



AEROSPACE RECOMMENDED PRACTICE

ARP6265™

Issued 2014-12
Reaffirmed 2024-04

Tire Burst Test Methodology

RATIONALE

This SAE Aerospace Recommended Practice provides a standard method for testing tires to determine their burst characteristics. This test does not replace the FAA hydrostatic test to test the strength of the tire, nor does it replace the need to comply with 14CFR Part 25.729(f) and CS 25.734, and the associated AMC, including Type Burst Pressure Effect model.

ARP6265 has been reaffirmed to comply with the SAE Five-Year Review policy.

INTRODUCTION

The standard test methodology presented in this ARP is based on two of the more prevalent types of tire damage that lead to a tire burst: (1) partial skid-through of the tread and casing and (2) FOD (Foreign Object Debris) perforation of the casing. The test method presented in this ARP is based on actual test experience.

It should be noted that tire under inflation is the biggest contributor to tire bursts on the ground. However, listing or cataloging all the tire failure modes is not the intent of this ARP, rather the purpose of this ARP is to develop a test to characterize the response of a tire when bursting.

TABLE OF CONTENTS

1.	SCOPE.....	3
1.1	Purpose.....	3
2.	REFERENCES.....	3
2.1	Applicable Documents	3
2.2	DEFINITIONS	4
3.	TEST PARAMETERS	5
3.1	Burst Pressure	5
3.2	Test Article	5
3.3	Test Temperature.....	5
4.	SIMULATED TIRE DAMAGE.....	5
4.1	Partial Skid-Through (Brake Lock-up Skid Damage).....	5
4.2	FOD Cut	6
5.	MEASUREMENTS AND PHOTOGRAPHY	6
6.	TEST PROCEDURE	6
6.1	Trial and Error Method	7
6.2	Hot Wire or Hot Disk Method	7

SAE Executive Standards Committee Rules provide that: "This report is published by SAE to advance the state of technical and engineering sciences. The use of this report is entirely voluntary, and its applicability and suitability for any particular use, including any patent infringement arising therefrom, is the sole responsibility of the user."

SAE reviews each technical report at least every five years at which time it may be revised, reaffirmed, stabilized, or cancelled. SAE invites your written comments and suggestions.

Copyright © 2024 SAE International

All rights reserved. No part of this publication may be reproduced, stored in a retrieval system, transmitted, in any form or by any means, electronic, mechanical, photocopying, recording, or otherwise, or used for text and data mining, AI training, or similar technologies, without the prior written permission of SAE.

TO PLACE A DOCUMENT ORDER: Tel: 877-606-7323 (inside USA and Canada)
Tel: +1 724-776-4970 (outside USA)
Fax: 724-776-0790
Email: CustomerService@sae.org
http://www.sae.org

SAE WEB ADDRESS:

Full document details: SAE ARP6265

For more information on this standard, visit
<https://www.sae.org/standards/content/ARP6265/>

Documents

Standard, visit Sharing Hub

7.	DATA REDUCTION	7
7.1	Final Report.....	8
8.	NOTES	8
Figure 1	Tire Buffed to Simulate Partial Skid-Through with Hot Wire	9
Figure 2	FOD Damage 20% of Tire Width (shown without hot wire)	10
Figure 3	Tire Prepared to Simulate FOD Damage - With Hot Wire	11
Figure 4	Example Shown with Hot Disk	12
Figure 5A	Pressure Transducer Array	13
Figure 5B	Fixture for Pressure Transducer Array.....	14
Figure 6	Alternate Pressure Transducer Array	15

1. SCOPE

This document describes a recommended test procedure to assess the burst characteristics of tires used on 14CFR Part 25 or similar transport airplanes.

1.1 Purpose

Each airframer is required to demonstrate compliance to 14 CFR Part 25.729(f) (FAA) and CS 25.734 and 25.1309 (EASA) with regard to the performance of the equipment and systems under a failure condition. The AMC 25.734 provides a set of models defining the threats originating from failures of tires and wheels.

