

Safety Regulation Group



CAP 717

Radar Control - Collision Avoidance Concepts

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Revision History

Revisions in the third edition

23 January 2009

In addition to minor editorial corrections the following changes have been made to the third edition: where necessary, terminology has been updated and a Glossary and Abbreviations page included, paragraph formatting has been improved for the reader's convenience. A dedicated section on Avoiding Action has been included – previously published by the CAA as AT SIN 141 (15 September 2008).

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Foreword

In 2002, the CAA published CAP 717 with the aim of ensuring that controller emergency training programmes were enhanced. At the time it was considered that avoiding action instructions issued by controllers were not always well understood by controllers and pilots.

CAP 717 discusses the factors affecting the issuing of avoiding action instructions by controllers within controlled airspace. A number of example scenarios are provided, offering guidance on avoiding action instructions that may be suitable.

This guidance, recently reviewed and updated by the CAA, is to be incorporated into controller training schemes to encourage the instinctive use of the words "avoiding action" whenever controllers realise that the possibility of a serious loss of separation exists. The contents of this document will also be of interest to pilots and flying training organisations.

Any correspondence regarding CAP 717 should be sent to ats.enquiries@caa.co.uk.

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Glossary and Abbreviations

1 Glossary

ATS Surveillance System

A generic term meaning variously, ADS-B, PSR, SSR or any comparable ground-based system that enables the identification of aircraft. A comparable ground-based system is one that has been demonstrated, by comparative assessment or other methodology to have a level of safety and performance equal to or better than monopulse SSR. (ICAO)

Avoiding Action

Instructions given by controllers when immediate action is required to prevent a mid-air collision or loss of required separation. (CAP 717)

Position Symbol

The visual indication in symbolic form, on a situation display, of the position of an aircraft, aerodrome vehicle or other object obtained after automatic processing of positional data derived from any source. (ICAO)

Situation Display

An electronic display depicting the position and movement of aircraft and other information as required. (ICAO)

2 Abbreviations

ACAS	Airborne Collision Avoidance System
ATC	Air Traffic Control
ATS	Air Traffic Service
CAP	Civil Aviation Publication
ft	Feet
ICAO	International Civil Aviation Organisation
NM	Nautical Mile
PANS-ATM	Procedures for Air Navigation Services - Air Traffic Management
PSR	Primary Surveillance Radar
rpm	Revolutions per Minute
RTF	Radiotelephony
SSR	Secondary Surveillance Radar
TCAS	Traffic Collision Avoidance System

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Collision Avoidance Concepts

1 Introduction

- 1.1 At some time during their career, controllers can expect to be faced with a situation in which they have to take decisive action to assist in preventing a potential collision between aircraft. This document offers advice on handling traffic situations that may lead to a risk of collision and on giving avoiding action. The use of the techniques described herein is not mandatory, but they offer possible solutions and are included to stimulate debate, particularly in the context of training to handle aircraft in unusual circumstances.
- 1.2 Controllers assure the safety of aircraft under their control by applying specified standard separation minima. In most airspace, the standard separation in the horizontal plane is 5 NM but, in areas where the performance of ATS surveillance systems meet required criteria, this may be reduced to 3 NM. In the vertical plane the standard separation minima is 1,000 ft. Exceptionally, this may be reduced to 500 ft in emergency situations.
- 1.3 Pilots are taught to maintain a situational awareness, but they may not be aware of the vertical or horizontal separations being used by controllers for that particular airspace; or that these separations have been compromised - until a potential collision risk is identified. When English is not the pilot's first language, an increase in this lack of awareness may occur.
- 1.4 Controllers and trainees who have not experienced a situation when they have had to give avoiding action may not appreciate the way in which, or how quickly, a situation in which separation is lost can develop into one where there is a risk of collision.

2 The ATC System

In the context of CAP 717, the system within which controllers operate can be thought of as including:

- **Environment** – controlled airspace, its associated procedures and separation standards.
- **Aircraft** – only those flying in accordance with the Instrument Flight Rules.
- **ATS Surveillance System Limitations.**
- **Controllers**
- **Pilots**
- **Radiotelephony (RTF)** – communication procedures and phraseology.

2.1 Environment

- 2.1.1 The environment being considered herein is limited to controlled airspace, within which the controller is providing an air traffic control service. The controller will know all the aircraft in the airspace under his jurisdiction.
- 2.1.2 Separation standards are designed to ensure that, when applied, the risk of a collision between aircraft is so remote as to be almost inconceivable. Safeguards built into the separation standards take account of the limitations associated with the system within which they are being used. These limitations are associated with the surveillance equipment being used and are discussed below. In the scenarios provided, because standard separation has been lost, these safeguards no longer exist – an exceptional circumstance that many controllers will face without warning.

2.2 Aircraft

CAP 717 considers all aircraft to be flying in accordance with the Instrument Flight Rules. Pilots will be expected to comply with ATC instructions, except where the pilot decides not to comply for the purposes of avoiding immediate danger. The vast majority of aircraft will be equipped with ACAS, but pilots are still expected to be looking out of the cockpit for visual acquisition of conflicting traffic.

