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Civil Aviation Authority of Singapore

Advisory Circular

CREW RESOURCE MANAGEMENT AND HUMAN PERFORMANCE CONCEPTS FOR GENERAL AVIATION OPERATIONS

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GENERAL

Advisory Circulars (ACs) are issued by the Director-General of Civil Aviation (DGCA) from time to time to provide practical guidance or certainty in respect of the statutory requirements for aviation safety. ACs contain information about standards, practices and procedures acceptable to CAAS. An AC may be used, in accordance with section 11 of the Air Navigation Act 1966 (ANA), to show that compliance with a statutory requirement has been achieved. The revision number of the AC is indicated in parenthesis in the suffix of the AC number.

PURPOSE

This Advisory Circular provides guidance on the application of Crew Resource Management (CRM) and Human Performance concepts in General Aviation (GA) operations conducted under the Air Navigation (91-General Operating Rules) Regulations 2018 (ANR-91). It also explains how the related concepts of Threat and Error Management (TEM), Single-Pilot Resource Management (SRM) and Aeronautical Decision Making (ADM) may be applied to support the safe conduct of flight operations.

The guidance is intended to assist pilots and organisations conducting GA operations in applying these concepts to flight preparation, operational decision-making and the conduct of flight. The guidance should be applied proportionately having regard to the nature, scale and complexity of the operation.

APPLICABILITY

This AC is applicable to pilots exercising pilot-in-command responsibilities in GA operations conducted in Singapore-registered aircraft under the ANR-91. The guidance contained in this AC may also be used by flying clubs, aircraft owners, operators and other organisations involved in conducting or supporting GA flight operations.

RELATED REGULATIONS

This AC relates specifically to Regulations 18, 23, 24 and 25 of the ANR-91.

Regulation 18 relates to the responsibilities of the pilot-in-command. Regulations 23, 24 and 25 relate to flight preparation, flight planning and the information relevant to the intended flight.

RELATED ADVISORY CIRCULARS

- AC 121-9-8 Training on Crew Resource Management (CRM)

CANCELLATION

This AC is the first on the subject.

EFFECTIVE DATE

This AC is effective from 20 November 2026.

OTHER REFERENCES

The following references were considered in the development of this AC:

- ICAO Human Factors Training Manual (Doc 9683)
- FAA AC 120-51E – Crew Resource Management Training
- FAA AC 60-22 – Aeronautical Decision Making
- FAA Risk Management Handbook (FAA-H-8083-2A)
- FAA Pilot's Handbook of Aeronautical Knowledge (FAA-H-8083 Series)
- Civil Aviation Advisory Publication (CAAP) 5.59-1 – Teaching and Assessing Single-Pilot Human Factors and Threat and Error Management (CASA)

1 INTRODUCTION

1.1 CRM improves aviation safety by addressing human performance limitations and enhancing the effective use of available resources during flight operations. CRM recognises that safe operations require more than technical flying skill and include effective communication, decision-making, situational awareness and workload management.

1.2 In commercial air transport operations, CRM has traditionally focused on multi-crew coordination and teamwork. However, the underlying concepts of CRM are equally applicable to GA operations, including single-pilot operations. Where more than one pilot is involved in the conduct of a flight, effective coordination and communication remain important elements of CRM.

1.3 In GA operations, the pilot-in-command is often the sole pilot on board and is required to perform multiple functions, including aircraft control, navigation, communication, monitoring systems, managing weather and traffic, and making operational decisions, often under time pressure.

1.4 For this reason, CRM concepts in GA are commonly applied through SRM and ADM. CRM remains the overarching human performance framework for the effective use of available resources to support safe flight operations, while SRM and ADM support the practical application of CRM concepts in the single-pilot GA environment.

1.5 TEM complements CRM, SRM and ADM by providing a practical framework to identify threats, manage errors and prevent undesired aircraft states. TEM supports and reinforces the application of CRM concepts by enhancing situational awareness, risk management and decision-making throughout flight operations.