Should an airframer wish to use a model other than those provided by the AMC, then they would have to gather sufficient evidence and present the data to the certifying authority in order to gain their acceptance of the alternative means of showing compliance.

There is no standard tire test methodology by which it can be determined how a tire will behave during an actual tire burst event. Standardization of the test and measurement method is beneficial since it allows the tire suppliers, airframers, and certifying authorities to consistently characterize the response of each candidate tire. This ARP presents such a standardized test.

It should be noted that this test method does not provide a characterization of every failure mode a tire can experience. It cannot be used to model a failure leading to a flailing tread, or a tread disbond failure, for instance. It is for this reason that it is important to involve the certifying authority at an early stage, in order to agree the extent to which the results of the test can be used in the showing of compliance.

This test has been proposed for the current tire technologies (bias and radial), however, should a new tire design be proposed, then the validity of this test method for fully capturing the failure modes of the new design would need to be re-evaluated.

2. REFERENCES

2.1 Applicable Documents

The following publications form a part of this document to the extent specified herein. The latest issue of SAE publications shall apply. The applicable issue of other publications shall be the issue in effect on the date of the purchase order. In the event of conflict between the text of this document and references cited herein, the text of this document takes precedence. Nothing in this document, however, supersedes applicable laws and regulations unless a specific exemption has been obtained.

2.1.1 SAE Publications

Available from SAE International, 400 Commonwealth Drive, Warrendale, PA 15096-0001, Tel: 877-606-7323 (inside USA and Canada) or 724-776-4970 (outside USA), www.sae.org.

Lay, M., Macy, W., and Baxter, A., "An Investigation of Aircraft Tire Blowouts," SAE Technical Paper 961312, 1996, doi:10.4271/961312.

(This paper was written as a result of work performed at the WPAFB Landing Gear Test Facility (LGTF) in which a skid patch was buffed into a sample tire and measured the burst pressure wave that resulted from the release of the inflation pressure.)

2.1.2 Other Publications

FARS are available from Federal Aviation Administration, 800 Independence Avenue, SW, Washington, DC 20591, Tel: 866-835-5322, www.faa.gov.

14 CFR Part 25.729(f) Retracting Mechanism

To obtain JARs (this is IHS): Complete online form, Tel: 800-447-3352 (USA/Canada) or +1-303-397-2295 (Worldwide), FAX: 303-397-2599, TDD: 303-754-4032, E-mail: custsvc@ihs.com

EASA Certification Standards (CS) are available from European Aviation Safety Agency, Postfach 10 12 53, D-50452 Cologne, Germany, Tel: +49-221-8999-000, www.easa.eu.int.

CS 25.734 Protection against wheel and tyre failures

AMC 25.734 Protection against wheel and tyre failures

2.2 Definitions

2.2.1 IN-SERVICE TIRE BURST

A tire burst is the rapid, if not instantaneous, release of a tire/wheel assembly's pressurized gas due to a perforation of the tire's casing.

2.2.2 TIRE RESPONSE TO AN IN-SERVICE BURST

A tire can burst while rolling on the ground (landing gear extended), or less frequently, in the wheel well. In the case of the tire on-ground with the gear extended, damage can result from the high-pressure gas plume impinging on the surrounding equipment installations, or the flailing tire structure (loose tread that is spinning) striking surrounding equipment or in some cases separating from the tire as thrown tread (treadshed). In-flight tire bursts are related to previous damage to the tire, while rolling on-ground. Upon the tire's burst, the damage to the surrounding structure and systems is considered to be caused by radially displaced sections of the tire (no debris separation due to tire spinning) and from the pressure effect of the resulting nitrogen jet.

