Department of Transport and Regional Developmen

Bureau of Air Safety Investigation

Violations of Controlled Airspace

SPECIAL STUDY

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Bureau of Air Safety Investigation

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The Bureau of Air Safety Investigation would like to thank the many pilots who gave their time and knowledge to this project. The Bureau would also like to thank Airservices Australia and the Civil Aviation Safety Authority for their valuable contributions to several aspects of the project.

Both CASA and BASI had independently identified violations of controlled airspace as an issue which required additional research. Both agencies had initially planned to conduct separate studies into the issue. However, in the interests of efficiency, CASA agreed to cancel its proposed study and await the results of the BASI study.

Throughout the course of the study, BASI kept CASA appraised of any significant developments as they occurred, and at the end of the study made available to CASA a copy of the resultant database in de-identified format for independent analysis.

Abbreviations and definitions

AMATS	Airspace Management and Air Traffic Services
ATC	Air Traffic Control
ATPL	Air Transport Pilot Licence
ATS	Air Traffic Services
Class C	Class-C airspace (overlies airports with a control tower and radar with steps up to 20,000 ft)
Class D	Class-D airspace (overlies airports with a control tower but without radar with steps usually up to 4,500 ft, to the beginning of Class C)
CPL	Commercial Pilot Licence
CTA	Control Area
CASA	Civil Aviation Safety Authority
ESIR	Electronic Safety Incident Report (Airservices Australia)
GAAP	General Aviation Airport (capital cities)
GPS	Global Positioning System
IFR	Instrument Flight Rules
NOTAM	Notice to Airmen
PPL	Private Pilot Licence
VCA	Violation of Controlled Airspace
VFR	Visual Flight Rules
VTC	Visual Terminal Chart

Synopsis

A violation of controlled airspace (VCA) occurs when a pilot enters controlled airspace without a clearance. Unauthorised aircraft in controlled airspace present a potential collision threat to other aircraft.

VCAs are reported to BASI more frequently than any other type of air safety occurrence. In 1992 BASI noted a significant increase in the number of VCAs. The frequency of VCAs has decreased since 1993, although the incidents are still occurring in excess of one per day.

The current study was conducted with the aim of identifying the human and system factors which lead to VCAs. The study focused on violations of civil airspace.

The study was conducted during a 2.5-month period in which the Bureau analysed 62 incident reports from Airservices Australia. Fifty-seven of the incident pilots took part in telephone interviews with the aim of identifying the circumstances which led to the incident.

The study found that the experience profile of the VCA pilots closely resembled that of the general pilot population. No evidence was found to suggest that VCA pilots differ from the general pilot population in terms of flying experience.

A taxonomy of VCAs was developed which contained three categories of incident. Group-A incidents involved pilots who intended to enter the airspace but penetrated the airspace without a clearance. Group-B incidents involved pilots who were unaware of the airspace or unaware it was active, and entered inadvertently. Group-C incidents involved pilots who were aware of the airspace and intended to avoid it by planning to fly around, over or under it, but who entered inadvertently.

Most incidents were of the last type (Group C), where the pilot entered controlled airspace after experiencing navigational difficulties. In these cases, the occurrence was primarily a navigation incident, with the VCA occurring as a result.

Improved navigation training may help to reduce the frequency of this type of occurrence; however, it can be expected that no amount of navigation training can guarantee that navigation errors will not occur from time to time. This study has suggested that many pilots who do not intend to enter controlled airspace do not apply sufficient track tolerance when tracking near a controlled airspace boundary. Increased track tolerances by such pilots would help to limit the consequences of navigation errors.

A significant minority of incidents were of the first type (Group A), where pilots entered controlled airspace as intended but failed to obtain a clearance before doing so. While most of these pilots requested a clearance, it was apparent that many of these pilots were not allowing sufficient time to obtain a clearance as they approached the airspace boundary.

As a result of this study, the Bureau has issued four recommendations. These deal with navigation training for student pilots, the margin which pilots should maintain between their position and an airspace boundary which they do not intend to cross, and the need for pilots intending to enter controlled airspace to request a clearance sufficiently in advance of arriving at the airspace boundary.

1. Introduction

1.1 Definition

A VCA occurs when a pilot enters controlled airspace without a clearance. Controlled airspace is a section of airspace surrounding an airport with a tower, and/or airspace up to a certain altitude overlying Australia. This airspace may or may not be radar monitored. The controller needs to be aware of all aircraft within his/her section of controlled airspace so as to provide a complete traffic service. Pilots are required to request a clearance before entering the airspace.

The term *violation* does not necessarily imply a deliberate act by the pilot to enter the controlled airspace without a clearance, but refers, rather, to all unauthorised entries of controlled airspace.

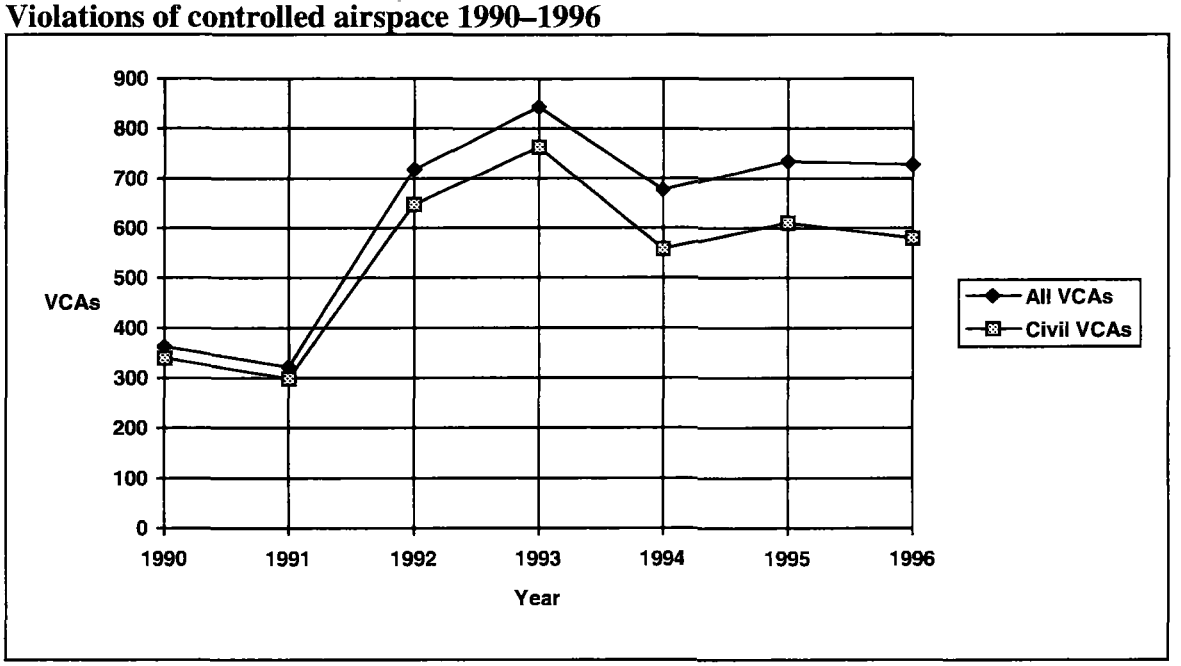
1.2 Background

This study was initiated to assess whether the number of VCAs has changed relative to two previous studies carried out by the Bureau and to identify common significant factors from a number of occurrences.

