IATA

Guidance Material and Best Practices for the Implementation of Upset Prevention and Recovery Training

2nd Edition

NOTICE

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Guidance Material and Best Practices for the Implementation of
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Publications

The table below shows a list of publications, issued by Regulators and the industry, used in this manual.

Publication / Task	Date	Abbreviated essentials
Airplane Upset Prevention and Recovery Training Aid (AUPRTA) – Rev.3	February 2017	a) Based upon ICAO document 10011, Airbus, ATR, Boeing, Bombardier, Embraer and ICAO have created Revision 3 of the Airplane Upset Recovery Training Aid (AURTA) and renamed it AUPRTA. This revision is expanded to include transport category straight wing propeller airplanes and regional jet airplanes. b) The document redefines airplane upsets applying the established concept of undesired airplane state (part of the Threat and Error Management Model) and the pilot's awareness of this regardless of airspeed or specific pitch and/or bank angle parameters. c) AUPRTA proposes academic training and OEM recommended FSTD exercises (within the capabilities of existing FSTDs) to expose the pilots to the airplane's handling characteristics and performance envelope, adding significant benefits to managing undesired airplane states and preventing upsets. d) The OEM recommended training sequences within this document are grouped by upset-inducing topics, with each topic consisting of the exercise conditions, training objectives, description and rationale. e) Recommended crew actions for both "Stall Recovery Procedure" and "Upset Recovery Techniques" as well as training scenarios have unanimous agreement among these OEMs and are reflected in this Training Aid.
FAA InFO 10010	7/6/10	Highlights availability and merits of AURTA
FAA SAFO 10012	7/6/10	Recovery from stall does not mandate a predetermined value for altitude loss

Publication / Task	Date	Abbreviated essentials
FAA AC No: 120-109	8/6/2012	Stall and Stick Pusher Training a) Reduction of angle of attack (AOA) is the most important response to a stall event b) Evaluation criteria for a recovery from stall event that does not include a predetermined value for altitude loss c) Realistic scenarios d) Training emphasizes treating "approach-to-stall" the same as a "full stall" and execute recovery at first indication of a stall e) Incorporation of stick pusher training
FAA SAFO 13002	1/4/13	To encourage operators to promote manual flight operations when appropriate.
EASA SIB No.: 2013-02	22 January 2013	Stall and Stick Pusher training Corresponds to AC No: 120-109
EASA SIB No.: 2013-05	23 April 2013	Manual Flight Training and Operations Reminder for National Aviation Authorities (NAAs) and operators of the importance of manual flying during recurrent simulator training and also, when appropriate, during flight operations.
TCAA AC 700-031	2013-11-08	a) Guidance for the prevention and recovery from stall events b) Best practices and guidance for training, testing, and checking c) Emphasizes reducing the AOA as the most important response to a stall event
FAA NOTICE N 8900.241	11/4/2013	Compliance required no later than March 2019 a) Ground training on stall prevention and recovery and upset prevention and recovery b) Flight training in a Level C or higher FFS on specified maneuvers and procedures during initial, transition, upgrade, and recurrent training c) Flight training and checking on runway safety maneuvers and procedures and crosswind takeoffs and landings with gusts d) PM and workload management e) Scenario-based or maneuver-based stall prevention training during LOFT

Publication / Task	Date	Abbreviated essentials
		f) For PICs a proficiency check, within 12 calendar-months, in each aircraft type g) Initial or transition and recurrent training on the operation of FSTD and FSTD limitations for flight instructors, check pilots, and check Flight Engineers who conduct training or checking in FSTD h) Remedial training and tracking of pilots with performance deficiencies i) Approval of training equipment
ICATEE Research and Technology Report	12/2013	Analysis of training tasks and proposals to enhance FTSD capabilities.
ICAO Annex 1 – Amdt.172 Annex 6 – Amdt.38 PANS-TRG – Amdt. 3 **Doc 10011**	02/2014	ICAO amendments to Annex 1, Annex 6 and PANS-TRG (Doc 9868) to a) Meet the UPRT requirements for an MPL, contained in Annex 1 b) Provide UPRT recommendations for a CPL(A), contained in Annex 1 c) Meet the requirements for type-rating, contained in Annex 1 d) Meet the requirements for the recurrent training of pilots, contained in Annex 6, Part I, paragraph 9.3 – *Flight crew member training programmes* ICAO Doc 10011 – 1st Edition – Manual on Aeroplane Upset Prevention and Recovery Training (MAUPRT)
FAA AC No: 120-109A	11/24/15	Stall Prevention and Recovery Training This revision of AC 120-109 reflects new part 121 regulatory terms and incorporates the full stall training requirement of Public Law 111–216. Considerable evaluation of the full flight simulator (FFS) must occur before conducting full stall training in simulation. a) Reducing angle of attack (AOA) is the most important pilot action in recovering from an impending or full stall. b) Pilot training should emphasize teaching the same recovery technique for impending stalls and full stalls. c) Evaluation criteria for a recovery from an impending stall should not include a

Publication / Task	Date	Abbreviated essentials
		predetermined value for altitude loss. Instead, criteria should consider the multitude of external and internal variables that affect the recovery altitude. d) Once the stall recovery procedure is mastered by maneuver-based training, stall prevention training should include realistic scenarios that could be encountered in operational conditions, including impending stalls with the autopilot engaged at high altitudes. e) Full stall training is an instructor-guided, hands-on experience of applying the stall recovery procedure and will allow the pilot to experience the associated flight dynamics from stall onset through the recovery.
FAA AC No: 120–111	4/14/15	Upset Prevention and Recovery Training a) Enhanced instructor training on the limitations of simulation b) Comprehensive pilot academic training on aerodynamics c) Early recognition of divergence from intended flight path d) Upset prevention through improvements in manual handling skills e) Training that integrates crew resource management including progressive intervention strategies for the pilot monitoring
EASA SIB No.: 2015–07	15 April 2015	Prevention of Hazardous Low Speed at High Altitude Cruise
EASA ED Decision 2015/012/R	4 May 2015	Amendment to Acceptable Means of Compliance and Guidance Material to Part-Definitions and Part-ORO of Regulation (EU) No 965/2012
EASA SIB No.: 2015–17 and EASA SIB No.: 2015–17R1	29 September 2015 and 16 October 2015	Unreliable Airspeed Indication at High Altitude/ Manual Handling at High Altitude
FAA FR Vol. 81 No. 61 amending	March 30, 2016	Flight Simulation Training Device Qualification Standards for Extended Envelope and Adverse Weather Event Training Tasks; Final Rule.

Publication / Task	Date	Abbreviated essentials
14 CFR PART 60		The compliance date of FSTD Directive No. 2 is March 12, 2019. After this date, any FSTD being used to conduct specific training tasks as defined in FSTD Directive No. 2 must be evaluated and qualified in accordance with the Directive.
EASA ED Decision 2018/006/R amending CS FSTD(A)	3 May 2018	Update of flight simulation training device requirements. The objective is to increase the fidelity of the provisions to support the approach-to-stall and the upset prevention and recovery training (UPRT) requirements. Furthermore, it proposes to increase the fidelity of the simulation of the engine and airframe icing effects, and develop and deploy an instructor operating station (IOS) feedback tool. This Decision amends the Certification Specifications for Aeroplane Flight Simulation Training Devices (CS-FSTD(A) and one of its primary objectives is to achieve the maximum alignment possible with FAA CFR 14 Part 60 Change 2 and with the applicable elements of ICAO Doc 9625 “Manual of Criteria for the Qualification of Flight Simulation Training Devices”.

Abbreviations and Acronyms

AC	FAA Advisory Circular
A/C	Aircraft
AOA	Angle of Attack
AOC	Air operator certificate / Air operator certificate holder
ANU	Aeroplane Nose Up
AND	Aeroplane Nose-Down
AURTA	Airplane Upset Recovery Training Aid
ATO	Approved Training Organization
CBT	Competency-Based Training
CBTA	Competency-based Training and Assessment
CAA	Civil Aviation Authority
CFE	Certified Flight Envelope
FBW	Fly by wire
FOQA	Flight Operational Quality Assurance
IMC	Instrument Meteorological Conditions
IOS	Instructor Operating Station
LOFT	Line Oriented Flight Training
LOSA	Line Operations Safety Audit
LOC-I	Loss of Control In-Flight
NAA	National Aviation Authority
NFE	Normal Flight Envelope, synonymous to Normal Operating Flight Envelope
OEM	Original Equipment Manufacturer
PANS-TRG	Procedures for Air Navigation Services – Training (ICAO Doc 9868)
PF	Pilot Flying
PM	Pilot Monitoring
QRH	Quick Reference Handbook
RAeS	Royal Aeronautical Society
SAFO	FAA Safety Alert for Operators

SIB	EASA Safety Information Bulletin
SOP	Standard Operating Procedure
TCCA	Transport Canada Civil Aviation
Vls	Lowest Selectable Speed, synonymous to Maneuvering Speed
VMC	Visual Meteorological Conditions
Vs	Stall Speed

Definitions Related to UPRT

Academic training. Training that places an emphasis on studying and reasoning designed to enhance knowledge levels of a particular subject, rather than to develop specific technical or practical skills.

Adapted competency model. A group of competencies with their associated description and performance criteria adapted from an ICAO competency framework that an organization uses to develop competency-based training and assessment for a given role.

Airplane upset. An airplane upset is an undesired airplane state characterized by unintentional divergences from parameters normally experienced during operations.

An airplane upset may involve pitch and/or bank angle divergences as well as inappropriate airspeeds for the conditions.

> **Note:** undesired airplane state is defined in the Line Operations Safety Audit (LOSA) manual, ICAO Doc 9803, 1st edition.

Deviations from the desired airplane state will become larger until action is taken to stop the divergence.

Return to the desired airplane state can be achieved through natural airplane reaction to accelerations, auto-flight system response or pilot intervention.

Angle of attack (AOA). Angle of attack is the angle between the oncoming air, or relative wind, and a defined reference line on the aeroplane or wing.

> **Critical angle of attack.** The angle of attack that produces the maximum coefficient of lift beyond which an aerodynamic stall occurs

Assessment. The determination by an instructor, assessor, or evaluator as to whether a candidate meets a required competency standard under given conditions, by collecting evidence from observable behaviors. Assessment takes place during instruction and evaluation.

Behavior. The way a person responds, either overtly or covertly, to a specific set of conditions, which is capable of being measured.

> **Observable behavior (OB).** A single role-related behavior that can be observed and may or may not be measurable.

Competency. A dimension of human performance that is used to reliably predict successful performance on the job. A competency is manifested and observed through behaviors that mobilize the relevant knowledge, skills and attitudes to carry out activities or tasks under specified conditions.

IATA Guidance Material distinguishes between "Pilot competencies" and "Instructor and Evaluator competencies".

- Pilot competencies. An ICAO competency framework for aeroplane pilots.
- Instructor and Evaluator competencies. A competency framework for instructors and evaluators as described in the IATA Guidance Material for Instructor and Evaluator Training.

Competency-based training and assessment. Training and assessment that are characterized by a performance orientation, emphasis on standards of performance and their measurement, and the development of training to the specified performance standards.

Competency standard. A level of performance that is defined as acceptable when assessing whether or not competency has been achieved.

Conditions. Anything that may qualify a specific environment in which performance will be demonstrated.

Contributing factor. A reported condition that contributed to the development of an aircraft accident or incident.

Critical system malfunctions. Aeroplane system malfunctions that place significant demand on a proficient crew. These malfunctions should be determined in isolation from any environmental or operational context.

Energy state. How much of each kind of energy (kinetic, potential or chemical) the aeroplane has available at any given time.

Envelope. The term envelope is used in various documents, in various contexts for various purposes. This manual refers to some specific envelopes related to aircraft certification, FDTD qualification, flight operations and training. The most relevant envelopes in the context of UPRT are described in Section 6 in this manual.

Error. See **Threat and Error Management**.

Event. A combination of a task or a sub-task and the conditions under which the task or sub-task is to be performed.

Evidence-based training (EBT). Training and assessment based on operational data that is characterized by developing and assessing the overall capability of a trainee across a range of core competencies rather than by measuring the performance of individual events or maneuvers.

Note: Guidance on EBT is contained in the Procedures for Air Navigation Services – Training (PANS-TRG, Doc 9868) and the Manual of Evidence-based Training (Doc 9995). EBT is competency-based and is applicable, as an option, to the recurrent training of flight crew members engaged in commercial air transport operations that is conducted in an FSTD. IATA has published the Evidence-Based Training Implementation Guide and the Data Report for Evidence-Based Training.

Extended Envelope Training (FAA). The flight training contained in §121.423 consisting of:

- Manually controlled slow flight
- Manually controlled loss of reliable airspeed
- Manually controlled instrument departure and arrival
- Upset recovery maneuvers
- Recovery from bounced landing; and,
- Instructor-guided hands-on experience of recovery from full stall and stick pusher activation

Fidelity level. The level of realism assigned to each of the defined FSTD features.

Flight crew resilience. The ability of a flight crew member to recognize, absorb and adapt to disruptions.

Flight path. The trajectory or path of an object (aeroplane) travelling through the air over a given space of time.

Flight simulation training device (FSTD). A synthetic training device that is in compliance with the minimum requirements for FSTD qualification as described in Doc 9625.

High Angle of Attack (EASA). High angle of attack means flying at an angle of attack higher than in normal operation beyond the first indication of stall or stall protection systems, whichever occurs first.

High Angle of Attack (FAA). Not explicitly defined however, Part 60 Qualification Performance Standards require High Angle of Attack Model Evaluation for all simulators that are used to satisfy training requirements for stall maneuvers that are conducted at angles of attack beyond the activation of the stall warning system. For stall recovery training tasks, satisfactory aerodynamic model fidelity must be shown through at least 10 degrees beyond the stall identification angle of attack.

Load factor. The ratio of a specified load to the weight of the aeroplane, the former being expressed in terms of aerodynamic forces, propulsive forces, or ground reactions.

Maneuvers. A sequence of deliberate actions to achieve a desired flight path. Flight path control may be accomplished by a variety of means including manual aeroplane control and the use of autoflight systems.

Maneuver-based training. Training that focuses on a single event or maneuver in isolation.

Motion turnaround bumps. A phenomenon associated with FSTD motion actuators when their direction of travel reverses, which results in acceleration spikes that can be felt by the pilot thus giving a false motion cue.

Negative training. Training which unintentionally introduces incorrect information or invalid concepts, which could actually decrease rather than increase safety.

Negative transfer of training. The application (and "transfer") of what was learned in a training environment (e.g., a classroom, an FSTD) to the job environment, i.e., it describes the degree to which what was learned in training is applied on the job. In this context, "negative transfer of training" refers to the inappropriate generalization of a knowledge or skill to a situation or setting on the job that does not equal the training situation or setting.

On-aeroplane training. A component of a UPRT program designed to develop skill sets in employing effective upset prevention and recovery strategies utilizing only suitably-capable light aeroplanes.

Phase of flight. A defined period within a flight. Example: Take-off, climb, cruise, descent, approach and landing.

Quality assurance (QA). All the planned and systematic actions necessary to provide adequate confidence that all activities satisfy given standards and requirements, including the ones specified by the approved training organization in relevant manuals.

Quality management. A management approach focused on the means to achieve product or service quality objectives through the use of its four key components: quality planning; quality control; quality assurance; and quality improvement.