2.3 ATIS Surveillance System Limitations

One of the limitations of the ATC system is that caused by the surveillance equipment being used.

For example, a radar with a rotational speed of 10 rpm will update the indicated position of an aircraft once every 6 seconds. An aircraft flying with a ground speed of 420 knots being surveyed by that radar will travel approximately $\frac{3}{4}$ of a mile between rotations. This can result in the aircraft's position, presented to the controller on the situation display, being $\frac{3}{4}$ of a mile out of date immediately prior to the next update. Similarly, an aircraft climbing at 3,000 ft/min with a 6 second radar update rate could actually be 300 ft higher than indicated on the situation display.

These figures only take account of the physical delays imposed by the speed of the aircraft, which may vary considerably between aircraft types, and the rotation rate of the radar head. Processing delays associated with the transmission of data between sites can also add to this time lag. Processed radars may have a facility to predict and display the likely position of an aircraft based on its previous track and speed (known as coasting) should the aircraft target not be detected by the radar for a limited number of rotations of the radar head. If the aircraft commences a turn during the time the radar is predicting its track, the aircraft's actual position and the displayed position will be different. Thus, in reality, the distance between the displayed position of the aircraft and its actual position can be more than would be expected.

2.4 Controllers

2.4.1 It is the task of the controller to prevent collisions between aircraft within this system by applying techniques to ensure that the separation provided does not fall below the required minima. A controller will determine separation based on the aircraft positions on the situation display; as described above, this may not in fact be the actual position of the aircraft. To add to this uncertainty a controller may miss an update of position symbols whilst engaged in another task or concentrating on another traffic situation. Just one missed update means doubling the distance the aircraft has travelled since the controller last updated his appreciation of the position of the aircraft (in the example above, now $1\frac{1}{2}$ miles horizontally and 600 ft vertically). The controller may also experience difficulties in appreciating deviations from planned tracks when viewing a large area on the situation display. It may not be immediately apparent when the radar misses a return and displays a predicted position, or it may be difficult to interpret aircraft positions when the SSR responses are garbled or overlaid.

2.4.2 Therefore, the traffic picture as understood by the controller can be a significant mismatch with reality at any given time. The controller will also experience some delay whilst taking in, understanding and subsequently reacting to the situation. In the case of faster aircraft, or aircraft on reciprocal tracks closing head on, the time available to the controller in which to make a decision is much reduced, further exacerbating the situation.

- 2.4.3 The fact that the controller is responsible for ensuring that separation minima are maintained can also have a bearing on the situation. When a loss of separation occurs, there is some evidence that indicates controllers may take a short while to assess the blame aspects of a situation before reacting, or that they perhaps deny to themselves that the event is happening. At worst, such factors can result in no action being taken, or incorrect action such as non-urgent tones and inappropriate RTF phraseology being used.
- 2.4.4 As discussed, the delays built into the system are such that safety margins can be eroded significantly in a very short time. In order to apply separation, it is not good enough for controllers to give instructions reactively to pilots - that would be too late. Instead, controllers are trained to manage the traffic situation pro-actively so that separation minima are not infringed. However, occasionally something goes wrong and those separation minima are compromised. When this happens, controllers will be operating without the safety margins that allow for equipment limitations and their training in establishing and maintaining separation standards loses much of its relevance. As the distance between aircraft decreases, the limitations of the surveillance equipment to display the actual positions of the aircraft becomes more significant. In the example above, the controller's display would still show the aircraft some $\frac{3}{4}$ miles apart when they could have already collided.
- 2.4.5 When separation has already been, or is in the process of being, lost and the controller perceives a risk of collision, there is no longer an issue of providing standard separation; the essential task is preventing a collision. It is necessary that instructions passed by the controller in these circumstances must be passed without delay and must be phrased as an urgent instruction.

2.5 Pilots

- 2.5.1 Pilots have been instructed that, upon receiving an avoiding action instruction from ATC, priority should be given to initiating and executing the required manoeuvre; except when responding to an ACAS Resolution Advisory (RA), which **always** takes priority over the vertical element of an ATC instruction¹.
- Pilots are unlikely to be aware that the controller's information, as explained in preceding paragraphs, may be significantly out of date within the timescales associated with a loss of separation. The final decision on how best to avert the risk of collision must therefore rest with the pilot, who may have data from other sources, including a visual sighting of the conflicting aircraft or a Resolution Advisory. However, if the pilot is only in receipt of the controller's avoiding action instructions, those instructions will be followed.
- 2.5.2 Both the controller and the pilot will have to act very quickly and not necessarily on the same information. If the pilot decides to deviate from the controller's instructions because of other factors, he will not have the controller's awareness of the more general traffic situation. Any decisions he makes on actions to avoid the perceived collision risk that vary from the controller's instructions may well have an adverse effect on the safety of other aircraft not involved in the original conflict.
- 2.5.3 Therefore, controllers ought not to be surprised if a pilot does not comply with avoiding action instructions and should be ready to deal with unexpected aircraft manoeuvres, which may well compromise the overall ATC scenario.

