NP-AVION-FCE-LRESP**		
		Incorrect response to flight instrument failure	ER16B23	FCE – incorrect flight crew response to detected flight instrument failure	**ER-SCF-NP-AVION-FCE-INCRESP**		OR Flight instrument failure detected by the aircraft computer AND pilot input to flight instrument control classified as incorrect in given situation
		Insufficient response to flight instrument failure	ER16B24	FCE – insufficient flight crew response to detected flight instrument failure	**ER-SCF-NP-AVION-FCE-INSRESP**		OR Flight instrument failure detected by the aircraft computer AND pilot input to flight instrument control classified as insufficient in given situation (too low extend, too short input time etc.)
3. Maintain the control over the aircraft after the flight	Flight crew maintains the control over the aircraft after flight	Recovery impractical	ER16B11	Aircraft in unrecoverable configuration in result of flight instrument indication error	**ER-SCF-NP-AVION-LOC-I**	Phase 2. Following Phase 1. AND Speed below V1 and not increasing, and at	Aircraft configuration, attitude and flight parameters classified as unrecoverable
		Lack of recovery action	ER16B12	FCE – lack of recovery action	**ER-LOC-I-FCE-LRESP**		OR Aircraft configuration, attitude and flight parameters classified as recoverable AND lack of pilot input to aircraft control

instrument failure	instrument failure	Incorrect recovery action	ER16B13	FCE – incorrect recovery action	**ER-LOC-I-FCE-INCRESP**	least 1 from: 1. Altitude above 1000ft AGL, 2. thrust in cruise mode.	OR Aircraft configuration, attitude and flight parameters classified as recoverable AND pilot input to aircraft control classified as incorrect in given situation
		Insufficient recovery action	ER16B14	FCE – insufficient recovery action	**ER-LOC-I-FCE-INSRESP**		OR Aircraft configuration, attitude and flight parameters classified as recoverable AND pilot input to aircraft control classified as insufficient in given situation (too low extend, too short input time etc.)

Table 16 ASCOS ESD 17 - Aircraft encounters adverse weather

Barrier	Description	Possibilities for braking the barrier – Base event	Code	Possible occurrence (CICTT)	Designation (CICTT)	Flight phase indicator	Proposed method for failure detection (trigger logic)
1. Weather avoidance	All available means to avoid flying into adverse weather conditions area available and appropriately used	Severe Clear Air Turbulence (CAT)	ER17B1111	Severe turbulence encountered during en route	**ER-TURB**	Phase 1. Following phase 0 (take-off) and at least 2 from: 1. Speed above V2, 2. Altitude above 1000ft AGL, 3. Thrust cruise mode.	Flight parameters indicate on turbulence AND turbulence classified as severe
		No indication of severe CAT	ER17B11121	CAT encountered during en route	**ER-TURB-UNDTCBL**		OR Flight parameters indicate on turbulence AND turbulence classified as undetectable or unavoidable (lack of earlier indication for this event)
		Inadequate information from preceding aircraft	ER17B11122	FCE – incorrect information provided from preceding aircraft	**ER-TURB-FCE-PRECAIRCFTINF**		OR message received by the aircraft computer from preceding aircraft in terms of weather picture does not fit to the real conditions (simultaneously to flight crew communication the same information transfer between aircraft computer is necessary)
		Encounter too sudden	ER17B11123	CAT encountered during en route	**ER-TURB-UNDTCBL**		OR Flight parameters indicate on turbulence AND turbulence classified as undetectable or unavoidable (lack of earlier indication for this event)
		Unfavorable weather conditions	ER17B1121	Unfavorable weather conditions during en route	**ER-TURB-EXTRWTHR**		OR weather picture indicate on unfavourable flight conditions and increased / unacceptable risk related
		Weather report information inadequate	ER17B112211	GSE – weather report inadequate (related to the responsible entity)	**ER-TURB-GSE-INWTHRINF**		OR strong inconsistency between received weather information and real conditions encountered
		Flight crew fail to obtain weather	ER17B112212	Lack of weather report during en route	**ER-TURB-GSE-LWTHRINF**		OR weather report data unavailable

		reports					
		Onboard weather radar failure	ER17B112213	Navigational information loss caused by weather radar failure during en route	**ER-TURB-SCF-NP-AVION-NAVLS-WTHRRDR**		OR Lack of on-board weather radar activity AND / OR warning about weather radar failure received by the aircraft computer.
				Navigational information error caused by weather radar failure during en route	**ER-TURB-SCF-NP-AVION-NAVERR-WTHRRDR**		
				Warning loss related to weather radar failure during en route	**ER-TURB-SCF-NP-AVION-WRNLS-WTHRRDR**		
		Unsuccessful weather information management	ER17B112214	FCE – incorrect weather radar operating	**ER-TURB-FCE-INCOPER-WTHRRDR**		OR flight crew control input to the on-board weather radar inconsistent with appropriate manual (classified as incorrect)
		Flight crew disregard weather information	ER17B112215	FCE – incorrect use of weather information	**ER-TURB-FCE-IGNWTHRRDR**		OR flight crew input to the aircraft control classified as inconsistent with assumed as reference model for given weather information
		Flight crew commands flight into unfavorable conditions	ER17B112221		**ER-TURB-FCE-FLINTOUNFVCOND**		
		Flight crew unable to avoid unfavorable weather conditions	ER17B112222	Turbulence encountered during en route	**ER-TURB-UNAVOIDBL**		OR Flight parameters indicate on turbulence AND turbulence classified as undetectable or unavoidable (lack of earlier indication for this event)

		Aircraft suffers severe upset	ER17B121	Aircraft suffers upset during en route	**ER-TURB-UPSET**		OR rapid change in aircraft flight parameters indicated on upset resulted from turbulence
		Aircraft suffers structural damage	ER17B122	Aircraft suffers structural damage resulted from turbulence during en route	**ER-TURB-STRUCT**		OR Aircraft upset detected AND extreme risk of structural damage of aircraft detected AND / OR change in measurable structure specifications detected (amplitude and / or vibration frequency change indicating on structural changes)
		No time to secure cabin	ER17B12311	Severe turbulence encountered resulted with unsecured cabin during en route	**ER-TURB-UNDTCBL - UNSECCAB**		OR Flight parameters indicate on turbulence AND turbulence classified as undetectable or unavoidable (lack of earlier indication for this event)
		Flight crew fail to secure cabin	ER17B12312	FCE – lack of secure cabin from turbulence consequence during en route	**ER-TURB-FCE-UNSECCAB**		OR significant risk of turbulence encountered AND aircraft computer did not detect that flight crew executed cabin secure procedure
		Unsuccessful securing of cabin	ER17B12313	FCE – incorrect cabin secure during en route	**ER-TURB-FCE-UNSECCAB**		OR significant risk of turbulence encountered AND aircraft computer did not detect that flight crew executed cabin securing procedure correctly (on base of cabin voice analysis or adequate input to the aircraft system controls)
		Occupants suffer significant injury	ER17B1232	Significant injury of occupants resulted from turbulence encountered during en route	**ER-TURB-INJ**		OR turbulence encountered AND analyses of previous flight crew actions as well as turbulence scale indicate on high risk of occupants' injury.
2. Encounter	Flight crew reacts	Flight crew command	ER17B211	FCE – extreme maneuver	**ER-TURB-FCE-EXTMNVREXEC**		OR significant risk of turbulence encountered AND manoeuvre executed

risk mitigation	correctly to encountered risk without exceeding the aircraft design loads	extreme maneuver		commanded in order to avoid the turbulence			by the flight crew classified as extreme
		Turbulence causes extreme maneuver	ER17B212	Encountered turbulence resulted with extreme maneuver of aircraft	**ER-TURB-EXTMNVR**		OR significant risk of turbulence encountered AND manoeuvre executed by the flight crew classified as extreme AND impact of turbulence on aircraft movement detected
		Ultimate design load exceeded	ER17B22	Encountered turbulence resulted with ultimate design load exceeding	**ER-TURB-ULTLOADEXC**		OR analysis of aircraft flight parameters being an effect of turbulence as well as tensions in critical structure indicate on ultimate load exceeding
3. Maintain control after adverse weather encountered	Flight crew maintains control over the aircraft after encountering adverse weather	Adverse weather makes aircraft uncontrollable	ER17B31	Aircraft in unrecoverable configuration in result of adverse weather	**ER-TURB-LOC-I**	Phase 2. Following Phase 1. AND Speed below V1 and not increasing, and at least 1 from: 1. Altitude above 1000ft AGL, 2. thrust in cruise mode.	Aircraft configuration, attitude and flight parameters classified as unrecoverable
		Lack of control	ER17B32	FCE – lack of recovery action	**ER-TURB-LOC-I-FCE-LCTRL**		
		Incorrect control	ER17B33	FCE – incorrect recovery action	**ER-TURB-LOC-I-FCE-INCTRL**		OR Inconsistency between flight crew input to aircraft control and identified as optimal for given situation (defined and coded in aircraft system)

Table 17 ASCOS ESD 18 - Single engine failure

Barrier	Description	Possibilities for braking the barrier – Base event	Code	Possible occurrence (CICTT)	Designation (CICTT)	Flight phase indicator	Proposed method for failure detection (trigger logic)
1. Single engine and its critical systems integrity	Integrity of one of aircraft's propulsion systems as its critical subsystems. It includes also proper flight crew engine operation and appropriate maintenance.	Reduction Gear Failure	ER18B1111	Other engine malfunction – reduction gear failure during en route	**ER-SCF-PP-OTHEM-RGF**	Phase 1. Following phase 0 (take-off) and at least 2 from: 1. Speed above V2, 2. Altitude above 1000ft AGL, 3. Thrust cruise mode.	- Warning about reduction gear failure
				Loss of engine functionality / engine malfunction procedural trigger - reduction gear failure during en route	**ER-SCF-PP-LOE-RGF**		
		Severe Failure	ER18B1112	In-flight shutdown resulted with reduction gear failure during en route	**ER-SCF-PP-IFSD-RGF**		- OR Warning about reduction gear failure AND in-flight shutdown
		Compressor Failure	ER18B1121	Loss of engine functionality / engine malfunction procedural trigger – compressor failure during en route	**ER-SCF-PP-LOE-COMP**		- OR Warning about compressor failure
				Other engine malfunction – compressor failure during en route	**ER-SCF-PP-OTHEM-COMP**		
		Severe Failure	ER18B1122	In-flight shutdown resulted from compressor failure during en route	**ER-SCF-PP-IFSD-COMP**		- OR Warning about compressor failure AND in-flight shutdown
		Combustor Failure	ER18B1131	Loss of engine functionality / engine	**ER-SCF-PP-LOE-COMB**		- OR Warning about combustor failure

				malfunction procedural trigger – combustor failure during en route			
				Other engine malfunction – combustor failure during en route	**ER-SCF-PP-OTHEM-COMB**		
		Severe Failure	ER18B1132	In-flight shutdown resulted from combustor failure during en route	**ER-SCF-PP-IFSD-COMB**		- OR Warning about combustor failure AND in-flight shutdown
		Turbine Failure	ER18B1141	Loss of engine functionality / engine malfunction procedural trigger – turbine failure during en route	**ER-SCF-PP-LOE-TURB**		- OR Warning about turbine failure
				Other engine malfunction – turbine failure during en route	**ER-SCF-PP-OTHEM-TURB**		
		Severe Failure	ER18B1142	In-flight shutdown	**ER-SCF-PP-IFSD-TURB**		- OR Warning about turbine failure AND in-flight shutdown
		Oil Distribution System Failure	ER18B1151	Loss of engine functionality / engine malfunction procedural trigger – oil distribution system failure during en route	**ER-SCF-PP-LOE-OIL**		- OR Warning about oil distribution system failure
				Other engine malfunction oil distribution system failure during en route	**ER-SCF-PP-OTHEM-OIL**		
		Severe Failure	ER18B1152	In-flight shutdown resulted from oil	**ER-SCF-PP-IFSD-OIL**		- OR Warning about oil distribution system failure AND in-flight

				distribution system failure during en route			shutdown
		Accessory Drive Failure	ER18B1161	Loss of engine functionality / engine malfunction procedural trigger – accessory drive failure during en route	**ER-SCF-PP-LOE-ADF**		- OR Warning about accessory drive failure
				Other engine malfunction – accessory drive failure during en route	**ER-SCF-PP-OTHEM-ADF**		
		Severe Failure	ER18B1162	In-flight shutdown resulted from accessory drive failure during en route	**ER-SCF-PP-IFSD-ADF**		- OR Warning about accessory drive failure AND in-flight shutdown
		Icing Conditions	ER18B12111	Icing conditions encountered during en route potentially dangerous for aircraft propulsion	**ER-ICE-PP**		- OR Icing conditions detected
		Engine Anti-Ice Unavailable	ER18B121121	Other engine malfunction – anti-ice system failure during en route	**ER-ICE-SCF-PP-OTHEM-ANTICEFL**		- Or icing conditions detected AND anti-ice system unavailable AND / OR warning about anti-ice system failure detected
		Engine Anti-Ice Utilization Failure	ER18B121122	FCE – incorrect operation of anti-ice system attached to the engine during en route	**ER-ICE-FCE-INCOPER-ENGANTICES**		- OR icing conditions detected AND flight crew input to the aircraft engine anti-ice system is inconsistent with optimised procedure coded / defined by the aircraft computer for given conditions
		Ice shed from wings	ER18B121123	Other engine malfunction caused by	**ER-ICE-SCF-PP-OTHEM-**		- OR Engine work parameters indicate on foreign object

		enters engine		ice ingestion during en route	**ICEINJ**		ingestion AND icing conditions detected AND lack of or inactive anti-ice system in engine
		Ice impact causes damage to engine	ER18B121131	Other engine malfunction caused by ice ingestion during en route	**ER-ICE-SCF-PP-OTHEM-ICEINJ**		
				In-flight shutdown caused by ice ingestion during en route	**ER-ICE-SCF-PP-IFSD-ICEINJ**		- OR Engine work parameters indicate on foreign object ingestion AND icing conditions detected AND lack of or inactive anti-ice system in engine AND engine shutdown
		Ice restricts airflow	ER18B121132	Restriction of inlet area caused by ice accumulation	**ER-ICE-AIRFLRESTR**		- OR Engine work parameters indicate on decrease of inlet area AND icing conditions AND lack of or inactive anti-ice system in engine
		Thrust reduction	ER18B121133	Restriction of inlet area caused by ice accumulation resulted with thrust reduction.	**ER-ICE-AIRFLRESTR**		- OR Engine work parameters indicate on decrease of inlet area AND icing conditions AND lack of or inactive anti-ice system in engine AND thrust value decrease
		Severe storm conditions	ER18B12121	Severe storm encountered during en route	**ER-WSTRW-STORM**		- OR weather conditions (severe storm) indicates on serious risk of engine flame-out (exceeds the engine operational limits)
		A/C unable to avoid storm	ER18B121221	Severe storm encountered during en route impossible to be avoided	**ER-WSTRW-STORM-UNVDBL**		
		PIC commands flight into storm	ER18B121222	FCE – flight into area of adverse weather	**ER-WSTRW-FCE-FLINTOSTR**		- OR flight trajectory of the aircraft incorrect with regard to adverse weather area location

					M		
		Rain quantity exceeds operating limits of engine	ER18B121231	Extreme rain quantity encountered during en route	**ER-WSTRW-RAIN**		- OR weather conditions (severe storm) indicates on serious risk of engine flame-out (exceeds the engine operational limits)
		Flight crew fails to maintain engine speed	ER18B121232	In-flight shutdown caused water saturation during en route	**ER-WSTRW-SCF-PP-IFSD-RAIN**		- OR weather conditions (severe storm) indicates on serious risk of engine flame-out (exceeds the engine operational limits) AND engine flame-out or nearly flame-out
		Fuel System Maintenance Failure	ER18B122111	Fuel leak resulted from incorrect maintenance of the engine	**ER-SCF-NP-FUEL-LK-ENGINE-MF**		- OR Fuel leak detected AND warning about fuel system failure AND system work parameters analysis indicates on maintenance process failure AND precursors for fuel leak detected during last adequate maintenance of the engine
		Fuel System Damaged	ER18B122112	Bird impact during take-off or landing roll resulting with fuel system damage and fuel leak	**ER-BIRD-FUEL-LK**		- OR Fuel leak detected AND warning about fuel system failure AND impact of foreign object detected (on base of engine work parameters).
				Foreign object impact during take-off or landing roll resulting with fuel system damage and fuel leak during en route	**ER-ADRM-FUEL-LK**		
				Separation of large items from aircraft	**ER-SCF-NP-STRUCT-**		- OR Fuel leak detected AND warning about fuel system failure

				resulted with fuel leak during en route	**PDA-FUEL-LK**		AND impact of foreign object detected AND increased level of structure vibration detected (indicating on lack of aircraft components – case)
		Fuel Distribution System Failure	ER18B1221211	Other engine malfunction – fuel distribution system failure during en route	**ER-SCF-PP-OTHEM-FSF**		- OR disruptions of fuel transfer to the engine detected
		Distribution Failure	ER18B1221212	In-flight shutdown caused by fuel distribution system failure during en route	**ER-SCF-PP-IFSD-FSF**		- OR Temporary or permanent lack of fuel transfer to the engine detected AND engine shutdown
		Control Surfaces in incorrect configuration	ER18B1221221	Autopilot control or guidance error resulting with incorrect aircraft configuration during en route	**ER-SCF-NP-AFC-APERR-DRAGGEN**		- OR Inconsistency between indicated flight parameters and external conditions pointing at suboptimal configuration AND lack of incorrect actions executed by the flight crew detected
				FCE – incorrect configuration set during en route	**ER-FCE-INCCONF**		- OR Inconsistency between indicated flight parameters and external conditions pointing at suboptimal configuration AND incorrect actions executed by the flight crew detected
		Undercarriage Failure	ER18B1221222	Landing gear structural failure – retraction failure during en route	**ER-SCF-NP-LG-STRUCTFL-LGDOWN**		- OR Warning about not retracted landing gear AND lack of incorrect flight crew actions detected
				FCE – incorrect landing gear retraction	**ER-FCE-LGDOWN**		- OR Warning about not retracted landing gear AND incorrect flight crew actions detected
		FCMC Failure	ER18B122211	Warning loss – incorrect	**ER-SCF-NP-**		- OR warning about Incorrect fuel

