

**SERIOUS INCIDENT**

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| <b>Aircraft Type and Registration:</b> | 1) Airbus A300-605R, TC-MNV<br>2) Boeing Vertol CH-47D Chinook HC2, ZA720   |
| <b>No &amp; Type of Engines:</b>       | 1) 2 General Electric CF6-80C2 turbofan engines<br>2) 2 Honeywell T55-GA-712 turboshaft engines   |
| <b>Year of Manufacture:</b>            | 1) 1999<br>2) Not known   |
| <b>Date &amp; Time (UTC):</b>          | 18 November 2011 at 1505 hrs  |
| <b>Location:</b>                       | Near RAF Brize Norton Aerodrome, Oxfordshire  |
| <b>Type of Flight:</b>                 | 1) Commercial Air Transport<br>2) Military  |
| <b>Persons on Board:</b>               | 1) Crew - 3                      Passengers - None<br>2) Crew - 4                      Passengers - None  |
| <b>Injuries:</b>                       | 1) Crew - None                Passengers - N/A<br>2) Crew - None                Passengers - N/A  |
| <b>Nature of Damage:</b>               | 1) None<br>2) None  |
| <b>Commander's Licence:</b>            | 1) Airline Transport Pilot's Licence<br>2) Military command qualification   |
| <b>Commander's Age:</b>                | 1) 44 years<br>2) 29 years  |
| <b>Commander's Flying Experience:</b>  | 1) 7,334 hours (of which 135 were on type)<br>Last 90 days - 135 hours<br>Last 28 days - 66 hours<br>2) 1,500 hours (of which 500 were on type)<br>Last 90 days - 80 hours<br>Last 28 days - 20 hours |
| <b>Information Source:</b>             | AAIB Field Investigation  |

**Synopsis**

The crew of the A300 were cleared to depart from RAF Brize Norton on a Malby Standard Instrument Departure (SID), which required them to climb to FL080. The departure clearance was issued on the ground radio frequency. When the crew changed to the tower frequency a Climb-out Restriction (COR) of 2,200 ft on the airfield QNH was imposed by ATC, to provide

vertical separation from a military Chinook helicopter in the holding pattern above the airfield. The COR instruction, which was not standard RT phraseology, was misinterpreted by the A300 crew. The A300 aircraft did not level off at 2,200 ft after departure but climbed through the level of the Chinook. The returns from the two aircraft were seen to merge on the ATC radar

display. The A300 crew received a TCAS Resolution Advisory (RA), which they followed.

According to TCAS data from the A300, the minimum lateral separation between the A300 and the Chinook was 0.11 nm and the minimum vertical separation was 496 ft. Two Safety Recommendations are made with the intention of preventing similar incidents in the future.

### History of the flight

#### *Chinook helicopter*

The crew of the military Chinook helicopter were carrying out instrument flying training and were tracking 307°(T), inbound to the Brize Norton (BZ) NDB, to take up the holding pattern. The holding pattern is a standard, right hand hold with an inbound heading of 100°. This required the crew to perform a parallel join, followed by a left turn to return to the BZ. The helicopter, which was equipped with a Mode S transponder but squawking Mode C, was flying at 3,000 ft on the Cotswold QNH of 1010 hPa. The crew were instructed by ATC to set the Brize Norton QFE of 1005 hPa, adjust their height to 3,000 ft on that setting and contact the Brize Norton Director on 133.750 MHz. In order to provide vertical separation from a departing Airbus A300, the Chinook crew were then instructed to climb to 3,500 ft on the QFE.

After passing over the BZ NDB, the Chinook tracked 280° outbound from the beacon at 3,500 ft on the QFE. A level, rate one turn to the left was then initiated to return to the BZ. As the helicopter continued the turn towards the south, crew members saw the A300 pass over them. The Chinook crew filed an Airprox report following the incident.

#### *Airbus A300*

The A300 arrived from Istanbul that morning and was carrying out a return, freight-only flight to Istanbul Sabiha Gokcen International airport in Turkey. The crew comprised two pilots and a loadmaster. The aircraft commander was the pilot handling and the co-pilot was the pilot monitoring; his duties included radio communications. It was the commander's first rotation through Brize Norton, but the co-pilot had been there a number of times before. Both were Turkish nationals with a good working knowledge of English.

