APPENDIX C

FAA SAFETY ALERT FOR OPERATORS 06012

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

SAFO
Safety Alert for Operators

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A SAFO contains important safety information and may include recommended action. SAFO content should be especially valuable to air carriers in meeting their statutory duty to provide service with the highest possible degree of safety in the public interest.

Subject: Landing Performance Assessments at Time of Arrival (Turbojets)

1. Purpose. This SAFO urgently recommends that operators of turbojet airplanes develop procedures for flightcrews to assess landing performance based on conditions actually existing at time of arrival, as distinct from conditions presumed at time of dispatch. Those conditions include weather, runway conditions, the airplane's weight, and braking systems to be used. Once the actual landing distance is determined an additional safety margin of at least 15% should be added to that distance. Except under emergency conditions flightcrews should not attempt to land on runways that do not meet the assessment criteria and safety margins as specified in this SAFO.

2. Discussion: This SAFO is based on the FAA's policy statement published in the Federal Register on June 7, 2006, and incorporates revisions based on public comments received by the FAA. Accordingly, the FAA has undertaken rulemaking that would explicitly require the practice described above. Operators may use Operation/Management Specification paragraph C382 to record their voluntary commitment to this practice, pending rulemaking.

> **Operators engaged in air transportation have a statutory obligation to operate with the highest possible degree of safety in the public interest.**

3. Applicability:

a. This SAFO applies to all turbojet operators under Title 14 of the Code of Federal Regulations (14 CFR) parts 121, 135, 125, and 91 subpart K. The intent of providing this information is to assist operators in developing methods of ensuring that sufficient landing distance exists to safely make a full stop landing with an acceptable safety margin on the runway to be used, in the conditions existing at the time of arrival, and with the deceleration means and airplane configuration that will be used. The FAA considers a 15% margin between the expected actual airplane landing distance and the landing distance available at the time of arrival as the minimum acceptable safety margin for normal operations.

b. The FAA acknowledges that there are situations where the flightcrew needs to know the absolute performance capability of the airplane. These situations include emergencies or abnormal and irregular configurations of the airplane such as engine failure or flight control

Approved by AFS-1 Page 1

malfunctions. In these circumstances, the pilot must consider whether it is safer to remain in the air or to land immediately and must know the actual landing performance capability (without an added safety margin) when making these evaluations. This guidance is not intended to curtail such evaluations from being made for these situations.

c. This guidance is independent of the preflight landing distance planning requirements of part 121, section 121.195, part 135, section 135.385, and part 91, section 91.1037.

d. This 15% safety margin should not be applied to the landing distance determined for compliance with any other OpSpec/MSpec requirement. The landing distance assessment of this guidance is independent of any other OpSpec/MSpec landing distance requirement. The minimum landing distance should comply with all applicable landing distance requirements. Hence, the minimum landing distance at the time of arrival should be the longer of the landing distance in this guidance and that determined to be in compliance with any other applicable OpSpec/MSpec.

e. This guidance does not apply to Land and Hold Short Operations (LAHSO).

4. Definitions: The following definitions are specific to this guidance and may differ with those definitions contained in other published references.

a. Actual Landing Distance. The landing distance for the reported meteorological and runway surface conditions, runway slope, airplane weight, airplane configuration, approach speed, use of autoland or a Head-up Guidance System, and ground deceleration devices planned to be used for the landing. It does not include any safety margin and represents the best performance the airplane is capable of for the conditions.

b. Airplane Ground Deceleration Devices. Any device used to aid in the onset or rate of airplane deceleration on the ground during the landing roll out. These would include, but not be limited to: brakes (either manual braking or the use of autobrakes), spoilers, and thrust reversers.

c. At Time of Arrival. For the purpose of this guidance means a point in time as close to the airport as possible consistent with the ability to obtain the most current meteorological and runway surface conditions considering pilot workload and traffic surveillance, but no later than the commencement of the approach procedures or visual approach pattern.

d. Braking Action Reports. The following braking action reports are widely used in the aviation industry and are furnished by air traffic controllers when available. The definitions provided below are consistent with how these terms are used in this guidance.

