SAE G-12 AWG Subcommittee Meeting
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AS5900 Standard Update

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Sponsor AMS AS5900

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a) The High Speed Ramp Test is used to simulate large ~~transport~~ jet aircraft takeoffs, with rotation speeds exceeding 100 knots and a time from brake release to rotation speed greater than 20 s. The test is conducted at 65 m/s (126 knots), representing a nominal speed at which ~~the~~an aircraft may safely become airborne with one engine inoperative[1] (V_2), after a 25 s acceleration at 2.6 m/s².

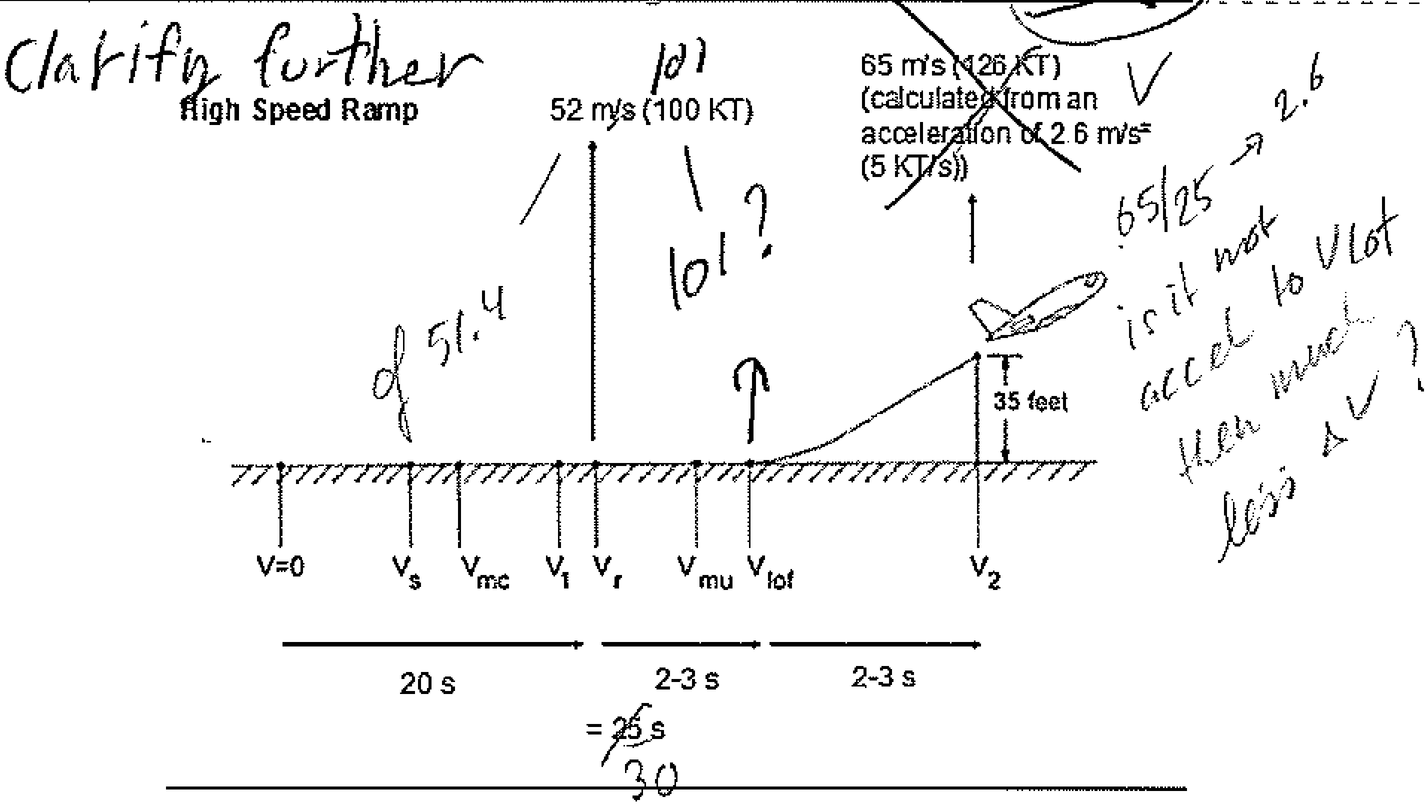

Figure 1 - High Speed Ramp Take-off

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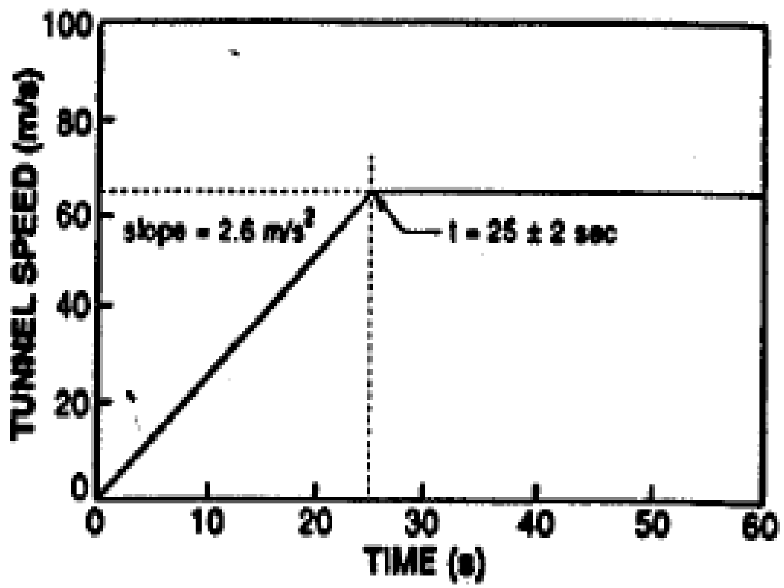
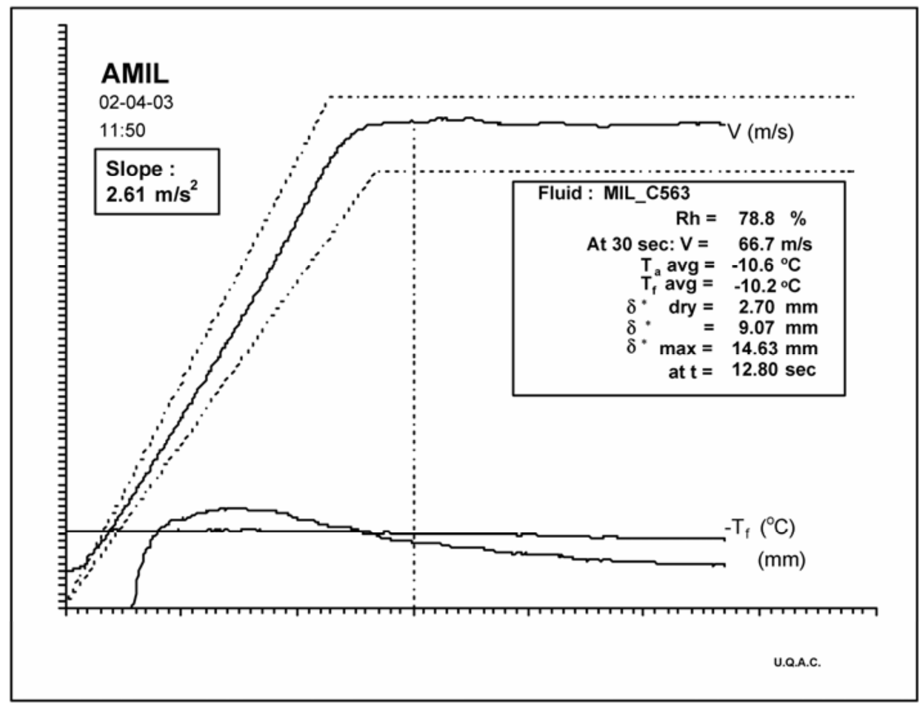
- **Since the test requires a 5 min stabilization, the initial speed ususally is around 3-4 m/s (V0 < 5m/s).**

- **The program aims to accelerate from this starting frequency to a frequency equalling 65 m/s in 25 seconds. After this period of time, the PID control of the wind tunnel takes over the control of**





