Australian Government

Civil Aviation Safety Authority

TRAFFIC ALERT AND COLLISION AVOIDANCE SYSTEM (TCAS II)

Version 1.0 – Effective June 2004

Traffic Alert and Collision Avoidance System (TCAS II)

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Competency Standards for TCAS II Operations

Aeronautical Knowledge Syllabus of Training

Version 1.0 – 01 June 2004

Copies of the syllabus are available from: www.casa.jsmcmillan.com.au**.**

Revision History

Version	Date	Section(s)	Details of Change
1.0	June 2004	All	Initial issue.

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OVERVIEW

Introduction

The operational standards and aeronautical knowledge syllabus in this document apply to the Airborne Collision Avoidance System (ACAS), known as TCAS II.

The purpose of the standard and syllabus is to provide guidance to pilots, instructors and assessors about the system operating skills and theoretical knowledge requirements for an applicant to obtain a TCAS II endorsement. In addition, the document explains the standard of operational competency that must be demonstrated to qualify for the endorsement, which is entered into the pilot's logbook.

Pilots must complete an oral, written or multiple choice test; or provide correct responses to questions generated by an interactive multi-media programme such as a computer based training programme (CBT) or any combination of these, as detailed in the Aeronautical Syllabus of Training section of this document. A pass mark of not less than 80% must be achieved.

The Competency Based Standards for TCAS II Operations consist of Units and Elements of competency, and Assessment Guides.

All the pre-flight and in-flight requirements of TCAS II operations are divided into realistic individual tasks called Units of Competency, such as 'Perform TCAS II Pre-flight Procedures'.

The Units are further divided into Elements of Competency, which simply describe what the candidate must do.

Each Element of Competency has Performance Criteria which clearly define the performance an applicant must demonstrate to achieve the required standard.

Included with each Unit is an Assessment Guide. This guide is provided to applicants, instructors and assessors to objectively measure whether the actions required to meet the competency standard have been achieved.

When assessing pilot competency, assessors should use the specified tolerances as a guide to confirm that approved TCAS II techniques are always used.

To this end, the assessor should be driven by approved technique, rather than solely by specified numerical tolerances.

For initial endorsement and renewals, the pre-flight and in-flight competencies must be demonstrated in an approved flight simulator, or by means of interactive multi-media or CBT programmes acceptable to CASA, except that the pre-flight competencies and the control of the TCAS II display may be demonstrated in an aircraft.

Where a flight simulator is used, control inputs should be positive, smooth and coordinated and changes in vertical speed accomplished within the specified acceleration tolerances.

For initial endorsement, all elements of the pre-flight and in-flight competencies must be demonstrated. For renewal of the endorsement, only those items identified with an asterisk (*) are required to be demonstrated.

On initial endorsement an entry must be made in the pilot's logbook certifying that the pilot has successfully completed the required TCAS II training. The form of the entry should be:

I consider (<u>Pilots name and ARN</u>) competent in the operation of TCAS II equipment; he/she has been instructed and found competent in all required elements of training in the use of TCAS II prepared by CASA and published under CAR 5.59 (h).

Name_____ ARN_____ Date___/___/_____"

For renewals of TCAS II the form of the logbook entry should be:

(<u>Pilots Name and ARN</u>) has completed TCAS II renewal training as required under CAR 5.59(h).

Name_____ ARN_____ Date___/___/_____"

Definitions

When these terms appear in the text of the standard they are <u>underlined.</u>

The checks and actions detailed in these definitions are advisory. Checks and actions in approved checklists, placards, Flight Manual/POHs, or Operations Manuals have precedence and must be complied with.