Good – More braking capability is available than is used in typical deceleration on a non-limiting runway (i.e., a runway with additional stopping distance available). However, the landing distance will be longer than the certified (unfactored) dry runway landing distance, even with a well executed landing and maximum effort braking.

Fair/Medium – Noticeably degraded braking conditions. Expect and plan for a longer stopping distance such as might be expected on a packed or compacted snow-covered runway.

Poor – Very degraded braking conditions with a potential for hydroplaning. Expect and plan for a significantly longer stopping distance such as might be expected on an ice-covered runway.

Nil – No braking action and poor directional control can be expected.

NOTE: Conditions specified as "nil" braking action are not considered safe, therefore operations under conditions specified as such should not be conducted. Do not attempt to operate on surfaces reported or expected to have nil braking action.

e. Factored Landing Distance. The landing distance required by 14 CFR part 25, section 25.125 increased by the preflight planning safety margin additives required by the applicable operating rules. (Some manufacturers supply factored landing distance information in the Airplane Flight Manual (AFM) as a service to the user.)

f. Landing Distance Available. The length of the runway declared available for landing. This distance may be shorter than the full length of the runway.

g. Meteorological Conditions. Any meteorological condition that may affect either the air or ground portions of the landing distance. Examples may include wind direction and velocity, pressure altitude, and temperature. An example of a possible effect that must be considered includes crosswinds affecting the amount of reverse thrust that can be used on airplanes with tail mounted engines due to rudder blanking effects.

h. Reliable Braking Action Report. For the purpose of this guidance, means a braking action report submitted from a turbojet airplane with landing performance capabilities similar to those of the airplane being operated.

i. Runway Surface Conditions. The state of the surface of the runway: either dry, wet, or contaminated. A dry runway is one that is clear of contaminants and visible moisture within the required length and the width being used. A wet runway is one that is neither dry nor contaminated. For a contaminated runway, the runway surface conditions include the type and depth (if applicable) of the substance on the runway surface, e.g., standing water, dry snow, wet snow, slush, ice, sanded, or chemically treated.

j. Runway Friction or Runway Friction Coefficient. The resistance to movement of an object moving on the runway surface as measured by a runway friction measuring device. The resistive force resulting from the runway friction coefficient is the product of the runway friction coefficient and the weight of the object.

k. Runway Friction Enhancing Substance. Any substance that increases the runway friction value.

l. Safety Margin. The length of runway available beyond the actual landing distance. Safety margin can be expressed in a fixed distance increment or a percentage increase beyond the actual landing distance required.

m. Unfactored Certified Landing Distance. The landing distance required by section 25.125 without any safety margin additives. The unfactored certified landing distance

may be different from the actual landing distance because not all factors affecting landing distance are required to be accounted for by section 25.125. For example, the unfactored certified landing distances are based on a dry, level (zero slope) runway at standard day temperatures, and do not take into account the use of autobrakes, autoland systems, head-up guidance systems, or thrust reversers.

5. Background: After any serious aircraft accident or incident, the FAA typically performs an internal audit to evaluate the adequacy of current regulations and guidance information in areas that come under scrutiny during the course of the accident investigation. The Southwest Airlines landing overrun accident involving a Boeing 737-700 at Chicago Midway Airport in December 2005 initiated such an audit. The types of information that were evaluated in addition to the regulations were FAA orders, notices, advisory circulars, ICAO and foreign country requirements, airplane manufacturer-developed material, independent source material, and the current practices of air carrier operators. This internal FAA review revealed the following issues:

a. A survey of operators' manuals indicated that approximately fifty percent of the operators surveyed do not have policies in place for assessing whether sufficient landing distance exists at the time of arrival, even when conditions (including runway, meteorological, surface, airplane weight, airplane configuration, and planned usage of decelerating devices) are different and worse than those planned at the time the flight was released.

b. Not all operators who perform landing distance assessments at the time of arrival have procedures that account for runway surface conditions or reduced braking action reports.

c. Many operators who perform landing distance assessments at the time of arrival do not apply a safety margin to the expected actual landing distance. Those that do are inconsistent in applying an increasing safety margin as the expected actual landing distance increased (i.e., as a percentage of the expected actual landing distance).