Quality System. The aggregate of all the organization's activities, plans, policies, processes, procedures, resources, incentives and infrastructure working in unison towards a total quality management approach. It requires a complete organizational construct with documented policies, processes, procedures and resources that underpin a commitment by all employees to achieve excellence in product and service delivery through the implementation of best practices in quality management.

Scenario. Part of a training module plan that consists of predetermined maneuvers and training events.

Scenario-based training. Training that incorporates maneuvers into real-world experiences to cultivate practical flying skills in an operational environment.

Stall. An aerodynamic loss of lift caused by exceeding the critical angle of attack.

Note: A stalled condition can exist at any attitude and airspeed, and may be recognized by continuous stall warning activation accompanied by at least one of the following:

1. Buffeting, which could be heavy at times
2. Lack of pitch authority and/or roll control; and
3. Inability to arrest the descent rate

Stall warning. A natural or synthetic indication provided when approaching a stall that may include one or more of the following indications:

a) Aerodynamic buffeting (some airplanes will buffet more than others)

b) Reduced roll stability and aileron effectiveness

c) Visual or aural cues and warnings

d) Reduced elevator (pitch) authority

e) Inability to maintain altitude or arrest rate of descent; and

f) Stick shaker activation (if installed)

Notes: 1. A stall warning indicates an immediate need to reduce the angle of attack.

2. Stall and stall warning definitions and descriptions are presently under review as they may not be fully consistent with Airworthiness Standards / Certification Specifications.

First indication of a stall. The initial aural, tactile or visual sign of an impending stall, which can be either naturally or synthetically induced.

Stall event (EASA). An occurrence whereby the aeroplane experiences conditions associated with an approach-to-stall or an aerodynamic stall.

Approach-to-stall. Flight conditions bordered by stall warning and aerodynamic stall.

Aerodynamic stall. An aerodynamic loss of lift caused by exceeding the critical angle of attack (synonymous with the term 'stall').

Post-stall regime. Flight conditions at an angle of attack greater than the critical angle of attack.

Full stall (FAA). Any one, or combination of, the following characteristics: (a) an uncommanded nose-down pitch that cannot be readily arrested, which may be accompanied by an uncommanded rolling motion; (b) buffeting of a magnitude and severity that is a strong and effective deterrent to further increase in AOA; (c) no further increase in pitch occurs when the pitch control is held at the full aft stop for 2 seconds, leading to an inability to arrest descent rate; (d) activation of a stick pusher.

Stall recovery procedure. The manufacturer-approved aeroplane-specific stall recovery procedure. If a manufacturer-approved recovery procedure does not exist, the aeroplane-specific stall recovery procedure developed by the operator based on the stall recovery template contained in the FAA Advisory Circular AC 120–109 and in the EASA SIB 2013–02.

Surprise and Startle.

Surprise. The emotionally-based recognition of a difference in what was expected and what is actual.

Startle. The initial short-term, involuntary physiological and cognitive reactions to an unexpected event that commence the normal human stress response.

Stick shaker. A device that automatically vibrates the control column to warn the pilot of an approaching stall.

Note: A stick shaker is not installed on all aeroplane types.

Stick pusher. A device that automatically applies a nose-down movement and pitch force to an aeroplane's control columns, to attempt to decrease the aeroplane's angle of attack. Device activation may occur before or after aerodynamic stall, depending on the aeroplane type.

Note: A stick pusher is not installed on all aeroplane types.

Stress (response). The response to a threatening event that includes physiological, psychological and cognitive effects. These effects may range from positive to negative and can either enhance or degrade performance.

Threat and Error Management.

Threat. Events or errors that occur beyond the influence of the flight crew, increase operational complexity and must be managed to maintain the margin of safety.

Threat management. The process of detecting and responding to threats with countermeasures that reduce or eliminate the consequences of threats and mitigate the probability of errors or undesired aeroplane states.

Error. An action or inaction by the flight crew that leads to deviations from organizational or flight crew intentions or expectations.

Error management. The process of detecting and responding to errors with countermeasures that reduce or eliminate the consequences of errors, and mitigate the probability of further errors or undesired aeroplane states.

Undesired aircraft state. Flight crew-induced aircraft position or speed deviations, misapplication of flight controls, or incorrect systems configuration, associated with a reduction in margins of safety.

Notes:

1. Undesired states can be managed effectively, restoring margins of safety; or flight crew response(s) can induce an additional error, incident, or accident.
2. All countermeasures are necessarily flight crew actions. However, some countermeasures to threats, errors and undesired aircraft states that flight crews employ build upon "hard" / systemic-based resources provided by the aviation system.

Train-to-proficiency. Approved training designed to achieve end-state performance objectives, providing sufficient assurances that the trained individual is capable to consistently carry out specific tasks safely and effectively.

Note: In the context of this definition, the words train-to-proficiency can be replaced by training-to-proficiency.

Training event. Part of a training scenario that enables a set of competencies to be exercised.

Training objective. A clear statement that is comprised of three parts, i.e.:

a) The desired performance or what the trainee is expected to be able to do at the end of training (or at the end of particular stages of training)

b) The conditions under which the trainee will demonstrate competence; and

c) The performance standard to be attained to confirm the trainee's level of competence

Transport category aeroplane. A category of airworthiness applicable to large civil aeroplanes, which are either:

a) Turbojets with 10 or more seats, or having a maximum take-off mass (MTOM) of greater than 5 700 kg (12 566 lb.); or

b) Propeller-driven aeroplanes with greater than 19 seats, or a MTOM greater than 8618 kg (19 000 lb.)

Upset. See Aeroplane Upset.

Unsafe situation. A situation, which has led to an unacceptable reduction in safety margin.

Foreword

Dear Colleagues,

It is my pleasure to introduce the 2nd Edition of the IATA Guidance Material and Best Practices for the Implementation of Upset Prevention and Recovery Training (UPRT).

A revision of the 1st Edition of this guidance material was necessary to ensure alignment with the recent publication of the ICAO Airplane Upset Prevention and Recovery Training Aid (AUPRTA) – Rev.3, and to take into consideration operators' experience in implementing UPRT programs since the introduction of the new regulatory requirements.

This second edition also provides an overview on the differences in regulatory UPRT requirements between EASA and the FAA.

The IATA Safety Report 2017, shows a 10-year trend of a declining accident rate and reduction in fatalities. Even if this positive trend is also noticeable for the Loss of Control – In-flight (LOC-I) accident category, IATA continues to work with the industry to lead UPRT enhancements.

It is our belief that the shared efforts put into a consistent UPRT implementation contribute to achieving our common goal of improving aviation safety worldwide.

Best regards,

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Section 1—Scope of the Manual

This document serves as guidance material for AOCs to develop an Upset Prevention and Recovery Training (UPRT) program. The document specifically focuses on practical guidance for UPRT instructor training. It also includes recommendations for AOCs cooperating with ATOs providing licensing training for their ab-initio cadets.

Guidance is based on expert information within the industry, international working groups, such as Loss of Control Avoidance and Recovery Training (LOCART) and International Committee for Aviation Training in Extended Envelopes (ICATEE), ICAO Doc 10011, *Manual on Aeroplane Upset Prevention and Recovery Training (MAUPRT)*, and documents listed under the Publications section at the beginning of this manual.

Air exercises are based on the *Airplane Upset Prevention and Recovery Training Aid (AUPRTA) Revision 3, 2017*, created by Airbus, ATR, Boeing, Bombardier, Embraer and ICAO, related FAA and EASA documents.

This manual may be used for both, traditional and competency-based training schemes. When addressing pilot competency, this manual uses the competencies as set out in the ICAO Doc 9995[1] and its associated terminology.

As sufficient study material is available, existing information will not be replicated and academic training is not further detailed in this manual; however essential topics and sources are discussed.

This manual is provided for information and guidance purposes. It only describes examples of means, but not the only examples and means, of designing a UPRT program, in order to achieve compliance with regulations and standards. AOCs and ATOs are responsible to ensure compliance with regulations and standards and to obtain approval by their Authorities for their UPRT programs.

Note: The pronoun "he" is used synonymously for "she" or "he" throughout this manual.

[1] ICAO Doc 9995 Manual of Evidence-based Training

Section 2—Essentials from ICAO

ICAO has amended Annex 1, Annex 6 and PANS-TRG (Doc 9868) to provide procedures to Civil Aviation Authorities, operators and approved training organizations to:

- Meet the UPRT requirements for an MPL, contained in Annex 1
- Provide UPRT recommendations for a CPL(A), contained in Annex 1
- Meet the requirements for type-rating, contained in Annex 1
- Meet the requirements for the recurrent training of pilots, contained in Annex 6, Part I, paragraph 9.3 – *Flight crew member training programmes.*

A new Chapter 7 was added in PANS-TRG (Doc 9868) to provide procedures in the delivery of upset prevention and recovery training for aeroplane pilots. This Chapter is supported by the *Manual on Aeroplane Upset Prevention and Recovery Training* (ICAO Doc 10011).

"Although not obligatory, training organizations engaged in the recurrent assessment and training of flight crew engaged in the operations of large or turbojet aeroplanes in accordance with Annex 6, Part II — *International General Aviation — Aeroplanes* (Section 3 refers) should also use this information to enhance the scope of their training services being offered"[2].

2.1 Manual on Aeroplane Upset Prevention and Recovery Training (Doc 10011)

Doc 10011 addresses in detail the following distinct areas for UPRT:

- Single-pilot training on-aeroplane
- Multi-crew training in an FSTD
  - non-type-specific and type-specific
- OEM recommendations in prevention and recovery techniques
- FSTD requirements for UPRT

To standardize terminology for UPRT, it provides an enhanced set of definitions, including "aeroplane upset", various "stall" terms, "startle" and "surprise".

[2] Amendment 3 to PANS-TRG

Areas/objectives of UPRT are divided into:

- **"PREVENTION"** including
  - heightened ***awareness*** and
  - effective ***avoidance***
- **"RECOVERY"**

Note: The training philosophy of FAA AC No: 120–111 uses the areas of **Prevention** (timely action to avoid progression toward a potential upset), **Recognition** (timely action to recognize divergence from the intended flight path and interruption of progression toward a potential upset), and **Recovery** (timely action to recover from an upset in accordance with the air carrier's procedures, or in the absence thereof, in accordance with recommendations provided in Chapter 4 of the AC).

Doc 10011 is supplemented by two important OEM recommended recovery techniques (or strategies) for Nose-high and Nose-low. They were jointly developed by representatives from Airbus, ATR, Boeing, Bombardier and Embraer.

Doc 10011 refers to the *Airplane Upset Recovery Training Aid* (AURTA) Revision 2. It is important to keep in mind that the AURTA was mainly developed to deal with topics pertaining to swept-wing airplanes with more than 100 passenger seats; in February 2017 ICAO, Airbus, ATR, Boeing, Bombardier, Embraer published AUPRTA Revision 3 which was expanded to include transport category straight wing propeller airplanes and regional jet airplanes.

Amendment 3 to PANS-TRG states that UPRT programs should be competency-based in their design and delivery[3] and Doc 10011, Appendix, provides guidance to ATOs, organizations conducting EBT and other organizations that decide to conduct UPRT under an approved competency-based training curriculum.

UPRT should also be implemented within traditional training schemes. It is recognized that not all CAAs, AOCs, nor ATOs at this time have the capability to develop, maintain and oversee a competency-based UPRT program. Hence, the core of Doc 10011 is developed upon the premise that "it is well understood that several CAAs, ATOs, and air operators are currently unable to implement CBT[4] methodologies as defined in ICAO documentation, and that more traditionally used training paradigms relying on predetermined performance tolerances may have to suffice."[5]

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[3] Amendment No. 3 to PANS-TRG, 7.6.1

[4] CBT – Competency-based training

[5] ICAO Doc 10011, 6.2.1

Section 3—Regulatory Compliance

Both the Federal Aviation Administration (FAA) and the European Aviation Safety Agency (EASA) have implemented regulations that require AOCs to comply with.

FAA NOTICE N 8900.241 of 11/4/13 "...outlines the regulatory and guidance changes related to the Qualification, Service, and Use of Crewmembers and Aircraft Dispatchers final rule. This rule revises the training and qualification requirements for pilots conducting operations under Title 14 Code of Federal Regulations (14 CFR) part 121". "All pilots operating under part 121 must complete ground training on stall prevention and recovery and upset prevention and recovery during initial, transition, upgrade, and recurrent training". Compliance is required no later than 12 March 2019. All associated recurrent training must be completed by 31 March 2020.

EASA Executive Director Decision 2015/012/R, published on 4 May 2015, amends the Acceptable Means of Compliance and Guidance Material to Part-Definitions and Part-ORO of Regulation (EU) No 965/2012, mandating UPRT for the operator recurrent training program and the conversion course. Amendments to Part-FCL of Regulation 1178/2011 are expected to be effective in April 2019, aligning it with PART ORO.

FAA and EASA both have amended their Qualification Standards for FSTDs, requiring that FSTDs must be qualified to perform the UPRT tasks.

Section 4—The Ideal UPRT Program

The overarching aim of UPRT is to develop the necessary flight crew resilience to prevent and recover from all undesired aircraft states, including upsets.

The ideal UPRT program involves both, ATO training and AOC training. Many AOCs are connected to ATOs delivering various services. IATA recognizes the benefits of AOC/ATO partnerships and encourages engagement at an early stage of the pilot education (e.g., in MPL courses) to ensure a top-down approach to training and to improve the quality of ab-initio pilot training.

The ideal UPRT program structure should therefore be designed as a coordinated effort between the operator and the ATO. It should include consistent on-aeroplane and non-type-specific UPRT by the ATO, and type-specific UPRT of the operator.

The following table shows an example of an ideal UPRT program setup for an AOC/ATO partnership.

The ideal complete UPRT program	
Academic training	It is highly recommended to provide the required academic training before commencing hands on on-aeroplane or FSTD training.
Phase 1: On-aeroplane UPRT MPL, CPL	Exposure to the psycho-physiological effects during flight within the full range of the FAA25/CS25 certification g-envelope, all attitude exposure, essential human factor training. ● Adapting to all attitudes ● Developing AOA awareness ● Adapting to g-exposure (-1g to 2,5g) ● Recovery from stalls ● Overcoming surprise and startle ● Developing counter-intuitive recovery skills Developing self-confidence/trust through personal experience of successfully recovering and “surviving” various all-attitude upsets in a real environment.
Phase 2: Non-type-specific UPRT in FSTDs MPL, CPL	Non type-specific upset prevention and recovery training, consolidation of OEM recommendations.
Phase 3: Type-specific UPRT in FSTDs Operator training (type rating, conversion, recurrent, command upgrade) and MPL	Type-specific upset prevention and recovery training including SOPs, OEM recommendations and operator training content.

Section 5—Academic Training

Thorough understanding of environmental factors, aerodynamics, flight dynamics, aircraft performance, aircraft design principles and human factors, is an indispensable prerequisite for successful upset *prevention*. Academic training is therefore of critical importance for the success of a UPRT program.

Operators are encouraged to begin with the identification of possible gaps in the theoretical knowledge of their pilots and then to use the AUPRTA and the variety of existing publications or Apps to develop the academic part of their UPRT program. Guidance for the content of academic training can be taken from the latest editions of sources such as:

- ICAO Doc 10011
- AUPRTA
- FAR 25 / CS 25
- FAA Advisory Circulars
- EASA ED Decisions
- 14CFR Part 60 and/or CS FTSD(A)
- OEM UPRT guidance

To provide context, it is recommended to present academic training in a practical way by connecting training material to the cockpit and to the working environment of the pilots.