2.2.3 TEST GOALS AND OBJECTIVES

The primary reason for performing the tire burst tests is to determine how the tire fails, the size of the burst opening, the physical distortions, extensions, and orientations of the casing, and the size and direction of any released debris or "flap" (i.e., a displaced section of tire material). This characterization should be made on a number of sample tires which represent a class or family of tire design or architecture.

Some questions that should be kept in mind: Does the radial open into a 30 degree wedge shape which is the basis for the EASA radial tire burst model? Does the burst produce flap(s) that can strike equipment in the wheel well when the landing gear is fully retracted or on the ground with the gear extended. The desired outcome would be no flap(s). If flap(s) are present, the tire manufacture and the airframer will need to decide if the tire needs to be redesigned such that there are no flaps.

If the intent is to use the results of this test to justify an alternative means of compliance to the models described in AMC 25.734, then it is recommended that this intention and the test proposal be discussed with the certifying authority before any effort is expended in the planning and preparation of the test.

Pressure data may also be collected to validate a computational fluid dynamic (CFD) analysis that an airframer may wish to use as an alternate means of compliance.

NOTE: A test where the pressure slowly decays (not instantaneously), a “fizzle,” is not considered a successful test and must be rerun. The tire must burst.

3. TEST PARAMETERS

3.1 Burst Pressure

A typical tire bursts as the result of damage to the tire. The damage can be a partial skid-through (tree rings) or a cut from FOD (Foreign Object Debris) damage.

In the wheel well the tire is pressurized, unloaded and not spinning. For a tire to burst in the wheel well, the tire's structural strength to resist the force of the contained inflation pressure must be overcome by the contained inflation pressure. The condition after take-off which typically brings about the tire burst is the heating of the contained gas. For landing gear with braked wheels, heat transfer into the contained gas of the tire/wheel assembly can cause the pressure of the contained gas to increase, increasing the pressure beyond the remaining strength of a damaged tire casing. The increase in tire pressure is the result of heat soak back from the brake. The resulting internal tire gas temperature is less than the fuse plug temperature and the internal tire pressure is lower than the pressure relief valve setting.

For a non-braked gear, there is no heat source other than tire flexing that will substantially increase the tire inflation pressure. Once the gear is retracted the tire begins to cool and the gauge pressure of the tire reduces, this differentiates it from a tire on a braked gear.

For purposes of characterizing the tire's response to burst failure, the pressure level at the point of burst is recommended to be at least 130% of the maximum operational unloaded inflation pressure for the applicable aircraft. The “requestor” (airframer) is responsible for defining the pressure and obtaining the agreement of the certification authorities.

3.2 Test Article

The burst tests should be conducted on production quality tires. This test would need to be performed for each new tire p/n to confirm it was no worse than current p/n.

It may be necessary to perform tests on a tire of similar size and construction if a production tire is not yet available for the desired size. The validity of such a test should be coordinated with the certifying authorities prior to being performed.

3.3 Test Temperature

It is not necessary to elevate the temperature of the tire since the tire burst pressure as stated in 3.1 is satisfactory to simulate brake heating. Therefore, the temperature of the test tires can be at the ambient conditions of the test facility, around 80 °F ± 20 °F.

4. SIMULATED TIRE DAMAGE

Two of the more common reasons for a tire to burst in the wheel well are from brake lock-up skid damage (partial skid through) and FOD (Foreign Object Debris) perforations. The test article preparation should be as follows.

4.1 Partial Skid-Through (Brake Lock-up Skid Damage)

The test article should be prepared in such a manner to simulate a partial skid-through. The size and shape of the skid patch should be similar to the (loaded) footprint that is reported in the qualification test report at rated service inflation pressure. Remove the skid patch area either by buffing, cutting away tire material or a similar method to produce a skid pattern similar to that shown in Figure 1. Care must be taken to ensure that the test article is prepared in a manner that closely simulates actual in-service skid damage. The depth of the skid damage should be such that the calculated tire burst strength is equal to or slightly above the burst pressure level per 3.1.