CIVIL AVIATION GUIDANCE MATERIAL – 1008

UPSET PREVENTION AND RECOVERY TRAINING

UPRT

CIVIL AVIATION AUTHORITY OF MALAYSIA

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Introduction

This Civil Aviation Guidance Material 1008 – Upset Prevention and Recovery Training (CAGM 1008 - UPRT) is issued by the Civil Aviation Authority of Malaysia (CAAM) to provide guidance for the implementation of Upset Prevention and Recovery Training programmes by ATOs and AOC holders. This CAGM is provided pursuant to Civil Aviation Directive 1 – Personnel Licensing (CAD 1 – PEL) and Civil Aviation Directive 6 (CAD 6).

Organisations may use these guidelines to demonstrate compliance with the provisions of the relevant CAD's issued. Without prejudice to Regulation 204 and Regulation 205 of the Malaysian Civil Aviation Regulations 2016 (MCAR 2016), when the CAGMs issued by the CAAM are used, the related requirements of the CAD's are considered as met, and further demonstration may not be required.

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Chief Executive Officer
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Civil Aviation Guidance Material components and Editorial practices

This Civil Aviation Guidance Material is made up of the following components and are defined as follows:

Standards: Usually preceded by words such as *"shall"* or *"must"*, are any specification for physical characteristics, configuration, performance, personnel or procedure, where uniform application is necessary for the safety or regularity of air navigation and to which Operators must conform. In the event of impossibility of compliance, notification to the CAAM is compulsory.

Recommended Practices: Usually preceded by the words such as "*should"* or "*may*", are any specification for physical characteristics, configuration, performance, personnel or procedure, where the uniform application is desirable in the interest of safety, regularity or efficiency of air navigation, and to which Operators will endeavour to conform.

Definitions: Terms used in the Standards and Recommended Practices which are not self-explanatory in that they do not have accepted dictionary meanings. A definition does not have an independent status but is an essential part of each Standard and Recommended Practice in which the term is used, since a change in the meaning of the term would affect the specification.

Notes: Included in the text, where appropriate, Notes give factual information or references bearing on the Standards or Recommended Practices in question but not constituting part of the Standards or Recommended Practices;

It is to be noted that some Standards in this Civil Aviation Directive incorporates, by reference, other specifications having the status of Recommended Practices. In such cases, the text of the Recommended Practice becomes part of the Standard.

The units of measurement used in this document are in accordance with the International System of Units (SI) as specified in CAD 5. Where CAD 5 permits the use of non-SI alternative units, these are shown in parentheses following the basic units. Where two sets of units are quoted it must not be assumed that the pairs of values are equal and interchangeable. It may, however, be inferred that an equivalent level of safety is achieved when either set of units is used exclusively.

Any reference to a portion of this document, which is identified by a number and/or title, includes all subdivisions of that portion.

Throughout this Civil Aviation Guidance Material, the use of the male gender should be understood to include male and female persons

Record of Revisions

Revisions to this CAGM shall be made by authorised personnel only. After inserting the revision, enter the required data in the revision sheet below. The *‘Initials’* has to be signed off by the personnel responsible for the change.

Rev No.	Revision Date	Revision Details	Initials

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1 Applicability

1.1 This CAGM applies to:

a) ATOs providing training leading to the issuance of a Commercial Pilot Licence (CPL), Multi-Crew Pilot Licence (MPL) and endorsement of a type rating.

b) An AOC holder conducting UPRT in their recurrent training programme for type-rated pilots.

1.2 Definitions

An aeroplane upset means an aeroplane in flight unintentionally exceeding the parameters normally experienced in line operations or training, normally defined by the existence of at least one of the following parameters:

a) pitch attitude greater than 25°, nose up; or

b) pitch attitude greater than 10°, nose down; or

c) bank angle greater than 45°; or

d) within the above parameters, but flying at airspeeds inappropriate for conditions.

Note. – These values are not set values but examples that need to be tailored to the aircraft type. Please refer to Airline Upset Recovery & Prevention Training Aid (AUPRTA) revision 3 for more details.

Aeroplane upset prevention and recovery training (UPRT) means a combination of theoretical knowledge and flying training with the aim of providing flight crew with the requisite competencies to recognise and thus prevent or recover from developing or developed aeroplane upsets.

ICATEE means International Committee for Aviation Training in Extended Envelopes.

Loss of control in flight (LOC-I) means a categorisation of an accident or incident resulting from a deviation from the intended flight path.

Manoeuvre-based training means training that focuses on a single event or manoeuvre in isolation.

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

Negative transfer of training means the application and 'transfer'(see note) of what was learned in a training environment i.e. a classroom, a Flight Simulator Training Device (FSTD) to normal practice, i.e. it describes the degree to which what was learned in training is applied to actual normal practices. In this context, negative transfer of training refers to the inappropriate generalisation of knowledge and skill to a situation or setting in normal practice that does not equal the training situation or setting.

Note. - This includes negative transfer from on-aeroplane training on a light aircraft to transport category aeroplanes.

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

Scenario-based training means training encompassing one or more scenario elements, constructed to facilitate real-time assessment or training.

Startle means an uncontrollable, automatic muscle reflex, raised heart rate, blood pressure, etc., elicited by exposure to a sudden, intense event that violates a pilot's expectations.

Surprise means an unexpected event that violates a pilot's expectations and can affect the mental processes used to respond to the event.

2 UPRT Training

2.1 Incorporating UPRT Into A Pilot's Training Programme

2.1.1 UPRT shall be incorporated into a pilot's training as part of:

a) CPL, MPL and type-rating training provided by an ATO, and

b) recurrent training provided by the AOC holder.

2.1.2 ATOs and AOC holders are to update their pilot training programmes to incorporate UPRT and are to submit the UPRT programme and the instructor qualification programme for the CAAM's approval.

2.1.3 This programme should also be kept up-to-date with the latest concepts, techniques and recommendations.

2.1.4 The ATOs and AOC holders may refer to this CAGM for developing and implementing UPRT.

2.2 Scope Of An UPRT Programme

2.2.1 The UPRT programme should include clear training objectives stating what the trainee is expected to perform, and the desired learning outcomes. The trainee should be able to demonstrate the knowledge and skill in preventing, recognising and recovering from an aeroplane upset before being considered as having successfully completed the UPRT.

