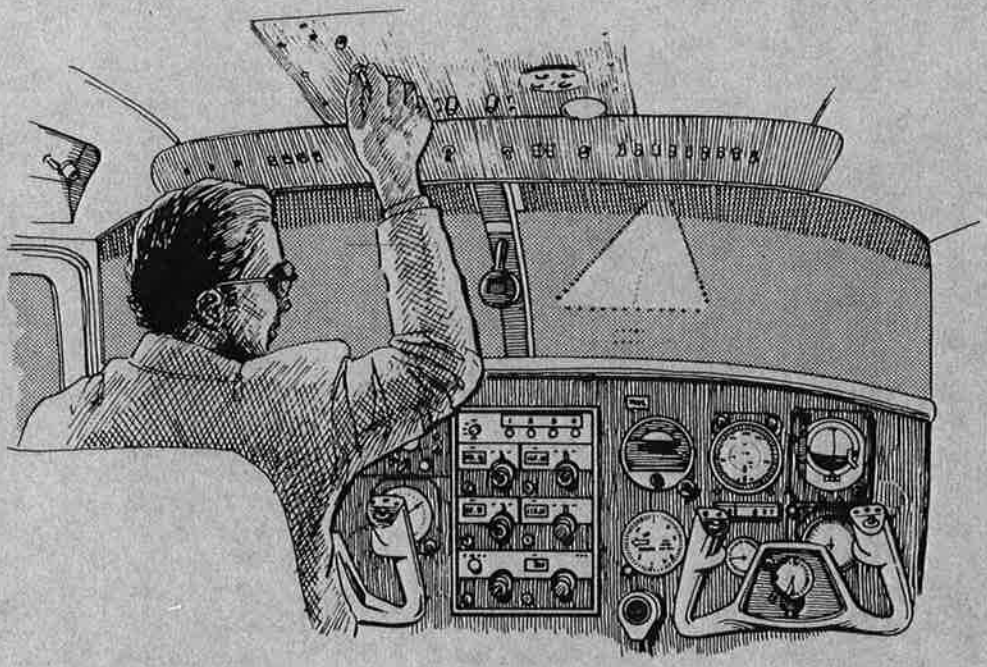
REPORT NO. FAA-MS-78-5

GENERAL AVIATION AVIONICS STATISTICS: 1975



JUNE 1978

ANNUAL REPORT

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Prepared for

U.S. DEPARTMENT OF TRANSPORTATION
Federal Aviation Administration
Office of Management Systems
Washington DC 20590

REPORT NO. FAA-MS-78-5 GA AVIONICS ST

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16. Abstract This report presents avionics statistics for the 1975 general aviation (GA) aircraft fleet and updates a previous publication, General Aviation Avionics Statistics: 1974. The statistics are presented in a capability group framework which enables one to relate airborne avionics equipment to the capability for a GA aircraft to function in the National Airspace System. The word "capability" is used in this report to mean in what segments of the airspace an aircraft can fly, under what conditions it can fly, and at what airports it can land. The framework permits the GA fleet to be divided into groups according to their capabilities as dictated by the avionics configurations of the aircraft. Differences in various characteristics of the aircraft are examined among the capability groups. The FAA's 1975 Aircraft Statistical Master File is the source of all the statistical data used in this report.

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PREFACE

This report describes the 1975 avionics data study performed at the Transportation Systems Center (TSC) under Project Plan Agreement FA-843 sponsored by the Federal Aviation Administration, Office of Management Systems, Information and Statistics Division. It is a sequel to General Aviation Avionics Statistics: 1974, which was produced for the same sponsor and which contains much of the groundwork for the 1975 effort. TSC performed the study as part of a continuing program to assure the quality and usefulness of general aviation data. The study is based on information collected and processed by the FAA through its Aeronautical Center in Oklahoma City, Oklahoma.

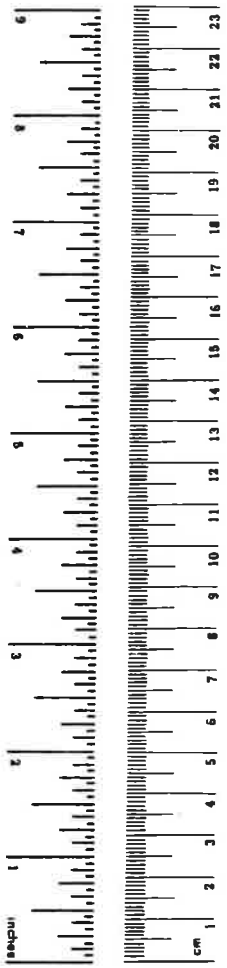
The author would like to acknowledge the contributions to this report by several FAA personnel: Carolyn Edwards and Nicholas Soldo, AMS-230, assisted and guided the project as sponsors; Stephen W. Hopkins, AMS-230, produced data tapes for the analysis. James E. Smith of Kentron Hawaii, Ltd. was responsible for manipulating the data and writing the computer programs to produce the tables appearing in this publication.

Distribution: ZMS-348C. FAS-1, FAT-0, FFS-1,2,3,5,7,8, FIA-0 (1 copy only)

METRIC CONVERSION FACTORS

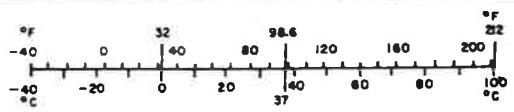
Approximate Conversions to Metric Measures

Symbol	When You Know	Multiply by	To Find	Symbol
		LENGTH		
in	inches	2.5	centimeters	cm
ft	feet	30	centimeters	cm
yd	yards	0.9	meters	m
mi	miles	1.6	kilometers	km
		AREA		
in^2	square inches	6.5	square centimeters	cm^2
ft^2	square feet	0.09	square meters	m^2
yd^2	square yards	0.8	square meters	m^2
mi^2	square miles	2.6	square kilometers	km^2
	acres	0.4	hectares	ha
		MASS (weight)		
oz	ounces	28	grams	g
lb	pounds	0.45	kilograms	kg
	short tons (2000 lb)	0.9	tonnes	t
		VOLUME		
tsp	teaspoons	5	milliliters	ml
Tbsp	tablespoons	15	milliliters	ml
fl oz	fluid ounces	30	milliliters	ml
c	cups	0.24	liters	l
pt	pints	0.47	liters	l
qt	quarts	0.95	liters	l
gal	gallons	3.8	liters	l
ft^3	cubic feet	0.03	cubic meters	m^3
yd^3	cubic yards	0.76	cubic meters	m^3
		TEMPERATURE (exact)		
°F	Fahrenheit temperature	5/9 (after subtracting 32)	Celsius temperature	°C



Approximate Conversions from Metric Measures

Symbol	When You Know	Multiply by	To Find	Symbol
		LENGTH		
mm	millimeters	0.04	inches	in
cm	centimeters	0.4	inches	in
m	meters	3.3	feet	ft
m	meters	1.1	yards	yd
km	kilometers	0.6	miles	mi
		AREA		
cm^2	square centimeters	0.16	square inches	in^2
m^2	square meters	1.2	square yards	yd^2
km^2	square kilometers	0.4	square miles	mi^2
ha	hectares (10,000 m^2)	2.5	acres	
		MASS (weight)		
g	grams	0.035	ounces	oz
kg	kilograms	2.2	pounds	lb
t	tonnes (1000 kg)	1.1	short tons	
		VOLUME		
ml	milliliters	0.03	fluid ounces	fl oz
l	liters	2.1	pints	pt
l	liters	1.06	quarts	qt
l	liters	0.26	gallons	gal
m^3	cubic meters	35	cubic feet	ft^3
m^3	cubic meters	1.3	cubic yards	yd^3
		TEMPERATURE (exact)		
°C	Celsius temperature	9/5 (then add 32)	Fahrenheit temperature	°F



EXECUTIVE SUMMARY

This document is the second in the General Aviation Avionics Statistics report series, and presents avionics statistics and other descriptive information for the 1975 general aviation (GA) aircraft fleet. The report series results from a study which was designed first, to develop a framework for the GA fleet relating airborne avionics equipment to aircraft capability to perform in the National Airspace System (NAS), and second, within this framework to analyze the activity and other characteristics of the GA fleet.

The source of data for the study was the FAA's 1975 Aircraft Statistical Master (ASM) File, created by merging information from two primary sources: 1) aircraft owners' responses to the Aircraft Registration Eligibility, Identification and Activity Report, AC Form 8050-73, mailed annually to al U.S civil aircraft owners, and 2) the Aircraft registration File. In addition to air carrier records, the ASM File contained one record for each of the 193,661 validly registered GA aircraft as of December 31, 1975. However, because avionics information was not available for all GA aircraft, this report is based only on 177,807 GA aircraft, or 91.8 percent of the 1975 GA fleet.

In developing the framework for analyzing the capabilities of the GA fleet, the main assumption was that the avionics equipment contained in an aircraft determined the maximum capabilities of that aircraft to perform in the NAS. The word "capability" was used to mean where and under what conditions an aircraft could fly, at what airports it could land, and to what extent it could participate in various navigation, communication, and landing systems. Capability groups were defined, each group consisting of a combination of avionics equipment and the associated capabilities. By assigning each GA aircraft to its appropriate capability groups according to its avionics configuration, and then studying the differences in characteristics among the groups, relationships between the level of avionics in an aircraft and other physical and

operating characteristics could be drawn.

Some of the significant findings, based on the 177,807 GA aircraft for which avionics information was available, are listed below:

- Only about 11 percent of the GA fleet have the avionics equipment required to fly above 18,000 feet in positive controlled airspace. In fact, over 86 percent cannot fly above 12,500 feet due to avionics limitations alone.
- Almost 80 percent of the GA fleet can fly IFR.
- 14 percent of the GA fleet can land at Group I Terminal Control Areas (TCA's).
- At least 52 percent of the GA fleet have some degree of instrument landing system (ILS) receiving capability.
- From 1974 to 1975 there was a significant increase in the number of aircraft with avionics equipment enabling them to land at Group I TCA's and to fly in positive controlled airspace.
- There was significant growth from 1974 to 1975 in the number of aircraft containing complete ILS systems, weather radars, and area navigation systems.
- As the level of avionics in an aircraft increases,
  - primary uses change from mostly personal to mostly business and executive,
  - the type of aircraft becomes more sophisticated,
  - the aircraft usage (number of hours flown) increases,
  - the age of the aircraft decreases.

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1. INTRODUCTION

1.1 DEFINITIONS

1.1.1 General Aviation (GA)

The term general aviation (GA) refers to all facets of civil aviation except air carriers holding a certificate of public convenience and necessity from the Civil Aeronautics Board, and large aircraft commercial operators. GA includes such varied services as air taxi, air cargo, industrial, agricultural, business, personal, instructional, research, patrol, and sport flying. GA aircraft range in complexity from four engine turbojets to simple gliders and balloons.

1.1.2 Avionics

The term avionics, as used in this report, refers to the airborne electronic equipment used by an aircraft to transmit and receive various forms of radio signals for purposes of navigation, communication, tracking and landing the aircraft. Some examples are the VHF communications equipment which transmits and receives voice communications via very high frequency radio waves, and the weather radar transmitter which locates the centers of electrical storms using X-band electromagnetic waves.

1.2 BACKGROUND

The General Aviation Avionics Statistics report series began with a report on the 1974 GA fleet. The report revealed the findings of a study designed first, to develop a framework for the GA fleet relating airborne avionics equipment to aircraft capability to perform in the National Airspace System (NAS), and second, within this framework to analyze the activity and other characteristics of the GA fleet. The 1975 report is an update of the 1974 report and follows the 1974 format to facilitate year-to-year comparisons.

The usefulness of such reports is easily established when one considers GA's dominance of the civil air fleet, and the scarcity of reliable information on GA activities. In calendar year 1976 GA aircraft comprised almost 99 percent of the U.S. civil air fleet,[1] and accounted for over 84 percent of civilian operations at FAA towered airports.[2] However, in contrast to the air carriers

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[1] Source: Census of U.S. Civil Aircraft Calendar Year 1976, U.S. Department of Transportation, Federal Aviation Administration, (Washington DC, 1978), p. 4.

[2] This figure includes operations for both GA and air taxi. Source: FAA Aircraft Activity Calendar Year 1976, U.S. Department of Transportation, Federal Aviation Administration, (Washington DC, 1977), p. 2.

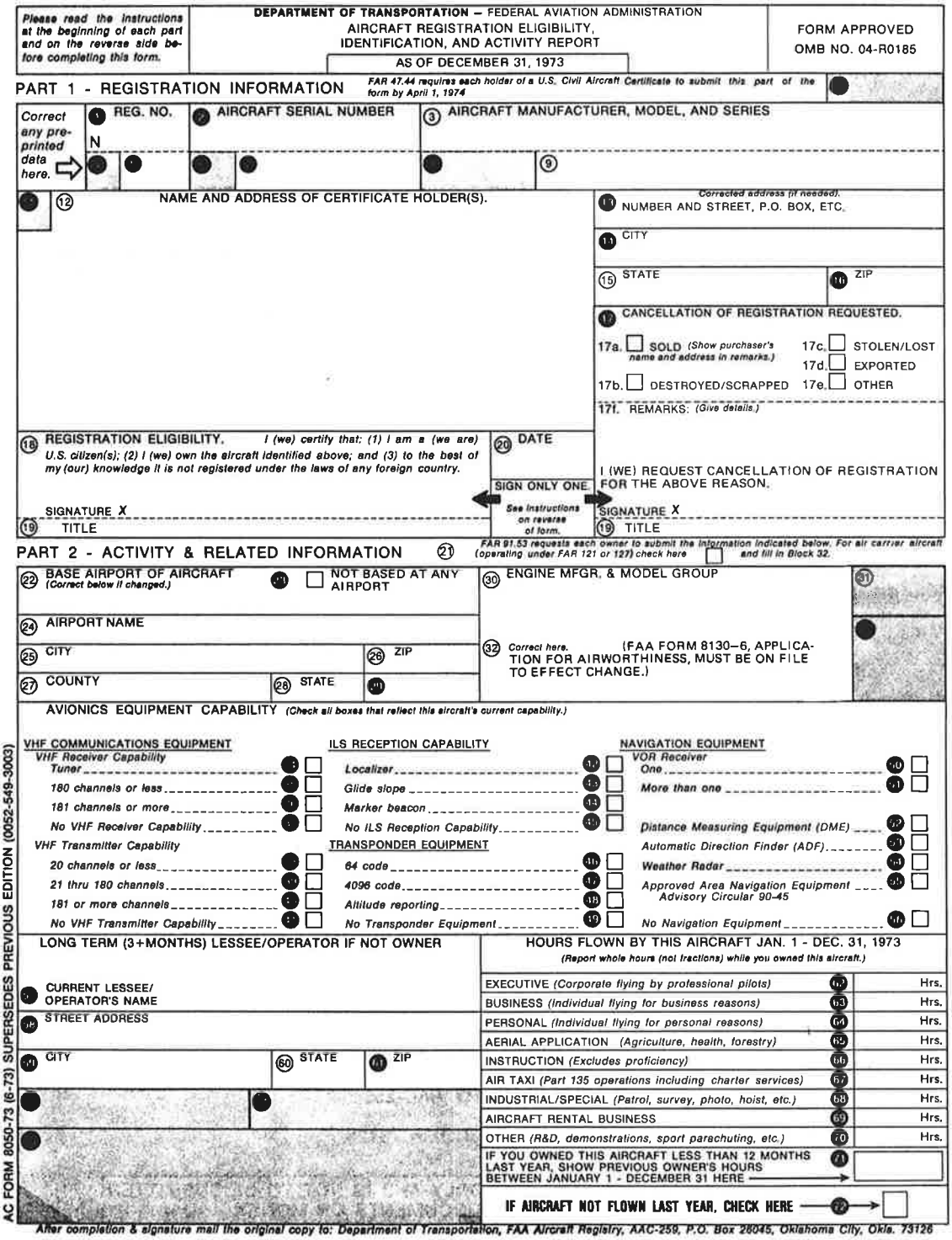
which account for the remaining civilian aircraft and operations, GA has no requirement for reporting activity and avionics information to the Federal government. Therefore one's knowledge of GA is confined to what can be extracted from the limited data available, acquired mostly through voluntary surveys. Analyses of the data and resulting inferences provide much needed insight into the nature of the GA fleet.

1.3 SOURCE OF DATA

Until recently the FAA's means of obtaining information on the activities and avionics of the GA fleet was the version of the Aircraft Registration Eligibility, Identification and Activity Report, AC Form 8050-73, shown in Figure 1. FAA mailed this form to all U.S. civil aircraft owners in January of every year beginning in 1970 and continuing until 1976, requesting information on the previous year's activities of the aircraft. The form was divided into two parts: the first was mandatory for all U.S. civil aircraft; the second applied only to GA aircraft and was voluntary. The first part asked for information on the aircraft's identification and status for the purpose of updating the Aircraft Registration File. The second part requested information on the aircraft's activities, usage, avionics equipment and base airport location. For four consecutive mailouts ending with 1976, Part 2 achieved an average annual response rate of approximately 73 percent.

Every year FAA combined the information from Part 2 of the 8050-73 form with the records from the Aircraft Registration File to create the Aircraft Statistical Master (ASM) File. Each ASM File contained one record for every U.S. civil aircraft validly registered on December 31 of that year. The ASM File was the source of data for both the 1974 and 1975 issues of General Aviation Avionics Statistics. A record layout appears in Appendix A.

FAA modified the 8050-73 form for the January 1977 mailout by updating the avionics equipment questions to include modern and newly developed equipment common on many GA aircraft today. FAA discontinued the 8050-73 form altogether in January 1978, replacing Part 1 with a proposed triennial aircraft registration and Part 2 with an annual voluntary GA sample survey. The survey requests the same type of activity and avionics information formerly obtained through Part 2 of the 8050-73 form, but covers only a 15 percent sample of the GA aircraft. Because of these changes in the source of data, future issues of General Aviation Avionics Statistics, though written in the same format as the 1974 and 1975 issues, will not permit direct comparisons with previous years.



Please read the instructions at the beginning of each part and on the reverse side before completing this form.

DEPARTMENT OF TRANSPORTATION — FEDERAL AVIATION ADMINISTRATION
AIRCRAFT REGISTRATION ELIGIBILITY, IDENTIFICATION, AND ACTIVITY REPORT
AS OF DECEMBER 31, 1973

FORM APPROVED
OMB NO. 04-R0185

PART 1 - REGISTRATION INFORMATION

FAR 47.44 requires each holder of a U.S. Civil Aircraft Certificate to submit this part of the form by April 1, 1974

Correct any pre-printed data here.

(1) REG. NO. N
(2) AIRCRAFT SERIAL NUMBER
(3) AIRCRAFT MANUFACTURER, MODEL, AND SERIES
(9)

(12) NAME AND ADDRESS OF CERTIFICATE HOLDER(S).

Corrected address (if needed).
(11) NUMBER AND STREET, P.O. BOX, ETC.
(14) CITY
(15) STATE
(16) ZIP

(17) CANCELLATION OF REGISTRATION REQUESTED.
17a. ☐ SOLD *(Show purchaser's name and address in remarks.)*
17b. ☐ DESTROYED/SCRAPPED
17c. ☐ STOLEN/LOST
17d. ☐ EXPORTED
17e. ☐ OTHER
17f. REMARKS: *(Give details.)*

(18) REGISTRATION ELIGIBILITY. *I (we) certify that: (1) I am a (we are) U.S. citizen(s); (2) I (we) own the aircraft identified above; and (3) to the best of my (our) knowledge it is not registered under the laws of any foreign country.*

(20) DATE

SIGN ONLY ONE. *See instructions on reverse of form.*

I (WE) REQUEST CANCELLATION OF REGISTRATION FOR THE ABOVE REASON.

SIGNATURE X
(19) TITLE

SIGNATURE X
(19) TITLE

PART 2 - ACTIVITY & RELATIVE INFORMATION (21)

FAR 91.53 requests each owner to submit the information indicated below. For air carrier aircraft (operating under FAR 121 or 127) check here ☐ and fill in Block 32.

(22) BASE AIRPORT OF AIRCRAFT *(Correct below if changed.)* (23) ☐ NOT BASED AT ANY AIRPORT
(24) AIRPORT NAME
(25) CITY
(26) ZIP
(27) COUNTY
(28) STATE
(29)

(30) ENGINE MFGR. & MODEL GROUP
(31)
(32) *Correct here.* (FAA FORM 8130-6, APPLICATION FOR AIRWORTHINESS, MUST BE ON FILE TO EFFECT CHANGE.)

AVIONICS EQUIPMENT CAPABILITY *(Check all boxes that reflect this aircraft's current capability.)*

VHF COMMUNICATIONS EQUIPMENT
VHF Receiver Capability
Tuner
180 channels or less
181 channels or more
No VHF Receiver Capability
VHF Transmitter Capability
20 channels or less
21 thru 180 channels
181 or more channels
No VHF Transmitter Capability

ILS RECEPTION CAPABILITY
Localizer
Glide slope
Marker beacon
No ILS Reception Capability

TRANSPONDER EQUIPMENT
64 code
4096 code
Altitude reporting
No Transponder Equipment

NAVIGATION EQUIPMENT
VOR Receiver
One
More than one
Distance Measuring Equipment (DME)
Automatic Direction Finder (ADF)
Weather Radar
Approved Area Navigation Equipment Advisory Circular 90-45
No Navigation Equipment

LONG TERM (3+MONTHS) LESSEE/OPERATOR IF NOT OWNER

CURRENT LESSEE/ OPERATOR'S NAME
STREET ADDRESS
CITY
STATE
ZIP

HOURS FLOWN BY THIS AIRCRAFT JAN. 1 - DEC. 31, 1973
(Report whole hours (not fractions) while you owned this aircraft.)

EXECUTIVE *(Corporate flying by professional pilots)*	62	Hrs.
BUSINESS *(Individual flying for business reasons)*	63	Hrs.
PERSONAL *(Individual flying for personal reasons)*	64	Hrs.
AERIAL APPLICATION *(Agriculture, health, forestry)*	65	Hrs.
INSTRUCTION *(Excludes proficiency)*	66	Hrs.
AIR TAXI *(Part 135 operations including charter services)*	67	Hrs.
INDUSTRIAL/SPECIAL *(Patrol, survey, photo, hoist, etc.)*	68	Hrs.
AIRCRAFT RENTAL BUSINESS	69	Hrs.
OTHER *(R&D, demonstrations, sport parachuting, etc.)*	70	Hrs.
IF YOU OWNED THIS AIRCRAFT LESS THAN 12 MONTHS LAST YEAR, SHOW PREVIOUS OWNER'S HOURS BETWEEN JANUARY 1 - DECEMBER 31 HERE →	71	

IF AIRCRAFT NOT FLOWN LAST YEAR, CHECK HERE → (72) ☐

AC FORM 8050-73 (6-73) SUPERSEDES PREVIOUS EDITION (0052-549-3003)

After completion & signature mail the original copy to: Department of Transportation, FAA Aircraft Registry, AAC-259, P.O. Box 26045, Oklahoma City, Okla. 73126

FIGURE 1. AIRCRAFT REGISTRATION ELIGIBILITY, IDENTIFICATION, AND ACTIVITY REPORT FORM

NOTE: *Entries made on the original will appear on the second copy without using carbon paper. The second copy of this form is for the aircraft owner. Shaded areas are for FAA use only.*

INSTRUCTIONS FOR COMPLETING AND SIGNING THE FORM ON THE REVERSE.

For your convenience this form has been preprinted with all available information in FAA records as of December 31, 1973. Where the preprinted information is correct, no entry is needed. Where the information is incorrect or out-of-date insert the correct information in the space provided. Where no information is preprinted please enter the information requested in the space provided.

GUIDELINES FOR COMPLETING SIGNATURE BLOCKS 17 AND 18.

1. *If this aircraft is still eligible for registration, and you wish to continue its registration, sign Block 18 and enter the date in Block 20. Follow the guidelines for signature below.*

2. *If the aircraft is now ineligible for registration in your name or you wish to cancel its registration for other reasons, complete and sign Block 17 and enter the date in Block 20, following the guidelines for signature below.*

GUIDELINES FOR SIGNATURE

1. *INDIVIDUAL OWNER. An individual owner whose name appears in Block 12 must sign his name.*

2. *PARTNERSHIP. Any general partner may sign for the partnership but must show his title "partner."*

3. *CORPORATIONS. Any corporate officer or person holding a managerial position with the corporation may sign for the corporation. He must also indicate the title of his office below his signature.*

4. *CO-OWNER. Unless cancellation of registration is requested, any co-owner may sign certifying citizenship and ownership for all co-owners. If cancellation is requested, the signature of each co-owner must appear on this form or on an attached sheet.*

5. *GOVERNMENT. Any authorized person may sign showing his title.*

After you complete and sign the form send the original (first copy) to:

DEPARTMENT OF TRANSPORTATION
FAA AIRCRAFT REGISTRY AAC-259
P.O. BOX 26045
OKLAHOMA CITY, OKLAHOMA 73126

THIS IS AN ANNUAL REPORTING FORM ONLY AND IS NOT TO BE SUBMITTED WITH OTHER AIRCRAFT REGISTRATION DOCUMENTS OR MONEY.

FIGURE 1. AIRCRAFT REGISTRATION ELIGIBILITY, IDENTIFICATION, AND ACTIVITY REPORT FORM (CONTINUED)

2. DEVELOPMENT AND METHODOLOGY

2.1 FLEET SIZE AND REPORT COVERAGE

The 1975 GA aircraft fleet, as represented by the 1975 ASM File, contained 193,661 registered aircraft as of December 31, 1975. The response rate to Part 2 of the 8050-73 form was 71.6 percent or 138,591 aircraft. However, avionics information from previous years was available in the records of 39,216 additional GA aircraft, yielding avionics information for a total of 177,807 GA aircraft, or 91.8 percent of the GA fleet (see Figure 2).

The tables appearing in this report are all based on the 177,807 GA aircraft for which avionics information was available. Therefore the absolute aircraft counts do not represent the entire GA fleet. Further, because the responses are not the result of any scientific sampling design, the potential for bias exists in the relative capability group sizes and in the distributions of aircraft across the various classifications. In a non-respondent follow-up to a sample survey conducted by Price Waterhouse & Company, results indicated that non-respondents usually fly fewer hours than responding GA aircraft.[1] If this result is true for surveys in general, the distribution of aircraft across hours flown shown in this report most likely has a slight upward bias. A more extensive follow-up study would be required to determine the extent of this and other possible biases. However, because the tables include over 90 percent of the GA fleet, the magnitude of any bias is limited.

Aircraft statistics found in this report agree generally with those appearing in other FAA sources. Some FAA publications, such as the Census of U.S. Civil Aircraft 1975, are based on the entire fleet size of 193,661. This report, as mentioned earlier, deals with only the 91.8 percent of the GA aircraft for which avionics information is available. Other FAA publications, such as General Aviation: Aircraft, Owner and Utilization Characteristics, are based on those fractions of the GA fleet selected to participate in sample surveys. Sample survey results are estimates with bounded errors rather than true population values, introducing another cause for differences in figures between this report and reports based on samples: sampling error. However, results of this report fall within the intervals of estimates found in General Aviation.

[1] Design of an On-Going Statistical Sampling Survey to Collect and Estimate General Aviation Aircraft Activity Measures, Price Waterhouse and Co., (Washington DC, 1976), Exhibit 3.