d. Some operators have developed their own contaminated runway landing performance data or are using data developed by third party vendors. In some cases, these data indicate shorter landing distances than the airplane manufacturer's data for the same conditions. In other cases, an autobrake landing distance chart has been misused to generate landing performance data for contaminated runway conditions. Also, some operators' data have not been kept up to date with the manufacturer's current data.

e. Credit for the use of thrust reversers in the landing performance data is not uniformly applied and pilots may be unaware of these differences. In one case, there were differences found within the same operator from one series of airplane to another within the same make and model. The operator's understanding of the data with respect to reverse thrust credit, and the information conveyed to pilots, were both incorrect.

f. Airplane flight manual (AFM) landing performance data are determined during flight-testing using flight test and analysis criteria that are not representative of everyday operational practices. Landing distances determined in compliance with 14 CFR part 25, section 25.125 and published in the FAA-approved AFM do not reflect operational landing distances (Note: some manufacturers provide factored landing distance data that addresses operational requirements.) Landing distances determined during certification tests are aimed at demonstrating the shortest

landing distances for a given airplane weight with a test pilot at the controls and are established with full awareness that operational rules for normal operations require additional factors to be added for determining minimum operational field lengths. Flight test and data analysis techniques for determining landing distances can result in the use of high touchdown sink rates (as high as 8 feet per second) and approach angles of -3.5 degrees to minimize the airborne portion of the landing distance. Maximum manual braking, initiated as soon as possible after landing, is used in order to minimize the braking portion of the landing distance. Therefore, the landing distances determined under section 25.125 are shorter than the landing distances achieved in normal operations.

g. Wet and contaminated runway landing distance data are usually an analytical computation using the dry, smooth, hard surface runway data collected during certification. Therefore, the wet and contaminated runway data may not represent performance that would be achieved in normal operations. This lack of operational landing performance repeatability from the flight test data, along with many other variables affecting landing distance, are taken into consideration in the preflight landing performance calculations by requiring a significant safety margin in excess of the certified (unfactored) landing distance that would be required under those conditions. However, the regulations do not specify a particular safety margin for a landing distance assessment at the time of arrival. This safety margin has been left largely to the operator and/or the flightcrew to determine.

h. Manufacturers do not provide advisory landing distance information in a standardized manner. However, most turbojet manufacturers make landing distance performance information available for a range of runway or braking action conditions using various airplane deceleration devices and settings under a variety of meteorological conditions. This information is made available in a wide variety of informational documents, dependent upon the manufacturer.

i. Manufacturer-supplied landing performance data for conditions worse than a dry, smooth runway is normally an analytical computation based on the dry runway landing performance data, adjusted for a reduced airplane braking coefficient of friction available for the specific runway surface condition. Most of the data for runways contaminated by snow, slush, standing water, or ice were developed to show compliance with European Aviation Safety Agency and Joint Aviation Authority airworthiness certification and operating requirements. The FAA considers the data developed for showing compliance with the European contaminated runway certification or operating requirements, as applicable, to be acceptable for making landing distance assessments for contaminated runways at the time of arrival.

6. Recommended Action:

a. A review of the current applicable regulations indicates that the regulations do not specify the type of landing distance assessment that must be performed at the time of arrival, but operators are required to restrict or suspend operations when conditions are hazardous.

b. 14 CFR part 121, section 121.195(b), part 135, section 135.385(b), and part 91, section 91.1037(b) and (c) require operators to comply with certain landing distance requirements at the time of takeoff. (14 CFR part 125, section 125.49 requires operators to use airports that are adequate for the proposed operation). These requirements limit the allowable takeoff weight to that which would allow the airplane to land within a specified percentage of the landing distance available on: (1) the most favorable runway at the destination airport under still air conditions;

and (2) the most suitable runway in the expected wind conditions. Sections 121.195(d), 135.385(d), and 91.1037(e) further require an additional 15 percent to be added to the landing distance required when the runway is wet or slippery, unless a shorter distance can be shown using operational landing techniques on wet runways. Although an airplane can be legally dispatched under these conditions, compliance with these requirements alone does not ensure that the airplane can safely land within the distance available on the runway actually used for landing in the conditions that exist at the time of arrival, particularly if the runway, runway surface condition, meteorological conditions, airplane configuration, airplane weight, or use of airplane ground deceleration devices is different than that used in the preflight calculation. Part 121, sections 121.533, 121.535, 121.537, part 135, section 135.77, part 125, section 125.351, and part 91, sections 91.3, and 91.1009 place the responsibility for the safe operation of the flight jointly with the operator, pilot in command, and dispatcher as appropriate to the type of operation being conducted.

