

**ACCEPTABLE METHOD OF COUNTING
AIRCRAFT OPERATIONS AT
NON-TOWER AIRPORTS**

FINAL REPORT

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INTRODUCTION

Accurate information on aircraft activity at non-towered airports is of significant concern to airport owners and operators as well as to those responsible for planning, developing, and administering these facilities. Unfortunately, without on-site air traffic controllers it is not possible to accurately record aircraft activities. Certain planning functions require estimates of airport activities to facilitate the programming of airport improvements. Historically, the process of forecasting future airport activities through the use of airport operation counts has been relatively imprecise, at best. Having reliable aircraft activity counts provides obvious benefits—better information can reduce the risks involved with facility investment decisions. This involves decision-making for capital improvements, design criteria, and operating costs.

This report summarizes the current state-of-the-practice for counting airport operations at non-towered airports. Five primary areas are addressed: 1) current procedures for counting airport activity, 2) current data collection practices in Iowa and other midwestern states, 3) review of existing literature and research on this topic, 4) available technology and technology providers, and 5) alternatives and recommendations for future data collection.

CURRENT PROCEDURES FOR COUNTING AIRCRAFT ACTIVITY AT NON-TOWERED AIRPORTS (1)

Several methods have been used to collect sample operations data. These include visual observations, pneumatic tube counters, inductance loop counters, and acoustical counters. Each method has its strengths and weaknesses in terms of accuracy, cost, ease of use, and ability to collect additional information about operations. Methods also differ in their suitability to the particular airport being sampled. Each of the methods is described briefly. Table 1 provides a summary comparison of the different counting methods.

Visual Observation

Visual observation relies on observers physically present at the airport to count operations. It is the most accurate counting method, subject only to human error. However, observers must be trained to ensure the counts are consistent and complete. While it is possible to conduct visual counts 24 hours a day, it is most feasible to visually count operations during daylight hours, especially if additional information about operations is desired. This limitation may decrease the accuracy of the visual count, unless operations are known to occur only in daylight hours.

Visual observation is a relatively expensive way to collect sample data, since workers must be hired to make the observations. Costs may be reduced if volunteer or low cost

Table 1 Comparison of Alternative Counting Methods (2)

	Visual	Pneumatic Tubes and Inductance Loops	Acoustical Counters
Ability to count: Total operations	Very accurate	Counts only operations that cross tubes	Counts fixed-wing take-offs, including touch-and-gos
Local/itinerant operations	Can be distinguished by trained observers	Cannot be distinguished	Cannot be distinguished
Aircraft type	All classes can be distinguished	Cannot be distinguished	Distinguishes major classes: single, multi, jet, and helicopter
Unit cost	Not applicable	Up to \$2,500. An airport may require more than one unit. Units can be rotated among airports	About \$3,900. Units can be rotated among airports
Operating cost	Very high if observers are paid	Relatively low	Relatively low
Major advantage compared to other methods	Very accurate. Can identify a variety of information about operations	Inexpensive	Inexpensive and more accurate than pneumatic tube
Major disadvantage compared to other methods	High cost	Least accurate. Only counts operations that cross tube or loop	Requires interpretation of recorded sounds

labor is available. However, if volunteer observers are used, it may be difficult to control the consistency and accuracy of the counts.

It is possible to gather a variety of information about operations counted using visual observation. Information can include time of operation, type of operation, or type of aircraft. If additional information is desired, the observer must be trained in how to consistently identify the desired characteristic, such as a local or itinerant flight.

Visual observation is most suitable at airports that have operations concentrated in an eight- to 12-hour daylight period. Airports with multiple or widely spaced runways may require more than one observer, especially if additional information about operations is being collected. In spite of its accuracy and ease of use, visual observation has not been

widely used. This is because of the high cost for even a small sample of operations. Cost becomes even more critical if a 10- or 12-week sample of operations is required.