			1	work of fuel system during en route	**AVION-WRNLS-FCMCF**		system work parameters
		No ECAM	ER18B12221121	Lack of ECAM system	**ER-LECAM**		- OR warning about Incorrect fuel system work parameters AND No ECAM system detected on aircraft
		ECAM gives insufficient advisory action	ER18B12221122	Advisory provided by the ECAM insufficient during en route	**ER-INSECAM**		- OR warning about Incorrect fuel system work parameters AND ECAM or aircraft computer diagnostic system cannot find the solution for given problem
		ECAM Failure	ER18B12221123	Warning loss – ECAM failure during en route	**ER-SCF-NP-AVION-WRNLS-ECAM**		- OR Lack ECAM activity detected
				Other avionic failure or malfunction – ECAM system failure during en route	**ER-SCF-NP-AVION-OTHR-ECAM**		
		Lack of monitoring	ER18B122212 1	FCE – lack of fuel level monitoring during en route	**ER-FCE-FUEL-LMON**		- OR aircraft computer detect the fuel problem AND lack of warning about the problem AND lack of flight crew reaction on the problem AND aircraft computer evaluated that the problem is detectable on base of cockpit instruments
		Insufficient Monitoring	ER18B122212 2	FCE – insufficient fuel level monitoring during en route	**ER-FCE-FUEL-INSMON**		
		Flight crew ignore independent checks	ER18B122212 3	FCE – ignoring of independent checks during en route	**ER-FCE-FUEL-INSMON**		
		Crew response inadequate	ER18B12222	FCE –incorrect response to the fuel problem during en route	**ER-FCE-FUEL-INCRESP**		- OR aircraft computer detect the fuel problem AND lack of warning about the problem AND flight crew reaction on the problem

							does not cover the procedure assumed as optimal for given conditions
		Foreign Object Damage	ER18B131	Engine mount damage caused by foreign object impact resulted with engine mount damage	**ER-BIRD-ENGINEM**		- OR Increased level of vibration or change of vibration characteristics detected in engine mount AND foreign object impact detected during take-off or landing roll
					ER-ADRM-ENGINEM		
				Separation of large items from aircraft resulted with engine mount damage	**ER-SCF-NP-STRUCT-PDA-ENGINEINJ**		- OR Increased level of vibration or change of vibration characteristics detected in engine mount AND foreign object impact detected during take-off or landing roll AND Increased level of vibration or change of vibration characteristics detected in other aircraft component
		Engine Mount Design Failure Revealed	ER18B1321	Design failure of the engine mount	**ER-SCF-NP-STRUCT-ENGINEM-DF**		- OR flight parameters indicate on exceedance of engine mount ultimate loads (coded in aircraft computer) AND adequate precursors during design process detected
		Engine Mount Maintenance Failure Revealed	ER18B1322	Maintenance findings resulted with decrease value of engine mount ultimate load	**ER-SCF-NP-STRUCT-ENGINEM-MF**		- OR flight parameters indicate on exceedance of engine mount ultimate loads (coded in aircraft computer) AND precursor for engine mount failure detected during last maintenance of the component
		Load exceeds	ER18B133	Engine mount ultimate load exceedance	**ER-SCF-NP-STRUCT-**		- OR flight parameters indicate on exceedance of engine mount

		engine mount design load		resulted from extreme turbulence during en route	**ENGMOUNT-WSTRW**		ultimate loads (coded in aircraft computer) AND extreme turbulence detected AND lack of precursors indicating on design or maintenance related failure
		Turbulent Conditions	ER18B141	In-flight shutdown due to engine surge caused by extreme turbulence	**ER-TURB-SCF-PP-IFSD-SRGE**		- OR warning about engine in-flight shutdown AND/OR Monitored flight parameters indicated on extreme turbulence.
		Flight crew command altitude outside engine operating envelope	ER18B142	FCE - In-flight shutdown due to altitude outside engine operating envelope commanded	**ER-SCF-PP-IFSD-FCE-IGNFENV**		- OR flight parameters outside the engine operating envelope
		Engine Thrust too high for altitude	ER18B1431	FCE - In-flight shutdown due to altitude outside engine operating envelope for given thrust level commanded	**ER-SCF-PP-IFSD-FCE-OVRTHR**		
2. Single engine response	Flight crew performs successful actions in order to restart the engine. The external conditions (flight altitude) as well as	Restart Unnecessary	ER18B21	FCE - In-flight shutdown during en route and restart of engine assumed as unnecessary	**ER-SCF-PP-IFSD-FCE-LENGREST**	Phase 2. Following phase 1 AND one engine inoperative and at least 2 from: 1. Speed above V2, 2.	- In-flight shutdown AND restart classified as unnecessary due to power redundancy
		Aircraft too low to allow restart	ER18B221	In-flight shutdown and lack of possibility to restart due to low altitude	**ER-SCF-PP-IFSD-LOC-I-LENGREST**		- OR in-flight shutdown AND aircraft altitude, attitude and configuration classified as being of higher priority to be recovered than flamed out engine
		Engine too damaged	ER18B222	In-flight shutdown during en route due to	**ER-SCF-PP-IFSD-**		- OR in-flight shutdown AND restart impossible due to engine damage

	engine condition do not disable the restart.			damage excluding its restart	**RESTIMP**	Altitude above 1000ft AGL, 3. Thrust cruise mode.	(engine components failure detected and classified as critical)
		Engine not attached	ER18B223	Engine separation during en route	**ER-SCF-PP-ES**		- OR in-flight shutdown AND engine separation detected
		A/C System Failure prevents restart	ER18B231	Other engine malfunction disabling the engine restart during en route	**ER-SCF-PP-OTHEM-ENGREST**		- OR in-flight shutdown AND engine control system failure detected AND restart unsuccessful
		Flight Crew unable to perform APU Restart	ER18B232	Auxiliary Power Unit failure disabling engine restart during en route	**ER-SCF-NP-MISC-APUFL-ENGREST**		- OR in-flight shutdown AND APU response not detected AND/OR warning about APU failure received
				FCE – incorrect APU restart after in-flight shutdown during en route	**ER-SCF-PP-IFSD-FCE-INCOPER-APU**		- OR in-flight shutdown AND flight crew input to the APU control inconsistent with APU manual for given conditions
		Restart not attempted	ER18B24	FCE – lack of restart of engine not attempted after shutdown during en route	**ER-SCF-PP-IFSD-FCE-LENGREST**		
3. Dual engine integrity	Engines are operated and maintained properly and under acceptable conditions, correct flight crew fuel management, engine	Severe Engine Damage	ER18B311	In-flight shutdown – severe engine damage during en route followed by loss of engine integrity	**ER-SCF-PP-IFSD-FRSTENGRES**	Phase 3a. Following Phase 2. AND lack of thrust and at least 1 from: 1. Altitude above 1000ft AGL, 2. Speed	- In-flight shutdown followed by in-flight shutdown of the second engine AND acoustic impact detected indicating on rapid loss of integrity of the first engine.
				Multiple engine power loss during en route resulted from loss of integrity of the first engine during en route	**ER-SCF-PP-MEPL-FRSTENGRES**		
		Second Engine damaged by	ER18B312	In-flight shutdown – severe engine damage during en route	**ER-SCF-PP-IFSD-FRSTENGRE**		

	location minimizes the risk of engine damage due to other engine disintegration.	first		followed by loss of engine integrity	**S**	below V1 and not increasing.	
				Multiple engine power loss during en route resulted from loss of integrity of the first engine during en route	**ER-SCF-PP-MEPL-FRSTENGRES**		
		Single Engine suffers Ice Flame-out	ER18B32111	In-flight shutdown caused by ice ingestion by the engine during en route	**ER-ICE-SCF-PP-IFSD-ICEING**		- OR engine in-flight shutdown AND engine work parameters before flame-out indicated on ice accumulation and ingestion AND icing conditions detected
		Second Engine suffers Ice Flame-out	ER18B32112	Multiple engine power loss during en route resulted from ice ingestion by the engines.	**ER-ICE-SCF-PP-MEPL-ICEINJ**		- OR engine in-flight shutdown AND engine work parameters before flame-out indicated on ice accumulation and ingestion AND icing conditions detected AND followed by second engine in-flight shutdown proceeded by similar indications
		Single Engine suffers Rain Flame-out	ER18B32121	In-flight shutdown caused by extreme rain during en route	**ER-WSTRW-SCF-PP-IFSD-RAIN**		- OR engine in-flight shutdown AND engine work parameters before flame-out indicated on water saturation AND adverse weather detected (extreme rain)
		Second Engine suffers Rain Flame-out	ER18B32122	Multiple engine power loss during en route caused by water saturation due to extreme rain	**ER-WSTRW-SCF-PP-MEPL-RAIN**		- OR engine in-flight shutdown AND engine work parameters before flame-out indicated on water saturation AND adverse weather detected (extreme rain) AND followed by second engine in-flight shutdown proceeded by similar indications

		Single Engine suffers Fuel Exhaustion	ER18B3221	In-flight shutdown during en route caused by fuel starvation	**ER-SCF-PP-IFSD-FSF**		- OR engine in-flight shutdown AND fuel starvation in engine detected AND/OR fuel system failure detected
		Fuel starvation occurs simultaneously	ER18B32221	Multiple engine power loss during en route caused by fuel starvation	**ER-SCF-PP-MEPL-FSF**		- OR engine in-flight shutdown AND fuel starvation in engine detected AND/OR fuel system failure detected AND followed by second engine in-flight shutdown proceeded by similar indications
		Further Fuel Monitoring Unsuccessful	ER18B32222	Multiple engine power loss - FCE – prevention of second engine fuel starvation by fuel situation monitoring	**ER-SCF-PP-MEPL-FCE-LFSMON**		- OR engine in-flight shutdown AND second engine in-flight shutdown AND fuel starvation detected AND flight crew input to the aircraft fuel system control does not cover the procedure optimal for efficient problem diagnose.
		Crew response inadequate	ER18B32223	Multiple engine power loss - FCE – prevention of second engine fuel starvation by correct response to the problem	**ER-SCF-PP-MEPL-FCE-INCRESP**		
		Single Engine separates	ER18B331	Engine separation during en route	**ER-SCF-PP-ES**		- OR engine separation detected
		Second Engine struck by First Engine	ER18B3321	Second engine separation during en route	**ER-SCF-PP-ES-FIRSTSTR**		- OR engine separation detected AND followed by second engine separation AND impact in the second engine before its separation detected
				Multiple engine power loss during en route caused by engines separation (the second by the first)	**ER-SCF-PP-MEPL-ENGSTR**		
		Second Engine	ER18B3322	Multiple engine power loss during en route	**ER-SCF-PP-MEPL-**		- OR engine separation detected AND followed by second engine

		separates independently		caused by engines separation (independent)	**ENGSEP**		separation AND no impact in the second engine before its separation detected
		Single Engine suffers surge	ER18B341	In-flight shutdown during en route caused by engine surge	**ER-TURB-SCF-PP-IFSD-SRGE**		- OR engine in-flight shutdown AND engine surge detected
		Simultaneous surge	ER18B3421	Multiple engine power loss during en route caused by engine surge of all engines	**ER-TURB-SCF-PP-MEPL-SRGE**		- OR all engines in-flight shutdown AND engines surge detected
		Second Engine surges independently	ER18B3422	Multiple engine power loss during en route caused by engines surge (independent)	**ER-TURB-SCF-PP-MEPL-SRGE**		- OR engine in-flight shutdown AND engine surge detected AND followed by the second engine in-flight shutdown proceeded by similar indications
4. Total power loss response	Flight crew performs successful actions in order to restart the engines. The external conditions (flight altitude) as well as the engines condition do not disable the restart.	Aircraft too low to allow restart	ER18B3511	Multiple engine power loss – during en route and low altitude disables the engine restart	**ER-LOC-I-LENGREST**		- Multiple engine power loss AND aircraft altitude, attitude and configuration classified as being of higher priority to be recovered than flamed out engines
		Engines too damaged	ER18B3512	Engines damage during en route	**ER-SCF-PP-MEPL-RESTIMP**		- OR Multiple engine power loss AND restart impractical due to engines damage (engine components failure detected and classified as critical).
		Engines not attached	ER18B3513	Engines separation during en route	**ER-SCF-PP-MEPL-ES**		- OR Multiple engine power loss AND all engines separation detected
		No fuel	ER18B3514	Lack of fuel during en route	**ER-SCF-PP-MEPL-RESTIMP-FUEL**		- OR Multiple engine power loss AND lack of fuel detected
		A/C System	ER18B3521	Other engine	**ER-SCF-PP-**		- OR Multiple engine power loss

		Failure prevents restart		malfunction preventing restart	**OTHEM-ENGREST**		AND engines control system failure detected AND restart unsuccessful
		Flight Crew unable to perform APU Restart	ER18B3522	Auxiliary Power Unit failure disabling engine restart during en route	**ER-SCF-NP-MISC-APUFL**		- OR Multiple engine power loss AND APU response not detected AND/OR warning about APU failure received
				FCE – incorrect APU restart after in-flight shutdown during en route	**ER- SCF-PP-MEPL-FCE-INCOPER-APU**		- OR Multiple engine power loss AND flight crew input to the APU control inconsistent with APU manual
		Flight Crew perform Incorrect Windmill Restart	ER18B3523	FCE – incorrect windmill restart execution	**ER-SCF-PP-MEPL-RESTIMP-FCE-INCWNDMLL**		- OR Multiple engine power loss AND flight crew input to the aircraft control does not cover the procedure optimized for given conditions – windmill restart.
5. Engine operation	All conditions necessary to enable correct engine shutdown are met.	Engine Sensor Failures	ER18B41111	False/misleading indication during en route causing incorrect engine shutdown	**ER-SCF-PP-FMI-ENGNW**	Phase 3b. Following phase 2 AND one engine inoperative and at least 2 from: 1. Speed above V2, 2. Altitude above 1000ft AGL, 3.	- In-flight shutdown AND engine sensor failure detected AND sensor failure classified as disabling correct decision support
		Dual FWS Failure	ER18B41112	Warning loss about the engine failure	**ER-SCF-NP-AVION-WRNLS-ENGNW**		- OR In-flight shutdown AND lack of warning about the engine shutdown
		DMC Failure	ER18B41113	Integrated display unit loss during en route	**ER-SCF-NP-AVION-DULS-ENGNW**		- OR In-flight shutdown AND lack of warning about the engine shutdown AND DMC failure detected.
		Warning not Obvious	ER18B4112	Warning error – engine sensors	**ER-SCF-NP-AVION-WRNERR-ENGNW**		- OR In-flight shutdown AND sensor indications classified as disabling efficient decision support

