U.S. Department
of Transportation
**Federal Aviation
Administration**

Advisory Circular

Subject: Bird Ingestion Certification Standards

Date: 04/03/2023

Initiated By: AIR-624

AC No: 33.76-1B

1 **PURPOSE.**

This advisory circular (AC) describes an acceptable means for demonstrating compliance with the requirements of Title 14, Code of Federal Regulations (14 CFR) 33.76, *Bird Ingestion*. Section 33.76 specifies the bird ingestion test requirements that apply to turbine aircraft engines.

2 **APPLICABILITY.**

2.1 The guidance in this AC is for aircraft engine manufacturers, modifiers, Federal Aviation Administration (FAA) engine type certification engineers, and FAA designees.

2.2 This AC is not mandatory and does not constitute a regulation. This AC describes an acceptable means, but not the only means, for showing compliance with § 33.76. However, if you use the means described in the AC, you must follow it in all important respects. When the method of compliance in this AC is used, terms such as "should," "may," and "must" are used only in the sense of ensuring applicability to this particular method of compliance. The FAA will consider other means of showing compliance that an applicant may elect to present. While these guidelines are not mandatory, they are derived from extensive FAA and industry experience in determining compliance with the relevant regulations. If, however, the FAA becomes aware of circumstances that convince us that following this AC would not result in compliance with the applicable regulations, the agency will not be bound by the terms of this AC and may require additional substantiation as a basis for finding compliance.

2.3 The contents of this AC do not have the force and effect of law and are not meant to bind the public in any way, and this AC is intended only to provide information to the public regarding existing requirements under the law or agency policies.

3 CANCELLATION.

This AC cancels AC 33.76-1A, *Bird Ingestion Certification Standards*, issued August 07, 2009.

4 TITLE 14, CODE OF FEDERAL REGULATIONS.

The following regulations are referenced in this AC. Unless otherwise indicated, you should use the current edition if following the method of compliance set forth in this AC.

- Section 21.21, *Issue of type certificate: normal, utility, acrobatic, commuter, and transport category aircraft; manned free balloons; special classes of aircraft; aircraft engines; propellers*.
- Section 23.2400, *Powerplant installation.*
- Section 27.901, *Installation.*
- Section 29.901, *Installation.*
- Section 33.4, *Instructions for Continued Airworthiness.*
- Section 33.5, *Instruction manual for installing and operating the engine.*
- Section 33.76, *Bird ingestion.*
- Section 33.94, *Blade containment and rotor unbalance tests.*

5 DEFINITIONS.

- **Bird Ingestion.** Bird passage into the engine inlet or bird impact with engine structure certified under part 33.
- **Critical Impact Parameter.** Parameter used to characterize the state of stress, strain, deflection, twist, or other condition that will result in the maximum impact damage to the engine for the prescribed bird ingestion condition.
- **Engine Core.** In a turbofan engine, additional compressor stages behind the fan.
- **First Stage Rotating Blades.** Exposed stages of any fan or compressor rotor susceptible to a bird strike or bird ingestion. These blades are considered to be part of the "front of the engine" (see definition below). This definition encompasses ducted, unducted, and aft fan engine designs; in these latter cases, blading on multiple rotors (primary and secondary airflow paths) should be considered separately when complying with § 33.76.
- **Front of the Engine.** Any engine part that can be struck by a bird including, but not limited to, inlet mounted components, (for example, inlet sensors), nose cone, fan or compressor rotor spinner (centerbody), engine inlet guide vane assemblies, engine protection devices (for example, screen or inlet barrier filter), and fan or compressor blades, including front and aft fan designs.

- **Inlet Throat Area.** The projected capture area of the aircraft engine inlet nacelle at its minimum inside diameter.
- **Minimum Engine.** A new production engine that exhibits the type design's most limiting operating parameter(s) with respect to the bird ingestion conditions of this AC. These operating parameters include, but are not limited to, power or thrust, turbine temperature, and rotor speed.

6 BACKGROUND.

This AC addresses bird ingestion related to FAA type certification standards for aircraft turbine engines under § 33.76. This revision adds guidance that manufacturers may use for conducting the climb flocking bird test or approach flocking bird test.

7 FACTORS IMPACTING ENGINE DEMONSTRATION COMPLIANCE.

7.1 Front of the Engine.

The front of the engine contains critical engine components that will be affected by any bird ingestion event. The applicant should define the critical parameters for each test, to include bird size, bird velocity, target location, and rotor speed. For example, a spinner assessment should rate the ability of its critical parameters to withstand bird impact.

7.2 Artificial Birds.

Applicants may use artificial birds or devices for the bird ingestion test if the test bird or device simulates the mass, shape, density, and effects of bird impact to the engine core. The specific design of an artificial bird must be accepted by the FAA prior to use in certification testing (§ 33.76(a)(5)).

7.3 Critical Impact Parameter (CIP).

7.3.1 CIP Functions.

Bird mass, bird velocity, fan or rotor speed, bird impact or aiming location, and fan or rotor blade geometry are used to characterize the maximum impact damage to the engine at bird ingestion conditions of § 33.76. For most modern turbofan engines, the CIP is the fan blade leading edge stress. However, for any given engine model, the CIP may be other design features or parameters. For turboprop, turboshaft, and turbojet engines, the CIP will most likely be a core feature such as a compressor airfoil. The FAA recommends that applicants identify the most limiting critical ingestion parameter before any demonstration, regardless of engine design. The FAA will evaluate any unplanned variations in controlling test parameters for their effect on the CIP and § 33.76 requirements.