1. UK AIC 99/2006 (Pink 102) 17 August. Avoiding Action – Pilot Response to Air Traffic Control.

2.6 Radiotelephony

The use of standard phraseology and good RTF technique is essential when passing instructions to pilots; particularly when timeliness and clarity are important as is the case when passing avoiding action instructions. Any misunderstanding may result in the pilot asking the controller to repeat the instruction, further reducing the time available to avoid a collision. Controllers should also remember that foreign pilots may have limited English proficiency and will only understand ATC instructions constructed from standard phraseology. The use of non-standard phraseology, advanced vocabulary or complex syntax may lead to misunderstanding. However, an urgent tone is something likely to be universally understood and should be used when giving avoiding action instructions, but always in conjunction with the appropriate phraseology.

3 General Factors

3.1 It is not possible to tell controllers exactly how to react to any particular collision risk; the possible variations in the situational geometry are too great. However, experience gained from the consideration of previous incidents, how they developed and how they were resolved, can be used to develop training scenarios. These, together with the teaching of established avoiding action skills, should assist controllers who are faced with a real collision risk.

3.2 Taking the most obvious situation as an example: the rule for avoiding aerial collisions² states that: 'When two aircraft are approaching head-on or approximately so in the air and there is danger of collision, each shall alter its course to the right'.

3.3 This may seem a simple enough rule, until we start asking questions such as:

- Does this apply to controllers, or only to pilots, or to both?
- What is meant by 'approximately'?
- What if the aircraft tracks are offset such that right turns will make the paths cross?
- What about ATS surveillance system performance and situation display settings?
- Is instructing both aircraft to turn right feasible in the timescales associated with a loss of separation?
- How large should the alteration of course be?
- Will solving this problem compromise the safety of other traffic?
- Does this only apply to aircraft in level flight?
- What if ACAS Resolution Advisories conflict with this?

3.4 The answer to these questions, amongst others, always depends upon the circumstances at the time the controller notices the problem. Similar doubts are associated with the other configurations noted in the Rules of the Air. It becomes apparent that these rules are no more than a very basic framework upon which controllers can base their actions to deal with real situations. These rules are appropriate to flights operating without an ATS surveillance service and its associated separation techniques, where instead, pilots rely upon visual traffic avoidance. However, controllers ought to be aware of these rules, not least because pilots may be following them to avoid a collision even as a controller speaks to pass avoiding action.

2. Rules of the Air Regulations 2007, Rule 10.

3.5 A pilot faced with conflicting instructions from a controller and an ACAS RA must follow the ACAS RA. Once the pilot has advised that he is manoeuvring in response to a Resolution Advisory the controller must not provide any further control instructions until the pilot has reported that the ACAS RA has been completed.

3.6 Controllers should not forget that ACAS also generates Traffic Advisories, which do not result in aircraft manoeuvres, but can result in RTF interchanges as the pilot tells the controller that he "sees the traffic on TCAS". Such reports should not dissuade the controller from continuing to pass avoiding action instructions until he is satisfied that the collision risk no longer exists - or until the pilot reports "Unable, TCAS RA".

Likewise, pilot reports of visual sightings should be viewed with caution - the wrong aircraft may have been seen. Another aircraft can be 1,000 ft away vertically and very close horizontally and yet be separated. In the heat of the moment such an aircraft could conceivably be mistaken for the real threat.

3.7 Controllers should understand the limitations of the surveillance system they are using. For radars, factors such as range from the radar head, tangential fading, limits of cover, distance from the edge of the display and overlapping SSR labels can affect collision risk assessment.

For example, if two aircraft are approaching head on, it may be that the position symbols on the situation display have an uncertainty associated with them. The real aircraft positions may in fact be some distance (within design limits) displaced from the indicated positions and this distance varies with range. Such variation is taken into account when devising separation standards. The relative importance of such factors will vary with the equipment in use at any particular unit, so they cannot be addressed in any detail here. ATC units however, should make assessments of the equipment they use and provide specific advice to controllers in their unit training programmes.

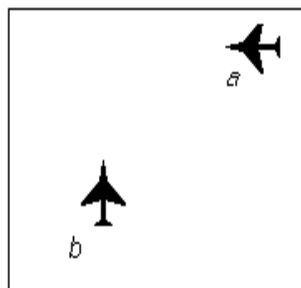
3.8 Aircraft inertia and type are relevant too. For instance, if a single seat military fast jet is approaching a large commercial heavy aircraft, it is likely that the fast jet is able to manoeuvre far more quickly than the heavy aircraft. It should also be remembered that the fast jet may manoeuvre so quickly that the surveillance system does not indicate the manoeuvre for a few sweeps. (The surveillance software may not display the correct position because the aircraft's track history causes a predicted path to be displayed until sufficient responses have been received to convince the system that the change in direction is real).

3.9 Aircraft performance and inertia play their parts in other ways too. Controllers should remember that, even if the pilot responds immediately to avoiding action, the aircraft may take some time to manoeuvre. Large heavy aircraft can take many miles to complete a turn. Likewise, establishing or stopping a climb/descent also takes time.

