Alaska Aviation System Plan

Critical Aircraft Determination

Challenges and Impacts on Airport Development

February 2024

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Appendices

Acronyms	
AAC	Aircraft Approach Category
AASP	Alaska Aviation System Plan
AC	FAA Advisory Circular
ACIP	Airports Capital Improvement Program
ADG	Airplane Design Group
AIP	Airport Improvement Program
ALP	Airport Layout Plan
APEB	Airport Project Evaluation Board (DOT&PF AIP eligible projects)
ARC	Airport Reference Code
ATC	FAA Air Traffic Control
AWSS	Airport Weather Sensors System
BTS	Bureau of Transportation Statistics
Department/DOT&PF	Alaska Department of Transportation and Public Facilities
EMAS	Engineered Materials Arresting Systems
FAA	Federal Aviation Administration
M&O	DOT&PF Maintenance and Operations
NAS	National Airspace System
NPIAS	National Plan of Integrated Airport Systems
PFC	Passenger Facility Charge
RDC	Runway Design Code
SWA	DOT&PF Statewide Aviation
TDG	Taxiway Design Group
USDOT	United States Department of Transportation

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Introduction

Continual improvement of the safety and efficiency of our aviation system is key in airport project development. The Federal Aviation Administration (FAA) plays an important role by developing guidance for airport planning, design, and construction projects and administering grant funding for airport projects through the Airport Improvement Program (AIP). An analysis called a Critical Aircraft Determination is conducted to identify the aircraft with the most demanding operational requirements that regularly operate at a specified airport. This aircraft, or grouping of aircraft with similar attributes, is identified as the critical aircraft. The critical aircraft is used to define the dimensional standards for the aircraft movement areas (e.g., runways and taxiways), as well as separation, operational, and infrastructure requirements.

AIP Project Justification

The Critical Aircraft Determination is a key consideration in FAA decision making on project justification.

AC 150/5000-17§1

Policies, procedures, and guidance for AIP grants are in FAA Order 5300.38D, Change 1, Airport Improvement Program Handbook[1]. The AIP Handbook requires the FAA to determine project eligibility, justification, and applicable standards based on the approved critical aircraft, using the process detailed in the current version of FAA Advisory Circular (AC) 150/5000-17, Critical Aircraft and Regular Use Determination[2]. The FAA uses the term critical aircraft synonymously with previously used terms design aircraft and critical design aircraft.

FAA AIP Handbook Definition of Critical Aircraft

The critical aircraft is the most demanding airplane which is currently, or is planned to use a runway, taxiway, apron or other aeronautical facility on a regular basis. The weight, wingspan, performance characteristics of the airplane impact the design of the facility.

The FAA and the National Transportation Safety Board have determined that using airport design requirements of critical aircraft reduces the probability of accidents/incidents and inversely increases the survivability of commercial and general aviation accidents. Further determining the critical aircraft and using that information to design airfield improvement projects ensures more accurate cost estimates to maximize limited federal funding for capital improvements. Overall, the process aligns with the FAA's mission to ensure the National Airspace System (NAS) serves the needs of the public safely and efficiently.

Critical Aircraft Influences on Project Planning and Design

The State of Alaska Department of Transportation and Public Facilities (Department/DOT&PF) owns and operates 235 rural airports. Like other public airport sponsors, the Department depends almost exclusively on FAA AIP grants to fund airport capital improvement projects, such as runway and taxiway

[1] *https://www.faa.gov/airports/aip/aip_handbook?Chapter=0*
[2] *https://www.faa.gov/airports/resources/advisory_circulars/index.cfm/go/document.current/documentNumber/150_5000-17*

rehabilitation, at these essential transportation assets. This white paper focuses on the DOT&PF process, but the AIP Handbook requires all airport sponsors to use the FAA processes for identifying or validating critical aircraft. These projects must indisputably qualify for AIP grant funding.