		Engine Indication Systems Failure	ER18B41131	Warning loss lack of warning about engine shutdown	**ER-SCF-NP-AVION-WRNLS-ENGNW**	Thrust cruise mode.	- OR In-flight shutdown AND lack of warning about the engine shutdown
				False/misleading indication – about number of engine shutdown	**ER-SCF-PP-FMI-ENGNW**		- OR In-flight shutdown AND sensor indications classified as disabling efficient decision support AND engine indication systems failure detected
		Total Loss of engine indication	ER18B41132	False/misleading indication – lack of engine indication during en route	**ER-SCF-PP-FMI-ENGNW**		- OR In-flight shutdown AND lack of engine indication detected
		Lack of Verification	ER18B4121	FCE – lack of verification the data suggesting the engine shutdown during en route	**ER-FCE-ENGNW-LVERIF**		- OR In-flight shutdown AND flight crew input to the aircraft control systems does not cover the procedure designed and coded in aircraft computer for given situation and conditions
		Inadequate Verification	ER18B4122	FCE – inadequate verification the data suggesting the engine shutdown during en route	**ER-FCE-ENGNW-LINCVERIF**		
		Flight crew ignore warnings	ER18B42	FCE – ignoring the warning about the shutdown engine.	**ER-FCE-IGNOR - ENGNW**		- OR In-flight shutdown AND sensor indications classified as enabling efficient decision support AND working engine shutdown by the flight crew
6. Single engine control response	Flight crew recovers control over the aircraft after single	Flight Control Surfaces Severely Damaged	ER18B511	Damage of flight control surface caused by engine	**ER-LOC-I-SURFDAM**	Phase 3c. Following phase 2 AND one engine inoperati	- In-flight shutdown AND flight control surface detected as inoperable
		Aircraft Stalls	ER18B512	Aircraft stalls during en	**ER-LOC-I-**		- OR In-flight shutdown AND

	engine failure			route	**STLL**	ve and at least 2	aircraft attitude and flight parameters indicates on stall.
		Lack of Immediate Flight Control	ER18B52	FCE – lack of response to the problem	**ER-LOC-I-FCE-LCTRL**	from: 1. Speed above V2, 2. Altitude above 1000ft AGL, 3. Thrust cruise mode.	- OR In-flight shutdown AND flight crew input to the aircraft control does not cover the procedure designed and coded in aircraft computer for given situation and conditions.
		Flight crew misdiagnose which engine has failed	ER18B531	FCE –incorrect response to the problem	**ER-LOC-I-FCE-MISD-ENGNWNB**		- OR In-flight shutdown AND flight crew input to the aircraft control does not cover the procedure designed and coded in aircraft computer for given situation and conditions.
		Flight crew apply incorrect controls	ER18B532		**ER-LOC-I-FCE-INCTRL**		
7. Total power loss control response	Flight crew is able to recover the control over the aircraft after total power loss	Flight Control Surfaces Severely Damaged	ER18B611	Damage of flight control surface caused by engines	**ER-LOC-I-SURFDAM**	Phase 4. Following phase 3 (a,b or c) AND lack of thrust and at least 1 from: 1. Altitude above 1000ft AGL, 2. Speed below V1 and not increasin	- Multiple engine power loss AND flight control surface detected as inoperable
		Aircraft Stalls	ER18B612	Aircraft stalls during en route	**ER-LOC-I-STLL**		- OR Multiple engine power loss AND aircraft attitude and flight parameters indicates on stall
		Lack of Immediate Flight Control	ER18B62	FCE – lack of response to the problem	**ER-LOC-I-FCE-LCTRL**		- OR Multiple engine power loss AND flight crew input to the aircraft control does not cover the procedure designed and coded in aircraft computer for given situation and conditions.
		Immediate & Continuing Control Incorrect	ER18B63	FCE –incorrect response to the problem	**ER-LOC-I-FCE-INCTRL**		
8.	All	Aircraft fails	ER18B71	FCE – decision about	**ER-SCF-PP-**		- Multiple engine power loss AND

Achieve airport	conditions necessary to reach the nearest airport and safely land on it are met.	to return to departure airport		back to the departure airport	**MEPL-FCE-GLTODEPADR**	g.	flight crew decisions (revealed through the input to the aircraft control) do not cover the optimal solution for given conditions
		Aircraft fails to reach destination airport	ER18B72	FCE – decision about flight to the destination airport	**ER-SCF-PP-MEPL-FCE-GLTODEST**		
		Flight Crew unable to maintain control on approach	ER18B731	FCE – maintain control on approach	**AL-LOC-I-MEPL**		- OR Multiple engine power loss AND flight crew input to the aircraft controls during approach classified as incorrect
		Distance to airport greater than glide distance	ER18B732	FCE – error in calculating the gliding distance / distance to the nearest airport	**ER-SCF-PP-MEPL-FCE-UNREACHBL**		- OR Multiple engine power loss AND flight crew decisions (revealed through the input to the aircraft control) do not cover the optimal solution for given conditions
		Diversion occurs too late	ER18B733	FCE – diversion too late	**ER-SCF-PP-MEPL-FCE-DIVTL**		
		Airport not suitable	ER18B734	FCE – error in airport choosing	**ER-SCF-PP-MEPL-ADRNS**		

Table 18 ASCOS ESD 19 - Unstable approach

Barrier	Description	Possibilities for braking the barrier – Base event	Code	Possible occurrence (CICTT)	Designation (CICTT)	Flight phase indicator	Proposed method for failure detection (trigger logic)
1. Stable Approach	Flight crew handle aircraft properly in order to avoid unstable approach. The weather conditions do not disable the stable approach.	Poor manual flight control causes UA	AL19B111	FCE – poor manual flight control during approach	**AL-FCE-PMANFC**	Phase 1 following phase 0 (en route) and at least 2 from: 1. Speed below 240 kts and not increasing 2. Altitude below 2000ft AGL and not increasing, 3. Application of approach mode thrust	Flight crew input to the aircraft control classified as incorrect for given conditions
		Checklist failure	AL19B1121	FCE – checklist failure during approach	**AL-FCE-CRMF-CHCKLF**		OR lack of or incorrect executed procedure for briefing and checklist (e.g. via cabin voice analysis for key words)
		Improper control exchange	AL19B1122	FCE – improper control exchange during approach	**AL-FCE-CRMF-CTRLEXCH**		OR exchange the control detected in incorrect conditions
		Poor automated systems management causes UA	AL19B113	FCE – incorrect use of flight management systems during approach	**AL-FCE-INCOPER-FMS**		OR incorrect use of flight management detected (inconsistency with system manual)
		Loss of visual	AL19B121	Loss of visual during approach	**AL-WSTRW-VISLSS**		OR external conditions analysis indicate on loss of visual by the flight crew
		Severe turbulence	AL19B122	Severe turbulence during approach encountered	**AL-TURB-UA**		OR external conditions analysis indicate on strong turbulence encountered
		Crosswind exceeded	AL19B123	Crosswind during approach encountered	**AL-WSTRW-UA**		OR external conditions analysis indicate on cross wind encountered
2. Missed approach	Flight Crew performs missed approach as a	Flight crew fail to recognize unstable approach	AL19B211	FCE – lack of recognition of unstable approach	**AL-FCE-UAREC**	Phase 2a following phase 1 and at least 2 from: 1. Speed below	Flight parameters during approach classify the approach as unstable AND flight crew input to the aircraft controls does not cover the adequate procedure
		Crew fail to	AL19B21	FCE – incorrect	**AL-FCE-**		

	result of unstable approach	respond appropriately to unstable approach	2	response to unstable approach	**INCRESP-UA**	240 kts and not increasing 2. Altitude below 2000ft AGL and not increasing, 3. Application of approach mode thrust	
		AOA protection prevents MA	AL19B221	AOA protection prevents MA	**AL-AOAPE-INCUARESP**		OR Flight parameters during approach classify the approach as unstable AND missed approach blocked by AOA protection
		PF fails to execute correctly	AL19B222	FCE – lack of missed approach execution	**AL-FCE-INCUAEXEC**		OR Flight parameters during approach classify the approach as unstable AND flight crew input to the aircraft controls does not cover the adequate procedure
3. Maintain control	Flight crew recovers control over the aircraft after failed execution of missed approach	Uncontrollable	AL19B31	Aircraft in unrecoverable configuration in result of unsuccessful missed approach	**AL-LOC-I-FCE-INCUAEXEC**	Phase 3a following phase 2a and at least 2 from: 1. Speed below 240 kts and not increasing 2. Altitude below 2000ft AGL and not increasing, 3. Application of approach mode thrust	Unsuccessful missed approach executed AND aircraft configuration, attitude and flight parameters classified as unrecoverable
		Lack of control	AL19B32	FCE – lack of recovery action	**AL-LOC-I-FCE-LCTRL**		OR Unsuccessful missed approach executed AND inconsistency between flight crew input to aircraft control and identified as optimal for given situation (defined and coded in aircraft system)
		Incorrect Control	AL19B33	FCE – incorrect recovery action	**AL-LOC-I-FCE-INCTRL**		
		Insufficient control	AL19B34	FCE – insufficient recovery action	**AL-LOC-I-FCE-INSCTRL**		
4. Structural integrity	Aircraft structure is free of structural	Structure too weak	AL19B41	Landing gear structural failure resulted from abnormal runway contact	**AL-ARC-SCF-NP-LG-STRUCTFL**	Phase 2b following phase 1 and at least 2 from: 1.	Abnormal runway contact detected AND tension distribution over the aircraft structure indicates on risk of landing gear failure AND change in vibration characteristics in landing gear detected

	weaknesses or touchdown was made without exceeding the design loads			Tire failure resulted from abnormal runway contact	**AL-ARC-SCF-NP-LG-TIREFL**	Speed below approach speed 2. Altitude 0ft AGL, 3. Landing gear compression	OR Abnormal runway contact detected AND tension distribution over the aircraft structure indicates on risk of landing tire failure AND change in pressure level in tire detected
				Wheel failure resulted from abnormal runway contact	**AL-ARC-SCF-NP-LG-WHLFL**		OR Abnormal runway contact detected AND tension distribution over the aircraft structure indicates on risk of wheel failure AND change in vibration characteristics in wheel detected
				Cracks in aircraft structure resulted from abnormal runway contact	**AL-ARC-SCF-NP-STRUCT-CRK**		OR Abnormal runway contact detected AND tension distribution over the aircraft structure indicates on risk of aircraft structure failure
		Design load exceeded	AL19B42	Design load exceeded as a result of abnormal runway contact	**AL-ARC-DSGNLEXC**		OR Abnormal runway contact detected AND tension distribution exceeded the aircraft design loads
5. Maintain control after hard landing	Flight crew maintains control over the aircraft after hard landing being a result of unstable approach	Uncontrollable	AL19B51	Aircraft in unrecoverable configuration in result of abnormal runway contact	**AL-LOC-G-ARC-INCUAEXEC**		Abnormal runway contact detected AND aircraft configuration, attitude and flight parameters classified as unrecoverable
		Lack of control	AL19B52	FCE – lack of recovery action	**AL-LOC-G-FCE-LCNTTR**		OR Aircraft configuration, attitude and flight parameters classified as recoverable AND lack of pilot input to aircraft control
		Incorrect Control	AL19B53	FCE – incorrect recovery action	**AL-LOC-G-FCE-INCNTTR**		OR Aircraft configuration, attitude and flight parameters classified as recoverable AND pilot input to aircraft control classified as incorrect in given situation
		Insufficient control	AL19B54	FCE – insufficient recovery action	**AL-LOC-G-FCE-INSCNTTR**		OR Aircraft configuration, attitude and flight parameters classified as recoverable AND pilot input to aircraft control

							classified as insufficient in given situation (too low extend, too short input time etc.)
6. Maximum braking	Parameters of braking systems and devices included into assumed / expected range	Insufficient runway length	AL19B61	Runway too short due to poor surface condition (ice or wet)	**AL-ADRM-INSRWYL**		Runway excursion AND braking devices work correctly AND braking performed correctly.
		Brakes not functioning correctly	AL19B62	Automatic braking loss during landing roll	**AL-SCF-NP-AFC-ABRKLS**		OR Deceleration parameters lower than expected (calculated for current conditions) AND/OR braking asymmetry AND all braking devices applied on time and correctly
				Automatic braking operation error during landing roll	**AL-SCF-NP-AFC-ABRKERR**		
				Brake system failure during landing roll	**AL-SCF-NP-LG-BRKFL**		
				Reverser / beta malfunction - failure to deploy during landing roll	**AL-SCF-PP-RFD**		OR thrust reverser not deployed
		Brakes not applied correctly	AL19B63	FCE – braking application error	**AL-FCE-BRAKAPP**		OR execution of braking procedure conducted by the flight crew differs significantly from the assumed as reference model.
7. Maintain control	Flight crew maintains control over the aircraft after execution of missed approach	Uncontrollable	AL19B71	Aircraft in unrecoverable configuration in result of missed approach execution	**MA-LOC-I**	Phase 2c following phase 1 and at least 2 from: 1. Speed below 240 kts and not increasing 2. Altitude below 2000ft	Missed approach execution AND aircraft configuration, attitude and flight parameters classified as unrecoverable
		Lack of control	AL19B72	FCE – lack of recovery action	**MA-LOC-I-FCE-LCTRL**		OR Aircraft configuration, attitude and flight parameters classified as recoverable AND lack of pilot input to aircraft control
		Incorrect Control	AL19B73	FCE – incorrect recovery action	**MA-LOC-I-FCE-INCTRL**		OR Aircraft configuration, attitude and flight parameters classified as recoverable AND pilot input to aircraft control

						AGL, 3. Application of missed approach mode thrust	classified as incorrect in given situation
		Insufficient control	AL19B74	FCE – insufficient recovery action	**MA-LOC-I-FCE-INSCTRL**		OR Aircraft configuration, attitude and flight parameters classified as recoverable AND pilot input to aircraft control classified as insufficient in given situation (too low extend, too short input time etc.)
8. Fuel management	All necessary conditions enabling successful execution of next approach are met	Flight crew fail to notify ATC of inadequate reserves	AL19B811	FCE – lack of notification to the ATC about fuel reserve	**MA-FUEL-FCE-INADFLAM-NOT2ATM**	Phase 3c following phase 2c and at least 2 from: 1. Speed below 240 kts and not increasing 2. Altitude below 2000ft AGL and not increasing, 3. Application of approach mode thrust	Missed approach execution AND lack of message to ATC about fuel reserve AND not enough amount of fuel detected for next approach for given conditions
		Poor flight planning	AL19B8121	FCE – poor flight planning	**MA-FUEL-FCE-PFPL**		OR Missed approach execution AND executed flight plane classified as not optimal for given conditions
		Aircraft diverted from other location	AL19B8122	Change in flight plan	**MA-FUEL-RTDIV**		OR Missed approach execution AND executed flight plane classified as not optimal for given conditions AND flight plan change noted
		Aircraft executes multiple MA	AL19B82	Multiple missed approach execution	**MA-FUEL-FCE-MMAEXEC**		OR Missed approach execution AND lack of message to ATC about fuel reserve AND not enough amount of fuel detected for next approach for given conditions AND more than two missed approach executed.

Table 19 ASCOS ESD 21 - Aircraft Weight & Balance Outside Limits

Barrier	Description	Possibilities for braking the barrier – Base event	Code	Possible occurrence (CICTT)	Designation (CICTT)	Flight phase indicator	Proposed method for failure detection (trigger logic)
1. Aircraft Weight & Balance	Aircraft loading and fuelling processes are free from any failures able to affect the aircraft weight & balance issues.	Aircraft Overweight	AL21B11	GSE – maximum amount of load for given route exceeded resulting with maximum landing weight exceeded	**AL-GSE-LOADEXC**	Phase 1 following phase 0 (en route) and at least 2 from: 1. Speed below 240 kts and not increasing 2. Altitude below 2000ft AGL and not increasing, 3. Application of approach mode thrust	- Aircraft load weights and/or fuel weight exceeds the maximum acceptable values for given flight route.
				FCE – poor flight planning resulting with maximum landing weight exceeded	**AL-FCE-PFPL**		
		Incorrect or No Load Sheet	AL21B121	GSE - Lack of or incorrect load sheet	**AL-GSE-INCLDSHT**		- OR aircraft computer detected errors in input load sheet OR lack of load sheet(electronic version of load sheet required)
		Load Sheet not Adhered to	AL21B122	GSE - Load sheet not adhered to	**AL-GSE-INCLDDISTR**		- OR aircraft computer detected inconsistencies between programmed load sheet and measured aircraft weights.
		Fore-Aft Tanks Installed on Aircraft	AL21B131	Aircraft equipped with fuel tanks located far from aircraft C G.	**AL-FTLOC-DF**		- OR aircraft uses for-aft tanks during flight
		Flight Crew Command Fuel Transfer	AL21B1321	FCE – flight crew commanded fuel transfer negatively affecting aircraft	**AL-FCE-INCFLTRNSFR**		- OR fuel transfer negatively affecting aircraft weight and balance commanded by the flight crew detected/

				weigh and balance.			
		Fuel System Failure	AL21B13221	Fuel control system failure during approach and landing phase	**AL-SCF-NP-FUEL-CTRL-INCFLTRNSFR**		- OR Fuel control system failure detected OR warning about fuel control system received
		Uncommanded Fuel Transfer	AL21B13222	Fuel control failure resulting with uncommanded fuel transfer	**AL-SCF-NP-FUEL-CTRL-UNCFLTRNSFR**		- OR Fuel control system failure detected OR warning about fuel control system received AND uncommanded fuel transfer detected
		Fuel Load Distribution Incorrect	AL21B13223	FCE - Fuel distribution at take-off is incorrect	**AL-FCE-FLDISTR**		- OR fuel distribution exceeds the maximum acceptable values for given flight route
		Cargo Shifts	AL21B14	Cargo restraint system failure – appeared or revealed during approach and landing phase	**AL-SCF-NP-MISC-CARGRSTFL**		- OR rapid aircraft C.G movement detected AND cargo restraint system failure detected
		Failure to Diagnose Problem	AL21B21	FCE – failure to diagnose the weigh and balance problem	**AL-FCE-MISD-WBALPR**		- OR inconsistencies between flight crew input to the aircraft controls and procedure assumed by the system as optimal for given conditions AND / OR lack of unambiguous solution for given problem AND / OR lack of possibility to solve the problem by the flight crew on base of for them available information
		Failure to Resolve Problem	AL21B22	FCE – failure to response correctly to the weight and balance problem occurred during approach and landing	**AL-FCE-INCRESP-WBALPR**		
2.Control recovery	Flight crew recovers	Stall Unavoidable	AL21B311	Loss of control in flight due to stall	**AL-LOC-I-STALL**	Phase 2 following phase 1 and	- Aircraft configuration, and flight parameters indicate on stall due to weight and balance problems

	the control over the aircraft after detection of weight and balance problem	Pilot fails to avoid stall	AL21B312	FCE – failure to avoid stall	**AL-LOC-I-FCE-INCTRL**	at least 2 from: 1. Speed below 240 kts and not increasing 2. Altitude below 2000ft AGL, 3. Application of approach and landing mode of thrust	- OR Aircraft configuration, and flight parameters indicate on nearly stall which is not unavoidable AND inconsistencies between pilot input to the aircraft controls and control input sequence assumed by the aircraft computer as optimal for given conditions AND aircraft stall
		Control Unrecoverable	AL21B321	Loss of control in flight – situation unrecoverable	**AL-LOC-I-STALL**		- OR Aircraft configuration, and flight parameters indicate on appearing of unrecoverable conditions
		Lack of Control	AL21B322	FCE – lack of flight crew response to aircraft attitude	**AL-LOC-I-FCE-LCTRL**		- OR Aircraft configuration, and flight parameters indicate on nearly loss of control state which is not unavoidable AND inconsistencies between pilot input to the aircraft controls and control input sequence assumed by the aircraft computer as optimal for given conditions.
		Incorrect Control	AL21B323	FCE – incorrect flight crew response to aircraft attitude	**AL-LOC-I-FCE-INCTRL**		