Having completed their preparations and started engines, the crew requested taxi clearance at 1452:09 hrs on the Ground frequency of 121.725 MHz. The weather was QFE 1005 hPa, QNH 1015 hPa, visibility greater than 10 km, few clouds at 1,800 ft, broken cloud at 12,000 ft and 25,000 ft, surface wind 180° at 08 kt. The clearance, initially, was to holding point Delta for Runway 26, but in order to give way to another aircraft, the A300 was held at its parking position. Once the other aircraft was clear the A300, callsign 'Blacksea 508', was cleared to taxi to holding point Echo for Runway 26. The crew commenced taxiing at 1457:00 hrs and at 1458:29 hrs the ground controller transmitted their departure clearance:

“BLACKSEA FIVE ZERO EIGHT AFTER DEPARTURE CLIMB MALBY SID, FLIGHT LEVEL EIGHT ZERO. SQUAWK FIVE TWO ONE ZERO AND WITH BRIZE APPROACH ONE TWO SEVEN DECIMAL TWO FIVE ZERO”.

The crew responded:

“CLEARED VIA MALBY SID, FLIGHT LEVEL ZERO EIGHT ZERO AND AFTER DEPARTURE ONE TWO SEVEN TWO FIVE. CONFIRM TO SQUAWK FIVE TWO ONE ZERO?”

The ground controller confirmed the squawk and the crew activated the departure in the Flight Management System (FMS) with 8,000 ft selected as the target altitude. The departure had been briefed and the commander intended to use the autopilot engaged with the 'Profile Mode' to be selected after takeoff. In this mode the autopilot follows the horizontal and vertical profile of the departure and levels off at the target altitude.

The crew calculated that there was sufficient runway length available from the Echo holding point intersection for their takeoff and offered to depart from there. The ground controller acknowledged this and instructed them to hold at Echo and change to the tower frequency of 123.725 MHz.

Having changed frequency, the next information the crew were expecting to be passed was either to line up at Echo or to continue the taxi to holding point Foxtrot, from which the full length of the runway is available for takeoff.

The crew contacted the tower controller on the dedicated frequency and the Radiotelephony (RT) exchange detailed in Table 1 took place between the co-pilot and the tower controller.

During this exchange the crew, who were expecting taxiway and runway related information, interpreted the 2,200 ft to be the runway length reduction when entering the runway from holding point Echo. Although both pilots were familiar with the term 'Climb-out Restriction', they did not register the information as an altitude and therefore did not read back the phrase.

The aircraft entered Runway 26 from holding point Echo and was cleared for takeoff at 1505:02 hrs. At 1506:13 hrs the crew were instructed to contact Brize Norton Approach.

The crew contacted the approach controller at 1506:16 hrs. Table 2 contains a transcript of the radio exchange that then took place.

| TO      | FROM    | RT TRANSMISSION   | TIME     |
|---------|---------|---|----------|
| MNB 508 | TWR     | BLACK SEA FIVE ZERO EIGHT, CLIMB OUT RESTRICTION TWO THOUSAND TWO HUNDRED FEET ON BRIZE QNH ONE ZERO ONE FIVE ACKNOWLEDGE | 15:03:13 |
| TWR     | MNB508  | ONE ZERO ONE FIVE COPIED, WE ARE ALSO ABLE TO TAKE THE ECHO FOR, FOR DEPARTURE  | 15:03:19 |
| MNB 508 | TWR     | BLACK SEA FIVE ZERO EIGHT, JUST CONFIRM CLIMB OUT RESTRICTION TWO THOUSAND TWO HUNDRED FEET ON ONE ZERO ONE FIVE          | 15:03:26 |
| TWR     | MNB 508 | YES GOOD COPIED, THANK YOU  | 15:03:30 |
| MNB 508 | TWR     | SEA 50, I NEED YOU TO SAY BACK, CLIMB OUT RESTRICTION TWO THOUSAND TWO HUNDRED FEET                                       | 15:03:35 |
| TWR     | MNB 508 | YEAH, TWO THOUSAND TWO HUNDRED FEET COPIED  | 15:03:40 |
| MNB 508 | TWR     | SEA FIVE ZERO, VIA ECHO LINE UP AND WAIT  | 15:03:44 |