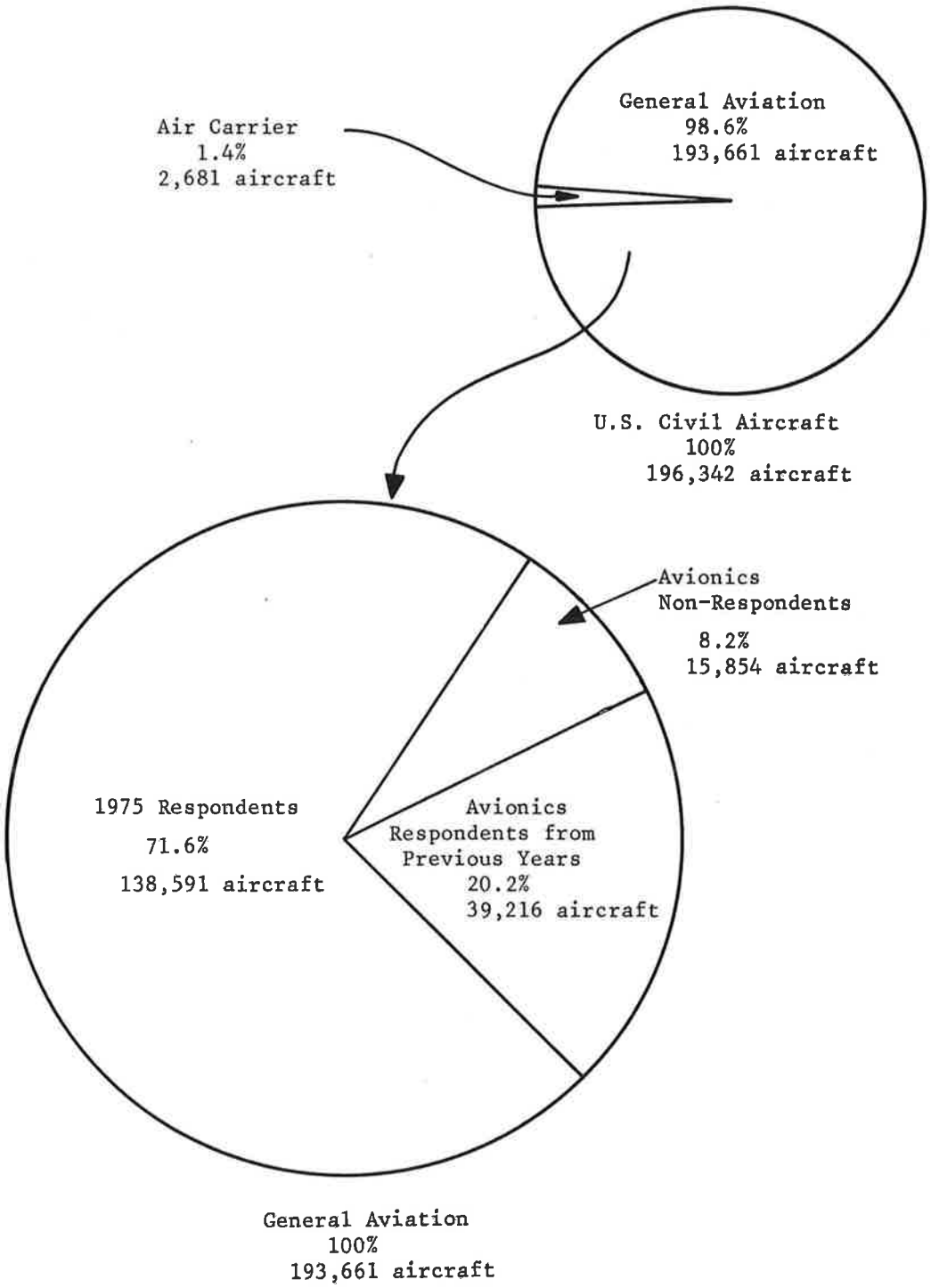


FIGURE 2. COMPOSITION OF THE U.S. CIVIL AIR FLEET
(as of December 31, 1975)

2.2 PROFILE OF GA AVIONICS

Table 1 summarizes the basic avionics data provided by the 1975 ASM File for the analysis of the 1975 GA fleet. It shows the number of aircraft containing each piece of avionics equipment listed on the 8050-73 form. The usefulness of Table 1 is limited because it does not provide the means to determine the number of aircraft containing important groups of equipment, but deals solely with individual types of equipment. For example, one cannot determine the number of aircraft with all three components of an instrument landing system (ILS): localizer, glide slope, and marker beacon receivers. Thus the capability groups, discussed below, were developed to make the study of groups of avionics equipment possible.

2.3 AVIONICS CAPABILITY GROUPS

2.3.1 Function of Capability Groups

Avionics capability groups (CG's) are the means through which significant groups of avionics equipment are associated with aircraft capability to perform in the NAS. The word "capability" takes on a number of meanings in conjunction with the NAS. It can refer to where an aircraft can fly, at what airports it can land, under what flying conditions it can fly, or to what extent it can participate in the air route, landing, and communications systems. Avionics equipment is installed in an aircraft because of the capabilities gained from it; consequently, one should be able to identify an aircraft's general potential capabilities from knowledge of its avionics equipment configuration. Often several pieces of equipment are required to obtain a certain capability in the NAS; it thus becomes necessary to study groups of avionics, rather than individual pieces. The CG definitions are designed to provide the link between groups of avionics equipment and capabilities. In addition, the GC's provide a framework within which other aspects of the GA fleet can be examined.

2.3.2 Assumptions

Several assumptions must be made in order to simplify the process of designing the groups and to minimize the number of groups needed. First, it is assumed that an aircraft's avionics equipment defines its capability to perform in the NAS. In actuality, an aircraft's engine size and power, pilot's certification, lack of cabin pressurization, or lack of other types of required equipment may prevent the aircraft from performing at its highest capability level according to its avionics configuration. Second, the capability groups are based on regulations and equipment requirements for the majority of general aviation aircraft. There may be exceptions to the avionics needed for certain capabilities depending on the use of the aircraft, the model of the aircraft, and the pilot's skill at maximizing the capabilities that his avionics equipment gives him. Third, it is assumed that

TABLE 1. BASIC AVIONICS DATA FOR 1975 GA FLEET*

VHF Communications Equipment	No. of Aircraft
VHF Receiver Capability	
Tuner	74,698
180 channels or less	53,417
181 channels or more	93,517
VHF Transmitter Capability	
20 channels or less	14,279
21 thru 180 channels	47,546
181 channels or more	88,034
ILS Reception Capability	
Localizer	92,894
Glide slope	52,830
Marker beacon	76,918
Transponder Equipment	
64 code	5,567
4096 code	75,887
Altitude reporting	24,623
Navigation Equipment	
VOR receiver	
One	59,299
More than one	83,410
Distance measuring equipment (DME)	36,496
Automatic direction finder (ADF)	79,793
Weather radar	8,765
Approved area navigation equipment (RNAV) Advisory Circular 90-45	12,967

*Based on 177,807 aircraft for which avionics information was available.

area navigation (RNAV) equipment[1] on GA aircraft is comprised of VOR/DME-based course line computers rather than inertial or Doppler systems, since as of January 1, 1975, fewer than 0.5 percent of GA aircraft contained the self-contained type of RNAV equipment.[2] Thus, RNAV equipment is considered to comply with FAA requirements for both VOR equipment and distance measuring equipment (DME).

2.3.3 Methodology

Two classifcations of capability groups evolved: the first type consisted of avionics equipment meeting FAA requirements for use of the various aspects of the NAS; the second type was avionics equipment which gave an aircraft additional capability, but which was not required equipment according to FAA regulations. These two types of equipment necessitated the formation of two types of CG's.

To form the first type of CG, three sets of avionics requirements were obtained: one for flight in different segments of the airspace, another for flight in different flying conditions, and the third for landing at different airports. The three sets of requirements were combined into one set of avionics requirements dealing with the above three aspects of the NAS simultaneously. These combined requirements formed the basis for the first type of capability group. They were augmented by miscellaneous requirements for helicopters, air taxis, and gliders.

The formation of the second type of CG was a simpler task. It involved grouping component pieces of avionics equipment which together would form a complete avionics system for enabling an aircraft to make full use of a landing, communications, or navigation system in the NAS. However, except for the instrument landing system (ILS), it was found that an aircraft can gain full use of a system in the NAS by installing only one piece of airborne avionics equipment. Consequently, the second type of CG consists mainly of "groups" containing one piece of equipment each.

2.3.4 Definition of Capability Groups

Definitions of the two types of CG's mentioned above, known as hierarchical and non-hierarchical CG's respectively, are given below in terms of the avionics equipment found in AC Form 8050-73. A glossary at the end of this report explains the numerous terms relating to avionics equipment and the NAS found in the definitions below. Appendix B shows the various segments of the airspace and the regulations pertaining to the airspace, airports, and flying conditions.

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[1] See the Glossary for definitions of area navigation equipment and other technical terms.

[2] Avionics Installation Navigation and Communication Report, FAA/AEM.

2.3.4.1 Hierarchical CG's

The FAA has established airborne avionics equipment requirements for aircraft use of the various segments of the NAS. In this regulatory sense, an aircraft's avionics equipment determines its capabilities to perform in areas of the NAS. FAA regulations deal with three basic capabilities: (1) to fly in different segments of the airspace, (2) to fly in visual flight rules (VFR) and instrument flight rules (IFR) flying conditions, and (3) to land at different classes of airports. In the formation of CG's of avionics equipment which relate to these three capabilities, the groups take on a hierarchical nature, that is, there is an order to the groups. In general, the avionics equipment and the associated capabilities for one capability group are a subset of the avionics equipment and the associated capabilities for the next higher group.

These groups have the additional properties that they are mutually exclusive and exhaustive. When assigning individual aircraft to CG's, mutual exclusiveness means that an aircraft can be assigned to only one group. Exhaustiveness means that every aircraft will fall into a group.

Table 2 describes the hierarchical CG's in terms of avionics equipment and capabilities. The capabilities described represent the highest level at which an aircraft has avionics potential to participate in the NAS. Generally, an aircraft can also participate at all lower levels. Each group of equipment below is described in terms of (1) airspace capability, (2) flying condition capability, and (3) airport capability. Exceptions to airport and airspace capabilities are noted for helicopter and glider operations, respectively.

Figure 3 is a schematic diagram of the hierarchical capability groups, which summarizes the relationship of three types of aircraft capabilities to their required avionics equipment, namely flying conditions, airspace, and airport capabilities. In the diagram, the capabilities increase from top to bottom. To determine the capability associated with a particular avionics box, simply position the box relative to the lines of the capability of interest.

2.3.4.2 Non-Hierarchical CG's

Many kinds of avionics equipment exist which give an aircraft additional capabilities to the three types discussed in the previous section. Whereas the latter capabilities are derived from regulatory considerations, those to be discussed in this section are based on engineering and safety considerations. The avionics CG's of this section have none of the properties of the

TABLE 2. HIERARCHICAL CAPABILITY GROUPS

AVIONICS		CAPABILITIES
Group 1 No regulatory avionics	(1)	Up to and including 12,500 feet mean sea level (MSL) Gliders...Up to and including 18,000 feet MSL ADF...Colored airways below 12,500 feet MSL VOR or RNAV...VOR airways below 12,500 feet MSL RNAV...Low altitude RNAV airways below 12,500 feet MSL
	(2)	VFR flight, day and night
	(3)	Uncontrolled airports
Group 2 Two-way communications	(1)	Up to and including 12,500 feet MSL Gliders...Up to and including 18,000 feet MSL
	(2)	VFR flight, day and night
	(3)	Non-TCA controlled airports Group III TCA's Helicopters with 4096 code transponders...Group II TCA's All helicopters...Group I and II TCA's below 1000 feet above ground level (AGL)
Group 3 Two-way communications VOR or Automatic Direction Finder (ADF) or RNAV	(1)	Up to and including 12,500 feet MSL Gliders...Up to and including 18,000 feet MSL ADF...Colored airways below 12,500 feet MSL VOR or RNAV...VOR airways below 12,500 feet MSL RNAV...Low altitude RNAV airways below 12,500 feet MSL
	(2)	IFR flight

TABLE 2. HIERARCHICAL CAPABILITY GROUPS (CONTINUED)

AVIONICS		CAPABILITIES
	(3)	Non-TCA controlled airways Group III TCA's Helicopters with 4096 code transponders...Group II TCA's All helicopters...Group I and II TCA's below 1000 feet AGL
Group 4 Two-way communications 4096 code transponder VOR or RNAV	(1)	Up to and including 12,500 feel MSL Gliders...Up to and including 18,000 feet MSL VOR airways below 12,500 feet MSL RNAV...Low altitude RNAV airways below 12,500 feet MSL
	(2)	IFR flight
	(3)	Non-TCA controlled airports Group II TCA's Helicopters...Group I TCA's below 1000 feet AGL
Group 5 4096 code transponder Altitude encoding equipment	(1)	Non-positive controlled airspace
	(2)	VFR flight, day and night
	(3)	Uncontrolled airports Group III TCA's
Group 6 Two-way communications 4096 code transponder Altitude encoding equipment	(1)	Non-positive controlled airspace
	(2)	VFR flight, day and night
	(3)	Non-TCA controlled airports Group III TCA's Helicopters...Group I TCA's
Group 7 Two-way communications 4096 code transponder Altitude encoding equipment VOR	(1)	Non-positive controlled airspace VOR airways
	(2)	IFR flight

TABLE 2. HIERARCHICAL CAPABILITY GROUPS (CONTINUED)

AVIONICS		CAPABILITIES
	(3)	Group I TCA's
Group 8 Two-way communications 4096 code transponder Altitude encoding equipment VOR } or RNAV DME }	(1)	Positive controlled airspace Jet routes RNAV...RNAV routes
	(2)	IFR flight
	(3)	Group I TCA's

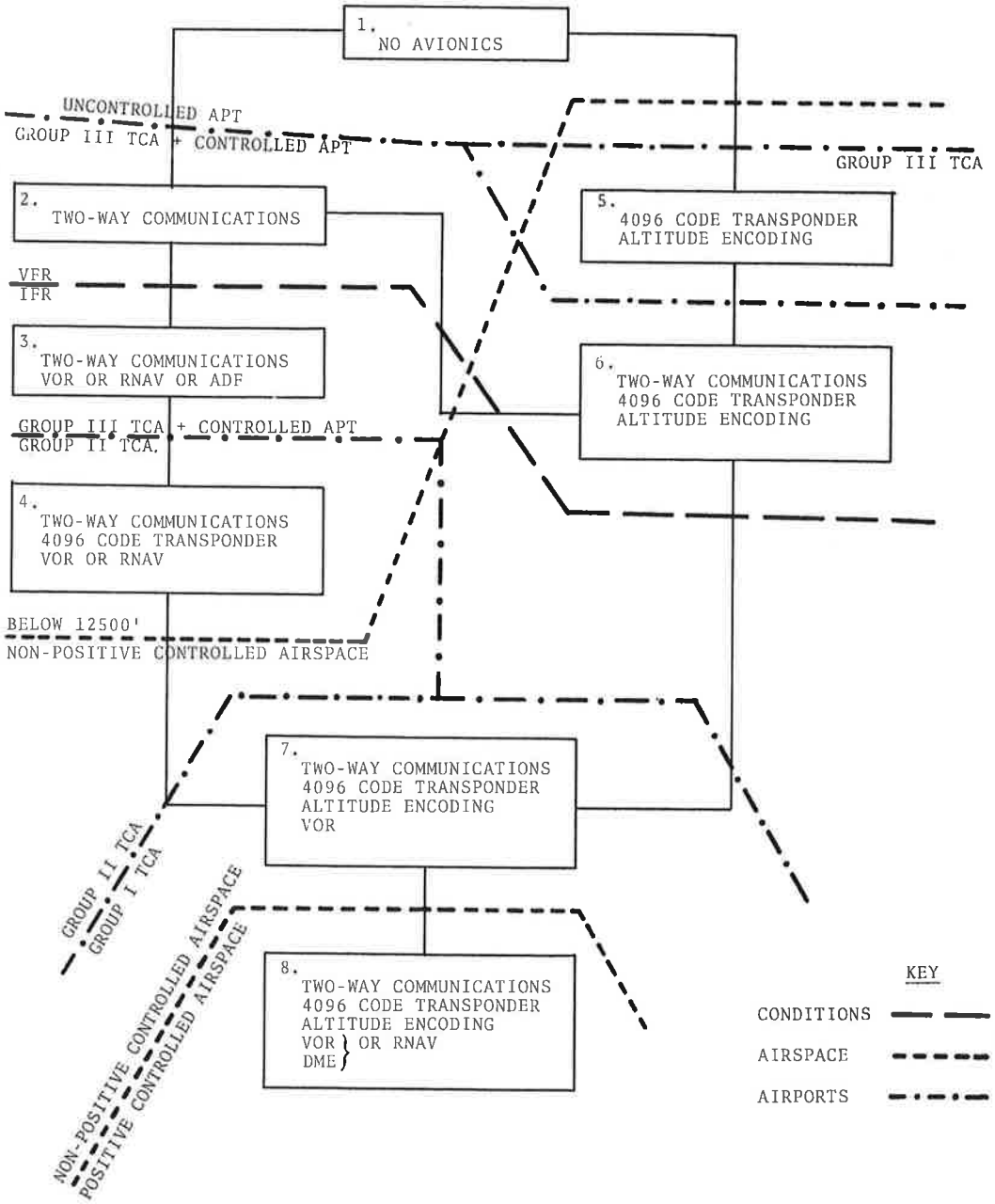


FIGURE 3. HIERARCHICAL CAPABILITY GROUPS (CG'S)

previous groups. That is, they are not hierarchical in nature, nor are they mutually exclusive and exhaustive. The CG's are described below in Table 3 in terms of the avionics equipment and associated capabilities.

TABLE 3. NON-HIERARCHICAL CAPABILITY GROUPS

AVIONICS	CAPABILITIES
Group 1	
Localizer	Partial use of ILS at airports.
Group 2	
Localizer Marker Beacon	Partial use of ILS at airports.
Group 3	
Localizer Marker Beacon Glide Slope	Full use of ILS at airports.
Group 4	
RNAV	Area navigation capability.
Group 5	
Weather Radar	Detection of storms in aircraft's route.

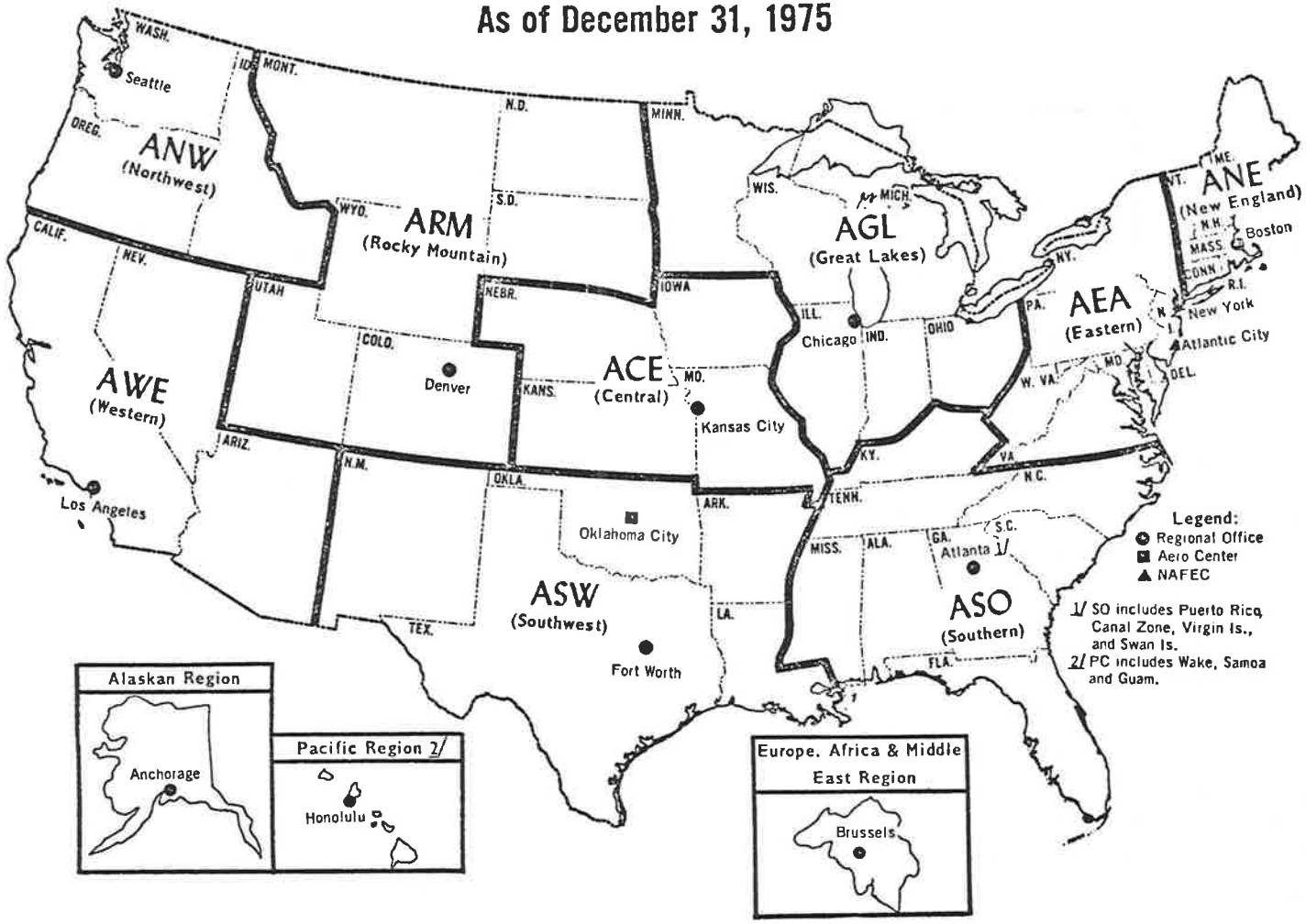
2.4 DESCRIPTION OF AIRCRAFT CHARACTERISTICS

Nine aircraft characteristics were available on the 1974 ASM File for analysis in the framework of the newly developed CG's. They are listed below with appropriate comment.

a. Primary use of aircraft during 1975.

b. Base airport region: See Figure 4 for an FAA regional map.

c. Hours flown during 1975: This variable was discretized into 50-hour intervals for easier reporting.



FAA Air Traffic Activity Calendar Year 1975, (March, 1975), p. 10.

FIGURE 4. FEDERAL AVIATION ADMINISTRATION REGIONAL MAP

d. Age of aircraft in 1975: This variable was discretized into 5-year intervals for easier reporting.

e. Computed aircraft type: The 13 computed aircraft types listed in Table 4 combine the four aircraft characteristics of engine type, number of engines, aircraft type (simple), and number of seats into meaningful combinations for the GA fleet.

f. Aircraft type (simple).

g. Engine type.

h. Number of engines.

i. Number of seats.

TABLE 4. COMPUTED AIRCRAFT TYPES

TYPE	DESCRIPTION
1.	Fixed wing single engine piston 1-3 seats
2.	Fixed wing single engine piston 4+ seats
3.	Fixed wing two engine piston 1-6 seats
4.	Fixed wing two engine piston 7+ seats
5.	Fixed wing piston other
6.	Fixed wing two engine turboprop 1-12 seats
7.	Fixed wing two engine turboprop 13+ seats
8.	Fixed wing turboprop other
9.	Fixed wing two engine turbojet
10.	Fixed wing turbojet other
11.	Rotorcraft piston
12.	Rotorcraft turbine
13.	Other aircraft

3. RESULTS

3.1 NON-HIERARCHICAL VERSUS HIERARCHICAL CAPABILITY GROUPS (CG'S)

Table 5 presents the distribution of the 177,807 reporting GA aircraft among the hierarchical and non-hierarchical CG's. Hierarchical CG's vary across the columns and non-hierarchical CG's vary across the rows, each beginning with the least sophisticated CG in the upper left hand corner of the table. Entries in the table are aircraft counts.

Examination of Table 5 reveals the following observations on the reporting GA fleet.

3.1.1 Hierarchical CG's

a. Only about 11 percent of these aircraft have the avionics equipment enabling them to fly above 18,000 feet in positive controlled airspace. In fact, over 86 percent of the reporting GA fleet cannot fly above 12,500 feet due to avionics limitations alone.

b. Almost 80 percent of these aircraft are equipped to fly IFR.

c. 16 percent of the reporting GA fleet are limited to landing at uncontrolled airports. Approximately 41 percent can land at either uncontrolled airports or Group III TCA's. Approximately 29 percent can land at any type of airport except a Group I TCA. Only about 14 percent can land at Group I TCA's.

d. Hierarchical CG's 5 and 6 together contain only 0.14 percent of the reporting GA fleet. Examination of the avionics equipment associated with these groups reveals that both include transponder equipment, but neither includes navigation equipment. One includes two-way communications. This suggests that the reason for the small number of aircraft in these groups and the comparatively large number in the remaining groups is that the most common path of acquisition of avionics equipment proceeds from communications to navigation to transponder equipment.

3.1.2 Non-Hierarchical CG's

a. At least 52 percent of the reporting GA fleet have some degree of ILS receiving capability.

b. In contrast, only between 7 and 10 percent have at least two of the three most sophisticated avionics systems (complete ILS receivers, weather radar, area navigation).

c. Only 0.5 percent of the reporting aircraft fall into the non-heirarchical CG "Localizer and Glide Slope" (L,G). This would suggest that the most common pattern in acquiring ILS equipment is to begin with a localizer, then add marker beacon equipment, and finally add a glide slope receiver.

In general, it appears that those aircraft in the least sophisticated non-hierarchical CG's also comprise the bulk of the least sophisticated hierarchical CG's. Of the 81,406 aircraft possessing none of the non-hierarchical CG equipment (ie. the NG group), 73,981 fall into hierarchical CG's 1, 2 and 3 and represent 73 percent of these three CG's. Conversely, those aircraft in the most sophisticated non-hierarchical CG's are also in the most sophisticated hierarchical CG's. For example, 90 percent of the aircraft possessing a complete ILS, weather radar and area navigation system fall into hierarchical CG 8.

Figures 5, 6, and 7 illustrate the changes which occurred to the hierarchical CG's from 1974 to 1975. Figure 5 provides a simple comparison of the major hierarchical CG sizes from 1974 to 1975 and also enables one to gauge the group sizes relative to each other. It is evident from this figure that groups 3 and 4 comprise more than half of the reporting GA aircraft.

Figure 6 shows the absolute changes in group sizes from 1974 to 1975. By far, the largest growth in number of aircraft occurred in group 8, the highest level hierarchical CG, with group 7 second largest in growth.

Figure 7 presents the normalized[1] growth of the CG's relative to the growth of the fleet as a whole. Normalization allows one to observe clearly changes in group sizes which are significantly greater or lesser than what would be expected if each CG grew evenly with the overall fleet. From 1974 to 1975, the reporting GA fleet increased 5.2 percent from 169,030 aircraft to 177,797 aircraft. Figure 7 shows that CG1 grew slightly faster than the fleet as a whole; CG2 grew at the same rate as the overall fleet; CG3 lost ground; CG4, while increasing slightly in absolute number of aircraft, grew at a lower rate than the fleet as a whole; CG's 7 and 8 experienced a rate of growth that far overshadowed that of the total reporting GA fleet. The implication is that the higher order CG's are acquiring increasing importance in the GA fleet as a result of both new aircraft coming equipped with sophisticated avionics and older aircraft upgrading their avionics configurations.