Figure 1 presents the annual frequency of all VCAs (including violations of military and restricted airspace) and the frequency of VCAs which involved civil aircraft penetrating civil airspace in the years 1990 to 1996.

As figure 1 indicates, the frequency of VCAs increased after 1991 and then subsided from a peak in 1993. Incident numbers now appear to have stabilised at around 600 civil VCAs and 720 total VCAs per year.

FIGURE 1
Violations of controlled airspace 1990–1996



1.3 Previous research

In 1992 a study was carried out to examine VCA occurrences (Bureau of Air Safety Investigation 1993). The report found that VCAs had increased sharply following changes to procedures introduced by the Airspace Management and Air Traffic Services (AMATS) system[1] in December 1991. The report revealed that:

1. A significant proportion of pilots were confused by charts.

2. Many private pilots did not subscribe to a document amendment service and hence may not have had access to up-to-date charts.

3. The then CAA had not evaluated the AMATS pilot education program which ceased in December 1991.

4. The publicity which accompanied the changes to the airspace system may not have reached all target groups.

The Bureau released a number of recommendations to the then CAA, seeking to address the above findings.

The Bureau carried out another review of VCAs for the period January 1991 to June 1994, (Bureau of Air Safety Investigation 1995). The review found that there appeared to be a downward trend in the number of VCAs. However, VCAs remained at levels higher than during the period prior to 1991 and the introduction of AMATS. The Bureau did not release any formal recommendations from that study but has continued to monitor the frequency of VCAs.

1.4 Scope

In accord with BASI's focus on the issues which affect the safety of paying passengers, this study was limited to incidents which involved a violation of civil and joint user controlled airspace and therefore posed a potential collision risk to commercial passenger operations.

This study involved violations of civil and joint user controlled airspace which occurred in the period 9 December 1996 to 28 February 1997.

Approximately 20% of all airspace violations in 1996 involved single-use military airspace or other restricted areas. However, these incidents were excluded from the current study as:

1. in most cases, airspace violations of restricted airspace involve non-commercial aircraft and hence pose no risk to paying passengers; and
2. the risk of a single aircraft accident as a result of a violation of restricted airspace, that is an aircraft being hit by military firing, is considered to be low.

Violations of civil airspace by military aircraft were excluded from this study as the numbers of such incidents are comparatively low.

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[1] A number of changes were introduced in December 1991 to AMATS, including the withdrawal of full reporting by, and monitoring of, VFR aircraft.

2. Objectives

The objectives of this study were to:

1. identify trends of VCAs in Australia;
2. analyse VCA incidents to identify common factors;
3. identify potential solutions to the VCA problem; and
4. make recommendations as appropriate.

3. Method

All VCA incidents meeting the criteria outlined in section 4.4 were examined. Basic information was derived from the Electronic Safety Incident Reports (ESIRs) submitted to BASI by Airservices Australia. An attempt was then made to contact all pilots of the aircraft involved. In some cases this was not possible as the aircraft callsign was not known. Penetrations of purely military airspace such as Puckapunyal in Victoria were not followed up, whereas penetrations of joint user military airspace such as Amberley in Queensland were investigated.

The pilot in command took part in a telephone survey which was designed to elicit information such as flying experience, operational currency, phase of flight, unusual flight circumstances, charts, training, GPS use, awareness of airspace procedures and situational awareness. During the period of the survey, 113 VCAs were reported to the Bureau. Twenty-seven of these were violations of purely military airspace by civil aircraft or military aircraft penetrating civil airspace whilst the remaining 86 occurrences involved civil or joint-user airspace. In 24 of these cases the aircraft were registered to a company with no contact details other than a postal address. Because of the time frame involved, it was decided not to attempt to contact the pilots of these aircraft. Information derived from the remaining 62 ESIRs was analysed. Of these, 57 pilots were contacted and surveyed. The remaining five incidents contained sufficient information to warrant their entry into the survey results. These ESIRs account for the unknown category in some of the charts.

4. Findings and discussion

4.1 Trends and patterns

The questions which did not require a detailed answer are analysed and presented in section 4.1. Those questions which elicited detailed responses are covered in section 4.2

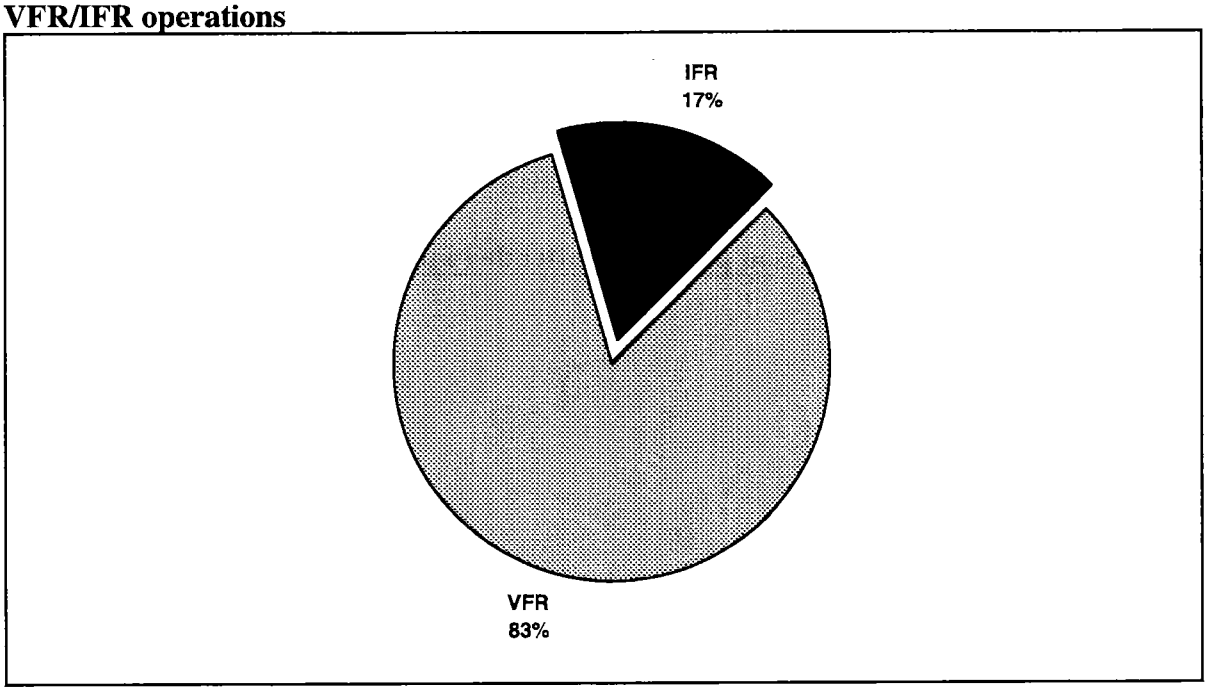
4.1.1 Phase of flight

Pilots were asked what phase of flight the aircraft was in when the incident occurred. Sixty-six per cent were on level flight, 28% were climbing and 6% were descending. Pilots were also asked if they had the autopilot engaged at the time of the occurrence. Eighty-five per cent reported that an autopilot was not engaged, while 6% indicated that an autopilot was engaged. In the remaining 9% of cases, no information concerning the autopilot was obtained.