When initiating an airside project, the Department needs to validate the critical aircraft. The critical aircraft is often identified in an Airport Master Plan or Airport Layout Plan (ALP). However, these documents are infrequently updated, given the immense size of the Alaska rural airport system. Revalidation of the critical aircraft is also necessary because of the ever-changing fleet mix, route structures, and air carriers serving rural Alaska.

A change in the critical aircraft can affect runway length, width, separation, safety areas, and other aspects of the project, which in turn have a dynamic impact on preliminary cost estimates, require significant long-range planning efforts (e.g., changing an action from CATEX to EA), or drive additional land acquisition, facility relocation, and other unanticipated costs. Major changes to a single airport project may also have consequences for the entire DOT&PF 5-year spending plan, impacting other projects in the Alaska rural airport system.

When the initial project development process is complete and scored through the Department's Airport Project Evaluation Board (APEB) process, the funding may not be programmed in the Airports Capital Improvement Program (ACIP) for 3 or more years, and the project may not go to construction for another 5 or more years. Periodically reassessing the critical aircraft is important—especially if an upcoming airfield project is in the queue and there is anecdotal information that the fleet mix is changing.

The FAA Office of Airports approves the Critical Aircraft Determination and has the authority to require reevaluation before issuing an AIP grant. The consequence of completing project design and cost estimations based on a less demanding critical aircraft is ruinous to a project.

Critical Aircraft Standards

The FAA ACs define and clarify the terminology associated with Critical Aircraft Determinations. The following definitions aid in understanding FAA guidance for assessing critical aircraft and airport design. Additionally, these terms can assist planners in communicating with design engineers. The definitions are listed in a manner that allows each definition to build on the previous information as it relates to critical aircraft influences on airport improvement projects.

Planning and design must consider that multiple Critical Aircraft Determinations may be required for airports with multiple runways. Distinct operational areas of an airport that may require separate Critical Aircraft Determinations are taxiways, ramps, and Engineered Materials Arresting Systems (EMAS). A common example at rural airports is a taxiway that provides access for small aircraft transitioning from the main ramp to a general aviation parking area, T-hangars, or a ski strip.

These definitions are directly or summarized from the most recent FAA Airport Design and Critical Aircraft ACs. New ACs sometimes redefine or modify definitions. The airport sponsor is responsible for verifying that the most recent AC is used in project design to ensure eligibility for AIP grant funding.

- **Critical Aircraft:** The most demanding aircraft type or grouping of aircraft with similar characteristics that make regular use of the airport. Critical aircraft, design aircraft, and critical design aircraft are synonymous across FAA guidance.
- **Regular Use:** Replaces the previously used term substantial use and is defined as 500 annual operations, including both itinerant and local operations but excluding touch-and-go operations. An operation is either a takeoff or landing.
- **Similar Characteristics:** Refers to the FAA-approved practice of grouping aircraft by comparable operational performance and/or physical dimensions. This grouping, sometimes referred to as a "family" of aircraft, recognizes that it is sometimes necessary to group similar aircraft together when a single aircraft type does not meet the threshold of 500 annual operations.
- **Future Critical Aircraft:** Determined with an FAA-approved forecast that considers aircraft "highly likely" or "expected" to regularly use the airport. This is usually part of an update to the ALP or Master Plan, but the distinction between existing and future critical aircraft is important because the timeframe for when an aircraft could regularly use the airport is relevant to planning, funding, and implementation.
- **Military Aircraft:** The FAA guidance states that "prudent facility planning should include consideration for the requirements of military aircraft or other federally owned aircraft operating at the airport. However, this determination is made for airport planning purposes only" (AC 150/5000-17 §2.4).
  AIP grant funded or Passenger Facility Charge (PFC) revenue funded project eligibility and justification excludes military and federal government-owned aircraft. Projects funded exclusively from these sources may require a secondary determination for AIP or PFC eligibility that excludes military and federally owned aircraft. Aircraft operated by civil operators working under military or other federal government agency contracts are counted as civil aircraft. This includes civil aircraft operating under contract with the U.S. Forest Service for aerial firefighting activities. Working closely with the local FAA Office of Airports is important to ensure project design and Critical Aircraft Determinations meet the requirements for AIP funding eligibility and project justification.
- **Aircraft Approach Category (AAC):** A grouping of aircraft related to aircraft approach speed (operational characteristic), per Table 1.