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[1] Each CG is normalized by the formula below:

$$\left(\frac{\text{no. aircraft in CG in 1975}}{\text{no. reporting aircraft in 1975}}\right) \div \left(\frac{\text{no. aircraft in CG in 1974}}{\text{no. reporting aircraft in 1974}}\right)$$

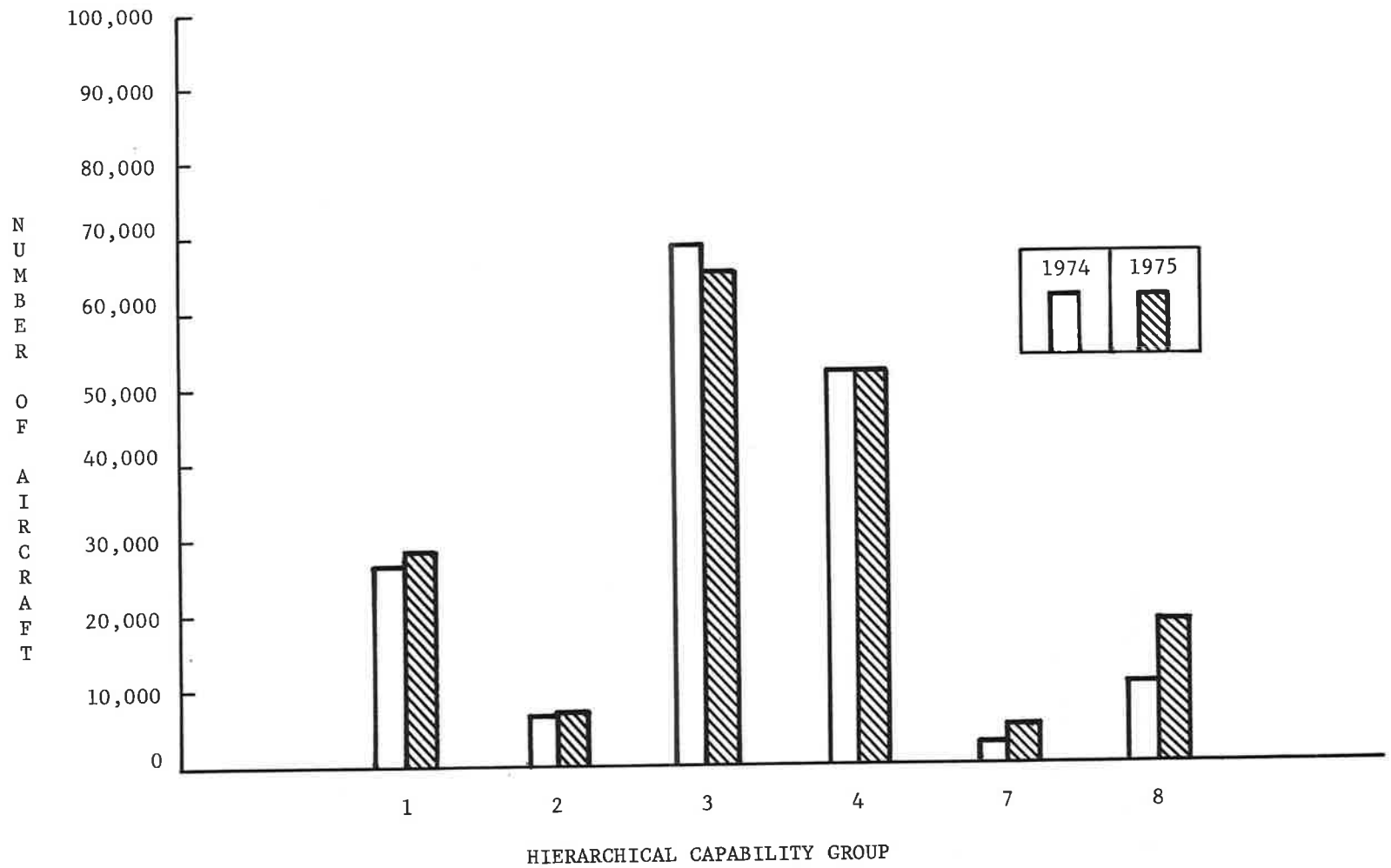


FIGURE 5. A COMPARISON OF HIERARCHICAL GROUP SIZES FROM 1974 TO 1975

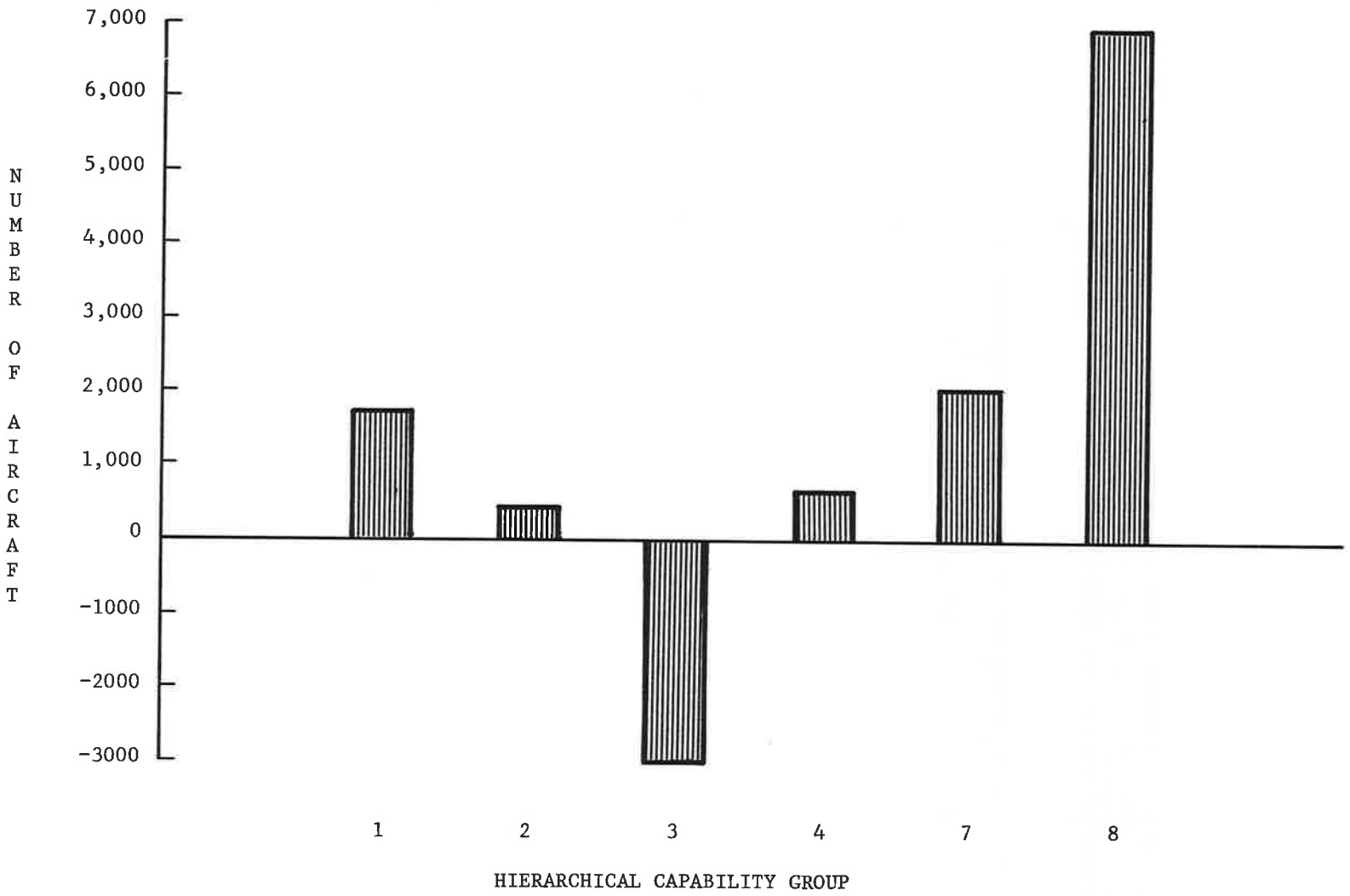


FIGURE 6. ABSOLUTE CHANGE IN HIERARCHICAL GROUP SIZE FROM 1974 TO 1975

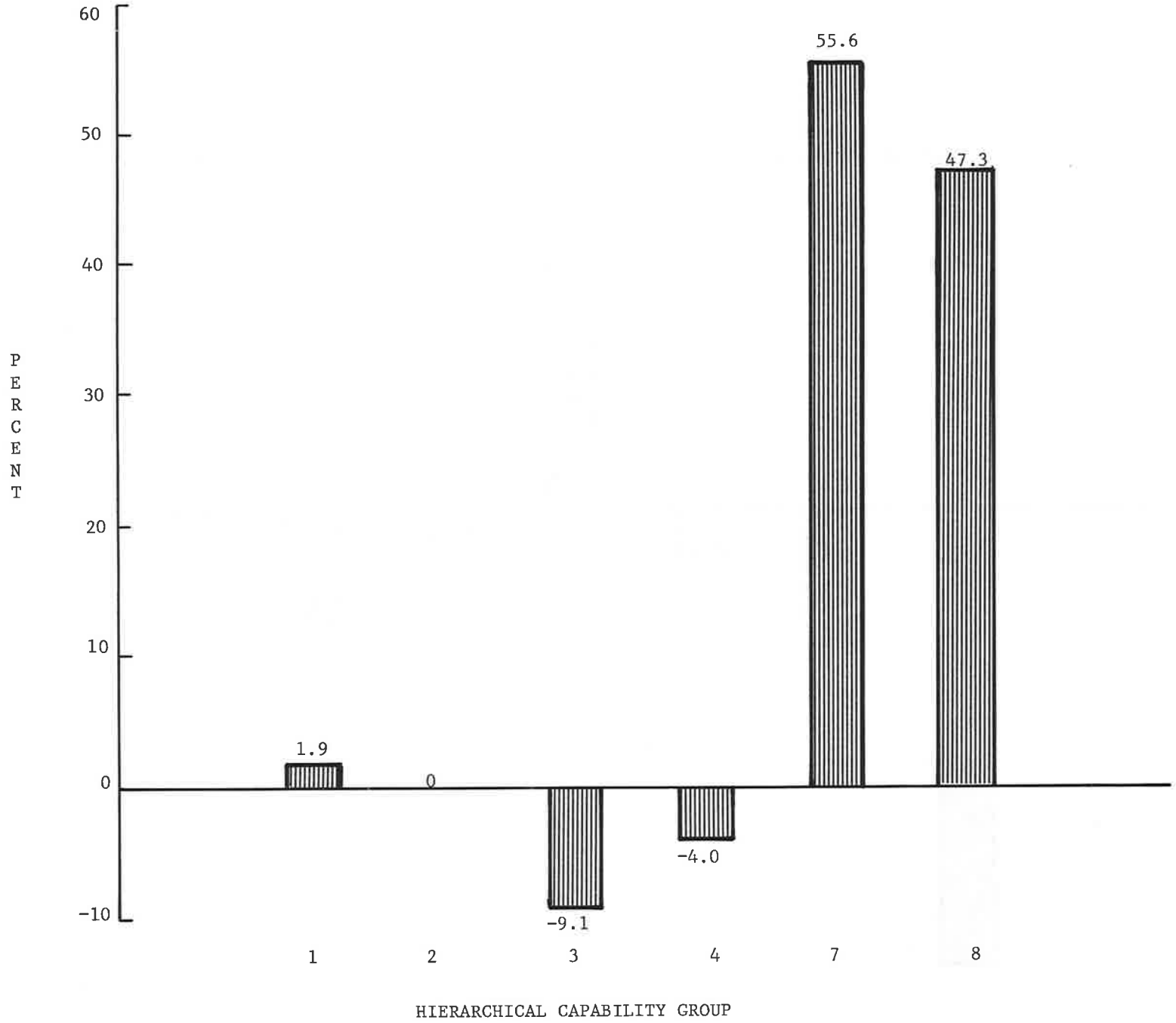


FIGURE 7. NORMALIZED GROWTH IN HIERARCHICAL GROUP SIZE FROM 1974 TO 1975

Figures 8, 9, and 10 illustrate the changes occurring to to the non-hierarchical CG's from 1974 to 1975. A study of the three figures reveals the same trend toward sophistication in avionics exhibited by the hierarchical CG's. Although the non-grouped aircraft (NG) still outnumber the other non-hierarchical CG's, their growth from 1974 to 1975 lagged behind the growth of the reporting GA fleet as a whole. Many of the non-hierarchical CG's grew significantly faster than the total GA fleet. They include the complete ILS (LMG), area navigation (RNAV), weather radar (WRAD), and combination (IR, ALL) groups. While these CG's except for LMG, are the smallest non-hierarchical CG's, their growth nevertheless is indicative of the increasing willingness of GA aircraft owners to invest in sophisticated avionics equipment and to benefit from the resulting additional capabilities.

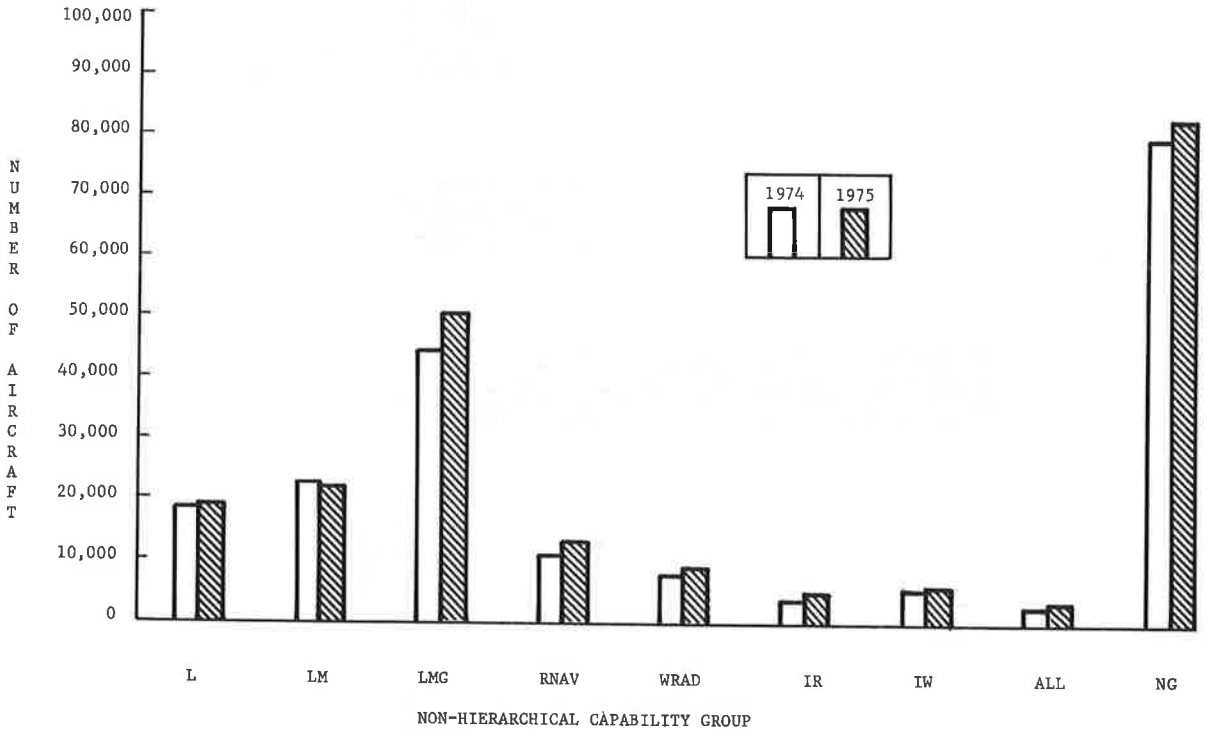


FIGURE 8. A COMPARISON OF NON-HIERARCHICAL GROUP SIZES FROM 1974 to 1975

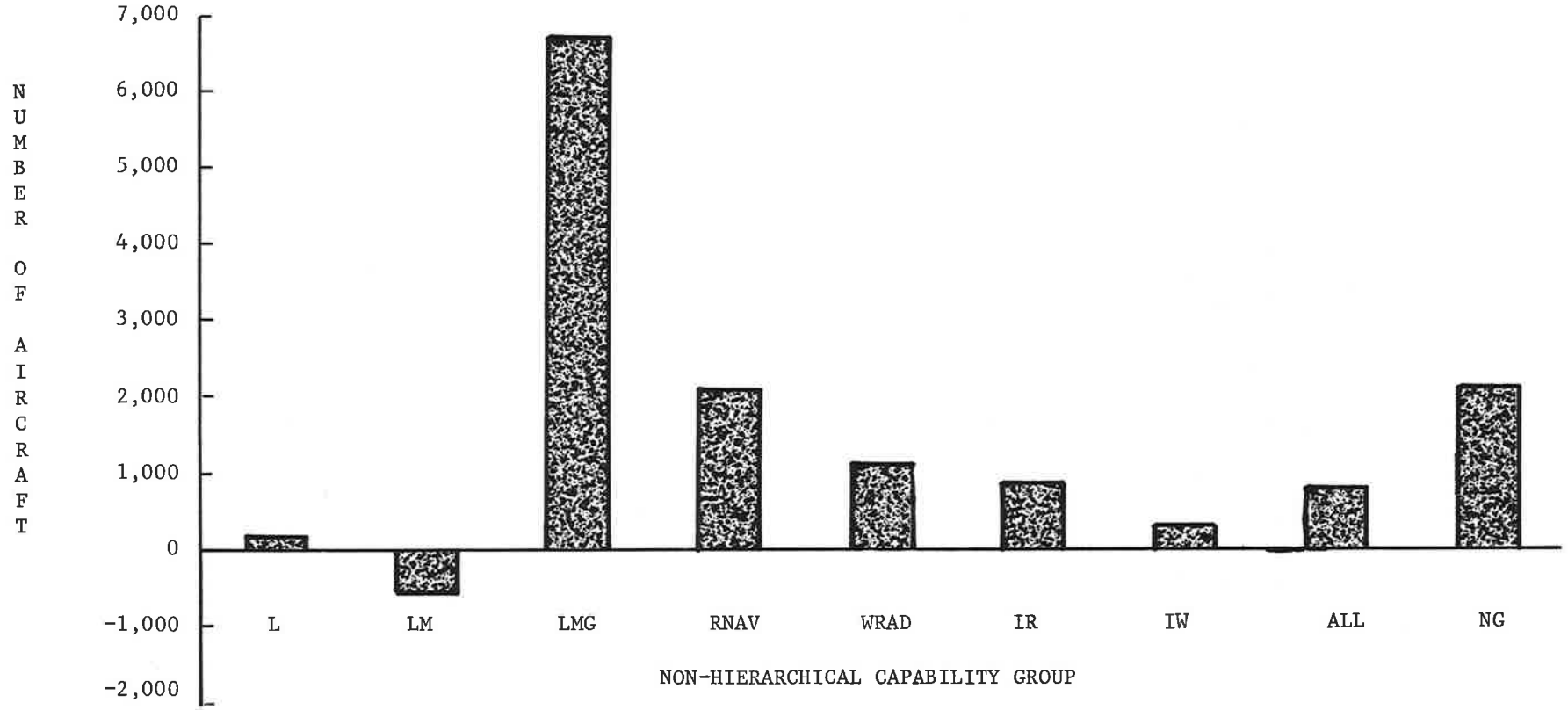


FIGURE 9. ABSOLUTE CHANGE IN NON-HIERARCHICAL GROUP SIZE FROM 1974 TO 1975

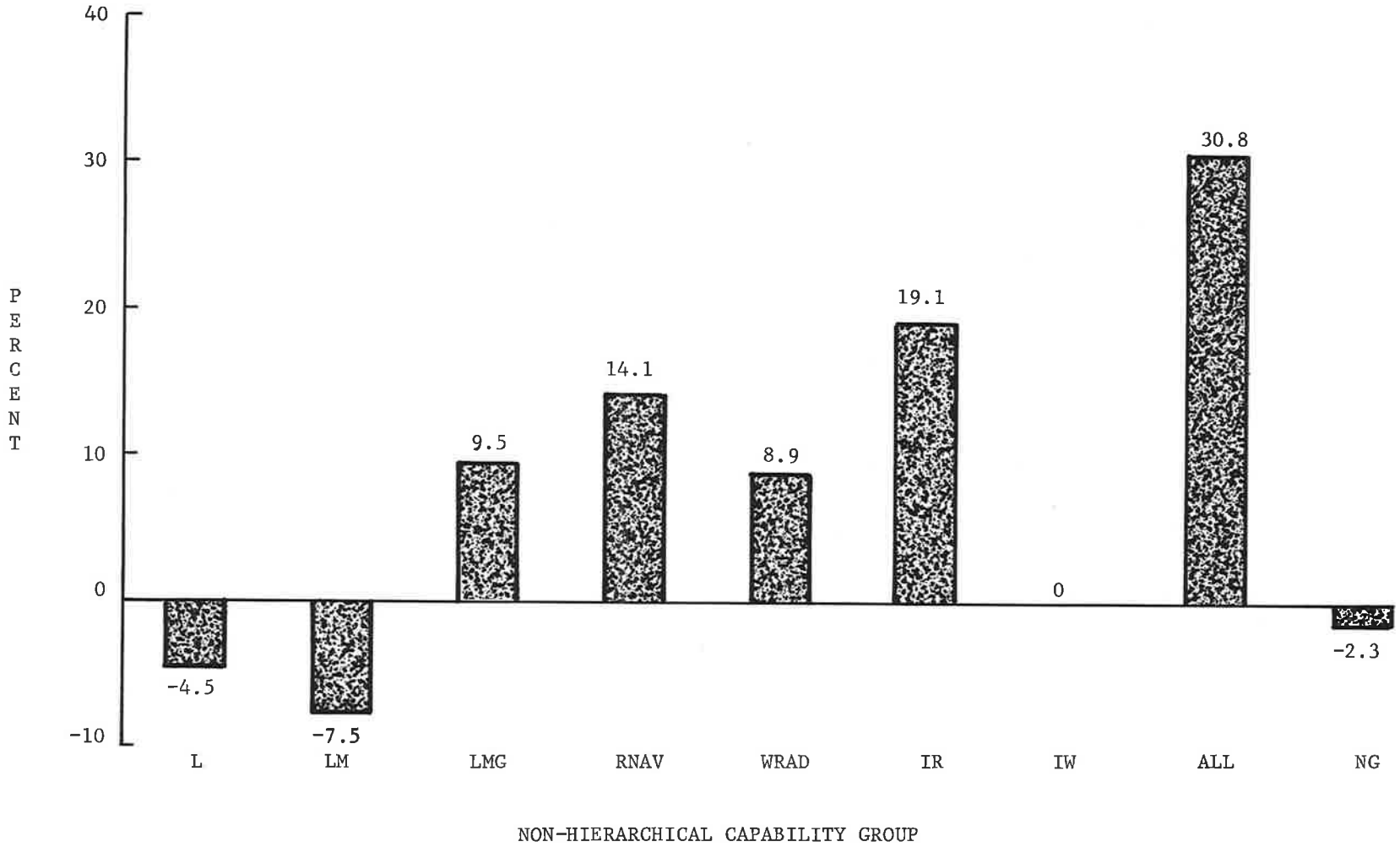


FIGURE 10. NORMALIZED GROWTH IN NON-HIERARCHICAL GROUP SIZE FROM 1974 TO 1975

3.2 CHARACTERISTICS OF CAPABILITY GROUPS (CG'S)

Tables 6 through 23 show three numbers in each cell. The first is the number of aircraft falling into the particular capability group-category combination represented by the cell. The second number is the percent of the row or category that the number of aircraft represents. The third number is the percent of the column or capability group that the number of aircraft represents.

The key appearing at the bottom of each table gives avionics associated with the CG's. Hierarchical group reports are additive across the columns as these groups are mutually exclusive. The numbers in the right-hand columns of the non-hierarchical group reports are the marginal distributions of the GA fleet across the categories, but are not row totals since non-hierarchical CG's are not mutually exclusive.

3.2.1 Characteristics of Hierarchical CG's

As mentioned in the discussion of Table 5, there was significant growth in hierarchical CG's 7 and 8 from 1974 to 1975, attributable to both upgrading avionics systems in pre-1975 aircraft and installing complex avionics equipment in new aircraft. Tables 6 through 14 and Figures 11 through 16 show the kinds of aircraft exhibiting these changes and present other characteristics of the GA fleet.

Generally, those aircraft in low order CG's have less sophisticated characteristics than those aircraft in higher order CG's as follows:

a. As the hierarchical CG's increase in sophistication, the predominant uses also grow in sophistication from personal, to business and personal, to executive, business and personal (Table 6, Figures 11 and 12).

b. Similarly, the computed aircraft type, as well as the four individual characteristics which are combined to form computed aircraft type (simple aircraft type, engine type, number of engines, number of seats), become progressively more sophisticated moving from low to high order CG's (Tables 10 through 14, Figures 15 and 16).

c. Aircraft containing more avionics equipment and capabilities are flown more hours than those with smaller investments in avionics equipment (Table 8, Figure 13).

d. Higher order CG's contain newer aircraft on the average than lower order CG's (Table 9, Figure 14).

A comparison of the 1975 tables with the 1974 tables reveals the following characteristics of the aircraft responsible for the growth in hierarchical CG's 7 and 8:

a. The main primary uses of aircraft shifting into CG's 7 and 8 were executive, business and air taxi. For example, in 1974, 63 percent of executive aircraft fell into CG's 7 and 8; in 1975 the number increased to over 75 percent (Table 6).

b. All regions exhibited increases in avionics sophistication; however, this increase was smallest in the Alaskan, Pacific and New England regions (Table 7).

c. The aircraft flown more than 150 hours during 1975 made the largest contribution to the surge in CG's 7 and 8. The aircraft not flown or flown fewer than 150 hours exhibited little or no change in distribution across CG's from 1974 (Table 8).

d. The largest growth by far in CG's 7 and 8 was exhibited by planes in the 0 to 4 year age category, indicating that new planes are being more fully equipped with avionics than at any time in the past. CG8 contained 12 percent of planes 0 to 4 years old in 1974. In 1975 this number increased to 18 percent. A comparatively smaller proportion of aircraft in the 5 to 19 years age category had their avionics equipment upgraded while aircraft 20 years and older exhibited no changes (Table 9).

e. The main aircraft types shifting into CG's 7 and 8 were fixed wing twin engine piston aircraft with 1-6 seats and 7 or more seats. Whereas in 1974, 30 and 35 percent, respectively of these two groups fell into CG8, in 1975 46 and 50 percent fell into CG8. Other aircraft types exhibited little or no changes (Table 10).

TABLE 6. HIERARCHICAL GROUPS - PRIMARY USE VS. CAPABILITY GROUP

	1	2	3	4	5	6	7	8	SUM
EXECUTIVE	75	74	340	1127	15	2	139	4888	6660
ROW %	1.13	1.11	5.11	16.92	0.23	0.03	2.09	73.39	
COLUMN %	0.26	1.01	0.52	2.18	7.98	3.45	2.77	25.26	3.75
BUSINESS	755	326	6106	10742	40	12	1313	5935	25229
ROW %	2.99	1.29	24.20	42.58	0.16	0.05	5.20	23.52	
COLUMN %	2.66	4.44	9.30	20.74	21.28	20.69	26.12	30.67	14.19
PERSONAL	7479	2374	26413	18081	47	10	1689	2694	58787
ROW %	12.72	4.04	44.93	30.76	0.08	0.02	2.87	4.58	
COLUMN %	26.33	32.34	40.23	34.91	25.00	17.24	33.60	13.92	33.06
AERIAL APPLICATION	3072	434	328	136	9	1	27	42	4049
ROW %	75.87	10.72	8.10	3.36	0.22	0.02	0.67	1.04	
COLUMN %	10.82	5.91	0.50	0.26	4.79	1.72	0.54	0.22	2.28
INSTRUCTION	417	254	4548	2917	3	1	248	276	8664
ROW %	4.81	2.93	52.49	33.67	0.03	0.01	2.86	3.19	
COLUMN %	1.47	3.46	6.93	5.63	1.60	1.72	4.93	1.43	4.87
AIR TAXI	45	209	869	1423	6	1	244	1571	4368
ROW %	1.03	4.78	19.89	32.58	0.14	0.02	5.59	35.97	
COLUMN %	0.16	2.85	1.32	2.75	3.19	1.72	4.85	8.12	2.46

TABLE 6. HIERARCHICAL GROUPS - PRIMARY USE VS. CAPABILITY GROUP (CONTINUED)

GROUP	1	2	3	4	5	6	7	8	
INDUSTRIAL/SPECIAL	88	347	518	511	1	5	105	172	1747
ROW %	5.04	19.86	29.65	29.25	0.06	0.29	6.01	9.85	
COLUMN %	0.31	4.73	0.79	0.99	0.53	8.62	2.09	0.89	0.98
AIRCRAFT RENTAL BUS.	210	114	1721	2628	3	0	345	363	5384
ROW %	3.90	2.12	31.97	48.81	0.06	0.00	6.41	6.74	
COLUMN %	0.74	1.55	2.62	5.07	1.60	0.00	6.86	1.88	3.03
OTHER	481	303	981	585	6	2	67	340	2765
ROW %	17.40	10.96	35.48	21.16	0.22	0.07	2.42	12.30	
COLUMN %	1.69	4.13	1.49	1.13	3.19	3.45	1.33	1.76	1.56
IMPUTED/NOT REPORTED	15782	2906	23823	13642	58	24	850	3069	60154
ROW %	26.24	4.83	39.60	22.68	0.10	0.04	1.41	5.10	
COLUMN %	55.56	39.59	36.29	26.34	30.85	41.38	16.91	15.86	33.83
TOTALS	28404	7341	65647	51792	188	58	5027	19350	177807
ROW %	15.97	4.13	36.92	29.13	0.11	0.03	2.83	10.88	

KEY

GROUP

1. No regulatory avionics
2. Two-way communications
3. Two-way communications
   VOR or ADF or RNAV
4. Two-way communications
   4096 code transponder
   VOR or RNAV
5. 4096 code transponder
   Altitude encoding equipment
6. Two-way communications
   4096 code transponder
   Altitude encoding equipment
7. Two-way communications
   4096 code transponder
   Altitude encoding equipment
   VOR
8. Two-way communications
   4096 code transponder
   Altitude encoding equipment
   VOR } or RNAV
   DME }

TABLE 7. HIERARCHICAL GROUPS - BASE AIRPORT REGION VS. CAPABILITY GROUP

	1	2	3	4	5	6	7	8	SUM
NEW ENGLAND	1077	281	2461	1695	8	2	309	702	6535
ROW %	16.48	4.30	37.66	25.94	0.12	0.03	4.73	10.74	
COLUMN %	3.79	3.83	3.75	3.27	4.26	3.45	6.15	3.63	3.68
EASTERN	3326	731	7501	6873	23	8	1046	2998	22506
ROW %	14.78	3.25	33.33	30.54	0.10	0.04	4.65	13.32	
COLUMN %	11.71	9.96	11.43	13.27	12.23	13.79	20.81	15.49	12.66
SOUTHERN	3838	935	8711	8116	27	4	628	3395	25654
ROW %	14.96	3.64	33.96	31.64	0.11	0.02	2.45	13.23	
COLUMN %	13.51	12.74	13.27	15.67	14.36	6.90	12.49	17.55	14.43
GREAT LAKES	5555	1036	12800	9902	23	6	778	3656	33756
ROW %	16.46	3.07	37.92	29.33	0.07	0.02	2.30	10.83	
COLUMN %	19.56	14.11	19.50	19.12	12.23	10.34	15.48	18.89	18.98
CENTRAL	2344	290	4805	3694	17	6	250	1253	12659
ROW %	18.52	2.29	37.96	29.18	0.13	0.05	1.97	9.90	
COLUMN %	8.25	3.95	7.32	7.13	9.04	10.34	4.97	6.48	7.12
ROCKY MOUNTAINS	1754	445	3837	2495	15	0	204	763	9513
ROW %	18.44	4.68	40.33	26.23	0.16	0.00	2.14	8.02	
COLUMN %	6.18	6.06	5.84	4.82	7.98	0.00	4.06	3.94	5.35
NORTHWESTERN	1824	658	4303	2809	6	7	216	764	10587
ROW %	17.23	6.22	40.64	26.53	0.06	0.07	2.04	7.22	
COLUMN %	6.42	8.96	6.55	5.42	3.19	12.07	4.30	3.95	5.95