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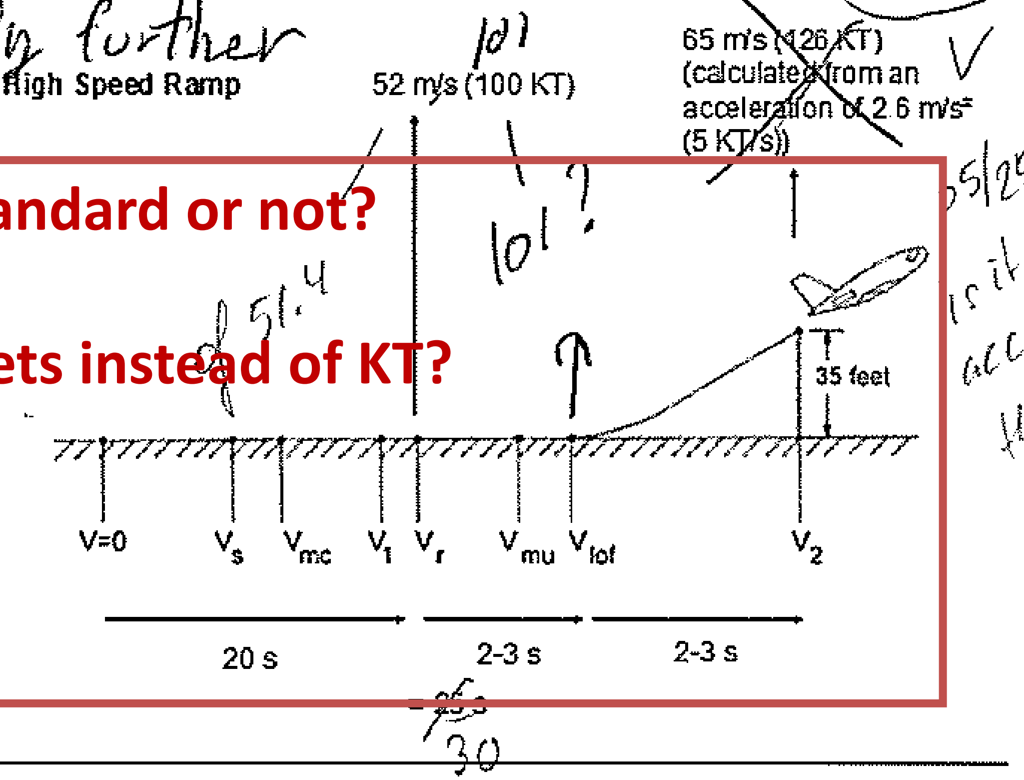

Figure 1 - High Speed Ramp Take-off

- Include in the Standard or not?
- Put m/s in brackets instead of KT?

Use 100 or 101 KT?

- …

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For the LSR, the same reasoning is applied. The time to reach a target final value of 35 m/s is 17 sec. The BLDT is measured between the 19 and 21st second and averaged.

''The test is conducted at 35 m/s (70 knots), representing the lift-off speed (V_{lof}), which is considered more critical for propeller driven aircraft, where the propeller slipstream is expected to help fluid flow off[2], after a 17 s acceleration at 2.1 m/s². "

Looked at '' Ellis, N.D., Nettleton, T.R. and Eggleston, B., (1991). BOEING CANADA 1991 "Effects of Anti-icing/De-icing fluids on the Take-off Performance of Commuter Aircraft". Report DHC-TDC-90-1 Transport Canada De Havilland March 91, 101 p.''

and "Boundary Layer Evaluation of Anti-Icing Fluids for Commuter Aircraft," Transport Canada Document No. TP11811E, August 1994.''

b) The Low Speed Ramp Test is used to simulate commuter turbo-prop ~~type-~~aircraft takeoffs, with rotation speeds ~~exceeding~~ between 60 and 100 knots, and a time from brake release to rotation speed ~~exceeding~~ between 15 and 20 s. The test is conducted at 35 m/s (70 knots), representing the lift-off speed (V_{lof}), which is considered more critical for propeller driven aircraft, where the propeller slipstream is expected to help fluid flow off[2] ~~(V_{lof})~~, after a 17 s acceleration ~~of~~ at 2.1 m/s².[1]

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"The test is conducted at 35 m/s (70 knots), representing the lift-off speed (V_{lof}), which is considered more critical for propeller driven aircraft, where the propeller slipstream is expected to help fluid flow off[2], after a 17 s acceleration at 2.1 m/s². "