Theoretical training should precede and be integrated into practical training. It should include classroom instruction and self-study in preparation for on-aeroplane and FSTD lessons. Briefings and debriefings may then refer to essentials from the preparation course. The time between academic training and practical training should be kept as short as possible to promote the integration of theoretical content to practice.

Effective Energy Management (especially for high altitude flight) has been identified as one of the critical training elements, as energy trading in certain conditions may be of vital importance. The purpose of energy management is to keep the aircraft in the Normal Flight Envelope (NFE)[6]. The key question for pilots should be “do I have enough energy to stay within the NFE” or “is my energy state sufficient to maintain level flight”?

Course developers should include a suitable learning model for energy management in their UPRT course, an example is provided in Section 11 in this manual.

[6] See Section “Training envelopes” in this manual.

Section 6—Practical Training

6.1 Conceptual Aspects

Upset prevention and recovery is not an isolated "art", it should be embedded in today's current safety concept of Threat and Error Management (TEM)[7]. This is why TEM is described, in this manual, under "Practical training".

6.2 UPRT, TEM, CRM and the Pilot Competencies

AUPRTA Rev.3 defines an airplane upset as an undesired airplane state. Undesired aircraft state is an element of TEM, as described in ICAO documents. Threats and errors may cause undesired aircraft states.

AUPRTA groups the causes of upsets into *environmentally-induced, systems-induced* and *pilot-induced*.

Due to the infinite number of variables that comprise upset situations, it is impossible to cover all upsets during training. Some situations will always remain unforeseeable and pilots may be confronted with events they have not been explicitly prepared for.

Competency-based Training and Assessment (CBTA) aims at preparing flight crews to better cope with the *unforeseen* by shifting the training focus from replicating known events to developing the underlying pilot and instructor competencies.

Note: ICAO Doc 9995, *Manual of Evidence-based Training* (Section 7.6.1) states, "The purpose of the scenario-based training phase is to develop, retain and practice the competencies for effective management of threats and errors to enhance the crew's ability to cope with both predictable and unforeseen situations."

The new definition of "Competency", as proposed by ICAO, focuses on the prediction of successful human performance on the job, mobilizing the relevant knowledge, skills and attitudes.

Note: ICAO describes knowledge, skills and attitude as:

- Knowledge is specific information required to enable a learner to develop and apply the skills and attitudes to recall facts, identify concepts, apply rules or principles, solve problems, and think creatively in the context of work.

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[7] Threat and Error Management: ICAO Doc 9683 Human Factors Manual, Doc 9803 LOSA, Doc 9868 PANS-TRG

- A skill is an ability to perform an activity or action. It is often divided into three types: motor, cognitive and metacognitive skills.
- Attitude is a persistent internal mental state or disposition that influences an individual's choice of personal action toward some object, person or event and that can be learned. Attitudes have affective components, cognitive aspects and behavioral consequences. To demonstrate the "right" attitude, a learner needs to "know how to be" in a given context.

In the TEM framework, competencies are the individual and team countermeasures against threats, errors and undesired aircraft states. They are the tools against the "ever present rain" of threats, errors and undesired aircraft states. Their continuous application is necessary for the *prevention* of undesired aircraft states and is needed during the *recovery*. Instructors should therefore highlight how TEM can effectively be used in UPRT.

Operators are encouraged to develop their Adapted Competency Models using the set of pilot competencies suggested by ICAO. CRM skills are embedded in the pilot competencies and remain a special training focus.

Notes:

1. During the last decades, the huge potential of TEM has been discovered by the industry. TEM has evolved from being solely a tool for Line Operations Safety Audits (LOSA) to being a practical tool in training. Its biggest advantage is that it can be applied consistently and practically at all levels of training, from licensing training with the ATO to operator training.
2. IATA supports the "total systems approach", which suggests using one defined set of pilot competencies throughout the entire career of a pilot. The same competencies would be trained and assessed throughout the entire pilot's path, starting with pilot aptitude testing, continuing through licensing training (MPL, CPL and ATPL) and to operator training programs.

   Training program evaluation would then be based on consistent performance data from all phases of pilot training.

The diagram below shows the integration of the competencies as Individual and Team Countermeasures in the TEM model. The term Core-Competencies originates from ICAO DOC 9995 and may be replaced in the future by "Pilot competencies" and "Instructor/Evaluator competencies".

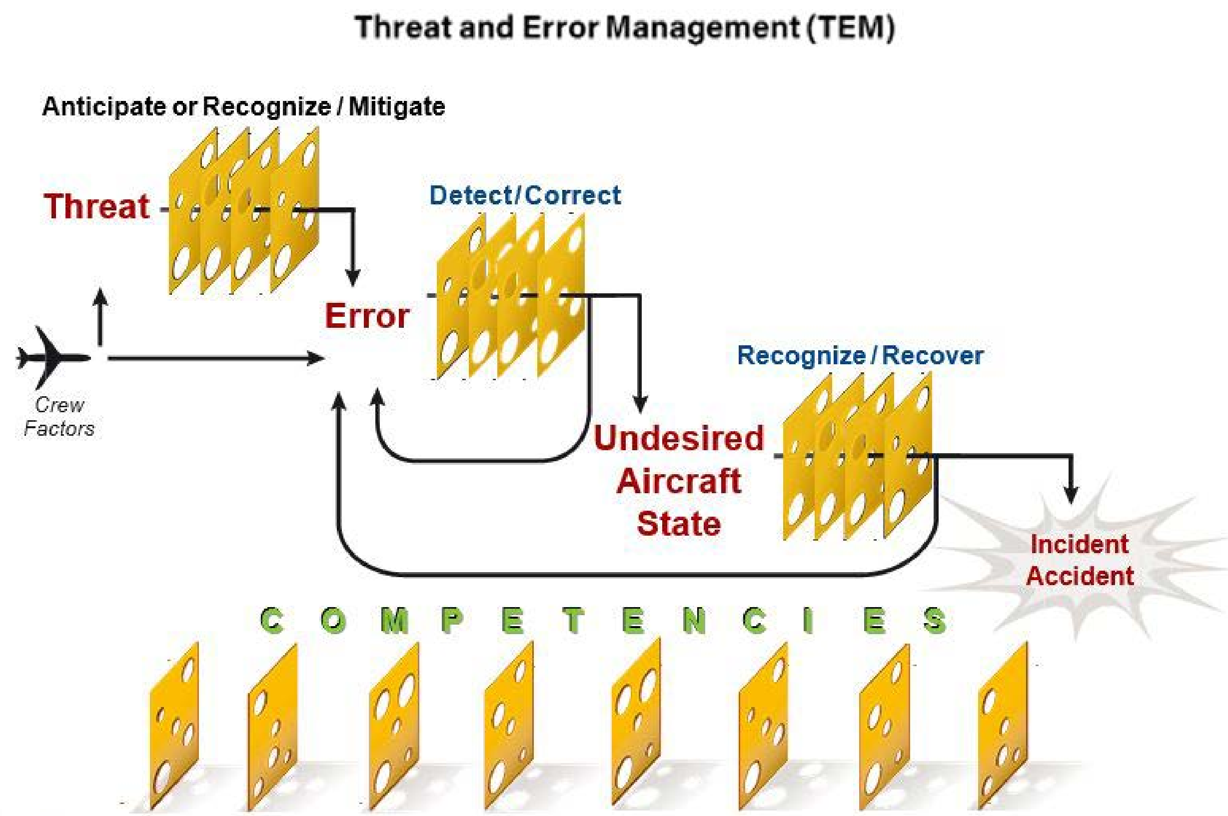

Figure 1. Integration of competencies in the TEM model to prevent, recognize and recover undesired aircraft states.

6.3 Flight Crew Discipline

A professional attitude is the key foundation of every competency. "Failures of flight-crew discipline can – in a single instant – overcome years of skill development, in-depth systems knowledge and thousands of hours of experience", this verdict of an experienced aviation expert should encourage instructors to reinforce the importance of discipline in the cockpit. Flight crews should understand that it is vitally important to avoid inattention and to fight complacency. Their goal should be to continuously perceive and comprehend all relevant information and to anticipate what could happen that may affect their operation.

"What would you do if…?" reflections, especially during phases of low workload, have a beneficial effect on the response to stress in situations of surprise. "The hypothesis was that simply talking about novel events and creating solutions in a relaxed, stress free environment, would allow pilots to develop a cognitive "pre-plan" that could be stored away as a long-term memory, to be revisited in the event that such a situation, or even some unrelated novel event, ever occurred for real. Having a "model" solution to a complex problem already stored away, lets individuals use that knowledge to resolve future situations very quickly, simply by using or modifying a solution which has already been determined to work. The alternative, where a complex novel situation is encountered without having been previously considered, requires an enormous amount of cognitive effort, at a time when information processing is severely impaired by stress, and possibly at the expense of other processes such as situation awareness"[8].

To avoid erosions of discipline over time, pilots should also be mindful of and maintain obvious basics such as correct seating position, fastened seatbelts, as well as permanent situation awareness of the airplane's energy state and flight path.

6.4 Monitoring and Situation Awareness

Monitoring is a crew effort (PF and PM), it is not only the PM's responsibility. Flight path monitoring already begins at ground operations.

In the context of undesired airplane states, active monitoring means keeping track of the environment, the airplane's energy state and flight path trajectory[9]. This helps crews anticipate future airplane states and assists in detecting deviations and take corrective actions in a timely manner.

Effective fight path monitoring results in increased awareness and avoidance of threats and errors related to undesired aircraft states; therefore, it plays a key role in the prevention part of UPRT.

Recent guidance is available from the following studies:

- IATA Guidance Material for Improving Flight Crew Monitoring, 2016
- CAA Paper 2013/02, *Monitoring Matters*
- Flight Safety Foundation, November 2014, *A Practical Guide for Improving Flight Path Monitoring*

Correlations exist between monitoring and the TEM performance of flight crews. LOSA data show that effective monitoring and crosschecking occur on flights that have fewer mismanaged errors and undesired aircraft states[10]. UPRT-specific monitoring techniques, or crew cooperation procedures specifically addressing the important role of the PM in undesired aircraft states, still need to be developed.

In some instances, the PM may be more aware of the airplane state than the PF. Training should emphasize crew interaction to vocalize any unintentional airplane divergence at its first indication. A progressive intervention strategy is initiated by communicating a flight path deviation (alert), then suggesting a course of

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[8] Wayne L. Martin, Patrick S. Murray, Paul R. Bates, What would you do if....? Improving pilot performance during unexpected events through in-flight scenario discussions, Aeronautical, Issue 1, 2011

[9] AUPRTA Rev.3

[10] FSF, Nov. 2014, A Practical Guide for Improving Flight Path Monitoring

action (advocacy and assertion), and then directly intervening, if necessary, by taking the controls to prevent an incident or accident[11].

Active engagement in monitoring will increase situation awareness and help pilots adapt to difficult situations. This will also reduce stress response, such as surprise and startle. "An un-engaged pilot will need to regain situational awareness in order to identify the situation. Only an engaged (and therefore situationally aware) pilot/crew can effectively recover from an upset"[12].

Recovery from upset is not trivial, it requires that pilots avoid fixation and recognize and confirm the situation before reacting.

6.5 Flight Path Management – Manual Flying Skills

Flight crews manage the airplane's flight path using a combination of automation and manual handling. Continuous use of autoflight systems could lead to degradation of the pilot's manual handling skills and ability to recover the aircraft from an upset[13]. As manual handling errors have been increasing[14], operators and authorities have recognized that operators need to enhance the manual flying skills of flight crews. This includes new guidance by regulators[15], OEMs, and the review of operator policies to promote manual flying and manual throttle/thrust operation where appropriate in line operations, and the respective adaptation of recurrent training programs in FSTDs.

When implementing UPRT, operators should consider combining UPRT with manual flying skills training to allow flight crews to gain proficiency. This includes unplanned transition from automated to manual flight, and transition from using a flight director to "raw data", as applicable. AUPRTA Rev. 3 presents OEM Recommended Training Sequences which "effectively teach the trainee when (or if it is necessary) to disconnect the autoflight system".

6.6 Scenario-Based Training, Maneuver-Based Training

As a basic rule maneuver-based training should precede scenario-based training. From a training perspective, it is important to understand how the methodologies of scenario- and maneuver-based training are linked to the training objectives of *prevention* and *recovery* during UPRT.

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[11] AC No:120-111

[12] AUPRTA Rev.3

[13] AC No:120-111 3-b

[14] FAA SAFO 13002

[15] EASA SIB 2013-05

6.6.1 Scenario-Based Training and Upset *Prevention*

Training scenarios should be designed in a way that crews can develop the competencies to recognize and manage threats, errors and undesired aircraft states successfully and achieve a safe outcome. Scenario-based training requires flight crews to use all pilot competencies to recognize and manage threat and errors.

The ultimate training objective of scenario-based training is to take appropriate and timely measures to prevent further divergence from the intended flight path. Scenario-based training is therefore ideal for upset prevention training; to avoid negative training, scenarios leading to upsets, despite correct intervention by the crew, are not recommended. Therefore, the methodology of scenario-based training mainly serves *prevention* training.

Note: Operators should work with their OEMs when designing scenarios to ensure that all assumptions related to aircraft behavior are valid. It is advisable to group the scenarios by upset-inducing causes when creating a scenario database for UPRT (1. Environmentally-induced, 2. Systems-induced, 3. Pilot-induced) and use the OEM Recommended Training Sequences of AUPRTA Rev.3.

6.6.2 Maneuver-Based Training and Upset *Recovery*

Recovery training should be delivered as maneuver-based training; it is assumed that prevention has failed and that an upset condition exists. The instructor, not the crew, takes responsibility for the creation of the upset condition. Training starts after the upset condition has been established. Reasons/causes for upset conditions may be taken from case studies, but they should not be the responsibility of the crew under training.

The ultimate training objective for the trainees is to analyze the situation, perform initial control inputs appropriate to the situation, recover from an upset, manage the energy, arrest the flight path divergence and recover to a stabilized flight path. It should be noted that recovery training addresses only a limited number of pilot competencies, such as Situation Awareness, Communication and, mainly Flight Path Management – manual control.

6.7 Training Envelope

All UPRT should remain within an "area", or envelope, where "realistic" data describing the aircraft behavior are available. Various definitions of flight envelopes exist that serve flight testing, certification and air operations.

Note: As an example, some of the "envelopes" are Aeroplane Operating Envelope, Operational Envelope, Flight Envelope, Service Envelope, Safe Envelope, Protected Envelope, Flight Maneuvering Envelope, Limit Flight Envelope, Operational Flight Envelope, Normal Flight Envelope, etc.

6.7.1 The FSTD Training Envelope

To improve existing technical standards and introduce new ones, FAA and EASA have amended and widely harmonized 14CFR PART 60 and EASA CS FTSD(A). These new and improved technical standards are intended to fully define FSTD fidelity requirements and technical evaluation standards for conducting UPRT, and other flight training tasks introduced through recent changes to operator training requirements, such as takeoff and landing maneuvers in gusting crosswinds, bounced landing recovery maneuvers and maneuvers in airborne icing conditions.

OEMs and FSTD manufacturers offer updated simulator data packages supporting the FSTD envelopes required by the FAA and EASA.