Table 20 ASCOS ESD 23 - Aircraft encounters windshear during landing

Barrier	Description	Possibilities for braking the barrier – Base event	Code	Possible occurrence (CICTT)	Designation (CICTT)	Flight phase indicator	Proposed method for failure detection (trigger logic)
1. Windshear detection	All means allowing for windshear detection are available and explored	LLWAS not installed	AL23B111	Lack of LLWAS system at the airport	**AL-WSTRW-ADRM-LLLWAS**	Phase 1 following phase 0 (en route) and at least 2 from: 1. Speed below 240 kts and not increasing 2. Altitude below 2000ft AGL and not increasing, 3. Application of approach mode thrust	- ATCO system is not equipped with LLWAS
		LLWAS not activated	AL23B112	LLWAS system failure	**AL-WSTRW-ADRM-LLWASNA**		- OR LLWAS system not active
		Failure of ATC to advise pilot	AL23B113	ATCOER – alerting the flight crew about the windshear	**AL-WSTRW-ATM-ATCOER-FCADV**		- OR aircraft computer did not detect the message from ATCO warning about windshear AND receive automatic message from ATM system equipped with LLWAS
		PWS not installed	AL23B121	Lack of PWS installed on aircraft	**AL-WSTRW-LPWS**		- OR PWS not available
		PWS not activated	AL23B122	Failure of the PWS during approach and landing phase	**AL-SCF-NP-AVION-WRNLS-PWS**		- OR PWS not activated AND aircraft computer received warning from ATM system AND/ OR detected the alert warning communicated by the ATCO
		Crew fail to recognize windshear	AL23B13	FCE – failure to windshear symptoms detection in case of lack of automatic systems.	**AL-WSTRW-FCE-WSHRREC**		- OR weather conditions as well as programmed airport specifications indicate on risk of windshear
2. Windshear management	Flight crew executes WEM	Failure to avoid windshear	AL23B21	Windshear unavoidable during approach and landing phase	**AL-WSTRW-FCE-WSHRAF**		- Aircraft computer detected ATCO alert about windshear appearing AND/OR received message from ATM system about detected windshear by the LLWAS AND/OR detected with

							PWS windshear followed by aircraft flight parameters indicating on windshear encounter by the aircraft AND windshear unavoidable(e.g. due to too short time distance between windshear detection and experiencing)
		Aircraft too low to execute a WEM	AL23B221	Windshear unavoidable due to too low altitude during approach and landing phase	**AL-WSTRW-WSHRAF**		- OR Aircraft computer detected ATCO alert about windshear appearing AND/OR received message from ATM system about detected windshear by the LLWAS AND/OR detected with PWS windshear followed by aircraft flight parameters indicating on windshear encounter by the aircraft AND windshear classified as unavoidable(due to too low altitude)
		Pilot fails to execute a WEM	AL23B222	FCE – WEM execution during approach and landing phase	**AL-WSTRW-FCE-WSHRDAF**		- OR Aircraft computer detected ATCO alert about windshear appearing AND/OR received message from ATM system about detected windshear by the LLWAS AND/OR detected with PWS windshear followed by aircraft flight parameters indicating on windshear encounter by the aircraft AND Actions taken by the flight crew do not cover WEM procedure assumed as optimal for given conditions.
3.Structural integrity	Aircraft structure is free of structural	Structure too weak	AL23B31	Landing gear structural failure caused by ARC due to windshear	**AL-ARC-SCF-NP-LG-STRUCTFL**	Phase 2 following phase 1 and at least 2	- Abnormal runway contact detected AND tensions distribution over the aircraft structure indicates on risk of landing gear failure AND change in

	weaknesses or touchdown was made without exceeding the design loads					from: 1. Speed below approach speed 2. Altitude 0ft AGL, 3. Landing gear compression	vibration characteristics in landing gear detected
				Tire failure caused by ARC due to windshear	**AL-ARC-SCF-NP-LG-TIREFL**		- OR Abnormal runway contact detected AND tensions distribution over the aircraft structure indicates on risk of landing tire failure AND change in pressure level in tire detected
				Wheel failure caused by ARC due to windshear	**AL-ARC-SCF-NP-LG-WHLFL**		- OR Abnormal runway contact detected AND tensions distribution over the aircraft structure indicates on risk of wheel failure AND change in vibration characteristics in wheel detected
				Cracks in aircraft structure caused by ARC due to windshear	**AL-ARC-SCF-NP-STRUCT-CRK**		- OR Abnormal runway contact detected AND tension distribution over the aircraft structure indicates on risk of aircraft structure failure
		Design load exceeded	AL23B32	Design load exceedance caused by ARC after windshear encountered	**AL-ARC-DSGNLEXC**		- OR Abnormal runway contact detected AND tension distribution exceeded the aircraft design loads
4.Maintain control	Flight crew maintains control over the aircraft after structural failure being a result of	Uncontrollable	AL23B41	Aircraft in unrecoverable configuration in result of abnormal runway contact	**AL-LOC-G-WSHR**		- Abnormal runway contact detected AND aircraft configuration, attitude and flight parameters classified as unrecoverable
		Lack of control	AL23B42	FCE – lack of recovery action	**AL-LOC-G-FCE-LCTRL**		- OR Abnormal runway contact detected AND aircraft configuration, attitude and flight parameters classified as recoverable AND lack of pilot input to aircraft control

	windshear during landing	Incorrect Control	AL23B43	FCE – incorrect recovery action	**AL-LOC-G-FCE-INCTRL**		- OR Abnormal runway contact detected AND aircraft configuration, attitude and flight parameters classified as recoverable AND pilot input to aircraft control classified as incorrect in given situation
		Insufficient control	AL23B44	FCE – insufficient recovery action	**AL-LOC-G-FCE-INSCTRL**		- OR Abnormal runway contact detected AND aircraft configuration, attitude and flight parameters classified as recoverable AND pilot input to aircraft control classified as insufficient in given situation (too low extend, too short input time etc.)
5.Maximum braking	Braking procedures is executed appropriately by the flight crew, the braking system is free from failures, runway length as well as the surface conditions enable safe landing roll	Insufficient runway length	AL23B51	Automatic braking loss during landing roll	**AL-ADRM-INSRWYL**		- Runway excursion AND braking devices work correctly AND braking performed correctly.
		Brakes not functioning correctly	AL23B52	Automatic braking operation error during landing roll	**AL-SCF-NP-AFC-ABRKLS**		- OR Deceleration parameters lower than expected (calculated for current conditions) AND/OR braking asymmetry AND all braking devices applied on time and correctly
				Brake system failure during landing roll	**AL-SCF-NP-AFC-ABRKERR**		
				Reverser / beta malfunction - failure to deploy during landing roll	**AL-SCF-NP-LG-BRKFL**		
				FCE – braking application error	**AL-SCF-PP-RFD**		- OR thrust reverser not deployed
		Brakes not applied correctly	AL23B53	Automatic braking loss during landing roll	**AL-FCE-BRAKAPP**		- OR execution of braking procedure conducted by the flight crew differs significantly from the assumed as reference model.

Table 21 ASCOS ESD 25 - Aircraft handling by crew during flare inappropriate

Barrier	Description	Possibilities for braking the barrier – Base event	Code	Possible occurrence (CICTT)	Designation (CICTT)	Flight phase indicator	Proposed method for failure detection (trigger logic)
1. Windshear detection	All means allowing for windshear detection are available and explored	Loss of lift during flare	AL25B11	Loss of lift during flare	**AL-WSTRW-LLDFLARE**	Phase 1 following phase 0 (en route) and at least 2 from: 1. Speed below 240 kts and not increasing 2. Altitude below 2000ft AGL and not increasing, 3. Application of approach mode thrust	Loss of lift during flare execution detected
		PF flares too late	AL25B12	Flare executed too late	**AL-FCE-INCFLAREXEC**		OR inconsistencies between pilot input to the aircraft controls and model flare execution procedure coded in aircraft computer (for given conditions)
		PF flares too soon	AL25B13	Flare executed too soon	**AL-FCE-INCFLAREXEC**		
		PF handling incorrect	AL25B14	Incorrect aircraft handling during flare	**AL-FCE-INCFLAREXEC**		
2.Structural integrity	Aircraft structure is free of structural weaknesses or touchdown was made without exceeding the design loads	Structure too weak	AL25B21	Landing gear structural failure caused by ARC due to windshear	**AL-ARC-SCF-NP-LG-STRUCTFL**	Phase 2 following phase 1 and at least 2 from: 1. Speed below approach speed 2. Altitude 0ft AGL, 3. Landing gear compression	Abnormal runway contact detected AND tension distribution over the aircraft structure indicates on risk of landing gear failure AND change in vibration characteristics in landing gear detected
				Tire failure caused by ARC due to windshear	**AL-ARC-SCF-NP-LG-TIREFL**		OR Abnormal runway contact detected AND tension distribution over the aircraft structure indicates on risk of landing tire failure AND change in pressure level in tire detected
				Wheel failure caused by ARC due to windshear	**AL-ARC-SCF-NP-LG-WHLFL**		OR Abnormal runway contact detected AND tension distribution over the aircraft structure indicates on risk of wheel failure AND change in vibration characteristics in wheel detected
				Cracks in aircraft	**AL-ARC-**		OR Abnormal runway contact detected

				structure caused by ARC due to windshear	**SCF-NP-STRUCT-CRK**		AND tension distribution over the aircraft structure indicates on risk of aircraft structure failure OR Abnormal runway contact detected AND tension distribution exceeded the aircraft design loads
		Design load exceeded	AL25B22	Design load exceedance caused by ARC after windshear encountered	**AL-ARC-DSGNLEXC**		
3.Maintain control	Flight crew maintains control over the aircraft after structural failure being a result of windshear during landing	Uncontrollable	AL25B31	Aircraft in unrecoverable configuration in result of abnormal runway contact	**AL-LOC-G-WSHR**		Abnormal runway contact detected AND aircraft configuration, attitude and flight parameters classified as unrecoverable
		Lack of control	AL25B32	FCE – lack of recovery action	**AL-LOC-G-FCE-LCTRL**		OR Abnormal runway contact detected AND aircraft configuration, attitude and flight parameters classified as recoverable AND lack of pilot input to aircraft control
		Incorrect Control	AL25B33	FCE – incorrect recovery action	**AL-LOC-G-FCE-INCTRL**		OR Abnormal runway contact detected AND aircraft configuration, attitude and flight parameters classified as recoverable AND pilot input to aircraft control classified as incorrect in given situation
		Insufficient control	AL25B34	FCE – insufficient recovery action	**AL-LOC-G-FCE-INSCTRL**		OR Abnormal runway contact detected AND aircraft configuration, attitude and flight parameters classified as recoverable AND pilot input to aircraft control classified as insufficient in given situation (too low extend, too short input time etc.)

Table 22 ASCOS ESD 26 - Aircraft handling by crew during landing roll inappropriate

Barrier	Description	Possibilities for braking the barrier – Base event	Code	Possible occurrence (CICTT)	Designation (CICTT)	Flight phase indicator	Proposed method for failure detection (trigger logic)
1. Landing roll handling	Aircraft is handled by the flight crew during landing roll correctly	Directional handling failure	AL26B 11	FCE - Directional handling failure	**AL-FCE-AHAN**	Phase 1 following phase 0 (approach) and at least 2 from: 1. Speed below approach speed 2. Altitude 0ft AGL, 3. Landing gear compression	- Landing roll parameters indicates on errors in flight crew inputs to the aircraft controls AND lack of adverse weather conditions
		Braking application failure	AL26B 12	FCE - Braking application failure	**AL-FCE-BRAKAPP**		- OR execution of braking procedure conducted by the flight crew differs significantly from the assumed as model.
		Thrust reverser application failure	AL26B 13	Reverser / beta malfunction - failure to deploy during landing roll	**AL-SCF-PP-RFD**		- OR Deceleration parameters low than expected (calculated for current conditions) AND / OR thrust asymmetry
		Adverse weather conditions	AL26B 14	Adverse weather conditions	**AL-WSTRW-FCE-AHAN**		- OR Landing roll parameters indicates on errors in flight crew inputs to the aircraft controls AND adverse weather conditions detected
2.Maintain control	Flight crew maintains control over the aircraft after structural failure being a result of windshear during landing	Uncontrollable	AL26B 21	Aircraft in unrecoverable configuration in result of abnormal runway contact	**AL-LOC-G-WSHR**		- Abnormal runway contact detected AND aircraft configuration, attitude and flight parameters classified as unrecoverable
		Lack of control	AL26B 22	FCE – lack of recovery action	**AL-LOC-G-FCE-LCTRL**		- OR Abnormal runway contact detected AND aircraft configuration, attitude and flight parameters classified as recoverable AND lack of pilot input to aircraft control
		Incorrect Control	AL26B 23	FCE – incorrect recovery action	**AL-LOC-G-FCE-INCTRL**		- OR Abnormal runway contact detected AND aircraft configuration, attitude and flight parameters classified as recoverable AND pilot input to aircraft control classified as incorrect in given situation

		Insufficient control	AL26B 24	FCE – insufficient recovery action	**AL-LOC-G-FCE-INSCTRL**		- OR Abnormal runway contact detected AND aircraft configuration, attitude and flight parameters classified as recoverable AND pilot input to aircraft control classified as insufficient in given situation (too low extend, too short input time etc.)
3.Maximum braking	Braking procedures is executed appropriately by the flight crew, the braking system is free from failures, runway length as well as the surface conditions enable safe landing roll	Insufficient runway length	AL26B 31	Automatic braking loss during landing roll	**AL-ADRM-INSRWYL**		- Runway excursion AND braking devices work correctly AND braking performed correctly.
		Brakes not functioning correctly	AL26B 32	Automatic braking operation error during landing roll	**AL-SCF-NP-AFC-ABRKLS**		- OR Deceleration parameters lower than expected (calculated for current conditions) AND/OR braking asymmetry AND all braking devices applied on time and correctly
				Brake system failure during landing roll	**AL-SCF-NP-AFC-ABRKERR**		
				Reverser / beta malfunction - failure to deploy during landing roll	**AL-SCF-NP-LG-BRKFL**		
				FCE – braking application error	**AL-SCF-PP-RFD**		- OR thrust reverser not deployed
		Brakes not applied correctly	AL26B 33	Automatic braking loss during landing roll	**AL-FCE-BRAKAPP**		- OR execution of braking procedure conducted by the flight crew differs significantly from the assumed as reference model.