These factors are especially relevant when aircraft are being flown in the thinner air of typical jet cruising levels, where they may be operating close to critical operational limitations. For instance, they may have a very narrow window of speed in which to operate; any climb may result in a reduction in speed sufficient to stall the aircraft, any but the gentlest of turns may have a similar result, and any attempt at rapid descent may cause an unacceptable overspeed situation. Similarly, aircraft operating in an approach or landing configuration are often less manoeuvrable than the same aircraft in a clean configuration. Thus a rapid response to avoiding action may not always be possible, making it particularly important that such instructions are given clearly, unambiguously and as early as possible.

4 Tactical Guidance

- 4.1 Although each operational scenario must be judged on its own merits, it may be useful to imagine some very basic scenarios involving two aircraft and use these as a foundation on which to build avoiding action techniques. In each case, considerations are not exhaustive and can vary depending on whether or not the aircraft are climbing, descending or in level flight. This guidance assumes that the aircraft involved are commercial jet aircraft unless otherwise stated, so it may need interpretation to be relevant to another specific aircraft type. It should be remembered that a controller may not be in RTF contact with both aircraft at the time a collision risk is noticed - one aircraft may be on another frequency, or lost and unaware that controlled airspace has been penetrated.
- 4.2 A general caution about the interpretation of position symbols on situation displays may also be useful:



The Rules of the Air require that, subject to provisos, 'when two aircraft are converging in the air at approximately the same altitude, the aircraft which has the other on its right shall give way'³ and 'an aircraft which has the right-of-way under this rule shall maintain its course and speed'⁴. Therefore, in the diagram above, aircraft 'a' should maintain its course and aircraft 'b' should turn to the right and go behind. In an ATC situation, especially if one aircraft is not in contact with ATC, this can lead to the controller seeing some unexpected manoeuvres.

- 4.3 For example, if the pilot of aircraft 'b' sees aircraft 'a', then aircraft 'b' should turn to its right. However, if aircraft 'a' is receiving an ATC service and the controller sees the situation as a collision risk, then the controller may well elect to turn aircraft 'a' to the left to go behind the other aircraft, thus apparently worsening the situation (especially if aircraft 'b' is not in RTF contact).

Additionally, the controller's perception of the situation as being an imminent collision risk may have implications for the safe management of other traffic, which consequently receive less than their usual share of the controller's attention. Controllers should be aware that pilots may manoeuvre their aircraft in accordance with the Rules of the Air and this may lead to difficulty in interpreting a scenario as viewed on the situation display. For this, and many other reasons, controllers should not assume that aircraft involved in collision risk scenarios are flying in accordance with their last ATC clearance.

3. Rules of the Air Regulations 2007, Rule 9.
4. Rules of the Air Regulations 2007, Rule 8.

5 Avoiding Action

5.1 Purpose of Avoiding Action

5.1.1 Avoiding action shall be used when immediate action is required to prevent a mid-air collision or a loss of required separation. Pilots receiving such an instruction have been instructed that they are expected to initiate a response immediately and execute the directed manoeuvre briskly (but not so abruptly that there is a risk of losing control, of exceeding performance margins, or of exposing passengers and crew to unnecessary hazards). Significantly, whilst the main purpose of avoiding action is to prevent a mid-air collision, action should not be confined only to circumstances where the required separation has already been lost. Avoiding action instructions are also appropriate in circumstances where immediate action is needed in order to avoid a loss of required separation. This is consistent with the guidance provided in the Manual of Air Traffic Services (MATS) Part 1⁵:

'When avoiding action is issued to an aircraft under a Radar Control Service, **controllers must seek to achieve the required minima** and pilots must comply with the instructions given. In these circumstances, pilots must comply with avoiding action even if they report visual with the other aircraft.'

5.1.2 The CAA does not wish controllers to hesitate in issuing avoiding action instructions where they are judged necessary in order to prevent a potential mid-air collision or loss of separation.

5.2 Avoiding Action Phraseology

5.2.1 The phraseology laid down in CAP 413 Radiotelephony Manual and MATS Part 1 requires the words "Avoiding Action" to follow the aircraft callsign at the beginning of the message. Although the use of these words is a slight variation from the ICAO standard phraseology detailed in ICAO Doc. 4444 PANS-ATM, these key words have been retained because they convey the required degree of urgency. Avoidance in the lateral and vertical planes remain options available to controllers to suit the tactical situation.

5.3 Interaction with ACAS

5.3.1 Flight crews have been instructed that any corrective action indicated by an ACAS Resolution Advisory is to be initiated immediately even where this is in conflict with the lateral and/or vertical element of an ATC instruction.

5.4 Training Aspects

5.4.1 ATC units and colleges shall ensure that the above guidance is reflected in controller training material. In particular, units should consider the benefits of including scenarios involving the necessity for avoiding action within plans for Training in Unusual Circumstances and Emergencies (TRUCE). In this regard, greater use of CAP 717 is encouraged in the development of local training material.