4.1.2 VFR/IFR operations

Figure 2 indicates that 83% of the pilots surveyed were conducting VFR operations when they penetrated the airspace. VFR pilots are required to monitor their flight progress and to ask for an airways clearance at the appropriate time. While IFR pilots are also required to ask for the clearance, ATS will frequently offer them a clearance as they approach the airspace boundary, or direct them to change frequency to obtain a clearance.

FIGURE 2
VFR/IFR operations

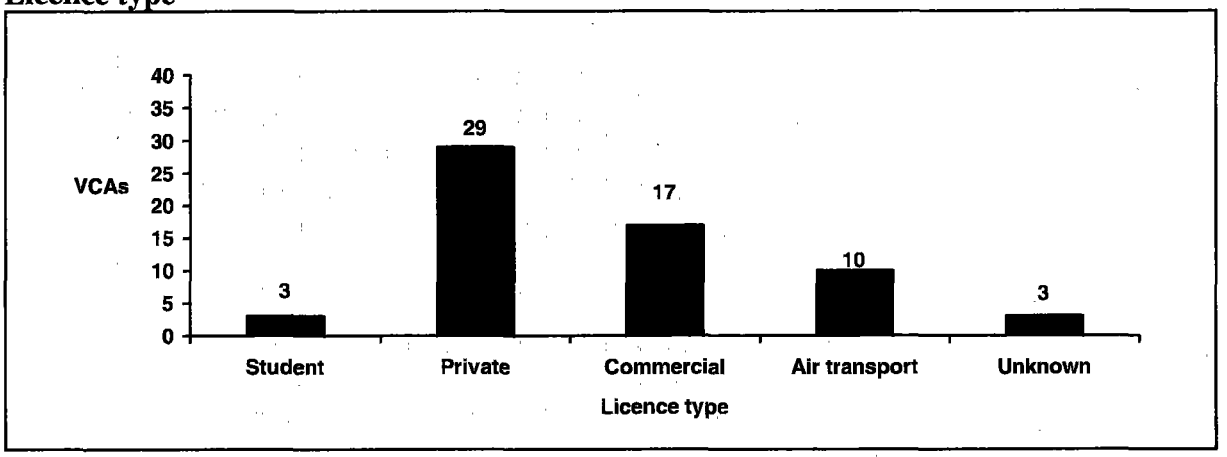


The pilot of a light aircraft was flying over rising ground, to the north of Melbourne, beneath controlled airspace steps. Because of turbulence and poor ground features, the pilot allowed the aircraft to climb over 1,500 ft. The controller called the pilot and advised of a separation breakdown with a Boeing 737. The pilot of the light aircraft sighted the Boeing 737.

4.1.3 Pilot licence type

Figure 3 indicates that the greatest proportion of pilots who penetrated controlled airspace held Private Pilot Licences (PPLs). However, holders of Commercial Pilot Licences (CPLs) and Air Transport Pilot Licences (ATPLs) were also involved in incidents.

FIGURE 3
Licence type



4.1.4 Total experience

Figure 4 indicates that more than half the pilots surveyed had less than 500 hours total flying experience. Figure 4 also compares the total flying hours of the survey group with a representative group of pilots who completed CASA surveys at Flight Safety Forums (Civil Aviation Safety Authority 1997). When pilots who are involved in VCAs are compared in terms of total flying hours, no particular group appears to be overly represented.

FIGURE 4
Total flying hours of surveyed pilots and pilots who attended Flight Safety Forums

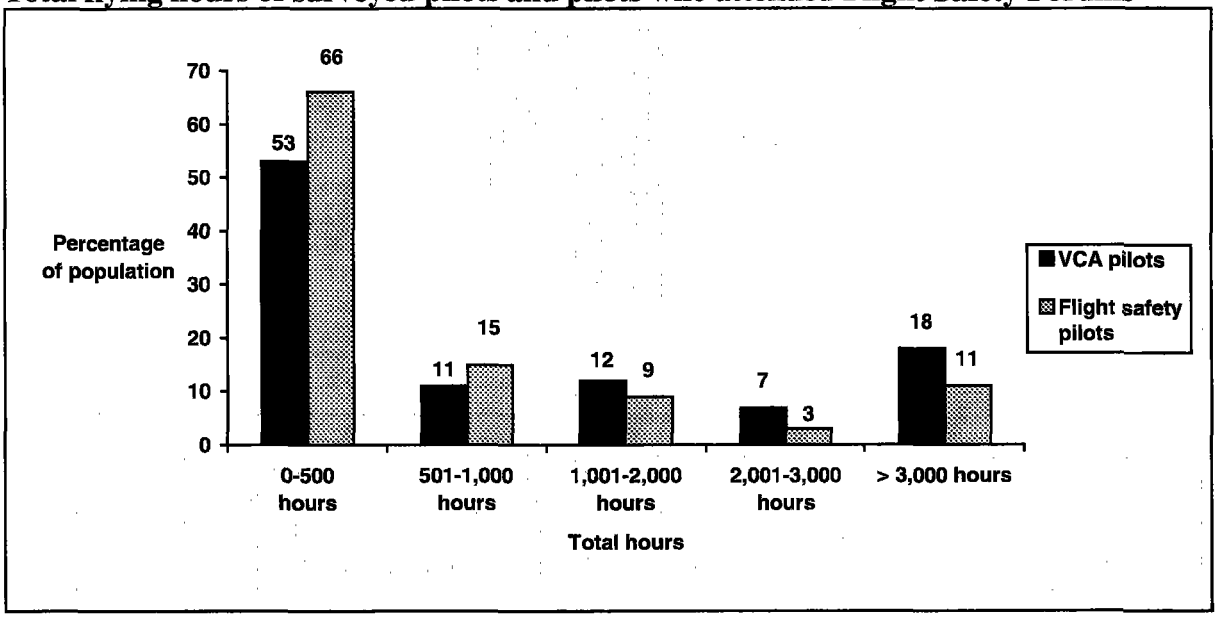


Table 1 compares the average flying hours by licence type of the pilots who took part in the VCA survey with the average flying hours of the general pilot population, gathered from the Flight Safety Forums. The information in table 1 supports the conclusion that in terms of total flying hours, the pilots involved in VCAs are typical of the general pilot population.

Table 1 Average flying hours

	Student pilot licence	Private pilot licence	Commercial pilot licence	Air transport pilot licence
VCA survey group	70	590	1,644	6,938
Flight safety group	64	600	2,115	10,871

4.1.5 Currency

Pilots involved in VCA incidents were asked how frequently they operated aircraft. This information is presented in figure 5. This information was not collected from occurrences during the first 2 weeks of the survey period, and hence data is available from only 49 pilots. It had been predicted that the pilots involved in VCA incidents would be mostly inexperienced and would fly infrequently. However, as can be seen from figure 5, most of the incident pilots indicated that they flew regularly. Thirty-five per cent of pilots indicated that they flew daily, while 33% indicated that they flew on a weekly basis. None of the pilots reported flying less than once a month. Frequent fliers are exposed to the risk of a VCA more than less frequent fliers, which may account for the fact that they are heavily represented among the incident pilots.