TABLE 7. HIERARCHICAL GROUPS - BASE AIRPORT REGION VS CAPABILITY GROUP (CONTINUED)

GROUP		1	2	3	4	5	6	7	8	
WESTERN		3632	1551	10024	8905	20	16	1036	2564	27748
	ROW %	13.09	5.59	36.13	32.09	0.07	0.06	3.73	9.24	
	COLUMN %	12.79	21.13	15.27	17.19	10.64	27.59	20.61	13.25	15.61
SOUTHWESTERN		4415	874	7892	6744	42	5	522	3118	23612
	ROW %	18.70	3.70	33.42	28.56	0.18	0.02	2.21	13.21	
	COLUMN %	15.54	11.91	12.02	13.02	22.34	8.62	10.38	16.11	13.28
PACIFIC		35	49	209	113	1	1	7	16	431
	ROW %	8.12	11.37	48.49	26.22	0.23	0.23	1.62	3.71	
	COLUMN %	0.12	0.67	0.32	0.22	0.53	1.72	0.14	0.08	0.24
ALASKAN		593	487	2967	390	6	3	25	81	4552
	ROW %	13.03	10.70	65.18	8.57	0.13	0.07	0.55	1.78	
	COLUMN %	2.09	6.63	4.52	0.75	3.19	5.17	0.50	0.42	2.56
FOREIGN		11	4	137	56	0	0	6	40	254
	ROW %	4.33	1.57	53.94	22.05	0.00	0.00	2.36	15.75	
	COLUMN %	0.04	0.05	0.21	0.11	0.00	0.00	0.12	0.21	0.14
TOTALS		28404	7341	65647	51792	188	58	5027	19350	177807
	ROW %	15.97	4.13	36.92	29.13	0.11	0.03	2.83	10.88	

KEY

GROUP
1. No regulatory avionics
2. Two-way communications
3. Two-way communications VOR or ADF or RNAV

GROUP
4. Two-way communications 4096 code transponder VOR or RNAV
5. 4096 code transponder Altitude encoding equipment

GROUP
6. Two-way communications 4096 code transponder Altitude encoding equipment
7. Two-way communications 4096 code transponder Altitude encoding equipment VOR

GROUP
8. Two-way communications 4096 code transponder Altitude encoding equipment VOR / DME } or RNAV

TABLE 8. HIERARCHICAL GROUPS - HOURS FLOWN VS. CAPABILITY GROUP

	1	2	3	4	5	6	7	8	SUM
1 - 49	5425	1480	11994	4233	30	13	346	839	24360
ROW %	22.27	6.08	49.24	17.38	0.12	0.05	1.42	3.44	
COLUMN %	19.10	20.16	18.27	8.17	15.96	22.41	6.88	4.34	13.70
50 - 99	2706	979	11145	7867	20	6	722	1595	25040
ROW %	10.81	3.91	44.51	31.42	0.08	0.02	2.88	6.37	
COLUMN %	9.53	13.34	16.98	15.19	10.64	10.34	14.36	8.24	14.08
100 - 149	1205	541	6397	7813	16	3	856	2235	19066
ROW %	6.32	2.84	33.55	40.98	0.08	0.02	4.49	11.72	
COLUMN %	4.24	7.37	9.74	15.09	8.51	5.17	17.03	11.55	10.72
150 - 199	576	254	2780	4618	12	2	553	1956	10751
ROW %	5.36	2.36	25.86	42.95	0.11	0.02	5.14	18.19	
COLUMN %	2.03	3.46	4.23	8.92	6.38	3.45	11.00	10.11	6.05
200 - 249	617	230	2089	3566	8	0	458	1977	8945
ROW %	6.90	2.57	23.35	39.87	0.09	0.00	5.12	22.10	
COLUMN %	2.17	3.13	3.18	6.89	4.26	0.00	9.11	10.22	5.03
250 - 299	389	142	1045	1987	4	1	261	1433	5262
ROW %	7.39	2.70	19.86	37.76	0.08	0.02	4.96	27.23	
COLUMN %	1.37	1.93	1.59	3.84	2.13	1.72	5.19	7.41	2.96
300 - 349	410	150	1095	1771	11	3	244	1395	5079
ROW %	8.07	2.95	21.56	34.87	0.22	0.06	4.80	27.47	
COLUMN %	1.44	2.04	1.67	3.42	5.85	5.17	4.85	7.21	2.86

TABLE 8. HIERARCHICAL GROUPS - HOURS FLOWN VS. CAPABILITY GROUP (CONTINUED)

GROUP		1	2	3	4	5	6	7	8	
350 - 399		225	81	578	991	6	0	113	879	2873
	ROW %	7.83	2.82	20.12	34.49	0.21	0.00	3.93	30.60	
	COLUMN %	0.79	1.10	0.88	1.91	3.19	0.00	2.25	4.54	1.62
400 - 449		294	87	722	1008	7	0	134	852	3104
	ROW %	9.47	2.80	23.26	32.47	0.23	0.00	4.32	27.45	
	COLUMN %	1.04	1.19	1.10	1.95	3.72	0.00	2.67	4.40	1.75
450 - UP		775	491	3979	4296	16	6	490	3120	13173
	ROW %	5.88	3.73	30.21	32.61	0.12	0.05	3.72	23.68	
	COLUMN %	2.73	6.69	6.06	8.29	8.51	10.34	9.75	16.12	7.41
NOT FLOWN		9182	1060	4355	702	11	4	59	148	15521
	ROW %	59.16	6.83	28.06	4.52	0.07	0.03	0.38	0.95	
	COLUMN %	32.33	14.44	6.63	1.36	5.85	6.90	1.17	0.76	8.73
IMPUTED HOURS		6600	1846	19468	12940	47	20	791	2921	44633
	ROW %	14.79	4.14	43.62	28.99	0.11	0.04	1.77	6.54	
	COLUMN %	23.24	25.15	29.66	24.98	25.00	34.48	15.74	15.10	25.10
TOTALS		28404	7341	65647	51792	188	58	5027	19350	177807
	ROW %	15.97	4.13	36.92	29.13	0.11	0.03	2.83	10.88	

KEY

GROUP
1. No regulatory avionics
2. Two-way communications
3. Two-way communications VOR or ADF or RNAV

GROUP
4. Two-way communications 4096 code transponder VOR or RNAV
5. 4096 code transponder Altitude encoding equipment

GROUP
6. Two-way communications 4096 code transponder Altitude encoding equipment
7. Two-way communications 4096 code transponder Altitude encoding equipment VOR

GROUP
8. Two-way communications 4096 code transponder Altitude encoding equipment VOR / DME } or RNAV

TABLE 9. HIERARCHICAL GROUPS - AGE OF AIRCRAFT VS. CAPABILITY GROUP

	1	2	3	4	5	6	7	8	SUM
0 - 4 YEARS	3666	1330	7910	11986	77	29	1322	6024	32344
ROW %	11.33	4.11	24.46	37.06	0.24	0.09	4.09	18.62	
COLUMN %	12.91	18.12	12.05	23.14	40.96	50.00	26.30	31.13	18.19
5 - 9 YEARS	2653	1284	15290	15191	23	9	1455	6278	42183
ROW %	6.29	3.04	36.25	36.01	0.05	0.02	3.45	14.88	
COLUMN %	9.34	17.49	23.29	29.33	12.23	15.52	28.94	32.44	23.72
10 - 14 YEARS	1883	872	10935	10666	19	2	884	3164	28425
ROW %	6.62	3.07	38.47	37.52	0.07	0.01	3.11	11.13	
COLUMN %	6.63	11.88	16.66	20.59	10.11	3.45	17.59	16.35	15.99
15 - 19 YEARS	1326	576	10530	6937	8	4	666	1328	21375
ROW %	6.20	2.69	49.26	32.45	0.04	0.02	3.12	6.21	
COLUMN %	4.67	7.85	16.04	13.39	4.26	6.90	13.25	6.86	12.02
20 - 24 YEARS	847	362	5305	2314	4	5	250	340	9427
ROW %	8.98	3.84	56.27	24.55	0.04	0.05	2.65	3.61	
COLUMN %	2.98	4.93	8.08	4.47	2.13	8.62	4.97	1.76	5.30
25 - 29 YEARS	8776	1554	11838	1801	34	5	167	177	24352
ROW %	36.04	6.38	48.61	7.40	0.14	0.02	0.69	0.73	
COLUMN %	30.90	21.17	18.03	3.48	18.09	8.62	3.32	0.91	13.70

TABLE 9. HIERARCHICAL GROUPS - AGE OF AIRCRAFT VS. CAPABILITY GROUP (CONTINUED)

		1	2	3	4	5	6	7	8	
30 - 34 YEARS		3504	421	938	356	2	1	31	181	5434
	ROW %	64.48	7.75	17.26	6.55	0.04	0.02	0.57	3.33	
	COLUMN %	12.34	5.73	1.43	0.69	1.06	1.72	0.62	0.94	3.06
35 + YEARS		2480	239	415	75	1	0	9	31	3250
	ROW %	76.31	7.35	12.77	2.31	0.03	0.00	0.28	0.95	
	COLUMN %	8.73	3.26	0.63	0.14	0.53	0.00	0.18	0.16	1.83
NOT REPORTED		3269	703	2486	2466	20	3	243	1827	11017
	ROW %	29.67	6.38	22.57	22.38	0.18	0.03	2.21	16.58	
	COLUMN %	11.51	9.58	3.79	4.76	10.64	5.17	4.83	9.44	6.20
TOTALS		28404	7341	65647	51792	188	58	5027	19350	177807
	ROW %	15.97	4.13	36.92	29.13	0.11	0.03	2.83	10.88	

KEY

GROUP
1. No regulatory avionics
2. Two-way communications
3. Two-way communications VOR or ADF or RNAV

GROUP
4. Two-way communications 4096 code transponder VOR or RNAV
5. 4096 code transponder Altitude encoding equipment

GROUP
6. Two-way communications 4096 code transponder Altitude encoding equipment
7. Two-way communications 4096 code transponder Altitude encoding equipment VOR

GROUP
8. Two-way communications 4096 code transponder Altitude encoding equipment
VOR / DME } or RNAV

TABLE 10. HIERARCHICAL GROUPS - COMPUTED AIRCRAFT TYPE VS. CAPABILITY GROUP

		1	2	3	4	5	6	7	8	SUM
FIXED WING SINGLE ENGINE PISTON 1 - 3 SEATS	TYPE 1	22444	3491	30278	5191	54	12	337	121	61928
	ROW %	36.24	5.64	48.89	8.38	0.09	0.02	0.54	0.20	
	COLUMN %	79.02	47.55	46.12	10.02	28.72	20.69	6.70	0.63	34.83
FIXED WING SINGLE ENGINE PISTON 4 + SEATS	TYPE 2	2282	841	32349	38024	61	14	4003	5995	83569
	ROW %	2.73	1.01	38.71	45.50	0.07	0.02	4.79	7.17	
	COLUMN %	8.03	11.46	49.28	73.42	32.45	24.14	79.63	30.98	47.00
FIXED WING TWO ENGINE PISTON 1 - 6 SEATS	TYPE 3	181	50	1150	5914	28	5	430	6697	14455
	ROW %	1.25	0.35	7.96	40.91	0.19	0.03	2.97	46.33	
	COLUMN %	0.64	0.68	1.75	11.42	14.89	8.62	8.55	34.61	8.13
FIXED WING TWO ENGINE PISTON 7 + SEATS	TYPE 4	195	33	688	1761	14	0	140	2854	5685
	ROW %	3.43	0.58	12.10	30.98	0.25	0.00	2.46	50.20	
	COLUMN %	0.69	0.45	1.05	3.40	7.45	0.00	2.78	14.75	3.20
FIXED WING OTHER PISTON	TYPE 5	19	4	119	81	0	0	10	53	286
	ROW %	6.64	1.40	41.61	28.32	0.00	0.00	3.50	18.53	
	COLUMN %	0.07	0.05	0.18	0.16	0.00	0.00	0.20	0.27	0.16
FIXED WING TWO ENGINE TURBOPROP 1 - 12 SEATS	TYPE 6	14	0	9	139	6	0	11	1530	1709
	ROW %	0.82	0.00	0.53	8.13	0.35	0.00	0.64	89.53	
	COLUMN %	0.05	0.00	0.01	0.27	3.19	0.00	0.22	7.91	0.96
TWO ENGINE TURBOPR 13 + SEATS	TYPE 7	6	0	27	84	3	0	13	394	527
	ROW %	1.14	0.00	5.12	15.94	0.57	0.00	2.47	74.76	
	COLUMN %	0.02	0.00	0.04	0.16	1.60	0.00	0.26	2.04	0.30
FIXED WING OTHER TURBOPROP	TYPE 8	3	4	16	31	0	0	1	36	91
	ROW %	3.30	4.40	17.58	34.07	0.00	0.00	1.10	39.56	
	COLUMN %	0.01	0.05	0.02	0.06	0.00	0.00	0.02	0.19	0.05

TABLE 10. HIERARCHICAL GROUPS - COMPUTED AIRCRAFT TYPE VS. CAPABILITY GROUP (CONTINUED)

GROUP		1	2	3	4	5	6	7	8	
FIXED WING TWO ENGINE TURBOJET	TYPE 9	1	2	5	37	5	2	1	1423	1476
	ROW %	0.07	0.14	0.34	2.51	0.34	0.14	0.07	96.41	
	COLUMN %	0.00	0.03	0.01	0.07	2.66	3.45	0.02	7.35	0.83
FIXED WING OTHER TURBOJET	TYPE 10	58	8	21	28	2	0	3	175	295
	ROW %	19.66	2.71	7.12	9.49	0.68	0.00	1.02	59.32	
	COLUMN %	0.20	0.11	0.03	0.05	1.06	0.00	0.06	0.90	0.17
ROTORCRAFT PISTON	TYPE 11	1537	1455	342	66	8	13	12	11	3444
	ROW %	44.63	42.25	9.93	1.92	0.23	0.38	0.35	0.32	
	COLUMN %	5.41	19.82	0.52	0.13	4.26	22.41	0.24	0.06	1.94
ROTORCRAFT TURBINE	TYPE 12	44	223	612	430	0	3	62	58	1432
	ROW %	3.07	15.57	42.74	30.03	0.00	0.21	4.33	4.05	
	COLUMN %	0.15	3.04	0.93	0.83	0.00	5.17	1.23	0.30	0.81
OTHER AIRCRAFT	TYPE 13	1620	1230	31	6	7	9	4	3	2910
	ROW %	55.67	42.27	1.07	0.21	0.24	0.31	0.14	0.10	
	COLUMN %	5.70	16.76	0.05	0.01	3.72	15.52	0.08	0.02	1.64
	TOTALS	28404	7341	65647	51792	188	58	5027	19350	177807
	ROW %	15.97	4.13	36.92	29.13	0.11	0.03	2.83	10.88	

KEY

GROUP
1. No regulatory avionics
2. Two-way communications
3. Two-way communications VOR or ADF or RNAV

GROUP
4. Two-way communications 4096 code transponder VOR or RNAV
5. 4096 code transponder Altitude encoding equipment
6. Two-way communications 4096 code transponder Altitude encoding equipment

GROUP
7. Two-way communications 4096 code transponder Altitude encoding equipment VOR
8. Two-way communications 4096 code transponder Altitude encoding equipment VOR / DME } or RNAV

TABLE 12. HIERARCHICAL GROUPS - ENGINE TYPE VS. CAPABILITY GROUP

	1	2	3	4	5	6	7	8	SUM
RECIPROCATING	26680	5888	64928	51037	165	45	4936	15732	169411
ROW %	15.75	3.48	38.33	30.13	0.10	0.03	2.91	9.29	
COLUMN %	93.93	80.21	98.90	98.54	87.77	77.59	98.19	81.30	95.28
TURBOPROP	23	4	54	254	9	0	25	1960	2329
ROW %	0.99	0.17	2.32	10.91	0.39	0.00	1.07	84.16	
COLUMN %	0.08	0.05	0.08	0.49	4.79	0.00	0.50	10.13	1.31
TURBOSHAFT	41	223	610	430	0	3	62	58	1427
ROW %	2.87	15.63	42.75	30.13	0.00	0.21	4.34	4.06	
COLUMN %	0.14	3.04	0.93	0.83	0.00	5.17	1.23	0.30	0.80
TURBOJET	59	10	26	65	7	2	4	1598	1771
ROW %	3.33	0.56	1.47	3.67	0.40	0.11	0.23	90.23	
COLUMN %	0.21	0.14	0.04	0.13	3.72	3.45	0.08	8.26	1.00
TURBINE AIR GEN.	0	0	0	1	0	0	0	0	1
ROW %	0.00	0.00	0.00	100.00	0.00	0.00	0.00	0.00	
COLUMN %	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
RAMJET	2	0	0	0	0	0	0	0	2
ROW %	100.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
COLUMN %	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

TABLE 12. HIERARCHICAL GROUPS - ENGINE TYPE VS. CAPABILITY GROUP (CONTINUED)

GROUP		1	2	3	4	5	6	7	8	
NO ENGINE		1596	1216	29	5	7	8	0	2	2863
	ROW %	55.75	42.47	1.01	0.17	0.24	0.28	0.00	0.07	
	COLUMN %	5.62	16.56	0.04	0.01	3.72	13.79	0.00	0.01	1.61
NOT REPORTED		3	0	0	0	0	0	0	0	3
	ROW %	100.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
	COLUMN %	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
TOTALS		28404	7341	65647	51792	188	58	5027	19350	177807
	ROW %	15.97	4.13	36.92	29.13	0.11	0.03	2.83	10.88	

KEY

GROUP
1. No regulatory avionics
2. Two-way communications
3. Two-way communications VOR or ADF or RNAV

GROUP
4. Two-way communications 4096 code transponder VOR or RNAV
5. 4096 code transponder Altitude encoding equipment

GROUP
6. Two-way communications 4096 code transponder Altitude encoding equipment
7. Two-way communications 4096 code transponder Altitude encoding equipment VOR

GROUP
8. Two-way communications 4096 code transponder Altitude encoding equipment VOR / DME } or RNAV

TABLE 13. HIERARCHICAL GROUPS - NUMBER OF ENGINES VS. CAPABILITY GROUP

		1	2	3	4	5	6	7	8	SUM
ONE		26381	6024	63562	43723	123	42	4412	6194	150461
	ROW %	17.53	4.00	42.24	29.06	0.08	0.03	2.93	4.12	
	COLUMN %	92.88	82.06	96.82	84.42	65.43	72.41	87.77	32.01	84.62
TWO		404	97	1923	7958	56	8	604	12908	23958
	ROW %	1.69	0.40	8.03	33.22	0.23	0.03	2.52	53.88	
	COLUMN %	1.42	1.32	2.93	15.37	29.79	13.79	12.02	66.71	13.47
THREE		4	2	6	0	0	0	1	16	29
	ROW %	13.79	6.90	20.69	0.00	0.00	0.00	3.45	55.17	
	COLUMN %	0.01	0.03	0.01	0.00	0.00	0.00	0.02	0.08	0.02
FOUR		19	2	127	105	2	0	10	230	495
	ROW %	3.84	0.40	25.66	21.21	0.40	0.00	2.02	46.46	
	COLUMN %	0.07	0.03	0.19	0.20	1.06	0.00	0.20	1.19	0.28
MORE		0	0	0	1	0	0	0	0	1
	ROW %	0.00	0.00	0.00	100.00	0.00	0.00	0.00	0.00	
	COLUMN %	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
NONE		1596	1216	29	5	7	8	0	2	2863
	ROW %	55.75	42.47	1.01	0.17	0.24	0.28	0.00	0.07	
	COLUMN %	5.62	16.56	0.04	0.01	3.72	13.79	0.00	0.01	1.61
TOTALS		28404	7341	65647	51792	188	58	5027	19350	177807
	ROW %	15.97	4.13	36.92	29.13	0.11	0.03	2.83	10.88	

TABLE 13. HIERARCHICAL GROUPS - NUMBER OF ENGINES VS. CAPABILITY GROUP (CONTINUED)

KEY

GROUP	GROUP	GROUP	GROUP
1. No regulatory avionics	4. Two-way communications 4096 code transponder VOR or RNAV	6. Two-way communications 4096 code transponder Altitude encoding equipment	8. Two-way communications 4096 code transponder Altitude encoding equipment VOR } or RNAV DME }
2. Two-way communications			
3. Two-way communications VOR or ADF or RNAV	5. 4096 code transponder Altitude encoding equipment	7. Two-way communications 4096 code transponder Altitude encoding equipment VOR	

TABLE 14. HIERARCHICAL GROUPS - NUMBER OF SEATS VS. CAPABILITY GROUP

	1	2	3	4	5	6	7	8	SUM
1 SEAT	7141	1824	852	105	20	7	11	19	9979
ROW %	71.56	18.28	8.54	1.05	0.20	0.07	0.11	0.19	
COLUMN %	25.14	24.85	1.30	0.20	10.64	12.07	0.22	0.10	5.61
2 SEATS	14213	2552	26324	4960	35	8	305	137	48534
ROW %	29.28	5.26	54.24	10.22	0.07	0.02	0.63	0.28	
COLUMN %	50.04	34.76	40.10	9.58	18.62	13.79	6.07	0.71	27.30
3 SEATS	3870	1527	3442	233	11	17	31	9	9140
ROW %	42.34	16.71	37.66	2.55	0.12	0.19	0.34	0.10	
COLUMN %	13.62	20.80	5.24	0.45	5.85	29.31	0.62	0.05	5.14
4 SEATS	2227	1060	29633	32975	51	12	3416	4333	73707
ROW %	3.02	1.44	40.20	44.74	0.07	0.02	4.63	5.88	
COLUMN %	7.84	14.44	45.14	63.67	27.13	20.69	67.95	22.39	41.45
5 SEATS	317	159	2314	3572	4	0	410	1118	7894
ROW %	4.02	2.01	29.31	45.25	0.05	0.00	5.19	14.16	
COLUMN %	1.12	2.17	3.52	6.90	2.13	0.00	8.16	5.78	4.44
6 SEATS	230	68	1979	7786	40	10	676	7704	18493
ROW %	1.24	0.37	10.70	42.10	0.22	0.05	3.66	41.66	
COLUMN %	0.81	0.93	3.01	15.03	21.28	17.24	13.45	39.81	10.40

TABLE 14. HIERARCHICAL GROUPS - NUMBER OF SEATS VS. CAPABILITY GROUP (CONTINUED)

GROUP		1	2	3	4	5	6	7	8	
7 - 11 SEATS		212	70	580	1604	21	2	132	4752	7373
	ROW %	2.88	0.95	7.87	21.76	0.28	0.03	1.79	64.45	
	COLUMN %	0.75	0.95	0.88	3.10	11.17	3.45	2.63	24.56	4.15
12 - 19 SEATS		101	60	202	161	1	1	16	463	1005
	ROW %	10.05	5.97	20.10	16.02	0.10	0.10	1.59	46.07	
	COLUMN %	0.36	0.82	0.31	0.31	0.53	1.72	0.32	2.39	0.57
20 - 49 SEATS		48	16	206	250	3	1	23	557	1104
	ROW %	4.35	1.45	18.66	22.64	0.27	0.09	2.08	50.45	
	COLUMN %	0.17	0.22	0.31	0.48	1.60	1.72	0.46	2.88	0.62
50 - UP SEATS		22	4	115	146	2	0	7	258	554
	ROW %	3.97	0.72	20.76	26.35	0.36	0.00	1.26	46.57	
	COLUMN %	0.08	0.05	0.18	0.28	1.06	0.00	0.14	1.33	0.31
NOT REPORTED		23	1	0	0	0	0	0	0	24
	ROW %	95.83	4.17	0.00	0.00	0.00	0.00	0.00	0.00	
	COLUMN %	0.08	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.01
TOTALS		28404	7341	65647	51792	188	58	5027	19350	177807
	ROW %	15.97	4.13	36.92	29.13	0.11	0.03	2.83	10.88	

KEY

GROUP
1. No regulatory avionics
2. Two-way communications
3. Two-way communications VOR or ADF or RNAV

GROUP
4. Two-way communications 4096 code transponder VOR or RNAV
5. 4096 code transponder Altitude encoding equipment

GROUP
6. Two-way communications 4096 code transponder Altitude encoding equipment
7. Two-way communications 4096 code transponder Altitude encoding equipment VOR

GROUP
8. Two-way communications 4096 code transponder Altitude encoding equipment
VOR / DME } or RNAV

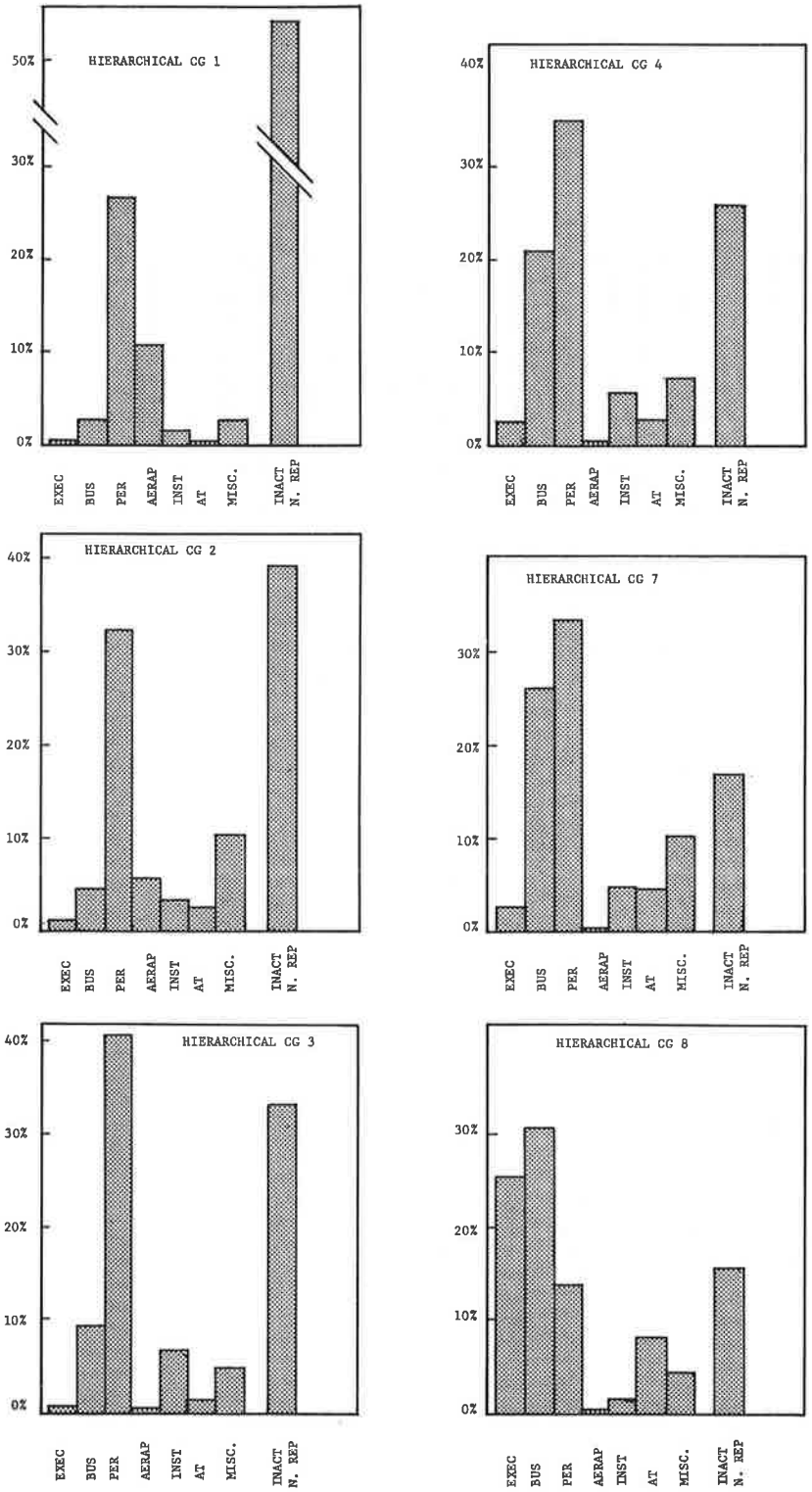
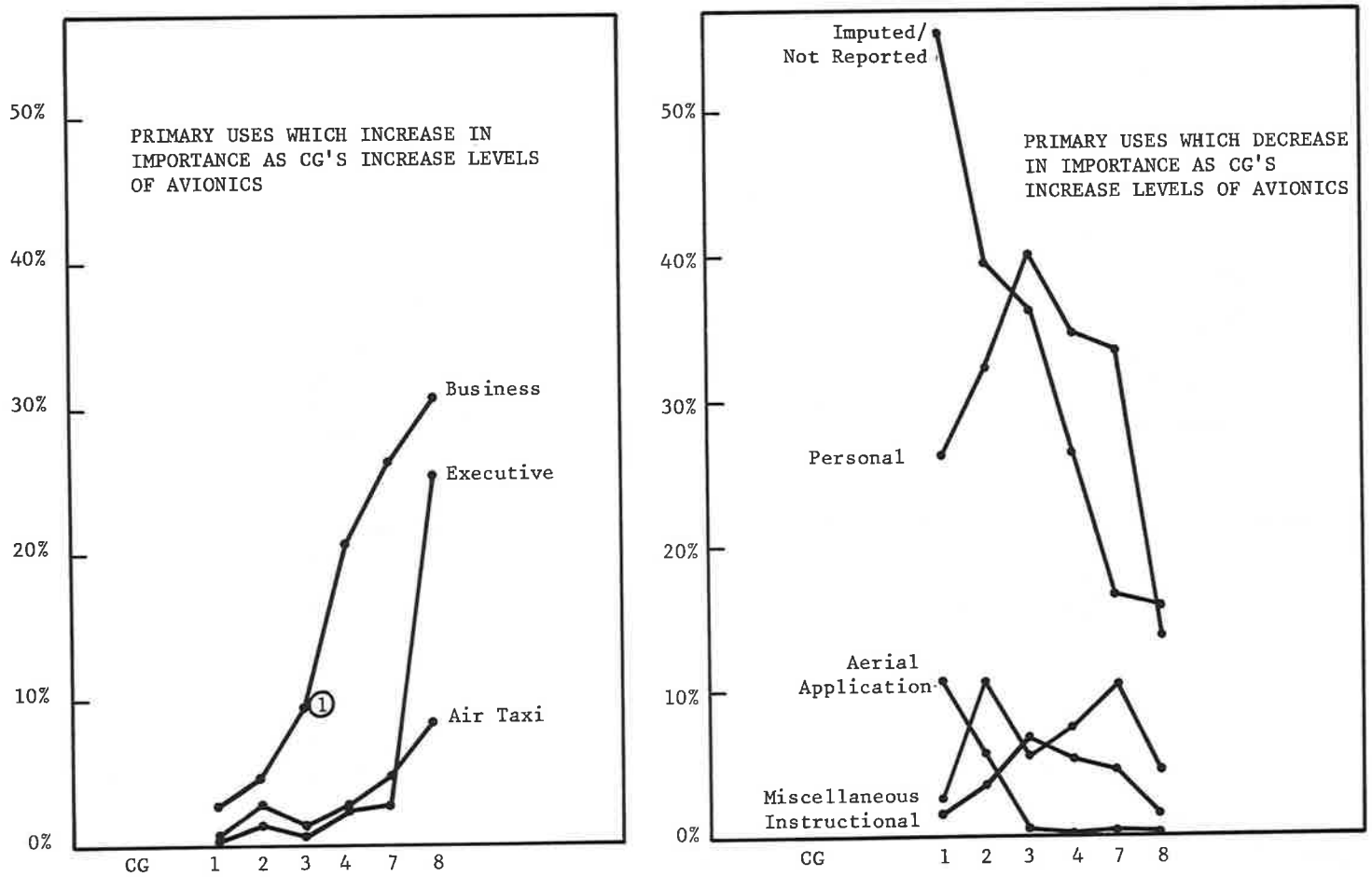


FIGURE 11. PERCENT DISTRIBUTION OF HIERARCHICAL CG's BY PRIMARY USE



(1) This point represents the precent of Hierarchical CG 3 which have a primary use of Business.