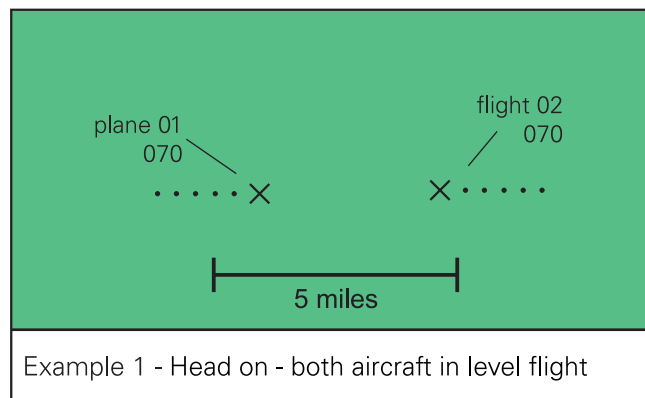
5. CAP 493, Section 1 Chapter 5 paragraph 14.3 (20 November 2008).

6 Example Scenarios

Important Note:

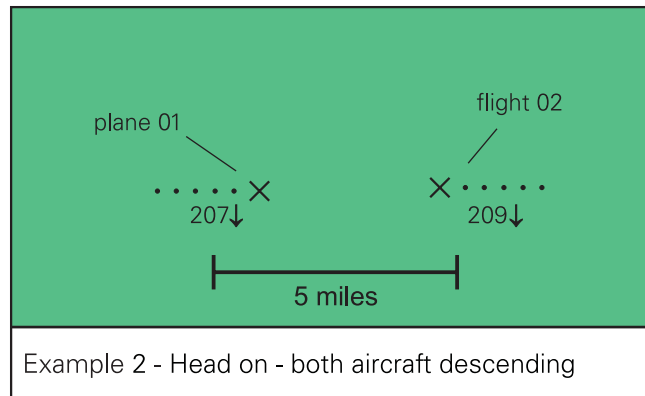
- It must be remembered that the following guidance is not exhaustive and is intended to be built upon by training and experience.
- Every situation is different and the actual collision avoidance instructions can only be decided upon by the controller at the time.
- Standard phraseology, with clear enunciation and an urgent tone, must be used for collision avoidance instructions.
- In the examples given, standard separation is 5 NM or 1,000 ft.

6.1 Example 1 – Head on – both aircraft in level flight



- 6.1.1 Visual sighting by pilots is possible, but will probably be late due to high closing speed and lack of apparent movement across the pilots' visual field.
- 6.1.2 Climb or descent instructions may not agree with ACAS advice to the pilot.
- 6.1.3 Turning the aircraft is usually preferable to changing levels.
- 6.1.4 Turning the more manoeuvrable (usually smaller) aircraft first is likely to result in the fastest de-confliction.
- 6.1.5 If the aircraft appear to be heading straight towards one another then an initial instruction turning both aircraft to the right should be considered.
- 6.1.6 If the aircraft tracks are offset such that a right turn will cause the paths to cross, a left turn may be more appropriate (remember ATS Surveillance System performance characteristics).
- 6.1.7 Consider the magnitude of the turn. A balance should be sought between a turn which is sufficiently large enough to avoid a collision, yet will not compromise the service being provided to other flights. Bear in mind that a pilot may perceive wrongly that a small turn is indicative of a lack of urgency, so avoiding action phraseology is particularly important.
- 6.1.8 Do not assume that the aircraft is flying on a steady heading – for a number of reasons it may already be turning, e.g. visual sighting of traffic, flight-planned turn.
- 6.1.9 Be aware that pilots may not act as you expect because of ACAS advice, visual sightings or other reasons.

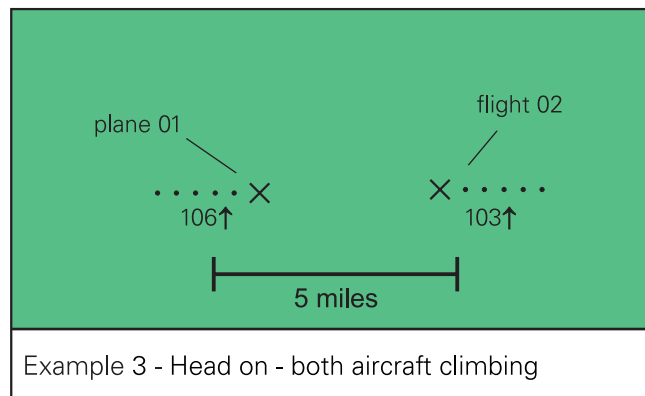
6.2 Example 2 - Head on - both aircraft descending



6.2.1 As Example 1, however:

- Consider stopping the descent of only one aircraft - probably the smaller, more manoeuvrable of the two.
- Consider increasing the rate of descent of only one aircraft - perhaps in conjunction with stopping the descent of the other.