7.3.2 Examples of CIP Identification.

- For turbofan first stage fan blades, the CIP may shift from the fan blade leading edge stress to blade root stress depending on bird velocity or bird mass as these can affect the slice mass.
- For fan blades with part span shrouds, the CIP may be blade deflection that produces shroud shingling, thrust loss, or a blade fracture.
- For unshrouded wide chord fan blades, the CIP may be a twist of the blade in the dovetail that allows it to impact and damage the trailing blade.

7.3.3 CIP Tolerance.

For certification tests, the CIP variation from the planned test values should not be significant. Historically, CIP variation has not been greater than 10 percent due to deviations in controlling test parameters.

7.3.4 Climb Flocking Bird Test and Approach Flocking Bird Test.

Paragraph 11 of this AC provides guidance on critical parameters for the climb flocking bird test and the approach flocking bird test.

7.4 **Critical Test Parameters.**

Applicants should determine critical test parameters using analysis or component tests. Applicants should consider experience with engines of similar type design and size, paying particular attention to types and causes of failures in those engines.

7.5 **Engine Tests.**

7.5.1 Engine tests should be conducted with an operational engine that is representative of the type design being certified. In addition, the demonstration of compliance must account for engine operation on the hottest day that a minimum engine can achieve maximum rated takeoff thrust or power (§ 33.76(a)(1)). The normal functioning of any automatic protective or recovery systems not requiring pilot intervention is acceptable, including automatic power lever movement. However, the installation manual should note that such systems are required for the engine to comply with its type certificate, if functions are necessary to meet the run-on requirements of § 33.76(c), (d) or (e), or to prevent a condition described in § 33.75(g)(2), which is specified in § 33.76(b)(3). Applicants may also conduct the test(s) with any automatic system in a functionally degraded state, if doing so does not constitute a less severe test.

7.5.2 Automatic protection or recovery systems that can reduce engine thrust or shut down the engine should remain active during the engine tests. Inadvertent activation of an automatic protection or recovery system that causes thrust loss outside the limits of § 33.76(c)(6), 33.76(d)(4), 33.76(e)(1)(ii), or 33.76(e)(2)(ii) will be considered a test failure.

7.6 **Test Facilities Calibration.**

The test facility should be calibrated to ensure that the controlling test parameters, such as bird speed and aiming locations, remain within an acceptable tolerance band and take into account CIP sensitivity to variations in the controlling test parameters. The FAA recommends setting the tolerance band so that the CIP varies no more than 10 percent from any combination of controlling test parameter variations. Certain test facilities and installations may affect or reduce engine stability margin, due to airflow distortion attributed to the proximity of bird gun(s) to the engine inlet. These effects should be identified before the test.

Note: Power or thrust should be measured within an accuracy of ± 3 percent.

7.7 **Turboprop and Turboshaft Engine Tests.**

Applicants may test a turboprop or turboshaft engine using an alternative load device. However, this could produce different engine response characteristics compared to an engine installed in an aircraft. In this circumstance, applicants should document response differences. If the turboshaft test is performed with an inlet, applicants should record pertinent engine or facility interface data during the test to ensure an installed engine complies with § 33.76 requirements.

7.8 **Aircraft and Engine Interface.**

The installation manual should describe engine and aircraft interfaces that could be affected by bird ingestion. Dynamic interactions between the engine and engine systems such as automatic surge recovery, auto relight, or propeller auto feather should be discussed in the installation manual if the functioning of those systems is needed to comply with the requirements in § 33.76.

7.9 **Inlet Throat Area.**

Applicants must identify the inlet throat area used to determine the quantity and weight of birds for the overall test, and then record the inlet throat area as a limitation in the installation manual (§ 33.76(a)(2)). Applicants should carefully determine the inlet throat area for the installation limitation value because future models or installations may require a larger number or size of birds. Tables 1 and 2 of § 33.76 base the bird quantities and weights on the engine inlet throat area (D^t), not the inlet highlight (D^S), or engine front face (D^e) projected areas. See figure 1 for standard inlet dimension definitions.

Note: For variable geometry inlet designs, further evaluation may be necessary to determine an effective inlet throat area.

Figure 1. Generic Turbofan and Nacelle Configuration

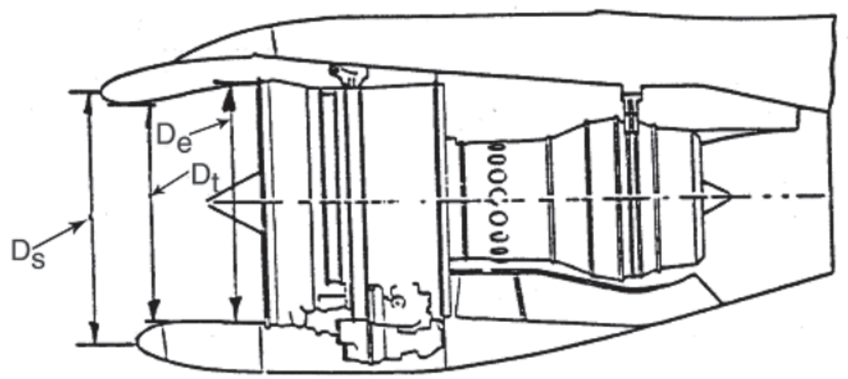


FIGURE 1. GENERIC TURBOFAN AND NACELLE CONFIGURATION

D_s = nacelle inlet lip stagnation point diameter, (i.e., highlight diameter).
D_t = nacelle inlet throat diameter
D_e = engine front face inlet diameter, (i.e., bare-engine inlet diameter).