Two FSTD envelopes have been defined:

1. The FSTD Validation Envelope, comprising the following three subdivisions:
    a) Flight-test-validated region
    b) Wind tunnel and/or analytical region
    c) Extrapolated
2. The **FSTD Training Envelope,** meaning the high (flight-test validated) and moderate (wind tunnel and/or analytical) confidence regions of the FSTD validation envelope.

To avoid negative training and negative transfer of training, UPRT in FSTDs should stay within the FSTD Training Envelope.

6.7.2 The Normal Flight Envelope (NFE)

The established boundary of parameters associated with the practical and routine operation of a specific aeroplane that is likely to be encountered on a typical flight is referred to as *Normal Operating Flight Envelope* (term used in FAA documents), or *Normal Flight Envelope* (NFE), term used in EASA documents.

Prevention training focuses on awareness and avoidance of upsets; this may include developing upsets leaving the NFE.

Recovery exercises assume that the NFE has unintentionally been exceeded and upset conditions exist. The training objective is to effectively apply recovery techniques and procedures to return to a stabilized flight path within the NFE.

6.7.3 Staying within the FSTD Training Envelope

The newly defined FSTD Training Envelope provides a level of fidelity (the level of cueing, simulator modeling, visual, motion and environmental features) sufficient to support *prevention* and *recovery* training as required by EASA and FAA. However, EASA and FAA requirements differ substantially with respect to stall recovery training.

While Extended Envelope Training under FAA must include instructor-guided hands on experience of recovery from *full stall* and stick pusher activation (if equipped). EASA considers approach-to-stall recovery as sufficient and does not require operators to perform full stall recovery training.

However, should an operator decide to perform full stall recovery training as an option, CS FSTD(A) provisions are in place to qualify FSTDs in a very similar way to FAA regulations.

Both, PART 60 and CS FSTD(A), require High Angle of Attack Model Evaluation for FSTDs which are used for stall recovery training.

Note: The FAA term "Full Stall" means the same as the EASA terms "Post-stall" and "Stall". The EASA term "Stall event" means either an approach-to-stall or a stall.

Note: EASA defines High Angle of Attack as "flying at an angle of attack higher than in normal operation beyond the first indication of stall or stall protection systems, whichever occurs first."

High angle of attack modeling intends to evaluate the recognition cues and performance and handling qualities of a developing stall through the stall identification angle-of-attack and the recovery.

Recognition cues from the *first indication of stall until the stall break* must be type specific. Recognition cues and handling qualities *from the stall break through stall recovery* must be sufficiently *exemplar* of the airplane being simulated to allow successful completion of the stall recovery training tasks.

Note: For the purposes of stall maneuver evaluation of the FTSD, FAA defines the term "*exemplar*" as "a level of fidelity that is type specific of the simulated airplane to the extent that the training objectives can be satisfactorily accomplished".

For the same purpose, EASA uses the term "*representative*" and defines it also as "a level of fidelity that is type-specific of the simulated aeroplane to the extent that the training objectives can be satisfactorily accomplished."

The FSTD operator must declare the range of AOA and sideslip where the aerodynamic model remains valid for training.

For stall recovery training tasks, FAA requires satisfactory aerodynamic model fidelity through at least 10 degrees beyond the stall identification AOA.

Under EASA the validity range is not specified, CS FSTD(A) only states that "satisfactory aerodynamic model fidelity must be shown through stall recovery training tasks", and, "for the validity range, the modelling continuity should allow for an angle of attack range that is adequate to allow for the completion of stall recovery".

For aeroplanes equipped with a stall envelope protection system, the model should allow training with the protection systems disabled or otherwise degraded (such as a degraded flight control mode as a result of a pitot/static system failure).

Within the declared validity range, the FSTD model must incorporate, where applicable by aeroplane type, the following stall characteristics:

- degradation of the static/dynamic lateral-directional stability
- degradation in control response (pitch, roll, and yaw)
- uncommanded roll acceleration or roll-off requiring significant control deflection to counter
- apparent randomness or non-repeatability
- changes in pitch stability
- stall hysteresis
- Mach effects
- stall buffet, and
- angle of attack rate effects

These characteristics are of vital importance for two reasons: first, some of them provide natural (and therefore reliable under all conditions) warnings for pilots of an impending stall, and second, they constitute the key challenges for the flight crew during recovery.

UPRT course designers should highlight that prevention exercises (approach-to-stall, ending at the first indication of an impending stall, remaining well below the critical AOA, possible in FSTDs without High AOA Modelling) are not comparable to stall recoveries.

The fact, that pilots will always apply the same SOP for both, approach-to-stall exercises (stall prevention) and for stall-recoveries, should not distract from the fact that under the presence of the above described flight characteristics, the level of stress and the required manual flying skills are significantly higher during recovery from stall. Additionally, the applicability of certain steps in the SOP and the magnitude of control inputs may differ.

Note: For the purposes of determining the FSTD validity range, the *stall* identification AOA has been defined as the AOA where the pilot is given a clear and distinctive indication to cease any further increase in AOA, where one or more of the following aerodynamic characteristics occur.

- no further increase in pitch occurs when the pitch control is held at the full aft stop for two seconds, leading to an inability to arrest the descent rate;

- an uncommanded nose-down pitch that cannot be readily arrested, which may be accompanied by an uncommanded rolling motion;
- buffeting of a magnitude and severity that is a strong and effective deterrent to a further increase in the angle of attack;
- activation of a stick pusher.

It is important to respect the FSTD Training Envelope. Exercises outside this envelope can create misperceptions, as the FSTD's simulation model may not satisfactorily represent the airplane behavior. Therefore, exposing crews to un-validated flight regimes should be avoided. If the FSTD is not qualified for stall recovery, training should be limited to approach-to-stall training.

Before submitting UPRT programs to the Authorities, operators should cooperate with the FSTD manufacturer to ensure that each exercise contained in the UPRT program can be performed within the FSTD Training Envelope.

EASA and FAA regulations require Instructor Operating Stations (IOS) to be equipped with enhanced instructor tools allowing accurate feedback during UPRT and showing performance, and convey:

- The FSTD validation envelope
- Flight control inputs
- Airplane operational limits
- Optionally, a recorded feedback mechanism

6.7.4 FSTDs, Required Levels of Qualification

FAA has mandated extended envelope training to be conducted in Full Flight Simulators (FFS), Level C or D, during initial, transition, upgrade, and recurrent training. Other flight training that is part of UPRT, but not required by regulation to be conducted in an FFS, may be conducted in another type of FSTD. However, the FSTD should have the level of fidelity required to meet the learning objective. Training providers are encouraged to use the highest level FFS available when developing their UPRT curriculums[16].

EASA requires FFS, Level C or D for *recovery* training under Part ORO, under certain conditions a Level B FFs may be qualified.

Both regulators will provide provisions for cases were such FSTDs for a specific aircraft type should not exist or are not available.

[16] U.S. Department of Transportation, FAA, NOTICE N8900.241

6.8 Training Policies from the OEMs – Liability Aspects

Most aircraft manufacturers have included UPRT in their basic documentation for flight crews. Some OEMs provide additional specific UPRT guidance documents. When designing their UPRT programs, operators should always follow the guidance provided by their aircraft OEM as it may be more restrictive than the AUPRTA.

FAA advises operators to also consult the Flight Standardization Board (FBS) reports. EASA has implemented the concept of Operational Suitability Data (OSD) covering this issue. Type-specific SOPs and recommendations from the OEMs take precedence over the general guidance from ICAO and national ACs or SIBs. In the absence of type-specific OEM-approved SOPs or recommendations, the AUPRTA applies. As AUPRTA REV3 has been jointly developed by Airbus, ATR, Boeing, Bombardier, Embraer and ICAO it can be assumed that all exercises contained in the AUPRTA are compliant with regulations and with OEMs guidance, and that there are no technical objections against these exercises.

Operators should work closely with Authorities and OEMs when wishing to design their own UPRT exercises. This would present a significant challenge to operators because normally operators are not in a position to fully evaluate the type-specific technical implications of "self-made" exercises. Therefore, operators should carefully evaluate all aspects when developing training with exercises and scenarios other than those recommended by OEMs, ICAO, NAAs or the AUPRTA, and should submit scenarios or exercises, not included in the OEM Recommended Training Sequences of the AUPRTA, to the OEM for consultation.

Section 7—The "OEM Recommended Training Sequences"

Airbus, ATR, Boeing, Bombardier, Embraer and ICAO have created Recommended Training Sequences in the AUPRTA Rev. 3. The training sequences are grouped by:

- Aircraft Handling Characteristics
- Upset Recognition and Recovery
- Stall
- Environmental Factors
- Wake Vortex
- Mechanical / System-Induced
- Pilot Factors

Each topic consists of the exercise conditions, training objectives, description and rationale. The scenarios provided address both prevention and recovery training. Recovery techniques comprise recommendations for Nose-HIGH and Nose-LOW situations. For stall recovery, the AUPRTA refers solely to the OEM procedure.

The table below shows an outline of the OEM recommended training sequences:

AUPRTA OEM Recommended Training Sequences		
1	**Aircraft Handling Characteristics**	
	1.1	Pitch Capabilities
	1.2	Roll Capabilities
	1.3	Use of Rudder Demonstration
	1.4	Energy Management
	1.5	Buffet
2	**Upset Recognition and Recovery**	
	2.1	Nose High / Nose Low
	2.2	Spiral Dive
3	**Stall**	

4	**Environmental Factors**	
	4.1	Mountain Wave, Rotor Cloud, Horizontal and Vertical Windshear
	4.2	Effect on Icing on Turboprop Airplane Performance (PROP)
5.	**Wake Vortex**	
6.	**Mechanical / System-Induced**	
7.	**Pilot Factors**	
	7.1	Loss of Situation Awareness
	7.2	Autoflight System Induced

When designing an UPRT course, designers should use the training sequences recommended in the AUPRTA in combination with the UPRT guidance of the respective aircraft OEM.

Section 8—Instructors

8.1 Regulatory Aspects

ICAO has mandated UPRT for MPL, type-rating and recurrent training, and recommended it for CPL courses. Instructor qualification requirements are specified by the national authorities.

AC No: 120-111 Chapter 2 describes instructor requirements, training and standardization/validation under FAA. EASA describes the instructor requirements in Air Operations Regulation PART ORO; further regulations for instructors under Aircrew Regulation PART FCL are expected to come into effect in early 2019.

ICAO Doc 10011 Chapter 5, Paragraph 5.2, states that "Regardless of an individual's background, all instructors assigned to provide training in a UPRT programme should successfully complete a UPRT instructor qualification training course approved by the Licensing Authority."

It is expected that in the future:

- Risk assessment of on-aeroplane UPRT may lead to special qualification requirements for UPRT flight instructors
- Instructor training courses for FTSD instructors will include UPRT elements
- Operators and ATOs will be required to provide appropriate UPRT instructor training courses (train-the-trainer courses) to their existing instructors before they can deliver UPRT

There is consensus that special emphasis on instructor training is needed as "In UPRT the safety implications and the consequences of applying poor instructional technique or providing misleading information are arguably more significant than in some other areas of pilot training"[17].

8.2 Training and Standardization

8.2.1 The Core-Group

When starting a UPRT project, operators should first select an individual or a team to be charged with the design and implementation of the program. This team should form the core-group of instructors to setup the UPRT program. As an example, operators with several fleets might select two instructors per fleet as core instructors.

[17] ICAO Doc 10011 Chapter 5, Paragraph 5.1.1.

The core-group will first acquire expertise, then design the program, thereafter start UPRT and in parallel train the remaining regular instructors of the operator for that task.

Thorough training and standardization of the core-group is key to success as the core-group will be tasked with training and standardization of all regular instructors later on. When selecting instructors for the core-group the following aspects should be considered:

- Motivation to deliver UPRT
- All-attitude flying experience (civil or military, UPRT or aerobatics)
- Experience as a Flight Instructor
- Experience as a Test Pilot
- Experience as FTSD Instructor
- Scientific degree in aerodynamics

Instructors selected for the core-group should then be qualified through a UPRT train-the-trainer course.

8.2.2 Train-the-Trainer Course for Core-Group FSTD Instructors

The aim of the train-the-trainer course for core-group FSTD instructors is to qualify them to deliver UPRT and to enable them to train the remaining regular instructors of the operator.

As an example, the initial course for core-group FSTD instructors may include:

Pre-studies and Academic instructor training
On-aeroplane UPRT (human factors – counter intuitive behaviors)
FTSD training

The operator may build an "in-house" train-the-trainer course (if possible supported by experts, i.e., Training Captains with previous experience as test pilots, etc.) or send the core-group to an experienced UPRT provider. Typically train-the-trainer courses take 4-5 days and contain academic, on-aeroplane and FSTD training. Academic training elements for instructors include knowledge and use of the FSTD, including the FSTD Training Envelope, motion capability, human factors during upsets (see also Section 8.3.4), UPRT related functions of the IOS and instructional aspects specific to the delivery of UPRT[18].

Notes:

1. ICAO Doc 10011 Chapter 5 and AC No: 120-111 Chapter 2.5 describe training elements and subject areas of instructor training to ensure accurate UPRT and to minimize the risk of negative transfer of training.

[18] ICAO Doc 10011, Section 5

2. On-aeroplane training for the core-group instructors is not a requirement. It is recommended however to allow the core-group to acquire first-hand experience of the success-critical human factors during recoveries of upsets. The core-group will later-on train the operator's regular FSTD instructor staff, who normally do not possess this experience and will have to rely on the expertise of the core-group to compensate for this gap.
3. New FSTDs are also available for specialized additional instructor or pilot training. They are presently not qualified under EASA or FAA regulations; however, they offer extended hexapod modes, aerodynamic models with extended validity ranges of AOA, enhanced motion cueing and, in some cases exposure to sustained G-loading.[19]

FSTD instructor training for the core-group should include a part where the instructor flies the recovery maneuvers as a trainee, and a second part where he practices teaching under supervision. Such instructor training does not necessarily need to be type-specific, as in some cases the core-group will be composed of instructors of several fleets, and fleet-/type-specific UPRT program variants will have to be developed by them in the next step.

Once qualified, the core-group will develop the operator's type-specific UPRT programs for each fleet (ideally in cooperation with the OEMs) and finally submit them for approval to the authority.

Before qualifying the remaining regular FSTD instructors of the organization, it would be beneficial for the core-group instructors to gain experience in the delivery of UPRT by teaching trainees for a certain time. Ideally, this phase would be supervised/accompanied by an experienced mentor, preferably from the initial UPRT train-the-trainer course.

8.2.3 Regular Instructor Training

The authority should be involved again when designing the instructor training course for the remaining regular instructors of the organization. This course should be type-specific and will normally be conducted in the operator's FSTDs.

As a minimum the course should include:

Pre-studies and Academic instructor training
FTSD training – Plus*

Academic and FSTD training can be structured in the same way as for the core-group.

* As regular instructors might not receive on-aeroplane UPRT, additional emphasis should be placed on their ability to teach the human-factor effects during recovery exercises in the absence of realistic motion cues in FSTDs.

[19] JOURNAL OF GUIDANCE, CONTROL, AND DYNAMICS Vol. 40, No. 4, April 2017, Motion Simulation of Transport Aircraft in Extended Envelopes: Test Pilot Assessment

When selecting and qualifying new instructors, the operator should consider requiring recent on-aeroplane UPRT experience or including such training in the initial instructor training course. EASA is expected to recommend on-aeroplane UPRT for new Type Rating Instructors (TRIs) with the amendment of Aircrew Regulation PART FCL in 2019.