2.2.2 The UPRT programme should emphasise pilot awareness of his aeroplane performance at all times with the primary aim of preventing an aeroplane upset. Adhering to Standard Operating Procedures (SOP) and employing threat and error management (TEM) skills should be adopted as sound strategies to enhance awareness.

2.2.3 The UPRT programme should focus on achieving trainee comprehension of aerodynamics, promulgating vigilance for detection of flight path divergence and emphasising the timely and appropriate intervention to correct the divergence. Automation and system anomalies and how they can lead to flight path deviation should also be included in the syllabus of the programme.

2.2.4 Most upsets eventually call for manual handling skills and techniques for positive recovery. Therefore the UPRT programme should include training the pilot to manually recover from an upset. Recovery techniques using automation should not be ruled out completely but emphasis should be drawn to the potential complexity associated with this option in some cases if recovery is time critical. For example, if transitioning wake turbulence, it may be best to leave the autoflight system engaged rather than disconnecting it as long as the autoflight system is performing adequately.

2.2.5 Special emphasis should be drawn to the fundamental shift in the context of stall recovery, where reducing the angle of attack (AOA) is the primary action for successful recovery from the high-altitude stall. Please refer to 6.1-Attachment A.

Note. – An ICATEE report determined that some 36% of LOC-I events to date are stall related. Consequently, recovery from the approach to high-altitude stall is considered an integral part of UPRT.

2.2.6 In a research of 18 accidents and incidents resulting from pilot loss of aeroplane-state awareness, it was determined that 17 of them occurred when the pilots did not have visual reference (i.e. instrument meteorological conditions (IMC) or night conditions). Therefore UPRT should include training in the FSTD under visual meteorological conditions (VMC) and IMC, including day and night settings.

2.2.7 Apart from active vigilance, crew interaction on the flight deck should be emphasised as a critical defence mechanism against flight path divergence.

Note. – FAA, in its AC 120-111 of April 2015, indicated that research evidence showed that in many LOC-I incidents and accidents, the pilot monitoring (PM) may have been more aware of the aeroplane state than the pilot flying (PF).

2.2.8 Exercises which include the element of startle or surprise may be added to FSTD training. However, to avoid negative training, instructors should guard against inputs which could create or evoke manoeuvres that exceed the limitations of the FSTD.

Note. – Startle or surprise has been a factor in LOC-I incidents and accidents as upsets that occur in normal operations are unplanned and inadvertent, adversely impacting recognition or recovery.

2.2.9 ATOs and AOC holders should adopt a holistic, competency-based approach to UPRT by incorporating both theoretical and flight (aircraft or FSTD) training in the curriculum. The training elements, components and platforms that should be included are listed in 5.1 – Appendix 1. Subsequent paragraphs in this CAGM provide more guidance for the ATO and AOC holder in their respective scope of UPRT.

2.3 UPRT in CPL, MPL and type rating training by ATO

2.3.1 The UPRT to be provided by an ATO as part of CPL, MPL and type-rating training is described below.

2.3.1.1 Theoretical Training

2.3.1.1.1 Understanding what can lead to an aeroplane upset and how to recover if such a situation occurs is critical to UPRT. Therefore the theoretical training for UPRT establishes the foundation from which situational awareness, insight, knowledge, and skills are developed, and therefore should be accomplished prior to training the associated flight events in an aeroplane or FSTD. The scope of the theoretical training can be found in 5.1 – Appendix 1.

2.3.1.2 Flight Training

2.3.1.2.1 Flight training is for the pilot to acquire practical skills to effectively employ upset avoidance strategies and, when necessary, effectively recover the aeroplane to the originally intended flight path. The flight training component may consist of two distinct subcomponents:

a) On-aeroplane training

This kind of training is to be conducted in suitably capable light aeroplanes by appropriately qualified instructors. The intent of this training is to develop the knowledge, awareness and experience of aeroplane upsets and unusual attitudes, and how to effectively analyse the event and then apply the correct recovery techniques. ATOs will be responsible for risk mitigation strategies for this type of training. Refer to 6.2 – Attachment B.

b) FSTD training (for multi-crew transport type aeroplanes)

1) For this type of training, the FSTD to be used must be capable of producing the correct effects in the context of UPRT. The FSTD must not be required to perform outside the limits of the Valid Training Envelope (VTE) of the type. Replication of the actual type-design response and flight control effects are essential characteristics to prevent negative training or negative transfer of training.

2) FSTD training should be conducted in a FFS Level D full flight simulator. It should have the fidelity to meet the learning objectives of the training and preferably be IOS-equipped to run pre-programmed UPRT manoeuvres and scenarios for ease and standardisation of instruction. The Manual of Criteria for the Qualification of FSTDs (ICAO Doc 9625) provides guidance on the approval of FSTD for UPRT. This is discussed further in Chapter 3.

3) FSTD training should follow a logical progression where pilots are introduced to the aeroplane's capabilities within the operating limits prior to training at the edge of the normal flight envelope.

4) FSTD training should include both manoeuvre-based and scenario-based training. Stakeholders are encouraged to seek guidance from the Original Equipment Manufacturer (OEM) in development of all UPRT training. Please refer to 6.3 – Attachment C.

5) Whilst Manoeuvre-Based Training (MBT) focusses mainly on prevention and recovery, Scenario-Based Training (SBT) should develop perception and decision-making skills relating to upset

recognition, prevention and recovery, while providing the pilot with an opportunity to use the skills learned in manoeuvre-based training in a realistic scenario. Using evidence-based data to develop SBT is encouraged to lend realism and comparative analyses to the training. Startle can only be induced in SBT. Please refer to 6.4 – Attachment D.

6) Feedback applications which monitor and record operational limit exceedances in the FSTD are effective briefing tools for the instructor. They enhance debriefing where the instructor would be able point out erroneous control inputs.

2.4 Recurrent training by AOC holder

2.4.1 The theoretical portion of UPRT recurrent training to be provided by an AOC holder should include refresher and type-specific information for the FSTD sessions. The AOC holder may refer to paragraph 2.3.1.1 for guidance on theoretical training.