7.10 **Repeating Tests on Derivative Engines and Major Design Changes.**

Applicants should analyze design changes that may affect compliance with § 33.76. Design changes where analysis shows that the critical impact parameters fall within 10 percent of the engine certification baseline values may not require retesting. The CIP is often associated with impact load at the point of bird rotor blade contact. This 10 percent variation on the CIP should not be an assumed tolerance on proposed changes to the takeoff power or thrust ratings.

Note: For the climb flocking bird test, a lower fan speed is more critical than a higher fan speed, unlike other tests. The reason is that lower fan speed results in less centrifuging of the bird, and thus more bird mass entering the core, at the same bird ingestion speed (airspeed).

7.11 **Hot Day Corner Point Operation.**

The intent of § 33.76(a)(1) is to ensure the engine is structurally and operationally tolerant to bird ingestion. The applicant compliance demonstrations may include an actual engine test at hot day corner point conditions under § 33.76(a)(1). Other representative engine or component tests, validated analysis, representative service events, or any combination thereof, may be used that the FAA finds acceptable. Tests may be conducted at reasonable levels of power or thrust over boost (for example, operation at P3 limit) to minimize the use of less direct methods of showing compliance. This is especially true if proposed engine test ambient conditions are less severe than sea level standard day conditions. The applicant should show that analysis techniques used are capable of accurately predicting bird ingestion event outcomes relative to the requirements and criteria of § 33.76.

7.12 **Fan Frame Struts and Bifurcation Strut Fairings.**

Fan frame struts or bifurcation strut fairings may be exposed to bird debris impact from debris exiting the upstream fan rotor. The struts and fairings may house fuel, oil, hydraulic or high-pressure bleed air lines, or engine control system associated wiring. Applicants should assess the potential for bird debris impact damage to these ducts. Sufficient design strength should exist to minimize damage to critical internal components if an impact to such structures occurs.

7.13 **Protected Inlets.**

7.13.1 Section 33.76(a)(6) allows an applicant to specify an installation requirement for a protected inlet, in place of certification engine test demonstrations. Therefore, engine-level protection from specified bird threats would be provided at the installation level by the inlet design. See § 33.5(a) for installation instruction requirements.

7.13.2 The engine manufacturer may specify detailed inlet design in the installation manual or leave detailed protection methods to aircraft manufacturer discretion.

Note: When specifying this type of installation requirement, the aircraft manufacturer must comply with the applicable aircraft-level requirement consistent with the engine installation instructions of § 33.5 required by §§ 23.2400(e), 25.901(b)(1)(i), 27.901(c)(1), and 29.901(b)(1)(i).

7.13.3 The threat level the aircraft manufacturer will need to address is normally associated with the certification basis for the engine. This means that the required size and number of birds the protected inlet will have to accommodate would normally be the same as required for an engine test. However, the aircraft manufacturer could show compliance to later threat levels (14 CFR part 33 amendment), or aircraft certification basis threat levels, as approved by the ACO Branch managing that specific aircraft certification program. If the applicant does not perform bird testing because inlet protection will be used (§ 33.76(a)(4)), the applicant must note this on the engine type certificate data sheet (TCDS) and installation manual (§ 33.76(a)(6)).

8 LARGE SINGLE BIRD INGESTION TEST.

8.1 **Test and Measurement Methods.**

Complete loss of engine power or thrust after bird ingestion for the large single bird ingestion engine test specified in § 33.76(b) is acceptable.

8.2 **Target Selection.**

The applicant may determine the most critical target location on the first stage rotating blades from analysis, component tests, or both. The test plan and report should include evidence of the bird strike effect on rotating components, compressor casing strength, multiple blade failure possibilities, engine structure strength (fan frame struts and fairings), and main shafts relative to the unbalance and excessive torque likely to occur, as needed.

8.3 **Compliance Using the § 33.94(a) Blade-Out Test.**

The applicant may use the blade containment and rotor unbalance compliance (engine) test requirements, specified in § 33.94(a), in place of the single large bird ingestion test, if the § 33.94(a) blade-out test constitutes a more severe demonstration than a single large bird ingestion test with respect to rotor blade containment and rotor unbalance. The comparison to the § 33.94(a) blade-out test should consider the engine dynamic response to a single large bird ingestion event. Examples of dynamic responses include the effects of engine unbalance loads, engine torque loads, surge related loads, and axial loads resulting from bird impact that transmit to the engine structure.

8.4 **Ingestion Speed.**

In accordance with § 33.76(b), an ingestion speed of 200-knots true for the large bird requirement was selected as the optimum speed to accommodate the various CIP associated with current turbofan engine designs. An ingestion speed higher than 200-knots may be more critical when considering the overall criteria of § 33.76(b) for a specific engine design. If an applicant shows that a different bird ingestion speed is more conservative, or more completely evaluates the proposed design, the applicant may conduct tests and analyses at that ingestion speed under an equivalent level of safety (§ 21.21(b)(1)). All components considered to be part of the front of the engine must be evaluated under § 33.76(a)(3) and (b)(3).