Virginia has used visual counts by Civil Air Patrol volunteers. Operations were counted only once per year during peak activity periods. The counts were used to determine the percent change in activity from one year to the next, not to estimate total annual operations. In 1981 Florida estimated annual operations at 28 airports using visual observation. Two people visually counted operations at each airport from 7 am to 7 pm on seven consecutive days. The sample data were expanded to estimate annual operations using independent factors, such as based aircraft and fuel sales. Additional information about operations, aircraft, passengers, and weather was also collected during the visual survey. The cost of Florida's 1981 counting program was about \$1,000 to \$1,200 per airport. Most of the cost was for the survey crew, but costs also included editing and analysis of the sample data.

Pneumatic Tube Counters

Pneumatic tube, or highway, counters were one of the first mechanical devices used to count aircraft operations. The device consists of a rubber tube attached to a counter. As an aircraft rolls over the tube, air pressure registers a count on a paper tape. Placement of the tube is critical to obtain an accurate count of operations. Because of excessive wear of the tubes when placed across the runway, tubes are often placed across taxiways leading to runways. Therefore, the counts recorded are actually of ground movement to and from runways. When placed across the taxiways, pneumatic tubes cannot count touch-and-gos or missed approaches. An estimated ratio of touch-and-go operations to counted operations is needed to separately estimate touch-and-gos from the counter operation data. This limitation reduces the accuracy of pneumatic tube counts. When tubes are placed across the runway, they still may not count all operations. Usefulness of pneumatic tube counters is further reduced because they cannot distinguish between type of operation and between aircraft and non-aircraft vehicles.

Pneumatic tube counters cost about 50 cents a foot for the rubber tube, plus \$110 to \$1,900, depending on the sophistication of the counter that is hooked to the tube. The least expensive counter registers counts with about a four percent error. This is a measure of mechanical error and is in addition to the error due to the limitations from the placement of the tube and interpretation of the counter data. The more expensive counters register counts with less than one percent error and provide day and time of count as well. The total cost of counting operations at an airport using pneumatic tubes depends on the number of runways and taxiways that must be counted.

Michigan has used the Abrams Aircraft Counter for over 20 years. The pneumatic tubes are placed across taxiways leading to runways. The Abrams Counter counts movement in one direction only and is set to count aircraft taxiing to the runway for departure. Regis-

tered counts are doubled to represent total operations. About 40 airports are counted each year. Each airport is counted for six to eight consecutive weeks during the spring, summer, or fall. The sample data are expanded using “M” factors to estimate total annual operations. “M” factors were calculated during the mid-1960s from tower operations data to account for seasonal fluctuation in annual operations. Since touch-and-gos cannot be counted directly, they are estimated to be 35 percent of the total counted operations estimate. The total annual estimate is then split between itinerant and local operations using a standard 35/65 percent split, unless the airport manager provides a more accurate ratio.

Inductance Loop Counters

The inductance loop is another type of highway counter that has been used to count aircraft activity. Unlike the pneumatic tube, which is portable, the wire inductance loop is installed in the pavement of the runway or taxiway. It can be attached to the same type of counter device as used with the pneumatic tube. Operations are counted electronically as aircraft roll over the loop or fly over the loop within three feet of the surface. Loops can encompass a maximum of 180 square feet of surface area in which aircraft can be counted.

Like the pneumatic tube, correct placement is critical to obtain accurate counts. Even though the loop may be placed directly on the runway, the same limitation of pneumatic tubes exists with loops: they cannot count missed approaches, they likely will not count all touch-and-gos, they cannot distinguish between aircraft and other vehicles on the runway, and they cannot distinguish between landings and departures. Count accuracy could be improved by using a number of loops on the runway and on access taxiways; however, the cross interpretation of data from all counters would be complex. Given the potential for missed operations and incorrect interpretation of the counts obtained, the suitability of the inductance loop is limited to short runways with limited access. Even in this case not all touch-and-go operations may be counted.

An inductance loop costs about \$650, including installation, plus \$150 to \$1,900 for the counter device, depending on its sophistication. Increased runway maintenance costs are also incurred because of increased deterioration of the runway pavement around the area of installation. Massachusetts has used inductance loop counters. The loops were believed to be at least as accurate as pneumatic tubes and more durable. Loops were installed 700 to 800 feet from each end of the runways in an attempt to count most landings and departures. Loops were initially installed only on the runway, but it was recognized that counts could be improved if loops or rubber tubes were also placed across access taxiways.