From " Ellis, N.D., Nettleton, T.R. and Eggleston, B., (1991). BOEING CANADA 1991 "Effects of Anti-icing/De-icing fluids on the Take-off Performance of Commuter Aircraft". Report DHC-TDC-90-1 Transport Canada De Havilland March 91, 101 p." :

Any reduction in $C_{\ell\ MAX\ 1g}$ reduces the margin between it and $C_\ell\ (V = V_2)$. A loss of 8% would leave the aircraft capable of 30° banked turns but with no remaining stall margin. This reduced margin may be acceptable for the short period between lift-off and further clearing of the fluids, particularly with the multi-engined propeller-driven aircraft where a sizeable portion of the wing (on the order of 30%) is immersed in propeller slipstream from the moment of power application and will thus have substantially more fluid cleared; even in the case of an engine failure, a portion of the wing will provide powered lift from the remaining engine(s) and will increase the margin between normal flight and stall.

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From ''Louchez, P.R., Laforte, J.L. and Bouchard, G., "Boundary Layer Evaluation of Anti-Icing Fluids for Commuter Aircraft," Transport Canada Document No. TP11811E, August 1994.''

according to equation (1). Now, considering the "mitigating circumstances for multi-engined propeller driver aircraft " [4], the acceptable lift loss in C_{lmax} can be increased from 5.25% for large aircraft to 8% for commuter aircraft. This means that between lift-off and climb out, the propeller slipstream is expected to help fluid flow off and thus bring down the loss in C_{lmax} to less than 5.25%. Consequently, the critical moment to be considered is taken as the lift-off time (unstick): a more severe constraint than for large aircraft which compensates for the higher lift loss acceptability. Thus, in equation

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b) The Low Speed Ramp Test is used to simulate commuter turbo-prop ~~type-~~aircraft takeoffs, with rotation speeds ~~exceeding~~ between 60 and 100 knots, and a time from brake release to rotation speed ~~exceeding~~ between 15 and 20 s. The test is conducted at 35 m/s (70 knots), representing the lift-off speed (V_{lof}), which is considered more critical for propeller driven aircraft, where the propeller slipstream is expected to help fluid flow off[2] ~~(V_{lof})~~, after a 17 s acceleration ~~of~~ at 2.1 m/s².[1]

- **Refer to Ellis, N.D., Nettleton, T.R. and Eggleston, B., (1991). BOEING CANADA 1991 instead of Louchez?**
- **...**