FIGURE 5
Aircraft operational frequency

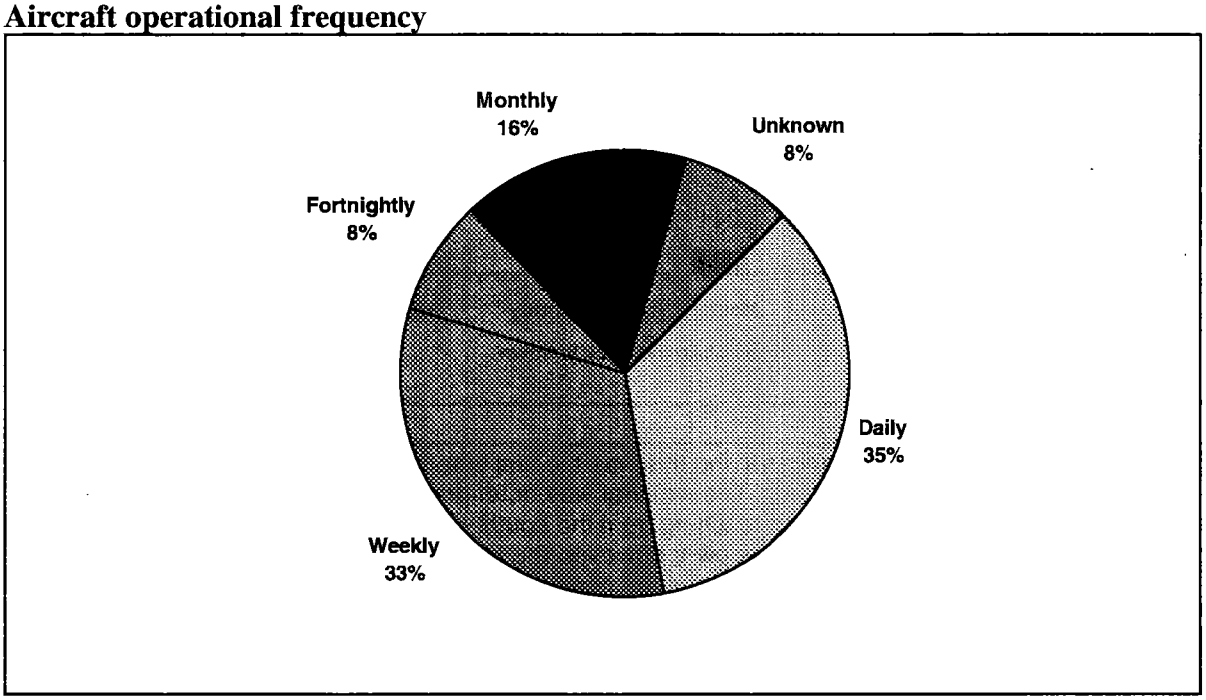
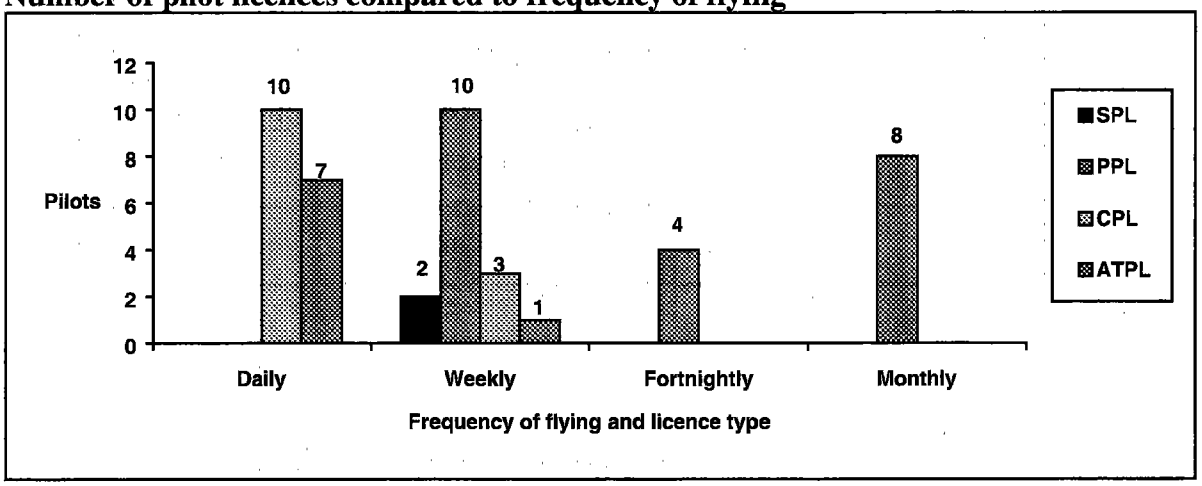


Figure 6 illustrates that of those pilots surveyed in the VCA study, holders of a CPL or ATPL flew daily or weekly, whereas PPL holders flew less frequently.

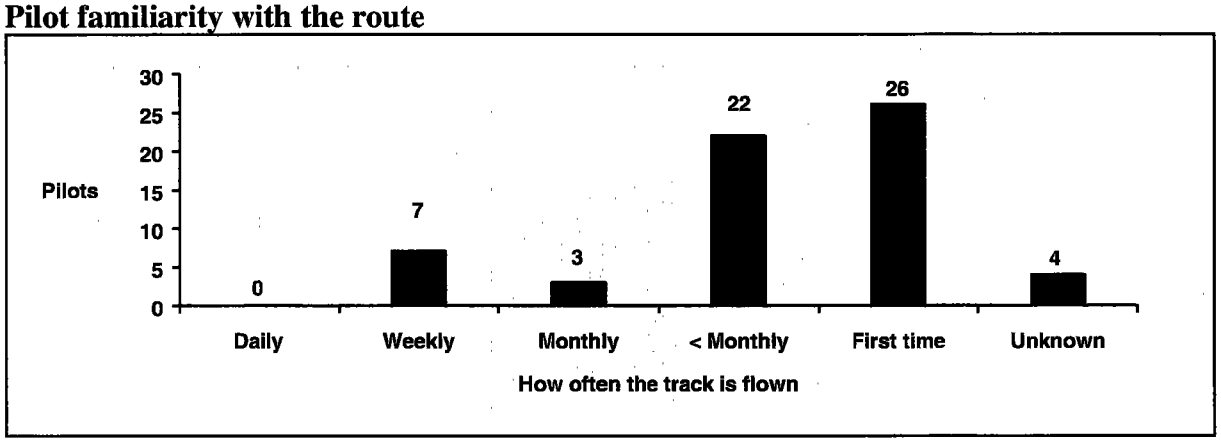
FIGURE 6
Number of pilot licences compared to frequency of flying



4.1.6 Route frequency

In order to assess the pilots' familiarity with the incident routes, pilots were asked to indicate how frequently they flew that particular route. Figure 7 illustrates that most of the incident pilots were flying the route for the first time when the VCA occurred. A large percentage of the pilots also flew the route less than once a month. This suggests that some incidents may be associated with pilot unfamiliarity with the track and the lack of an established routine while flying the route.