Acoustical Counters

Acoustical counters use a microphone near the runway to pick up the sound of a departing aircraft at full engine power. The sound is recorded by a tape recorder and registered on a digital or a microprocessor memory. The recorded tape is then edited to pick out only the sounds of aircraft departures, including touch-and-gos and missed approaches. Some systems use sound activation to avoid this manual operation. Departures are doubled to represent total operations. Total operations are not counted directly because quiet landings normally are not picked up by the microphone.

Acoustical counters are capable of accurately recording all departures if they are placed along the runway within their performance standards. Performance standards are adequate for most general aviation airports. If they are placed too far away from the path of departing aircraft, they may not record the departure or not record it distinctly.

Although the acoustical counter accurately records aircraft sounds, the correct interpretation of the recordings is necessary to ensure accurate operations counts. Interpretation of the recordings is necessary to ensure all the departures recorded are identified and counted as departures, but that non-departure sounds are not mistaken for departures. Software packages are available that are able to convert the sound patterns to counts of aircraft by type. If done manually, with minimal training a person can distinguish between departures and other aircraft sounds and identify the type of aircraft departing, such as single engine, multi-engine, or jet. Helicopters can be detected by the counter, but operations cannot be estimated from the recorded sound of the helicopter. In addition to type of aircraft, day and hour of departure can also be determined from hourly time tones on the recorded tape.

The acoustical counter is relatively easy to use and is suitable for use at most airports (with up to 6,000-foot long runways). Some training is necessary on the operation of the counter and the optimal location of the counter near the runway. The counter is self-contained and weather resistant and may be left at an airport for several weeks to continuously count operations. Counters cost between \$3,500 and \$6,000 and are available from the RENS Manufacturing Co. and also from Larson-Davis Laboratories. The RENS AAC-14 counters are currently in use by the Oregon, Nevada, Texas, and Washington DOTs.

Oregon has been testing and using acoustical counters since 1978. The counter is used to take week-long sample counts four to 12 times a year at each airport, depending on the activity level of the airport. The sample data are used to estimate annual, quarterly, and in some cases monthly operations using standard statistical methods. One counter is rotated among several airports to maximize the use of each counter. Thirty-seven airports were counted during two years of sample counts.

Airports can cost from between \$1,000 to \$2,000 each to count, including wages and mileage expenses, supplies, maintenance and repair of the counters, allocated capital cost of the counters, interpretation of the recorded tapes, data processing and analysis, and management of the program. Small and remote airports are the most expensive to count because they require a larger sample size, longer driving time, and higher mileage costs.

IOWA DOT AIRCRAFT ACTIVITY COUNT PROGRAM

The Iowa Department of Transportation (Iowa DOT) has used a program of aircraft operation counting that employs RENS acoustical counters and Lockheed Aircraft Classification System software. Aircraft activity counts are taken at Iowa's publicly owned, public use airports—state system airports. There are currently 114 state system airports. In addition, the new Marion airport is under development and will probably become operational by 1998. Aircraft activity counts are taken at selected state system airports, the five non-towered Level I commercial service airports, as well as all Level II and III airports. Level IV airports are not counted unless for a specific purpose. Two Level IV airports, Audubon and Clarion, are being considered for reassignment to Level III. Therefore, they are to be added to the count schedule. A total of 72 state system airports are to be counted.

Each airport is to be counted once every four years. The count is to be conducted over a one-year period, preferably a calendar year period (January 1 through December 31). A total of four weeks of count are recorded during each of the four seasons of the year for a total of 16 weeks of recorded counts. The counts are to be done in incremental periods of two weeks followed by a gap of approximately six weeks in duration.