8.2.4 Standardization

New UPRT instructors should teach under the supervision of a core-group instructor until they are competent in delivering the course. Thereafter UPRT should become a regular topic of the existing instructor standardization program; it can be included in instructor meetings, instructor assessments, etc. AC No: 120–111 Chapter 2–6 divides Instructor Standardization into Initial Standardization Validation and Continuing Standardization.

In general, standardization topics should include:

- Correct demonstration of the operator's/OEM's recommended upset recovery techniques and SOPs
- Ability to distinguish between SOPs and recommended techniques
- Understanding of the importance of adhering to the scenarios that have been validated by the training program developer, and correct facilitation of the scenarios to trainees
- Capabilities and limitations of FSTDs:
    - Understanding of the capabilities and limitations of the FSTD used for each UPRT exercise
    - Understanding the fidelity of the FSTD with regard to MACH buffet and STALL buffet
    - Appropriate use of the Instructor Operating Station (IOS) of the FSTD in the context of effective UPRT delivery
    - Appropriate use of the FSTD instructor tools available for providing accurate feedback on flight crew performance
    - Awareness for the potential of negative training that may exist when training outside the capabilities of the FSTD
- Understanding the missing critical human factor aspects due to the limitations of the FSTD's motion system, and conveying this to the trainees to support their resilience.

8.3 Instructors, Practical Guidance

The topics contained in this section are selected highlights, but not a complete list, from various source documents and are intended to support instructors and operators when developing the instructor training course.

8.3.1 Understanding AOA

Instructors should ensure that trainees know:

A) If, and where, the AOA can be identified on the flight instruments

B) That critical AOA at a given aircraft configuration depends on Mach-No.

C) That critical AOA at high Mach-No. is lower than at low Mach-No.

D) That critical AOA increases significantly when slats are extended

E) That critical AOA decreases when trailing edge devices (flaps and ailerons) are extended.

F) That stall is always related to high AOA

G) That stall can occur at any attitude

H) That stall can occur at any airspeed

I) That stall always occurs at the critical AOA, but at various airspeeds

J) The relation between Airspeed, AOA, G-Load and stall-speed

8.3.2 Teaching the Stall Recovery SOP

Instructors should ensure that:

A) They do not distinguish between approach-to-stall and aerodynamic stall conditions and instruct trainees to always immediately react to any stall warning[20] by decreasing the AOA (pushing/unloading).

B) They emphasize the natural stall warnings; these warnings are always reliable because they are independent from technical aircraft systems, e.g., buffet will likely precede an impending stall on swept wing airplanes and may even occur before the activation of stall warning devices.

C) Trainees internalize the difference between Stall-buffet, Mach-buffet and atmospheric buffet (turbulence).

D) Trainees understand the benefits of "unloading" when applying the Stall Recovery SOP. Unloading directly reduces the stall speed (ref. Vn-diagram), which might eliminate the stall condition already before / until sufficient airspeed for flight at 1g or higher than 1g is regained.

E) They explain that one-fits-all pitch values for stall recovery do not exist, as the necessary recovery pitch attitude depends on various conditions; e.g., at high altitude pitch attitudes for recovery will be significantly lower than what is experienced at lower altitudes. Additionally, instructors must be aware that their previous experience from approach-to-stall recovery exercises may not be transferable to full stall recovery, because the AOA from which a full-stall recovery is initiated may be significantly higher than the AOA at the first indication of stall.

[20] See Section Definitions related to UPRT for clarification of terms

F) They emphasize that the timing and magnitude of control inputs during recoveries may vary depending on the individual situation; control inputs should be coordinated with the aircraft response as seen on the flight instruments.

G) Besides increasing thrust to regain airspeed, thrust may also be used as a secondary flight control to control pitch movements. In certain stall conditions, and with underwing mounted engines, thrust reduction to induce a nose-down moment may be necessary. The ability to reduce thrust if necessary during a stall recovery is a counter-intuitive action which requires training; in some cases, unlearning of existing habits may be necessary.

8.3.3 Teaching the OEM Recommendations

Flight crews are faced with several SOPs containing memory items. To recover from undesired aircraft states related to LOC-I the predominant SOPs appear to be STALL RECOVERY and UNRELIABLE AIRSPEED. The OEM recommendations for recovery from nose-high and nose-low attitudes are not necessarily procedural as the number of possible upset conditions and energy states is infinite; they are for guidance only and present a series of options for the crew. [21]

To recognize and memorize the small differences in the sequence of steps between the NOSE-HIGH and NOSE-LOW recommendation (they are also referred to as “techniques” or “strategies”) might be challenging for regular crews and distinction from other SOPs might be difficult.

Instructors should, in particular:

- Analyze and fully comprehend the strategies and underlying rationale of the OEM recommendations
- Understand the effectiveness of control surfaces and the order in which the control surfaces lose and regain their effectiveness (e.g., spoilers, ailerons, elevator, etc.)
- Know UPRT related essentials of transport category airplane certification requirements (e.g., CS25/FAR25 stall demonstration, stall characteristics, stall warning, stall reference speed)
- Point out
    - o The necessity for smooth, deliberate, and positive control inputs to avoid unacceptable load factors and secondary stalls
    - o Avoiding cyclical or oscillatory control inputs to prevent exceeding the structural limits of the airplane
    - o Structural considerations, including explanation of limit load, ultimate load, and the dangers of combining accelerative and rolling forces (the ***rolling pull***) during recovery

As a teaching methodology, some operators (see also TCCA for the stall recovery template[22]) support learning of the ICAO/OEM recovery recommendations by offering alternative ways of presenting the recommended steps.

[21] ICAO Doc 10011, 3.5.3

[22] TCCA AC 700-031, 8.3

The following tables show examples and variants of such teaching methodologies. The terms used are examples and are not explained in detail.

Note: The sequential steps shown will not always necessarily trigger actions.

Recognize and confirm
DISCONNECT

UNLOAD	Thrust and Drag as required
ROLL	
STABILIZE	

or

Centralize – Analyze
DISCONNECT

PUSH
ROLL
POWER
STABILIZE

or

Recognize and Confirm – Disconnect

PUSH to UNLOAD	
ROLL	Thrust and Drag as required
STABILIZE	

It is important however for operators to be aware that such methodologies serve as learning aids only and that in all cases where operators might suggest using a technique that differs from the published OEM recommendation, a determination of "no-technical-objection" should be obtained from the respective OEM.

8.3.4 Teaching Human Factors in the FSTD

8.3.4.1 Achieving Resilience

Flight crew resilience has been defined by EASA as "the ability of a flight crew member to recognize, absorb and adapt to disruptions". (A system is resilient if it can adjust its functioning prior to, during, or following events -changes and disturbances, but also opportunities- and thereby sustain required operations under both expected and unexpected conditions.)

Flight crew resilience can be increased by raising the level of ***competence*** and by achieving the appropriate level of ***confidence*** (trust). Besides teaching technical knowledge and skills, instructors should be aware of their obligation to deliver UPRT in a spirit of collaborative learning so that success is possible. Success will allow crews to build positive thinking and confidence that they are able to prevent upsets and to recover successfully. Such experience may positively contribute to resilience and consequentially reduce the level of stress in difficult situations. Lower stress levels will then allow problem-focused coping with the situation and prevent or reduce emotional effects, such as attention channeling and degraded information processing.

8.3.4.2 Deviating from 1g

In simple words, it is common understanding that motion systems of modern full flight simulators are only capable of delivering less than 10% of the real g-loads. Hence, when teaching upset-recovery exercises instructors are faced with the problem that the simulation environment cannot deliver the real sensations associated with the exercises (sometimes referred to as "teaching how to swim without water"). As the human factors in recovery situations are essential, it is up to the instructor to compensate for the shortcomings of FSTD motion by persistently including hints regarding the actual "feel" during the exercises.

Note: First-hand all-attitude on-aeroplane – or extended hexapod + g-load simulation – experience is beneficial to UPRT students and instructors. For many of today's instructors it might have been long ago since they received such training, or some may not have received it at all in their career. Therefore, it might be considered to undergo, or refresh, all-attitude training during UPRT instructor training courses.

G-loads: During an aircraft upset and subsequent recovery, g-loads that vary greatly from the +1g feeling of level flight may be experienced by the crew. Pilots not familiar with such g-load deviations might suffer from degraded perception and psycho-motor performance.

G-loads below +1g: G-loads below 1g may be experienced at any time when unloading the wing to reduce AOA during a STALL RECOVERY or nose-high recovery and therefore are vitally important in UPRT.

Flight close to zero-G removes all "normal" load from the airframe and is structurally benign; G-loadings between +1 and zero create a physiological effect that might feel like "floating". Normal movements of the arms and legs are not affected, but as the loading approaches zero, movements can become uncoordinated because of the lack of normal gravitational cues. Prolonged low-g sensations may lead to regurgitation or vomiting in those unfamiliar with the weightless sensation.

At g-loadings less than zero, unsecured items or personnel will move towards the aircraft "ceiling". Crew will be incapacitated unless secured by belts and will have to maintain a physical effort to keep their feet on the floor or rudder controls. At –1g pilots may experience sensory inputs equivalent to being inverted, even though the aeroplane may be physically upright. Pilots without previous exposure to this situation are likely to be disorientated and incapacitated, thus unable to ensure returning the aeroplane to a normal flight path.

G-loads exceeding +1g: G-loads greater than 1g may be experienced during the later stages of recoveries from Nose-low attitudes, STALLs, or when initiating a PULL-UP maneuver following a GPWS alert. Transport aircraft are certificated to withstand g-loadings in the range of –1g to +2.5g, or +3g for some business aircraft. Sustained high positive g-loadings can induce loss of vision and subsequently loss of consciousness, but not when the duration of the exposure is short, 2-3 seconds, or within the range of –1 to 2,5g.

The increase in limb weight, as the g-loading increases, hinders control inputs for those unfamiliar with the condition. At +2g, most people without prior experience are unable to lift a foot from the floor or to maintain a visual scan of their surroundings. Between +2g and +3g this temporary incapacitation can be easily overcome by trained pilots, but might result in stasis and lack of situational awareness in pilots unfamiliar with the sensations.

G-load tolerance. Exposure during on-aeroplane training or on specialized UPRT platforms[23] to these "unusual" g-loads increases crew resilience by improving g-load tolerance, reduction of disabling symptoms such as startle, and the ability to retain psychomotor functions. Retention of this tolerance relies on the recency and regularity of the exposure.

8.3.4.3 Motion ON or OFF

The use of motion in FSTDs becomes relevant for UPRT when pilots are taught to include this particular stimulus in their prevention and recovery skills. Literature comparing the use of motion versus no-motion in upset maneuvering is available as given below[24] [25].

This literature does not elicit concerns for using typical hexapod motion in UPRT.

Field: "No negative effect was observed when upset or stall maneuvers were flown on motion compared to fixed base, this suggests that motion can be applied for UPRT on conventional simulators."[26]

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[23] Chris Long, CAT Magazine - Issue 6/2014

[24] AIAA 2012–4949, Some Aspects of Upset Recovering Simulation On Hexapod Simulators

[25] 2012–4947, Development and Testing of an Adaptive Motion Drive Algorithm for Upset Recovery Training

[26] AIAA 2012–4948, Developing Upset Cueing for Conventional Flight Simulators

Groen: "Moreover, the study showed no negative effects of conventional hexapod motion versus no-motion simulation on UPRT."[27]

AC 700-031 of TCAA states:

"(1) As an aeroplane approaches a stall, it typically becomes less stable and, in some cases, may even become unstable. This may be characterized by degraded, ineffective or reversed control inputs, or uncontrolled departures from stable flight conditions in roll or pitch. Motion feedback is particularly important as a system becomes less stable, where visual information may not provide timely feedback. The human eyes are relatively slow compared to the vestibular system and visual information may not even be available, depending on the situation or scenario. In the approach-to-stall regime, FFS motion cueing can provide significant benefits to recognizing changes to the airplane stability, and applying proper recovery techniques.

(2) …

(3) Buffet is an important indication of stall and approach to stall. For some aeroplane types, buffet may be the first indication of stall at high altitude or in icing conditions. For training, it is important that the onset and amplitudes of the buffet components are consistent with the occurrence of stall warning and the stall break or critical stall angle of attack. Considerable variation may exist in buffet onset and randomness in the buffet magnitude depending on entry rate and load factor."

When tuned correctly, motion feedback can help pilots recognize upset conditions and trigger timely intervention. Initial accelerations during upsets, such as from a wing-drop during stall events can be simulated by current hexapods devices.

Some aircraft manufacturers explicitly recommend Motion-On or Motion-OFF for certain exercises.

Note: In the Operations Training Transmission OTT-999-0012-17-00 Rev 00 dated 10-FEB-2017 Airbus states "…that the exercises are performed without the use of any motion system if there is a risk to go beyond the FSTD normal law flight envelope. The FSTD crash conditions should be checked and the "crash inhibit" function activated if there is a risk of flight freeze during the exercise."

It can be assumed that modern FSTDs are able to support *prevention* training. For *recovery* training the limitations of motion systems must be carefully observed. The disparity between the real aircraft motion cues and the simulator motion cues increases in upset recovery training compared to prevention training.

Hexapod motion systems are unable to create sustained positive or negative g-loading in the vertical direction, or along the pilot's spine. During recovery from upsets, the airplane may undergo unloading or positive loading, which FFS motion systems cannot replicate. It is impossible to correctly reproduce these motions 1:1 in any device except in the real airplane. Instructors are therefore obliged to point out to trainees that the sensations in the FSTD will vary from the ones experienced on the aircraft.

[27] AIAA 2012–4630, SUPRA – Enhanced Upset Recovery Simulation

As there will indeed be confusing sensations during any real upset condition, it is difficult to conclude that training in a "no-motion-cues" environment would be more adequate.

Therefore, in general, the use of FSTD motion is recommended unless explicitly discouraged by the OEM. "Motion in an FFS should be used when those cues influence recognition or recovery."[28]

Note: When the motion system is turned OFF, the device is being operated as a fixed-base device and is no longer considered to meet the qualification level of a Full Flight Simulator.

8.3.4.4 Visual Meteorological Conditions (VMC) or Instrument Meteorological Conditions (IMC)

The Commercial Aviation Safety Team (CAST) study of 18 accidents and incidents determined that 17 occurred in IMC or at night. Recovery training should therefore be done in both visual and instrument conditions, as well as in day and night.

8.3.4.5 Surprise, Stress and Startle

Stress is an individual's reaction to the perception of threat and it manifests itself physiologically, emotionally, and cognitively. Startle is one of the responses of the human brain to an emotional stimulus. The startle reflex is common to all mammals, birds, reptiles and amphibians. It happens within milliseconds following a startling stimulus, possibly caused by a potential threat. If the threat persists, the startle may transition from a simple aversive reflex to a full-blown startle or surprise reaction (sometimes also referred to as startle response).[29]

Note: "The perception of threat comes about through a conditioning process, a gradual learning of what is fearful and what isn't which we develop throughout our lives. The amygdala, which is part of the emotional centre of the brain, is largely responsible for this appraisal of threatening stimuli, and is continuously involved in evaluating the environment for meaningful components... Where the amygdala does detect something which has been previously associated with harm, threat, loss, or even challenge, then it will induce autonomic bodily reactions to help manage those stressors... These are commonly referred to as "fight or flight" reactions, and involve the activation of the sympathetic nervous system which enables the individual to deal physically with a threatening situation, and to orient the attentional system.