FIGURE 7
Pilot familiarity with the route



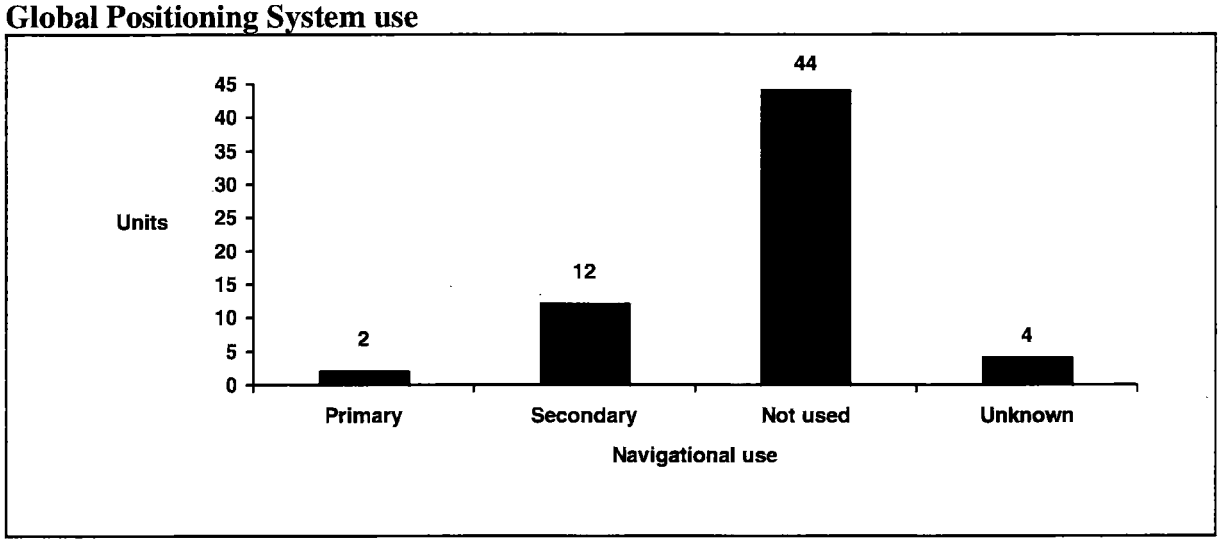
The pilot was returning to Coolangatta and this was the first time he had flown in the light-aircraft lane north of Bankstown. The weather was deteriorating and he was trying to beat a storm which was approaching from the south-west. The pilot decided to turn around and track back to Bankstown; however, the weather had deteriorated as well. The decision was then made to continue north as this was seen as the better option. As the aircraft proceeded north, the weather improved. The pilot thought he had violated controlled airspace vertically and was surprised to find out that he had done so laterally.

4.1.7 Global Positioning System (GPS)

Pilots were asked if they were carrying a GPS and if so, to indicate the model of the unit and whether it was being used at the time of the occurrence for primary or secondary navigation. For the purposes of the survey, *primary navigation* means that the GPS is used by the pilot as the main source of navigational information, whereas *secondary navigation* entails using the GPS as a supplemental navigation aid.

Figure 8 illustrates that most of the incident pilots were not using a GPS. These results could suggest that the use of GPS may help to reduce the incidence of penetrations of controlled airspace. However, in the absence of information on the utilisation rate of GPS amongst the general pilot population, no firm conclusions can be drawn. Of those pilots who were not using a GPS, nine were carrying a GPS which was not in operation at the time of the occurrence. Pilots were not asked why they were not utilising the GPS for navigation.

FIGURE 8
Global Positioning System use

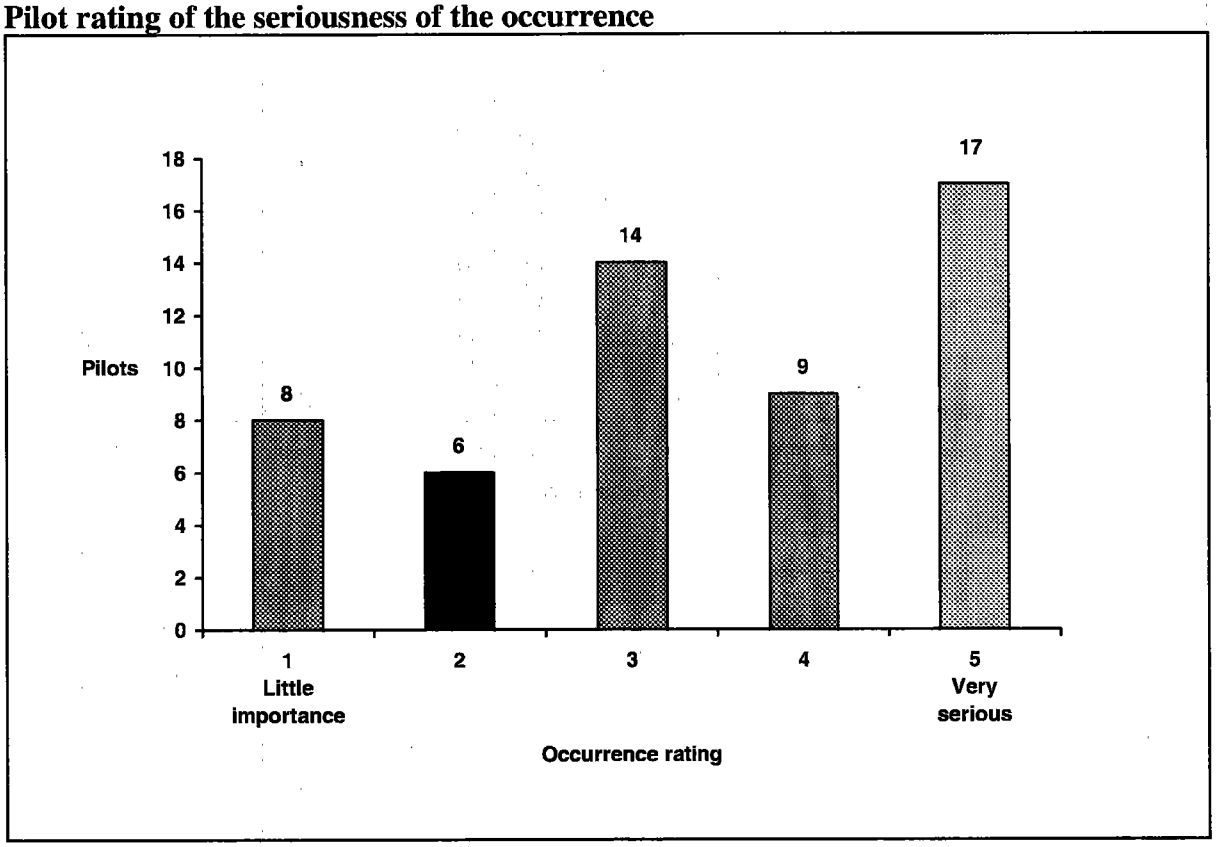


4.1.8 Pilot rating of the importance of the incident

Pilots were asked to rate the importance, on a scale of 1–5, of their VCA. A rating of one signified that the pilot felt the incident was of little importance, whereas five indicated that the pilot felt the incident was very serious.

Fifteen per cent of pilots surveyed expressed the opinion that the incident was of little importance. For example, one survey respondent who was the pilot of a light GA aircraft at the time of the incident stated that he could see the 737 and knew it wasn't going to hit him. Only 31% of pilots surveyed attached a very serious rating to the VCA. A breakdown of these ratings by licence type (not shown) revealed a relatively even spread across the ratings. There was a slight tendency for the CPL and ATPL licence holders to rate the occurrence more seriously than the holders of the PPL (see figure 9).