FIGURE 12. PRIMARY USE TRENDS IN HIERARCHICAL CG'S

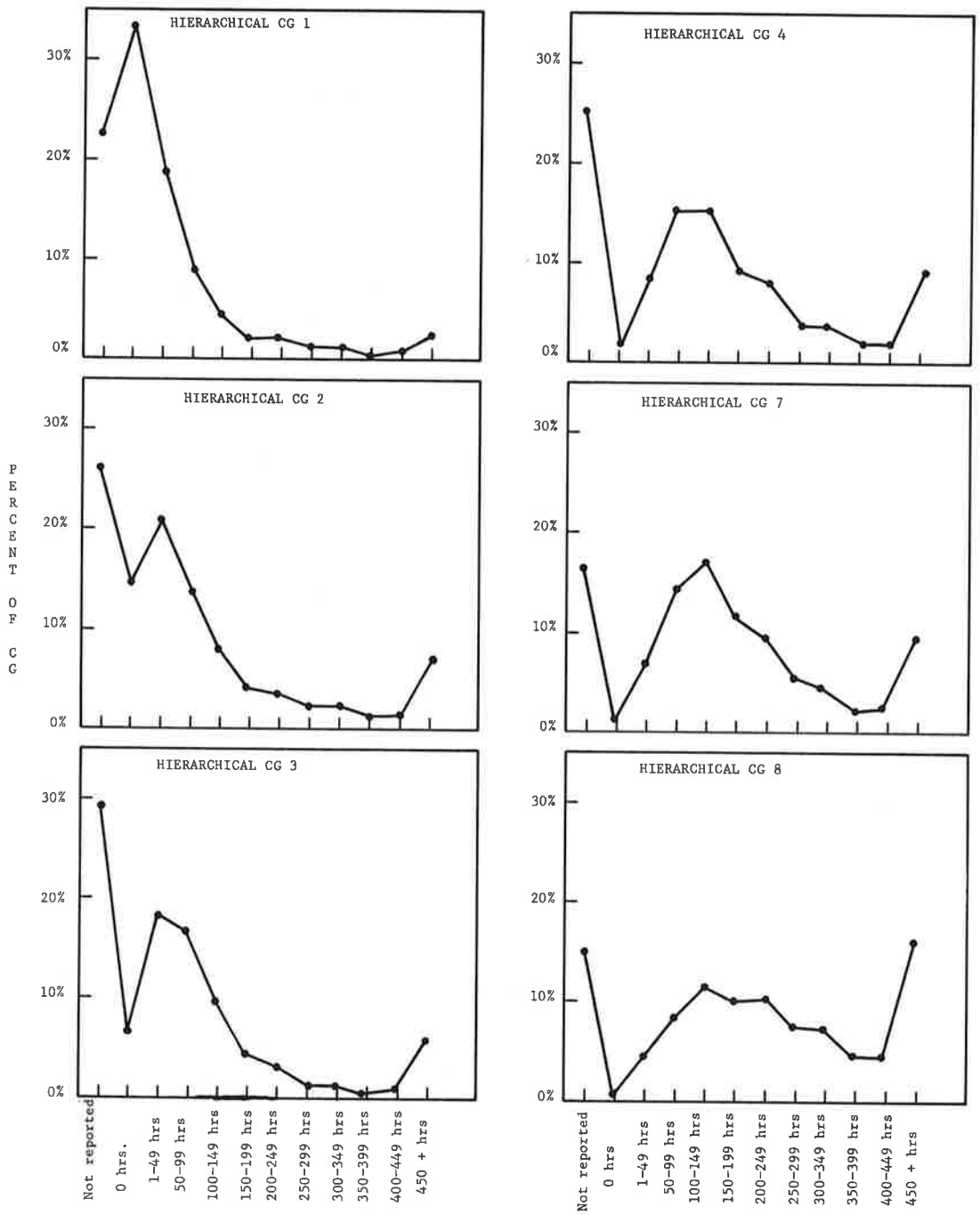


FIGURE 13. PERCENT DISTRIBUTION OF HIERARCHICAL CG's BY ANNUAL HOURS FLOWN

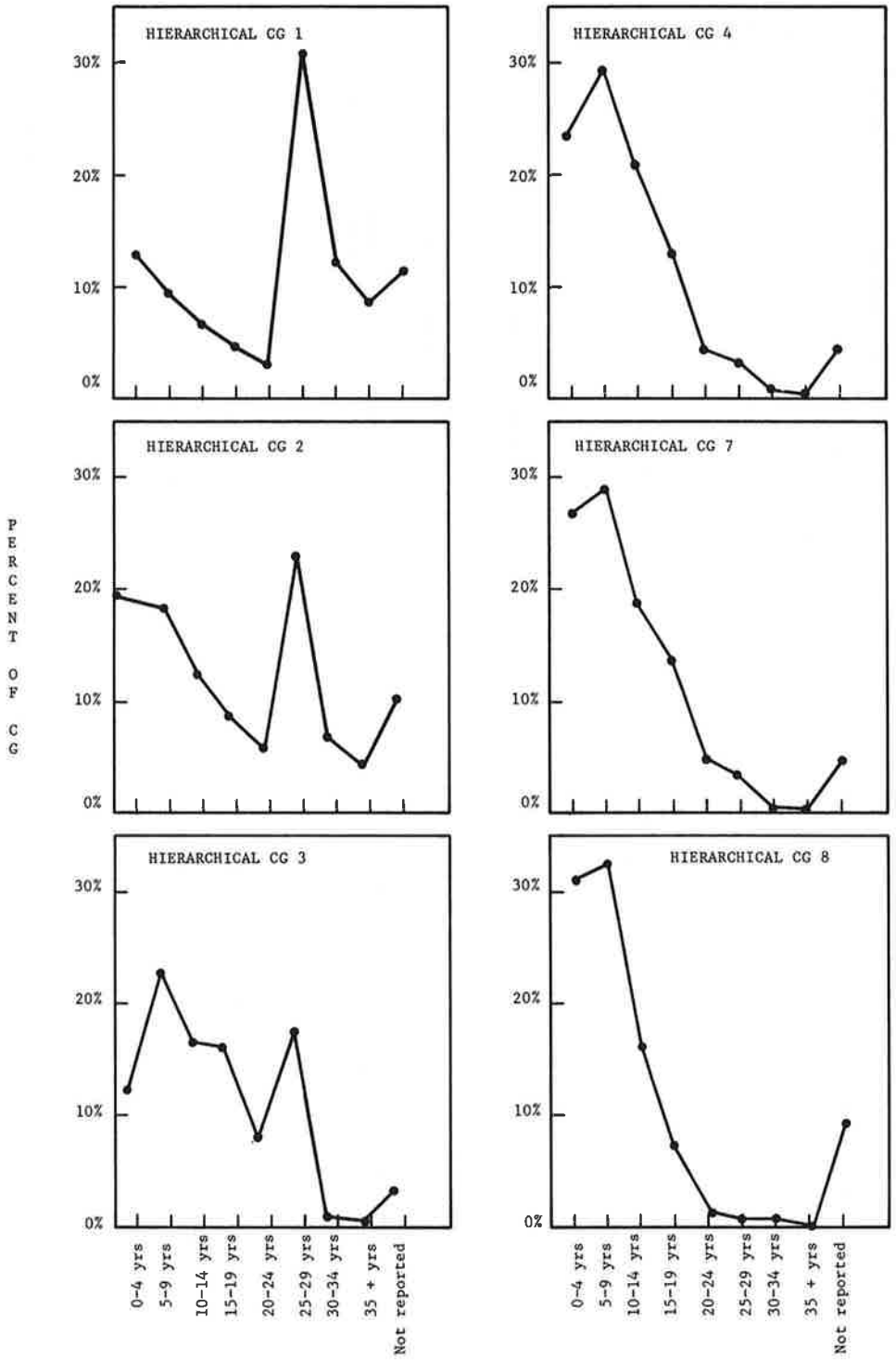


FIGURE 14. PERCENT DISTRIBUTION OF HIERARCHICAL CG's BY AGE

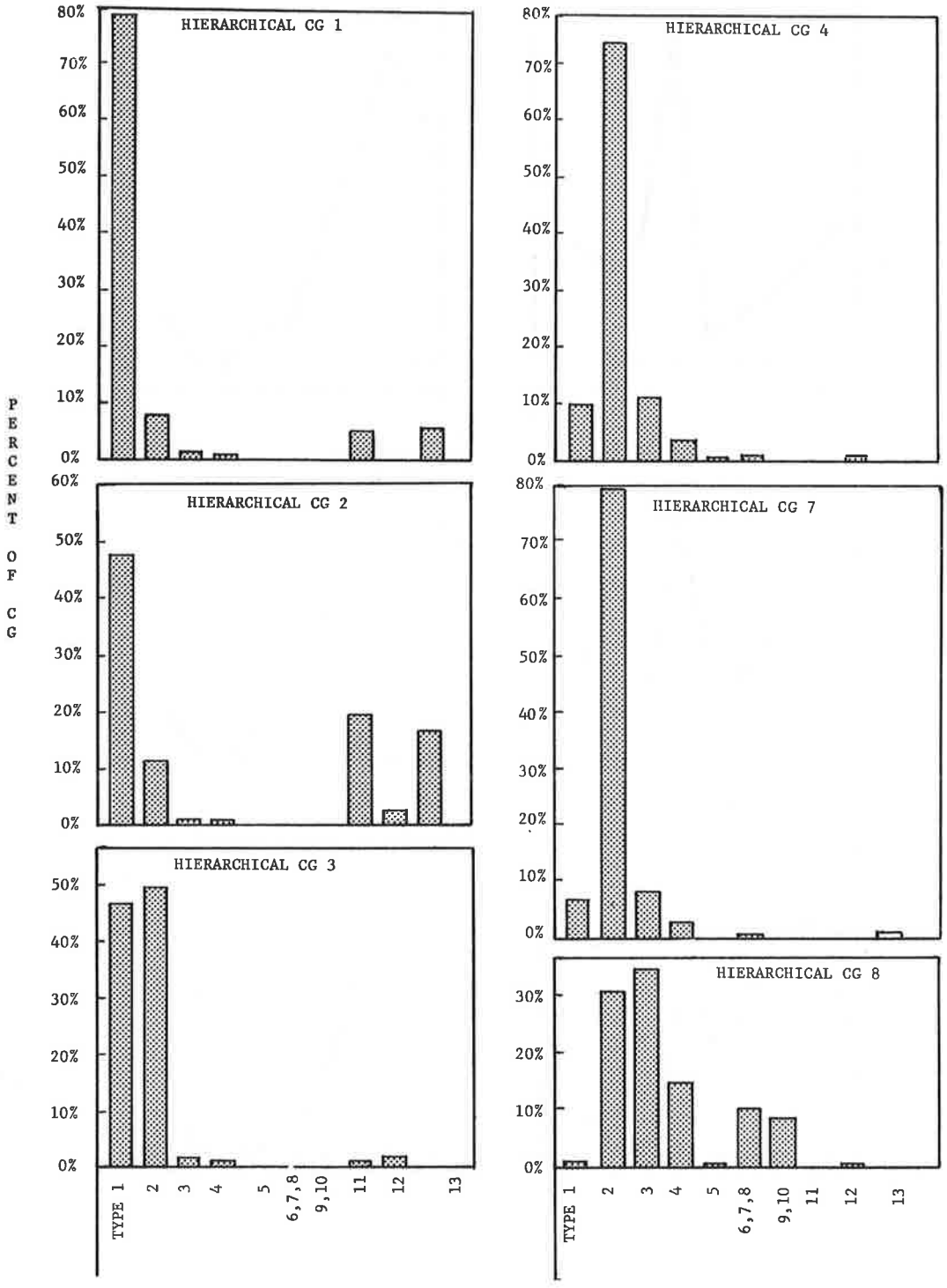
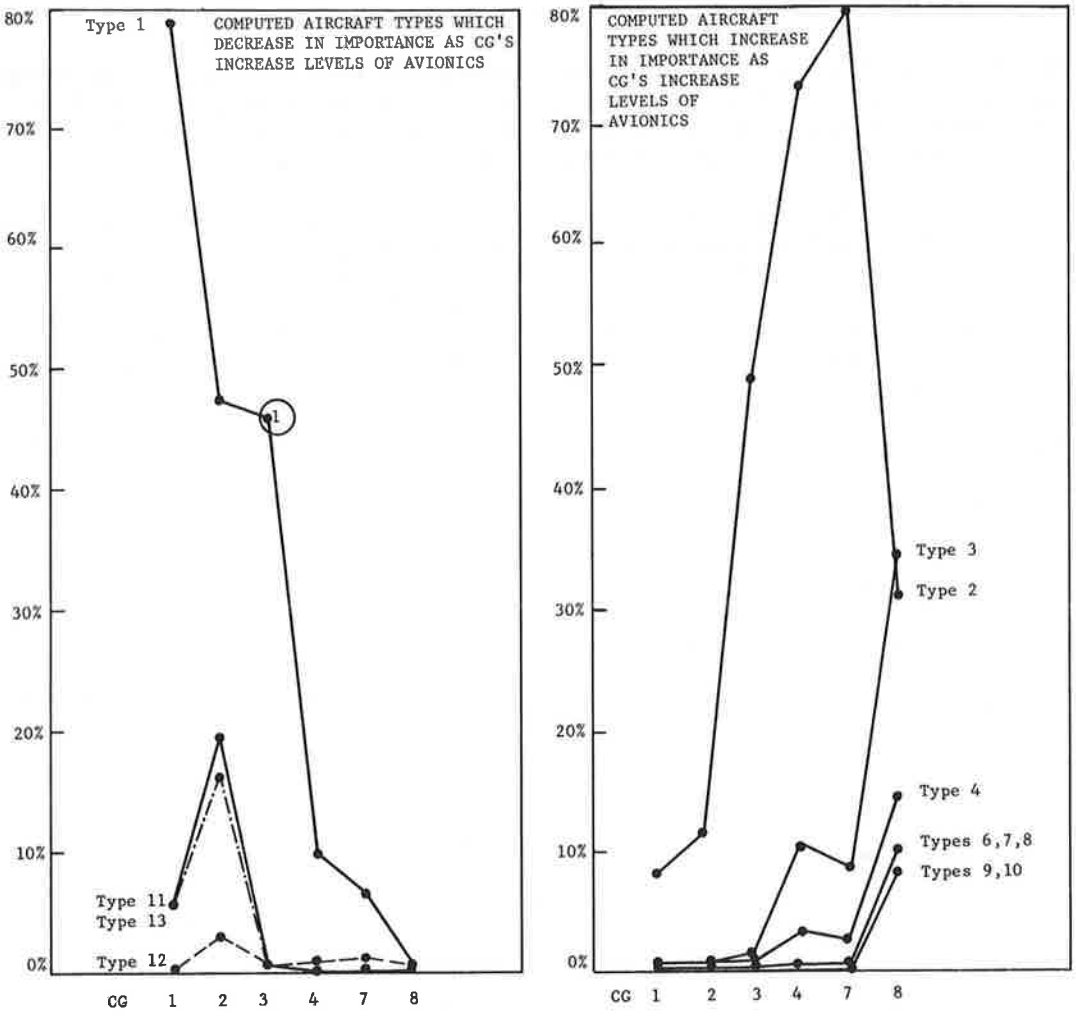


FIGURE 15. PERCENT DISTRIBUTION OF HIERARCHICAL CG's BY COMPUTED AIRCRAFT TYPE



(1.) This point represents the percent of Hierarchical CG3 which are computed aircraft type 3, double engine piston, 1-6 seats

FIGURE 16. COMPUTED AIRCRAFT TYPE TRENDS IN HEIRARCHICAL CG'S

3.2.2 Characteristics of Non-Hierarchical CG's

In the discussion of Table 5 it was noted that the non-hierarchical groups containing complete ILS, area navigation, and weather radar equipment individually or in combination grew substantially from 1974 to 1975. Tables 15 through 23 and Figures 17 through 21 help to identify which kinds of GA aircraft installed these avionics systems during 1975, and to characterize in general the kinds of GA aircraft equipped with these avionics.

Tables 15 through 23 show that sophisticated aircraft in terms of characteristics such as primary use, aircraft type, flying hours, etc., are more likely to possess advanced avionics systems than the simpler aircraft in the GA fleet as follows:

a. As non-hierarchical CG's increase in sophistication, the predominant primary uses of aircraft change from personal and business, to personal, business and executive, to business and executive. For example, executive aircraft alone compose over 50 percent of the ALL non-hierarchical CG, yet executive aircraft compose only 3.75 percent of the reporting fleet (Table 15 and Figure 17).

b. Aircraft containing more avionics equipment and capabilities fly more hours than aircraft with small investments in avionics equipment (Table 17 and Figure 19).

c. Aircraft falling into the non-grouped category are older than those falling into the other non-hierarchical CG's. Within the latter groups, age decreases as the level of avionics increases(Table 18 and Figure 20).

d. Computed aircraft type increases in sophistication as the level of avionics increases. This direct relationship also holds for the following four characteristics which are combined to form computed aircraft type: simple aircraft type, engine type, number of engines, and number of seats (Tables 19 through 23 and Figure 21).

An interesting geographical pattern of aircraft containing weather radar can be observed from Table 16 and Figure 18. Non-hierarchical CG's WRAD, IW and ALL, all of which are defined to include weather radar, are found in high concentrations in the Southern and Southwestern regions and in low concentrations in the Rocky Mountain and Western regions. Weather patterns provide a possible explanation of this phenomenon. Storms in the southern portions of the U.S. cover wide areas with clouds, making location of the electrical storm centers difficult. In the West, storms are more concentrated and easier to track visually. Thus weather radars are more useful in the South and Southwest.

Comparing Tables 15 through 23 with the equivalent tables from 1974 identifies the characteristics of aircraft which acquired new avionics equipment during 1975 as follows:

a. Business and personal use aircraft accounted for the bulk of new complete ILS's in 1975; however, all primary use categories showed increases in the number of ILS's over 1974. Executive and business use aircraft accounted for the major portion of the gains in the ALL non-hierarchical CG. Decreases in the not grouped NG category were registered by the industrial/special, aircraft rental business, and other use aircraft indicating increasing avionics sophistication in these use categories (Table 15).

b. All regions of the U.S. showed substantial increases in the number of complete ILS's and slight gains in weather radar and area navigation equipment (Table 16).

c. Acquisition of the advanced avionics systems (LMG, RNAV, WRAD) was most evident in those aircraft flying 300 hours or more during 1975. Complete ILS's were also acquired by aircraft flying fewer than 300 hours (Table 17).

d. Addition of a complete ILS weather radar and area navigation equipment was limited mainly to aircraft less than 25 years old (Table 18).

e. Increases in the number of complete ILS's were spread over all computed aircraft types, but increases in the number of area navigation and weather radar systems were confined mainly to fixed wing twin engine piston and turbojets (Table 19).

TABLE 15. NON-HIERARCHICAL GROUPS - PRIMARY USE VS. CAPABILITY GROUP

	L	L G	L M	LMG	RNAV	WRAD	I,R	I,W	ALL	N G	CNT
EXECUTIVE	205	16	174	5811	1854	4017	308	2507	1494	421	6660
ROW %	3.08	0.24	2.61	87.25	27.84	60.32	4.62	37.64	22.43	6.32	
COLUMN %	1.08	1.80	0.79	11.38	14.30	45.83	6.97	44.53	50.07	0.52	3.75
BUSINESS	1699	147	3834	13214	3019	1241	1669	726	489	5856	25229
ROW %	6.73	0.58	15.20	52.38	11.97	4.92	6.62	2.88	1.94	23.21	
COLUMN %	8.97	16.57	17.42	25.88	23.28	14.16	37.75	12.90	16.39	7.19	14.19
PERSONAL	6956	300	9963	11012	3631	295	950	148	99	28962	58787
ROW %	11.83	0.51	16.95	18.73	6.18	0.50	1.62	0.25	0.17	49.27	
COLUMN %	36.74	33.82	45.26	21.57	28.00	3.37	21.49	2.63	3.32	35.58	33.06
AERIAL APPLICATION	94	8	32	129	52	23	7	17	6	3749	4049
ROW %	2.32	0.20	0.79	3.19	1.28	0.57	0.17	0.42	0.15	92.59	
COLUMN %	0.50	0.90	0.15	0.25	0.40	0.26	0.16	0.30	0.20	4.61	2.28
INSTRUCTION	2201	37	753	2064	240	34	87	22	12	3530	8664
ROW %	25.40	0.43	8.69	23.82	2.77	0.39	1.00	0.25	0.14	40.74	
COLUMN %	11.63	4.17	3.42	4.04	1.85	0.39	1.97	0.39	0.40	4.34	4.87
AIR TAXI	279	25	264	2941	437	748	226	564	181	840	4368
ROW %	6.39	0.57	6.04	67.33	10.00	17.12	5.17	12.91	4.14	19.23	
COLUMN %	1.47	2.82	1.20	5.76	3.37	8.53	5.11	10.02	6.07	1.03	2.46

TABLE 15. NON-HIERARCHICAL GROUPS - PRIMARY USE VS. CAPABILITY GROUP (CONTINUED)

GROUP		L	LG	LM	LMG	RNAV	WRAD	I,R	I,W	ALL	NG	CNT
INDUSTRIAL/SPECIAL		317	8	135	408	89	56	33	42	10	844	1747
	ROW %	18.15	0.46	7.73	23.35	5.09	3.21	1.89	2.40	0.57	48.31	
	COLUMN %	1.67	0.90	0.61	0.80	0.69	0.64	0.75	0.75	0.34	1.04	0.98
AIRCRAFT RENTAL BUS.		982	33	672	2121	214	69	91	33	35	1536	5384
	ROW %	18.24	0.61	12.48	39.39	3.97	1.28	1.69	0.61	0.65	28.53	
	COLUMN %	5.19	3.72	3.05	4.15	1.65	0.79	2.06	0.59	1.17	1.89	3.03
OTHER		326	12	219	718	198	229	45	119	107	1453	2765
	ROW %	11.79	0.43	7.92	25.97	7.16	8.28	1.63	4.30	3.87	52.55	
	COLUMN %	1.72	1.35	0.99	1.41	1.53	2.61	1.02	2.11	3.59	1.78	1.56
IMPUTED/NOT REPORTED		5874	301	5967	12643	3233	2053	1005	1452	551	34215	60154
	ROW %	9.76	0.50	9.92	21.02	5.37	3.41	1.67	2.41	0.92	56.88	
	COLUMN %	31.03	33.93	27.11	24.76	24.93	23.42	22.73	25.79	18.47	42.03	33.83
TOTALS		18933	887	22013	51061	12967	8765	4421	5630	2984	81406	177807
	ROW %	10.65	0.50	12.38	28.72	7.29	4.93	2.49	3.17	1.68	45.78	

KEY

GROUP
L: Localizer

M: Marker beacon

G: Glide slope

R, RNAV: Area navigation system

GROUP
W, WRAD: Weather radar

I, LMG: Complete ILS system

ALL: I, R, and W

NG: Non-grouped aircraft

TABLE 16. NON-HIERARCHICAL GROUPS - BASE AIRPORT REGION VS. CAPABILITY GROUP

	L	L G	L M	LMG	RNAV	WRAD	I,R	I,W	ALL	M G	CNT
NEW ENGLAND	775	29	876	1777	372	212	136	129	77	2983	6535
ROW %	11.86	0.44	13.40	27.19	5.69	3.24	2.08	1.97	1.18	45.65	
COLUMN %	4.09	3.27	3.98	3.48	2.87	2.42	3.08	2.29	2.58	3.66	3.68
EASTERN	2500	93	3533	6963	1675	1290	572	841	426	9049	22506
ROW %	11.11	0.41	15.70	30.94	7.44	5.73	2.54	3.74	1.89	40.21	
COLUMN %	13.20	10.48	16.05	13.64	12.92	14.72	12.94	14.94	14.28	11.12	12.66
SOUTHERN	2815	148	2939	8355	2196	1892	741	1169	701	10908	25654
ROW %	10.97	0.58	11.46	32.57	8.56	7.38	2.89	4.56	2.73	42.52	
COLUMN %	14.87	16.69	13.35	16.36	16.94	21.59	16.76	20.76	23.49	13.40	14.43
GREAT LAKES	3672	136	4764	9266	2541	1804	814	1193	583	15223	33756
ROW %	10.88	0.40	14.11	27.45	7.53	5.34	2.41	3.53	1.73	45.10	
COLUMN %	19.39	15.33	21.64	18.15	19.60	20.58	18.41	21.19	19.54	18.70	18.98
CENTRAL	1352	63	1432	3403	952	607	321	370	225	6144	12659
ROW %	10.68	0.50	11.31	26.88	7.52	4.80	2.54	2.92	1.78	48.53	
COLUMN %	7.14	7.10	6.51	6.66	7.34	6.93	7.26	6.57	7.54	7.55	7.12
ROCKY MOUNTAINS	1010	54	917	2188	646	274	203	163	104	5109	9513
ROW %	10.62	0.57	9.64	23.00	6.79	2.88	2.13	1.71	1.09	53.71	
COLUMN %	5.33	6.09	4.17	4.29	4.98	3.13	4.59	2.90	3.49	6.28	5.35
NORTHWESTERN	1085	43	1264	2560	589	197	202	130	55	5423	10587
ROW %	10.25	0.41	11.94	24.18	5.56	1.86	1.91	1.23	0.52	51.22	
COLUMN %	5.73	4.85	5.74	5.01	4.54	2.25	4.57	2.31	1.84	6.66	5.95