Table 23 ASCOS ESD 27 - Aircraft directional control related systems failure

Barrier	Description	Possibilities for braking the barrier – Base event	Code	Possible occurrence (CICTT)	Designation (CICTT)	Flight phase indicator	Proposed method for failure detection (trigger logic)
1. Directional Control Systems Integrity (landing gear)	Landing gear is free of failures resulting from inadequate design or maintenance. The runway is also free of contamination able to affect the aircraft directional controllability	Landing gear extension failure	AL27B111	Landing gear extend failure during landing	**AL-SCF-NP-LG-EXTFL**	Phase 1 following phase 0 (en route) and at least 2 from: 1. Speed below 240 kts and not increasing 2. Altitude below 2000ft AGL and not increasing, 3. Application of approach mode thrust	- Landing gear not extended
		Landing gear structure too weak	AL27B112	Landing gear structural failure during landing	**AL-SCF-NP-LG-STRUCTFL**		- OR Loads recorded indicate on extreme risk of landing gear structural failure OR deceleration and attitude related parameters of aircraft different than expected (calculated for current conditions) AND transverse acceleration value in both directions, higher than expected (calculated /estimated for current conditions) AND engine parameters correct
		Foreign object damage to landing gear	AL27B113	Landing gear failure caused by bird impact during landing	**AL-BIRD-SCF-NP-LG-STRUCTF**		- OR Work parameters of flight control components sharply worsening suggesting failure resulted from impact of foreign object (bird or RWY loose object) AND/OR analysis of received noise spectrum around the aircraft indicates on high energy contact with foreign object.
				Landing gear failure caused by foreign object impact during landing	**AL-ADRM-SCF-NP-LG-STRUCTF**		
		Landing gear failure due to inadequate maintenance	AL27B114	Landing gear structural failure during landing due to incorrect maintenance	**AL-SCF-NP-LG-STRUCTFL-MF**		- OR Deceleration and attitude related parameters of aircraft different than expected (calculated for current conditions) AND transverse acceleration value in both directions, higher than expected (calculated /estimated for current conditions) AND engine parameters correct AND adequate precursors during landing gear maintenance detected

		Landing gear failure due to inadequate design	AL27B115	Landing gear structural failure during landing due to design error	**AL-SCF-NP-LG-STRUCTFL-DF**		- OR Deceleration and attitude related parameters of aircraft different than expected (calculated for current conditions) AND transverse acceleration value in both directions, higher than expected (calculated /estimated for current conditions) AND engine parameters correct AND adequate precursors during landing gear design process detected
2. Directional Control Systems Integrity (wheel)	Wheel is free of failures resulting from inadequate design or maintenance. The runway is also free of contamination able to affect the aircraft directional controllability	Wheel structure too weak	AL27B121	Wheel failure during landing	**AL-SCF-NP-LG-WHLFL**		- Loads recorded indicate on extreme risk of landing gear structural failure OR Deceleration and attitude related parameters of aircraft different than expected (calculated for current conditions) AND transverse acceleration value in both directions, higher than expected (calculated /estimated for current conditions) AND engine parameters correct
				Tire failure during landing	**AL-SCF-NP-LG-TIREFL**		
		Foreign object damage to wheels	AL27B122	Wheel failure caused by bird impact during landing	**AL-BIRD-SCF-NP-LG-WHLF**		- OR Work parameters of flight control components sharply worsening suggesting failure resulted from impact of foreign object (bird or RWY loose object) AND/OR analysis of received noise spectrum around the aircraft indicates on high energy contact with foreign object.
				Wheel failure caused by foreign object impact during landing	**AL-ADRM-SCF-NP-LG-WHLF**		
		Wheel failure due to inadequate maintenance	AL27B123	Wheel failure due to incorrect maintenance	**AL-SCF-NP-LG-WHLFL-MF**		- OR Deceleration and attitude related parameters of aircraft different than expected (calculated for current conditions) AND transverse acceleration value in both directions, higher than expected (calculated /estimated for current conditions) AND engine parameters correct AND adequate precursors during wheel maintenance detected
				Tire failure due to incorrect maintenance	**AL-SCF-NP-LG-TIREFL-MF**		
		Wheel	AL27B1	Brake system	**AL-SCF-**		- OR transverse acceleration value in both

		system failure	24	failure during landing roll	**NP-LG-BRKFL-DIR**		directions, higher than expected/ (calculated /estimated for current conditions) AND engine (reverse) parameters correct
		Wheel failure due to inadequate design	AL27B125	Wheel failure during landing roll due to incorrect design	**AL-SCF-NP-LG-WHLFL-DF**		- OR Deceleration and attitude related parameters of aircraft different than expected (calculated for current conditions) AND transverse acceleration value in both directions, higher than expected (calculated /estimated for current conditions) AND engine parameters correct AND adequate precursors during tire design/selection detected
				Tire failure during landing roll due to incorrect design	**AL-SCF-NP-LG-TIREFL-DF**		
3.Maintain control	Flight crew maintains control over the aircraft after structural failure being a result of windshear during landing	Uncontrollable	AL27B21	Aircraft in unrecoverable configuration in result of abnormal runway contact	**AL-LOC-G-WSHR**	Phase 2 following phase 1 and at least 2 from: 1. Speed below approach speed 2. Altitude 0ft AGL, 3. Landing gear compression	- Abnormal runway contact detected AND aircraft configuration, attitude and flight parameters classified as unrecoverable
		Lack of control	AL27B22	FCE – lack of recovery action	**AL-LOC-G-FCE-LCTRL**		- OR Abnormal runway contact detected AND aircraft configuration, attitude and flight parameters classified as recoverable AND lack of pilot input to aircraft control
		Incorrect Control	AL27B23	FCE – incorrect recovery action	**AL-LOC-G-FCE-INCTRL**		- OR Abnormal runway contact detected AND aircraft configuration, attitude and flight parameters classified as recoverable AND pilot input to aircraft control classified as incorrect in given situation
		Insufficient control	AL27B24	FCE – insufficient recovery action	**AL-LOC-G-FCE-INSCTRL**		- OR Abnormal runway contact detected AND aircraft configuration, attitude and flight parameters classified as recoverable AND pilot input to aircraft control classified as insufficient in given situation (too low extend, too short input time etc.)

Table 24 ASCOS ESD 31 - Aircraft are positioned on collision course

Barrier	Description	Possibilities for braking the barrier – Base event	Code	Possible occurrence (CICTT)	Designation (CICTT)	Flight phase indicator	Proposed method for failure detection (trigger logic)
1. Strategic planning	Strategic planning is free from errors	Strategic conflict	ER31F53	Strategic conflict appeared	**ER-MAC-STRCONF**	Pre-flight phase – strategic planning	- Strategic conflict detected (computer supported planning required)
		Ineffective ATFCM	ER31B10	Ineffective ATFCM resulting with pre-tactical conflict	**ER-MAC-ATFCMF-PRTCTCNF**		- OR Strategic conflict detected AND no warning by the system received (computer supported planning required)
				ATCOER - Ineffective ATFCM resulting with pre-tactical conflict	**ER-MAC-ATCOER-ATFCMF-PRTCTCNF**		- OR Strategic conflict detected AND no input to the plan by controller detected (computer supported planning required)
2. Pre-tactical planning	Pre-tactical planning is free of errors	No ATC planning	ER31B91	ATCOER- No ATC planning resulting with pre-tactical conflict	**ER-MAC-ATCOER-LPLAN-PRTCTCNF**	Pre-flight phase – pre-tactical planning	- Pre-tactical conflict detected no input to the plan by controller detected (computer supported planning required)
		Inadequate strategic surveillance picture	ER31B9211	Inadequate strategic surveillance picture resulting with pre-tactical conflict	**ER-MAC-STRSURVPICT-PRTCTCNF**		- OR strategic surveillance picture detected as being inadequate (computer supported planning required in all stages) AND / OR high probability for change identified
		Inadequate flight plan data	ER31B9212	Inadequate flight plan data resulting with pre-tactical conflict	**ER-MAC-INPLAND-PRTCTCNF**		
		Planning controller failure to recognize conflict	ER31B922	ATCOER - Failure to recognize conflict resulting with pre-tactical conflict	**ER-MAC-CONFLRECF-PRTCTCNF**		- OR Pre-tactical conflict detected and no input to the plan by controller detected (no adequate input to the plan was detected, computer supported planning required)
		Planning controller	ER31B923	ATCOER - Misjudgment of	**ER-MAC-MISJ-CONFLPREV-**		- OR Pre-tactical conflict detected AND no adequate input to the plan was detected

		misjudgment of conflict prevention		conflict prevention resulting with pre-tactical conflict	**PRTCTCNF**		(computer supported planning required)
		Inadequate planning controller coordination	ER31B93	ATCOER - Inadequate coordination with other sector(s) resulting with pre-tactical conflict	**ER-MAC-INCORD-PRTCTCNF**		- OR inadequate synchronization with other sector(s) detected AND no input to the plan by controller detected
		Planning controller failure to alert tactical controller to conflict	ER31B94	ATCOER - Failure to alert tactical controller about the conflict	**ER-MAC-LALERT-PRTCTCONFL**		- OR Pre-tactical conflict detected AND lack of alert message to tactical controller about the conflict detected (computer process supervision required)
3. Flight plan	Flight plan is free of errors	Inadequate tactical surveillance picture	ER31B5111	Inadequate tactical surveillance picture resulting with tactical conflict	**ER-MAC-INTSPICT-TCTCNF**	Pre-flight phase – tactical planning / Phase 1. Following phase 0 (take-off) and at least 2 from: 1. Speed above V2, 2. Altitude above 1000ft AGL, 3. Thrust cruise mode.	- Tactical surveillance picture detected as being inadequate (due to not fixed strategic and/or pre-tactical conflict).
		Inadequate flight plan data	ER31B5112	Inadequate flight plan data resulting with tactical conflict	**ER-MAC-INFPD-TCTCNF**		
		ATCO failure to recognize conflict	ER31B512	ATCOER - failure to recognize conflict	**ER-MAC-ATCOER-CONFLRECF-TCTCNF**		- OR tactical conflict detected AND no input to the plan by controller detected
		ATCO misjudgment in tactical separation	ER31B513	ATCOER - misjudgment in tactical separation	**ER-MAC-ATCOER-MISJ-CNFLPREV-TCTCNF**		- OR tactical conflict detected AND no adequate input to the plan by controller detected
		Inadequate ATCO co-ordination	ER31B514	ATCOER - Inadequate coordination	**ER-MAC-ATCOER-INCONTRCORD**		- OR inadequate synchronization with other sector(s) detected by appearing of conflict)

				resulting with tactical conflict			
		Inadequate ATCO transmission of instructions	ER31B521	ATCOER - Inadequate transmission of instructions	**ER-MAC-ATCOER-ININSTRTRNSM-TCTCNF**		- OR Negative cabin voice record analysis for key words AND / OR transmitted clearance results with new conflict
		Loss of communication	ER31B522	Communication with ATC loss during en route	**ER-MAC-SCF-NP-AVION-COMMLS**		- OR Incomplete pilot-controller communication loop (e.g. lack of controller hearback)
		Inadequate pilot readback	ER31B523	FCE – inadequate pilot readback	**ER-MAC-FCE-INRDBCK**		- OR Negative cabin voice record analysis for key words
		Inadequate pilot response to ATC	ER31B53	FCE - Inadequate pilot response to ATC	**ER-MAC-FCE-MACCOMMER**		- OR inconsistencies between correct ATCO instructions and aircraft route detected
4.Flight plan stability and validity	Flight crew handles aircraft according to understandable ATC clearances, all flight control instruments able to affect aircraft flight trajectory are free of failures,	Conflict due to military traffic	ER31F6111	Conflict due to military traffic	**ER-MAC-MILINFR**		- Military traffic detected AND conflict with regular ATC traffic
		Conflict due to VFR traffic	ER31F6112	Conflict due to VFR traffic	**ER-MAC-AVRINFR**		- OR VFR traffic detected AND conflict with regular ATC traffic
		Inadequate ATCO transmission of instructions	ER31F61211	ATCOER - Inadequate transmission of instructions leading to vertical deviation	**ER-MAC-ATCOER-ININSTRTRNS**		- OR Military OR VFR traffic detected AND Negative cabin voice record analysis for key words AND / OR transmitted clearance results with vertical deviation
		Inadequate pilot readback	ER31F61212	FCE - Inadequate readback leading to vertical deviation	**ER-MAC-FCE-INRDBCK**		
		Pilot handling error	ER31F6122	FCE – pilot handling error resulting with vertical deviation	**ER-MAC-FCE-AHAN**		- OR Inconsistencies between the ATCO instructions and aircraft route detected
		Altimeter setting error	ER31F6123	Altitude information error during en route	**ER-MAC-SCF-NP-AVION-ALTERR**		- OR Inconsistency between different sources of aircraft altitude indicating on error of one of them
		Technical	ER31F612	Navigational	**ER-MAC-SCF-**		- OR Warning error about failure of

	CAT is free of uncleared traffic of VFR or military movement and there are no any ACAS warning, the weather does not affect the aircraft trajectory	failure in autopilot or nav equipment	4	information loss during en route	**NP-AVION-NAVLS**		navigation or autopilot related system AND/OR inconsistency between indication of different systems suggesting failure of one of them
				Navigational information error during en route	**ER-MAC-SCF-NP-AVION-NAVERR**		
				Autopilot control or guidance error during en route	**ER-MAC-SCF-NP-AFC-APERR**		
		ACAS RA	ER31F6125	ACAS RA activation during en route	**ER-MAC-ACASRA**		- OR ACAS RA followed by adequate flight crew action
		Weather induced level bust	ER31F6126	Level bust during en route caused be adverse weather	**ER-WSTRW-LVLBST**		- OR adverse weather detected AND level bust executed
		Level bust results in conflict	ER31C6	Level bust during en route resulting with conflict	**ER-LVLBST-CNFL**		- OR level bust executed AND new conflict detected
5.Unplannable conflict resolution	ATCO reacts correctly on unplanned conflict	Inadequate tactical surveillance picture	ER31B611	Inadequate tactical surveillance picture resulting with unplanned conflict during en route	**ER-MAC-INTCTSRVPICT-UNPLCNF**		- Tactical surveillance picture detected as being inadequate (due to new items detected).
		ATCO failure to recognize conflict in time	ER31B612	ATCOER - failure to recognize conflict in time	**ER-MAC-ATCOER-CONFLRECF-UNPLCNF**		- OR unplanned conflict detected AND no adequate input to the plan by controller detected
		Inadequate ATCO transmission of instructions	ER31B621	ATCOER - Inadequate transmission of instructions	**ER-MAC-ATCOER-UNPLCNF-ININSTRTRNSM**		- OR unplanned conflict detected AND negative cabin voice record analysis for key words AND / OR transmitted clearance does not result with conflict cancellation
		Loss of	ER31B62	Communication	**ER-MAC-SCF-**		- OR unplanned conflict detected AND

		communication	2	with ATC loss during en route	**NP-AVION-COMMLS**		Incomplete pilot-controller communication loop (e.g. lack of controller hearback)
		Inadequate pilot readback	ER31B623	FCE - Inadequate readback	**ER-MAC-FCE-INRDBCK**		- OR unplanned conflict detected AND negative cabin voice record analysis for key words AND / OR transmitted clearance does not result with conflict cancellation
		Inadequate pilot response to ATC	ER31B63	FCE - Inadequate response to ATC instructions	**ER-MAC-FCE-INCCOMMER**		- OR unplanned conflict detected AND inconsistencies between the ATCO correct instructions and aircraft route detected
6.ATCO efficacy	ATCO activity is free of errors resulting in new conflicts or these conflicts are immediately solved	Trajectory instructions result in conflict	ER31F71	ATCOER – instruction error during en route	**ER-MAC-ATCOER-INCINST**		- ATC instructions detected as resulting with conflict
		Ineffective tactical separation of ATCO induced conflict	ER31B7	ATCOER - Ineffective tactical separation during en route	**ER-MAC-ATCOER-INCINST**		- OR ATC instructions detected as resulting with conflict AND no reparation action conducted by the controller detected
7.Uncontrolled airspace ATCO resolution	ATCO efficiently solves the conflict in uncontrolled airspace	Conflict in uncontrolled airspace	ER31F81	Conflict in uncontrolled airspace	**ER-MAC-UNCTRL-CNFL**	Related to uncontrolled airspace traffic	- Conflict in uncontrolled airspace detected
		Inadequate traffic information from ATCO	ER31B81	ATCOER - Inadequate traffic information from ATCO	**ER-MAC-UNCTRL-ATCOER-INCINST**		- OR conflict in uncontrolled airspace detected AND Negative cabin voice record analysis for key words for aircraft in uncontrolled airspace
		Inadequate ATCO transmission of information	ER31B821	ATCOER - Inadequate transmission of information	**ER-MAC-UNCTRL-ATCOER-INCINST**		- OR conflict in uncontrolled airspace detected AND Incomplete pilot-controller communication loop (e.g. lack of controller hearback) AND / OR transmitted clearance does not result with conflict cancellation

		Loss of communication	ER31B822	Communication with ATC loss by aircraft in uncontrolled airspace	**ER-MAC-UNCTRL-SCF-NP-AVION-COMMLS**		- OR conflict in uncontrolled airspace detected AND negative cabin voice record analysis for key words (for not complete communication loop)
		Inadequate pilot readback	ER31B823	FCE - Inadequate pilot readback	**ER-MAC-FCE-INRDBCK**		- OR conflict in uncontrolled airspace detected AND negative cabin voice record analysis for key words AND / OR transmitted clearance does not result with conflict cancellation
		Inadequate separation by pilot	ER31B83	FCE - Inadequate separation by pilot	**ER-MAC-FCE-INSEP**		- OR conflict in uncontrolled airspace detected AND inconsistencies between the ATCO instructions and aircraft route detected
8.Separation recovery	separation recovery by ATCO or flight crew	Separation recovery essential	ER31C4	ATCOER – lack of Separation recovery when essential	**ER-MAC-ATCOER-LSEPREC**	Phase 1. Following phase 0 (take-off) and at least 2 from: 1. Speed above V2, 2. Altitude above 1000ft AGL, 3. Thrust cruise mode.	- Conflict detected AND lack of ATCO reaction classified as aiming at immediate conflict resolution
				FCE - lack of Separation recovery when essential	**ER-MAC-FCE-LSEPREC**		- OR Conflict detected AND lack of flight crew reaction classified as aiming at immediate conflict resolution
9.STCA warning	STCA system alerts about the conflict, the ATC reacts correctly on the alert	No STCA coverage	ER31B31	No STCA coverage	**ER-MAC-LSTCA**		- No STCA or similar system detected
		STCA fails to give warning in time	ER31B32	Warning loss – STCA system	**ER-MAC-STCAF**		- OR conflict detected (with other than STCA system means, e.g. with on-board systems) AND no warning from STCA received
		ATCO fails to respond to STCA warning	ER31B33	ATCOER – lack of response to STCA system	**ER-MAC-ATCOER-LSTCARESP**		- OR STCA warning detected AND lack of ATCO reaction classified as aiming at detected conflict resolution
		ATCO fails to recover separation in time	ER31B34	ATCOER – ineffective response to STCA system	**ER-MAC-ATCOER-INSSTCARESP**		- OR STCA warning detected AND ATCO reaction to detected conflict classified as being ineffective (does not resolve the conflict)
10.Other	Effective	No	ER31B41	No independent	**ER-MAC-**		- Lack of other ATCO monitoring detected