ACAS	Airborne Collision Avoidance System.
	For the purposes of these competency standards, ACAS is an approved TCAS II within the meaning given by CAR 262AB.
Approved checklist	A checklist derived from information set out in the Flight Manual/POH, placards or other documents provided with the aircraft, necessary to ensure the situation awareness operation of the aircraft.
Effect of turbulence	The effect of turbulence must be considered when measuring standards of flying competency.
	Assessors must evaluate each situation and then apply considered judgement to compensate for variations to the published standards.
Safe	Means that a manoeuvre of flight is completed without injury to persons, damage to aircraft or breach of aviation safety regulations, while meeting the requirements of the Australian National Competency Standards for Private and Commercial Pilots.
Situation awareness	An appreciation of all factors relevant to the <u>safe</u> progress of a flight.
TCAS II	Traffic Alert and Collision Avoidance System.
	TCAS II is an ACAS that provides both Traffic Advisories (TA) and Resolution Advisories (RA).

COMPETENCY STANDARDS FOR TCAS II OPERATIONS

Note: Only those items identified with an asterisk (*) are required to be demonstrated.

Unit 1 – Perform Pre-flight <u>TCAS II</u> Procedures

Description

Knowledge and skills to perform <u>TCAS II</u> pre-flight procedures in accordance with the <u>approved checklist</u>, company operations manual or Pilot's Handbook, determine the serviceability status of <u>TCAS II</u> equipment and select the appropriate modes of operation.

Elements	Performance Criteria
1.1 *Perform pre-flight procedures and determine serviceability of <u>TCAS II</u> equipment	• Perform pre-flight procedures in accordance with the approved checklist, company operations manual or Pilot's Handbook to ensure serviceability of TCAS II equipment in accordance with approved testing procedure and rectify faults when possible.
1.2 *Select required modes of <u>TCAS II</u>	• Appropriate <u>TCAS II</u> modes are selected for taxiing and take off in accordance with <u>approved checklist</u> or company operations manual or Pilot's Handbook.
1.3 *Brief Crew	• Carry out pre-flight briefing addressing the procedures that will be used in responding to TAs and RAs in accordance with the company operations manual.

Unit 1 – Assessment Guide

During assessment the pilot should be observed to perform the following checks and actions as evidence of ability to meet the TCAS II operating standards.

The checks and actions detailed in this guide are advisory. Checks and actions in <u>approved checklist</u>s, placards, Flight Manual/POHs, or Operations Manuals have precedence and must be complied with.

Element	Evidence
1.1 *Perform pre-flight procedures and determine serviceability of <u>TCAS II</u> equipment	• <u>TCAS II</u> pre-flight procedures are performed in accordance with <u>approved checklist</u>, company operations manual or Pilot's Handbook. • <u>TCAS II</u> self-test function is interpreted to determine system serviceability. • <u>TCAS II</u> unserviceabilities are identified and rectified when possible.
1.2 *Select required modes of <u>TCAS II</u>	• Prior to taxi, mode S transponder set to 'STANDBY', or transponder 'ON' and <u>TCAS II</u> 'OFF'. • Prior to take off Mode S transponder selected to 'TA/RA'. ***Note:*** *Selection of required modes may vary with specific operator procedure.*
1.3 *Brief Crew	• <u>TCAS II</u> briefing is completed in accordance with company operations manual. • Division and application of crew <u>TCAS II</u> duties are specified. • <u>TCAS II</u> advisory call out procedure is specified. • Conditions under which an RA might not be followed are specified. • Communication procedures relating to <u>TCAS II</u> alerts are specified.

Unit 2 – Control and Interpretation of TCAS II Display Information

Description

Knowledge and skills to control the display configuration in accordance with the <u>approved checklist</u>, company operations manual or Pilot's Handbook; and to recognise and interpret all information displayed by <u>TCAS II.</u>

Elements	Performance Criteria
2.1 *Select <u>TCAS II</u> display configuration	• Select appropriate <u>TCAS II</u> display configuration at various stages of flight in accordance with the <u>approved checklist</u>, company operations manual or Pilot's Handbook.
2.2 *Interpret <u>TCAS II</u> display elements	• Recognise and interpret all information displayed by <u>TCAS II</u>.