FIGURE 9
Pilot rating of the seriousness of the occurrence



4.2 Common factors

Many of the questions in the survey were intended to elicit verbal responses rather than simple binary answers, as this gave the interviewee increased scope to volunteer information. The answers were analysed with the aim of finding common factors.

4.2.1 All pilots

The following questions were asked of all pilots.

4.2.1.1 Departure and destination point

Pilots were asked their point of departure and destination and the location of the VCA. Most of the flights originated or terminated at a general aviation airport.

The locations of the VCAs were geographically scattered across the country, and there did not appear to be a concentration of VCAs at any particular location. Only four VCAs occurred as a result of pilots infringing controlled airspace while tracking along a VFR lane of entry.

4.2.1.2 Navigation training

Pilots were asked when they had undertaken their navigation training, who had trained them, and if they felt the training was adequate.

Date of training ranged from 1952 until 1996. Most of the pilots surveyed completed their training in the 1980s and the 1990s with fewer pilots completing their training in the 1960s and 1970s.

No particular flying school was over-represented. Six of the larger flying schools were mentioned more than once, but this could be expected as they would have been training more students.

Six pilots reported that they were not satisfied with the navigation training they had received, and made the following comments respectively:

- 'All of the training was conducted outside controlled airspace, that only the minimum standard was reached'.
- 'There were no pre-flight briefings conducted which contributed to many of the flight exercises being repeated'.
- 'Conducted 120 hours of training and hadn't achieved the PPL due to poor training. This had happened to others'.
- 'The training was very haphazard; the organisation was not interested'.
- 'The standard was lower than the United States'.
- 'The VFR training was adequate; however, the IFR training was inadequate'.

4.2.1.3 Publications checked before and during the flight

All the pilots surveyed checked at least one chart before the flight and they carried at least one chart, with the VTC being the most common. Fifty-five per cent of the survey pilots reported obtaining NOTAMs before the flight.

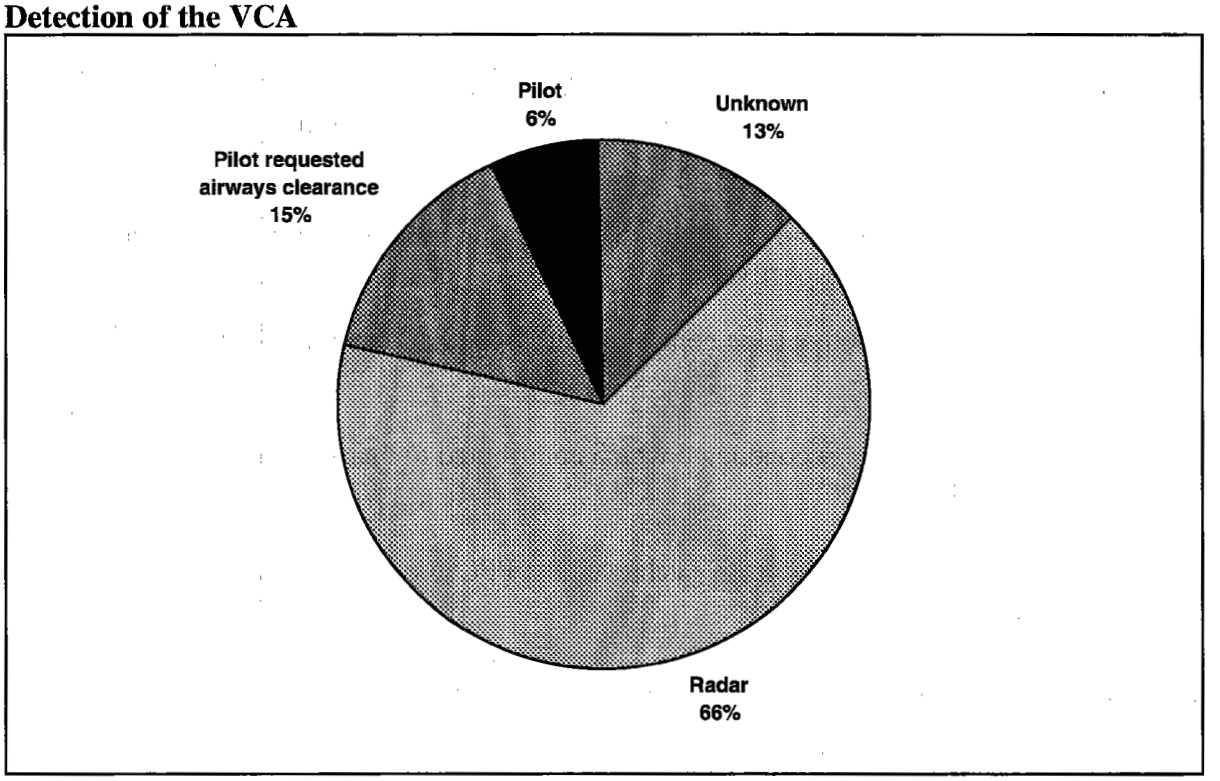
4.2.1.4 Airspace complexity

Twenty-two per cent of pilots considered that the airspace boundaries as depicted on the charts to be complex. When asked why they felt the boundaries were complex, the two most common comments were 'Airspace boundaries are not aligned with geographical points', and 'Unclear as to who has responsibility for the airspace'. The responsibility issue particularly relates to the airspace surrounding Brisbane, Coolangatta and Amberley, where pilots appear to be unsure as to the status of the overlying airspace if Amberley military airspace is de-activated.

4.2.1.5 VCA detection

Pilots were asked how the VCA was detected. Of the pilots surveyed, four (6%) called ATS, having realised that they had entered controlled airspace without a clearance. Sixty-six per cent were detected by air traffic controllers using radar and 15% of the pilots who were not aware they had penetrated controlled airspace, were detected by either a Class-D tower controller (procedural) or by flight service when they requested an airways clearance (see figure 10).

FIGURE 10
Detection of the VCA



Of the 57 pilots surveyed, only eight had not activated their transponders. Aeronautical Information Publication—Operations (OPS) 72.3 now requires pilots of all transponder-equipped aircraft to squawk transponder code 2000 when outside controlled airspace, if not participating in a radar advisory service. This initiative introduced by CASA in 1994 to encourage pilots to squawk transponder code 2000 appears to have been successful.

It should be noted that some undetected incidents may have occurred in the study period. If a pilot penetrates procedural airspace, i.e. non-radar airspace, and does not make a radio transmission or is not observed, then that aircraft may not be detected.

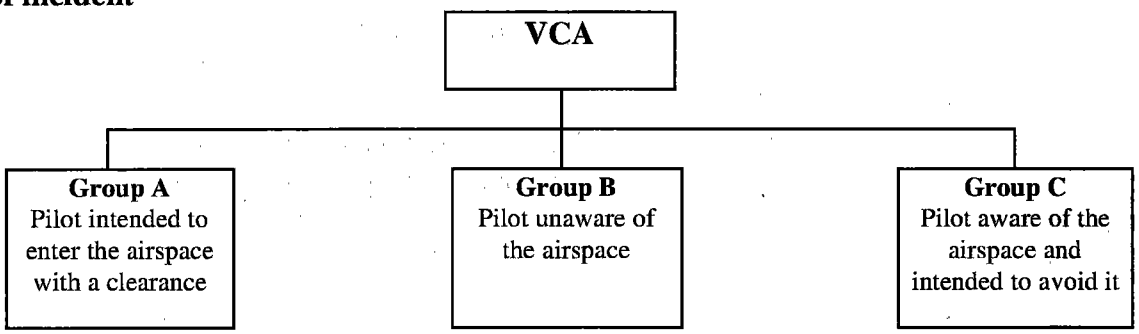
4.2.1.6 Pilot involvement in previous VCAs

Only four of the 57 surveyed pilots reported that they had been involved in a previous VCA. The continuing incidence of VCAs therefore is not related to a significant number of pilots who repeatedly violate controlled airspace.