2.4.2 The flight training aspects of the UPRT recurrent training programme should cover all UPRT exercises within every 3-year period incorporating a feedback mechanism to keep in pace with the continuous improvement of UPRT. The AOC holder may refer to paragraph 2.3.1.2.1 b) for guidance on flight training using FSTD.

2.5 Bridge Training

2.5.1 Many type-rated pilots within the current system might not have undergone a specific programme on UPRT. For these pilots to fully benefit from UPRT during recurrent training it would follow that they undergo a brief bridge training programme to bridge the gap in their theoretical and flight competencies in UPRT. It is envisaged that bridge training comprising a classroom session and one FSTD detail should be sufficient to transition

2.6 Templates And Scenarios

2.6.1 The templates and scenarios attached as attachments serve as guidance material for ATOs and AOC holders.

2.6.2 ATOs and AOC holders may design exercises which best suit their aircraft type and training rationale for UPRT. Some sample training scenarios are provided 6.5 – Attachment E for reference.

3 FSTD Requirements

3.1 Stall And UPRT Requirements For FSTD

3.1.1 Stall manoeuvres evaluation relates to FSTD qualification in meeting the training requirements of approach to stall manoeuvres. The following stall entry methods should be demonstrated in at least one of the three required flight conditions:

a) Stall entry at wings level (1g);

b) Stall entry in turning flight of at least 25° bank angle (accelerated stall) and

c) Stall entry in a power-on condition (required only for turboprop aeroplanes).

3.1.2 The "approach to stall" tolerances in stall characteristics tests apply up to the activation of the stall warning system or aerodynamic stall buffet, just prior to the stall break, whichever occurs first. Training recovery from the full stall should be avoided if the FSTD is not suitably qualified for the exercise.

3.1.3 For the purposes of UPRT, the instructor operating station should have adequate feedback about the aeroplane and its controls state during UPRT exercises. This should include:

a) FSTD validation envelope

b) Flight control positions

c) Aeroplane operational limits.

3.1.4 The FSTD should have selectable aeroplane upsets to trigger an upset condition. The instructor should be provided with appropriate guidance concerning the method utilised to drive the FSTD into an upset condition.

3.1.5 The following minimum set of upset recovery manoeuvres should be available to the instructor:

a) A nose high, wings level aircraft upset;

b) A nose low, wings level aircraft upset; and

c) A high bank angle aircraft upset.

3.1.6 The intentional degradation of FSTD functionality to drive an aeroplane upset is generally not acceptable unless used purely as a tool for repositioning with the pilot out of the loop.

Note. – Care should be taken with flight envelope protected aeroplanes, as artificially positioning the aeroplane to a specified attitude may not be representative because the flight control law may not be correctly initialised.

3.1.7 In addition to the flight training exercises in UPRT the instructor should also focus on improving the pilot monitoring skills which are almost always associated with LOC-I events.

4 Instructors

4.1 Requirements

4.1.1 The effectiveness of UPRT is dependent on the quality of the instructor. The ATOs and AOC holders are to ensure that their UPRT instructors are qualified through an approved instructional programme. The instructors should possess a sound knowledge of both the theoretical and flight training aspects of UPRT.

4.1.2 The review of LOC-I incidents and accidents is beneficial to UPRT. Instructors should be familiar with the learning outcomes of these events and the benefits it has on UPRT.

4.1.3 Instructors should understand aeroplane energy management, human factors (HF), including but not limited to spatial disorientation, somatogravic illusion, startle, surprise, effects of fatigue, distraction and TEM. Understanding of these human factor elements is critical to the instructor's ability to explain to his trainee the potential physiological catalysts to LOC-I.

4.1.4 Exercises with go-arounds from various stages of the approach should be included as this is known to have caused somatogravic illusion (or false pitch-up sensation) and disorientation effects in actual flight. Although, current-day FSTDs cannot provide the actual aerodynamic effects of the real aeroplane the experience, it is felt, will be beneficial to the trainee.

4.1.5 Instructors should go through the flight training of the Training Programme as regularly as required by the AOC holder or ATO to ensure that they are able to demonstrate the correct recovery techniques should the need arise. Please see 5.2 – Appendix 2.

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5 Appendices

5.1 Appendix 1 – Upset Training Elements, Components and Platforms

Subjects and training elements	*Theoretical training*	*On-aeroplane training - CPL(A)/ MPL(A)*	*Non-type-specific FSTD training - MPL(A))*	*Type specific FSTD training*	*AUPRTA Revision 3, references*
	For ATO and AOC holder	*For ATO*	*For ATO*	*For ATO and AOC holder*	
A. Aerodynamics					Section 6.4
1) general aerodynamic characteristics	√	√	√		
2) advanced aerodynamics	√	√	√	√	
3) aeroplane certification and limitations	√	√		√	
4) aerodynamics (high and low altitudes)	√	√	√	√	
5) aeroplane performance (high and low altitudes)	√	√	√	√	
6) angle of attack (AOA) and stall awareness	√	√	√	√	
7) stick shaker activation	√		√	√	
i) stick pusher activation	√		√	√	
ii) Mach effects — if applicable to aeroplane type	√		√	√	
8) aeroplane stability	√	√	√	√	
9) control surface fundamentals	√	√	√	√	
i) trims	√			√	
10) icing and contamination effects					
11) propeller slipstream (as applicable)	√		√	√	
B. Causes and contributing factors of upsets					Section 5
1) environmental	√			√	
2) pilot-induced	√			√	
3) mechanical	√			√	
C. Safety review of accidents and incidents relating to aeroplane upsets	√	√		√	
D. G-awareness					Sections 6.4.5 and 7.2.2
1) positive/negative/increasing/decreasing g-loads	√	√	√	√	
2) lateral g-awareness (sideslip)	√	√	√	√	
3) G-load management	√	√	√	√	
E. Energy management					Section 2
1) kinetic energy vs. potential energy vs. chemical energy (power)	√	√	√	√	
2) relationship between pitch and power and performance	√	√	√	√	
3) performance and effects of differing engines	√	√	√	√	
F. Flight path management					Section 4
1) automation inputs for guidance and control	√		√	√	
2) type-specific characteristics	√	√		√	
3) automation management	√		√	√	
4) manual handling skills	√	√	√	√	
G. Recognition					Section 6.4.4
1) type-specific examples of instrumentation during developing and developed upset	√	√		√	
2) pitch/power/roll/yaw	√	√	√	√	