c. Sections 121.195(e) and 135.385(e), allow an airplane to depart even when it is unable to comply with the conditions referred to in item (2) of paragraph 5b above if an alternate airport is specified where the airplane can comply with conditions referred to in items (1) and (2) of paragraph 5b. This implies that a landing distance assessment is accomplished before landing to determine if it is safe to land at the destination, or if a diversion to an alternate airport is required.

d. Part 121, sections 121.601 and 121.603, require dispatchers to keep pilots informed, or for pilots to stay informed as applicable, of conditions, such as airport and meteorological conditions, that may affect the safety of the flight. Thus, the operator and flightcrew use this information in their safety of flight decision making. Part 121, sections 121.551, 121.553, and part 135, section 135.69, require an operator, and/or the pilot in command as applicable, to restrict or suspend operations to an airport if the conditions, including airport or runway surface conditions, are hazardous to safe operations. Part 125 section 125.371 prohibits a pilot in command (PIC) from continuing toward any airport to which it was released unless the flight can be completed safely. A landing distance assessment should be made under the conditions existing at the time of arrival in order to support a determination of whether conditions exist that may affect the safety of the flight and whether operations should be restricted or suspended.

e. Runway surface conditions may be reported using several types of descriptive terms including: type and depth of contamination, a reading from a runway friction measuring device, an airplane braking action report, or an airport vehicle braking condition report. Unfortunately, joint industry and multi-national government tests have not established a reliable correlation between runway friction under varying conditions, type of runway contaminants, braking action reports, and airplane braking capability. Extensive testing has been conducted in an effort to find a direct correlation between runway friction measurement device readings and airplane braking friction capability. However, these tests have not produced conclusive results that indicate a repeatable correlation exists through the full spectrum of runway contaminant conditions. Therefore, operators and flightcrews cannot base the calculation of landing distance solely on runway friction meter readings. Likewise, because pilot braking action reports are subjective, flightcrews must use sound judgment in using them to predict the stopping capability of their airplane. For example, the pilots of two identical aircraft landing in the same conditions, on the same runway could give different braking action reports. These differing reports could be the result of differences between the specific aircraft, aircraft weight, pilot technique, pilot experience in similar conditions, pilot total experience, and pilot expectations. Also, runway surface conditions can degrade or improve significantly in very short periods of time dependent

on precipitation, temperature, usage, and runway treatment and could be significantly different than indicated by the last report. Flightcrews must consider all available information, including runway surface condition reports, braking action reports, and friction measurements.

(1) Operators and pilots should use the most adverse reliable braking action report, if available, or the most adverse expected conditions for the runway, or portion of the runway, that will be used for landing when assessing the required landing distance prior to landing. Operators and pilots should consider the following factors in determining the actual landing distance: the age of the report, meteorological conditions present since the report was issued, type of airplane or device used to obtain the report, whether the runway surface was treated since the report, and the methods used for that treatment. Operators and pilots are expected to use sound judgment in determining the applicability of this information to their airplane's landing performance.

(2) Table 1 provides an example of a correlation between braking action reports and runway surface conditions:

Braking Action	Dry (not reported)	Good	Fair/Medium	Poor	Nil
Contaminant	Dry	Wet Dry Snow (< 20mm)	Packed or Compacted Snow	Wet Snow Slush Standing Water Ice	Wet ice

Table 1. Relationship between braking action reports and runway surface condition (contaminant type)

NOTE: Under extremely cold temperatures, these relationships may be less reliable and braking capabilities may be better than represented. This table does not include any information pertaining to a runway that has been chemically treated or where a runway friction enhancing substance has been applied.