1.6 CRM, TEM, SRM and ADM are mutually supporting concepts that provide pilots with practical tools to manage operational risks and support the safe conduct of GA operations.

2 HUMAN PERFORMANCE AND CREW RESOURCE MANAGEMENT

2.1 Human Performance

2.1.1 Human performance refers to how human capabilities and limitations affect their ability to perform tasks safely and effectively in aviation operations. A pilot's performance may be affected by factors such as fatigue, stress, distraction, expectation bias, complacency, workload and time pressure. These factors may affect the pilot's ability to process information, maintain situational awareness, manage workload and make sound operational decisions.

2.1.2 Human performance is also influenced by the nature of the task, the operating environment, the aircraft and equipment being used, the information available to the pilot and the operational support available.

2.1.3 Understanding human performance therefore involves recognising both individual limitations and the operational conditions that may affect performance. This enables pilots to anticipate situations in which performance may be degraded and to act before safety margins are reduced.

2.2 Crew Resource Management (CRM)

2.2.1 CRM refers to the effective use of all available resources, including persons, equipment, procedures, and information, to achieve safe and effective flight operations. CRM includes coordination between pilots and other persons involved in the safe conduct of a flight. It also involves the clear communication of information and intentions, the appropriate allocation and prioritisation of tasks, and the effective use of operational information and assistance.

2.2.2 CRM applies to both multi-crew and single-pilot operations. In single-pilot operations, CRM requires the pilot to manage personal performance, workload and available resources while retaining responsibility for the safe conduct of the flight.

2.3 Threat and Error Management (TEM)

2.3.1 TEM recognises that threats and errors are a normal part of flight operations and require active management. A threat is any event or condition that increases operational complexity and may reduce safety margins if not managed appropriately. Threats may arise from weather, terrain, traffic, airspace, aerodrome conditions, aircraft serviceability, operational changes or Human Performance factors.

2.3.2 An error is an action or inaction that results in, or may result in, a deviation from the pilot's intentions, applicable procedures or accepted operating practices.

2.3.3 An undesired aircraft state is a condition in which the aircraft is placed at increased risk because of an error, an unmanaged threat or other operational circumstances. Examples include an unintended deviation from the planned flight path, an unstable approach, an unsafe fuel state or continued flight into deteriorating weather.

2.3.4 TEM involves:

(a) anticipating threats that may arise during the flight;

(b) establishing appropriate measures to manage those threats;

(c) detecting and correcting errors before they affect safety margins;

(d) recognising when the aircraft is approaching or has entered an undesired aircraft state; and

(e) taking timely action to restore an adequate safety margin.

2.4 Single-Pilot Resource Management (SRM)

2.4.1 SRM is the application of CRM and TEM concepts to single-pilot operations.

2.4.2 SRM requires the pilot to make effective use of all available resources. Depending on the circumstances, these may include:

(a) aircraft systems and automation;

(b) checklists and procedures;

(c) air traffic services;

(d) weather and aeronautical information;

(e) other persons on board;

(f) ground personnel and operational support; and

(g) the pilot's own knowledge, experience and judgement.

2.4.3 Effective SRM includes anticipating periods of high workload, preparing for likely threats, prioritising safety-critical tasks and seeking assistance before the situation becomes difficult to manage.

2.4.4 The use of automation or other equipment does not remove the need for the pilot to monitor the aircraft's flight path and system status. The pilot should understand the capabilities, operating modes and limitations of the systems used and verify that they are producing the intended outcome.

2.5 Aeronautical Decision Making (ADM)

2.5.1 ADM is a systemic approach to identifying hazards, assessing operational risks, considering available options and making decisions that support the safe conduct of a flight.

2.5.2 ADM applies throughout all phases of flight and is not limited to abnormal or emergency situations. It includes routine decisions relating to departure, routing, fuel, altitude, diversion, approach and landing.

2.5.3 A practical decision-making process involves:

(a) identifying what has changed or may go wrong;

(b) assessing how the change may affect the safety of the flight;

(c) considering the available options and the consequences of each option;

(d) selecting and implementing an appropriate course of action; and

(e) reviewing whether the action taken has achieved the intended outcome.