3) effective scanning (effective monitoring)	√	√	√	√	
4) stall protection systems and cues	√		√	√	
5) criteria for identifying stalls and upset	√	√	√	√	
H. *Upset prevention and recovery techniques*					sections 7 and 8.2
1) timely and appropriate intervention	√	√	√	√	
2) nose-high/wings-level recovery	√	√	√	√	
3) nose-low/wings-level recovery	√	√	√	√	
4) high bank angle recovery techniques	√	√	√	√	
5) consolidated summary of aeroplane recovery techniques	√	√	√	√	
I. *System malfunction section*					Section 5.2
1) flight control anomalies	√	√	√	√	
2) power failure (partial or full)	√	√	√	√	
3) instrument failures	√	√	√	√	
4) automation failures	√		√	√	
5) fly-by-wire protection degradations	√		√	√	
6) stall protection system failures, including icing alerting systems	√		√	√	
J. *Specialised training elements sections*					Section 7.3 and Section 8
1) spiral dive (graveyard spiral)	√	√	√note 3	√	
2) slow flight		√	√	√	
3) steep turns		√	√	√	
4) recovery from approach to stall		√	√	√	
5) recovery from stall, including uncoordinated stalls (aggravating yaw)		√	√note 4	√note 5	
6) recovery from stick pusher activation (as applicable)	√		√	√	
7) nose-high/high-speed recovery		√	√	√	
8) nose-high/low-speed recovery		√	√	√	
9) nose-low /high-speed recovery		√	√	√	
10) nose-low/low-speed recovery		√	√	√	
11) high bank angle recovery		√	√	√	
12) line-oriented flight training (LOFT) or line-operational simulation (LOS)			√	√	
K. *Human Factors*					Section 7.2.1
1) situation awareness					
i) human information processing	√	√	√	√	
ii) inattention, fixation, distraction	√	√	√	√	
iii) perceptual illusions (visual or physiological) and spatial disorientation	√	√	√	√	
iv) instrument interpretation	√	√	√	√	
2) startle and stress response					
i) physiological, psychological, and cognitive effects	√	√	√	√	
ii) management strategies	√	√	√	√	
3) threat and error management (TEM)					
i) TEM framework	√	√	√	√	
ii) active monitoring, checking	√	√	√	√	
iii) fatigue management	√	√	√	√	
iv) workload management	√	√	√	√	
v) crew resource management (CRM)	√	√	√	√	

Note 1. – Refer to the Airplane Upset Prevention & Recovery Training Aid (AUPRTA) Revision 3 for more details. However, the AUPRTA generally was developed to deal with topics pertaining to swept-wing aeroplanes with more than 100 passenger seats.

Note 2. – References made to relevant sections of AUPRTA may be changed in subsequent revisions.

Note 3. – The FSTD must have the correct modelling for this manoeuvre.

Note 4. - The FSTD must have the correct modelling for this manoeuvre.

Note 5. – The FSTD must have the correct modelling for this manoeuvre.

5.2 Appendix 2 – Instructor Training Elements

UPRT instructor training elements UPRT	*UPRT theoretical instructor*	*UPRT aeroplane instructor*	*UPRT FSTD instructor*
Comprehensive knowledge of all applicable training elements (refer to Appendix 1)*	√	√	√
Training platforms (aeroplanes and devices)			
1) limitations of training platform		√	√
2) operation of IOS and debriefing tools			√
Review of LOC-I accidents/incidents	√	√	√
Energy management factors*	√	√	√
Disorientation	√	√	√
Workload management	√	√	√
Distraction	√	√	√
OEM recommendations*	√		√
UPRT recognition and recovery strategies*	√	√	√
How to do a flight risk assessment (aeroplane)	As applicable	√	
Recognition of trainee errors	√	√	√
Intervention strategies		√	
Aeroplane type-specific characteristics*	√	√	√
Operating environment	√	√	√
How to induce the startle factor		√	√
Value and benefits of demonstration	√	√	√
How to assess pilot performance using core competencies if conducting CBT	√	√	√
*OEMs may at some point develop differing guidance regarding procedures to address these areas of training which may deviate from the material provided herein. In all cases, whenever type-specific UPRT is being conducted, training organisations should provide procedural training which conforms to the appropriate aeroplane operating manual.			

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6 Attachments

6.1 Attachment A – Stall Recovery Template (with associated rationale)

1.	**Autopilot and autothrottle…... Disconnect**
Rationale	*While maintaining the attitude of the aeroplane, disconnect the autopilot and autothrottle. Ensure the pitch attitude does not increase when disconnecting the autopilot. This may be very important in out-of-trim situations. Manual control is essential to recovery in all situations. Leaving the autopilot or autothrottle connected may result in inadvertent changes or adjustments that may not be easily recognised or appropriate, especially during high workload situations.*
2	**a) Nose down pitch control………… Apply until stall warning is eliminated** **b) Nose down pitch trim… ....As Needed**
Rationale	*a) Reducing the angle of attack is crucial for recovery. This will also address autopilot-induced excessive nose up trim.* *b) If the control column does not provide sufficient response, pitch trim may be necessary. However, excessive use of pitch trim may aggravate the condition, or may result in loss of control or high structural loads.*
3	**Bank….. Wings Level**
Rationale	*This orients the lift vector for recovery.*
4	**Thrust.. As Needed**
Rationale	*During a stall recovery, maximum thrust is not always needed. A stall can occur at high thrust or at idle thrust. Therefore, the thrust is to be adjusted accordingly during the recovery. For aeroplanes with engines installed below the wing, applying maximum thrust may create a strong nose-up pitching moment if airspeed is low. For aeroplanes with engines mounted above the wings, thrust application creates a helpful pitch-down tendency. For propeller-driven aeroplanes, thrust application increases the airflow around the wing, assisting in stall recovery.*
5	**Speed brakes/Spoilers..Retract**
Rationale	*This will improve lift and stall margin.*
6	**Return to the desired flightpath.**
Rationale	*Apply gentle action for recovery to avoid secondary stalls then return to desired flightpath.*

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6.2 Attachment B – UPRT Templates (For On-Aeroplane Training)

On-aeroplane UPRT applies to CPL(A) and MPL training program. Reference should also be made to CAD 1 – PEL as appropriate for CPL(A) and MPL. ATOs may propose alternative training templates that can also meet the requirements. Aeroplane performance capabilities must not be exceeded (refer to Aircraft Operating Manual and Flight Manual).