8.5 **Run-On Sequence Requirements.**

None.

9 SMALL AND MEDIUM FLOCKING BIRD INGESTION TEST.

9.1 **Rig Test and Measurement Method.**

The FAA will accept the use of rig tests to determine if a particular bird size will pass through the inlet and into the rotor blades to demonstrate compliance to § 33.76(c).

9.2 **Power or Thrust Measurement Method.**

The power or thrust measurement method should be accurate, and remain accurate, throughout the test. The applicant should be able to set the power or thrust without undue delay and maintain that setting within ± 3 percent of the specified levels. The power or thrust may be varied, as a protective measure, after the first 2 minutes of operation post bird ingestion, if there is sustained high engine vibration. Use of alternate load devices, such as water brakes, may not control power within the ± 3 percent tolerance. Therefore, the FAA recommends that an applicant obtain approval before beginning the test, if use of an alternate load device is intended.

9.3 **Target Selection.**

The applicant must select the critical target location for the small and medium bird ingestion tests (§ 33.76(c)(1)). When determining the most critical exposed location, the applicant should:

- Consider the expected aircraft flight path angle during the takeoff phase of flight. An area of the fan "front of engine" that is behind the lip of the inlet when the engine is level to the ground may not be protected when the aircraft is in-flight.
- Target the first, largest bird at the core primary flow path.
- Target the second bird (if two or more are required) at the most critical exposed location.
- Target any remaining birds over the fan face area so that any additional critical locations are tested, including the centerbody, if applicable. This will achieve an even distribution of birds over the front face of the engine.

Any critical locations not targeted may be evaluated separately by analysis, component testing, or both. All components considered to be part of the front of the engine, not just the blades, must be evaluated under § 33.76(a)(3) and (c)(6).

9.4 **Target Timing.**

Section 33.76 requires all birds be fired at the fan with approximately 1 second of elapsed time from the moment the first bird is ingested to the last.

9.5 **Engine Operation Requirements.**

The engine must produce at least 75 percent of takeoff power or thrust after ingestion of small and medium birds (see § 33.76(c)(6)(i)). A momentary, 3-second maximum, power or thrust decrease after bird ingestion, for example, surge recovery, below 75 percent is acceptable. Exceeding engine limitations is permitted to occur during the first 2 minutes following bird ingestion in the 20-minute run-on test specified in § 33.76(c)(7)(ii). Engine limitation exceedances should be recorded and shown by evidence (acceptable to the FAA Administrator) that an unsafe condition will not result, as specified in § 33.76(c)(10). This evidence may be from previous test, service experience, or analysis. Under such circumstances, the applicant should evaluate the operating instructions, installation manual, and maintenance manual to determine the need for guidelines on dealing with this type of over-limit condition specified in §§ 33.4 and 33.5.

9.6 **Multi-Engine Helicopters.**

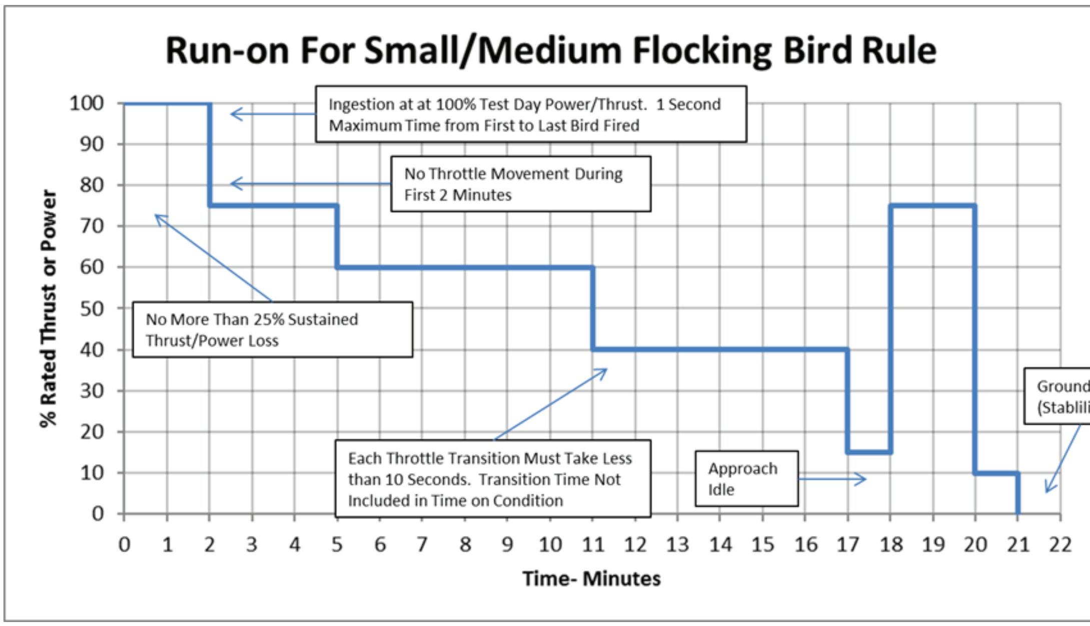
If the applicant does not run the MFB test, under the exception for multi-engine helicopter installations in § 33.76(c)(9), then the engine TCDS must be annotated to that effect.