The Iowa DOT uses airport traffic count data for a variety of planning activities. Listed below are the most frequent uses of the data; however, the Iowa DOT receives many inquiries from municipalities, airport boards, the FAA, and other agencies concerning operations at the state's general aviation airports. Data are used for the following:

- Continuing planning process—Iowa Aviation System Plan
- Airport design—determining runway length and number of taxiways
- Determining eligibility/need for federal funding
- Determining eligibility/need for state funding
- Forecasting demand, which is an integral and required part of FAA approved airport planning documents

The primary need for aircraft classification is in the area of airport design. The type of aircraft and frequency of use is the main factor in runway length and other geometric design parameters. (3)

LITERATURE REVIEW

There is very little published regarding estimating aircraft activity at non-towered airports. Nearly all of the articles which exist are reviews of the implementation of the RENS counters in various locations in the 1980s. The three most informative articles are summarized below. Each also refers to the continuing need for improved data collection procedures and technologies.

Lidman, J. Kirby. 1985. Aircraft Activity Counter AAC-10 Demonstration Project at the Ames Airport: Final Report. Office of Transportation Research, Iowa Department of Transportation.

This final report summarizes the results of a year-long sample during 1984 at the Ames airport using a RENS AAC-10 counter. The three areas of this report that are of interest to the current study are the accuracy of the RENS AAC-10, the percent sampling error based on sample size, and the problems associated with the counter itself. Visual counts were made at the Ames airport from July 30, 1985 to August 10, 1985. The counts were taken eight hours per day, five days per week during the two-week period for a total of 80 hours. The AAC-10 recorded 97 percent of the visual count activity during the same time period. It is believed that the three percent loss can be attributed to an occasional miss on touch-and-go operations when the throttle is applied well after the aircraft has passed the microphone. Estimates for percent sampling error were made for each 13-week season. These estimates were based on the number of weeks sampled in each season. Two-week samples, which is the length currently used, have a percent sampling error of +/-23 percent in the summer and fall, +/-27 percent in the spring, and +/-60 percent in the winter. These figures are probably representative of airports which have total operations similar to Ames (>50,000 annually). For airports with fewer operations, the sampling error could be greater due to the possible skewness of the distribution of operations. The impact of weather was probably the predominant factor in causing a relatively high percent sampling error in the winter. Several problems with the AAC-10 were identified in this report. First, the batteries would occasionally run down without adequate warning from the battery meter. Second, cold, damp weather can cause the recorder to slow down, which prevents the tapes from being properly interpreted. Third, cold weather can also cause the spindles of the cassette tape to bind. Fourth, the clock and microphone are on the same circuit, so that if the microphone cable becomes loose, the clock will reset to a random time, throwing the time distribution of the count off. The fifth and final problem mentioned is the omnidirectional microphone which allows noise from behind the microphone (on taxiways, for example) to trip the counter.

Ford, Mark L. and Rosalyn Shirack. 1984. Estimating Aircraft Activity at Nontowered Airports: Results of the Aircraft Activity Counter Demonstration Project. *Transportation Research Record*. 958: 24-29.

This paper reviews the results of samples taken with a RENS-10 counter between November 1980 and April 1982 at sites in Oregon, Washington, and Idaho. The paper analyzes independent measures of variation and also develops a table of percent sampling error based on number of operations and length of sample. The first independent measure of variation tested was the use of towered airport data. This was found to have little to no correlation with the activity of non-towered airports. The next measure was weather data, which was found to have some value as a predictor of activity, but it does not explain all of the variation in operations. The last measure examined is fuel sales data, which did show promise as a predictor. The correlation coefficient for fuel sales and departures range from 0.97 to 0.68. Possible causes of this variation include private tanks, unlicensed dealers, and fuel ferried into or out of the airport. The conclusion was that more study was needed to determine the suitability of fuel sales data as an independent indicator of variation. The table of percent sampling error in this report has airports with more than 30,500 operations per year that are sampled for eight weeks per year as having a +/-15 percent sampling error. This is significantly lower than the estimate made in the Lidman study, above.

Zakaria, Thabet. 1988. Estimation of Aircraft Operations at Nontowered Airports in the Delaware Valley Region. *Transportation Research Record*. 1158: 37-46.