Table 1. Slow flight template (clean configuration or with flaps at 1st stage)

Objective	To fly the aeroplane safely at 10kts above V_{s0} and V_{s1} without stalling	Maintain selected speed and altitude
Entry	1. From the level flight cruise, reduce speed to 10kts above stalling speed by selecting a lower power. 2. Carry out gentle turns whilst maintaining the selected speed.	Adjust attitude progressively to maintain altitude. Adjust power as required to maintain speed or when turning.
Recovery	Re-select cruise power. Progressively clean up Flaps and adjust nose attitude as the aeroplane speed increases.	Flaps should be raised only when above recommended speeds to prevent inadvertent stalls.

Table 2. Stall template

a) Clean configuration stall in level flight and recovery

1) Recovery at incipient stage
2) Recovery at fully developed stall

b) Stall with Power and/or Flaps

1) Stall with Power, no Flaps
2) Stall with Flaps, no Power
3) Stall with Power and Flaps
4) Stall in Approach Configuration – recovery at incipient stage only

Objective (a & b)	To recognise the symptoms of a stall at different configurations and recover safely	
Entry	1. From the level flight, select idle power setting. 2. Select power or flaps as required 3. Raise nose progressively to maintain height. If simulating an approach to land, commence a descent before raising the nose slowly to simulate stretching the approach and to induce the onset of stall symptoms. 4. Identify the symptoms of an approaching stall 5. Identify the symptoms of a fully developed stall 6. Note the speed and nose attitude differences at different configurations.	1. Maintain level flight unless simulating an approach configuration 2. Observe flaps limit speed 3. Call out the symptoms as they appear
Recovery (Standard Stall Recovery – SSR)	1. Lower nose attitude and simultaneously apply full power. (see note) 2. Use opposite rudder to prevent further wing-drop if it occurs 3. Above safe speed, roll wings level and recover to a climb	1. Raise flaps in stages. Do not exceed limit speeds 2. DO NOT use ailerons to correct a wing-drop as it will lead to auto-rotation and incipient spin

Note. – These on-aeroplane SSR actions are recommended for typical Single Engine Piston (SEP) aeroplanes used in the PPL(A), CPL(A) and MPL training. It is not intended to supersede the stall recovery actions recommended by the aeroplane manufacturers (OEM) as may be found in their respective Aircraft Operating Manual or Flight Manual

Table 3. Stall in a turn & spiral dive template

a) Stall in a turn (with high angles of bank) (refer (a) in table below)

b) Spiral dive (refer (b) in table below)

Objective	a) To recognise the symptoms of a stall in a turn and recover safely b) To recognise a spiral dive and recover safely	
Entry	a) From the cruise level flight, enter a steep level turn and progressively increase back pressure to induce a stall. b) From the level flight, reduce power and commence a steep descending turn with >30° bank.	a) Stall is identified as the aeroplane momentarily halting in the turn following the onset of stall symptoms. b) Observe aeroplane speed limits
Recovery	a) Apply SSR technique (refer to Table 2) b) Reduce power, roll wings level and recover from the dive.	DO NOT use ailerons to correct a wing-drop as it will lead to auto-rotation and incipient spin

Table 4. UNUSUAL ATTITUDE (UA) RECOVERY TEMPLATE

a) Without Bank

1) Nose High
2) Nose Low

b) With Bank

1) Nose High with Bank
2) Nose Low with Bank

Objective	To recognise an aeroplane upset attitude and recover safely	May also be conducted in simulated instrument Flying training.
Entry	1. The aeroplane is flown by the Instructor and put at nose attitudes >25° pitch up or 10° pitch down. 2. Power is set so as not to allow the aeroplane to exceed the airspeed limits during the recovery. 3. Angles of bank in excess of 45° should be introduced progressively after the student has demonstrated competency in recovery without bank.	1. To create the startle effect, the student may be asked to look at the aeroplane floor whilst the Instructor sets up the upset attitude condition. 2. DO NOT exceed the aeroplane limits.
Recovery	1. Apply power accordingly to correct a reducing or increasing airspeed situation. 2. If nose attitude is above horizon, first pitch the aeroplane to horizon before rolling the wings level. 3. If nose attitude is below horizon, roll the wings level first instead before pitching the aeroplane back to the horizon.	1. Recover the aeroplane to straight and level, and with cruise power set. 2. DO NOT use ailerons to correct a wing-drop as it will lead to auto-rotation and incipient spin

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6.3 Attachment C – Upset Recovery Templates (Multi-crew Transport Type Aeroplane)

Aeroplane Manufacturers (OEMs) contributed to the following upset recovery templates. Although these procedures represent the latest concepts of UPRT accepted by the various safety agencies, any future recommendations by the OEMs will take precedence over the recommendations here.

Note. – These techniques assume the aeroplane is not stalled. If the aeroplane is stalled, recovery from the stall must be accomplished first. Please see 6.1 – Attachment A.