Unit 2 – Assessment Guide

During assessment the pilot should be observed to perform the following checks and actions as evidence of ability to meet the <u>TCAS II</u> operating standards.

The checks and actions detailed in this guide are advisory. Checks and actions in <u>approved checklists</u>, placards, Flight Manual/POHs, or Operations Manuals have precedence and must be complied with.

Element	Evidence
2.1 *Select <u>TCAS II</u> display configuration	• <u>TCAS II</u> display range selected to 'LOW' in terminal area. • <u>TCAS II</u> selected to higher ranges enroute and in transition between terminal areas. • Lower ranges are selected when an advisory is issued. • 'Above' Mode selected during climb, when function is fitted. • 'Below' Mode selected during descent, when function is fitted. • Display configuration controlled to show appropriate <u>TCAS II</u> information without elimination of other necessary flight information. • 'Absolute' or 'relative' intruder altitude selected when appropriate to flight circumstances, if available. • Selected range changed to display all available information for off-scale TAs and RAs. • 'TA/RA' and 'TA ONLY' Modes selected as appropriate for the in-flight circumstances. ***Note:*** *Selection of <u>TCAS II</u> display configuration should be in accordance with the <u>approved checklist</u> or company operations manual and may vary with specific operator procedures.*
2.2 *Interpret <u>TCAS II</u> display elements	• Recognise proximate traffic or other traffic that is not causing a TA or RA to be issued, by interpreting <u>TCAS II</u> displays. • Recognise non-altitude-reporting traffic by interpreting TCAS II displays. • Identify 'no bearing' TAs. • Demonstrate by following RAs, an understanding of the meaning of the red and green areas, or the meaning of pitch and flight path angle cues, displayed on the RA command display.

Unit 3 – Manage <u>TCAS II</u> Traffic and Resolution Advisory Events

Description

Knowledge and skills to assess and respond appropriately to Traffic Advisories (TA) and Resolution Advisories (RA) issued by <u>TCAS II</u>.

Elements	Performance Criteria
3.1 Respond to Traffic Advisories (TA)	• Interpret displayed TA information to determine relative position of the traffic and assess the potential threat. • No manoeuvres initiated based solely on <u>TCAS II</u> TA information.

3.2 *Respond to Resolution Advisories (RA) issued for a range of encounter geometries	• Respond appropriately, within the specified time and acceleration tolerances, to RA issued for the following encounter geometries:
	   ○ Both TCAS and intruder aircraft in level flight
	   ○ TCAS aircraft in level flight, intruder with vertical rate
	   ○ TCAS aircraft with vertical rate, intruder in level flight
	   ○ Both TCAS and intruder aircraft with vertical rate
	• Ensures RA commands are followed in priority to conflicting ATC instructions.
	*Note: For renewal of the TCAS endorsement, it is only necessary to demonstrate an appropriate response for one corrective RA and one preventative RA, in any convenient encounter geometry.

3.3 *Perform radio communications procedures applicable to <u>TCAS II</u> operations	• Communicate with ATC using standard radiotelephone procedures applicable to the TCAS event.

Unit 3 – Assessment Guide

During assessment the pilot should be observed to perform the following checks and actions as evidence of ability to meet the <u>TCAS II</u> operating standards.

The checks and actions detailed in this guide are advisory. Checks and actions in <u>approved checklist</u>s, placards, Flight Manual/POHs, or Operations Manuals have precedence and must be complied with.