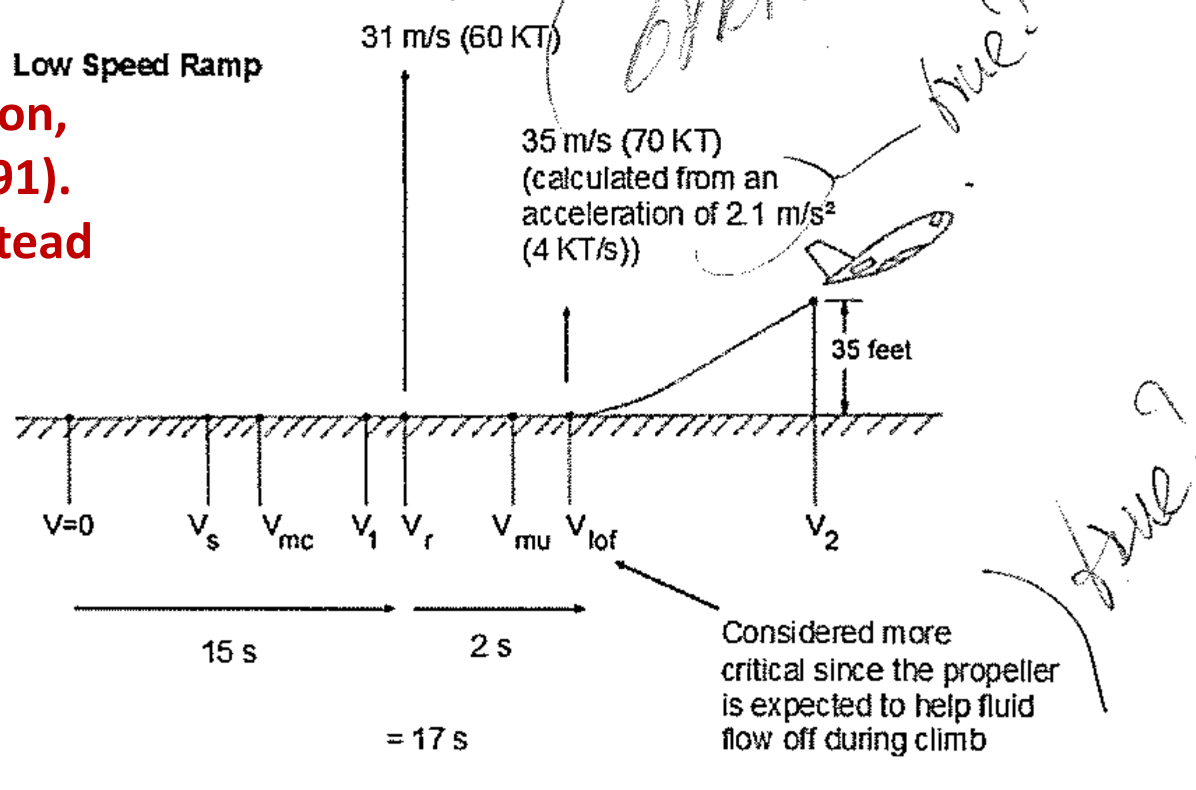

Figure 2 – Low Speed Ramp Take-off

Same as for HSR

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There is a maximum thickness requirement for Type 1 in AMS1424 (below 400µm for HSR and 600 µm for LSR). In AMS1428 there is an elimination requirement of 74% for type IV and 57% for type 3. It needs to comply to the AMS standards. Minimum thickness is preferable to eliminate the variance in initial thickness. What's remaining on the flat plate is what is important.

For this I will wait to see what is done in AMS1428 and will do the same.

~~21.1.10~~5.2.10 Fluid Elimination Requirements and Measurements

Type I: No requirement.

Types II,III, and IV: Fluid elimination shall be calculated ~~from~~ by determining the average thickness of fluid remaining on the lower plate of the test section. Measurements shall be taken within 5 min. of the end of the test at ~~THREE~~ three locations along the flat plate, as follows:

how calculated? still % or changed to mm?

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This is not new, this has always been done that way. This means that, if you have your 3 temperatures, example -28, -29 and -30, none of them can be higher than the acceptance, but the acceptable temperature will be the average of those 3. So the acceptable temperature will be the average, -29, but even -30 needs to be under the acceptance.

new ?

~~28.~~6.3 Fluid Acceptance

~~28.1.1~~6.3.1 Initial Testing

A deicing/anti-icing fluid is acceptable at an 'averaged test temperature' if none of the independent BLDT measurements is greater than the acceptance criteria as defined in Section 6.1, given that it meets the elimination requirement of AMS-1428 for Types II, III and IV. Theis averaged test temperature is the average of the three lowest temperatures of the acceptable data points. The temperature ranges at which the fluid and its dilutions are found to be acceptable shall be reported in the uid qualification statement of the report. If a fluid specimen is found unacceptable over a range of temperatures, such findings shall be explicitly stated in the prescribed report (see Section 8), and the fluid manufacturer shall be informed that the fluid cannot be used in that temperature ~~range or that the airframe manufacturer be consulted prior to using permitting use of the fluid within the unacceptable temperature range~~.

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1. SCOPE

1.1 Objective

This SAE Aerospace Standard (AS) establishes the aerodynamic flow-off requirements for SAE AMS 1424 Type I and SAE AMS 1428 Type II, III and IV fluids used to deice and/or anti-ice aircraft:

a. with takeoff rotation speeds exceeding approximately greater than 20 s, typical for large transport type jet air Test.

and/or

b. with takeoff rotation speeds exceeding approximately 60 than 15 s typical for c

NOTE: When comp procedure, t

The objective of this stan flow off aircraft lifting and

NOTE: These test metho fluids.

1.2 Fluid Acceptance a

An aircraft ground deicin accordance with this stan accordance with this test acceptance criteria descr requirements of this test Road, Warrendale, PA 15 technical suitability and c by submitting current data produce acceptable data.