Table 1. Nose high recovery template

Either Pilot: Recognise and confirm the developing situation. Announce: "Nose High" *Note1*	
Pilot Flying	**Pilot Monitoring**
AP: DISCONNECT *Note 2*	MONITOR airspeed and attitude throughout the recovery and ANNOUNCE any continued divergence.
A/THR: OFF	
Apply as much nose-down control input as required to obtain a nose-down pitch rate.	
THRUST: Adjust (if required)	
ROLL: Adjust (if required) not to exceed 60°	
When airspeed is sufficiently increasing: RECOVER to level flight *Note 3* *Note: Recovery to level flight may require use of pitch trim.*	

Table 2. Nose low recovery template

Either Pilot: Recognise and confirm the developing situation. Announce: "Nose Low" *Note 4*	
Pilot Flying	**Pilot Monitoring**
AP: DISCONNECT *Note 5*	MONITOR airspeed and attitude throughout the recovery and ANNOUNCE any continued divergence.
A/THR: OFF	
RECOVER from stall if required	
ROLL in the shortest direction to wings level *Note 6*.	
THRUST and DRAG: Adjust (if required)	
RECOVER to level flight *Note 7*. *NOTE: Recovery to level flight may require use of pitch trim.*	

Note 1. – If the A/P and/or A/T are responding correctly, it may not be appropriate to decrease the level of automation while assessing whether the divergence is being stopped.

Note 2. – A large out of trim condition could be encountered when the AP is disconnected

Note 3. – Avoid stall because of premature recovery or excessive g loading

Note 4. – If the A/P and/or A/T are responding correctly, it may not be appropriate to decrease the level of automation while assessing whether the divergence is being stopped.

Note 5. – A large out of trim condition could be encountered when the AP is disconnected.

Note 6. – It may be necessary to reduce the g loading by applying forward control pressure to improve roll effectiveness.

Note 7. – Avoid stall because of premature recovery or excessive g loading

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6.4 Attachment D: Examples Of Scenarios And Manoeuvres For Upset Prevention And Recovery Training (Training In FSTD For Multi-Crew Transport Type Aeroplane)

These three are constructed using the philosophies and concepts of the OEM and aviation safety agencies. ATOs and AOC holders are encouraged to develop additional scenarios that fit their training needs.

SCENARIO 1: NOSE-HIGH ATTITUDE IN AN AEROPLANE WITH UNDER-WING MOUNTED ENGINES	
INSTRUCTOR ROLE	Implement scenarios that result in an unexpected nose-high attitude (40° or greater) with full power.
OBJECTIVE	This scenario is ONLY for aeroplanes with under-wing mounted engines. The pilot will recognise the nose-high attitude and immediately perform the upset recovery procedure. If a detectable nose-down pitch rate is not initially achievable, the pilot should demonstrate recovery by reducing the thrust to a point where a nose-down pitch rate is achieved.
EMPHASIS AREAS	• Effect of thrust on pitch moment. • Recognition and recovery. • Crew coordination. • Angle of attack (AOA) management, including available AOA indications. • Aural and visual warnings (environment and aeroplane cueing). • Surprise and startle. • Situational awareness (SA) while returning to desired flightpath after the upset recovery, including such items as heading, altitude, other aeroplane, and flight deck automation.
FSTD SETUP CONSIDERATIONS	In order to create potential onset conditions, consider use of the following: • System malfunctions resulting in erroneous pitch attitude indications; • Other system malfunctions resulting in a nose high attitude; • Realistic environmental threats destabilising the flightpath.
SCENARIO ELEMENTS	• Upon recognising the first indication of an upset, perform the upset recovery procedure. • The necessity for smooth, deliberate, and positive control inputs to avoid increasing load factors. • Reducing thrust, if necessary, can reduce the upward pitch moment.
COMPLETION STANDARDS	• Recognises and confirms the situation. • Initiates recovery by reducing thrust to approximately midrange until a detectable nose-down pitch rate is achieved. • Verifies the autopilot and autothrottle/autothrust are disconnected. • Proper recovery consists of up to full nose-down elevator and by using stabilizer trim, if required. A steady nose-down pitch rate should be achieved and it should be noted that the aeroplane would be less than 1g and the associated characteristics of such. • When approaching the horizon the pilot checks airspeed, adjusts thrust, and establishes the appropriate pitch attitude and stabilizer trim setting for level flight. • The manoeuvre is considered complete once a safe speed is achieved and the aeroplane stabilised. • Satisfactory crew coordination must be demonstrated.
COMMON PILOT ERRORS	• Fails to disengage the autopilot and autothrottle. • Fails to reduce thrust sufficiently, if necessary, to obtain nose-down pitch. • Reduces thrust excessively. • Fails to use sufficient elevator authority • Fails to use stabilizer trim when necessary
COMMON INSTRUCTOR ERRORS	• Fails to notice improper control inputs. • If the FSTD training envelope was exceeded, fails to advise the pilot to prevent negative training.

SCENARIO 2: LOSS OF RELIABLE AIRSPEED	
INSTRUCTOR ROLE	Implement scenarios that result in erroneous airspeed indications.
OBJECTIVE	The pilot will recognise the airspeed discrepancy, determine airspeed data is erroneous, and apply the appropriate non-normal procedure while maintaining aeroplane control using pitch and power targets.
EMPHASIS AREAS	• Recognition. • Crew coordination. • AOA management including available AOA indications. • Maintain awareness of and manage flightpath and energy. • Aural and visual warnings (environment and aeroplane cueing). • Completion of the appropriate non-normal checklist. • Surprise and startle. • Manual flying skills. • Effects of altitude on control inputs.
FSTD SETUP CONSIDERATIONS	The scenario will be conducted at or near the maximum operating altitude in instrument meteorological conditions (IMC). Use of flight simulation training device (FSTD) capabilities to induce erroneous airspeed indications may include: • Full or partial pitot/static blockage or icing. • Air data computer failures.
SCENARIO ELEMENTS	• During cruise, one or two airspeed indicators will malfunction. • The pilot recognising the erroneous airspeed data indication will verbally announce the discrepancy. • The pilot flying will maintain control of the aeroplane and call for the appropriate non-normal checklist. • At the conclusion of the scenario, the instructor will discuss available aeroplane AOA indications.
COMPLETION STANDARDS	• The pilot flying will manage pitch and power to avoid a stall. • Satisfactory crew coordination must be demonstrated. • Correctly identifies the erroneous airspeed data. • Completes the appropriate non-normal checklist. • Verifies the autopilot and autothrottle/autothrust are disconnected. • The pilot monitoring provides the pilot flying with meaningful input (e.g., attitude and altitude deviations and trends).
COMMON PILOT ERRORS	• The importance of pitch control and AOA is not recognised. • Use of large thrust changes. • Failure to complete the appropriate non-normal checklist. • Over controlling the aeroplane, especially pitch.
COMMON INSTRUCTOR ERRORS	• Fails to notice improper control inputs. • If the validated FSTD envelope was exceeded, fails to advise the pilot and stop the scenario to prevent negative training.