This paper is a description of the aircraft counting program of the Delaware Valley Regional Planning Commission in 1986. The emphasis is on sample design, model structure, and data collection and analysis. The methodology used follows that which was developed in the paper by Ford and Shirack, above. Based on eight one-week samples, two per season, the percent sampling error was found to be from +/-9 percent to +/-21 percent. Two accuracy tests of the RENS counter were made for this study. The results showed the RENS counter results to be within -4.4 percent for the first test and 0.3 percent for the second test of the actual operations. This study also noted difficulty with the RENS counter in the winter, but found the results to be much more accurate than their previous method of multiplying the number of aircraft based at an airport by a set number of operations per year.

In addition, reports from the Oregon Department of Transportation (1985) and the Michigan Department of Transportation provide valuable information regarding airport selection and sampling techniques, aircraft counting methodologies, and annualized aircraft activity projection methodologies. There were no available reports that contained accuracy tests for multiple counting technologies. In other words, there are no comparisons of RENS counters and pneumatic tubes or inductance loops. A comparison of this sort was conducted during the month of June 1996 in Ames, Iowa by the Iowa DOT. A two-week

sample was taken that compared counts at the Ames airport using a RENS AAC-14 counter and pneumatic tubes placed on taxiways. These results are discussed later in this report.

Other Information Sources

Midwestern DOTs and airport officials were contacted to find out what counting methodologies they use. The survey was limited to the Midwest because of similarities in airport use and climate. We reported on states that used the same method for all airports. Some states use a variety of techniques, depending on airport and on authority/jurisdiction. The states of Minnesota and Oklahoma each use the RENS counter with a variety of sampling techniques. The Illinois and Michigan DOTs use pneumatic tube counters deployed by road workers on taxiways. Kansas and North Dakota both have used the RENS in the past but now rely on FAA Form 5010 inspections and airport managers. Of the six states contacted that had count programs in place, each method was equally represented.

COMPARISON OF RENS AAC-14 ACOUSTICAL COUNTER AND PNEUMATIC TUBE COUNTERS

As mentioned earlier in this report, because there are no published comparison tests between the RENS acoustical counters and other counting technologies, the Iowa DOT collected a two-week sample of aircraft activity to compare pneumatic tube counts with acoustical counts at the Ames airport. Pneumatic tubes were placed on the four taxiways with the RENS counter placed in an appropriate counting position. During the two-week period from June 4, 1996 to June 17, 1996, approximately 750 operations were counted. There were no technical problems reported other than a pneumatic tube being cut by a lawn mower on the ninth day of sampling, but it was promptly repaired. The graph (Figure 1) shows the daily differences between tube and acoustical counts. The average daily difference was approximately 16 operations while the overall total two-week difference was only four operations. The pneumatic tubes counted 757 operations while the acoustical counter reported 753, resulting in essentially no difference between the two methods. While there is obviously a strong correlation between the tube counts and acoustical counts, longer term samples are needed at a variety of airports in order to feel comfortable that the counts are reliable.

This sample does, however, present evidence that alternative methods to the acoustical counters are available at a potentially lower cost. The disadvantages of the pneumatic tube counters have been mentioned earlier in this report. These disadvantages can be alleviated through sampling techniques and a combination of different aircraft activity reporting schemes. The final section of this report describes some general recommendations that can be incorporated into a revised aircraft activity count program for the state of Iowa.