f. Some advisory landing distance information uses a standard air distance of 1000 feet from 50 feet above the runway threshold to the touchdown point. Unfactored dry runway landing distances in AFMs reflect the distances demonstrated during certification flight testing. These unfactored AFM landing distance data include air distances that vary with airplane weight, but are also nominally around 1000 feet. A 1000 foot air distance is not consistently achievable in normal flight operations. Additionally, the use of automatic landing systems (autoland) and other landing guidance systems (e.g., head-up guidance systems) typically result in longer air distances. Operators are expected to apply adjustments to this air distances to reflect their specific operations, operational practices, procedures, training, and experience.

g. To ensure that an acceptable landing distance safety margin exists at the time of arrival, the FAA recommends that at least a 15% safety margin be provided. This safety margin represents the minimum distance margin that must exist between the expected actual landing distance at the time of arrival and the landing distance available, considering the meteorological and runway surface conditions, airplane configuration and weight, and the intended use of airplane ground deceleration devices. In other words, the landing distance available on the

runway to be used for landing must allow a full stop landing, in the actual conditions and airplane configuration at the time of landing, and at least an additional 15% safety margin.

h. Operator compliance can be accomplished by a variety of methods and procedurally should be accomplished by the method that best suits the operator's current procedures. The operator's procedures should be clearly articulated in the operations manual system for affected personnel. The following list of methods is not all inclusive, or an endorsement of any particular methods, but provided as only some examples of methods of compliance.

- Establishment of a minimum runway length required under the worst case meteorological and runway surface conditions for operator's total fleet or fleet type that will provide runway lengths that comply with this guidance.

- The requirements of this paragraph could be considered along with the other applicable preflight landing distance calculation requirements and the takeoff weight adjusted to provide for compliance at the time of arrival under the conditions and configurations factored in the calculation. This information, including the conditions/configurations/etc. used in the calculation, would be provided to the flightcrew as part of the release/dispatch documents. (However, this method may not be sufficient if conditions/configurations/etc. at the time of arrival are different than those taken into account in the preflight calculations; therefore, the flightcrew would need to have access to the landing performance data applicable to the conditions present upon arrival.

- Tab or graphical data accounting for the applicable variables provided to the flightcrew and/or dispatcher as appropriate to the operator's procedures.

- Electronic Flight Bag equipment that has methods for accounting for the appropriate variables.

  NOTE: These are only some examples of methods of compliance. There are many others that would be acceptable.

7. Summary of Recommendation.

a. Turbojet operators have procedures to ensure that a full stop landing, with at least a 15% safety margin beyond the actual landing distance, can be made on the runway to be used, in the conditions existing at the time of arrival, and with the deceleration means and airplane configuration that will be used. This assessment should take into account the meteorological conditions affecting landing performance (airport pressure altitude, wind velocity, wind direction, etc.), surface condition of the runway to be used for landing, the approach speed, airplane weight and configuration, and planned use of airplane ground deceleration devices. The airborne portion of the actual landing distance (distance from runway threshold to touchdown point) should reflect the operator's specific operations, operational practices, procedures, training, and experience. Operators should have procedures for compliance with this guidance, absent an emergency, after the flightcrew makes this assessment using the air carrier's procedures, if at least the 15% safety margin is not available, the pilot should not land the aircraft.

(1) This assessment does not mean that a specific calculation must be made before every landing. In many cases, the before takeoff criteria, with their large safety margins, will be adequate to ensure that there is sufficient landing distance with at least a 15% safety margin at the time of arrival. Only when the conditions at the destination airport deteriorate while en route (e.g., runway surface condition, runway to be used, winds, airplane landing weight/configuration/speed/deceleration devices) or the takeoff was conducted under the provisions described in paragraph 5 (c) of this guidance, would a calculation or other method of determining the actual landing distance capability normally be needed. The operator should develop procedures to determine when such a calculation or other method of determining the expected actual landing distance is necessary to ensure that at least a 15% safety margin will exist at the time of arrival.