SCENARIO 3: SUB-THRESHOLD ROLL	
INSTRUCTOR ROLE	Implement scenarios that cause an imperceptibly slow roll rate (less than 3° per second) that result in an unexpected high bank angle.
OBJECTIVE	The pilot will recognise the high bank angle and immediately perform the upset recovery procedure.
EMPHASIS AREAS	• Recognition and recovery. • Crew coordination. • AOA management. • Out-of-trim control forces at autopilot disconnect (if engaged). • Aural and visual warnings (environment and aeroplane cueing). • Surprise and startle. • Effects of multiple levels of automation. • Effects of altitude on recovery. • SA while returning to desired flightpath after the upset recovery, including such items as heading, terrain, altitude, other aeroplane, and flight deck automation.
FSTD SETUP CONSIDERATIONS	The scenario will be conducted at an altitude that will allow for a recovery. Crew distractions may be used (e.g., minor malfunctions, air traffic control (ATC) instructions, weather). Use of FSTD capabilities to induce a slow, imperceptible roll rate (less than 3° per second) may include: • Attitude changes, • Thrust asymmetry, • System malfunctions (e.g., surreptitious disabling of automation). • Dynamic upsets should not be implemented in a manner that disables or unrealistically reduces flight control effectiveness for the purpose of generating or attaining an upset condition.
SCENARIO ELEMENTS	• The instructor will introduce a situation which causes the aeroplane to enter an imperceptible roll resulting in an unexpected bank angle greater than 30°. • Either pilot will notice and announce the excessive bank. • The pilot flying will demonstrate the proper recovery procedure. • Disengage the autopilot and autothrottle. • If a nose high or nose low condition exists, identify the situation and apply the correct recovery. • Maintain awareness of energy management and aeroplane roll rate. • Unload (reduce AOA) as necessary and roll to wings level as the nose approaches the horizon. Recover to a slightly nose-low attitude. Check airspeed and adjust thrust and pitch as necessary. • When recovery is assured, adjust the pitch attitude to return to the intended flightpath.
COMPLETION STANDARDS	• Rolls in the shortest direction to wings level. • Returns the aeroplane to the assigned flightpath. • Satisfactory crew coordination must be demonstrated.
COMMON PILOT ERRORS	• Recovery is initiated by rolling in the wrong direction, increasing the bank. • Losing situational awareness and failing to return to assigned flightpath or follow ATC instructions after recovery. • Pilot(s) slow to recognise or announce the excessive bank. • Executes improper recovery procedure. • Failure to disengage the autopilot and/or autothrottle/autothrust. • Slow to reduce angle of attack (unload). • Failure to maintain awareness of energy management.
COMMON INSTRUCTOR ERRORS	• Fails to notice improper control inputs. • If the FSTD training envelope was exceeded, fails to advise the pilot and stop the scenario to prevent negative training.

MANOEUVRE 1: MANUALLY-CONTROLLED SLOW FLIGHT	
OBJECTIVE	Recognise the low energy or high drag configuration and the slow response to flight control and thrust inputs to enhance the pilot's knowledge of the low speed handling qualities prior to stall training.
EMPHASIS AREAS	Manual flying skills
FSTD SETUP CONSIDERATIONS	• Select ceiling and visibility unlimited. • The manoeuvre will be conducted in the following two scenarios: o Low altitude beginning in a clean configuration, and then slowing while configuring the aeroplane for landing. This manoeuvre will be conducted at maximum landing gross weight while maintaining speed at the VREF for the configuration. o High altitude in a clean configuration (e.g., near the service ceiling), near maximum gross weight while maintaining minimum speed for the configuration. • Target speeds must be below the speeds that are normal and appropriate for the various configurations. The minimum speed must avoid stick shaker. Ideally a single speed can be selected for use throughout the manoeuvre that will permit judicious manoeuvring without stick shaker. Encountering stick shaker without executing a stall recovery could lead to negative training.
SCENARIO ELEMENTS	• While maintaining altitude, slowly establish the pitch attitude (using trim or elevator or stabilizer), bank angle, and power setting that will allow a controlled speed reduction to establish the desired target airspeed. • Manoeuvre in straight and level flight to stabilise speed and trim. • Turn left and right, and change direction of turn, to observe changing handling characteristics. • Turns through 90º left and right, at bank angles appropriate to speed and configuration. • Climb and descend at 500 feet per minute (fpm) while in a turn.
COMPLETION STANDARDS	• Recover to appropriate airspeed for the configuration and establish the appropriate altitude and heading. • Recovery is complete when straight and level un-accelerated flight is achieved.
COMMON PILOT ERRORS	• Inadequate back-elevator pressure as power is reduced, resulting in altitude loss. • Excessive back-elevator pressure as power is reduced, resulting in a climb, followed by a rapid reduction in airspeed and "mushing." • Inadequate compensation for adverse yaw during turns. • Fixation on the airspeed indicator. • Failure to anticipate changes in lift as flaps are extended or retracted. • Inadequate power management. • Inability to adequately divide attention between aeroplane control and orientation.

6.5 Attachment E – Sample Training Scenarios

Three scenarios were constructed using the philosophies and concepts described in this CAGM. They include clean configuration (high altitude), takeoff, and landing configuration impending stalls. Training providers are encouraged to develop additional scenarios that fit their training needs. The examples should be easily tailored to any transport category airplane. The examples given are not intended to be limiting in any way. They are provided as a framework for developing a training curriculum.