**Table 1**  
RT exchange prior to takeoff

| TO      | FROM    | RT TRANSMISSION   | TIME     |
|---------|---------|---|----------|
| APP     | MNB 508 | BRIZE DEPARTURE GOOD AFTERNOON BLACK SEA FIVE ZERO EIGHT AIRBORNE   | 15:06:16 |
| MNB 508 | APP     | BLACK SEA FIVE ZERO EIGHT BRIZE APPROACH GOOD AFTERNOON IDENTIFIED TRAFFIC ONE O'CLOCK ONE MILE SIMILAR HEADING COORDINATED ONE THOUSAND FEET ABOVE                     | 15:06:19 |
| APP     | MNB 508 | OK, WE HAVE IT IN SIGHT   | 15:06:27 |
| MNB 508 | APP     | BLACK SEA FIVE ZERO EIGHT REQUEST YOUR PASSING ALTITUDE?  | 15:06:48 |
| APP     | MNB 508 | NOW ABOVE TWO THOUSAND NINE HUNDRED AND NOW SETTING THE STANDARD ALTIMETER  | 15:06:51 |
| MNB 508 | APP     | BLACK SEA FIVE ZERO EIGHT YOUR CLIMB OUT RESTRICTION WAS TWO THOUSAND TWO HUNDRED FEET, AVOIDING ACTION STOP CLIMB IMMEDIATELY TURN RIGHT HEADING ZERO TWO ZERO DEGREES | 15:06:58 |
| APP     | MNB 508 | NOW ABOVE THREE THOUSAND FOUR HUNDRED, ER, RIGHT HEADING ZERO TWO ZERO CONFIRM?   | 15:07:04 |
| APP     | MNB 508 | TCAS CALL SO WE ARE CLIMBING  | 15:07:11 |
| MNB 508 | APP     | BLACK SEA FIVE ZERO EIGHT ROGER, CAN YOU SEE THE HELICOPTER IN YOUR ONE O'CLOCK BY HALF A MILE?   | 15:07:16 |
| APP     | MNB 508 | YEAH WE HAVE IT IN SIGHT NOW CROSSING VISUALLY  | 15:07:20 |
| MNB 508 | APP     | SEA FIVE ZERO EIGHT ROGER WITH THAT AIRCRAFT IN SIGHT CONTINUE CLIMB WHEN READY FLIGHT LEVEL EIGHT ZERO YOU'RE NOW ABOVE IT   | 15:07:23 |
| APP     | MNB 508 | NOW NORMAL VECTOR, AND WE ARE STILL CLIMBING AND MAINTAINING HEADING TWO EIGHT ZERO   | 15:07:30 |
| MNB 508 | APP     | BLACK SEA FIVE ZERO EIGHT   | 15:07:35 |

**Table 2**

## RT exchange after takeoff

The A300 crew were visual with the Chinook soon after takeoff and received an expected TCAS Traffic Alert. When the TCAS RA activated, the commander followed the operator's Standard Operating Procedures (SOPs) and disconnected the autopilot (AP) and autothrust (AT). He then followed the green arc of the vertical speed scale, adjusting the thrust to maintain speed and avoiding the red arc of the vertical speed scale. When clear of the conflict, the A300 was cleared by ATC to continue to join controlled airspace five miles north of Malby and to resume its own navigation. The commander re-engaged the AP and AT and continued with the departure.

The A300 crew did not pass their SID, passing altitude or cleared altitude on initial contact with the approach controller and the controller did not request this information. The approach controller did request the aircraft's passing altitude some 32 seconds later, by which time the aircraft had passed through the 2,200 ft Climb-out Restriction and was coming into conflict with the Chinook. The returns of the A300 and the Chinook merged on the approach controller's radar display. Both aircraft tracks are shown at Figure 1.