2.5.4 The pilot should make decisions sufficiently early to preserve viable options and adequate safety margins. Depending on the circumstances, this may involve delaying the flight, changing the route or altitude, carrying additional fuel, diverting, discontinuing an approach or terminating the flight.

2.6 Relationship Between CRM, TEM, SRM and ADM

2.6.1 CRM provides the overarching framework for the effective use of available resources.

2.6.2 SRM applies CRM and ADM principles to the particular demands of single-pilot operations.

2.6.3 TEM supports these concepts by helping pilots anticipate threats, detect and manage errors, and prevent or recover from undesired aircraft states.

2.6.4 Together, CRM, TEM, SRM and ADM support effective communication, workload management, situational awareness, and operational decision-making and risk management throughout a flight.

3 APPLICATION IN GENERAL AVIATION OPERATIONS

3.1 General

3.1.1 CRM, TEM, SRM and ADM concepts may be put into practice through:

(a) effective communication;

(b) effective workload management;

(c) maintaining situational awareness; and

(d) timely and risk-informed decision-making.

3.1.2 The concepts should be applied throughout the flight and adapted as operational circumstances change. The practical actions required will depend on factors such as the aircraft, flight conditions, operating environment, number of pilots involved and resources available.

3.2 Effective Communication

3.2.1 The pilot should communicate clearly, accurately and at an appropriate time to reduce misunderstanding and support safe decisions by the persons involved in the operation.

3.2.2 Effective communication includes:

(a) listening actively and confirming critical information;

(b) seeking clarification where information or an instruction is incomplete or ambiguous;

(c) communicating intentions and changes in circumstances promptly;

(d) using standard terminology and phraseology, where applicable; and

(e) ensuring that relevant information is understood by the intended recipient.

3.2.3 Where more than one pilot is involved, the allocation of responsibilities and the intended course of action should be understood by all pilots. Any difference in assessment or uncertainty about the intended action should be raised and resolved before it affects the safe conduct of the flight.

3.2.4 In single-pilot operations, effective communication includes the disciplined use of radio communications, briefings, flight-following arrangements and available operational support.

3.2.5 Where appropriate, the pilot should inform air traffic services or other relevant persons promptly when assistance is required or when the pilot's intentions have changed.

3.3 Effective Workload Management

3.3.1 The pilot should plan, prioritise and sequence tasks according to their importance to the immediate safety of the flight.

3.3.2 Aircraft control and flight-path management should take precedence over administrative or non-essential tasks. Navigation, communication, checklist actions and systems management should then be addressed in an orderly manner, having regard to the circumstances.

3.3.3 The pilot should anticipate periods of increased workload. Where practicable, briefings, equipment configuration, review of relevant information and other preparatory actions should be completed before entering a high-workload phase of flight.

3.3.4 If workload becomes excessive, the pilot should simplify the situation and defer non-essential tasks. Depending on the circumstances, the pilot may:

(a) reduce the number of tasks being performed;

(b) delay a non-essential action;

(c) use an appropriate level of automation where available;

(d) request assistance from air traffic services;

(e) extend the flight path to provide more time;

(f) discontinue an approach; or

(g) divert to a suitable aerodrome.

3.3.5 Checklists should be used as applicable to reduce reliance on memory and minimise the risk of omissions. If the use of a checklist is interrupted, the pilot should ensure that the checklist is resumed from an appropriate point and completed.

3.3.6 The pilot should understand the capabilities and limitations of the automation and navigation systems used for the flight. System modes and outputs should be monitored to confirm that the aircraft is following the intended flight path.

3.4 Maintaining Situational Awareness

3.4.1 The pilot should maintain an accurate understanding of:

(a) the aircraft's present condition, configuration and position;

(b) the intended flight path and the next significant action;

(c) the surrounding weather, traffic, terrain and airspace;

(d) fuel status and aircraft serviceability;

(e) applicable operational limitations; and

(f) how the situation may develop if the flight continues as planned.