Note: This exception and associated TCDS note is separate from the protected inlet allowance of § 33.76(a)(6).

9.7 **Run-On Sequence Requirements.**

Figure 2 shows the requirements specified in § 33.76(c)(7).

Figure 2. Run-On Sequence for Small and Medium Flocking Bird Ingestion Rule



10 LARGE FLOCKING BIRD INGESTION TEST.

10.1 **Test and Measurement Methods.**

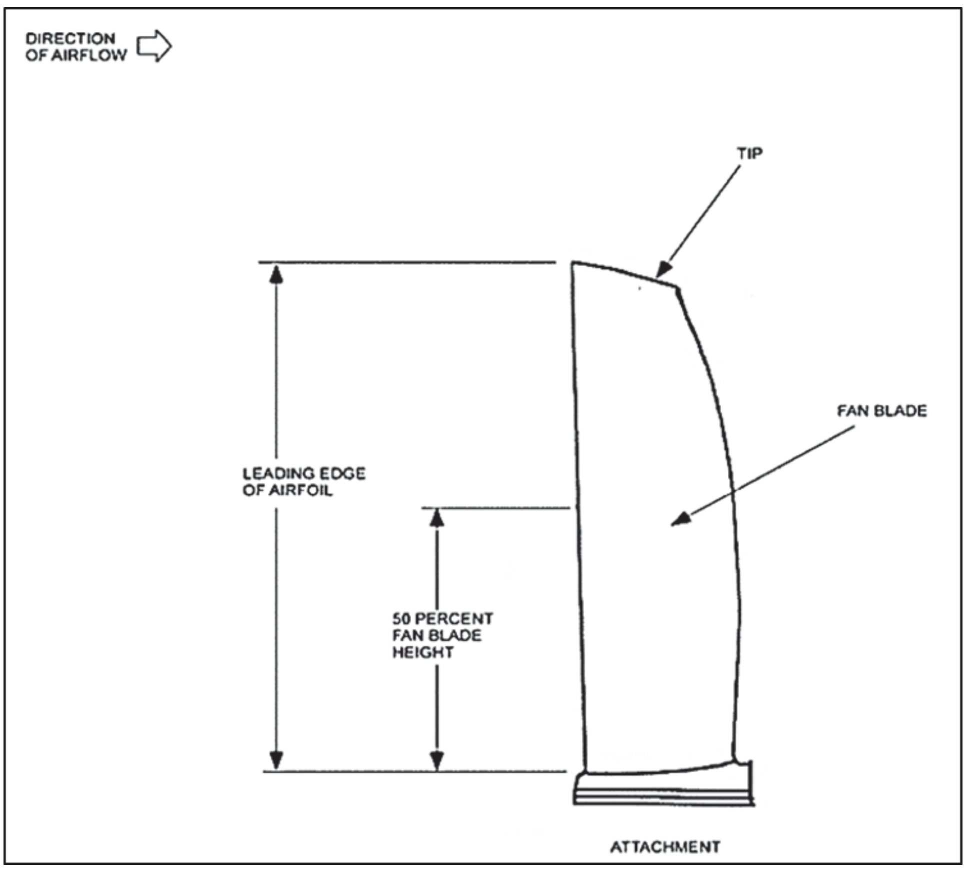
The large flocking bird (LFB) test may be run as an engine test or a subassembly test installed in an engine to demonstrate the run-on requirements. The subassembly test under the § 33.76(d)(6)(ii) method should include all type design hardware that the applicant considers significant to the outcome of the test, such as fan blades and their retention or spacer components; fan inlet and outlet (exit) guide vanes; spinners; fan disks; shafts; fan cases; frames; main bearings and bearing supports; including frangible bearing assemblies, or devices, and other critical parts. The subassembly test must adequately represent the mechanical aspects of the engine during LFB ingestion. The dynamic effects and related operability concerns noted in this paragraph include, but are not limited to, surge and stall, flameout, limit exceedance, and any other considerations relative to the engine's ability to comply with § 33.76(d)(4) and (d)(5) requirements.

Note: To use the subassembly test option, the applicant should show that the immediate dynamic effects of the bird ingestion will not result in one of the above conditions.

10.2 **Target Selection.**

The target point selection on the first exposed rotating stage or stages of the engine must not be less than 50 percent of airfoil height, as measured at the fan blade leading edge per § 33.76(d)(3). Figure 3 shows the target point location on the leading edge of a typical fan blade. Specify the chosen target location in the test plan. The term stage or stages addresses designs where multiple stages are exposed, such as rear-mounted fan configurations. Each exposed stage of these designs should be evaluated independently.

Figure 3. Location of Target Point on the Leading Edge of a Typical Fan Blade



10.3 **Engine Operation Requirements.**

10.3.1 The engine power or thrust must stabilize at a specific first stage rotor speed value, for example, fan speed (N1), etc., independent of test day ambient conditions, or actual power or thrust produced at the time of the test (§ 33.76(d)(2)). This physical N1 fan rotor speed value corresponds to 90 percent of maximum rated takeoff power or thrust, produced when the engine is operated on an International Standard Atmosphere (ISA) standard day at sea level.