4.2.2 Pilot intentions

After a series of initial questions, pilots were assigned to one of three groups (see figure 11), based on their intentions and situational awareness. Further questions were then asked of each specific group:

FIGURE 11
Type of incident



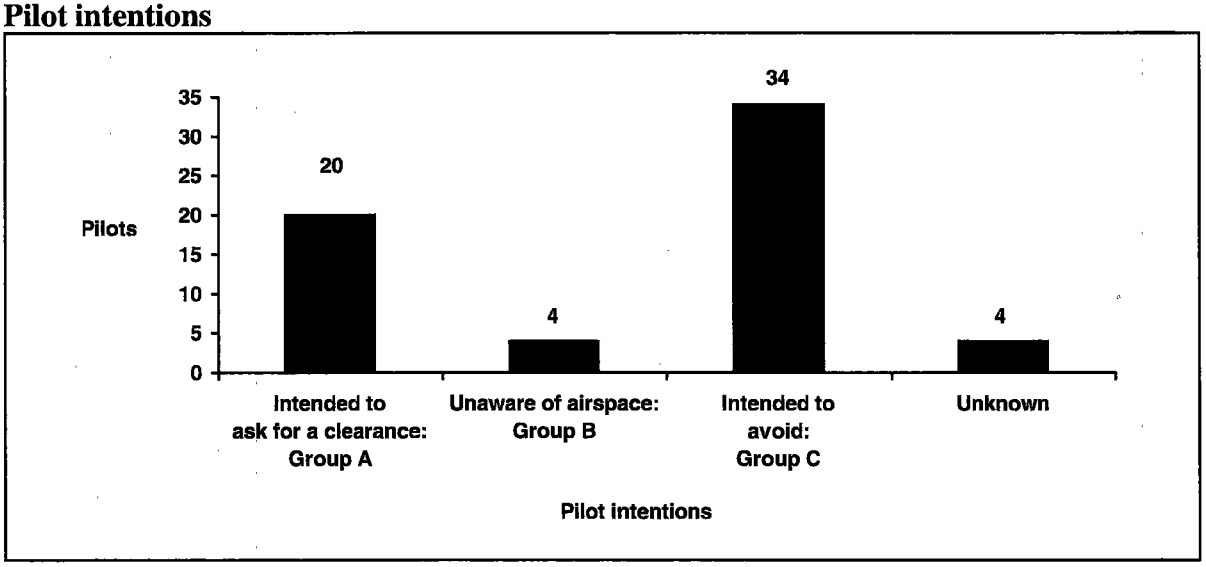
Group A consisted of pilots who intended to ask for a clearance and enter the airspace but penetrated the airspace without a clearance.

Group B consisted of pilots who were unaware of the airspace or unaware it was active and therefore entered without a clearance.

Group C consisted of pilots who were aware of the airspace and intended to avoid it by flying around, over or under it.

Figure 12 illustrates that the majority of pilots surveyed were aware of the existence of the controlled airspace and intended to avoid it. From discussions with the pilots during the survey, it would appear that many private pilots actively avoid planning through controlled airspace.

FIGURE 12
Pilot intentions



4.2.3 Pilots who intended to ask for a clearance: Group A

The following questions were asked of 20 pilots who had intended to ask Air Traffic Control for a clearance before entering the airspace.

4.2.3.1 Duties when the pilot penetrated the controlled airspace

Pilots who intended to ask for a clearance to enter the airspace were asked what they were doing when the incident occurred. This was to see if pilot distraction had a bearing on the incident.

Of the 20 pilots who were asked this question, 19 reported that they were distracted. Five gave the weather as a reason for being distracted and losing situational awareness. The other comments varied from selecting the wrong frequency, passenger distracting the pilot, and attempting to repair the transponder.

Fifteen pilots requested a clearance; however, it was not recorded whether the request took place before or after the occurrence. Of the five pilots who did not ask for a clearance, three were unaware they had entered controlled airspace, one was distracted and forgot, and the other had an inoperative radio.

4.2.3.2 Analysis

When pilots were asked when to request a clearance, either in time or distance, answers ranged from 30 minutes down to 2 minutes or 1 NM. At 1 NM, the pilot of an aircraft travelling at 120 kts has only 30 seconds to request a clearance, be identified if in a radar environment, and receive the clearance. At 5 NM, the same pilot has only 2.5 minutes to request and receive a clearance. At anything less than 5 minutes, the call needs to be successful the first time. Any unanticipated problems with the radio can quickly lead to a situation where the pilot arrives at the boundary without a clearance.

Aeronautical Information Publication— Operations (OPS) 20.2.1 provides general guidance as to when a pilot should request an airways clearance. The section states in part:

> In determining how far from the boundary to make the request, the pilot should allow for aircraft performance, and also the possibility of frequency congestion should the airspace be known to be busy.

The publication does not provide specific guidance or suggested distances or times at which to request a clearance.

The Bureau believes that pilots must allow sufficient time to obtain a clearance when approaching controlled airspace or be prepared to hold outside controlled airspace. The Civil Aviation Safety Authority should provide more specific guidance to pilots as to an appropriate time and/or distance at which to request a clearance when approaching controlled airspace.

The pilot was conducting his first trip away with friends. He found the navigation workload demanding and was continually distracted by his passengers. This resulted in a reduced awareness of his actual ground speed due to a stronger than expected tailwind component. He called Radar Advisory Service; however, he had already entered controlled airspace. The pilot is planning a career in the aviation industry and was mindful of the potential for collision and the seriousness of the incident.

4.2.4 Pilots who entered the airspace thinking that it was de-activated or were unaware of the airspace boundary: Group B

The four pilots in this category constituted the smallest group in the survey. They all reported that they had checked the status of the airspace along their track before the flight.

The four pilots gave the following reasons for the VCA:

1. The pilot checked the NOTAMs and found that there was no NOTAM in the system. Before entering the zone he called ATC. However, he received no reply, and assumed that the airspace was inactive. The aircraft had a faulty microphone and hence the transmission was not broadcast.

2. The pilot misread the charts and assumed that the airspace step was de-activated.

3. While flying interstate the pilot forgot about daylight saving and assumed the tower was still closed.

4. An incorrect approach frequency was printed in the documents.

The four reported that they were confident of asking for assistance either before or during the flight from the briefing office or from Air Traffic Services.

4.2.4.1 Analysis

The small number of pilots in this group suggests that most of the pilots surveyed, and most of the general pilot population, realise the need to be aware of airspace boundaries and the status of the airspace. The few occurrences were dissimilar. There does not appear to be an issue with information processing by the pilots. Perhaps greater emphasis in training or accessing and understanding aeronautical information would be appropriate.