3.4.2 The pilot should compare actual conditions with those expected and investigate any inconsistency or unexpected deviation.

3.4.3 Indications that situational awareness may be deteriorating include:

(a) uncertainty about the aircraft's position, configuration or system mode;

(b) missed radio calls or checklist actions;

(c) repeated corrections to the aircraft's flight path;

(d) fixation on a single task or problem;

(e) difficulty keeping pace with changing circumstances; or

(f) uncertainty about what is likely to happen next.

3.4.4 The pilot should also remain alert to human performance factors that may affect situational awareness, including fatigue, stress, distraction, expectation bias, complacency, workload and time pressure.

3.4.5 If situational awareness has deteriorated, the pilot should first maintain or regain control of the aircraft, establish a safe flight path and reduce workload. The pilot should then resolve the uncertainty using the available information and resources.

3.5 Timely and Risk-Informed Decision-Making

3.5.1 The pilot should identify changes that may affect the safety of the flight, assess the available options and make a decision before safety margins or available alternatives are unnecessarily reduced.

3.5.2 The assessment should take account of:

(a) the condition and capabilities of the aircraft;

(b) the pilot's fitness, experience and operational capability;

(c) weather, terrain, traffic, airspace and aerodrome conditions;

(d) fuel available and the fuel required for the available options;

(e) the time available to make and implement the decision;

(f) operational support and assistance available; and

(g) the likely consequences if conditions deteriorate further.

3.5.3 The pilot should use relevant information and resources to inform the decision. Depending on the circumstances, these may include input from another pilot, air traffic services, persons on board, ground personnel, weather information, aircraft systems or other operational support.

3.5.4 The pilot should not allow convenience, cost, destination pressure, perceived embarrassment or a desire to complete the flight to outweigh operational risk.

3.5.5 The decision should be reviewed as circumstances change. Where practicable, the pilot should establish clear points at which the flight will be delayed, modified, diverted, discontinued or terminated.

4 ABNORMAL AND EMERGENCY SITUATIONS

4.1 In an abnormal or emergency situation, the pilot-in-command should first maintain or regain control of the aircraft, establish a safe flight path and assess the time available before taking further action.

4.2 Immediate actions required by the aircraft flight manual or checklist should be completed as applicable. The relevant checklist should then be used when circumstances permit.

4.3 The pilot-in-command should prioritise:

(a) aircraft control;

(b) the safe management of the flight path;

(c) navigation to an appropriate location; and

(d) communication with air traffic services or other relevant persons.

4.4 Non-essential tasks should be deferred. Automation should be used only where it reduces workload, and its operation is understood and monitored.

4.5 Where appropriate, assistance should be sought from air traffic services or other available resources at an early stage. The nature of the problem, the assistance required and the pilot's intentions should be communicated as clearly as circumstances permit.

4.6 The pilot-in-command should periodically reassess the situation and confirm whether the action taken is producing the intended outcome.

5 APPLICATION BY GA OPERATORS AND ORGANISATIONS

5.1 Organisations conducting or supporting GA operations should consider how the concepts described in this AC may be incorporated into their operating practices in a manner proportionate to the nature and complexity of their operations.

5.2 This may include arrangements that support:

(a) the identification and assessment of operational threats before flight;

(b) effective communication between persons involved in conducting or supporting the operation;

(c) the appropriate use of procedures and checklists;

(d) the prioritisation and management of workload;

(e) the provision and use of relevant operational information;

(f) timely decisions when circumstances change;

(g) access to appropriate operational assistance; and

(h) the review of operational occurrences, difficulties or recurring threats.

5.3 A private owner-pilot may apply the concepts through personal flight preparation, the identification of decision points, disciplined checklist use, and a clear understanding of actions to be taken during abnormal and emergency situations.

5.4 A flying club or other GA operator may apply the concepts through its operating procedures, flight authorisation arrangements, pilot briefings, safety communications, occurrence reviews and the operational information provided to pilots.

5.5 The arrangements adopted should support sound operational judgement and should not be treated merely as administrative steps to justify proceeding with a flight.