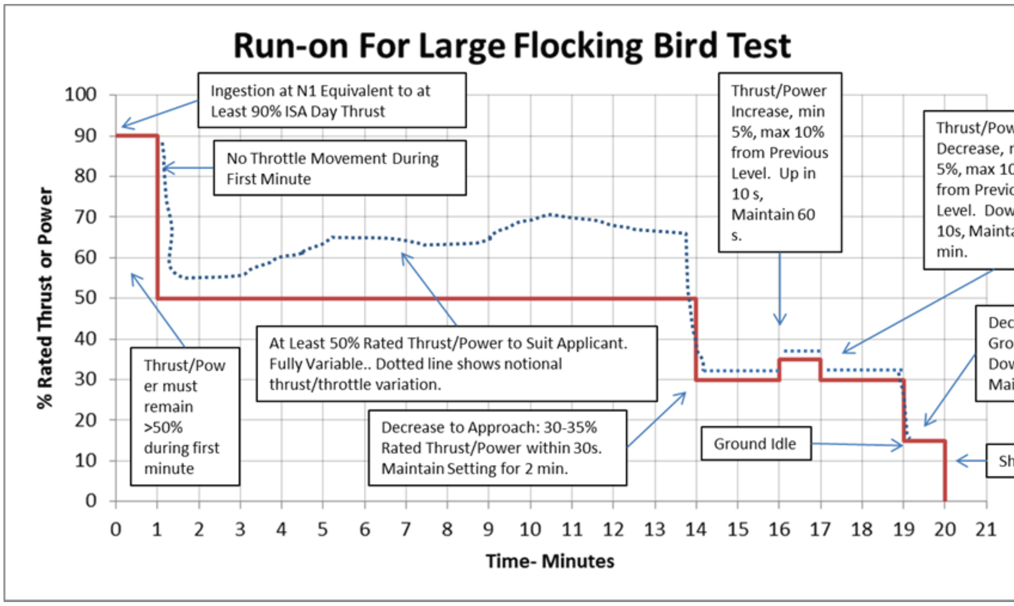
10.3.2 After ingesting a LFB, the engine must operate for a minimum of 20 minutes, per the required run-on schedule in § 33.76(d)(5). A momentary, 3-second maximum, power or thrust decrease below the required value during the first minute after bird ingestion is acceptable. A power or thrust loss greater than 3 seconds is considered a sustained power loss.

10.3.3 Engine limitation exceedances are permitted if they are recorded and shown by evidence that an unsafe condition will not result. See § 33.76(c)(10). This evidence may be from previous testing, service experience, or analysis. Under such circumstances, the operating instructions, installation, and maintenance manuals should be evaluated to determine the need for additional maintenance requirements for dealing with this type of over-limit condition. See §§ 33.4 and 33.5.

10.4 **Run-On Sequence Requirements.**

The total engine run-on sequence test duration may exceed 20 minutes, due to the time used for accelerations and decelerations. Wherever a percentage of maximum rated takeoff power or thrust is specified in this paragraph, the rotor speed to attain the specified power setting will vary with test day conditions. These power settings are a percentage of maximum rated takeoff power or thrust, not a percentage of the actual test day pre-ingestion power or thrust specified in § 33.76(d)(2). Figure 4 shows a graph of § 33.76(d)(5) run-on sequence requirements.

Figure 4. Run-On for Large Flocking Bird Ingestion Rule



11 MEDIUM FLOCKING BIRD TEST AT CLIMB CONDITION.

11.1 Test and Measurement Methods.

11.1.1 Climb Flocking Bird Test Rotor Speed Determination.

Calculation of the fan rotor speed associated with the climb phase of flight is dependent on the design and operation of the airplane. For each engine model and installation, the engine manufacturer should collaborate with the airplane manufacturer to determine the engine thrust needed to climb through an altitude of 3,000 feet in ISA standard day conditions (3,000 feet MSL) at 250 knots indicated airspeed (KIAS) (261-knots true airspeed). The associated minimum mechanical fan rotor speed for this condition should be established using engine performance simulations. The minimum speed should be the speed for the lowest rated thrust engine model offered for that aircraft installation. If multiple climb settings are available for a particular aircraft, use the lowest climb setting to determine the core-climb ingestion rotor speed targets. If the airplane manufacturer is unknown or if no coordination on climb settings took place, the engine applicant should include information on the climb settings used during the test in the installation manual.

11.1.2 Climb Rotor Speed Considerations.

Typically, little to no difference exists between takeoff and climb rotor speeds for the smaller turbofan engines installed on business jets. For this reason, the climb conditions for the core-climb ingestion demonstration will often be close to those prescribed for the MFB test of § 33.76(c), where the largest MFB is targeted at the engine core at full rated takeoff condition. For those engines, the most significant difference between the

§ 33.76(c) medium flocking bird test and the § 33.76(e) climb flocking bird test is the bird speed. An applicant may combine the 250 KIAS (261-knots true airspeed) climb flocking bird test with the existing MFB test if the climb fan rotor speed is within 3 percent of the rotor speed associated with rated takeoff thrust. The climb flocking bird test requirements may be satisfied by a single combined bird ingestion test using all of the following criteria:

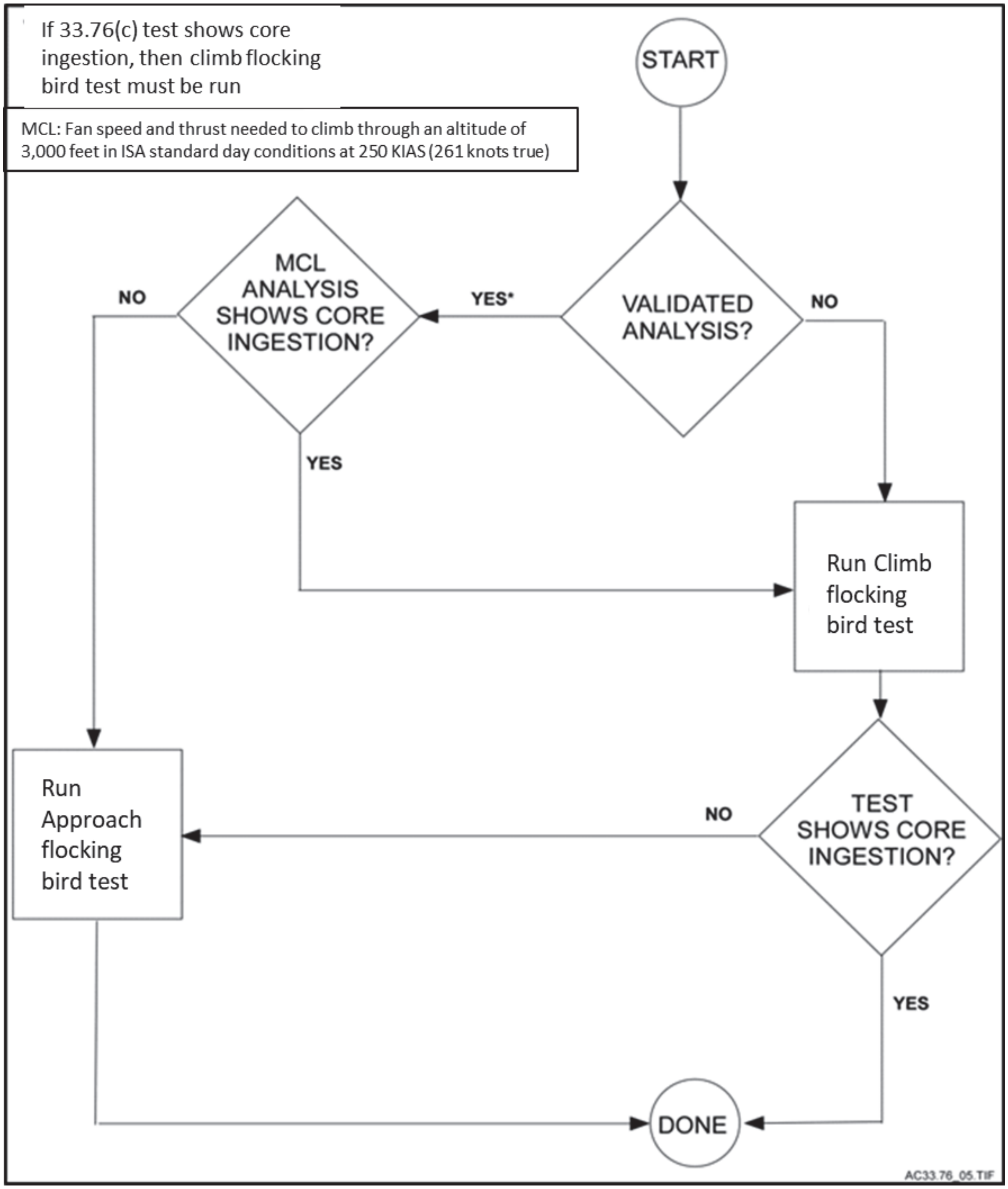
- Engine operating at rated takeoff thrust.
- Largest MFB fired at the 261-knots true airspeed at the engine core.
- Remaining bird velocities, targeting, and run-on in accordance with the § 33.76(c) MFB criteria. The remaining birds would be fired at the velocity associated with § 33.76(c), which represents aircraft normal flight velocity up to 1,500 feet AGL, but not less than V1 minimum.
- All birds to be fired within the 1-second requirement of § 33.76(c)(7)(i).

The goal is to show the core ingestion demonstration is as rigorous at the current MFB fan speed condition, as it would be at the (airplane) recommended climb fan speed condition. Use of this approach could eliminate a redundant test.

11.1.3 Core Ingestion Prediction Analysis.

Some engine configurations may include features that reject all bird material from the core intake at the takeoff and climb conditions. Such engines would be exempt from the recommended climb flocking bird test, but subject to the approach flocking bird test. The applicant may run the approach flocking bird test if an analysis shows that no bird material will enter the core during the climb flocking bird test. The applicant should validate the analysis using data derived from rig testing, engine testing, and field experience. The applicant should perform the core ingestion prediction analysis before running the § 33.76(c) MFB test. If any amount of bird material (including a single feather or tissue fluorescence under ultraviolet light illumination) is found in the core after the standard § 33.76(c) MFB core demonstration test, then the applicant must perform the climb flocking bird test. Figure 5 shows when an applicant may use the approach flocking bird test instead of the climb flocking bird test.

Figure 5. Core Ingestion Prediction Analyses for Climb Flocking Bird Test



11.2 **Target Selection.**

The optimum target location varies with engine design. The span-wise location depends on the geometric features of the front of the engine. Determine the target location that maximizes the amount of bird material ingested into the core for the given test condition. The optimum target location ensures the test properly challenges the core during engine demonstration. When determining the target location, use analysis based on component test, dynamic simulation verified by test, and experience with similar designs.