TABLE 16. NON-HIERARCHICAL GROUPS - BASE AIRPORT REGION VS. CAPABILITY GROUP (CONTINUED)

GROUP		L	LG	LM	LMG	RNAV	WRAD	I,R	I,W	ALL	NG	CNT
WESTERN		2773	138	3771	8333	1653	661	667	448	203	12256	27748
	ROW %	9.99	0.50	13.59	30.03	5.96	2.38	2.40	1.61	0.73	44.17	
	COLUMN %	14.65	15.56	17.13	16.32	12.75	7.54	15.09	7.96	6.80	15.06	15.61
SOUTHWESTERN		2339	138	2221	7474	2045	1698	710	1090	584	10958	23612
	ROW %	9.91	0.58	9.41	31.65	8.66	7.19	3.01	4.62	2.47	46.41	
	COLUMN %	12.35	15.56	10.09	14.64	15.77	19.37	16.06	19.36	19.57	13.46	13.28
PACIFIC		42	3	21	113	26	22	4	16	5	239	431
	ROW %	9.74	0.70	4.87	26.22	6.03	5.10	0.93	3.71	1.16	55.45	
	COLUMN %	0.22	0.34	0.10	0.22	0.20	0.25	0.09	0.28	0.17	0.29	0.24
ALASKAN		522	35	259	501	252	63	45	47	11	3063	4552
	ROW %	11.47	0.77	5.69	11.01	5.54	1.38	0.99	1.03	0.24	67.29	
	COLUMN %	2.76	3.95	1.18	0.98	1.94	0.72	1.02	0.83	0.37	3.76	2.56
FOREIGN		48	7	16	128	20	45	6	34	10	51	254
	ROW %	18.90	2.76	6.30	50.39	7.87	17.72	2.36	13.39	3.94	20.08	
	COLUMN %	0.25	0.79	0.07	0.25	0.15	0.51	0.14	0.60	0.34	0.06	0.14
TOTALS		18933	887	22013	51061	12967	8765	4421	5630	2984	81406	177807
	ROW %	10.65	0.50	12.38	28.72	7.29	4.93	2.49	3.17	1.68	45.78	

KEY

GROUP
L: Localizer
M: Marker beacon
G: Glide slope
R, RNAV: Area navigation system

GROUP
W, WRAD: Weather radar
I, LMG: Complete ILS system
All: I, R, and W
NG: Non-grouped aircraft

TABLE 17. NON-HIERARCHICAL GROUPS - HOURS FLOWN VS. CAPABILITY GROUP

	L	L G	L M	LMG	BNAV	WRAD	I,B	I,W	ALL	W G	CNT
1 - 49	2510	115	2544	3021	1362	348	273	223	103	15470	24360
ROW %	10.30	0.47	10.44	12.40	5.59	1.43	1.12	0.92	0.42	63.51	
COLUMN %	13.26	12.97	11.56	5.92	10.50	3.97	6.18	3.96	3.45	19.00	13.70
50 - 99	3020	139	4035	5366	1758	379	504	224	128	11797	25040
ROW %	12.06	0.56	16.11	21.43	7.02	1.51	2.01	0.89	0.51	47.11	
COLUMN %	15.95	15.67	18.33	10.51	13.56	4.32	11.40	3.98	4.29	14.49	14.08
100 - 149	2121	103	3526	6470	1534	443	647	263	162	6430	19066
ROW %	11.12	0.54	18.49	33.93	8.05	2.32	3.39	1.38	0.85	33.72	
COLUMN %	11.20	11.61	16.02	12.67	11.83	5.05	14.63	4.67	5.43	7.90	10.72
150 - 199	1051	55	1828	4725	973	529	473	331	194	2943	10751
ROW %	9.78	0.51	17.00	43.95	9.05	4.92	4.40	3.08	1.80	27.37	
COLUMN %	5.55	6.20	8.30	9.25	7.50	6.04	10.70	5.88	6.50	3.62	6.05
200 - 249	816	43	1351	4266	878	593	429	389	198	2336	8945
ROW %	9.12	0.48	15.10	47.69	9.82	6.63	4.80	4.35	2.21	26.12	
COLUMN %	4.31	4.85	6.14	8.35	6.77	6.77	9.70	6.91	6.64	2.87	5.03
250 - 299	422	29	677	2743	586	535	278	325	207	1340	5262
ROW %	8.02	0.55	12.87	52.13	11.14	10.17	5.28	6.18	3.93	25.47	
COLUMN %	2.23	3.27	3.08	5.37	4.52	6.10	6.29	5.77	6.94	1.65	2.96
300 - 349	506	22	544	2638	584	674	233	400	271	1331	5079
ROW %	9.96	0.43	10.71	51.94	11.50	13.27	4.59	7.88	5.34	26.21	
COLUMN %	2.67	2.48	2.47	5.17	4.50	7.69	5.27	7.10	9.08	1.64	2.86

TABLE 17. NON-HIERARCHICAL GROUPS - HOURS FLOWN VS. CAPABILITY GROUP (CONTINUED)

GROUP	L	LG	LM	LMG	RNAV	WRAD	I,R	I,W	ALL	NG	CNT
350 - 399	272	7	286	1546	362	528	125	338	188	739	2873
ROW %	9.47	0.24	9.95	53.81	12.60	18.38	4.35	11.76	6.54	25.72	
COLUMN %	1.44	0.79	1.30	3.03	2.79	6.02	2.83	6.00	6.30	0.91	1.62
400 - 449	379	16	261	1549	337	487	106	301	183	882	3104
ROW %	12.21	0.52	8.41	49.90	10.86	15.69	3.41	9.70	5.90	28.41	
COLUMN %	2.00	1.80	1.19	3.03	2.60	5.56	2.40	5.35	6.13	1.08	1.75
450 - UP	1962	57	994	6094	1360	2196	348	1384	799	3923	13173
ROW %	14.89	0.43	7.55	46.26	10.32	16.67	2.64	10.51	6.07	29.78	
COLUMN %	10.36	6.43	4.52	11.93	10.49	25.05	7.87	24.58	26.78	4.82	7.41
NOT FLOWN	767	54	493	868	357	197	61	155	37	13118	15521
ROW %	4.94	0.35	3.18	5.59	2.30	1.27	0.39	1.00	0.24	84.52	
COLUMN %	4.05	6.09	2.24	1.70	2.75	2.25	1.38	2.75	1.24	16.11	8.73
IMPUTED HOURS	5107	247	5474	11775	2876	1856	944	1297	514	21097	44633
ROW %	11.44	0.55	12.26	26.38	6.44	4.16	2.12	2.91	1.15	47.27	
COLUMN %	26.97	27.85	24.87	23.06	22.18	21.18	21.35	23.04	17.23	25.92	25.10
TOTALS	18933	887	22013	51061	12967	8765	4421	5630	2984	81406	177807
ROW %	10.65	0.50	12.38	28.72	7.29	4.93	2.49	3.17	1.68	45.78	

KEY

GROUP
- L: Localizer
- M: Marker beacon
- G: Glide slope
- R, RNAV: Area navigation system

GROUP
- W, WRAD: Weather radar
- I, LMG: Complete ILS system
- All: I, R and R
- NG: Non-grouped aircraft

TABLE 18. NON-HIERARCHICAL GROUPS - AGE OF AIRCRAFT VS. CAPABILITY GROUP

		L	L G	L M	LMG	RNAV	WBAD	I,R	I,W	ALL	N G	CNT
0 - 4 YEARS		4408	158	2243	13826	3105	2667	1233	1186	1465	11439	32344
	ROW %	13.63	0.49	6.93	42.75	9.60	8.25	3.81	3.67	4.53	35.37	
	COLUMN %	23.28	17.81	10.19	27.08	23.95	30.43	27.89	21.07	49.10	14.05	18.19
5 - 9 YEARS		4824	185	6613	15201	3385	2751	1318	2040	668	14555	42183
	ROW %	11.44	0.44	15.68	36.04	8.02	6.52	3.12	4.84	1.58	34.50	
	COLUMN %	25.48	20.86	30.04	29.77	26.10	31.39	29.81	36.23	22.39	17.88	23.72
10 - 14 YEARS		2807	154	5472	9235	2284	1039	840	777	228	10065	28425
	ROW %	9.88	0.54	19.25	32.49	8.04	3.66	2.96	2.73	0.80	35.41	
	COLUMN %	14.83	17.36	24.86	18.09	17.61	11.85	19.00	13.80	7.64	12.36	15.99
15 - 19 YEARS		2246	145	4066	5528	1703	561	467	421	123	8733	21375
	ROW %	10.51	0.68	19.02	25.86	7.97	2.62	2.18	1.97	0.58	40.86	
	COLUMN %	11.86	16.35	18.47	10.83	13.13	6.40	10.56	7.48	4.12	10.73	12.02
20 - 24 YEARS		1145	70	1376	1839	588	208	135	157	41	4733	9427
	ROW %	12.15	0.74	14.60	19.51	6.24	2.21	1.43	1.67	0.43	50.21	
	COLUMN %	6.05	7.89	6.25	3.60	4.53	2.37	3.05	2.79	1.37	5.81	5.30
25 - 29 YEARS		2219	82	1488	1044	866	113	76	84	17	18885	24352
	ROW %	9.11	0.34	6.11	4.29	3.56	0.46	0.31	0.34	0.07	77.55	
	COLUMN %	11.72	9.24	6.76	2.04	6.68	1.29	1.72	1.49	0.57	23.20	13.70

TABLE 18. NON-HIERARCHICAL GROUPS - AGE OF AIRCRAFT VS. CAPABILITY GROUP (CONTINUED)

GROUP		L	LG	LM	LMG	RNAV	WRAD	I,R	I,W	ALL	NG	CNT
30 - 34 YEARS		213	24	75	610	139	227	28	178	45	4452	5434
	ROW %	3.92	0.44	1.38	11.23	2.56	4.18	0.52	3.28	0.83	81.93	
	COLUMN %	1.13	2.71	0.34	1.19	1.07	2.59	0.63	3.16	1.51	5.47	3.06
35 + YEARS		90	0	27	132	48	30	13	26	4	2973	3250
	ROW %	2.77	0.00	0.83	4.06	1.48	0.92	0.40	0.80	0.12	91.48	
	COLUMN %	0.48	0.00	0.12	0.26	0.37	0.34	0.29	0.46	0.13	3.65	1.83
NOT REPORTED		981	69	653	3646	849	1169	311	761	393	5571	11017
	ROW %	8.90	0.63	5.93	33.09	7.71	10.61	2.82	6.91	3.57	50.57	
	COLUMN %	5.18	7.78	2.97	7.14	6.55	13.34	7.03	13.52	13.17	6.84	6.20
TOTALS		18933	887	22013	51061	12967	8765	4421	5630	2984	81406	177807
	ROW %	10.65	0.50	12.38	28.72	7.29	4.93	2.49	3.17	1.68	45.78	

KEY

GROUP
L: Localizer
M: Marker beacon
G: Glide slope
R, RNAV: Area navigation system

GROUP
W, WRAD: Weather radar
I, LMG: Complete ILS system
ALL: I, R and W
NG: Non-grouped aircraft

TABLE 19. NON-HIERARCHICAL GROUPS - COMPUTED AIRCRAFT TYPE VS. CAPABILITY GROUP

		L	L G	L H	LHG	RNAV	WRAD	I,R	I,W	ALL	N G	CNT
FIXED WING SINGLE ENGINE PISTON 1 - 3 SEATS	TYPE 1	8527	148	2819	1567	1861	37	77	7	7	47459	61928
	ROW %	13.77	0.24	4.55	2.53	3.01	0.06	0.12	0.01	0.01	76.64	
	COLUMN %	45.04	16.69	12.81	3.07	14.35	0.42	1.74	0.12	0.23	58.30	34.83
FIXED WING SINGLE ENGINE PISTON 4 + SEATS	TYPE 2	9758	624	18383	26988	6023	174	2405	51	42	25864	83569
	ROW %	11.68	0.75	22.00	32.29	7.21	0.21	2.88	0.06	0.05	30.95	
	COLUMN %	51.54	70.35	83.51	52.85	46.85	1.99	54.40	0.91	1.41	31.77	47.00
FIXED WING TWO ENGINE PISTON 1 - 6 SEATS	TYPE 3	140	50	725	13039	2372	1972	1525	1211	751	464	14455
	ROW %	0.97	0.35	5.02	90.20	16.41	13.64	10.55	8.38	5.20	3.21	
	COLUMN %	0.74	5.64	3.29	25.54	18.29	22.50	34.49	21.51	25.17	0.57	8.13
FIXED WING TWO ENGINE PISTON 7 + SEATS	TYPE 4	87	22	32	5207	1229	2837	309	1914	910	324	5685
	ROW %	1.53	0.39	0.56	91.59	21.62	49.90	5.44	33.67	16.01	5.70	
	COLUMN %	0.46	2.48	0.15	10.20	9.48	32.37	6.99	34.00	30.50	0.40	3.20
FIXED WING OTHER PISTON	TYPE 5	6	13	1	206	38	155	2	119	35	58	286
	ROW %	2.10	4.55	0.35	72.03	13.29	54.20	0.70	41.61	12.24	20.28	
	COLUMN %	0.03	1.47	0.00	0.40	0.29	1.77	0.05	2.11	1.17	0.07	0.16
FIXED WING TWO ENGINE TURBOPROP 1 - 12 SEATS	TYPE 6	2	2	1	1688	630	1501	39	910	590	15	1709
	ROW %	0.12	0.12	0.06	98.77	36.86	87.83	2.28	53.25	34.52	0.88	
	COLUMN %	0.01	0.23	0.00	3.31	4.86	17.12	0.88	16.16	19.77	0.02	0.96
TWO ENGINE TURBOPROP 13 + SEATS	TYPE 7	0	0	1	520	95	403	22	329	73	5	527
	ROW %	0.00	0.00	0.19	98.67	18.03	76.47	4.17	62.43	13.85	0.95	
	COLUMN %	0.00	0.00	0.00	1.02	0.73	4.60	0.50	5.84	2.45	0.01	0.30
FIXED WING OTHER TURBOPROP	TYPE 8	17	1	1	64	12	45	1	34	11	8	91
	ROW %	18.68	1.10	1.10	70.33	13.19	49.45	1.10	37.36	12.09	8.79	
	COLUMN %	0.09	0.11	0.00	0.13	0.09	0.51	0.02	0.60	0.37	0.01	0.05

TABLE 19. NON-HIERARCHICAL GROUPS - COMPUTED AIRCRAFT TYPE VS. CAPABILITY GROUP (CONTINUED)

GROUP		L	LG	LM	LMG	RNAV	WRAD	I,R	I,W	ALL	NG	CNT
FIXED WING TWO ENGINE TURBOJE'	TYPE 9	0	0	0	1471	466	1436	1	971	464	4	1476
	ROW %	0.00	0.00	0.00	99.66	31.57	97.29	0.07	65.79	31.44	0.27	
	COLUMN %	0.00	0.00	0.00	2.88	3.59	16.38	0.02	17.25	15.55	0.00	0.83
FIXED WING OTHER TURBOJET	TYPE 10	4	9	2	217	102	180	5	79	97	60	295
	ROW %	1.36	3.05	0.68	73.56	34.58	61.02	1.69	26.78	32.88	20.34	
	COLUMN %	0.02	1.01	0.01	0.42	0.79	2.05	0.11	1.40	3.25	0.07	0.17
ROTORCRAFT PISTON	TYPE 11	81	5	7	13	35	4	0	2	1	3306	3444
	ROW %	2.35	0.15	0.20	0.38	1.02	0.12	0.00	0.06	0.03	95.99	
	COLUMN %	0.43	0.56	0.03	0.03	0.27	0.05	0.00	0.04	0.03	4.06	1.94
ROTORCRAFT TURBINE	TYPE 12	304	13	38	79	92	18	35	2	3	954	1432
	ROW %	21.23	0.91	2.65	5.52	6.42	1.26	2.44	0.14	0.21	66.62	
	COLUMN %	1.61	1.47	0.17	0.15	0.71	0.21	0.79	0.04	0.10	1.17	0.81
OTHER	TYPE 13	7	0	3	2	12	3	0	1	0	2885	2910
	ROW %	0.24	0.00	0.10	0.07	0.41	0.10	0.00	0.03	0.00	99.14	
	COLUMN %	0.04	0.00	0.01	0.00	0.09	0.03	0.00	0.02	0.00	3.54	1.64
	TOTALS	18933	887	22013	51061	12967	8765	4421	5630	2984	81406	177807
	ROW %	10.65	0.50	12.38	28.72	7.29	4.93	2.49	3.17	1.68	45.78	

KEY

GROUP
L: Localizer

M: Marker beacon

G: Glide slope

R, RNAV: Area navigation system

GROUP
W, WRAD: Weather radar

I, LMG: Complete ILS system

ALL: I, R and W

NG: Non-grouped aircraft

TABLE 20. NON-HIERARCHICAL GROUPS - AIRCRAFT TYPE VS. CAPABILITY GROUP

	L	L G	L M	LMG	RNAV	WRAD	I,R	I,W	ALL	N G	CNT
GLIDER	7	0	0	0	8	1	0	0	0	2341	2357
ROW %	0.30	0.00	0.00	0.00	0.34	0.04	0.00	0.00	0.00	99.32	
COLUMN %	0.04	0.00	0.00	0.00	0.06	0.01	0.00	0.00	0.00	2.88	1.33
BALLOON	0	0	0	0	4	0	0	0	0	544	548
ROW %	0.00	0.00	0.00	0.00	0.73	0.00	0.00	0.00	0.00	99.27	
COLUMN %	0.00	0.00	0.00	0.00	0.03	0.00	0.00	0.00	0.00	0.67	0.31
BLIMP/DIRIGIBLE	0	0	3	2	0	2	0	1	0	0	5
ROW %	0.00	0.00	60.00	40.00	0.00	40.00	0.00	20.00	0.00	0.00	
COLUMN %	0.00	0.00	0.01	0.00	0.00	0.02	0.00	0.02	0.00	0.00	0.00
FIXED WING SINGLE	18306	782	21205	28605	7889	213	2487	59	49	73386	145644
ROW %	12.57	0.54	14.56	19.64	5.42	0.15	1.71	0.04	0.03	50.39	
COLUMN %	96.69	88.16	96.33	56.02	60.84	2.43	56.25	1.05	1.64	90.15	81.91
FIXED WING MULTIPLE	235	87	760	22362	4939	8527	1899	5566	2931	874	24376
ROW %	0.96	0.36	3.12	91.74	20.26	34.98	7.79	22.83	12.02	3.59	
COLUMN %	1.24	9.81	3.45	43.79	38.09	97.28	42.95	98.86	98.22	1.07	13.71
ROTORCRAFT	385	18	45	92	127	22	35	4	4	4260	4876
ROW %	7.90	0.37	0.92	1.89	2.60	0.45	0.72	0.08	0.08	87.37	
COLUMN %	2.03	2.03	0.20	0.18	0.98	0.25	0.79	0.07	0.13	5.23	2.74

TABLE 20. NON-HIERARCHICAL GROUPS - AIRCRAFT TYPE VS. CAPABILITY GROUP (CONTINUED)

GROUP		L	LG	LM	LMG	RNAV	WRAD	I,R	I,W	ALL	NG	CNT
NOT REPORTED		0	0	0	0	0	0	0	0	0	1	1
	ROW %	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	100.00	
	COLUMN %	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
TOTALS		18933	887	22013	51061	12967	8765	4421	5630	2984	81406	177807
	ROW %	10.65	0.50	12.38	28.72	7.29	4.93	2.49	3.17	1.68	45.78	

KEY

GROUP
L: Localizer

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R, RNAV: Area navigation system

GROUP
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I, LMG: Complete ILS system

ALL: I, R and W

NG: Non-grouped aircraft

TABLE 21. NON-HIERARCHICAL GROUPS - ENGINE TYPE VS. CAPABILITY GROUP

	L	L G	L M	LMG	RNAV	WRAD	I,R	I,W	ALL	N G	CNT
RECIPROCATING	18599	862	21970	47022	11559	5181	4318	3305	1746	77513	169411
ROW %	10.98	0.51	12.97	27.76	6.82	3.06	2.55	1.95	1.03	45.75	
COLUMN %	98.24	97.18	99.80	92.09	89.14	59.11	97.67	58.70	58.51	95.22	95.28
TURBOPROP	19	3	5	2272	737	1949	62	1273	674	28	2329
ROW %	0.82	0.13	0.21	97.55	31.64	83.68	2.66	54.66	28.94	1.20	
COLUMN %	0.10	0.34	0.02	4.45	5.68	22.24	1.40	22.61	22.59	0.03	1.31
TURBOSHAFT	304	13	36	79	92	18	35	2	3	951	1427
ROW %	21.30	0.91	2.52	5.54	6.45	1.26	2.45	0.14	0.21	66.64	
COLUMN %	1.61	1.47	0.16	0.15	0.71	0.21	0.79	0.04	0.10	1.17	0.80
TURBOJET	4	9	2	1688	568	1616	6	1050	561	64	1771
ROW %	0.23	0.51	0.11	95.31	32.07	91.25	0.34	59.29	31.68	3.61	
COLUMN %	0.02	1.01	0.01	3.31	4.38	18.44	0.14	18.65	18.80	0.08	1.00
TURBINE AIR GEN.	0	0	0	0	0	0	0	0	0	1	1
ROW %	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	100.00	
COLUMN %	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
RAMJET	0	0	0	0	0	0	0	0	0	2	2
ROW %	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	100.00	
COLUMN %	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

TABLE 21. NON-HIERARCHICAL GROUPS - ENGINE TYPE VS. CAPABILITY GROUP (CONTINUED)

GROUP		L	LG	LM	LMG	RNAV	WRAD	I,R	I,W	ALL	NG	CNT
NO ENGINE		7	0	0	0	11	1	0	0	0	2844	2863
	ROW %	0.24	0.00	0.00	0.00	0.38	0.03	0.00	0.00	0.00	99.34	
	COLUMN %	0.04	0.00	0.00	0.00	0.08	0.01	0.00	0.00	0.00	3.49	1.61
NOT REPORTED		0	0	0	0	0	0	0	0	0	3	3
	ROW %	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	100.00	
	COLUMN %	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
TOTALS		18933	887	22013	51061	12967	8765	4421	5630	2984	81406	177807
	ROW %	10.65	0.50	12.38	28.72	7.29	4.93	2.49	3.17	1.68	45.78	

KEY

GROUP
L: Localizer

M: Marker beacon

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R, RNAV: Area navigation system

GROUP
W, WRAD: Weather radar

I, LMG: Complete ILS system

ALL: I, R and W

NG: Non-grouped aircraft

TABLE 22. NON-HIERARCHICAL GROUPS - NUMBER OF ENGINES VS. CAPABILITY GROUP

		L	L G	L M	LMG	RNAV	WRAD	I,R	I,W	ALL	M G	CNT
ONE		18685	799	21247	28679	8000	228	2517	61	50	77621	150461
	ROW %	12.42	0.53	14.12	19.06	5.32	0.15	1.67	0.04	0.03	51.59	
	COLUMN %	98.69	90.08	96.52	56.17	61.70	2.60	56.93	1.08	1.68	95.35	84.62
TWO		235	75	765	21945	4809	8158	1901	5338	2791	878	23958
	ROW %	0.98	0.31	3.19	91.60	20.07	34.05	7.93	22.28	11.65	3.66	
	COLUMN %	1.24	8.46	3.48	42.98	37.09	93.07	43.00	94.81	93.53	1.08	13.47
THREE		2	0	0	15	12	18	0	3	12	9	29
	ROW %	6.90	0.00	0.00	51.72	41.38	62.07	0.00	10.34	41.38	31.03	
	COLUMN %	0.01	0.00	0.00	0.03	0.09	0.21	0.00	0.05	0.40	0.01	0.02
FOUR		4	13	1	422	135	360	3	228	131	53	495
	ROW %	0.81	2.63	0.20	85.25	27.27	72.73	0.61	46.06	26.46	10.71	
	COLUMN %	0.02	1.47	0.00	0.83	1.04	4.11	0.07	4.05	4.39	0.07	0.28
MORE		0	0	0	0	0	0	0	0	0	1	1
	ROW %	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	100.00	
	COLUMN %	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
NONE		7	0	0	0	11	1	0	0	0	2844	2863
	ROW %	0.24	0.00	0.00	0.00	0.38	0.03	0.00	0.00	0.00	99.34	
	COLUMN %	0.04	0.00	0.00	0.00	0.08	0.01	0.00	0.00	0.00	3.49	1.61
TOTALS		18933	887	22013	51061	12967	8765	4421	5630	2984	81406	177807
	ROW %	10.65	0.50	12.38	28.72	7.29	4.93	2.49	3.17	1.68	45.78	

TABLE 22. NON-HIERARCHICAL GROUPS - NUMBER OF ENGINES VS. CAPABILITY GROUP (CONTINUED)

KEY

GROUP
- L: Localizer
- M: Marker beacon
- G: Glide slope
- R, RNAV: Area navigation system

GROUP
- W, WRAD: Weather radar
- I, LMG: Complete ILS system
- ALL: I, R and W
- NG: Non-grouped aircraft

TABLE 23. NON-HIERARCHICAL GROUPS - NUMBER OF SEATS VS. CAPABILITY GROUP

	I	L G	L M	LMG	RNAV	WRAD	I,R	I,W	ALL	M G	CNT
1 SEAT	221	14	19	76	76	4	4	1	1	9578	9979
ROW %	2.21	0.14	0.19	0.76	0.76	0.04	0.04	0.01	0.01	95.98	
COLUMN %	1.17	1.58	0.09	0.15	0.59	0.05	0.09	0.02	0.03	11.77	5.61
2 SEATS	7674	130	2708	1529	1644	34	75	8	5	35281	48534
ROW %	15.81	0.27	5.58	3.15	3.39	0.07	0.15	0.02	0.01	72.69	
COLUMN %	40.53	14.66	12.30	2.99	12.68	0.39	1.70	0.14	0.17	43.34	27.30
3 SEATS	708	17	104	46	187	8	3	3	3	8103	9140
ROW %	7.75	0.19	1.14	0.50	2.05	0.09	0.03	0.03	0.03	88.65	
COLUMN %	3.74	1.92	0.47	0.09	1.44	0.09	0.07	0.05	0.10	9.95	5.14
4 SEATS	8946	543	16245	21750	5042	157	1786	49	33	24457	73707
ROW %	12.14	0.74	22.04	29.51	6.84	0.21	2.42	0.07	0.04	33.18	
COLUMN %	47.25	61.22	73.80	42.60	38.88	1.79	40.40	0.87	1.11	30.04	41.45
5 SEATS	638	59	1281	3996	653	111	379	70	36	1794	7894
ROW %	8.08	0.75	16.23	50.62	8.27	1.41	4.80	0.89	0.46	22.73	
COLUMN %	3.37	6.65	5.82	7.83	5.04	1.27	8.57	1.24	1.21	2.20	4.44
6 SEATS	592	77	1590	14759	2940	2185	1823	1310	859	1344	18493
ROW %	3.20	0.42	8.60	79.81	15.90	11.82	9.86	7.08	4.65	7.27	
COLUMN %	3.13	8.68	7.22	28.90	22.67	24.93	41.24	23.27	28.79	1.65	10.40

TABLE 23. NON-HIERARCHICAL GROUPS - NUMBER OF SEATS VS. CAPABILITY GROUP (CONTINUED)

GROUP		L	LG	LM	LMG	RNAV	WRAD	I,R	I,W	ALL	NG	CNT
7 - 11 SEATS		108	21	51	6746	1880	4693	279	3095	1588	436	7373
	ROW %	1.46	0.28	0.69	91.50	25.50	63.65	3.78	41.98	21.54	5.91	
	COLUMN %	0.57	2.37	0.23	13.21	14.50	53.54	6.31	54.97	53.22	0.54	4.15
12 - 19 SEATS		26	3	10	687	167	482	25	348	128	263	1005
	ROW %	2.59	0.30	1.00	68.36	16.62	47.96	2.49	34.63	12.74	26.17	
	COLUMN %	0.14	0.34	0.05	1.35	1.29	5.50	0.57	6.18	4.29	0.32	0.57
20 - 49 SEATS		19	12	4	974	260	661	39	430	221	87	1104
	ROW %	1.72	1.09	0.36	88.22	23.55	59.87	3.53	38.95	20.02	7.88	
	COLUMN %	0.10	1.35	0.02	1.91	2.01	7.54	0.88	7.64	7.41	0.11	0.62
50 - UP SEATS		1	11	1	498	118	430	8	316	110	39	554
	ROW %	0.18	1.99	0.18	89.89	21.30	77.62	1.44	57.04	19.86	7.04	
	COLUMN %	0.01	1.24	0.00	0.98	0.91	4.91	0.18	5.61	3.69	0.05	0.31
NOT REPORTED		0	0	0	0	0	0	0	0	0	24	24
	ROW %	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	100.00	
	COLUMN %	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.03	0.01
TOTALS		18933	887	22013	51061	12967	8765	4421	5630	2984	81406	177807
	ROW %	10.65	0.50	12.38	28.72	7.29	4.93	2.49	3.17	1.68	45.78	