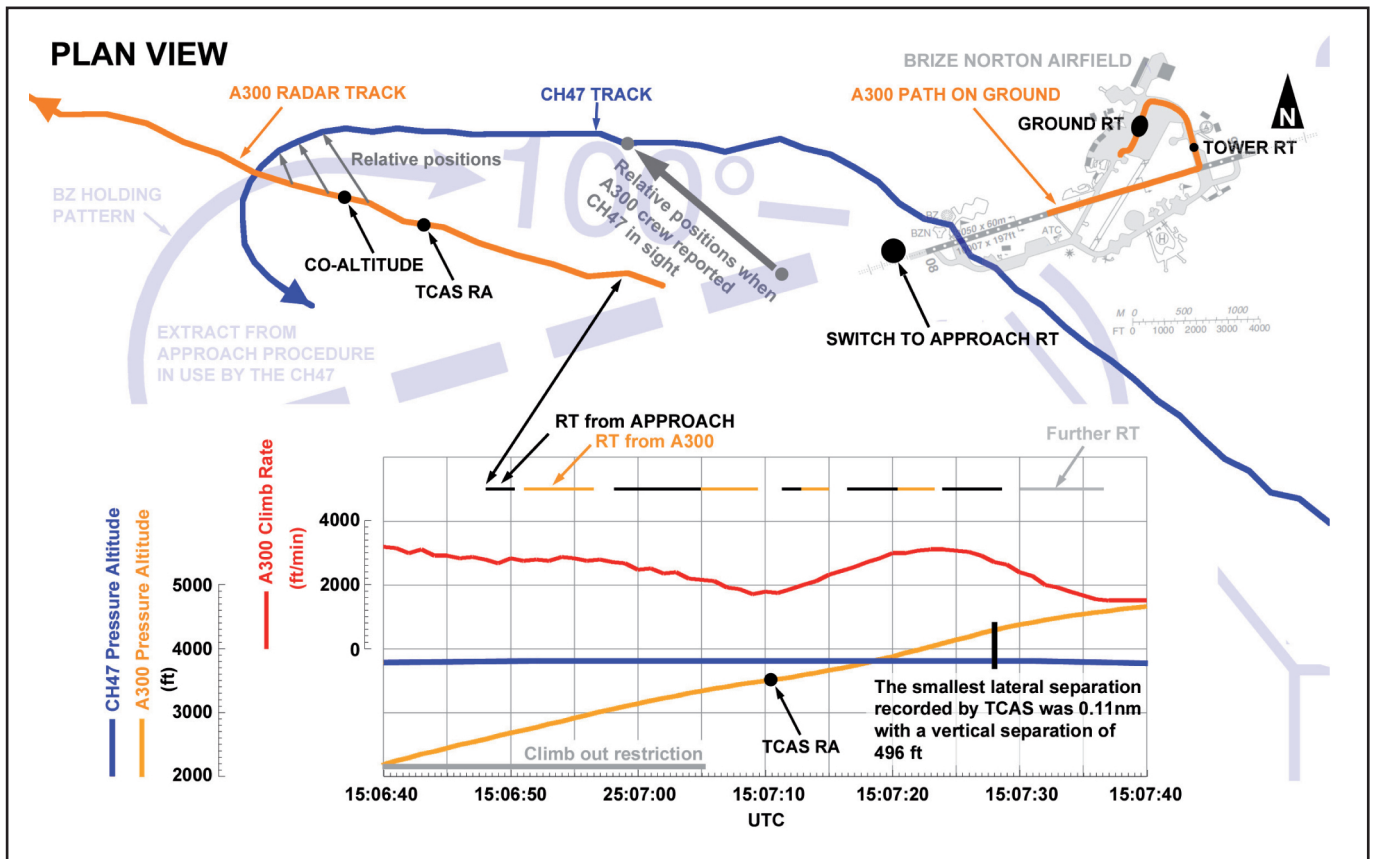


Figure 1

A300 and Chinook tracks

**Radiotelephony**

CAP 413, the ‘Radiotelephony Manual’, contains both the civilian and military RT terminology to be used when communicating on the radio. The term ‘Climb-out Restriction’ is not included in either the civilian or military sections. It does appear in other military documents but these are not available to civilian pilots.

CAP 413, Chapter 4, page 8, paragraph 1.7.10, states:

*‘Local departure instructions may be given prior to the take-off clearance. Such instructions are normally given to ensure separation between aircraft operating in the vicinity of the aerodrome.’*

It then gives an example of the phraseology to be used in relation to altitude restriction which is:

*‘Climb to altitude 6000 feet.’*

CAP 413 sets out the requirement for certain information to be included on initial contact with the controller during an instrument departure. The text is set out below:

**‘1.4 Initial Call – IFR flights**

**1.4.1 Format of Initial Calls**

*Pilots of aircraft flying Instrument Departures (including those outside controlled airspace) shall include the following information on initial contact with the first en-route ATS Unit.*

- a) *Callsign;*
- b) *SID or Standard Instrument Departure Route Designator (where appropriate);*
- c) *Current passing level; **PLUS***
- d) *Initial climb level (i.e. the first level at which the aircraft will level off unless otherwise cleared. For example, on a Standard Instrument Departure that involves a stepped climb profile, the initial climb level will be the first level specified in the profile.)*

The A300 crew's initial contact transmission after departure should have included the passing altitude and "climbing FL080". This would have immediately alerted the controller to the fact that the aircraft would not level at 2,200 ft.