> The pilot reported that the common traffic advisory frequency had a number of aircraft operating in the circuit. During the departure the workload was high and the pilot misread the chart believing the control step to be at 7,500 ft. He called and checked the status of a military aerodrome en route and was told that it was de-activated. The aerodrome control zone normally extends to 3,500 ft. He subsequently assumed that the airspace above 3,500 ft was also inactive and climbed into controlled airspace.

4.2.5 Pilots who intended to fly around the airspace: Group C

Thirty-four pilots had been aware of the existence of the controlled airspace and had intended to track around or under it. However, due to navigational difficulties, the pilot penetrated controlled airspace. This was the most common category of incident observed during the study.

4.2.5.1 Diversion

Pilots were asked if they had diverted intentionally from their planned track. Fifteen pilots of the 34 surveyed had diverted from their track prior to the VCA. Almost half of these cited weather as the reason for the diversion.

4.2.5.2 Tracking tolerance

Pilots were asked how much tolerance they allowed when tracking adjacent to controlled airspace. Three pilots allowed no lateral tolerance and tracked along the boundary. Twenty pilots planned tracking tolerances of 1–5 NM.

4.2.5.3 Pilots unsure of their position and their willingness to ask for assistance

Pilots were asked if they were unsure of their position at the time of the incident. Twenty-nine considered that they knew where they were, while the other five pilots, who were unsure of their position, were then asked if they had requested assistance from Air Traffic Services. None of the five pilots had requested assistance, although two said they were about to ask for it. One pilot was reluctant to ask for assistance as he felt that Air Traffic Services regarded VFR pilots as a nuisance.

4.2.5.4 Analysis

Of the Group-C pilots, only five planned to track more than 5 NM from the boundary.

Aeronautical Information Publication—Air Traffic Rules and Services (RAC) 44.5 advises pilots wishing to avoid controlled airspace to apply appropriate tolerances to the flight path to ensure that controlled airspace or restricted areas are not infringed. The document gives the following guidance as to appropriate tolerances.

Visual (powered aircraft)

0–2,000 ft AGL	± 1 NM(± 2 NM by night)
2,001–5,000 ft AGL	± 2 NM (± 3 NM by night)
5,001–10,000 ft AGL	± 4 NM (± 5 NM by night)

The Bureau believes that these suggested tolerances are insufficient and that the Civil Aviation Safety Authority should amend the Aeronautical Information Publication to reflect a more appropriate distance for pilots wishing to avoid controlled airspace.

4.2.5.5 Mis-identifying waypoints

Six of the pilots interviewed stated that they had either mis-identified or missed a waypoint prior to entering the airspace. Identification of waypoints and towns is considered by the industry to be a basic navigational skill. Student pilots are taught in their first few hours of cross-country flying how to identify the correct location or feature.

4.2.5.6 Analysis

From 1 January 1993 to 31 December 1996, 112 occurrences of pilots being unsure of their position or lost were reported to the Bureau. Of these 112 occurrences, 24, or almost one-quarter, resulted in a VCA.

In January 1996, the Bureau released the report *Flying Training in Australia* (Bureau of Air Safety Investigation 1996). The report found that for the period 1987–1991,

> most incidents (78%) involved either poor navigation techniques or improper in-flight procedures which led to the pilot becoming lost or unsure of position. In some instances the pilot then penetrated controlled airspace without a clearance.

The current study has indicated that navigational difficulty is the most common factor leading to VCAs.

Civil Aviation Regulation Part V, 5.84, which lays down the current training requirement for the PPL (aeroplane), requires the pilot, amongst other things, to have completed 5 hours of cross-country flight time as pilot in command.

Section 3.17 of the Day VFR Syllabus—Aeroplane, provides general guidance and standards for navigation training. Apart from fuel management, the navigation training requires the student to reach a PPL standard where he/she can consistently demonstrate proficiency in conducting the exercise and is deemed fit to operate without supervision.

There is scope for the Civil Aviation Safety Authority to provide more guidance either in the syllabus or the regulations regarding basic navigational abilities to be attained by the student. Increased emphasis should be placed on navigation training in the vicinity of controlled airspace including operations into controlled airspace. This would help to ensure that student pilots obtain the proper training.

> The pilot had planned to fly below the lower limit of controlled airspace. The intention was to identify a weir that was under the control step on the map and then climb. The pilot failed to make a positive position fix and misidentified the weir. The aircraft was subsequently climbed early and entered controlled airspace.

The incidence of penetrations of controlled airspace could perhaps be further reduced with the proposed introduction by CASA of the visual navigation chart. The proposed chart would have a scale of 1:500,000 and would include information such as airspace boundaries and geographic features.

5. Conclusions

VCA incidents have been analysed from incident reports and interviews with the pilots involved. The interviews were a valuable method of gathering pilots' attitudes and ideas regarding VCAs.

Previous studies found that the rate of VCAs increased after the introduction of AMATS in December 1991. During the first study, charts were identified as a factor in VCAs. The current study did not find that charts were an issue. The data presented in the current study indicates that the annual frequency of VCAs peaked in 1993; however, incident numbers now appear to have stabilised at around 600 violations of civil airspace by civil aircraft per year.

In terms of their flying experience, the pilots who were involved in VCAs were not significantly different to the general pilot population.

The majority of pilots who penetrated controlled airspace were intending to avoid this airspace but failed to follow their planned track with sufficient accuracy. It is apparent these incidents are primarily navigational incidents which happened to culminate in a VCA.

Improved navigation training may help to reduce the frequency of navigational difficulties, although it can be expected that no amount of training can eliminate navigation errors completely. This study has suggested that many pilots who do not intend to enter controlled airspace do not apply sufficient track tolerance when tracking near a controlled airspace boundary. Increased track tolerances by such pilots would help to limit the consequences of navigation errors.

Those pilots who intended to request a clearance for entry into controlled airspace often did not allow sufficient time to request the clearance. This was exacerbated if they were distracted either by weather or other concerns. In some cases, poor planning and navigational skills may have contributed to the incident.

Pilots need to be provided with guidance as to suitable distances when tracking adjacent to controlled airspace and likewise guidance on allowing sufficient time and/or distance to request a clearance before entering controlled airspace. Consideration should also be given to providing more specific directions regarding navigation training for the PPL.

6. Recommendations

As a result of this study the Bureau of Air Safety Investigation issues the following recommendations:

1. R970083
The Bureau of Air Safety Investigation recommends that the Civil Aviation Safety Authority provide specific guidance to pilots as to an appropriate time and/or distance at which to request a clearance when approaching controlled airspace.

2. R970084
The Bureau of Air Safety Investigation recommends that the Civil Aviation Safety Authority amend AIP RAC 44.5 to increase the tracking tolerance for pilots wishing to avoid controlled airspace.

3. R970085
The Bureau of Air Safety Investigation recommends that the Civil Aviation Safety Authority provide more guidance in either the syllabus or the regulations regarding basic navigational abilities to be attained by the student pilot.

4. R970096
The Bureau of Air Safety Investigation recommends that the Civil Aviation Safety Authority require greater emphasis to be placed on the navigation training in the vicinity of controlled airspace and the procedures for entry into controlled airspace.

7. References

Bureau of Air Safety Investigation 1993, *Violations of Controlled Airspace Special Study,* Research Project RP/92/10, BASI, Canberra.

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