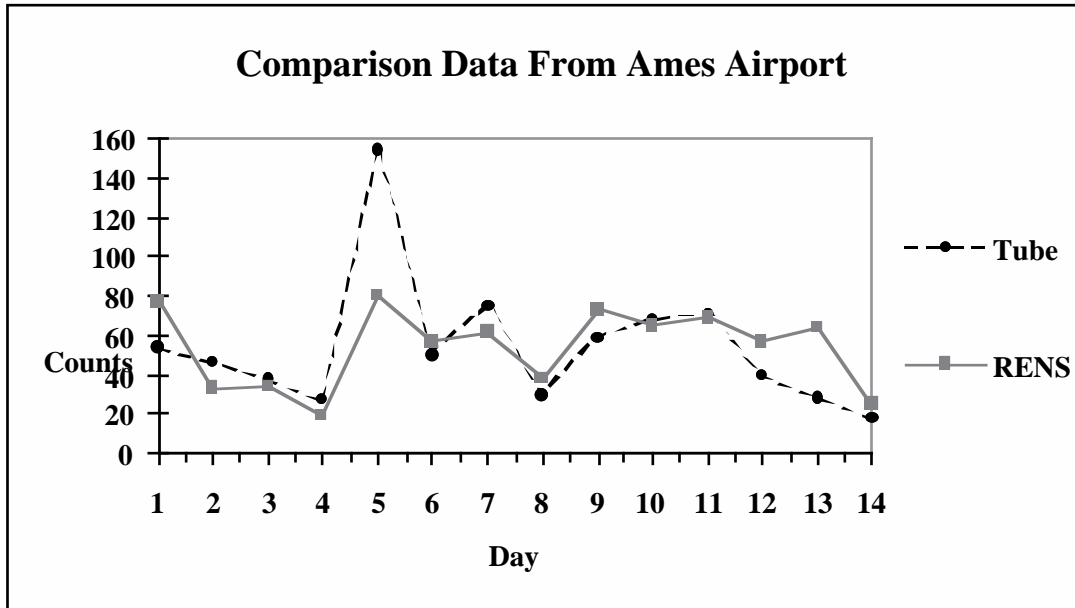


Figure 1 Comparison of Pneumatic Tube and Acoustical Counts

RECOMMENDATIONS

The objective of this research was to identify feasible methodologies for counting aircraft operations at non-towered airports in the state of Iowa. The Iowa DOT is presently using acoustical counting systems that are cumbersome to deploy and maintain. They are also extremely manpower-intensive to operate. In addition, the reliability of the existing equipment may be marginal, particularly in cold or inclement weather. Changes to the current Aircraft Activity Count Program sampling method should also be considered. After a review of the literature and methodologies used by other states, it is apparent that there is no single solution to the stated problem. The most efficient method, given current technologies, may include the following elements:

- Use of pneumatic tubes at airports of relatively stable aircraft activity. These counting devices can be deployed and maintained locally with counts being reported at regular intervals. Tube locations can be determined by knowledgeable facility personnel. Factors for estimating counts by month, quarter, or year as well as by aircraft type can be developed locally with historical data.
- Use of acoustical counting devices may still be necessary on a case-by-case basis. Acoustical counts of operations can be conducted when there is a reason to believe that the pattern of activity by aircraft classification is changing. This is especially true if new operations require facility design upgrades like runway extensions for certain

classes of aircraft. Acoustical counts can be performed by request of facility operators rather than as the routine method for counting.

- Telecommunications technologies should be utilized as much as possible for reporting aircraft operation counts. Approximately 43 airports currently are Automated Weather Observing Stations (AWOS) and/or modem installations. Automated, digital transmission of count data to a central location would be relatively inexpensive and far more efficient than on-site data collection.
- Revised sampling strategies can reduce the time and effort required for data collection. There are three distinct phases in conducting aircraft traffic counts. These are 1) airport selection, 2) counting intervals, and 3) projection of annual operations.

Airport Selection

Airports should be classified by the nature of counts that are needed at each location. Four basic classifications for counting purposes are 1) statistical control airports, 2) stable activity airports, 3) special project airports, and 4) airport manager requests.

Statistical control airports can be regional towered airports or airports that have continuously and accurately counted activity levels. Counts from these airports are used to establish monthly or seasonal adjustment factors to predict annual counts for sampled airports. Counts for control airports can also be used to predict operations by aircraft type. The factors are applied on a regional basis to surrounding sampled airports. See Table 2 for an example of adjustment factors.

Stable activity airports can be efficiently sampled using pneumatic tube or inductance loop counters. These airports are not experiencing or anticipating changes in activity levels. These airports can be identified by comparing basic indicators of potential aircraft activity such as number of based aircraft. If the reported counts for an airport are 10 to 20 percent (or other desirable threshold) different from estimated activity levels from basic indicators, the airport may be classified as a special project airport. This “window” will be used to identify airports that need to be looked at more closely and perhaps have acoustical counts performed.