Element	Evidence
3.1 *Respond to Traffic Advisories (TA)	• Intruder identified on <u>TCAS II</u> display, bearing and range of the intruder confirmed, relative altitude (data tag) and vertical speed direction (trend arrow) identified and correctly interpreted. • No manoeuvres initiated based solely on TCAS II TA display. • Use all available information to assist in visual acquisition. • State expected position for visual acquisition of TA traffic. • Visually acquire TA traffic where possible.
3.2 *Respond to Resolution Advisories (RA) issued for a range of encounter geometries	• Appropriate responses in accordance with the RAs issued in the encounter geometries listed at Unit 3 Performance Criteria 3.2. • Ensures RA commands are followed in priority to conflicting ATC instructions. • Where more than one intruder is present on the <u>TCAS II</u> display, the intruder causing the RA is correctly identified. • For 'corrective' RAs, response is initiated in the specified direction, using positive control inputs, within 5 seconds of the RA being displayed. • For 'increase rate' or 'reversal' RAs, the vertical speed is increased or reversed, using positive control inputs, within 2.5 seconds of the RA being displayed. • For 'weakening' RAs, the vertical speed is modified to initiate a return towards the original altitude specified in ATC clearance within 2.5 seconds of the RA being displayed. • For 'strengthening' RAs, the vertical speed is modified to comply with the revised RA within 2.5 seconds of the RA being displayed. • 'Altitude crossing' encounters are recognised and response to crossing RAs is performed in accordance with the RAs issued. • For 'maintain rate' RAs, the vertical speed is not reduced. • For 'preventative' RAs, the vertical speed needle remains outside the red area on the RA display. • When a decision is made not to follow the RA, no changes to the existing vertical speed must be made in a direction opposite to the sense of the displayed RA. • When 'Clear of Conflict' is annunciated, a prompt return to the original clearance is completed.
3.3 *Perform radio communications procedures applicable to <u>TCAS II</u> operations	• ATC informed of the RA when time and workload permit, using the radio phraseology "TCAS Climb" or "TCAS Descent". • ATC informed when return to assigned clearance has been initiated, using the radio phraseology "Returning to xxxxxft/FL xxx". • ATC clearances complied with where possible while responding to an RA or, where compliance is not possible, notification given to ATC using the radio phraseology "Unable to Comply; TCAS Resolution Advisory". • Amended ATC clearances are complied with following a TCAS event.

Unit 4 – Recognise and Manage <u>TCAS II</u> Failures

Description:

Knowledge and skills to recognise and respond appropriately to in-flight failures of the <u>TCAS II</u> system.

Elements	Performance Criteria
4.1 *Recognise and identify <u>TCAS II</u> failures	• Recognise and identify total <u>TCAS II</u> failure. • Recognise and identify failure of RA Mode.
4.2 *Rectify <u>TCAS II</u> fault or limit the use of <u>TCAS II</u>	• <u>TCAS II</u> faults are tested and rectified in accordance with the <u>approved checklist</u>, company operations manual or Pilot Operating Handbook, where possible. • Where faults cannot be rectified, the use of <u>TCAS II</u> is limited in accordance with the reduced capabilities of the equipment.

Unit 4 – Assessment Guide

During assessment the pilot should be observed to perform the following checks and actions as evidence of ability to meet the <u>TCAS II</u> operating standards.

The checks and actions detailed in this guide are advisory. Checks and actions in <u>approved checklist</u>s, placards, Flight Manual/POHs, or Operations Manuals have precedence and must be complied with.

Element	Evidence
4.1 *Recognise and identify <u>TCAS II</u> failures	• <u>TCAS II</u> failures appropriate to the specific <u>TCAS II</u> equipment are recognised and identified.
4.2 *Rectify <u>TCAS II</u> fault or limit the use of <u>TCAS II</u>	• Action taken to rectify the fault in accordance with the <u>approved checklist</u>, company operations manual or Pilot's Handbook. • When partial failure occurs, use of <u>TCAS II</u> is limited in accordance with the <u>approved checklist</u>, company operations manual or Pilot Operating Handbook. • Note: Differences in TCAS II equipment supplied by different manufacturers and differences in company operating procedures by specific operators will result in a wide variation of appropriate procedures.

AERONAUTICAL KNOWLEDGE
SYLLABUS OF TRAINING

Introduction

This syllabus provides details of the aeronautical knowledge requirements for the issue of a Traffic Alert and Collision Avoidance System (TCAS II) qualification.