Scenario 1: Clean configuration stall prevention (high altitude)

INSTRUCTOR ROLE	Implement scenarios that result in an unexpected impending stall near the airplane's maximum operating altitude.
OBJECTIVE	The pilot will recognise the impending stall and immediately perform the stall recovery procedure. The pilot should demonstrate willingness to trade altitude for airspeed to accomplish an expeditious recovery.
EMPHASIS AREAS	• Recognition and recovery. • Crew coordination. • AOA management. • Out of trim control forces at autopilot disconnect (if engaged). • Aural and visual warnings (environment and airplane cuing). • Surprise. • Reduced roll stability and increased buffeting. • Climbing at a slower than normal airspeed and higher than normal vertical speed may result in levelling off at a speed below that which can be maintained at the thrust available. • The role of increasing temperature and turbulence on high altitude performance. • Effects of multiple levels of automation. • Effects of altitude on recovery. • Knowledge of the aircraft's high- and low-speed buffet boundaries. • Thrust available versus thrust required to maintain altitude. • There is no predetermined value for altitude loss, maintaining altitude during recovery is not required, and the recovery will likely take several thousand feet. • Situational awareness (SA) while returning to desired flightpath after the stall recovery, including such items as heading, altitude, other aircraft, and flight deck automation.
FFS SETUP CONSIDERATIONS	This scenario will be conducted near maximum operating altitude for the specific airplane weight and temperature. Crew distractions (e.g., minor malfunctions, air traffic control (ATC) instructions, weather) and simulator capabilities may be used to induce impending stalls. Scenarios from actual events, such as climbing in vertical speed mode, which will result in the airplane levelling off at an airspeed behind the power curve can also be used.
SCENARIO ELEMENTS	• At level flight with the autopilot on, introduce an event or reduce thrust to less than adequate for manoeuvring flight. • Upon recognising the impending stall, perform the stall recovery procedure. • The necessity for smooth, deliberate, and positive control inputs to avoid excessive load factors and secondary stalls.

COMPLETION STANDARDS	• The pilot will perform a deliberate and smooth reduction of AOA. • Positive recovery from the stall event is paramount. There is no predetermined value for altitude loss and maintaining altitude during recovery is not required. • Appropriate application of thrust to accelerate and enable a positive recovery. • Establishing the appropriate AOA takes precedence over roll control (attempting to maintain wings level) for positive recovery from the stall event. • Intermittent secondary stall warnings, but not secondary stalls, may be acceptable due to the associated recovery challenges at altitude because of the lack of aerodynamic damping. • The manoeuvre is considered complete once a safe speed is achieved and the airplane stabilised. • Satisfactory crew coordination must be demonstrated.
COMMON PILOT ERRORS	• Recovery is attempted with thrust instead of reducing AOA. • Not maintaining a nose down input until the impending stall cues are eliminated. • Insufficient pitch down to allow desired energy conversion of altitude to airspeed. • Pilot fails to promptly recover from a secondary stall. • Reluctance to sacrifice significant altitude. • Pilot fails to distinguish between high speed buffet and low speed stall. • Pilot increases the load factor too quickly and gets multiple impending stalls or a stick pusher activation. • Inappropriate use of rudder. Pilot prioritises roll control (attempting to level the wings) before reducing AOA. • Not disconnecting the autopilot and/or autothrottle/autothrust prior to reducing AOA.

Scenario 2: Landing configuration stall prevention

INSTRUCTOR ROLE	Implement scenarios that result in an unexpected impending stall during an approach.
OBJECTIVE	The pilot will recognise the impending stall and immediately perform the stall recovery procedure, then commence missed approach.
EMPHASIS AREAS	• Recognition and recovery. • Crew coordination. • AOA management. • Out of trim control forces at autopilot disconnect (if engaged). • Aural and visual warnings (environment and airplane cueing). • Surprise. • Reduced roll stability and increased buffeting. • Effects of multiple levels of automation. • Effects of altitude on recovery. • SA while returning to desired flightpath after the stall recovery, including such items as heading, terrain, altitude, other aircraft, and flight deck automation. • There is no predetermined value for altitude loss. Maintaining altitude is not required.
FFS SETUP CONSIDERATIONS	The scenario will be conducted during approach to landing in the landing configuration, at an altitude that will allow for a recovery. Crew distractions (e.g., minor malfunctions, ATC instructions, weather) and simulator capabilities may be used to induce impending stalls.
SCENARIO ELEMENTS	• At 1,000 feet above ground level (AGL), reduce thrust to be inadequate to maintain a safe speed or descent angle, and results in an increase in AOA to maintain glidepath. Upon recognising the impending stall, perform the stall recovery procedure. When recovery is assured, adjust the pitch attitude to initiate a climb to comply with missed approach instructions.

COMPLETION STANDARDS	• The pilot will perform a deliberate and smooth reduction of AOA. Positive recovery from the stall event takes precedence over minimising altitude loss or roll control (attempting to maintain wings level before appropriate AOA is established). Appropriate application of thrust to accelerate and enable an expeditious recovery. The return of the airplane to safe flight without encountering secondary stall warnings. The manoeuvre is considered complete when safe speed has been achieved and the pilot initiates the missed approach. Satisfactory crew coordination must be demonstrated.
COMMON PILOT ERRORS	• Recovery is attempted with no loss of altitude. Recovery is attempted without recognising the importance of pitch control and AOA. Inappropriate use of rudder. Pilot prioritises roll control (attempting to level the wings) before reducing AOA. Not disconnecting the autopilot and/or autothrottle/autothrust prior to reducing AOA. Not maintaining a nose down input until the impending stall cues are eliminated. Pilot increases the load factor too quickly and gets multiple impending stalls or a stick pusher activation. Rolling wings level prior AOA reduction. Failure to roll wings level after AOA reduction to improve performance. Losing SA and failing to return to assigned flightpath and complete a missed approach, or follow ATC instructions after recovery.

Other suggested scenarios include:

1. After level-off from a descent with idle thrust, the pilot either forgets to increase thrust or on airplanes equipped with autothrottle/autothrust, the autothrottle/autothrust does not increase thrust.

2. While at low altitude and manoeuvring, banking at slow speeds.

3. During approach, while slowing to approach speed, the pilot does not add flaps soon enough or does not closely watch the energy trend.

4. The flight crew is instructed to climb to an altitude within the airplane's certified flight envelope, but is not possible to maintain given the weight and temperature conditions.