KEY

GROUP

L: Localizer

M: Marker beacon

G: Glide slope

R, RNAV: Area navigation system

GROUP

W, WRAD: Weather radar

I, LMG: Complete ILS system

ALL: I, R and W

NG: Non-grouped aircraft

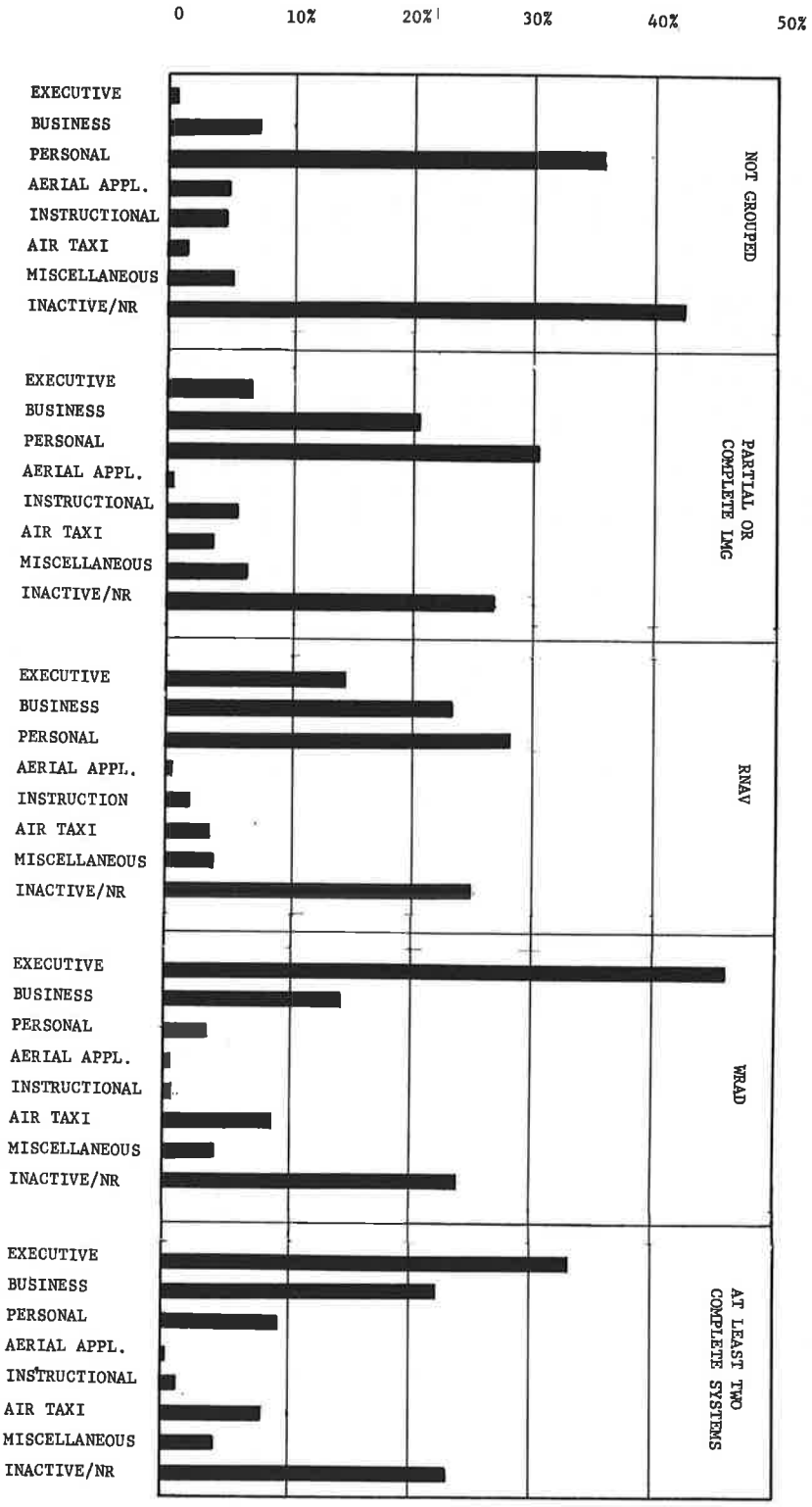


FIGURE 17. PERCENT DISTRIBUTION OF NON-HEIRARCHICAL CG'S BY PRIMARY USE

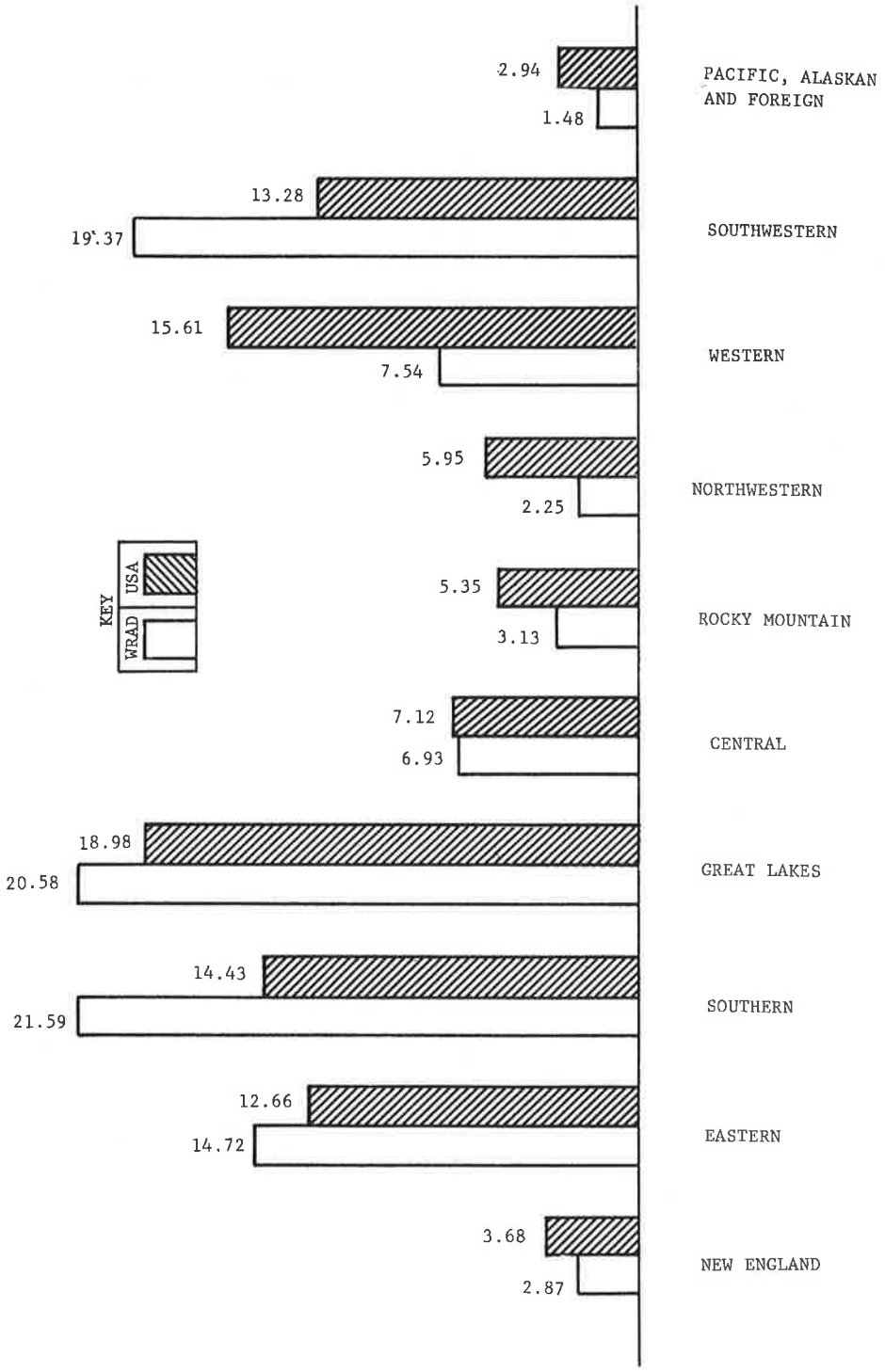


FIGURE 18. A COMPARISON OF THE PERCENT DISTRIBUTIONS OF WRAD EQUIPMENT AND ENTIRE GA FLEET BY FAA REGION

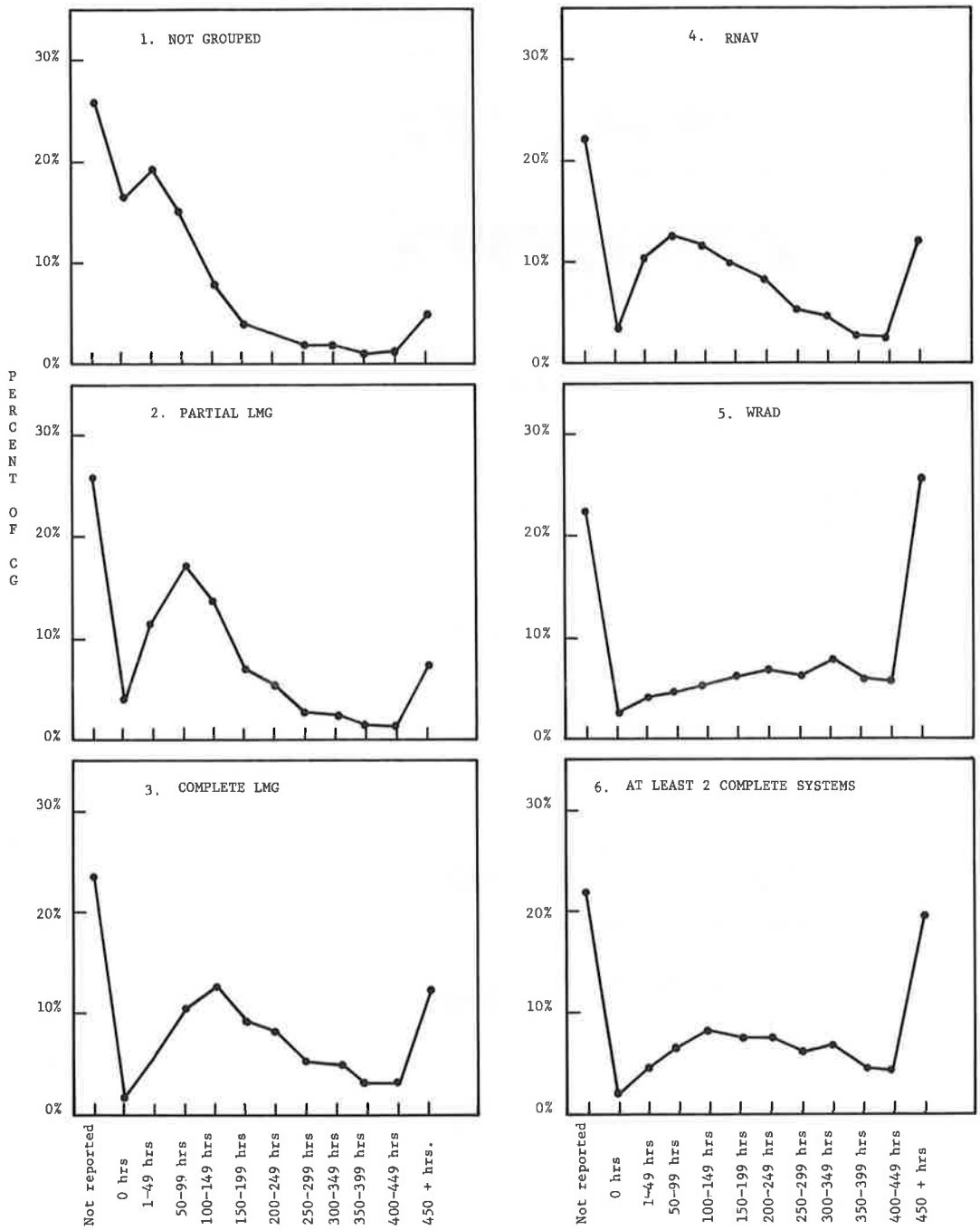


FIGURE 19. PERCENT DISTRIBUTION OF NON-HIERARCHICAL CG's BY ANNUAL HOURS FLOWN

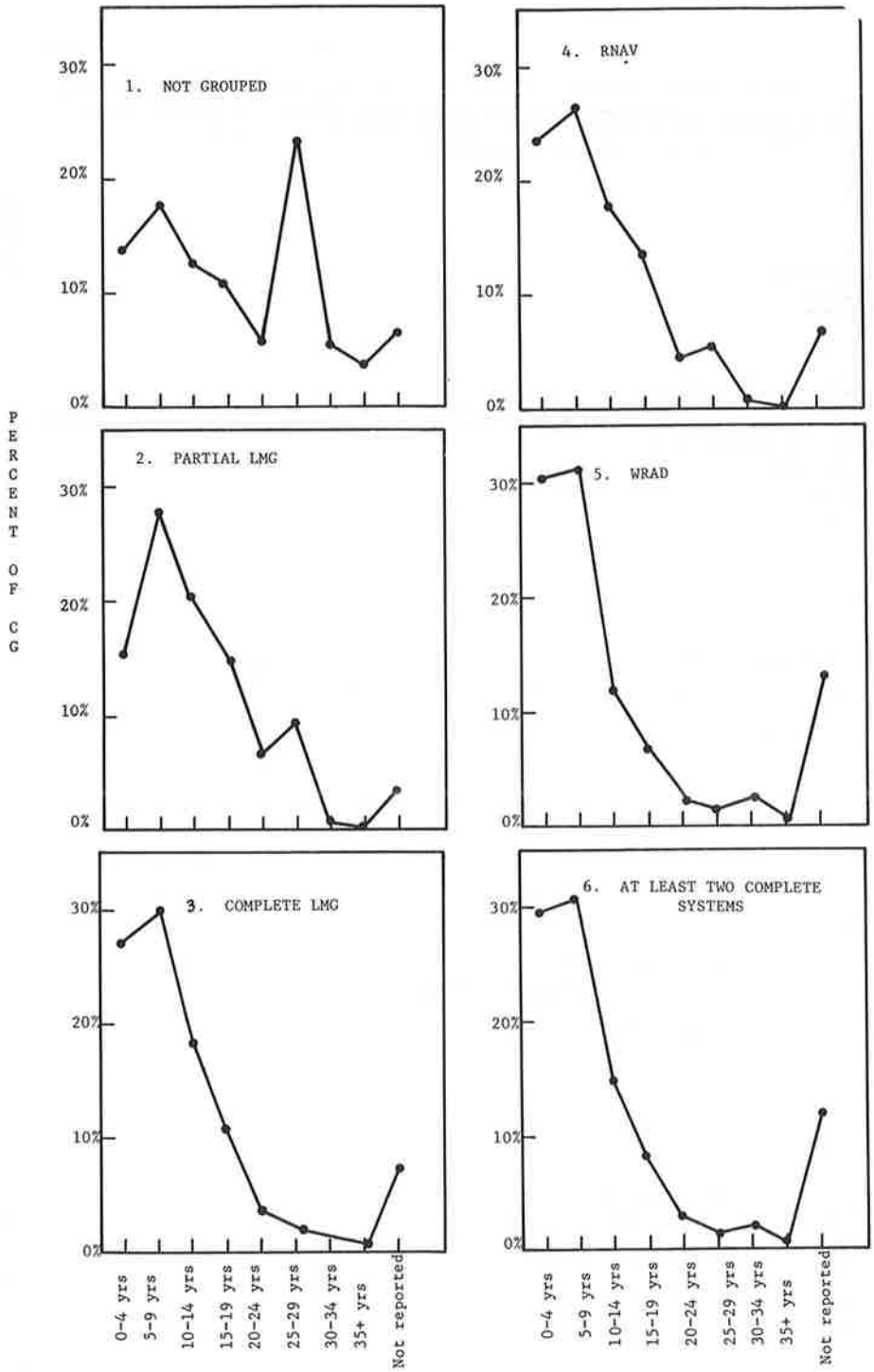


FIGURE 20. PERCENT DISTRIBUTION OF NON-HIERARCHICAL CG's BY AGE OF AIRCRAFT

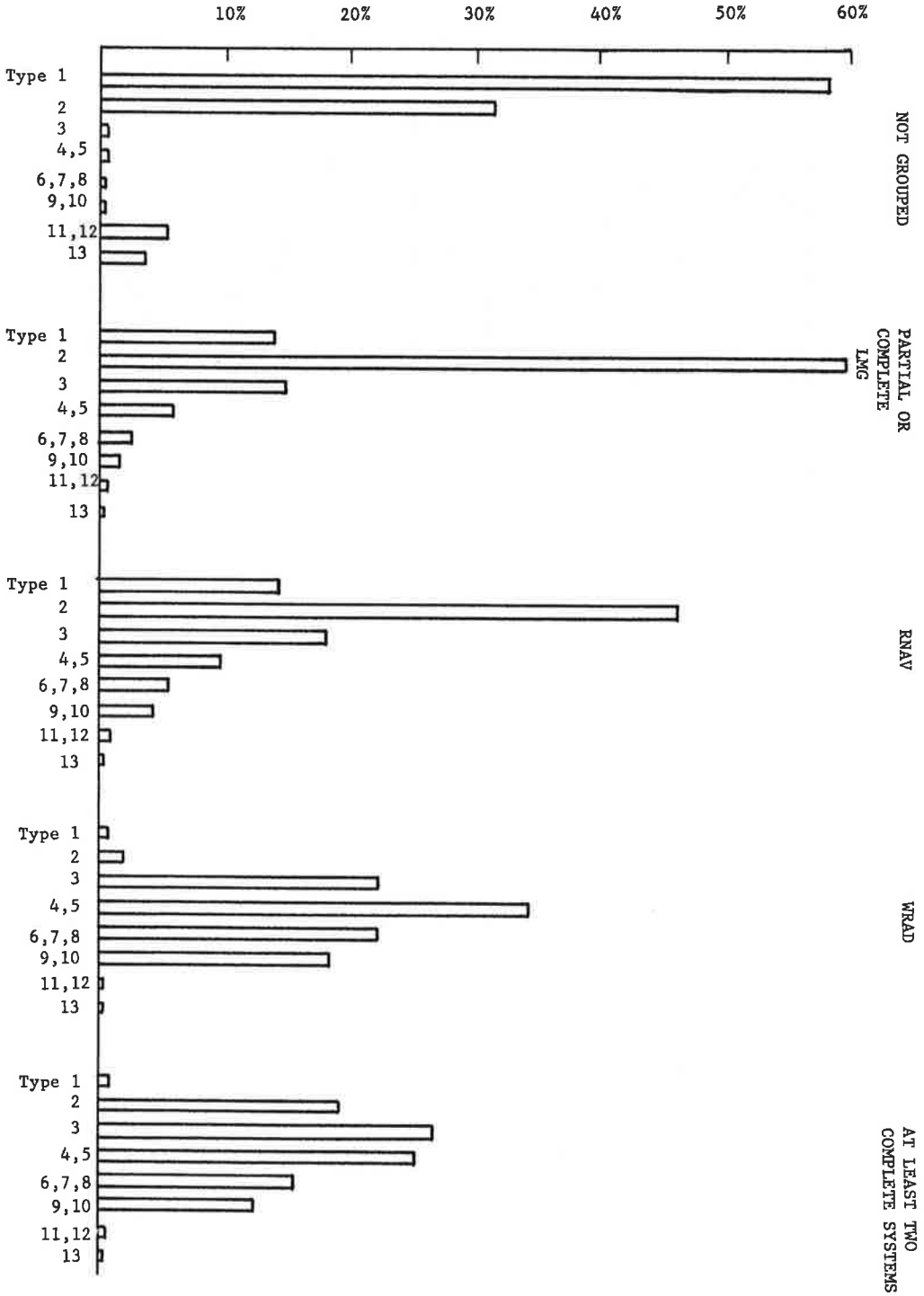


FIGURE 21. PERCENT DISTRIBUTION OF NON-HIERARCHICAL CG'S BY COMPUTED AIRCRAFT TYPE

3.3 SUBGROUPS OF HIERARCHICAL AND NON-HIERARCHICAL CAPABILITY GROUPS

Tables 24 and 25 are the results of an effort to identify for each CG subgroups of homogeneous aircraft. While each of Tables 6 through 23 broke out the CG's into subgroups based on one characteristic at a time, Tables 24 and 25 show subgroups of aircraft with more than one characteristic in common. This effort met with limited success because the aircraft within CG's were more diverse than expected. Only around 50 percent of the aircraft in any CG could be classified into non-overlapping subgroups of at least 3 percent in size. Entries in the tables are based on the aircraft in each CG considered useable, that is, the aircraft for which complete data on avionics and characterisitcs were available.

The study of the joint characteristics of the GA fleet yielded results similar to those obtained from the study of Tables 6 through 23. It can be seen from Tables 24 and 25 that the lower order hierarchical and non-hierarchical CG's contained subgroups of simple aircraft such as older fixed wing single engine piston aircraft with 1-3 seats which were not flown, and older personal use aircraft flown less than 100 hours. As the avionics in the CG's became more advanced, the aircraft types and primary uses became more sophisticated. Simultaneously, the amount of flying time increased and age decreased. Examination of the highest order CG's revealed subgroups of aircraft such as new turboprop aircraft and new twin engine aircraft used for executive purposes and flown more than 400 hours during the year. In Tables 24 and 25 the CG's and subgroups are arranged in order of increasing sophistication beginning with the simplest in the upper left hand corner of the report. The diagonal patterns in the tables indicate the strong relationship between increasing levels of avionics and sophistication in other aircraft characteristics.

TABLE 24. SUBGROUPS OF HIERARCHICAL CAPABILITY GROUPS

	CHARACTERISTICS				CAPABILITY GROUPS					
	PRIMARY USE	HOURS FLOWN	AGE IN YEARS	COMPUTED AIRCRAFT TYPE[1]	1	2	3	4	7	8
1		Not flown	0-25	1	1420/5.5%	209/3.1%				
2		Not flown	26+	1	4177/16.1%	308/4.4%	8488/13.1%			
3	Personal	1-100		1	5386/20.8%	1096/15.6%				
4	Personal	100-400		1		245/3.5%				
5		100-400	26+	1	922/3.6%					
6	Personal	100-400						9787/19.2%		1828/9.6%
7	Personal	1-100		2		179/2.5%	9557/14.8%	6118/12.0%		
8	Personal	1-100	0-10	13		383/5.4%				
9	Personal	1-100	0-10		1267/4.9%					
10	Aerial Application		0-10	1	1643/6.3%					
11	Personal	100-400		2			3993/6.2%			
12		1-100	11-25	2					374/7.5%	
13	Personal	100-400	0-10	2					470/9.4%	
14	Business		11-25	2			2427/3.8%	3439/6.7%		609/3.2%
15		100-400	0-10	1			3876/6.0%			
16		100-400	0-10	13		194/2.8%				
17		100-400	11-25	2					717/14.4%	
18		1-100	0-10	2					421/8.5%	
19	Business	100-400	0-10	2				2927/5.7%	447/9.0%	1281/6.7%
20	Air Taxi		0-10							1044/5.5%
21			0-10	11		545/7.7%				
22	Business	100-400	0-10	3						1267/6.6%
23	Executive	100-400	0-10	14						1454/7.6%
24		400+	0-10				3697/5.7%	4221/8.3%	458/9.2%	
25	Executive	400+	0-10	14						1460/7.7%
				TOTAL COUNTS	28,404	7,341	65,647	51,792	5,027	19,350
				Unuseable	2,520	298	993	773	47	285
				% in Subgroups[2]	57.2	45.0	49.6	51.9	58.0	46.9

1. Type
   1 Fixed wing single engine piston 1-3 seats
   2 Fixed wing single engine piston 4+ seats
   3 Fixed wing 2 engine piston 1-6 seats
   11 Piston Rotorcraft
   13 Other
   14 Fixed wing 2 engine
2. % is based on the capability group count minus the number of unuseable aircraft.

TABLE 25. SUBGROUPS OF NON-HIERARCHICAL CAPABILITY GROUPS

CHARACTERISTICS — CAPABILITY GROUPS

	PRIMARY USE	HOURS FLOWN	AGE IN YEARS	COMPUTED AIRCRAFT TYPE[1]	NG	L	LM	LMG	RNAV	WRAD	I,R	I,W	ALL
1		Not flown		1	7502/9.3%								
2		Not Flown		2	2250/2.8%								
3	Personal	1-100	26+	1	7103/8.8%	565/3.0%							
4	Personal	1-100	11-25			1874/10.0%		1849/3.7%			170/3.9%		
5	Personal	1-100	11-25	2			2536/11.6%						
6	Personal	1-100		2	7200/9.0%				1245/9.7%				
7		1-100	0-10	1	4194/5.2%	1003/5.4%							
8	Personal	100-400	11-25	2			2279/10.4%						
9	Personal	100-400		2	3186/4.0%								
10	Personal		0-10	2							377/8.6%		
11	Business	100-400	11-25	2			971/4.4%				154/3.5%		
12		100-400	0-10	1	4153/5.2%	1393/7.5%							
13		100-400	11-25	2		1318/7.1%		4018/8.0%	970/7.6%		348/8.0%		
14		1-100	0-10	2		796/4.3%	1600/7.3%	2702/5.4%					
15		400+	0-10	1	2368/2.9%	1294/6.9%							
16	Business	100-400	0-10	2							440/10.1%		
17		100-400	0-10	2		1301/7.0%	3082/14.1%	7952/15.8%	1173/9.2%				
18		100-400	11-25	3				2288/4.6%			268/6.1%		
19		400+	0-10	2		579/3.1%		2560/5.1%					
20	Business		0-10	3							364/8.3%		
21		100-400	0-10	3				3295/6.6%	768/6.0%	771/9.1%		447/8.2%	324/11.1%
22		400+	0-10	3						345/4.1%		221/4.0%	123/4.2%
23			0-10	4				2027/4.0%	718/5.6%	1413/16.6%		802/14.7%	605/20.8%
24			0-10	6					513/4.0%	1159/13.6%		676/12.4%	482/16.6%
				TOTAL COUNTS	81,406	18,933	22,013	51,061	12,967	8,765	4,421	5,630	2,984
				Unuseable	1,004	244	136	845	173	256	60	171	78
				% in Subgroups[2]	47.2	54.3	47.8	53.2	42.1	43.4	48.5	39.3	52.7

1. Type
   1 Fixed wing single engine piston 1-3 seats
   2 Fixed wing single engine piston 4+ seats
   3 Fixed wing 2 engine piston 1-6 seats
   4 Fixed wing 2 engine piston 7+ seats
   6 Fixed wing 2 engine turboprop 1-12 seats

2. % is based on the capability group count minus the number of unuseable aircraft.