11.3 **Engine Operation Requirements.**

After ingestion, a power or thrust decrease below the required value of each segment, or when setting power between segments, is acceptable provided the time below the required value is no longer than 3 seconds. A power or thrust loss greater than 3 seconds duration is considered a sustained power loss.

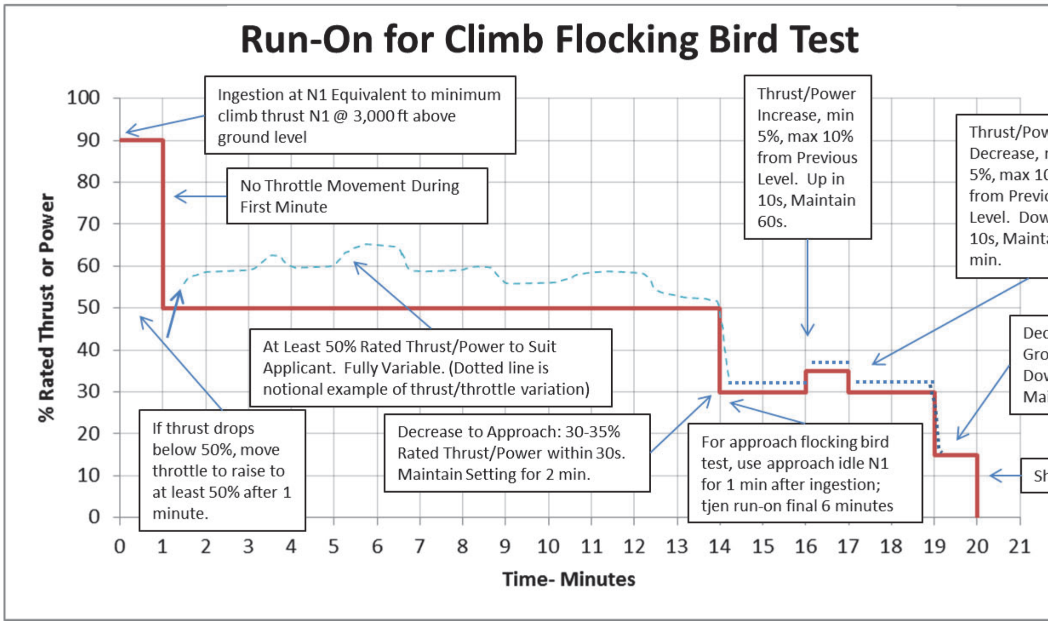
11.4 **Run-On Sequence Requirements.**

All steps in the test sequence must be completed for showing compliance with § 33.76(e)(1)(iii) or 33.76(e)(2)(iii). Requirements are specified in terms of maximum rated takeoff power or thrust in this paragraph. The rotor speed to attain the specified power setting will vary with test day conditions. These power settings are a percentage of maximum rated takeoff power or thrust, not a percentage of the actual test day pre-ingestion power or thrust specified in § 33.76(d)(2).

For the climb flocking bird test, the applicant must demonstrate the entire run-on sequence for showing compliance with § 33.76(e)(1)(iii). The total engine run-on sequence test duration may exceed 20 minutes, due to the time used for accelerations and decelerations.

For the approach flocking bird test, the applicant must demonstrate the entire run-on sequence for showing compliance with § 33.76(e)(2)(iii). The total engine run-on sequence test duration may exceed 7 minutes, due to the time used for accelerations and decelerations. The applicant must not move the throttle for 1 minute after bird ingestion as required by § 33.76(e)(2)(iii)(B). The thrust or power level may go below flight idle power or thrust for any amount of time in the first minute after bird ingestion, but the engine must not flame out or go sub-idle as required by 33.76(e)(2)(ii). If thrust or power is below 50 percent at the end of 1 minute, the throttle must be increased until thrust or power is between 30 and 35 percent maximum rated takeoff power or thrust. The remaining run-on for the approach flocking bird test is 6 minutes long as defined in § 33.76(e)(2)(iii). Figure 6 shows a graph of § 33.76(d)(5) run-on requirements.

Figure 6. Run-On for Climb Flocking Bird Test



12 SUGGESTIONS FOR IMPROVING THIS AC.

If you have suggestions for improving this AC, you may use the Advisory Circular Feedback Form at the end of this AC.

DANIEL J. ELGAS

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FOR

Victor Wicklund
Acting Director, Policy & Innovation Division
Aircraft Certification Service

OMB Control Number: 2120-0746
Expiration Date: 11/30/2024

Advisory Circular Feedback Form

If you find an error in this AC, have recommendations for improving it, or have suggestions for new items/subjects to be added, you may let us know by (1) emailing this form to (__________________) or (2) faxing it to the attention of the LOB/SO (___________________).

Subject:____________________________ Date: ____________________

Please mark all appropriate line items:

☐ An error (procedural or typographical) has been noted in paragraph __________________ on page _________________________.

☐ Recommend paragraph___________ on page _______________ be changed as follows:

☐ In a future change to this AC, please cover the following subject:
(Briefly describe what you want added.)

☐ Other comments:

☐ I would like to discuss the above. Please contact me.

Submitted by:_________________________________ Date: _______________________