Many Alaska Airports Have Limited Operations By A Single Aircraft

Many of Alaska's airports do not have 500 annual operations by a single aircraft. In these cases, the AC definition of similar characteristics is employed to determine the most demanding aircraft.

Table 1: Aircraft Approach Category

AAC	Approach Speed
A	Approach speed less than 91 knots
B	Approach speed 91 knots or more but less than 121 knots
C	Approach speed 121 knots or more but less than 141 knots
D	Approach speed 141 knots or more but less than 166 knots
E	Approach speed 166 knots or more

- **Airplane Design Group (ADG):** A grouping of aircraft related to aircraft tail height or wingspan (physical characteristics), whichever is most restrictive per Table 2.

Table 2: Airplane Design Group

Group #	Tail Height	Wingspan
I	< 20 ft (< 6.1 m)	< 49 ft (< 14.9 m)
II	20 ft to < 30 ft (6.1 m to < 9.1 m)	49 ft to < 79 ft (14.9 m to < 24.1 m)
III	30 ft to < 45 ft (9.1 m < 13.7 m)	79 ft to < 118 ft (24.1 m to < 36 m)
IV	45 ft to < 60 ft (13.7 m to < 18.3 m)	118 ft to < 171 ft (36 m to < 52 m)
V	60 ft to < 66 ft (18.3 m to < 20.1 m)	171 ft to < 214 ft (52 m to < 65 m)
VI	66 ft to < 80 ft (20.1 m to < 24.4 m)	214 ft to < 262 ft (65 m to < 80 m)

- **Taxiway Design Groups (TDG):** FAA grouping of aircraft based on undercarriage dimensions of the Main Gear Width (MGW) and Cockpit to Main Gear (CMG) distance. The FAA provides design standards for each TDG group, including taxiway width, Taxiway Edge Safety Margin (TESM), shoulder pavement width, and taxiway fillet design.
- **Runway Design Code (RDC):** Is established by the FAA and incorporates the AAC, ADG, and approach visibility minimums establishing the design characteristics for a particular runway. The critical aircraft with regular use defines the AAC and ADG components of the RDC, whereas the runway's lowest visibility published on an instrument approach chart determines the visibility component.
- **Runway Design Standards:** Table 3 shows that the design standards consider the difference between Small and Large Aircraft. The chart groups aircraft by the AAC denoted by a letter and ADG shown as a roman numeral. The FAA maintains a database of aircraft and the corresponding AAC and ADG at Aircraft Characteristics Data[3]. The database[4] includes the Taxiway Design Group for each aircraft in the database.

[3] *https://www.faa.gov/airports/engineering/aircraft_char_database/data*

[4] The user of this database should take care to refer to the data dictionary on the second tab because differences exist in some of the definitions in this database. For example, the FAA aircraft weight is determined by FAA Order JO 7360.1G, which is directed at Air Traffic Control (ATC) and related to wake turbulence. The order also uses different weight categories than those used in airport design, which is related to pavement strength.

Table 3: Runway Design Standards

ADG-I	ADG-II	ADG-III	ADG-IV	ADG-V	ADG-VI
A-I Small	A-II Small	-	-	-	-
A-I	A-II	A-III	-	-	-
B-I Small	B-II Small	-	-	-	-
B-I	B-II	B-III	B-IV	-	-
C-I	C-II	C-III	C-IV	C-V	C-VI
D-I	D-II	D-III	D-IV	D-V	D-VI
E-I	E-II	E-III	E-IV	E-V	E-VI