Data Element	Field Description	Position	Length	Comments
1. N-Number	A/N	1-5	5	Left adjusted.
2. Serial Number	A/N	6-20	15	Right adjusted.
3. Aircraft				
Manufacturer	N	21-23	3	Type Codes: 1 - Glider; 2 - Balloon; 3 - Blimp/Dirigible; 4 - Fixed Wing Single; 5 - Fixed Wing Multi Engine; 6 - Rotorcraft
Model	N	24-25	2	
Series	A/N	26-27	2	
Type	N	28	1	
4. Engine				
Type	N	29	1	Type Codes: 1 - Reciprocating; 2 - Turbopropeller; 3 - Turboshaft; 4 - Turbojet; 5 - Turbine Air Generator; 6 - Ram Jet; 9 - Unknown
Manufacturer	N	30-32	3	
Model	N	33-34	2	
5. Engine Horse Power (each)	N	35-39	5	Lbs. of thrust for turbo only.
6. Number of Engines	N	40-41	2	
7. Number of Seats	N	42-44	3	
8. Weight	N	45-51	7	Maximum gross takeoff
9. Cruise Speed	N	52-55	4	75% of average cruising speed X hours flown = miles flown
10. Wing Code	A/N	56	1	1 - Low Wing 2 - High Wing 3 - Biwing

Data Element	Field Description	Position	Length	Comments
11. Aircraft Category Code	N	57	1	1 - Land 2 - Sea 3 - Amphibian
12. Amateur Certification Code	A/N	58	1	Blank - Not Amateur 1 - Amateur Certification
13. Fuel Consumed	N	59-64	6	Fuel consumed per engine. Gallons of fuel consumed per hour, recorded in 2 decimal positions, decimal assumed.
14. Airworthiness Class	N	65	1	1 - Standard 2 - Limited 3 - Restricted 4 - Experimental 5 - Provisional 6 - Multiple 8 - Special Flight Permit
15. Approved Operations Code	A/N	66	1	See Enclosure 1
16. Year Manufactured	N	67-68	2	ØØ if Unknown

Data Element	Field Description	Position	Length	Comments
17. G/A Indicator	A/N	69	1	1 - Air Carrier Aircraft Type Unknown X - Air Carrier Aircraft Type Passenger Y - Air Carrier Aircraft Type Passenger/Cargo Z - Air Carrier Aircraft Type Cargo 2 - General Aviation Aircraft D - Dealer Aircraft 3 - General Aviation Aircraft continuous maintenance
18. Type of Registrant	A/N	70	1	1 - Individual 2 - Partnership 3 - Corporation 4 - Coownership 5 - Government
19. Base Airport ID	A/N	71-75	5	
20. Base Airport				
Region	A/N	76	1	
State	N	77-78	2	
GADO	A	79-81	3	
County	N	82-84	3	
Site	A/N	85-93	9	

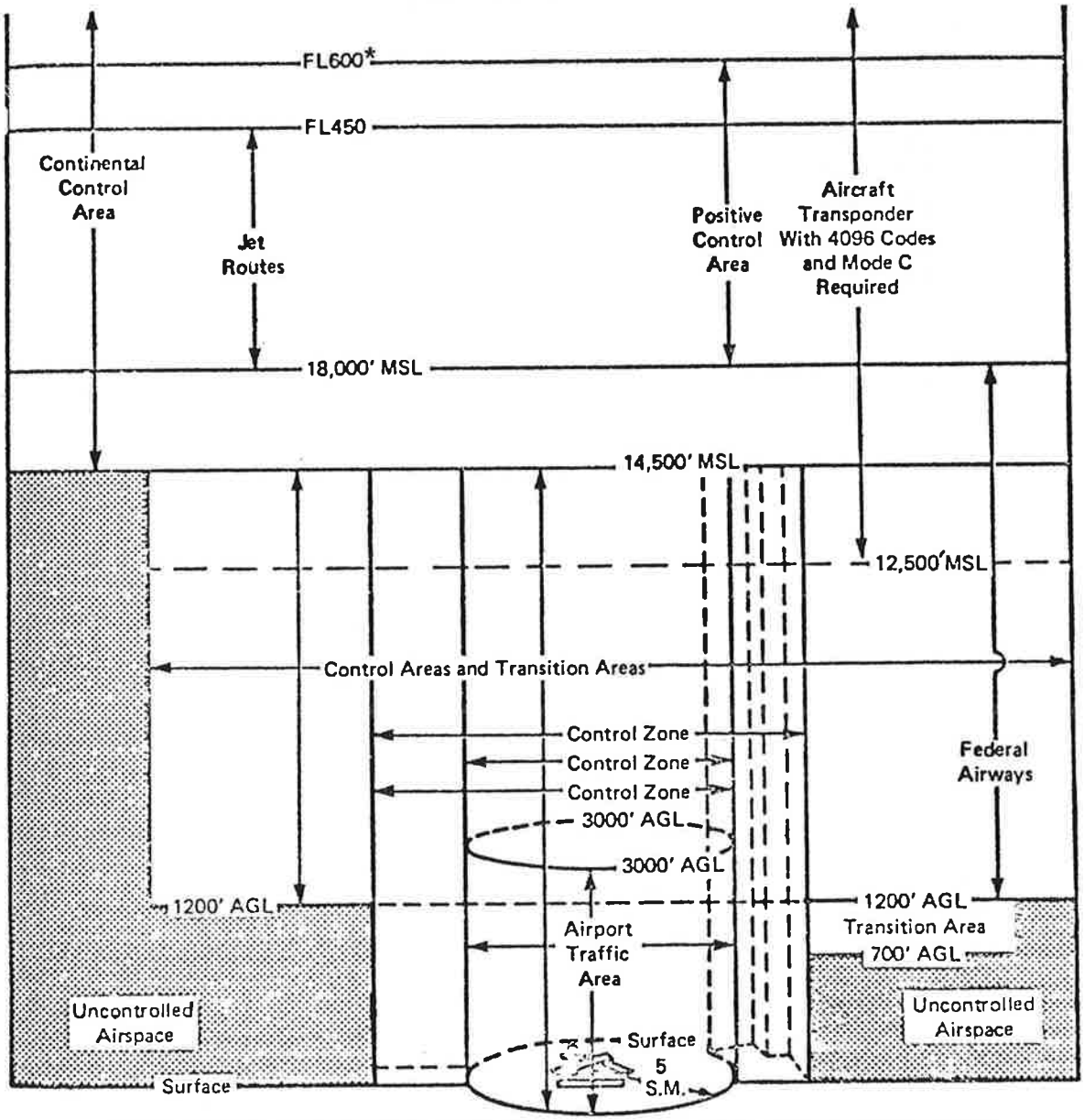
Data Element	Field Description	Position	Length	Comments
21. Owner				
Zip	N	94-98	5	
Region	A/N	99	1	
State	N	100-101	2	
GA Distr. Office	A	102-104	3	
County	N	105-107	3	
22. Operator				
Zip	N	108-112	5	
Region	A/N	113	1	
State	N	114-115	2	
GADO	A	116-118	3	
County	N	119-121	3	
23. Hours Flown by Use				
Executive	A/N	122-125	4	Distribution of previous owner's hours included in other 9 use categories
Business	A/N	126-129	4	
Personal	A/N	130-133	4	
Aerial Application	A/N	134-137	4	
Instructional	A/N	138-141	4	
Air Taxi	A/N	142-145	4	
Industrial/Special	A/N	146-149	4	
Rental	A/N	150-153	4	
Other	A/N	154-157	4	
Previous Owner	A/N	158-161	4	
24. Not Flown	A	162	1	1 - Inactive blank - Active

Data Element	Field Description	Position	Length	Comments
25. Primary Use	N	163	1	Ø - Unknown or Not Reported 1 - Executive 2 - Business 3 - Personal 4 - Aerial Application 5 - Instruction 6 - Air Taxi 7 - Industrial/Special 8 - Aircraft Rental Business 9 - Other
26. Communication Equipment				
VHF Tuner	N	164	1	Blank - Not Reported, 1 - Yes, 0-None
VHF Receiver	N	165	1	Blank - Not Reported, 0-None 1 - 180 channels or less 2 - 181 channels or more
VHF Transmitter	N	166	1	Blank - Not Reported 1 - 20 channels or less 2 - 21 through 180 channels 3 - 181 channels or more 0 - none
27. ILS				
Localizer	N	167	1	Blank - Not Reported, 1 -Yes, 0-None
Glide Slope	N	168	1	Blank - Not Reported, 1 -Yes, 0-None
Marker Beacon	N	169	1	Blank - Not Reported, 1 -Yes, 0-None

Data Element	Field Description	Position	Length	Comments
28. Transponder				
64 or 4096 code	N	170	1	Blank - Not Reported, 0-None 1 - 64 codes 2 - 4096 codes
Altitude Reporting	N	171	1	Blank - Not Reported, 1 - Yes, 0 - None
29. Navigational Equipment				
VOR	N	172	1	Blank - Not Reported, 0-None 1 - One 2 - More than One
DME	N	173	1	Blank - Not Reported, 1 - Yes, 0 - None
ADF	N	174	1	Blank - Not Reported, 1 - Yes, 0 - None
Weather Radar	N	175	1	Blank - Not Reported, 1 -Yes, 0-None
Area Navigation	N	176	1	Blank - Not Reported, 1 - Yes, 0 - None
30. Certification Issue Date				
Month	N	177-178	2	
Day	N	179-180	2	
Year	N	181-182	2	
31. Date Entered System				
Month	N	183-184	2	
Day	N	185-186	2	
Year	N	187-188	2	
32. Statistical Year	N	189-190	2	

Data Element	Field Description	Position	Length	Comments
33. Imputed Hours	N	191	1	1 - Yes(Imputed) Ø - No(Reported)
34. Imputed Airport	N	192	1	1 - Yes(Imputed) Ø - No(Reported)
35. Type Aircraft Sort	A/N	193-195	3	
36. Aircraft Manufacturer Name	A/N	196-225	30	
37. Aircraft Model & Series Name	A/N	226-245	20	
38. Engine Manufacturer Name	A/N	246-255	10	
39. Engine Model Name	A/N	256-268	13	
40. Airport State Name	A	269-283	15	
41. Airport County Name	A	284-305	22	
42. Airport Name	A	306-335	30	
43. Blank	A	336	1	
44. Random Number	A/N	337-342	6	
45. Engine Sort Code	N	343	1	
46. Total Recalcitrant	N	344	1	
47. Total Airframe Hours	N	345-349	5	
48. Blank	A	350-354	5	

APPENDIX B. AIRSPACE STRUCTURE



General Dimensions of Control Zones, Airport Traffic Areas, and the Vertical Extent of Airspace Segments

* FL600 means "Flight Level 60,000 feet MSL"

Airman's Information Manual, Basic Flight Manual and ATC Procedures, Part 1, (May, 1976), p. 1-23.

APPENDIX B. (CONTINUED)

Summary of Major Airspace Designated Areas

Designation	Measure	Present system 1975	Future system	
			In plan 1976-85	Total 1985
En route:				
Jet routes	Number	216	−66	150
Jet area navigation routes	Number	163	+47	200
Low altitude routes:				
Low frequency	Number	24	−24	0
VHF/UHF	Number	462	−214	248
Area navigation VHF	Number	8	+192	200
Area positive control	Altitude (FL)			
Conterminous U.S.		180-600	——	180-600
Alaska		240-600	——	240-600
Parallel	Number	0	+500	500
Three dimensional	Number	0	+1000	1000
Terminal:				
Control zones	Number	806	+287	1093
Transition areas	Number	1,495	−9	1486
Control area extension	Number	1	——	1
Terminal control areas (Group I & II)	Number	18	3	21
STARs/SIDs	Number	414	−239	175
RNAV STARs/SIDs	Number	2	+448	450
Special use:				
Prohibited areas	Number	7	+2	9
	Square Miles	1,626	——	——
Restricted areas	Square Miles	77,639	——	——
Joint use	Number	163	+6	169
Nonjoint use	Number	29	−18	11
Warning areas	Number	68	−33	35
	Square Miles	408,970	——	——
Alert areas	Number	35	−5	30
Jet training areas	Number	35	−5	30
	Square Miles	87,183	——	——

The National Aviation System Plan Fiscal Years 1976-1985, (March, 1975), p. 6-3.

Airborne Equipment Requirements

Types of Airspace	Flight condition	Equipment Requirements 1975	1985
Uncontrolled	VFR (day)	1. Airspeed indicator 2. Altimeter 3. Compass 4. Tachometer 5. Oil temperature 6. Emergency locator transmitter [1] 7. Manifold pressure 8. Fuel gage 9. Landing gear 10. Belts 11. Special equipment for over water flights (FAR 91.33)	Same as 1975
Uncontrolled	VFR (night)	All above plus: 1. Position lights 2. Anti-collision light 3. Landing light (if for hire) 4. Electrical source	Same as 1975
Uncontrolled	IFR	Same as VFR plus: 1. Two-way radio 2. Navigation system 3. Gyro turn/bank 4. Sensitive altimeter adjustable for barometric pressure 5. Clock with sweep second hand 6. Artificial horizon 7. Directional gyro or equivalent 8. Generator	Same as 1975
Controlled (non-positive)	VFR	Same as uncontrolled VFR plus transponder [2]	Same as 1975
	IFR	Same as uncontrolled IFR plus transponder [2]	Same as 1975
Positive control	VFR	Requires prior ATC approval	Same as 1975
	IFR	Same as uncontrolled IFR plus: 1. DME (if VOR/TACAN equipment carried) 2. Transponder [2] 3. VOR (In TCA's) 4. ADF (Air Carrier only) 5. ILS (Air Carrier only)	Same as 1975

[1] Does not apply to turbojet aircraft, scheduled air carriers (except charter), or certain training and agricultural flights.

[2] 4096 code, Mode 3A transponder with Mode C automatic altitude reporting capability will be required at Group I and II TCA Locations and in APC, and in controlled airspace of the 48 States above 12,500 feet. All non-participating aircraft operating within Group III TCA's will be transponder equipped with Mode C capability.

The National Aviation System Plan Fiscal Years 1976-1985, (March, 1975), p. 13-5.

National Terminal Radar Programs

Location	Terminal airspace designation	Equipment Requirements		Services provided
		Present	Under Consideration	
Top 9 Large Hub locations.	Group I TCA	(Effective Jan 1. 1975) 4096 Code Transponder and Mode C Automatic Altitude Reporting Capability; Two-way Radio; VOR or TACAN Receiver.	Relaxation of Transponder Requirements During Periods of Low Activity.	TCA Procedures
Next 12 Large Hub locations	Group II TCA	(Effective July 1, 1975) 4096 Code Transponder and Mode C Automatic Altitude Reporting Capability; Two-way Radio; VOR or TACAN Receiver.	Deletion of Altitude Encoding Requirement. (Has been Deleted)	TCA Procedures
Remaining 42 ARTS-III locations.	Group III TCA	(Effective July 1, 1975) 4096 Code Transponder and Mode C Automatic Altitude Reporting Capability *or* Two-way Radio Communications.		TCA Procedures
All other radar facilities	TRSA where Stage III service is provided	----------		Stage II or III service

The National Aviation System Plan Fiscal Years 1976-1985, (March, 1975), p. 6-4.

Designated Terminal Airspace (All ARTS-III Locations); Terminal Control Areas

GROUP I	Date designated or planned	GROUP II	Date designated or planned
1. Atlanta	June 1970	1. St. Louis	Jan. 1974
2. Chicago	Aug. 1970	2. Seattle	Jan. 1974
3. Washington National	Feb. 1971	3. Minneapolis	Feb. 1974
4. New York (LGA, JFK, EWR)	Sept. 1971	4. Denver	Mar. 1974
5. Los Angeles	Sept. 1971	5. Houston	Mar. 1974
6. San Francisco	Dec. 1972	6. Cleveland	May 1974
7. Boston	Feb. 1973	7. Detroit	May 1974
8. Miami	Apr. 1973	8. Pittsburgh	May 1974
9. Dallas	Jan. 1974	9. Las Vegas	Nov. 1974
		10. Philadelphia	Mar. 1975
		11. Kansas City	Mar. 1975
		12. New Orleans	Jul. 1975

Group III Terminal Areas (42 locations)

Albany	El Paso	Omaho	San Diego
Albuquerque	Hartford	Orlando	San Juan
Baltimore	Honolulu	Portland, Oreg.	Santa Ana/Long Beach
Birmingham	Indianapolis	Phoenix	Shreveport
Buffalo	Jacksonville	Providence	Syracuse
Burbank	Louisville	Raleigh-Durham	Tampa
Charlotte	Memphis	Ontario, California	Tucson
Cincinnati	Milwaukee	Rochester, N.Y.	Tulsa
Columbus, Ohio	Nashville	Sacramento	Washington-Dulles
Dayton	Norfolk	Salt Lake City	
Des Moines	Oklahoma City	San Antonio	

The National Aviation System Plan Fiscal Years 1976-1985, (March, 1975), p. 6-5.

GLOSSARY*

Aerial Application - Aerial application in agriculture consists of those activities that involve the discharge of materials from aircraft in flight and a miscellaneous collection of minor activities that do not require the distribution of any materials.

Air Carrier - The term "Air Carrier", as used in this report, refers to aircraft operators certified by the Federal Aviation Administration for the transportation by air of persons, property, and mail.

Air Carrier Operations - Aircraft operations under certificates of public convenience and necessity, issued by the CAB, authorizing the performance of scheduled air transportation over specified routes and a limited amount of nonscheduled operations.

Airport Advisory Area - The area within five statute miles of an airport not served by a control tower, i.e., there is no tower or the tower is not in operation, on which is located a Flight Service Station.

Airport Traffic Area - Unless otherwise specifically designated in FAR Part 93, that airspace within a horizontal radius of 5 statute miles from the geographical center of any airport at which a control tower is operating, extending from the surface up to, but not including, an altitude of 3,000 feet above the elevation of the airport. Unless otherwise authorized or required by ATC, no person may operate an aircraft within an airport traffic area except for the purpose of landing at, or taking off from, an airport within that area. ATC authorization may be given as individual approval of specific operations or may be contained in written agreements between airport users and the town concerned. (Refer to FAR Parts 1 and 91.)

Airport Traffic Control Tower - A central operations facility in the terminal air traffic control system, consisting of tower cab structure, including an associated common IFR room if radar equipped, using air/ground communications and/or radar, visual signalling and other devices, to provide safe and expeditious movement of terminal air traffic.

*These definitions have been taken from the following three sources: Airman's Information Manual, Part 1, Census of U.S. Civil Aircraft, Calendar Year 1975, and FAA Air Traffic Activity, Calendar Year 1975.

Air Taxi Operations - Air taxi operations and commuter air carrier operations (takeoffs and landings) carrying passengers, mail or cargo for revenue in accordance with FAR Part 135 or Part 121.

Airway/Federal Airway - A control area or portion thereof established in the form of a corridor, the centerline of which is defined by radio navigational aids. (Refer to FAR Part 7.)

Alititude - The height of the level, point or object measured in feet Above Ground Level (AGL) or from Mean Sea Level (MSL).

1. MSL Altitude - Altitude, expressed in feet measured from mean sea level.

2. AGL Altitude - Altitude, expressed in feet measured above ground level.

3. Indicated Altitude - The altitude as shown by an altimeter. On a pressure or barometric altimeter it is altitude as shown uncorrected for instrument error and uncompensated for variation from standard atmospheric conditions.

Area Navigation/RNAV - A method of navigation that permits aircraft operations on any desired course within the coverage of station-referenced navigation signals or within the limits of self-contained system capability. (Refer to FAR Part 71.)

a. Area Navigation Low Route - An area navigation route within the airspace extending upward from 1,200 feet above the surface of the earth to, but not including, 18,000 feet MSL.

b. Area Navigation High Route - An area navigation route within the airspace extending upward from and including 18,000 feet MSL to flight level 450.

c. Random Area Navigation Routes/Random RNAV Routes - Direct routes, based on area navigation capability, between waypoints, defined in terms of degree/distance fixes or offset from published or established routes/airways at specified distance and direction.

d. RNAV Waypoint/W/P - A predetermined geographical position used for route or instrument approach definition or progress reporting purposes that is defined to a VORTAC station position.

Automatic Altitude Reporting - That function of a transponder which responds to Mode C interrogations by transmitting the aircraft's altitude in 100-foot increments.

Automatic Direction Finder/ADF - An aircraft radio navigation system which senses and indicates the direction to a L/MF nondirectional radio beacon (NDB) ground transmitter. Direction is indicated to the pilot as a magnetic bearing or as a relative bearing to the longitudinal axis of the aircraft depending on the type of indicator installed in the aircraft. In certain applications, such as military, ADF operations may be based on airborne and ground transmitters in the VHF/UHF frequency spectrum.

Balloon - A lighter-than-air aircraft that is not engine driven.

Business Transportation - Any use of an aircraft not for compensation or hire by an individual for the purposes of transportation required by a business in which he is engaged.

Certificated Pilot - A person who holds a certificate issued by FAA, which qualifies him to operate aircraft within the limitations prescribed on the certificate.

Colored (L/MF) Airway - Low altitude airway over the state of Alaska predicated on L/MF navigation aids. It is depicted on aeronautical charts by color and number.

Continental United States - The 49 states located on the continent of North America and the District of Columbia.

Conterminous U.S. - The forty-eight adjoining states and the District of Columbia.

Controlled Airport - An airport at which a control tower is in operation.

Controlled Airspace - Airspace, designated as a continental control area, control area, control zone, terminal control area, or transition area, within which some or all aircraft may be subject to air traffic control (Refer to FAR Part 71).

Types of U.S. Controlled Airspace:

a. Continental Control Area - The airspace of the 48 contiguous states, the District of Columbia and Alaska, excluding the Alaska peninsula west of Long. 160 00'00"W at and above 14,500 MSL, but does not include:

   1. The airspace less than 1,500 feet above the surface of the earth or,

   2. Prohibited and restricted areas, other than the restricted areas listed in FAR Part 71.

b. Control Area - Airspace designated as Colored Federal Airways, VOR Federal Airways, Terminal Control Areas, Additional Control Areas, and Control Area Extensions, but not including the Continental Control Area. Unless otherwise designated, control areas also include the airspace between a segment of a main VOR airway and its associated alternate segments. The vertical extent of the various categories of airspace contained in control areas are defined in FAR Part 71.

c. Control Zone - Controlled airspace which extends upward from the surface and terminates at the base of the continental control area. Control zones that do not underlie the continental area have no upper limit. A control zone may include one or more airports and is normally a circular area within a radius of 5 statute miles and any extensions necessary to include instrument approach and departure paths.

d. Terminal Control Area/TCA - Controlled airspace extending upward from the surface or higher to specified altitudes within which all aircraft are subject to operating rules and pilot and equipment requirements specified in FAR Part 91. TCA's are depicted on Sectional, World Aeronautical, En Route Low Altitude and TCA charts. (Refer to FAR Part 91).

e. Transition Area - Controlled airspace extending upward from 700 feet or more above the surface of the earth when designated in conjunction with an airport for which an approved instrument approach procedure has been prescribed, or from 1,200 feet or more above the surface of the earth when designated in conjunction with airway route structures or segments. Unless otherwise limited, transition areas terminate at the base of the overlying controlled airspace. Transition areas are designed to contain IFR operations in controlled airspace during portions of the terminal operations and while transiting between the terminal and en route environment.

Dirigible - A lighter-than-air aircraft, engine propelled, with an inward metal frame which maintains its shape.

Distance Measuring Equipment/DME - Equipment (airborne and ground) used to measure, in nautical miles, the slant range distance of an aircraft from the DME navigation aid.

En Route - The route of flight from point of departure to point of destination, including intermediate stops (excludes local operations).

GLOSSARY (CONTINUED)

Executive Transportation - Any use of an aircraft by a corporation, company or other organization for the purposes of transporting its employees and/or property not for compensation or hire and employing professional pilots for the operation of the aircraft.

FAA - Federal Aviation Administration.

Fixed-Wing Aircraft - Aircraft having wings fixed to the airplane fuselage and outspread in flight, i.e., nonrotating wings.

Flight Service Station/FSS - Air Traffic Service facilities within the National Airspace System (NAS) which provide preflight pilot briefing and en route communications with VFR flights, assist lost IFR/VFR aircraft, assist aircraft having emergencies, relay ATC clearances, originate, classify, and dissemninate Notices to Airmen, broadcast aviation weather and NAS information, receive and close flight plans, monitor radio NAVAIDS, notify search and rescue units of missing VFR aircraft, and operate the national weather teletypewriter systems. In addition, at selected locations FSS's take weather observations, issue airport advisories, administer airman written examinations, advise Customs and Immigrations of transborder flight.

General Aviation/GA - That portion of civil aviation which encompasses all facets of aviation except air carriers holding a certificate of public convenience and necessity from the Civil Aeronautics Board, and large aircraft commercial operators.

General Aviation Aircraft - All civil aircraft except those classified as air carrier.

Group I Terminal Control Area - A TCA representing one of the nine busiest locations in the U.S. in terms of aircraft operations and passengers carried within which it is necessary for safety reasons to have strict requirements for operation.

Group II Terminal Control Area - A TCA representing one of the twelve less busy locations than a Group I TCA and requiring less stringent pilot and equipment requirements.

Group III Terminal Control Area - One of the 43 least busy TCA's where an ARTS-III system exists.

IFR Conditions - Weather conditions below the minimum for flight under visual rules.

Industrial/Special - Any use of an aircraft for specialized work allied with industrial activity; excluding transportation and aerial application. (Examples: pipe line patrol; survey; advertising; photography; helicopter hoist; etc.)

Instructional Flying - Any use of an aircraft for the purposes of formal instruction with the flight instructor aboard, or with the maneuvers on the particular flight(s) specified by the flight instructor.

Instrument Flight Rules/IFR - Rules governing the procedures for conducting instrument flight. Also a term used by pilots and controllers to indicate type of flight plan (See Visual Flight Rules).

Instrument Landing System/ILS - A precision instrument approach system consisting of the following electronic components and visual aids:

a. Localizer
b. Glide Slope
c. Outer Marker
d. Middle Marker
e. Approach Lights

Refer to FAR Part 91.

Jet Route - A route designed to serve aircraft operations from 18,000 feet MSL up to and including flight level 450. The routes are referred to as "J" routes with numbering to identify the designated route, e.g., J 105. (Refer to FAR Part 71.)

Low Altitude Airway Structure/Federal Airways - The network of airways serving aircraft operations up to but not including 18,000 feet MSL. (See Airway.)

Microwave Landing System/MLS - An instrument landing system operating in the microwave spectrum which provides lateral and vertical guidance to aircraft having compatible avionics equipment. (See Instrument Landing System.)

Non-Positive Controlled Airspace - Controlled airspace below 18,000 feet MSL.

Personal and Pleasure Flying - Any use of an aircraft for personal purposes not associated with business or profession, and not for hire. This includes maintenance of pilot proficiency.

Pilot Briefing - Information furnished a pilot to assist in flight planning. Principal items are weather conditions, notices to airmen, routes, and preparation and handling of the flight plan.

Piston-Powered Aircraft - An aircraft operated by engines in which pistons moving back and forth work upon a crank shaft or other device to create rotational movement.

Positive Controlled Area/PCA - Airspace designated in Far Part 71 wherein aircraft are required to be operated under Instrument Flight Rules (IFR). Vertical extent of PCA is from 18,000 feet to and including flight level 600 throughout most of the conterminous United States and from flight level 240 to and including flight level 600 in designated portions of Alaska.

Radio Altimeter/Radar Altimeter - Aircraft equipment which makes use of the reflection of radio waves from the ground to determine the height of the aircraft above the surface.

Region (FAA) - A principal subdivision of the Federal Aviation Administration organized to carry out FAA programs under the executive direction of a regional director within the specific geographic boundaries.

Registered Aircraft - Aircraft registered with FAA.

Rotorcraft - A heavier-than-air aircraft that derives lift from one or more revolving "wings" or blades, engine-driven about an approximately vertical axis. A rotorcraft does not have conventional fixed wings, nor in any but some earlier models is provided with a conventional propeller, forward thrust and lift being furnished by the rotor. The powered rotor blades also enable the machine to hover, and to land and take off vertically.

Transponder - The airborne radar beacon receiver/transmitter portion of the Air Traffic Control Radar Beacon System (ATCRBS), which automatically receives signals from interrogations being received on the mode to which it is set to respond.

Turbine-Powered Aircraft - Includes aircraft with either turbojet, turbofan, turboprop, or turboshaft engines.

Turbojet - Aircraft operated by jet engines incorporating a turbine-driven air compressor to take in and compress the air for the combustion of fuel, the gases of combustion (or the heated air) being used both to rotate the turbine and to create a thrust-producing engine.

Turboprop - Aircraft in which the main propulsive force is supplied by a gas turbine-driven conventional propeller. Additional propulsive force may be supplied from the discharge turbine engine gas.

Uncontrolled Airport - Also known as a non-tower airport, an airport at which no control tower is in operation. It may have an FSS, UNICOM operator, or no facility at all.

Uncontrolled Airspace - That portion of the airspace that has not been designated as continental control area, control area, control zone, terminal control area, or transition area. (See Controlled Airspace)

UNICOM - A non-government air/ground radio communication facility, which may provide airport advisory service at certain airports. Locations and frequencies of UNICOM's are shown on aeronautical charts and publications.

U.S. Civil Aircraft Fleet - All aircraft under U.S. registry exclusive of Military.

Visual Flight Rules/VFR - Rules that govern the procedures for conducting flight under visual conditions. The term "VFR" is also used in the United States to indicate weather conditions that are equal to or greater than minimum VFR requirements. In addition, it is used by pilots and controllers to indicate type of flight plan. (See Instrument Flight Rules). (Refer to FAR Part 91.)

VOR Airway - Low altitude airway designated from 1,200 feet AGL to 18,000 feet MSL predicated on VOR/VORTAC navigation aids. Also known as a "Victor" airway, it is indicated by a "V" on aeronautical charts and is numbered similarly to the U.S. highway system.

VOR/Very High Frequency Omnidirectional Range Station - A ground-based electronic navigation aid transmitting very high frequency navigation signals, 360 degrees in azimuth, oriented from magnetic north. Used as the basis for navigation in the national airspace system. The VOR periodically identifies itself by morse code and may have an additional voice identification feature. Voice features may be used by ATC or FSS for transmitting instructions/information to pilots.

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