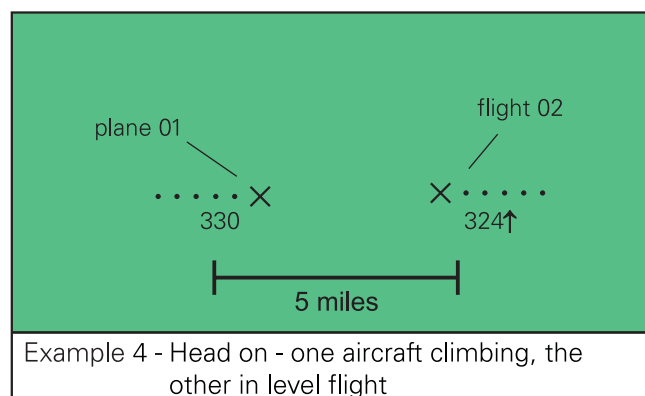
6.3 Example 3 - Head on - both aircraft climbing



6.3.1 As Example 1, however:

- Visual sightings by pilots unlikely.
- Consider reducing the climb rate of, or levelling off, one aircraft.
- An increase in climb rate may not be possible.

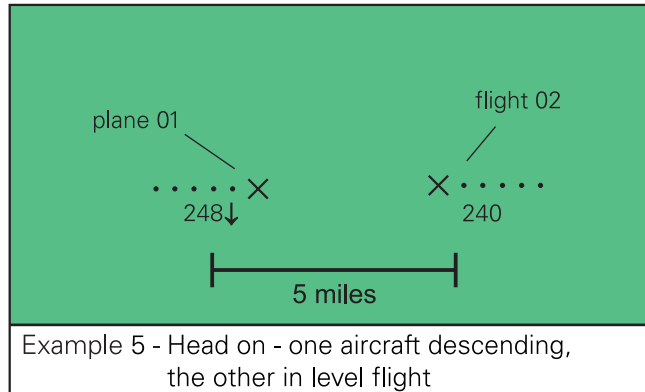
6.4 Example 4 - Head on - one aircraft climbing, the other in level flight



6.4.1 As Example 1, however:

- Visual sightings by pilots of level aircraft less likely.
- Consider reducing the climb rate of, or levelling off, the climbing aircraft - but not at the level of the other aircraft!

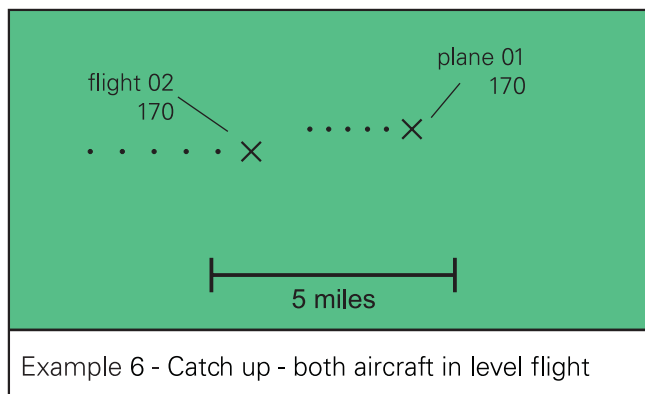
6.5 **Example 5 - Head on - one aircraft descending, the other in level flight**



6.5.1 As Example 1, however:

- Consider levelling off the descending aircraft - but not at the level of the other aircraft!
- Consider increasing the descent rate of the descending aircraft - inertia may be such that an attempt to level-off could make things worse.

6.6 **Example 6 - Catch up - both aircraft in level flight**



6.6.1 Visual sighting from the following aircraft is possible.

6.6.2 Closure rate is likely to be low so if there is an immediate collision risk the aircraft are probably already close together at the time the controller sees the problem.

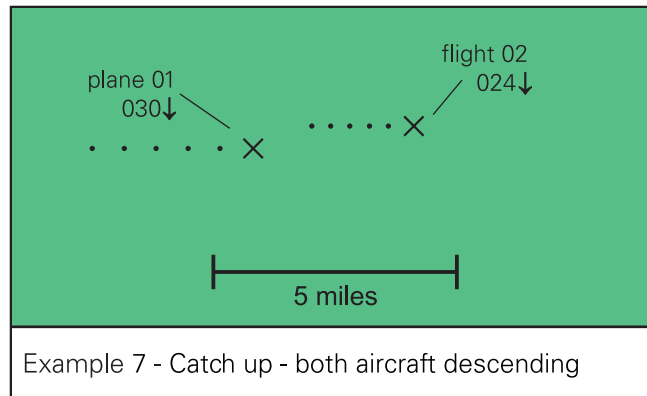
6.6.3 Speed changes are unlikely to change the situation quickly enough to be useful.

6.6.4 The following aircraft should be manoeuvred first (unless it is large and unmanoeuvrable and the lead aircraft is very manoeuvrable, e.g. military fast jet).