- **Large Aircraft:** An aircraft with a maximum certificated takeoff weight of more than 12,500 pounds.
- **Small Aircraft:** An aircraft with a maximum certificated takeoff weight of 12,500 pounds or less. The critical aircraft informs this metric, which can make a material difference in runway and taxiway design. An Alaska example of an aircraft under 12,500 pounds is a Piper PA 32 Cherokee Six.
- **Utility:** This term is no longer used in the current FAA Airport Design AC; both the Design AC and the Critical Aircraft AC have dropped the use of "utility" and use the definitions of large and small. The FAA AC 150/5300-4B - Utility Airports was canceled in 1989.
  Utility runway is defined in 14 CFR Part 77.3 as follows: a runway constructed for and intended to be used by propeller-driven aircraft of 12,500 pounds maximum gross weight and less. Perhaps the most important difference is the focus in the Part 77 definition of utility on "constructed for and intended to be used by," thus, there is no threshold of regular use involved in the designation and the owner's intent comes into play. Under Part 77, the alternative to utility is "other than utility."
  Utility aircraft is defined in 14 CFR Part 21 as an aircraft that contains nine seats or less, not including the pilots; has a maximum takeoff weight of 12,500 pounds or less; and is approved for limited aerobatics. Throughout the aviation community, the consensus is that utility aircraft are small aircraft capable of operating from rough strips with less runway while providing impressive load-hauling ability. Both the aircraft category and the short, rough runway description epitomize many of the airports in rural Alaska, and the term is likely to be used for the foreseeable future.
- **T-100 Data:** Published quarterly by the United States Department of Transportation (USDOT) Bureau of Transportation Statistics (BTS). The statistical data originates from the BTS Air Carrier Statistics database and is commonly referred to as T-100 data in reference to the Form T-100 that certificated U.S. carriers use to meet reporting requirements for air carrier traffic data.

Critical Aircraft Operational Data

AC 150/5000-17[5] Critical Aircraft and Regular Use Determination provides specific guidance for an FAA-approved Critical Aircraft Determination. The FAA guidance lists multiple sources that can be used to document regular use, including:

[5] *https://www.faa.gov/documentLibrary/media/Advisory_Circular/AC_150_5000-17.pdf*

- Landing fee reports
- Reliable fuel sales records if aircraft make and model or tail number is tracked
- Data from an airport or commercially operated flight tracking system
- Acoustical activity counters if attached to visual systems.

These options are unavailable, unrealistic, and cost-prohibitive at most rural Alaska airports. The accepted practice in Alaska is to begin by analyzing the USDOT BTS T-100 data. The requirement to report data via Form 41 Schedule T-100 is set by type and class of operator, not by airport type. The BTS T-100 Segment reports provide data on all revenue flights flown by U.S. certificated air carriers. The data do not include certain operations, such as those carried out by Part 135 Air Taxi/Commercial Operators or any other operations carried out by a non-air carrier. Some airports do not have any operations by the carriers required to file the T-100, or insufficient operations to identify an increased critical aircraft (above the default of A-I small). Analysis of the available data, in addition to interviews with the airport manager and known operators, will help inform the decision to conduct additional research or consider the installation of traffic counters or other acceptable means of documenting operations.

The BTS offers a T-100 Domestic Segment (U.S. Carriers) database of aviation activity for U.S. airports with several time-series limiters that can be analyzed. The database requires some data transformation and additional resources to bolster the data processing. Additional criteria, such as ADC, AAC, Taxiway Design Group (TDG) and small, large, or helicopter categories, are obtained from aircraft manufacturer manuals, Airworthiness Certification Categories, FAA aircraft characteristics database, and FAA airport design guidance to develop an aircraft definition library for calculations. The BTS T-100 data are based on the following AC definitions:

- **Operations** are determined by the number of departures multiplied by two. The guidance assumes that each departure has a corresponding landing. Both the landing and the departure count as separate operations.
- **Enplanements** are counted at departure only. An enplanement is defined as a passenger who loads onto an aircraft and leaves the airport.
- **Deplanements** are counted on arrival only. A deplanement is defined as a passenger who arrives on an incoming aircraft and remains at the airport.
- **Enplaned Bypass Mail** is recorded in tons by calculating landed weight minus departure weight. The methodology estimates the total bypass mail dropped off at the airport. Bypass mail is the operation performed by aircraft carriers to transport mailed goods outside of the U.S. Postal Service. This process is defined as mail that travels from a small or medium hub airport to a non-hub airport. Aircraft carriers log and report how much mail the aircraft has at the time of landing and the weight remaining at departure. This process by aircraft carriers is a safety precaution to guarantee that aircraft are not overloaded, which can impact takeoffs, landings, and fuel. The difference can be a reliable indicator of the weight delivered at the airport under review.
- **Deplaned Bypass Mail** (tons) is counted as mail arriving at the airport, which remains at the facility.
- **Enplaned Freight** (tons) is counted by landings minus departures. The aircraft carriers log and report how much freight is delivered to a specific location and how much remains at the time of departure, resulting in a reliable indicator of the freight delivered to the airport.
- **Deplaned Freight** (tons) is counted as freight arriving at the airport, which remains at the facility.

Planners and engineers should consider regular monitoring of T-100 statistics and anecdotal information from airport managers, DOT&PF maintenance and operations (M&O), and air carriers concerning fleet mix and schedule changes throughout the life of a project, from project nomination through design. In addition to the activities previously mentioned, when reviewing T-100 data and conducting interviews, planners and engineers should consider the following:

- **Community Population:** A growing or shrinking population impacts passenger and cargo operations and, thus, the air carrier's consideration of aircraft to service a community.
- **Load Rates:** A load rate is the percentage of capacity for an aircraft. A continual high capacity may indicate a future change to aircraft of larger capacity or more operations by the existing aircraft in an air carrier's fleet. The contrary is true for low load rates.
- **Route Structure:** Air operators often develop routes from a hub airport to several smaller airports for delivery of cargo and passengers before returning to the hub. Routes are developed for efficiency. Generally, the route is consistent so that passenger schedules can be maintained; however, routes sometimes vary depending on the cargo volume, passenger numbers, and available aircraft.
- **Existing Airport Condition:** Some Alaska airports have seasonal or permanent partial runway closures because of poor or unsafe operating conditions, which can skew the number of operations and the aircraft type operating at an airport.
- **Aviation Trends:** Trends, such as the limited number of pilots entering the industry, can affect air carriers wanting/needing to operate larger aircraft to meet the community passenger and cargo demands.

Essentially, the factors that affect an overall airport forecast are the same factors to be considered when determining the current and future critical aircraft. If there is any indication that more demanding aircraft are entering the market, monitoring traffic counts before actual design initiation is crucial. The project design phase should always include all the required steps for Critical Aircraft Determination and present the results to the FAA for approval.

Accurately determining the critical aircraft during the project nomination phase is important for DOT&PF planners because of the potential impact on the DOT&PF's ACIP. Developing an accurate and consistent process results in better management of the ACIP and more reliable planning for future spending.

Conclusion

Determination of the airport's critical aircraft is fundamental to project planning and developing an APEB nomination. Monitoring the air carrier activity and reassessing the critical aircraft if changes occur is necessary throughout the project design and funding stages of all ACIP projects. Accurate and timely Critical Aircraft Determinations not only improve the safety and efficiency of our aviation system but are a requirement for utilizing FAA funding for AIP projects.

Airport facility dimensions are driven by critical aircraft. The FAA offers several resources to assist in understanding Critical Aircraft Determinations and the potential impact on project development.

FAA Online Tools

The Runway Design Standards Matrices Form[6] allows the user to compare two AAC/ADG pairs and see the impact on runway length, width, and separation; taxiway design; and other airport protection and safety area criteria, with the difference highlighted in yellow. See Appendix B for an example output from the Runway Design Standards Matrices Form.

FAA ADG and TDG Classification Tool[7] is an automated tool that calculates the ADG and TDG automatically after you supply a few simple aircraft characteristics from the aircraft manufacturer's website or the FAA Aircraft Characteristics Data[8].

[6] *https://www.faa.gov/airports/engineering/airport_design/rdsm/*
[7] *https://www.faa.gov/airports/engineering/airport_design/adg_tdg_classification_tool*
[8] *https://www.faa.gov/airports/engineering/aircraft_char_database/data*