#### Safety action

Following this incident, Brize Norton amended the BZN ATC Controllers Order Book (COB), Part 2 document, '*Responsibilities of the Radar Approach Controller*'. The reason for this change was that if a Climb-out Restriction had been imposed on a departure and the crew did not state their cleared altitude or level on initial contact with the approach controller, the controller would remind them of the Climb-out Restriction (COR) at the first opportunity. This was to prevent the aircraft exceeding its cleared altitude or level. The following text was added:

*'On initial contact any COR must be repeated to the pilot unless the aircraft departs stating climbing to the appropriate level which complies with the COR passed. Traffic information should be passed ASAP on the unknown or co-ordinated traffic to improve situational awareness.'*

It was recognised that with high rates of climb, 3,000 ft/min in this incident, any delay in the crew changing to the approach frequency, or RT from other aircraft preventing communication, would not allow sufficient time for the climb to be stopped. This safety action was therefore modified to the following:

ATC to Aircraft: "CALLSIGNHOLDPOSITION,NEW DEPARTURE INSTRUCTIONS WHEN READY TO COPY".

Aircraft to ATC: "READY TO COPY".

ATC to Aircraft: "CALLSIGN AFTER DEPARTURE CLIMB MALBY SID TO ALTITUDE 2800' BRIZE QNH READ BACK".

Brize Norton ATC has also ceased using the term 'Climb-out Restriction'.

#### Previous incident

On 1 December 2009, an Airprox incident occurred involving an RAF Lockheed TriStar in the BZ holding pattern and a commercial Boeing 767 (B767) departing from Runway 08. The B767 crew were passed the following ATC clearance:

'AFTER DEPARTURE, MAINTAIN RUNWAY TRACK CLIMBING 2,800 FEET QNH, FOR RADAR VECTORS TO JOIN CONTROLLED AIRSPACE 5 NM NORTH OF MALBY LEVEL FL 080. SQUAWK FREQUENCY FOR LONDON CONTROL 134.750 WHEN INSTRUCTED. FREQUENCY FOR BRIZE APPROACH 127.250'.

The controller's intention was for the B767 to stop the climb and level at 2,800 ft. This was misunderstood by the B767 crew who interpreted the clearance as a climb on runway track to 2,800 ft but that their cleared level was still FL 080.

The UK Airprox Board (UKAB) assessed the cause of the incident as the controller passing an ambiguous clearance to the B767 crew, which included both a local departure clearance and an airways clearance. The UKAB recommended that the MoD conduct a review of the CAP 413 instructions about the passing of Climb-out Restrictions. Following the review the MoD stated that it would emphasize the need not to overcomplicate clearances and that airways clearances should be clearly separated from zone/departure clearances.

### Recorded information

The AAIB was notified of the incident too late for the A300 flight recorders to hold any relevant data. However, the military downloaded the flight data recorders from the Chinook on the day of the event and subsequently provided the relevant recordings to the AAIB to assist in the investigation. The audio recordings were all after the event but the flight data covered the period of interest. The A300 operator supplied flight data from the aircraft's Quick Access Recorder.

The A300 operator also downloaded the TCAS. This yielded a recording of the Resolution Advisories generated during the encounter, including relevant parameters associated with the Chinook, such as sensed distance and bearing and ATC transponder altitude.

Neither the radar returns from the Brize Norton radar, nor the Brize Norton controller displays are recorded<sup>1</sup>. However, the NATS<sup>2</sup> Cleve Hill radar feed, used by Brize Norton ATC, was recorded and provided to the AAIB by NATS, along with radar data from Heathrow. Both

Cleve Hill and Heathrow sources included primary and secondary radar with additional Mode S parameters from the A300. The A300 Mode S recordings yielded downlinked parameters such as selected altitude and vertical speed. The Chinook ATC transponder, although Mode S capable, was selected to Mode C, degrading the resolution of the transmitted altitudes to 100 ft increments instead of 25 ft increments. The Heathrow data provided the best refresh rate and was used for assessing the relative lateral positions of the aircraft during the encounter.

The radio transmissions recorded at Brize Norton were made available to the AAIB.

The data and audio recordings were amalgamated and the relevant information is presented in the 'History of the flight' section of this report.

### TCAS performance

NATS and the TCAS manufacturer assessed the encounter data and the effects of the A300 TCAS having to use the degraded Mode C 100 ft data instead of the Mode S 25 ft data. This data is used by TCAS to assess closing geometries, to select a strategy for resolving any conflict, and to issue appropriate Resolution Advisories. In this case, there was little effect on the TCAS resolution of the situation.