The other role of the amygdala and its related brain structures is the ongoing evaluation of coping mechanisms which would relieve the stress. This "secondary appraisal" is a process designed to alleviate an organism's stress by employing compensatory or coping strategies in order to return it to

[28] FAA AC No: 120-111

[29] Martin, W.L., Murray, P.S., & Bates, P.R. (2010). The effects of stress on pilot reactions to unexpected, novel, and emergency events

a state of homeostasis, or neutrality. These coping mechanisms may be long term strategies (generally called defence mechanisms) or may be short term, dynamic solutions employed to ease the perception of the situation.

Coping mechanisms fall under two distinct categories: problem focussed coping, and emotion focussed coping... Problem focussed coping strategies are generally employed where the individual has some control over the situation and can take some positive action to change or remove the problem... This is largely a rational, orchestrated mechanism which facilitates normal information processing, with nominal working memory and long term memory function.

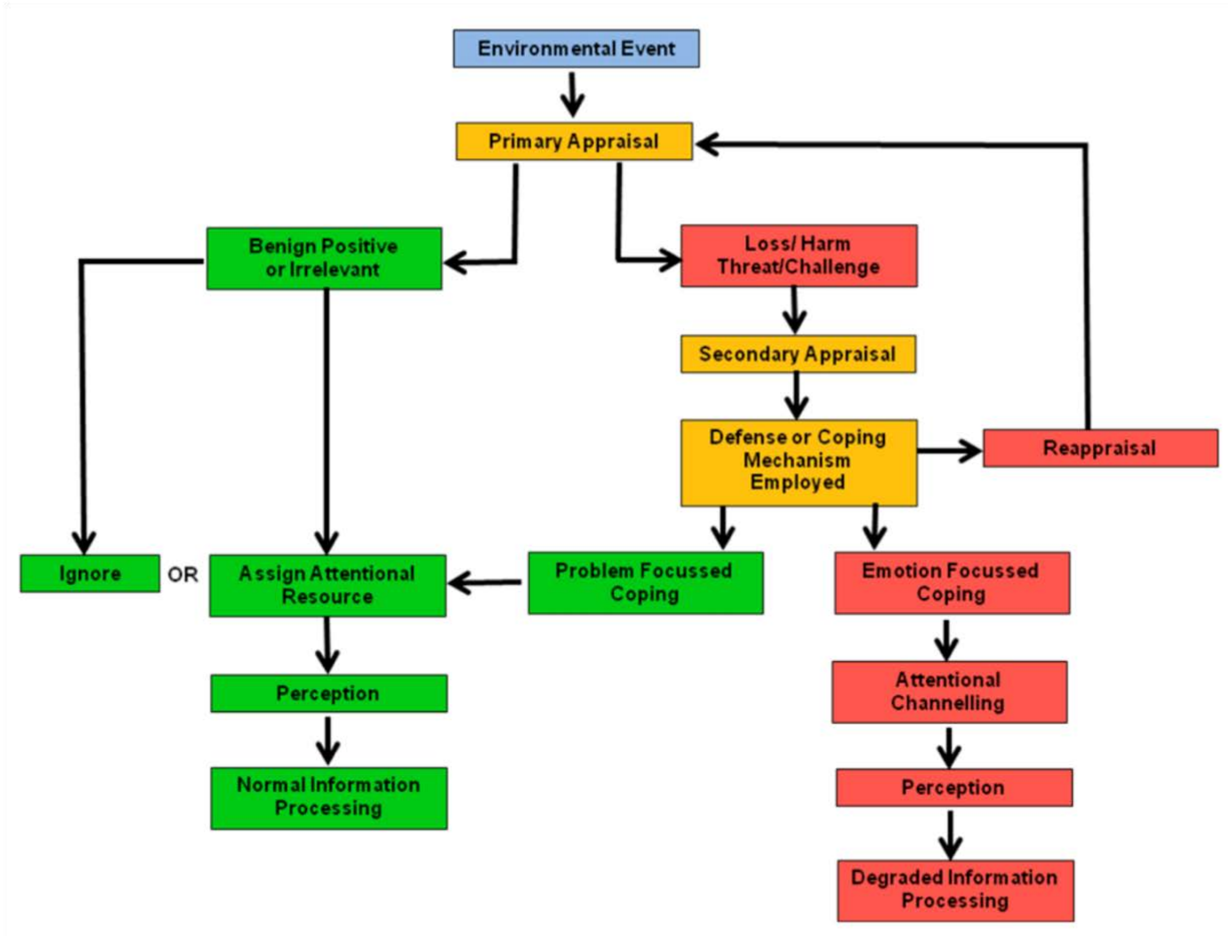
The second form of coping is the principal area for concern. Emotion focussed coping is generally employed where an individual feels no control over the situation, and is forced to take some withdrawal type action to avoid the harsh reality of the situation... Techniques such as denial are common in these types of situations, however other dissociative mechanisms such as freezing may also occur... Any of these emotion focussed coping mechanisms are very likely to be detrimental to situation outcome, and generally involve a partial or total breakdown in normal information processing."[30]

Martin, Murray and Bates[31] propose a certain relationship between appraisal, coping and information processing as provided in the table below.

[30] Martin, W.L., Murray, P.S., & Bates, P.R. (2010). The effects of stress on pilot reactions to unexpected, novel, and emergency events.

[31] Martin, W.L., Murray, P.S., & Bates, P.R. (2010). The effects of stress on pilot reactions to unexpected, novel, and emergency events.

Conceptual Relationship between Appraisal, Coping, and Information Processing



Reactions to surprise and startle are difficult to predict. The behavioral consequences can vary from being passive to uncontrolled instinctive reflexes, instant inadequate motor responses or an emotional shock. "Failure of a relatively simple system (e.g., radio altimeter) may have a cascade effect that may result in catastrophic outcome"[32]. Such effects may also appear at unexpected autopilot disengagements, an overspeed indication, an unexpected behavior of a system, etc. They may be amplified by a lack of proficiency in manual flying skills or inadequate training.

Potentially, surprise and startle can distract and occupy a crew for some time and control inputs may further destabilize the aircraft's flight path. To train crews to manage surprise and startle it is recommended to include elements of "unexpectedness" in UPRT. Scenarios should include the effects of surprise in order to train pilots to face these phenomena and to work in situations with a highly charged emotional factor.[33]

[32] IATA Safety Report 2013

[33] Recommendation FRAN-2012-046

The goal of using startle in training is to provide the crew with a startle experience, which allows for the effective recovery of the aeroplane. Considerable care should be used in startle training to avoid negative learning.[34]

Further guidance on "how to induce startle or surprise" can be taken from the AUPRTA and the ICATEE Research and Technology Report.

> "The surprise factor can be recreated in a simulation environment through the management of pilot's expectations in a training scenario to generate realistic unexpected distractions. Research is required to identify the best methods to introduce cognitive surprise within a training scenario in a realistic manner. In this way, the skills that are required in an unexpected event, such as an upset, can be trained to a level where the surprise factor can be anticipated, and potentially managed. The level to which surprise can be achieved in ground-based simulation that is transferable to the mentally and physically demanding environment of an upset needs to be identified.
>
> The physiological effects of startle that apply to managing an aeroplane upset cannot be fully achieved in ground-based simulation. The inclusion of on-aeroplane training in a UPRT program therefore immerses the pilot within an environment where the startle and surprise factor are present and are an important contribution to the training. The ability to reproduce the key physiological factors of startle in a ground-based simulator is a research topic for future UPRT support. The full effect of startle on the response of a trained pilot has not been analyzed, particularly with respect to upset recovery. This would be an important element of this research. This research would contribute to the definition of the optimum combination of training environments for initial and recurrent UPRT"[35].

8.3.4.6 Counter-Intuitive Behavior

Several vitally important flight control inputs required by pilots during upset recovery maneuvers are considered to be counter-intuitive. Training is needed to enable crews to perform counter-intuitive actions reliably. Some of the conditions requiring counter-intuitive actions are:

- Reducing thrust (with underwing mounted engines) in a stall recovery to achieve a nose-down pitch movement
- Unloading (pushing) during stall recovery in a nose-down attitude
- Unloading (pushing) at high bank angles before rolling wings level
- Not rolling wings level in nose-high situations before pitch attitude is acceptable and airspeed is sufficient
- Maintaining high g-load (up to 2,5g) during Ground Proximity Pull-Up

[34] TCCA, AC 700-031, 7.3.5

[35] RAeS ICATEE Research and Technology Report, Part A, 5.2

FSTD instructors should consider that counter-intuitive actions would be even more challenging under the influence of real accelerations.

8.3.4.7 Avoiding over-confidence

UPRT should be delivered in a very focused and professional manner. When trainees perform well they may be tempted to ask their instructors to try out additional maneuvers, or instructors may wish to add some challenges to syllabi and exercises. Both ideas can easily lead to over-confidence or more likely to failures and affect all previous learning outcomes. Instructors should set an example of flight crew discipline and professional attitude for the trainees.

8.4 Renewing Mental Models of Aerodynamics

The following topics are examples of areas where UPRT may provide an opportunity to realign or refresh previously acquired mental models for the benefit of better understanding prevention and recovery strategies.

8.4.1 Stall Speed is Variable, Unloading May Reduce it to ZERO

The Vn diagram can be used to explain in a practical way that the certified 1g stall speed may be less relevant during actual flight operations, as the aircraft may not be in a 1g condition when it stalls.

Instructors should ensure that trainees know that:

- Stall speed is variable, it depends on g-load
- G-load is induced by elevator input
- The aircraft may stall at any speed
- Unloading is achieved by a nose-down elevator input, “PUSH”
- “PUSH” also applies at bank angles beyond 90 degrees
- Unloading decreases stall speed
- At 0g the stall speed is Zero
- Bank angle per se does not increase stall speed, elevator-induced loading increases stall speed
- By loading or unloading you can increase or decrease stall speed

Discussion:

Wing loading, unloading and stalling speeds: When an aeroplane is flying in other than 1g conditions any change of g-load (induced by any initial elevator input, e.g., during level turning, etc.) changes the stall speed. Critical AOA is then reached at higher or lower airspeeds than in 1g- conditions.

The increase or decrease in stalling speed is related to elevator-induced g-loading only. The related numbers are shown in the following table: angle of bank is only relevant when maintaining altitude which requires increasing g-load to maintain level flight, otherwise the angle of bank has no influence on the stall speed.

Loading increases Vs						
Increased G-loading ("loading")	1.03g	1.15g	1.41g	2.00g	2,5g	3.86g
Increase of Vs	1.4%	8%	19%	41%	58%	96%
Angle of bank **in level turn**	15°	30°	45°	60°	67°	75°
Unloading decreases Vs						
Decreased G-loading "unloading"	0g	0.25g	0.5g	0.75g	1g	
Reduction of Vs	100%	**50%**	**30%**	13%	Vs_{1g}	

The relationship between angle of bank and g-loading or stalling speed is non-linear. The rapid increase of g-loading and stalling speeds at bank-angles in excess of 45°, when maintaining altitude in turning, is of particular interest. As the critical AOA changes with Mach number (at high Mach no. it is lower than at low Mach), g-loading (for example by level-turning) at high altitude is more critical.

If g-loading is reduced to less than 1g, for example in transitioning from a climbing to a descending flight path or by unloading during STALL RECOVERY, the wing may remain un-stalled at speeds well below published 1g stall speed.

Adequate unloading to 0.5g or 0.25g still **maintains positive g-load** of the aircraft (no objects floating around in the cabin or cockpit) but decreases stall speed by 30–50%.

8.4.2 It is Always "Push" to Unload – Even Beyond 90deg of Bank

If the airplane is close to the critical AOA, the unloading action is always to apply a nose-down elevator input (PUSH) regardless of bank angle or pitch attitude.

8.4.3 Stall Warning

Instructors should remind their trainees that besides synthetic indications, natural indications might also precede stall events[36]. Natural Stall warnings may be:

- Reduced roll stability and aileron effectiveness
- Reduced elevator (pitch) authority

[36] See Section Definitions, Stall Warning

- Inability to maintain altitude or arrest rate of descent
- Aerodynamic buffeting (some airplanes will buffet more than others)

The mental model of "how the airplane talks to you" might help trainees be receptive to indications associated with high AOA.

8.4.4 Flight Controls

Instructors should:

- Refresh trainees on the concept and control responses of Primary and Secondary Flight Controls
- Explain that the term "pitch-control" means "elevator / trim" and not pitch attitude
- Explain the use of rudder for normal flight, abnormal and emergency conditions
- Explain the risk of inappropriate rudder inputs
- Explain the conditions under which the use of rudder may be considered during application of the OEM Recommendations for NOSE-HIGH/LOW situations as described in AURTA and ICAO Doc 10011; if available, instructors should refer to the type-specific procedures and recommendations of the aircraft manufacturer.[37]

8.4.5 Energy Management

Instructors should:

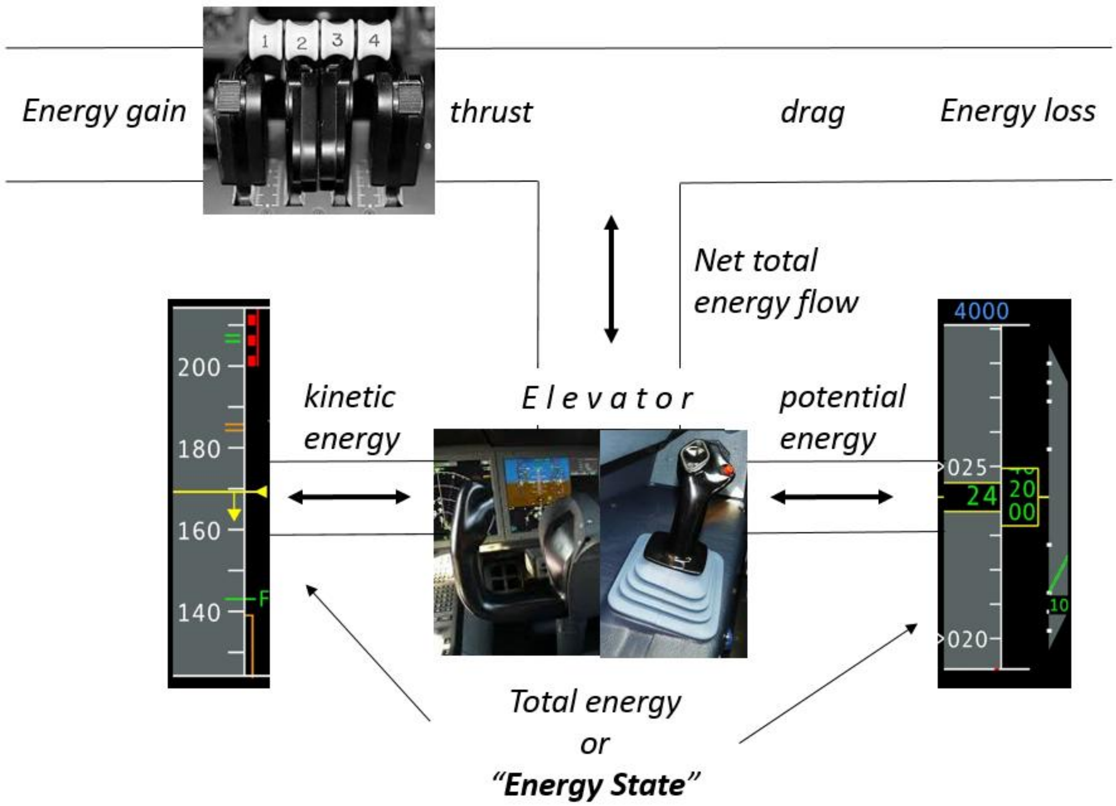
- Refresh the trainees on the 3 types of energy available
- Explain how to determine the "energy state" of the aircraft (there is no direct indication for it)
- Explain how to put the energy state of the aircraft into operational context (e.g., speed *margin* over stall speed and the altitude *margin* above obstacles)
- Explain the difference between thrust and energy state
- Explain energy trading (for example at high altitude)

The following picture shows one of the various models available to illustrate energy management.[38]

[37] ICAO Doc 10011, FAA AC No: 120-111, Proposed AC120-109A

[38] Juan R. Merkt, Flight Energy Management Training: Promoting Safety and Efficiency. Journal of Aviation Technology and Engineering 3:1 (2013) 24–36.