ATCO warning	other ATCO warning	independent ATCO monitoring		ATCO monitoring	**LINDPNDMON**		(no other ATCO activity detected)
		Other ATCOs fail to detect conflict	ER31B42	ATCOER – other ATCO fail to detect the conflict	**ER-MAC-ATCOER-OTHRATCOF**		- OR conflict detected AND lack of other ATCO reaction aiming at conflict resolution detected
		ATCOs fail to communicate warning	ER31B43	ATCOER – other ATCO fail to communicate the conflict	**ER-MAC-ATCOER-OTHRARCCOMF**		- OR conflict detected AND lack of other ATCO adequate reaction aiming at conflict resolution detected (no warning communicated to the ATCO responsible)
		ATCO fails to recover separation in time	ER31B44	ATCOER – lack of recover separation in time	**ER-MAC-ATCOER-INSSTCARESP**		- OR conflict detected AND other ATCO warning about conflict received AND inconsistency between ATCO reaction and procedure assumed as optimal for given situation
11.ACAS warning	ACAS system warns the flight crew	ACAS not installed	ER31B21	ACAS not installed	**ER-MAC-LACAS**		- Lack of ACAS or similar system on board
		ACAS fails to give RA in time	ER31B22	Warning loss - ACAS	**ER-MAC-SCF-NP-AVION-WRNLS-ACAS**		- OR Conflict detected AND ACAS not active AND / OR no warning about the conflict delivered
		Pilot fails to respond to RA in time	ER31B23	FCE – lack of respond to RA in time	**ER-MAC-FCE-INCRARESP**		- OR conflict detected AND ACAS warning received AND inconsistencies between pilot input to the aircraft controls and ACAS RA
		ACAS avoidance invalidated by other aircraft	ER31B24	ACAS avoidance invalidated by other aircraft	**ER-MAC-ACASINVLD**		- OR conflict detected AND ACAS warning received AND RA invalidation resulted from other aircraft action
12.Visual avoidance	Flight crew of one of affected aircraft	Other aircraft effectively invisible	ER31B111	Other aircraft effectively invisible	**ER-MAC-LVISIB**		- Conflict detected AND analysis of both conflicting aircraft' position as well as visibility conditions indicate that aircraft are effectively invisible for each other
		Flight crew fail	ER31B11	FCE – failure to	**ER-MAC-FCE-**		- OR Conflict detected AND analysis of both

	avoids the separation infringement by visual warning	to observe visible aircraft in time	2	observe visible aircraft	**LOBS**		conflicting aircraft' position as well as visibility conditions indicate that aircraft are visible for each other AND lack of flight crew reaction on visible conflict detected
		Pilot fails to take avoidance action in time	ER31B113	FCE – failure to take avoidance action in time	**ER-MAC-FCE-LAVACT**		
		Visual avoidance invalidated by other aircraft	ER31B114	Visual avoidance invalidated by other aircraft	**ER-MAC-AVAVOIDINV**		- OR Conflict detected AND analysis of both conflicting aircraft' position as well as visibility conditions indicate that aircraft are visible for each other AND visual avoidance invalidated by other aircraft
		Ineffective visual warning on other aircraft	ER31B12	FCE - Ineffective visual warning on other aircraft	**ER-MAC-FCE-INVISAVOID**		- OR Conflict detected AND analysis of both conflicting aircraft' position as well as visibility conditions indicate that aircraft are visible for each other AND incorrect see and avoid technique execution on one of the conflicting aircraft detected.
13.Separation recovery	Separation recovery by Flight Crew	Collision avoidance essential	ER31C3	FCE - lack of Separation recovery when essential	**ER-MAC-FCE-AVOIDESS**		- Conflict detected AND lack of flight crew reaction classified as aiming at immediate conflict resolution

Table 25 ASCOS ESD 32 - Incorrect presence of aircraft/vehicle on runway in use

Barrier	Description	Possibilities for braking the barrier – Base event	Code	Possible occurrence (CICTT)	Designation (CICTT)	Flight phase indicator	Proposed method for failure detection (trigger logic)
1. Runway configuration	Runway configuration is not conflict prone	Runway crossing movement	TO32B51	Runway crossing	**TO-ADRM-DF-RWYX**	Phase 1: Landing gear compression longer than 10min and at least 1 from: 1. Altitude equal 0ft AGL, 2. Thrust in taxiing mode.	Runway crossing detected (automatic vehicle/aircraft positioning system required)
		Runway entry at intermediate location	TO32B52	Runway entry at intermediate location	**TO-ADRM-DF-INTRMRWYENTR**		OR entering the runway at intermediate location detected (automatic vehicle/aircraft positioning system required)
		Alternating take-off and landing	TO32B53	Alternating take-off and landing	**TO-ADRM-DF-TOANDLARWY**		OR Alternating take-off and landing operations detected at the airport
		Incorrect runway entry point	TO32B54	FCE - Incorrect runway entry point	**TO-FCE-INCRWYENTRY**		OR inconsistency between ATC clearance and aircraft position o airsite detected.
2. Efficient communication	Pilot is provided with understandable instruction and follows them	Inadequate communication with pilot	TO32B412	ATCOER - Inadequate communication with pilot resulting with runway incursion	**TO-RI-ATCOER-FCCOM**		Negative cabin voice record analysis for key words AND /OR Incomplete pilot-controller communication loop (e.g. lack of controller hearback)
		Pilot failure to follow taxi route	TO32B421	FCE - failure to follow taxi route	**TO-RI-FCE-ATMINST**		OR Inconsistency between flight crew action and ATCO instructions (digital message to aircraft computer from ATCO needed)
		Pilot failure to follow runway entry	TO32B422	FCE - failure to follow runway entry instructions	**TO-RI-FCE-ATMINST**		

		instructions					
3. ATCO conflict detection on RWY	ATCO recognize and correctly judge the runway conflict	ATCO failure to recognize runway conflict	TO32B41121	ATCOER - failure to recognize runway conflict	**TO-RI-ATCOER-CONFLREC**		Runway conflict detected AND lack of ATCO reaction classified as aiming at conflict resolution
		ATCO misjudgment of runway separation	TO32B41122	ATCOER - misjudgment of runway separation	**TO-RI-ATCOER-MISJ-RWYSEP**		
4. Ground radar surveillance	Ground radar is available at the airport, is free of failure and operated correctly	Ground radar not present	TO32B411111	Lack of ground radar at the airport	**TO-RI-LGRDR**		Lack of ground radar coded as available in airport system
		Ground radar failure	TO32B411112	Ground radar failure	**TO-RI-GRDRF**		OR Runway conflict detected AND Ground radar not active AND / OR lack of warning about the conflict received
		Ineffective ATCO use of ground radar	TO32B411113	ATCOER - Ineffective use of ground radar	**TO-RI-ATCOER-INCGRDRUSE**		OR Runway conflict detected AND ATCO activity (input to the airsite traffic control) detected to be inconsistent with support delivered by the ground radar AND ground radar is free from failure
5. Non-radar surveillance	Efficient non-radar surveillance at the airport	Flight crew lost on airport	TO32B411121 1	FCE – lost on airport	**TO-RI-FCE-LOST**		Aircraft route classified as incorrect (related to ATC clearance) (detected via electronic messages sent to ATCO) AND flight crew reported position is incorrect
		ATCO failure to clarify position reports	TO32B411121 2	ATCOER - failure to clarify position reports	**TO-RI-ATCOER-FCPOSCLAR**		OR flight crew reported position is incorrect (detected via electronic messages sent to ATCO) AND lack of corrective message sent to flight crew (simultaneously to voice communication)
		Inadequate airport ATCO coordination	TO32B411122	ATCOER - Inadequate airport coordination	**TO-RI-ATCOER-INADRMCOORD**		OR Negative control tower voice record analysis for key words AND /OR Incomplete airport controller-approach controller communication loop (e.g. lack of adequate hearback)
6. Take-off procedure	Effective take-off	Take-off instruction	TO32B611	ATCOER - Take-off instruction	**TO-RI-ATCOER-**		ATCO take-off instructions detected as incorrect for given airsite situation

	procedure provided by ATCO	error by ATCO		error	**TOINSTRER**		
		Inadequate communication with pilot	TO32B612	ATCOER - Inadequate communication with pilot	**TO-RI-ATCOER-FCCOM**		OR Negative cabin voice record analysis for key words AND /OR Incomplete pilot-controller communication loop (e.g. lack of controller hearback)
		Pilot failure to follow take-off instructions	TO32B62	FCE - failure to follow take-off instructions	**TO-RI-FCE-ATMINST**		OR Inconsistency between flight crew action and ATCO instructions (digital message to aircraft computer from ATCO needed)
7. RIMCAS alert	Runway conflict warning system is installed at the airport, free of failures and operated correctly	RIMCAS not present	TO32B21	Lack of RIMCAS	**TO-RI-LRIMCAS**	Phase 2 following phase 1 AND at least 2 from: 1. Speed above ~35kts and not decreasing 2. Altitude: 0 - 50ft AGL, 3. Application of take-off power	Lack of RIMCAS coded as available in airport system
		RIMCAS failure to give warning in time	TO32B22	Loss of warning - RIMCAS	**TO-RI-RIMCASF**		OR runway conflict detect (with other means) AND RIMCAS not active AND / OR lack of warning about the conflict delivered
		Controller failure to respond to RIMCAS warning	TO32B23	ATCOER - failure to respond to RIMCAS warning	**TO-RI-ATCOER-LRIMCASRESP**		OR Inconsistency between ATCO action and RIMCAS resolution.
		Controller failure to resolve conflict in time	TO32B24	ATCOER - failure to resolve conflict in time	**TO-RI-ATCOER-INSRIMCASRESP**		
8. ATCO resolves the conflict on RWY	ATCO effectively resolves the conflict on RWY	Low visibility prevents conflict detection	TO32B111	Low visibility detected	**TO-RI-LVISIB**		Runway conflict detected AND low visibility conditions detected
		Darkness prevents conflict	TO32B112	Darkness prevents conflict	**TO-RI-DRKNSS**		OR Runway conflict detected AND darkness

		detection		detection			
		Restricted view from tower prevents conflict detection	TO32B113	Restricted view from tower	**TO-RI-ADRM-DF-RESTCTRVISIB**		OR Runway conflict detected AND tower location classified as disabling view on runway
		ATCO failure to see visible aircraft in time	TO32B114	ATCOER - failure to see visible aircraft in time	**TO-RI-ATCOER-LOBS**		OR conflict detected AND classified as being visible from tower AND lack of ATCO reaction classified as aiming conflict resolution
		ATCO failure to resolve conflict in time	TO32B115	ATCOER - failure to resolve conflict in time	**TO-RI-ATCOER-INSRESP**		OR conflict detected AND classified as being visible from tower AND lack of adequate ATCO reaction aiming conflict resolution
		Aircraft using runway	TO32B3	Aircraft using runway	**TO-RI**		OR Two aircraft on runway detected
9. Flight Crew avoidance	Flight crew of one of the colliding aircraft resolves the conflict	Avoidance essential	TO32C3	Avoidance essential	**TO-RI-FCE-AVOIDESS**		Conflict detected AND immediate avoidance action necessary
		Ineffective avoidance by intruding aircraft/vehicle	TO32B12	FCE - Ineffective avoidance	**TO-RI-FCE-INAVOD**		OR Conflict detected AND Conflict detected AND flight crew input to the aircraft controls inconsistent with procedure assumed as optimal for given situation
				GSE – ineffective avoidance	**TO-RI-GSE-INAVOD**		OR Conflict detected AND Conflict detected AND vehicle operator input to the vehicle controls inconsistent with procedure assumed as optimal for given situation
		Ineffective avoidance by impeded aircraft	TO32B13	FCE - Ineffective avoidance	**TO-RI-FCE-INAVOD**		OR Conflict detected AND Conflict detected AND flight crew input to the aircraft controls inconsistent with procedure assumed as optimal for given situation

Table 26 ASCOS ESD 33 - Cracks in aircraft pressure boundary

Barrier	Description	Possibilities for braking the barrier – Base event	Code	Possible occurrence (CICTT)	Designation (CICTT)	Flight phase indicator	Proposed method for failure detection (trigger logic)
1. Airframe integrity related with maintenance	The maintenance process meets all requirements able to affect aircraft structure integrity	Manufacturing Inadequate	ER33B11111	Breach of pressurized fuselage skin during en route resulted from inadequate manufacturing	**ER-SCF-NP-STRUCT-PRFSBR-MFF**	Phase 1. Following phase 0 (take-off) and at least 2 from: 1. Speed above V2, 2. Altitude above 1000ft AGL, 3. Thrust cruise mode.	- Breach of pressurized fuselage skin detected (e.g. with deformeters distributed in aircraft structure) AND occurred for stresses lower than expected indicating on manufacturing error AND precursor(s) for given occurrence was/were detected during manufacturing of the component
		Wear & Tear	ER33B11112	Breach of pressurized fuselage skin during en route resulted from extreme stresses	**ER-SCF-NP-STRUCT-PRFSBR**		- OR Breach of pressurized fuselage skin detected (e.g. with deformeters distributed in aircraft structure) AND extreme/frequent stresses occurred within the given component.
		Routine Inspection Failure	ER33B11121	Breach of pressurized fuselage skin during en route resulted from inspection failure	**ER-SCF-NP-STRUCT-PRFSBR-MF**		- OR Breach of pressurized fuselage skin detected (e.g. with deformeters distributed in aircraft structure) AND occurred for stresses lower than ultimate AND precursor(s) for given occurrence was/were detected during last adequate inspection
		Routine Repair Failure	ER33B11122	Breach of pressurized fuselage skin during en route resulted from routine repair failure	**ER-SCF-NP-STRUCT-PRFSBR-MF**		- OR Breach of pressurized fuselage skin detected (e.g. with deformeters distributed in aircraft structure) AND occurred for stresses lower than ultimate AND precursor(s) for given occurrence was/were detected during last repair indicating on incorrect

							repair result
2. Structure integrity related to damage	Aircraft is adequately inspectioned and maintained after damage resulted from incident or accident	Deterioration likely to propagate	ER33B1113	Breach of pressurized fuselage skin during en route resulted from deterioration likely to propagate	**ER-SCF-NP-STRUCT-PRFSBR-MF**		- Exceedance of ultimate loads in aircraft component was detected (with use of deformeters distributed over the aircraft) and classified as probable to propagate.
		Bird strike	ER33B112111	Breach of pressurized fuselage skin during en route resulted from bird strike	**ER-SCF-NP-STRUCT-PRFSBR-BIRD**		- OR Breach of pressurized fuselage skin detected (e.g. with deformeters distributed in aircraft structure) AND Bird strike detected (with deformeters and/or analysis of noise registered around the aircraft) AND event classified as dangerous for aircraft pressure skin integrity
		Collision whilst on ground	ER33B112112	Breach of pressurized fuselage skin during en route resulted from ground collision	**ER-SCF-NP-STRUCT-PRFSBR-GCOL**		- OR Breach of pressurized fuselage skin detected (e.g. with deformeters distributed in aircraft structure) AND collision on ground detected (with deformeters and/or analysis of noise registered around the aircraft) and/or aircraft-vehicle/aircraft positions analysis AND classified as dangerous for aircraft pressure skin integrity
		Tail strike	ER33B112113	Breach of pressurized fuselage skin during en route resulted from tail strike during previous take-off or landing	**ER-SCF-NP-STRUCT-PRFSBR-ARC**		- OR Breach of pressurized fuselage skin detected (e.g. with deformeters distributed in aircraft structure) AND tail strike detected (with deformeters and/or analysis of noise registered around the aircraft) and/or aircraft attitude analysis AND classified as dangerous for aircraft pressure skin