(2) Operators may require flight crews to perform this assessment, or may establish other procedures to conduct this assessment. Whatever method(s) the operator develops, its procedures should account for all factors upon which the preflight planning was based and the actual conditions existing at time of arrival.

b. Confirm that the procedures and data used to comply with paragraph 6 (a) above for actual landing performance assessments yield results that are at least as conservative as the manufacturer's approved or advisory information for the associated conditions provided therein. Although the European contaminated runway operations requirements are applied differently than the requirements of this guidance, the operator may choose to use data developed for showing compliance with the European contaminated runway operating requirements for making these landing distance assessments for contaminated runways at the time of arrival.

c. A safety margin of 15% should be added to the actual landing distance and require that the resulting distance be within the landing distance available of the runway used for landing. Note that the FAA considers a 15% margin to be the minimum acceptable safety margin.

d. If wet or contaminated runway landing distance data are unavailable, the factors in Table 2 should be applied to the pre-flight planning (factored) dry runway landing distances determined in accordance with the applicable operating rule (e.g., sections 91.1037, 121.195(b) or 135.385(b). Table 2 should only apply when no such data are available. The factors in Table 2 include the 15% safety margin recommended by this guidance, and are considered to include an air distance representative of normal operational practices. Therefore, operators do not need to apply further adjustments to the resulting distances to comply with the recommendations of this guidance.

Runway Condition	Reported Braking Action	Factor to apply to (factored) dry runway landing distance*
Wet Runway, Dry Snow	Good	0.9
Packed or Compacted Snow	Fair/Medium	1.2
Wet snow, slush, standing water, ice	Poor	1.6
Wet ice	Nil	Landing is prohibited

Table 2. Multiplication factors to apply to the factored dry runway landing distances when the data for the specified runway condition are unavailable.

* The factored dry runway landing distances for use with Table 2 must be based on landing within a distance of 60% of the effective length of the runway, even for operations where the preflight planning (factored) dry runway landing distances are based on landing within a distance other than 60% of the effective length of the runway (e.g., certain operations under part 135 and subpart K of par t91). To use unfactored dry runway landing distances, first multiply the unfactored dry runway landing distance by 1.667 to get the factored dry runway landing distance before entering Table 2 above.

> **NOTE: These factors assume maximum manual braking, autospoilers (if so equipped), and reverse thrust will be used. For operations without reverse thrust (or without credit for the use of reverse thrust) multiply the results of the factors in Table 2 by 1.2. These factors cannot be used to assess landing distance requirements with autobrakes.**

e. The landing distance assessment should be accomplished as close to the time of arrival as practicable, taking into account workload considerations during critical phases of flight, using the most up-to-date information available at that time. The most adverse braking condition, based on reliable braking reports or runway contaminant reports (or expected runway surface conditions if no reports are available) for the portion of the runway that will be used for the landing should be used in the actual landing performance assessment. For example, if the runway surface condition is reported as fair to poor, or fair in the middle, but poor at the ends, the runway surface condition should be assumed to be poor for the assessment of the actual landing distance. (This example assumes the entire runway will be used for the landing). If conditions change between the time that the assessment is made and the time of landing, the flightcrew should consider whether it would be safer to continue the landing or reassess the landing distance.

f. The operator's flightcrew and dispatcher training programs should include elements that provide knowledge in all aspects and assumptions used in landing distance performance determinations. This training should emphasize the airplane ground deceleration devices, settings, and piloting methods (e.g., air distance) used in determining landing distances for each make, model, and series of airplane. Elements such as braking action reports, airplane configuration, optimal stopping performance techniques, stopping margin, the effects of excess speed, delays in activating deceleration devices, and other pilot performance techniques should be covered. All dispatchers and flightcrew members should be trained on these elements prior to operations on contaminated runway surfaces. This training should be accomplished in a manner consistent with the operator's methods for conveying similar knowledge to flight operations

personnel. It may be conducted via operations/training bulletins or extended learning systems, if applicable to the operator's current methods of training.

g. Procedures for obtaining optimal stopping performance on contaminated runways should be included in flight training programs. All flight crewmembers should be made aware of these procedures for the make/model/series of airplane they operate. This training should be accomplished in a manner consistent with the operator's methods for conveying similar knowledge to flight operations personnel. It may be conducted via operations/training bulletins or extended learning systems, if applicable to the operator's current methods of training. In addition, if not already included, these procedures should be incorporated into each airplane or simulator training curriculum for initial qualification on the make/model/series airplane, or differences training as appropriate. All flight crewmembers should have hands on training and validate proficiency in these procedures during their next flight training event, unless previously demonstrated with their current employer in that make/model/series of airplane.