Energy Management Model



In this model the role of thrust and elevator in controlling the aircraft's energy balance is shown. Thrust levers control the energy gain while the elevator, like a "valve", regulates the distribution of net-energy between altitude and airspeed.

8.5 Avoiding Negative Training – Negative Transfer of Training

Course developers should ensure compliance and consistency of their training programs with the regulations, procedures and recommendations provided by Authorities, OEMs and the AUPRTA. Training described in these publications should be sufficient to cover state-of-the-art UPRT. A high risk of negative training is associated with the well-intended design of self-made exercises and is inherent to scenario-design; especially when deriving scenarios from case studies where the affected aircraft type may be different from the type used for the training. In such cases, operators should cooperate with their OEMs to avoid negative training.

Negative transfer of training can occur for example when using FSTDs outside the FSTD Training Envelope and from inappropriate on-aeroplane UPRT. Approach-to-stall and stall training in FSTDs with incorrectly tuned buffet may also not transfer to the real aircraft.

When following the exercises of ICAO Doc 10011 and AUPRTA most FSTDs may be able to provide the required level of fidelity, but course developers need to confirm this before commencing training.

Operators should work closely with ATOs delivering on-aeroplane training to their ab-initio cadets or to pilots wishing to refresh their on-aeroplane experience. As the flight characteristics and control responses of the aeroplanes used for UPRT (normally small propeller driven single engine piston aircraft) may differ from the type of transport aircraft used by the operators, there is a risk of negative transfer of training associated with such training.

On-aeroplane training should therefore focus mainly on the human factors associated with upsets and recovery, and use care when addressing the flying skills. Addressing human factors such as adapting to the impressions of deviations from 1g flight, high bank angles, the ability to perform counter-intuitive actions for recovery and to develop strategies to minimize the effects of surprise/startle, are most valuable aspects of on-aeroplane UPRT. Compared to flying skills, human factors are not specific to the training platform used and there is a low risk of negative transfer when on-aeroplane human factors training is delivered properly.

8.5.1 Instructor-Led Demonstrations

When conducting *recovery* training, the instructor takes the responsibility for setting up the upset condition. This can be accomplished in various ways. Instructors may take a pilot's seat, may use simulator pre-sets or may allow trainees to fly into the upset attitude.

When taking a pilot's seat, instructors should not only setup the upset condition but also be able to demonstrate the recoveries correctly.

Section 9—Assessing Pilots Performance

There is consensus in the training community that UPRT should be non-jeopardy. It is seen as training and not as checking. However, in terms of the instructional system design process, UPRT programs would not be effective without guidance for instructors on how to measure acceptable performance of crews.

Evaluation standards have shifted from precisely defined entry and recovery profiles to more realistic scenarios, with emphasis on recognition and avoidance of the event. The evaluator should also consider the actual conditions/variables.

In the absence of specific regulatory guidance for assessing nose-high, nose-low and high-bank recoveries, existing evaluation criteria for stall recovery may be used to measure crew performance for all *recoveries* of undesired aircraft states. These include:

- Prompt recognition
- Correct application of SOPs or recommendations/strategies
- Appropriate control inputs
- Recovery to the NFE without exceeding the aeroplane's limitations

As the predominant challenge of UPRT lies in the area of prevention, *prevention* training consequentially needs similar guidance regarding acceptable crew performance. For prevention, the recognition and management of threats and errors that may lead to undesired aircraft states is critical for success. In multi-crew operations this is a crew effort and performance should be measured as a crew. It is closely connected to their TEM task and to the application of the pilot competencies as countermeasures against threats and errors. Instructors may benefit from their experience in teaching LOFT scenarios containing conditions such as cold weather operations, all weather operations, windshear, high altitude operations, etc.

Therefore, performance criteria for *prevention* training would be observable behaviors related to:

- Timely recognition of threats and errors
- Effective application of countermeasures
- Recognition of developing upsets, arresting of divergence from the intended flight path, and
- Maintaining the aircraft within the NFE

Operators should have procedures in place to ensure that pilots have reached the required level of performance and to provide training, or re-training, up to proficiency if necessary.

In a similar way FAA AC No: 120-111 Chapter 2 includes Completion Criteria for Prevention, Recognition and Recovery. These completion criteria also highlight PF and PM duties.

Section 10—Operator UPRT Implementation

This Section provides suggestions for the implementation of UPRT programs.

Note: UPRT for "seasoned" pilots should still encompass all relevant topics; previous experience (number of flying hours) alone cannot be assumed to be a measure of competency.

10.1 UPRT in One Additional FSTD Lesson

Several operators have decided to enhance the manual flying skills of their crews by adding an additional FSTD lesson dedicated to the core competency of Flight Path Management, manual control.

The training objectives of UPRT and operational aspects of manual flight could be combined in one recurrent training (RT) lesson. Scenario-based training would thereafter be included in the subsequent lessons of the three-year recurrent training cycle.

The table below provides an example for a "one additional SIM" solution.

Academic UPRT course (i.e., classroom or computer-based self-study)	
One additional RT	• Setup 1 – Advanced handling skills • Setup 2 – AOA and g-awareness • Setup 3 – FAA specialized flight training elements for upset prevention • Setup 4 – Recovery from upsets including stall recovery • Manual flight during normal operations (raw data approach, Go-Around, TCAS, Ground Proximity, OEI at high altitude, etc.)
Existing RT lessons	• Scenario-based upset prevention training and recovery exercises

10.2 UPRT Integrated in Recurrent Training

If operators cannot provide an additional FTSD lesson for UPRT the following table provides an example on how academic and practical training can be distributed over an existing three-year recurrent cycle containing six refresher training lessons (RT1 to RT6).

Note: Operators with an Advanced Qualification Program (AQP) or Alternative Training and Qualification Program (ATQP) should integrate UPRT in conjunction with the current edition of FAA AC No: 120-54 or applicable EU regulations.

The scheme below shows academic training, practical training and also integrates scenario-based prevention training using type-specific SOPs.

Academic UPRT course (i.e., classroom or computer-based self-study)	
RT 1 & 4	• Causes and contributing factors • Case studies • UPRT Academics • Setup 1 – Advanced handling skills
RT 2 & 5	• TEM • Energy management • Flight path monitoring • Setup 2 – AOA and g-awareness
RT 3 & 6	• Aeroplane system induce causes • Setup 3 – Recovery from upsets including stall recovery • Human factors related to upset recovery
SOPs	
RT 1 & 3	• Unreliable Speed, Volcanic Ash, Stall Recovery
RT 5	• Abnormals leading to flight with degraded control laws • Abnormals affecting protection systems

Attachment 1 in this document shows an example of a UPRT implementation plan. It contains the development plan for instructors and a suggestion on how to integrate UPRT into an Evidence-Based Training program.

10.3 Checking and Testing

ICAO Doc 10011 recommends that "…CAAs should view UPRT as purely a train-to-proficiency programme designed to achieve end-state objectives. Accordingly, CAAs should not invoke direct testing requirements on the trainee as part of their oversight process."[39]

(Stall Recovery procedures continue to be required for existing tests and checks.)

[39] ICAO Doc 10011, Chapter 6, Paragraph 6.2.2

Operators should however install a process to validate their approved UPRT program and ensure that it meets its stated training objectives. "…criteria used to determine the programme's success should be based upon the trainees being able to consistently apply effective countermeasures to upset-related threats in a safe and expeditious manner upon completion of the approved training." 45

Section 11—ATOs Serving Operators

Operators engaged in ab-initio schemes should ensure that UPRT delivered by their contracted ATOs is consistent with their own training principles. Operators may also consider using contracted ATOs to offer on-aeroplane training to airline instructors and line pilots.

11.1 On-Aeroplane UPRT in Licensing Courses

EASA Opinion No 06/2017 requires UPRT to be delivered in the form of a special Advanced UPRT Course for the MPL and ATPL Integrated courses, and as a prerequisite prior to commencing the first type rating course in multi-pilot operations.

UPRT in an MPL course must be delivered at three levels:

a) On-aeroplane UPRT in an airplane

b) Multi-crew non type-specific UPRT in an FSTD (basic and/or intermediate phase)

c) Type-specific UPRT in an FSTD of the specific type (latest in the advanced phase)

The general MPL scheme of PANS-TRG suggests that on-aeroplane UPRT be delivered in Phase 2. Some states allocate on-aeroplane UPRT to Phase 1. It is also possible, and there are also good reasons to deliver on-aeroplane UPRT at later stages of the course.

When delivering UPRT, theoretical knowledge, especially in energy management, aerodynamics and aircraft performance (including at high altitude) and the effects of surprise and startle on human performance, needs to be consolidated.

11.2 On-Aeroplane Instructors

UPRT-qualified instructors are essential for this task. Specific instructor training is required prior to delivering UPRT. Whether training is in an FSTD or an airplane, UPRT involves the delivery of complex concepts and relationships, often in a dynamic setting. It is therefore essential to minimize risk through strict and disciplined operational safety management and highly competent instructors.

On-aeroplane and FSTD training should be “from the same page”. Both modules should be interconnected so that they complement each other. Simply put, FSTD training is the “*look*” module and on-aeroplane training is the “feel” module. Therefore, on-aeroplane instructors should also be familiar with FSTD training, especially the type-specific UPRT module, to ensure that negative transfer of training from small aeroplanes to heavy jets is avoided.

Special attention should be given to instructors teaching on-aeroplane training. Required instructor performance in the all-attitude/all-envelope environment is beyond that experienced in normal operations. By no means should an ATO assign this task to flight instructors without specific qualification. On-aeroplane UPRT instructors' training focuses on risk/safety-margin management, strong instructional skills with respect to human factors, students psychophysiological reactions (startle and surprise), confidence building, and in-flight recovery skills when the instructor needs to intervene to maintain flight safety.

On-aeroplane UPRT should be conducted under strict operational control procedures involving appropriate training airspace areas, minimum dispatch and weather conditions, and within a well-structured safety management system (SMS) environment.

ATOs should consider outsourcing the on-aeroplane UPRT to a specialized organization where the availability of suitable aeroplanes and instructors is assured. In case of outsourcing, the ATO remains responsible for the delivery of UPRT as part of the overall licensing program (see Section 3 for examples of other contractual arrangements).

11.3 Benefits of On-Aeroplane UPRT

Compared to, and in addition to teaching flying skills in FSTDs, on-aeroplane UPRT should first and foremost be a confidence-builder. It serves mainly human-factor training objectives and less flying skills training; therefore, the risk of negative transfer of training from small airplanes to large airplanes is mitigated.

On-aeroplane exposure to variations from 1g and training of counter-intuitive behaviors is required for the pilot to build resilience and the psycho-physiological skills required to apply appropriate control inputs in the event of an upset. For optimum delivery of UPRT objectives, the use of an aeroplane capable of all attitude maneuver training would be recommended.

On-aeroplane UPRT can be a valuable tool to build long-lasting confidence for the young pilot. This confidence is psychologically built on realistic proof of the student's ability to control and recover the airplane to normal flight from any upset situation (in terms of pitch-attitude and bank-angle unrestricted) in the "3D" environment. The existence of such proof forms the underlying basis of true confidence and is a prerequisite for the ability to contain the effects and the duration of startle.

Not only the flying skills, but the timely employment of effective strategies to prevent such an occurrence or, if unforeseen, during the actual recovery stage of an upset, should be the success-critical elements in the on-aeroplane UPRT module of an MPL course. The recovery strategies should include how to manage surprise and startle induced by unusual attitudes and stall, and how to perform even counter-intuitive actions under the presence of deviations from 1g flight.

11.3.1 Training Airplanes

ICAO did not mandate the use of aerobatic aircraft for on-aeroplane UPRT but expressed that it does not intend to "dissuade" states and ATOs from using them.

ICAO Doc 10011 states:

> "3.3.1.3 It is important to make the distinction that UPRT is not synonymous with aerobatic flight training. ..... From the human factors aspect, aerobatics does not specifically address the element of "startle". Nor does aerobatic flight training necessarily provide the best medium to develop the full spectrum of analytical reasoning skills required to rapidly and accurately determine the course of recovery action during periods of high stress. UPRT should address these psychological and reasoning responses, which are significant factors in most LOC-I accidents. These skills can be acquired using non-aerobatic aeroplanes, but the range of possible manoeuvres is appreciably smaller than for more capable aeroplanes. Given the resources available within the State, the additional safety benefits and the additional costs, the CAA should consider whether the use of those more capable aeroplanes, providing for an optimum on-aeroplane UPRT experience, are to be required for the issue of either a CPL(A) or MPL. "

and it's Appendix – Competency-Based UPRT Programmes, On-aeroplane training, states:

> "... Use of aerobatic aeroplanes would be the optimum solution to provide maximum training value and safety margins".

Therefore, though Annex 1, PANS-TRG and Doc 10011 do not require all-attitude UPRT and the use of aerobatic aeroplanes, conducting UPRT using such maneuvers and aeroplanes for the MPL provides the most effective training solution.

However, Normal or Utility category aeroplanes (certified to ≤60 or ≤90deg bank) are not suitable to achieve the complete human-factor training outcome and can only provide part of the desired outcome. Technically and operationally the use of Normal or Utility category aircraft for on-aeroplane UPRT may create a substantial safety risks, depending on the training maneuvers.

11.3.2 UPRT is Not Aerobatic Training

On-aeroplane UPRT should not be misinterpreted and approached in the same manner as aerobatic training. Although basic aerobatics do contribute to certain pilot competencies, such as "Airplane Flight Path Management, manual control", and "Situation Awareness", aerobatics are neither required during commercial pilot licensing nor do they contain the same training objectives as UPRT. Simply put, basic aerobatics focus on performing a sequence of precision maneuvers, passing through defined attitudes and using effective energy management.

UPRT focuses exactly on the contrary; the prevention of aircraft states outside of normal operating parameters and the most effective recovery from these abnormal attitudes/speeds, which often result from poor energy management. From that perspective, UPRT modules should be designed to develop the full spectrum of analytical reasoning skills required to rapidly and accurately determine the best course of recovery action during periods of high stress.

Section 12— The Safety Management System (SMS) and UPRT Implementation and Evaluation

The operator's Safety Management System should be utilized to support the implementation of UPRT and the evaluation of the training program.

12.1 Evaluation of the Training Program

Validation of training content and evaluation of the course are of special importance for UPRT programs. It is advisable to follow a structured Instructional System Design (ISD)[40] process. Training and safety management staff should cooperate to validate the program content and perform the evaluation of the training program based on all available data. Ineffective training can be avoided with this methodology.