6.6.5 A turn is often preferable to a level change.

6.6.6 Consider instructing the lead aircraft to continue on course and give traffic information.

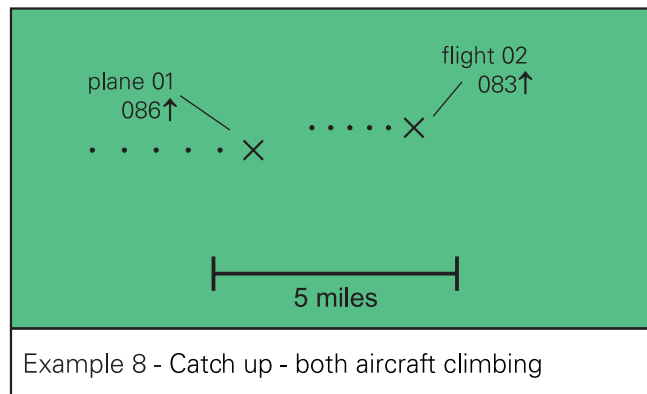
6.7 Example 7 - Catch up - both aircraft descending



6.7.1 As Example 6, however:

- A level bust is probably the most urgent same direction collision risk situation. The vertical closure rate may be very high and the position symbols may be superimposed upon each other.
- Consider stopping the higher aircraft's descent.
- Consider increasing the lower aircraft's descent rate.
- The Rules of the Air for avoiding aerial collisions require that the following aircraft 'shall keep out of the way of the other aircraft by altering course to the right'. However, if this results in the aircraft's paths crossing it may not be the best action.
- Especially for a level bust, a turn by both aircraft, in opposite directions may be the most effective solution.

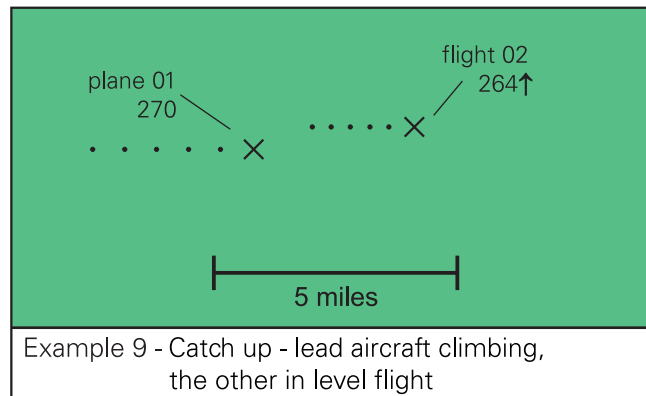
6.8 Example 8 - Catch up - both aircraft climbing



6.8.1 As Example 7, however:

- Consider stopping the lower aircraft's climb.
- Consider increasing the higher aircraft's climb rate - but do not expect this to change much or quickly.

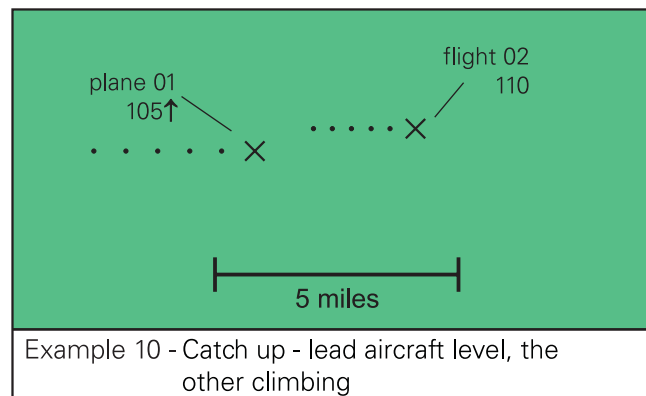
6.9 Example 9 - Catch up - lead aircraft climbing, the other in level flight



6.9.1 As Example 7, however:

- Consider stopping the lead aircraft's climb unless levels are about to be, or have already been, crossed. Bear in mind inertia.

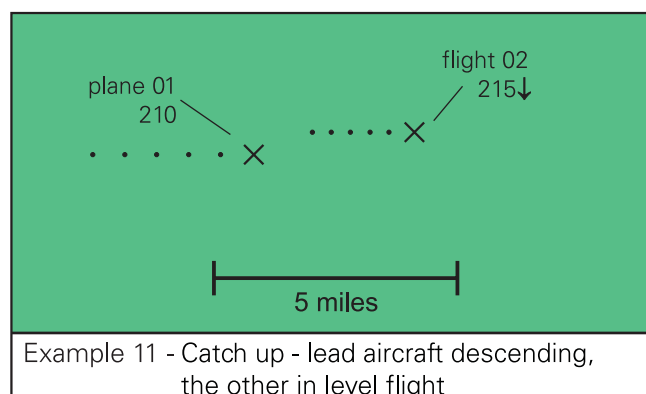
6.10 Example 10 - Catch up - lead aircraft level, the other climbing



6.10.1 As Example 7, however:

- Consider stopping the following aircraft's climb unless levels are about to be, or have already been, crossed. Bear in mind inertia.