1.3 Safety Hazards

This standard may involve hazardous materials, operations, any, or all, of the safety problems associated with its use. establish appropriate safety and health practices and determi

1.4 Significance In Use

Aerodynamic acceptance of an aircraft ground deicing/anti-icing fluid is based on the air and fluid BLDT (boundary layer displacement thickness) on a flat plate measured after experiencing the free stream velocity time history of a representative aircraft takeoff. Acceptability of the fluid is determined by comparing BLDT measurements of the candidate fluid with a datum established from the values of a reference fluid BLDT and the BLDT over the dry (clean) plate. Testing is carried out in the temperature range at which the fluid, undiluted and diluted, is to be used in airline service.

RATIONALE (required)

The Rationale Statement is required. Type Rationale Statement here.

INTRODUCTION (optional)

FOREWORD (optional)

3. Scope (Required)

a. All documents MUST have a SCOPE.

b. Section 1 will be designated as the SCOPE, which should briefly describe only the applicability of the document.

c. The statement of scope shall repeat the item (primary) name and its modifiers shown in the title, and shall define without ambiguity the subject matter.

d. Primary (1.x) and secondary (1.x.x) paragraphs of 1. SCOPE can be included at the discretion of the preparing committee. These paragraphs include Purpose, Field of Application, Product Classification, Form, etc.

e. The SCOPE should not be a summary of the contents of the document and should not be confused with the FOREWORD, RATIONALE, etc.

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1. SCOPE

1.1 Objective

This SAE Aerospace Standard (AS) establishes the aerodynamic flow-off requirements and test procedures for SAE AMS1424 Type I and SAE AMS1428 Type II, III and IV fluids used to deice and/or anti-ice aircraft:

a) with takeoff rotation speeds exceeding approximately 100 knots, with time from brake release to rotation speed greater than 20 s, typical for large transport type jet aircraft. This procedure is referred to as the High Speed Ramp Test.

and/or

b) with takeoff rotation speeds exceeding between approximately 60 and 100 knots, with time from brake release to rotation speed greater than between 15 and 20 s typical for commuter type turbo-prop aircraft. This procedure is referred to as the Low Speed Ramp Test.

The objective of this standard is to ensure acceptable aerodynamic characteristics of the deicing/anti-icing fluids as they flow off of aircraft lifting and control surfaces during the takeoff ground acceleration and climb.

NOTE: These test methods are based on glycol-based fluids, additional testing may be required for non-glycol-based fluids.

1.2 Fluid Acceptance and Facility/Site Qualification

An aircraft ground deicing/anti-icing fluid has acceptable aerodynamic flow—off characteristics if the fluid is tested in accordance with this standard and complies with the acceptance criteria described in Section 6. If results from testing in accordance with this test method are to be used to certify verify that an aircraft ground deicing/anti-icing fluid complies with the acceptance criteria described in Section 6, substantiation that the facility and associated staff and resources satisfy the requirements of this test method shall be documented and submitted to the Performance Review Institute, 161 Thornhill Road, Warrendale, PA 15086-7527, United States of America, or equivalent qualified third- party reviewers, to qualify the technical suitability and competency of the test site/facility. Such test site/facilities shall be qualified at five-year intervals by submitting current data, which demonstrate that, the facility, procedures, supporting resources, and staff continues to produce acceptable data.

1.3 Safety Hazards

This standard may involve hazardous materials, operations, and equipment. This standard does not purport to address any, or all, of the safety problems associated with its use. It is the responsibility of the standard user of this standard to consult and establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.

1.4 1.1 Significance Iin Use Purpose

Aerodynamic acceptance of an aircraft ground deicing/anti-icing fluid is based on the air and fluid BLDT (boundary layer displacement thickness (BLDT) on a flat plate, measured after experiencing the free stream velocity time history of a representative aircraft takeoff. Acceptability of the fluid is determined by comparing BLDT measurements of the candidate fluid with a datum established from the values of a reference fluid BLDT and the BLDT over the dry (clean) test plate. Testing is carried out in the temperature range at which the fluid, undiluted and diluted, is to be used in airline service.

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3. GENERAL INFORMATION
3.1 Ramp Definition
3.2 Reference Fluids
3.2.1 High Speed Ramp Reference Fluid
3.2.2 Low Speed Ramp Reference Fluid
3.3 Fluid Acceptance and Facility/Site Qualification
3.4 Safety Hazards