							integrity
		Post Incident Inspection Failure	ER33B112121	Breach of pressurized fuselage skin during en route resulted from post incident inspection failure	**ER-SCF-NP-STRUCT-PRFSBR-MF**		- OR Breach of pressurized fuselage skin detected (e.g. with deformeters distributed in aircraft structure) AND event classified as dangerous for pressurized fuselage skin was detected (for the same component/fragment) AND precursors for this event was detected during post incident inspection of the component /fragment of the fuselage skin
		Post Incident Repair Failure	ER33B112122	Breach of pressurized fuselage skin during en route resulted from post incident repair failure	**ER-SCF-NP-STRUCT-PRFSBR-MF**		- OR Breach of pressurized fuselage skin detected (e.g. with deformeters distributed in aircraft structure) AND event classified as dangerous for pressurized fuselage skin was detected (for the same component/fragment) AND precursors for this event was detected during post incident repair of the component /fragment of the fuselage skin
		Damage likely to propagate	ER33B11213	Breach of pressurized fuselage skin during en route resulted from damage likely to propagate	**ER-SCF-NP-STRUCT-PRFSBR-MF**		- OR Breach of pressurized fuselage skin detected (e.g. with deformeters distributed in aircraft structure) AND classified as probable to propagate.
		Pressure Boundary likely to fail	ER33B11221	Breach of pressurized fuselage skin	**ER-SCF-NP-STRUCT-PRFSBR-MF**		

		on next flight		during en route resulted from damage likely to propagate			
		Subsequent Inspection Failure	ER33B11222	Breach of pressurized fuselage skin during en route resulted from subsequent inspection failure	**ER-SCF-NP-STRUCT-PRFSBR-MF**		- OR Breach of pressurized fuselage skin detected (e.g. with deformeters distributed in aircraft structure) AND classified as needed reparation during following inspection AND lack of reparation detected in the following inspection AND precursor(s) for given occurrence detected during inspection
		Subsequent Repair Failure	ER33B11223	Breach of pressurized fuselage skin during en route resulted from subsequent repair failure	**ER-SCF-NP-STRUCT-PRFSBR-MF**		- OR Breach of pressurized fuselage skin detected (e.g. with deformeters distributed in aircraft structure) AND classified as needed reparation during following inspection AND precursor(s) for given occurrence detected during the reparation
3. Door integrity	Aircraft door are properly designed, manufactured and maintained	Door Design Potentially Unsafe	ER33B121	Breach of pressurized fuselage skin during en route resulted from door potentially unsafe	**ER-SCF-NP-STRUCT-PRFSBR-DR-DF**	Door design and airworthiness phase	- Aircraft door manual compared with envisioned operation procedure conducted by the crew (critical aircraft operation envisioning system necessary) indicating on error prone solutions AND these error classified as dangerous for aircraft pressure resistance
		Design fault not known	ER33B1221	Breach of pressurized fuselage skin during en route resulted from door	**ER-SCF-NP-STRUCT-PRFSBR-DR-DF**		- OR Aircraft door manual compared with envisioned operation procedure conducted by the crew (critical aircraft operation envisioning system necessary) indicating on error prone

				design fault which is not known			solutions AND these error classified as dangerous for aircraft pressure resistance AND the errors occurred indicating on lack of knowledge of the issue among the crew
		No safety directive issued	ER33B12221	Breach of pressurized fuselage skin during en route resulted from door design fault not covered by appropriate safety directive	**ER-SCF-NP-STRUCT-PRFSBR-DR-DF-UNREC**		- OR Aircraft door manual compared with envisioned operation procedure conducted by the crew (critical aircraft operation envisioning system necessary) indicating on error prone solutions AND these error classified as dangerous for aircraft pressure resistance AND lack of information about the appropriate safety directive issued coded in aircraft computer
		Manufacturer ignores safety directive	ER33B12222	Breach of pressurized fuselage skin during en route resulted from door design fault not covered by appropriate manufacturer modifications	**ER-SCF-NP-STRUCT-PRFSBR-DR-MFF**		- OR Aircraft door manual compared with envisioned operation procedure conducted by the crew (critical aircraft operation envisioning system necessary) indicating on error prone solutions AND these error classified as dangerous for aircraft pressure resistance AND aircraft computers installed on next versions of the aircraft the problem occurred for the first time detect the situation classified as the same or similar (as on the previous version of the aircraft) AND / OR problem is valid longer than 3 month (assumed as time for manufacturer' modifications) (not removed/reset by structural modifications)

		Airline ignores safety directive	ER33B12223	Breach of pressurized fuselage skin during en route resulted from door design fault not covered by implementation of the safety directive by the airline	**ER-AOER-SCF-NP-STRUCT-PRFSBR-DR-LSAFDIRIMPL**		- OR Aircraft door manual compared with envisioned operation procedure conducted by the crew (critical aircraft operation envisioning system necessary) indicating on error prone solutions AND these error classified as dangerous for aircraft pressure resistance AND aircraft computers installed on next versions of the aircraft the problem occurred for the first time detect the situation classified as the same or similar (as on the previous version of the aircraft) AND / OR problem is valid longer than 3 month (assumed as time for safety directive implementation by airline) (not removed by appropriate crew door operation)
		Modification inadequate	ER33B1223	Breach of pressurized fuselage skin during en route resulted from door design fault not covered due to inadequate manufacturer modifications	**ER-SCF-NP-STRUCT-PRFSBR-DR-MFF-SFDIRIMPLF**		- OR Aircraft door manual compared with envisioned operation procedure conducted by the crew (critical aircraft operation envisioning system necessary) indicating on error prone solutions AND these error classified as dangerous for aircraft pressure resistance AND aircraft computers installed on next versions of the aircraft the problem occurred for the first time detect the situation classified as the same or similar (as on the previous version of the aircraft) AND / OR problem is valid longer than 3 month (assumed as time for

							manufacturer' modifications) (not removed/reset despite structural modifications)
		Door damaged by personnel	ER33B1231	FCE - Breach of pressurized fuselage skin during en route resulted from door damage caused by incorrect operation	**ER-FCE-SCF-NP-STRUCT-PRFSBR-DR-INCOPER**	Phase 1. Following phase 0 (take-off) and at least 2 from: 1. Speed above V2, 2. Altitude above 1000ft AGL, 3. Thrust cruise mode.	- OR door system damage detected AND incorrect operation by crew detected
		Door Operation Failure	ER33B1232	FCE - Breach of pressurized fuselage skin during en route due to door operation failure	**ER-FCE-SCF-NP-STRUCT-PRFSBR-DR-INCOPER**		- OR door closing operation detected as being conducted incorrectly AND error classified as dangerous
		Separate fault causes failure	ER33B1233	Breach of pressurized fuselage skin during en route resulted from door flight during en route	**ER-SCF-NP-STRUCT-PRFSBR-DR**		- OR breach of pressure boundary detected AND door failure detected AND no precursors related to other failures detected (operation, maintenance, manufacture etc.)
4. Door operation	Door are correctly operated by the flight crew	Aircraft doors not secured	ER33B131	FCE – door closing incorrect	**ER-FCE-DRNSEC**	Phase 00: before take-off – phase 0 and phase 1 AND Landing gear compressio n longer	- Door detected as being incorrectly secured
		No Door Check	ER33B1321	FCE – lack of door check	**ER-FCE-LDRCHCK**		- OR lack of door check procedure detected (cabin voice analysis AND door system installed detectors)
		Door Check Unsuccessful	ER33B1322	FCE – incorrect door check	**ER-FCE-DRCHCKF**		- OR door check procedure detected as being conducted incorrectly (cabin voice analysis AND door system installed detectors)

		No Warning System	ER33B1331	Lack of door warning system installed on the aircraft	**ER-SCF-NP-STRUCT-PRFSBR-DR-LDRWRN**	than 10min and at least 1 from: 1. Altitude equal 0ft AGL, 2. Thrust in taxiing or idle mode.	- OR door warning system unavailable for the aircraft computer
		Warning system failure	ER33B1332	Warning loss – door failure warning	**ER-SCF-NP-AVION-WRNLS-DRF**		- OR door failure detected AND door warning system available AND no warning about the failure received
		Warning system inadequate	ER33B1333	Warning error – door failure	**ER-SCF-NP-AVION-WRNERR-DRF**		- OR door failure detected AND door warning system available AND warning about the other door failure received
		Crew ignore warning system	ER33B1334	FCE – ignoring the door failure warning	**ER-FCE-IGNDRWRN**		- OR door failure detected AND door warning received AND lack of flight crew actions aiming at problem resolution detected
5. Decompression resistance	Aircraft structural design disable catastrophic consequence of decompression	Rapid Decompression following Fuselage Failure	ER33B21	Cabin decompression resulted from structural failure	**ER-SCF-NP-STRUCT-DECOMP-FSLGE**	Phase 1. Following phase 0 (take-off) and at least 2 from: 1. Speed above V2, 2. Altitude above 1000ft AGL, 3. Thrust cruise mode.	- Aircraft structural component failure detected AND rapid decompression detected
		Rapid Decompression following Bulkhead Failure	ER33B22	Cabin decompression resulted from bulkhead failure	**ER-SCF-NP-STRUCT-DECOMP-BLKHD**		- OR Aircraft bulkhead structural failure detected AND rapid decompression detected
		Rapid Decompression following Window Failure	ER33B23	Cabin decompression resulted from window failure	**ER-SCF-NP-STRUCT-DECOMP-CABINWDW**		- OR Aircraft window structural failure detected AND rapid decompression detected
		Rapid	ER33B24	Cabin	**ER-SCF-**		- OR Aircraft door structural failure

		Decompression following Door Failure		decompression resulted from door failure	**NP-STRUCT-DECOMP-DRF**		detected AND rapid decompression detected
		Failure propagates catastrophically	ER33B3	Catastrophic cabin decompression resulted from structural failure	**ER-SCF-NP-STRUCT-DECOMP-CAT**		- OR Aircraft structural component failure detected AND rapid decompression detected AND situation classified as unrecoverable

Table 27 ASCOS ESD 35 - Flight crew decision error /operation of equipment error

Barrier	Description	Possibilities for braking the barrier – Base event	Code	Possible occurrence (CICTT)	Designation (CICTT)	Flight phase indicator	Proposed method for failure detection (trigger logic)
1. Trajectory Command Procedures	All procedures affecting commanded trajectory are executed correctly, on-board devices affecting commanded trajectory are free of failures	Ground navaid failure causes ITC	AL35F5211	ITC caused by ground Navaid failure	**AL-CFIT-GNAF**	Phase 1 following phase 0 (en route) and at least 2 from: 1. Speed below 240 kts and not increasing 2. Altitude below 2000ft AGL and not increasing, 3. Application of approach mode thrust	- Available flight trajectory data indicates on navaids failure risk (navaids data compared with data from GPS or other new sources like radio altimeter coupled with terrain surface model) AND current aircraft trajectory classified as incorrect
		On-board nav equipment failure causes ITC	AL35F5212	ITC caused by on-board nav equipment failure - navigational information loss	**AL-CFIT-SCF-NP-AVION-NAVLS**		- OR on-board navigational system failure detected (navigational information loss) AND aircraft trajectory classified as incorrect (active support of ground navigational system required)
				ITC caused by on-board nav equipment failure - Navigational information error	**AL-CFIT-SCF-NP-AVION-NAVERR**		- OR on-board navigational system failure detected (navigational information error detected) AND aircraft trajectory classified as incorrect (active support of ground navigational system required)
		Inadequate charts cause ITC	AL35F5213	FCE – inadequate charts causing ITC	**AL-CFIT-FCE-INCHRTS**		- OR ITC detected AND no warning about system failure detected
		Incorrect ATC clearance causes ITC	AL35F5214	ATCOER – incorrect clearance causes ITC	**AL-CFIT-ATM-ATCOER-INCCLRNC**		- OR ITC detected in ATC clearance (simultaneous digital message sent to aircraft computer with clearance required)
		Data	AL35F52	FCE – ITC caused	**AL-CFIT-FCE-**		- OR ITC detected AND no warning about

		interpretation by pilot causes ITC	2	by incorrect data interpretation by flight crew	**NAVDINTRP**		system failure detected
		Misjudgment by pilot causes ITC	AL35F523	FCE – ITC caused by pilot misjudgment of terrain separation	**AL-CFIT-FCE-MISJ-TERSEP**		
		Violation of procedures by pilot causes ITC	AL35F524	FCE – ITC caused by procedures violation by the flight crew	**AL-CFIT-FCE-PROCVIAL**		- OR ITC detected AND no warning about system failure detected AND pilot input to the aircraft controls as well as cabin voice analyses indicate on procedure violation
		Incorrect trajectory conflicts with terrain	AL35F53	ITC resulting with trajectory colliding with terrain	**AL-CFIT-FCE-ITC-CFIT**		- OR ITC detected AND current trajectory collides with terrain
		Ground navaid failure causes ITC	AL35F6211	ITC caused by ground Navaid failure	**AL-CFIT-GNAF**		- Available flight trajectory data indicates on navaids failure risk (navaids data compared with data from GPS or other new sources like radio altimeter coupled with terrain surface model) AND current aircraft trajectory classified as incorrect
		On-board nav equipment failure causes ITC	AL35F6212	ITC caused by on-board nav equipment failure - navigational information loss	**AL-CFIT-SCF-NP-AVION-NAVLS**		- OR on-board navigational system failure detected (navigational information loss) AND aircraft trajectory classified as incorrect (active support of ground navigational system required)
				ITC caused by on-board nav equipment failure - Navigational	**AL-CFIT-SCF-NP-AVION-NAVERR**		- OR on-board navigational system failure detected (navigational information error detected) AND aircraft trajectory classified as incorrect (active support of ground navigational system required)

				information error			
		False ILS capture causes ITC	AL35F6213	ITC caused by false ILS capture	**AL-CFIT-GNAF-ILS**		- OR false ILS capture detected (on base of data comparison with data from other sources) AND ITC detected
		FMS nav database error causes ITC	AL35F6214	ITC caused by navigational information error	**AL-CFIT-SCF-NP-AVION-NAVERR-DTBSER**		- OR ITC detected AND FMS navigational database error detected (when compared with data transferred from ground)
				ITC caused by flight management information error	**AL-CFIT-SCF-NP-AVION-FMIERR-DTBSER**		
		FMS fault causes ITC	AL35F622	ITC caused by flight management information error	**AL-CFIT-SCF-NP-AVION-FMIERR**		- OR ITC detected AND FMS failure detected
				ITC caused by autopilot control or guidance error	**AL-CFIT-SCF-NP-AFC-APERR**		
		FMS input error by flight crew causes ITC	AL35F623	FCE – incorrect FMS operation	**AL-CFIT-FCE-FMSNAVINPUT**		- OR ITC detected AND flight crew control input to the FMS system classified as incorrect
		Misuse of FMS by flight crew causes ITC	AL35F624	FCE – misuse of FMS	**AL-CFIT-FCE-INCOPER-FMS**		
		Incorrect trajectory	AL35F63	ITC resulting with trajectory	**AL-CFIT-FCE-ITC-CFIT**		- OR ITC detected AND current trajectory collides with terrain

		conflicts with terrain		colliding with terrain			
		Inadequate trajectory command (ITC) by ATCO	AL35F721	ATCOER – incorrect trajectory command causes ITC	**AL-CFIT-ATM-ATCOER-ITC-CFIT**		- OR ITC detected in ATC trajectory command (simultaneous digital message sent to aircraft computer with command required)
		Inadequate communication with pilot	AL35F722	ATCOER – inadequate communication with pilot	**AL-CFIT-ATM-ATCOER-FCCOM**		- OR Negative cabin voice record analysis for key words AND /OR Incomplete pilot-controller communication loop (e.g. lack of controller hearback)
		Inadequate pilot response to ATC	AL35F723	FCE – incorrect response to ATC command	**AL-CFIT-FCE-INCATMRESP**		- OR Inconsistency between flight crew action and correct ATCO instructions (digital message to aircraft computer from ATCO needed)
		Incorrect trajectory conflicts with terrain	AL35F73	ATCOER - ITC resulting with trajectory colliding with terrain	**AL-CFIT-ATM-ATCOER-ITC-CFIT**		- OR ITC detected AND current trajectory collides with terrain
2. On-board monitoring	Flight crew adherences to the CRM rules	Lack of fitness of PNF	AL35B4111	FCE – lack of fitness of PNF	**AL-CFIT-FCE-CRMF-LFPNF**		- Flight toward terrain commanded (FTTC) detected AND PNF reaction not detected AND precursor indicating on risk of PNF tiredness detected (workload near the limits and / or quality of work evaluation during flight etc.)
		Distraction of PNF by unplanned events	AL35B4112	FCE – PNF distraction by unplanned events	**AL-CFIT-FCE-CRMF-PNFDISTR**		- OR FTTC detected AND PNF reaction concerning commanded trajectory not detected AND need for PNF reaction in terms of other task identified as necessary AND PNF attention absorbed by other unplanned event AND attention absorption level classified as disabling execution of

							other tasks
		Absorption of PNF in routine tasks	AL35B4113	FCE – PNF absorbed in other routine tasks	**AL-CFIT-FCE-CRMF-PNFABS**		- OR FTTC detected AND PNF reaction concerning commanded trajectory not detected AND PNF attention absorbed by other routine tasks AND attention absorption level classified as disabling execution of other ones
		PF under instruction by PNF	AL35B4121	FCE - PF under instruction by PNF	**AL-CFIT-FCE-CRMF-PFUNPNF**		- OR FTTC detected AND cabin voice analysis indicates on situation when PF under instruction of PNF
		Flight crew jointly operating FMS	AL35B4122	FCE – joint operation of FMS	**AL-CFIT-FCE-CRMF-INCFMSOP**		- OR FTTC detected AND input to the FMS controls detected as being made by both pilots alternately
		PNF looking for terrain	AL35B4123	FCE – PNF looking for terrain	**AL-CFIT-FCE-CRMF-PNFLFT**		- OR FTTC detected AND PNF seems to look for the terrain (detected on base of eye pupil tracking)
		Inexperienced PNF not monitoring PF	AL35B4124	FCE – inexperienced PNF not monitoring PF	**AL-CFIT-FCE-CRMF-INEXPPNF**		- OR (FTTC) detected AND PNF reaction not detected AND precursor indicating on lack of self-confidence related to lack of experience detected
		Failure of on-board monitoring	AL35B42	FCE – failure of on-board monitoring	**AL-CFIT-FCE-CRMF-ONMONF**		- OR (FTTC) detected AND PNF involvement in monitoring detected (on base of cabin voice analysis for key words) AND PNF does not recognize the incorrect trajectory
		PNF subordinate and silent	AL35B431	FCE – PNF subordinate and silent	**AL-CFIT-FCE-CRMF-PNFSUB**		- OR (FTTC) detected AND PNF reaction not detected AND cabin voice analysis indicates on unbalanced relations between PNF and PF (advanced analytical methods required)
		PNF superior and silent	AL35B432	FCE – PNF superior and silent	**AL-CFIT-FCE-CRMF-PNFSUP**		- OR (FTTC) detected AND PNF involvement in monitoring detected (eye pupil tracking analysis) AND PNF does not warn the PF about the error (cabin voice analysis)