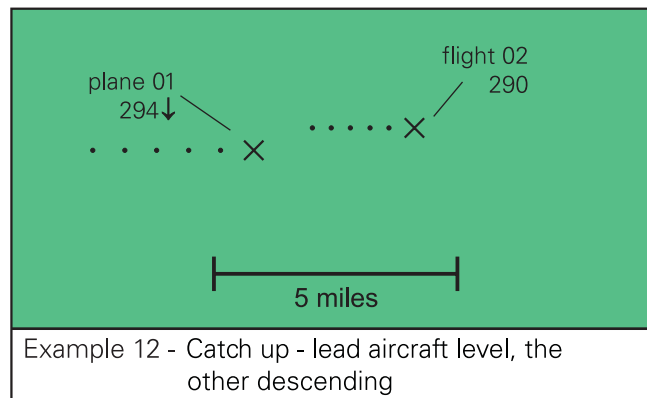
6.11 Example 11 - Catch up - lead aircraft descending, the other in level flight



6.11.1 As Example 7, however:

- Consider stopping the lead aircraft's descent unless levels are about to be, or have already been, crossed. Bear in mind inertia.

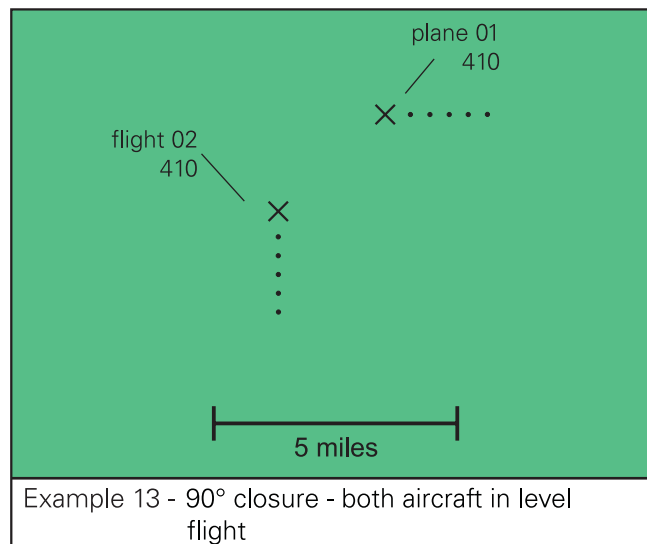
6.12 Example 12 - Catch up - lead aircraft level, the other descending



6.12.1 As Example 7, however:

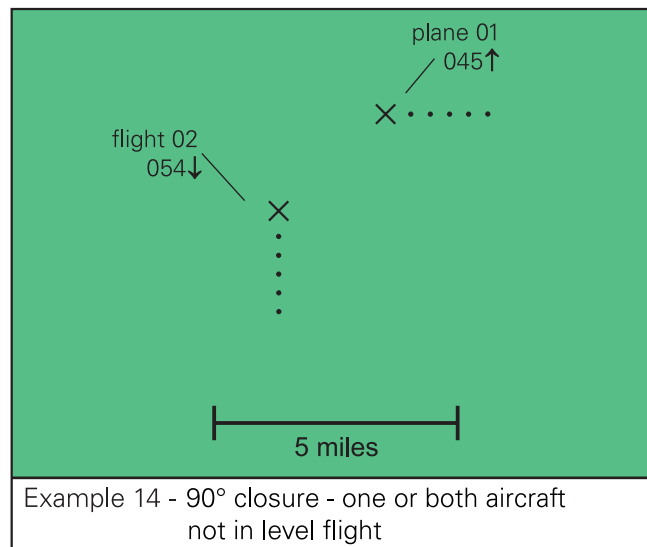
- Consider stopping the following aircraft's descent unless levels are about to be, or have already been, crossed. Bear in mind inertia.

6.13 Example 13 - 90° closure - both aircraft in level flight



- 6.13.1 If the aircraft are on a collision course then the bearing of one from the other will remain constant - at close quarters this may be difficult to assess.
- 6.13.2 Visual sighting by pilots is possible, however, if the aircraft are on a collision course then there will be no apparent movement of the other aircraft across a pilot's field of vision so an early sighting is not likely.
- 6.13.3 Climb or descent instructions may not agree with ACAS advice to the pilot.
- 6.13.4 Turning the aircraft is usually preferable to changing levels.
- 6.13.5 Turning the more manoeuvrable (usually smaller) aircraft first is likely to result in the fastest de-confliction.
- 6.13.6 Turning one aircraft behind the other is likely to be better than turning to pass ahead.
- 6.13.7 Turning both aircraft in the same direction, i.e. both left or both right, is likely to move the aircraft apart most quickly.

6.14 Example 14 - 90° closure - one or both aircraft not in level flight



6.14.1 As Example 13, however:

- The points noted in the head-on and catch-up scenarios are also applicable here.

7 Conclusion

It cannot be over emphasised that each situation must be judged on its own merits. It is not possible to give hard and fast collision avoidance guidance which is universally applicable. A controller is in a very difficult situation when faced with an immediate collision risk and must rely on both general and emergency orientated training when faced with such a scenario. It is incumbent on all those involved in providing controller training, together with the controllers who undertake it, that it is as comprehensive and meaningful as possible.