Theoretical training is divided into three units:

>   Unit 1 – Overview of TCAS II;
>
>   Unit 2 – Basic Concepts; and
>
>   Unit 3 – Operational Concepts.

A pass mark of 80% must be achieved. This can be accomplished through self-study, video presentations, computer based training programmes and classroom briefings or any combination of these methods of training. Successful completion of this phase can be demonstrated by means of oral, written or multiple-choice tests or by providing correct responses to computer based training questions or by any combination of these testing techniques.

For initial endorsement, the oral, written or multiple-choice test must include all items listed in Units one, two and three.

For renewal of a TCAS II endorsement, the oral, written or multiple-choice test is only required to include the items identified by an asterisk (*) in Unit 3.

A record of results must be maintained and retained by the training organisation.

Aeronautical Knowledge of Basic and Operational Concepts of TCAS II

Unit 1 – Overview of TCAS II

1.1   State the surveillance and collision avoidance functions of TCAS II.

1.2   Demonstrate knowledge of system limitations, selectivity and inhibits.

1.3   Identify the basic components of TCAS II.

1.4   Identify and demonstrate knowledge of the function of cockpit controls.

Unit 2 – Basic Concepts

2.1   Demonstrate knowledge of the listed terminology applicable to TCAS II:
   Proximate
   Intruder
   Threat
   Traffic Advisory (TA)
   Resolution Advisory (RA), and Closest Point of Approach (CPA).

2.2   Demonstrate knowledge of the effect of Tau and DMOD criteria on the protected area.

2.3   Demonstrate knowledge of altitude separation thresholds.

2.4   State the circumstances under which TCAS II inhibits RA at low altitude.

2.5   Demonstrate knowledge on level of protection provided by TCAS II applicable to:
   Altitude-reporting intruders
   Non altitude-reporting intruders
   Multiple intruders
   TCAS II to TCAS II coordination.

2.6   Demonstrate knowledge of TCAS II visual displays and symbology.

2.7   Demonstrate knowledge of audio alerts and annunciations.

2.8   State how TCAS II interfaces with other aircraft systems listed:
   Mode S transponder
   Barometric and radio altimeter inputs to TCAS II
   Weather radar
   Electronic flight instruments.

2.9   Demonstrate knowledge of differences between TCAS II versions 6.04A and 7.0.

Unit 3 – Operational Concepts

Note: For renewal of a TCAS II endorsement, the oral, written or multiple-choice test is only required to include the items identified by an asterisk (*)

3.1   *Interpret and apply displayed traffic information to enhance (improve) situation awareness.

3.2   *Interpret Traffic Advisory (TA) Mode and demonstrate knowledge of appropriate action to be taken.

3.3   *Interpret RA and demonstrate knowledge of appropriate action to be taken.

*Identify a strengthening or weakening RA and demonstrate knowledge of appropriate action to be taken.

3.4   *State why TCAS II logic would issue a crossing RA action (RA) after detection of a crossing threat aircraft.

3.5   *State why TCAS II logic would issue an RA reversal.

3.6   *State maximum time available to initiate and appropriate response to an RA to ensure collision avoidance.

3.7   Demonstrate knowledge of the appropriate crew response to:

Multiple TCAS II events

Parallel runway approach conflicts.

3.8   Demonstrate knowledge of the priorities given to:
Stall warnings
GPWS alert
Windshear
TCAS II RA.

3.9   State what advisories TCAS II will use when aircraft performance limits response to RA.

3.10   *Demonstrate knowledge of crew responses to cancellation of RA.

3.11   *Demonstrate knowledge of radiotelephone procedures following a TCAS II alert.

3.12   Demonstrate knowledge of when a written report of a TCAS II alert is required and to whom it must be submitted.

3.13   State under what circumstances flight with an unserviceable TCAS II is permitted.

3.14   Demonstrate awareness of increased probability of TCAS II alerts when using version 6.04A in Reduced Vertical Separation Minima (RVSM) airspace.