### Analysis

#### *TCAS performance – use of Mode C instead of Mode S*

The Chinook ATC transponder was Mode S capable but was selected to Mode C. This downgraded the resolution of the altitude data it transmitted from 25 ft to 100 ft increments. In this case the altitude data resolution difference did not have a significant effect on TCAS performance. However, this may not be the case with different encounter geometries.

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#### Footnote

<sup>1</sup> The CAA CAP 670 "AIR TRAFFIC SERVICES SAFETY REQUIREMENTS" requirement to record ATS surveillance data at civil airfields came into effect on 1 January 2012. This is not applicable to military airfields. Military capabilities in this regard are planned for the 2014-2020 time frame.

<sup>2</sup> NATS is the air traffic control service provider for UK airspace and the eastern part of the North Atlantic.

Whilst there is no requirement to use Mode S in the airspace the Chinook was being flown in at the time, given that changing to Mode S required only a switch selection, consideration should be given by the Chinook operation to using Mode S in preference to Mode C, to ensure the best available TCAS performance. The following Safety Recommendation is therefore made:

#### **Safety Recommendation 2012-006**

It is recommended that the Ministry of Defence review the practice of selecting Mode C on aircraft transponder equipment when Mode S, which allows enhanced TCAS performance, is available.

#### **Operational matters**

The sequence of events that led to the loss of separation was brought about by a combination of communication issues and misunderstanding. The initial clearance for the Malby SID was read back correctly and entered into the A300's Flight Management System (FMS) with the 8,000 ft step altitude selected as the target level.

The tower controller used the term 'Climb-out Restriction' in accordance with his Standard Operating Procedures (SOPs), to restrict the altitude to 2,200 ft. Both the commander and co-pilot of the A300 were familiar with this term, but because their focus was on the issue of runway length they misunderstood the altitude passed as being the runway length reduction when departing from holding point Echo.

When the co-pilot responded to the revised clearance he only read back the QNH. The controller asked him to confirm the Climb-out Restriction, but again, the co-pilot was focussed on runway length and simply responded "YES GOOD, COPIED THANK YOU". The controller then emphasised that "I NEED YOU TO SAY BACK, CLIMB OUT RESTRICTION 2,200 FEET". The co-pilot

responded "YEAH, TWO THOUSAND TWO HUNDRED FEET COPIED", but was still focussed on the runway length. The controller, who was unaware of the crew's misunderstanding of the instruction, did not pursue the full read back of the 'CLIMB OUT RESTRICTION', which might have alerted the crew, and cleared the aircraft to line up and wait. In order to correct the crew's belief that the 2,200 ft related to runway length, he would have had to explain, in plain language, that the 2,200 ft was an altitude.

After takeoff, the crew contacted the approach controller but did not pass their SID, passing altitude and cleared level. Had they passed what they understood to be their cleared level of FL 080, it would have been immediately apparent to the approach controller that they were not complying with the 2,200 ft altitude restriction.

The A300 was squawking Mode S and, although Brize Norton receives Mode S data, it does not have the necessary equipment to display the information on the radar monitors and is therefore limited to displaying only Mode C information. Mode S displays more information than Mode C, included in which is the selected target altitude. Had this been displayed it might have alerted the approach controller to the incorrect setting of the target altitude.

The A300 crew were visual with the Chinook soon after takeoff and received an expected TCAS Traffic Alert. This changed to an RA, to which the commander, as the pilot handling, responded correctly. The co-pilot informed the approach controller as required.

If the term 'Climb-out Restriction' is to be used by military controllers it should be included in Section 10 of CAP 413. Having adopted CAP 413, the MoD controllers should not use that term, but should use instead the phraseology included in CAP 413: '*climb to*



*altitude (allotted altitude) feet*'. The following Safety Recommendation is therefore made:

**Safety Recommendation 2012-007**

It is recommended that the Ministry of Defence ensure that standardised phraseology is used in accordance with the Civil Aviation Publication (CAP) 413: Radiotelephony Manual.

**Conclusions**

The Airprox occurred due to the misunderstanding by the A300 crew of the meaning of the ATC instruction

'CLIMB OUT RESTRICTION TWO THOUSAND TWO HUNDRED FEET', which they took to mean the runway length reduction when making an intersection departure from holding point Echo. They therefore did not change their selected target altitude from 8,000 ft to the required 2,200 ft. Contributory factors were that this phrase was not standard RT phraseology and the A300 crew omitted to provide their departure information on initial contact with the approach controller.