12.2 Implementation of the UPRT Program

The operator should use its SMS to ensure that the training program itself, or its implementation, will not introduce additional risks or that additional risks are properly mitigated. These risks may occur, for example, when evaluating pilot behavior in unrealistic FSTD scenarios.

The implementation of UPRT should therefore be undertaken with an understanding of the risks associated with inappropriate training, potential mitigations and the validity of such mitigations.

Operators should focus their mitigations on quantified deviations from the normal operating envelope; in other words, on developing upsets instead of developed upsets.

Availability of specific airline data indicating upsets may be limited, but a correlation between the rates of particular upsets and the rates of developing upsets may assist the airline in understanding which type of divergences are the most difficult to manage for pilots. Additionally, data from FSTD training and other inputs of the SMS should be used. By focusing on these areas, there is likely to be more available and relevant data from FOQA and LOSA.

This may help identify the areas of the operation that are most vulnerable to unintentional divergence from the intended flight path or airspeed. Greater exposure to such areas and resilience building in training may then assist pilots to prevent upsets.

[40] ICAO Doc 9868 PANS-TRG, Attachment to Chapter 2

If all divergences are managed before the aircraft is in upset conditions, then the current crew strategies are likely to be successful, which will increase safety.

Section 13—Attachments

13.1 Attachment 1 – UPRT Implementation Plan

5 - step UPRT implementation plan of an operator using EBT and 2 training events of 2 days per year

EBT Module / Recurrent Phase			**3**	**4**	**5**	**6**	**1**	**2**
Start Date			**FEB YY**	**AUG YY**	**FEB YY**	**AUG YY**	**FEB YY**	**AUG YY**
			LOE / LPC	LOE / LVO	LOE / LPC	LOE / LVO	LOE / LPC	LOE / LVO
	Aim	**Media**	**Time scale**					
1.	**UPRT Instructor Core-Group** Training (3 fleets, 6 Instructors)	External provider	JAN – FEB YY					
2.	**Distance Learning** development for: ● All pilots (including exam) ● Recurrent instructor standardization	In-house or purchase	MAR – OCT YY					
3.	**Instructors Training Course** development: ● For all instructors ● Incl. briefing guides for UPRT lessons	In-house or purchase						
4.	**Instructors Training** for ● all regular instructors	● Classroom ● SIM (combined with recurrent instructor standardization)			NOV – JUL YY			
5.	Maneuver-based **UPRT** ● min x hours pilot	Setups 1,2,3 ● Briefing ● SIM				AUG – FEB YY		
6.	Scenario-based **UPRT** ● Recurrent Day 2	EBT Module ● Academic ● SIM					FEB – AUG YY	

13.2 Attachment 2 – ICAO Competencies for Aeroplane Pilots

ICAO DOC 9995, Appendix 1, published in 2013, contains the 8 Core Competencies for Evidence-Based Training. Based on Amendment 5 to the PANS-TRG, ICAO has issued the State Letter AN 12/59.1-18/77 of 29 August 2018, which contains the following new proposal for an ICAO Competency Framework for Aeroplane Pilots.

Note: Comments of ICAO States were accepted by ICAO until 29 November 2018 and the proposed amendment to Annex 1 and the PANS-TRG is envisaged for applicability on 5 November 2020. Therefore, the ICAO Competency Framework below may be subject to change.

ICAO COMPETENCY FRAMEWORK TO DEVELOP COMPETENCY-BASED TRAING AND ASSESSMENT FOR AEROPLANE PILOT LICENCES, RATINGS, AND RECURRENT TRAINING

Competency	Description	Observable Behaviours (OB)
Application of procedures and compliance with regulations	Identifies and applies appropriate procedures in accordance with published operating instructions and applicable regulations.	OB 1.1 Identifies where to find procedures and regulations OB 1.2 Applies relevant operating instructions, procedures and techniques in a timely manner OB 1.3 Follows SOPs unless a higher degree of safety dictates an appropriate deviation OB 1.4 Operates aeroplane systems and associated equipment correctly OB 1.5 Monitors aircraft systems status OB 1.6 Complies with applicable regulations OB 1.7 Applies relevant procedural knowledge
Communication	Communicates through appropriate means in the operational environment, in both normal and non-normal situations.	OB 2.1 Determines that the recipient is ready and able to receive information OB 2.2 Selects appropriately what, when, how and with whom to communicate OB 2.3 Conveys messages clearly, accurately and concisely OB 2.4 Confirms that the recipient demonstrates understanding of important information OB 2.5 Listens actively and demonstrates understanding when receiving information OB 2.6 Asks relevant and effective questions OB 2.7 Uses appropriate escalation in communication to resolve identified deviations OB 2.8 Uses and interprets non-verbal communication in a manner appropriate to the organizational and social culture

Competency	Description	Observable Behaviours (OB)
		OB 2.9 Adheres to standard radiotelephone phraseology and procedures OB 2.10 Accurately reads, interprets, constructs and responds to datalink messages in English
Aeroplane Flight Path Management, automation	Controls the flight path through automation.	OB 3.1 Uses appropriate flight management, guidance systems and automation, as installed and applicable to the conditions (see Part I, Chapter 1, for the definition of conditions) OB 3.2 Monitors and detects deviations from the intended flight path and takes appropriate action OB 3.3 Manages the flight path safely to achieve optimum operational performance OB 3.4 Maintains the intended flight path during flight using automation while managing other tasks and distractions OB 3.5 Selects appropriate level and mode of automation in a timely manner considering phase of flight and workload OB 3.6 Effectively monitors automation, including engagement and automatic mode transitions
Aeroplane Flight Path Management, manual control	Controls the flight path through manual control.	OB 4.1 Controls the aircraft manually with accuracy and smoothness as appropriate to the situation OB 4.2 Monitors and detects deviations from the intended flight path and takes appropriate action OB 4.3 Manually controls the aeroplane using the relationship between aeroplane attitude, speed and thrust, and navigation signals or visual information OB 4.4 Manages the flight path safely to achieve optimum operational performance OB 4.5 Maintains the intended flight path during manual flight while managing other tasks and distractions OB 4.6 Uses appropriate flight management and guidance systems, as installed and applicable to the conditions (See Part I, Chapter 1, definitions) OB 4.7 Effectively monitors flight guidance systems including engagement and automatic mode transitions

Competency	Description	Observable Behaviours (OB)
Leadership and Teamwork	Influences others to contribute to a shared purpose. Collaborates to accomplish the goals of the team.	OB 5.1 Encourages team participation and open communication OB 5.2 Demonstrates initiative and provides direction when required OB 5.3 Engages others in planning OB 5.4 Considers inputs from others OB 5.5 Gives and receives feedback constructively OB 5.6 Addresses and resolves conflicts and disagreements in a constructive manner OB 5.7 Exercises decisive leadership when required OB 5.8 Accepts responsibility for decisions and actions OB 5.9 Carries out instructions when directed OB 5.10 Applies effective intervention strategies to resolve identified deviations OB 5.11 Manages cultural and language challenges, as applicable
Problem Solving and Decision Making	Identifies precursors, mitigates problems; and makes decisions	OB 6.1 Identifies, assesses and manages threats and errors in a timely manner OB 6.2 Seeks accurate and adequate information from appropriate sources OB 6.3 Identifies and verifies what and why things have gone wrong, if appropriate OB 6.4 Perseveres in working through problems while prioritizing safety OB 6.5 Identifies and considers appropriate options OB 6.6 Applies appropriate and timely decision-making techniques OB 6.7 Monitors, reviews and adapts decisions as required OB 6.8 Adapts when faced with situations where no guidance or procedure exists OB 6.9 Demonstrates resilience when encountering an unexpected event

Competency	Description	Observable Behaviours (OB)
Situation Awareness and Management of Information	Perceives, comprehends and manages information and anticipates its effect on the operation.	OB 7.1 Monitors and assesses the state of the aeroplane and its systems OB 7.2 Monitors and assesses the aeroplane's energy state, and its anticipated flight path. OB 7.3 Monitors and assesses the general environment as it may affect the operation OB 7.4 Validates the accuracy of information and checks for gross errors OB 7.5 Maintains awareness of the people involved in or affected by the operation and their capacity to perform as expected OB 7.6 Develops effective contingency plans based upon potential risks associated with threats and errors OB 7.7 Responds to indications of reduced situation awareness
Workload Management	Maintain available workload capacity by prioritizing and distributing tasks using appropriate resources	OB 8.1 Exercises self-control in all situations OB 8.2 Plans, prioritizes and schedules appropriate tasks effectively OB 8.3 Manages time efficiently when carrying out tasks OB 8.4 Offers and gives assistance OB 8.5 Delegates tasks OB 8.6 Seeks and accepts assistance, when appropriate OB 8.7 Monitors, reviews and cross-checks actions conscientiously OB 8.8 Verifies that tasks are completed to the expected outcome OB 8.9 Manages and recovers from interruptions, distractions, variations and failures effectively while performing tasks

13.3 Attachment 3 – Competencies for Instructor and Evaluator Competencies

In 2018 IATA published the Guidance Material for Instructor and Evaluator Training. The following tables show the IATA competency model for instructors and evaluators.

Outline:

<table>
<tr><th colspan="5">Competencies for Instructor and Evaluator</th></tr>
<tr><th rowspan="3">Name of the competency</th><th rowspan="3">Description</th><th colspan="3">Performance Criteria</th></tr>
<tr><th rowspan="2">Observable behavior (OB)</th><th colspan="2">Competency Assessment</th></tr>
<tr><th>Final competency standard</th><th>Conditions</th></tr>
<tr><td>Pilot competencies[41]</td><td>See ICAO Aeroplane Pilot Competency Framework and EASA documents (including “Knowledge”)</td><td rowspan="5">See the observable behaviors in the tables below</td><td rowspan="5">Operators and ATOs define in their OMs the level of performance to be achieved by the instructor / evaluator.</td><td rowspan="5">Ground training (incl. CRM)
and
Flight training
in aircraft and
in FSTDs:
● licensing
● type rating
● conversion
● line training
● recurrent</td></tr>
<tr><td>Management of the training environment</td><td rowspan="4">See descriptions in the tables below for the individual competencies</td></tr>
<tr><td>Instruction</td></tr>
<tr><td>Interaction with the trainee</td></tr>
<tr><td>Assessment and Evaluation</td></tr>
</table>

The following 5 tables separately show the individual **Instructors and Evaluators** Competencies (IEC1 – IEC5)

[41] For ground instructors some pilot competencies may not apply

13.3.1 IEC1 – Pilot competencies

Instructor/Evaluator Competency 1 – Pilot competencies				
Name of the competency	Description	Performance Criteria		
		Observable behavior (OB)	Competency Assessment	
			Final competency standard	Conditions
IEC1: **Pilot competencies**[42]	See ICAO Aeroplane Pilot Competency Framework and EASA documents (including "Knowledge")	See ICAO Aeroplane Pilot Competency Framework and EASA documents (including "Knowledge")	Operators and ATOs define in their OMs the level of performance to be achieved by the instructor / evaluator in each pilot competency.	**Ground training** (incl. CRM) and **Flight training** in aircraft and in FSTDs: ● licensing ● type rating ● conversion ● line training ● recurrent

[42] For ground instructors some competencies may not apply

13.3.2 IEC2 – Management of the training environment

Instructor/Evaluator Competency 2 - Management of the training environment				
Name of the competency	**Description**	**Performance Criteria**		
		Observable behavior (OB)	**Competency Assessment**	
			Final competency standard	**Conditions**
IEC2: **Management of the training environment**	Ensures that the environment is **safe** and **suitable** for learning, instruction, assessment and evaluation	• Applies TEM in the context of instruction or evaluation • Briefs safety procedures for situations that are likely to develop during instruction/evaluation • Intervenes appropriately at the correct time and level (e.g. progresses from verbal assistance to taking over control) • Resumes training/evaluation as practicable after any intervention • Creates and manages conditions (e.g. airspace, ATC, weather, time, etc.) to be suitable for the training objectives • Adapts to changes in the environment without disturbing the training • Manages time, training media and equipment to ensure that training objectives are met	Operators and ATOs define in their OMs the level of performance to be achieved by the instructor / evaluator.	**Ground training** (incl. CRM) and **Flight training** in aircraft and in FSTDs: • licensing • type rating • conversion • line training • recurrent

13.3.3 IEC3 – Instruction

Instructor/Evaluator Competency 3 – Instruction				
Name of the competency	**Description**	**Performance Criteria**		
		Observable behavior (OB)	**Competency Assessment**	
			Final competency standard	**Conditions**
IEC3: Instruction	Conducts training to develop the trainee's competencies	• References approved sources (operations, technical, training manuals, standards and regulations) • States clear objectives and clarifies roles for the training • Follows approved training syllabus • Applies instructional methods as appropriate (explanation, demonstration, learning by discovery, facilitation, in-seat instruction) • Sustains operational relevance and realism • Adapts the amount of instructor inputs to ensure that the training objectives are met • Adapts to situations that might disrupt a planned sequence of events • Continuously assesses trainee's competencies • Encourages the trainee to self-assess; • Allows trainee to self-correct in a timely manner • Provides positive reinforcement; • Applies appropriate corrective actions • Applies student centered feedback techniques	Operators and ATOs define in their OMs the level of performance to be achieved by the instructor / evaluator.	**Ground training** (incl. CRM) and **Flight training** in aircraft and in FSTDs: • licensing • type rating • conversion • line training • recurrent

13.3.4 IEC4 – Interaction with the trainee

Instructor/Evaluator Competency 4 – Interaction with the trainee				
Name of the competency	**Description**	**Performance Criteria**		
		Observable behavior (OB)	**Competency Assessment**	
			Final competency standard	**Conditions**
IEC4: **Interaction with the trainee**	Supports the trainee's learning and personal development	● Shows respect for the trainee, e.g. culture, language, experience ● Shows empathy, e.g. by actively listening, reading non-verbal messages and encouraging dialogue ● Manages trainee's barriers to learning ● Encourages trainee's self-confidence ● Coaches the trainee Exemplary behavior in the professional working environment (Role Model): ● Shows loyalty to goals of the AOC/ATO and authority ● shows integrity (honesty and professional principles) ● achieves credibility (reliability and knowledge) ● actively seeks and accepts feedback to improve own performance.	Operators and ATOs define in their OMs the level of performance to be achieved by the instructor / evaluator.	**Ground training** (incl. CRM) and **Flight training** in aircraft and in FSTDs: ● licensing ● type rating ● conversion ● line training ● recurrent

13.3.5 IEC5 – Assessment and Evaluation

Instructor/Evaluator Competency 5 – Assessment and evaluation				
Name of the competency	**Description**	**Performance Criteria**		
		Observable behavior (OB)	**Competency Assessment**	
			Final competency standard	**Conditions**
IEC5: **Assessment and evaluation**	Assesses the competencies of the trainee and evaluates the training system	• Complies with administrative requirements • Ensures that the trainee has understood the assessment or evaluation process • Assesses trainee's competencies • Applies the competency standards and conditions • Performs grading • Makes decisions based on the outcome of the assessment • Provides understandable feedback • Produces reports using provided forms and media • Reports strengths and weaknesses of the training system (e.g. training environment, curriculum, assessment, evaluation) including feedback from trainees • Suggests improvements for the training system	Operators and ATOs define in their OMs the level of performance to be achieved by the instructor / evaluator.	**Ground training** (incl. CRM) and **Flight training** in aircraft and in FSTDs: • licensing • type rating • conversion • line training • recurrent

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