		Press-on-itis	AL35B441	FCE – PF resistance to PNF warning	**AL-CFIT-FCE-CRMF-PFIGNPNFWRN**		- OR (FTTC) detected AND PNF warns the PF about the error AND lack of trajectory corrections detected
		ATC disregard flight crew concerns	AL35B442	ATCOER – disregard of flight crew concerns	**AL-CFIT-ATM-ATCOER-IGNFCWRN**		- OR (FTTC) detected AND flight crew express the concern about correctness of flight trajectory to ATCO AND lack of trajectory corrections detected
3. Visual warning	Flight crew executes trajectory correction on base of visible terrain	Imminent CFIT above decision height (DH)	AL35C2	Imminent CFIT above decision height (DH)	**AL-CFIT-ADH**		- (FTTC) detected AND aircraft above decision height AND aircraft situation related to the terrain classified as indicating on imminent CFIT
		Low visibility over terrain	AL35B2111	Lack of visibility	**AL-CFIT-ITC-LVISIB**		- OR aircraft situation related to the terrain classified as indicating on imminent CFIT AND aircraft above decision height AND weather conditions indicate on lack of visibility (and in consequence the terrain)
		Dark terrain	AL35B2112	Darkness	**AL-CFIT-ITC-DRKNSS**		- OR aircraft situation related to the terrain classified as indicating on imminent CFIT AND aircraft above decision height AND darkness (and in consequence the terrain)
		Flight crew fail to see visible terrain	AL35B212	FCE – fail to see visible terrain	**AL-CFIT-ITC-FCE-LTVIS**		- OR aircraft situation related to the terrain classified as indicating on imminent CFIT AND aircraft above decision height AND weather conditions indicate on clear weather AND lack of flight crew reaction aiming at trajectory correction AND no other factors detected (e.g. crew incapacitation)
		Unsuccessful avoidance of observed terrain	AL35B213	FCE – failure to avoid visible terrain	**AL-CFIT-ITC-FCE-TERAVOIDFAIL**		- OR aircraft situation related to the terrain classified as indicating on imminent CFIT AND aircraft above decision height AND flight crew fail to avoid visible terrain (impact detected)

		Imminent CFIT at decision height	AL35C3	Imminent CFIT at decision height (DH)	**AL-CFIT-DH**		- (FTTC) detected AND aircraft at decision height AND aircraft situation related to the terrain classified as indicating on imminent CFIT
		Unsuccessful missed approach procedure	AL35B22A	FCE - unsuccessful missed approach procedure	**AL-CFIT-FCE-MAF**		- OR aircraft situation related to the terrain classified as indicating on imminent CFIT AND aircraft at decision height AND missed approach procedure execution detected to be launched AND missed approach procedure classified as unsuccessful (on base of inconsistency between pilot input to the aircraft controls and missed approach model procedure coded in aircraft computer)
4. ATC warning	Flight crew warned by ATC	No terminal area radar (TAR) available	AL35B31	No terminal area radar (TAR) available at the aircraft location	**AL-CFIT-ATM-LTAR**		- Aircraft situation related to the terrain classified as CFIT AND aircraft location does not covered by TAR
		Unsuccessful ATCO monitoring of TAR	AL35B321	ATCOER – unsuccessful TAR monitoring	**AL-CFIT-ATM-ATCOER-LTAROBS**		- OR Aircraft situation related to the terrain classified as CFIT AND aircraft location indicated on TAR AND lack of ATCO reaction aiming at flight crew warning
		No MSAW available	AL35B3221	No MSAW available	**AL-CFIT-ATM-LMSAW**		- OR Aircraft situation related to the terrain classified as CFIT AND aircraft location indicated on TAR AND MSAW function not available
		MSAW failure to give warning in time	AL35B3222	Warning loss - MSAW	**AL-CFIT-ATM-WRNLS-MSAWF**		- OR Aircraft situation related to the terrain classified as CFIT AND aircraft location indicated on TAR AND MSAW function not available AND lack of warning about the MSA
		ATCO failure to respond to	AL35B3223	ATCOER – failure to respond to	**AL-CFIT-ATM-ATCOER-**		- OR Aircraft situation related to the terrain classified as CFIT AND MSAW detected AND

		MSAW warning		MSAW warning	**LMSAWRESP**		lack of ATCO reaction aiming at respond to MSAW warning
		ATCO failure to resolve conflict in time	AL35B33	ATCOER - failure to resolve conflict in time	**AL-CFIT-ATM-ATCOER-INCMSAWRESP**		- OR Aircraft situation related to the terrain classified as CFIT AND MSAW detected AND ATCO reaction aiming at respond to MSAW warning classified as inadequate
5. GPWS warning	Flight crew warned by GPWS system	GPWS not installed	AL35B11	Lack of GPWS	**AL-CFIT-LGPWS**		- Aircraft situation related to the terrain classified as CFIT AND GPWS function detected as unavailable at the aircraft
		No GPWS warning in time	AL35B12	Warning loss - GPWS	**AL-CFIT-SCF-NP-AVION-WRNLS-GPWS**		- OR Aircraft situation related to the terrain classified as CFIT AND GPWS function detected as available at the aircraft AND lack of warning about the ground proximity.

Table 28 ASCOS ESD 36 - Ground collision imminent

Barrier	Description	Possibilities for braking the barrier – Base event	Code	Possible occurrence (CICTT)	Designation (CICTT)	Flight phase indicator	Proposed method for failure detection (trigger logic)
1. Ground Collision avoidance	All procedures and means assuring proper ground movement executions are available and used	Ground agent error in moving equipment	TO36F11111	GSE – error in moving equipment	**GM-GCOL-GSE-EQMOV**	Phase 1: Landing gear compression and at least 1 from: 1. Altitude equal 0ft AGL, 2. Thrust in taxiing mode or idle.	- Incorrect location of ground service equipment detected (CCTV with appropriate software required) resulted from operator fault or equipment fault
		Ground equipment fault	TO36F11112	Ground equipment fault	**GM-GCOL-GSEQF**		- OR Incorrect location of ground service equipment detected (CCTV with appropriate software required) resulted from operator fault or equipment fault AND conflict with aircraft detected (by aircraft computer and / or airsite CCTV system)
		Ground movement deviation conflicts with aircraft	TO36F1112	Ground movement deviation conflicts with aircraft	**GM-GCOL-GSMOV-SEPINFR**		
		Flight crew braking error allows movement while parked	TO36F11211	FCE – braking error during parking	**GM-GCOL-FCE-BRAKAPP**		- OR braking application failure detected while parked (V=0)
		Movement of other aircraft deviates from procedures	TO36F11212	FCE – aircraft movement deviation	**GM-GCOL-FCE-TXDEV**		- OR aircraft movement deviation detected (route correctness monitored with e.g. GPS augmented by airport/aircraft systems)
		Aircraft deviation creates conflict	TO36F1122	FCE – aircraft movement deviation resulting with conflict	**GM-GCOL-FCE-SEPINFR**		- OR aircraft movement deviation detected AND conflict with other aircraft detected
		Inadequate pushback	TO36F12111	ATCOER – inadequate	**GM-GCOL-ATM-**		- OR pushback clearance provided by the ATCO identified as creating conflict with

		clearance		pushback clearance	**ATCOER-PSHBCKCLRER**		other aircraft/vehicle (detected on base of digital message sent by ATCO to aircraft computer identical as the voice communicate) AND aircraft in pushback phase
		Pushback equipment fault	TO36F1212	Deviation from intended pushback trajectory resulting from towbar fault	**GM-GCOL-GSEQF-PSHBCKEQF**		- OR Deviation from intended pushback trajectory detected (resulted from human or equipment fault) AND aircraft in pushback phase
		Ground crew error in pushback	TO36F1213	GSE – pushback error	**GM-GCOL-GSE-PUSHBCK**		
		Ineffective ground crew - flight crew communication	TO36F1214	FCE - Ineffective ground crew - flight crew communication	**GM-GCOL-FCE-GSCOMM**		
				GSE - Ineffective ground crew - flight crew communication	**GM-GCOL-GSE-FCCOMM**		
		Pushback deviation creates conflict	TO36F122	Deviation from intended pushback trajectory resulting with conflict	**GM-GCOL-PSHBCKDEV-SEPINFR**		- OR Deviation from intended pushback trajectory detected (resulted from human or equipment fault) AND aircraft in pushback phase AND conflict with other aircraft or vehicle detected
		Inadequate ground movement clearance or communication	TO36F1311	ATCOER - Inadequate ground movement clearance or	**GM-GCOL-ATM-ATCOER-GMCLRNCE**		- OR Negative cabin voice record analysis for key words AND /OR Incomplete pilot-controller communication loop (e.g. lack of controller hearback) AND / OR clearance identified as creating conflict

				communication			with other aircraft/vehicle (detected on base of digital message sent by ATCO to aircraft computer identical as the voice communicate) AND aircraft in taxi-in/taxi-out phase
		Ground crew error in marshalling off stand	TO36F1312	GSE – error in marshalling off aircraft	**GM-GCOL-GSE-MRSH**		- OR aircraft computer detected deviation from route trajectory during marshalling (continuous activity of some aircraft systems required)
		Flight crew misjudgment of separation in taxi	TO36F1313	FCE – misjudgment of separation in taxi resulting with movement deviation	**GM-GCOL-FCE-MISJ-TXSEP**		- OR conflicting trajectory with other aircraft or vehicle detected
		Movement of other aircraft deviates from procedures	TO36F1314	FCE - movement of other aircraft deviates from procedures	**GM-GCOL-FCE-MOVDEV**		- OR conflicting trajectory with other aircraft or vehicle detected AND movement deviation not detected indicating on movement deviation of other aircraft
		Taxi-out deviation creates conflict with aircraft	TO36F132	FCE - out deviation creates conflict with aircraft	**GM-GCOL-FCE-TXDEV-SEPINFR**		- OR conflicting trajectory with other aircraft or vehicle detected AND aircraft situation classified as imminent collision
		Inadequate ground movement clearance or communication	TO36F1411	ATCOER - Inadequate ground movement clearance or communication	**GM-GCOL-ATM-ATCOER-GMCLRNCE**		- OR Negative cabin voice record analysis for key words AND /OR Incomplete pilot-controller communication loop (e.g. lack of controller hearback) AND / OR clearance identified as creating conflict with other aircraft/vehicle (detected on base of digital message sent by ATCO to aircraft computer identical as the voice communicate) AND aircraft in taxi-in/taxi-

							out phase
		Inadequate stand allocation	TO36F1412	ATCOER - Inadequate stand allocation	**GM-GCOL-ATM-ATCOER-INCSTALL**		- OR stand allocated by ATCO is detected to be occupied
		Aircraft fault causes deviation in taxi-in	TO36F14131	Brake system failure resulting with taxiing deviation	**GM-GCOL-SCF-NP-LG-BRKFL**		- OR deviation from correct taxi trajectory detected AND aircraft fault detected AND fault identified as leading to taxi deviation (e.g. landing gear component related)
				Tire failure resulting with taxiing deviation	**GM-GCOL-SCF-NP-LG-TIREFL**		
				Wheel failure resulting with taxiing deviation	**GM-GCOL-SCF-NP-LG-WHLFL**		
				Steering system failure resulting with taxiing deviation	**GM-GCOL-SCF-NP-LG-STEERFL**		
		Flight crew handling error in taxi-in	TO36F14132	FCE - handling error in taxiing	**GM-GCOL-FCE-AHAN**		- OR deviation from correct taxi trajectory detected AND inconsistency between flight crew input to the aircraft control and control input assumed as correct for given conditions
		Flight crew violation of taxi procedures	TO36F14133	FCE - violation of taxi procedures	**GM-GCOL-FCE-TAXPROCVIOL**		
		Ground crew error marshalling onto stand	TO36F14134	GSE - error marshalling onto stand	**GM-GCOL-GSE-MRSH**		- OR aircraft computer detected deviation from route trajectory during marshalling (continuous activity of some aircraft systems required)
		Ground agent error in moving equipment	TO36F14141	GSE - error in moving equipment	**GM-GCOL-GSE-EQMOV**		- OR Incorrect location of ground service equipment detected (CCTV with appropriate software required) resulted from operator fault or equipment fault
		Ground	TO36F141	Ground	**GM-GCOL-**		

		equipment fault	42	equipment failure	**GSEQF**		
		Taxi-in deviation creates conflict	TO36F142	Taxiing deviation resulting with imminent collision	**GM-GCOL-TXDEV-SEPINFR**		- OR conflicting trajectory with other aircraft or vehicle detected AND aircraft situation classified as imminent collision
2. Conflict avoidance (Crew)	Flight crew avoids the collision on base of visual warning	Avoidance impracticable for flight crew	TO36B21	Avoidance impracticable for flight crew	**GM-GCOL-FCIMPR**		- Conflicting trajectory with other aircraft or vehicle detected AND aircraft situation classified as imminent collision AND avoidance impracticable (aircraft computer does not find resolution advisory)
		Conflict virtually invisible from flight deck	TO36B22	Conflict virtually invisible from flight deck	**GM-GCOL-INVFRCAB**		- OR conflicting trajectory with other aircraft or vehicle detected AND aircraft situation classified as imminent collision AND collision area invisible from the flight deck
		Flight crew misjudgment of clearance	TO36B23	FCE - misjudgment of clearance	**GM-GCOL-FCE-MISJ-CLRNCE**		- OR conflicting trajectory with other aircraft or vehicle detected AND aircraft situation classified as imminent collision AND lack of flight crew reaction aiming at collision avoiding (flight crew see the situation what is detected e.g. by eye pupil tracking system)
		Flight crew slow response to conflict	TO36B24	FCE - slow response to conflict	**GM-GCOL-FCE-LIMRESP**		- OR conflicting trajectory with other aircraft or vehicle detected AND aircraft situation classified as imminent collision AND lack of adequate flight crew reaction aiming at collision avoiding (flight crew see the situation what is detected e.g. by eye pupil tracking system)
3. Conflict	Ground crew	Avoidance impracticable for	TO36B11	Avoidance impracticable	**GM-GCOL-GSIMPR**		- Conflicting trajectory with aircraft or vehicle detected (with the airsite CCTV

Avoidance (Ground crew)	avoids the conflict on base of visual warning	ground crew		for ground crew			system) AND vehicle situation classified as imminent collision AND avoidance impracticable (aircraft computer does not find resolution advisory – if collision is with aircraft. Integration of airsite CCTV with aircraft computer required) Equipment of ground equipment with detection devices assumed as being too expensive)
		Conflict virtually invisible from tug	TO36B12	Conflict virtually invisible from tug	**GM-GCOL-INVFRTUG**		- OR conflicting trajectory with aircraft or vehicle detected with the airsite CCTV system) AND vehicle situation classified as imminent collision AND collision area invisible from the vehicle cabin (advanced software coupled with CCTV required)
		Inadequate monitoring by ground crew	TO36B13	GSE - Inadequate monitoring by ground crew	**GM-GCOL-GSE-INMON**		- OR Conflicting trajectory with aircraft or vehicle detected (with the airsite CCTV system) AND vehicle situation classified as imminent collision AND lack of vehicle driver reaction aiming at avoiding the collision (detected by the fact of collision)
		Inadequate ground crew - flight crew communication	TO36B14	GSE - ground crew - flight crew communication	**GM-GCOL-GSE-GSCOMM**		- OR OR Conflicting trajectory with aircraft or vehicle detected (with the airsite CCTV system) AND vehicle situation classified as imminent collision AND lack of communication with flight crew detected (with advanced CCTV system)