Special project airports include those with programming requests or airport construction, or where special studies are anticipated which may require facility upgrades. For example, if an increase in jet activity is suspected that will require specific facility investments, acoustical counts can be performed. This is also true for *airport manager requests*. If the concern is only in overall activity levels, pneumatic tubes or inductance loops can be positioned on runway taxiways. Otherwise, acoustical counts to classify aircraft operations can be performed.

Overall, the purpose for categorizing airports is to identify airports for total activity counts (with pneumatic tubes or inductance loops) which can be deployed locally with the data being reported to a central Iowa DOT location. This would allow Iowa DOT personnel to concentrate efforts on airports that have particular count needs such as special project airports or airport manager requests. This will effectively reduce the travel time and expenses for Iowa DOT personnel because it reduces the number of airports that have to be visited in order to place or maintain aircraft counting devices.

Counting Intervals

Currently 72 of the 114 state system airports are counted by the Iowa DOT Aircraft Activity Count Program once every four years. A total of four weeks of counts are recorded during each of the four seasons for a total of 16 weeks of recorded counts. Under the current schedule approximately 18 airports are counted per year, resulting in a four-year cycle to count all of the state system airports. If one-fourth (an estimate) of these airports were considered to be special project airports or had airport manager requests for counts, this would mean that approximately 18 airports may need acoustical counts. Adjustment factors from statistical control airports or historical data can be used to estimate aircraft type. All other sampled airports can use pneumatic tubes or inductance loop counters. Also, if counts are taken twice during the year (for instance, one month in spring and fall or one month in summer and fall) and projected using statistical control adjustment factors, instead of one month in each season, the time savings could result in perhaps a two-year cycle to count the 72 airports rather than the current four-year schedule. This is a conservative estimate given that the state of Michigan counts between 70 and 80 airports per year using pneumatic tube counters with four- to 12-week samples from each counted airport. (4)

Projection of Annual Operations

As count data become available, they can be analyzed to estimate the annual operations for each airport. The following steps can be used:

- A) Determine the exact number of days and total operations recorded by the counter.
Convert the figures into number of average daily recorded operations.
- B) Determine the annual estimated recorded operations by applying the following formula to each survey month. The annual recorded figure will be the average of each month.

$$(Total\ days\ in\ the\ month)(Total\ average\ daily\ operations)(Adjustment\ factor)$$

Examples of adjustment factors are shown in Table 2. These factors will need to be derived for each of the statistical control airports by region. Adjustment factors are calculated for each month by dividing 100 by the monthly percent of total traffic. The resulting adjustment factor is used to seasonally adjust the data collected during the airport activity counting period. Because of relative climate differences, factors should be established for each of the four sampling quadrants. Annual estimates for each airport can then be multiplied by an appropriate operational split (based upon historical data or current counts) to determine estimated annual itinerant and local operations. The method described above has been adapted from the program currently being used by the Michigan DOT.

Table 2 Example Regional Adjustment Factors

Month	Region			
	NW Sioux City	NE Waterloo	SW Des Moines	SE Cedar Rapids
January	21.7	29.4	20.8	20.8
February	19.2	17.8	14.8	14.8
March	14.7	12.2	11.7	11.7
April	13.2	14.5	11.5	11.5
May	10.5	12.0	10.1	10.1
June	9.8	9.4	10.3	10.3
July	7.1	6.8	9.2	9.2
August	7.3	6.7	9.4	9.4
September	10.6	10.5	10.7	10.6
October	12.3	12.2	11.5	10.9
November	16.7	16.6	15.1	16.3
December	20.4	27.0	18.4	19.1

The increased use of local airport operation count administration can potentially reduce data collection costs for the Iowa DOT. Visits to individual airports throughout the state would be limited to those airports that are in need of specific aircraft classification counts utilizing acoustical counters. Time savings from decreased data collection efforts can be used to administer the statewide counting program, as well as validation and analysis of count data.

REFERENCES

- (1) “Statistical Sampling of Aircraft Operations at Non-towered Airports,” Oregon Department of Transportation, Aeronautics Division, 1985.
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- (3) John Fleig, Iowa Department of Transportation.
- (4) Michigan DOT, “Aircraft Operations in Michigan, 1992.”