



AEROSPACE INFORMATION REPORT

AIR5797™

REV. A

Issued 2008-08
Reaffirmed 2013-10
Stabilized 2018-08

Superseding AIR5797

Aircraft Tire Wear Profile Development and Execution for Laboratory Testing

RATIONALE

This document outlines a specific approach for testing use one particular facility. Revisions to this document are not anticipated and Five-Year Reviews have been determined to be unnecessary by the subcommittee. Therefore, it was agreed to stabilize this document.

STABILIZED NOTICE

This document has been declared "Stabilized" by the SAE A-5C Aircraft Tires Committee and will no longer be subjected to periodic reviews for currency. Users are responsible for verifying references and continued suitability of technical requirements. Newer technology may exist.

SAE Technical Standards Board 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 © 2018 SAE International

All rights reserved. No part of this publication may be reproduced, stored in a retrieval system or transmitted, in any form or by any means, electronic, mechanical, photocopying, recording, or otherwise, 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 AIR5797A

SAE values your input. To provide feedback on this Technical Report, please visit <http://standards.sae.org/AIR5797A>

Documents
Document Sharing Hub

TABLE OF CONTENTS

1.	SCOPE.....	3
2.	REFERENCES.....	3
2.1	Applicable Documents	3
2.1.1	SAE Publications.....	3
2.1.2	U.S. Government Publications.....	3
2.2	Definitions	4
3.	TIRE PREPARATION	4
3.1	Tire Conditioning	4
3.2	Break-in Procedure	4
3.3	Tire Inflation	4
4.	MECHANICAL PROPERTIES	4
4.1	Mechanical Properties - Dynamometer	4
4.1.1	Sinusoidal Yaw Sweep	6
4.1.2	Braking Sweep	7
4.2	Supplemental Information - Tire Force Machine Footprint Data.....	8
4.2.1	Load Surface.....	8
4.2.2	Yaw Angle and Tire Speed	9
4.2.3	Py and Px Footprints.....	9
5.	ENERGY CALCULATIONS	9
5.1	Side Wear Energy	9
5.2	Drag Wear Energy	9
5.3	Power	10
5.4	Total Wear Energy	10
6.	WEAR SURFACE	10
7.	WEAR MODEL.....	10
7.1	Field Conditions	10
7.2	Tire Cross Sections.....	10

7.3	Spreadsheet.....	11
7.3.1	Speed	12
7.3.2	Yaw Angle	12
7.3.3	Brake Force.....	12
7.3.4	Energy	13
8.	WEAR TESTING	13
8.1	Initial Conditioning.....	13
8.1.1	Measurement of Material Removed.....	13
8.2	Number of Test Articles	13
8.3	Data Collection.....	14
8.4	Tire Indexing	14
9.	TESTING CORRELATION	14
10.	NOTES	15
FIGURE 1	COORDINATE SYSTEM	5
FIGURE 2	FORCE AND MOMENT DIAGRAM	5
FIGURE 3	YAW SWEEP DATA	6
FIGURE 4	SLIP DATA.....	7
FIGURE 5	FORCE AND MOMENT DIAGRAM - FOOTPRINT.....	8
FIGURE 6	EXAMPLE WEAR MODEL	11
TABLE 1	TRAINER SIZED TIRE.....	14
TABLE 2	FIGHTER SIZED TIRE.....	15
TABLE 3	TRANSPORT SIZED TIRE	15

1. SCOPE

This SAE Aerospace Information Report (AIR) describes the current process for performing comparative wear testing on aircraft tires in a laboratory environment. This technique is applicable to both radial and bias tires, and is pertinent for all aircraft tire sizes.

This AIR describes a technique based upon “wear” energy. In this technique, side wear energy and drag wear energy are computed as the tire is run through a prescribed test program. The specifics that drive the test setup conditions are discussed in Sections 4 through 7. In general, the technique follows this process:

- A test profile is developed from measured mechanical property data of the tires under study.
- Each tire is repeatedly run to the test profile until it is worn to the maximum wear limit (MWL). Several tires, typically 5 to 10, of each tire design are tested.
- Wear energy is computed for each test cycle and then summed to determine total absorbed wear energy.
- An index is calculated for each tire design. This is accomplished by dividing the total linear inches of wear at the most worn point into the total wear energy.
- The indexes are then normalized to provide a comparative wear rate.

The described technique is not meant to provide an absolute wear rate or wear index because the technique does not produce results that allow the user to say a tire will last for a specific number of landings. However, it does provide a comparative index. It will make a distinction from one tire design to another by indicating a percentage difference in abrasive wear rate under representative operational conditions. The technique has been demonstrated in a number of test programs and is shown to have an extremely high correlation to field data. Supporting data is included in Section 9.

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.

Cornering and Wear Behavior of the Space Shuttle Orbiter Main Gear Tire

Author(s): Daugherty, Robert H.; Stubbs, Sandy M., NASA Center: Langley Research

Report Number: SAE PAPER 871867

2.1.2 U.S. Government Publications

None.

2.2 Definitions

CONICITY: The condition of an asymmetric tire construction that causes a tire to generate a lateral force.

FOOTPRINT: The shape of a loaded tire in its contact patch. The shape varies based on the loading, and the inflation pressure of the tire.

LIFE CYCLE COST (LCC): Total cost of an object or system, factoring in everything from production, life, maintenance, and disposal.

MAXIMUM WEAR LIMIT (MWL): The maximum number of cords that can be worn through before the tire is no longer safe to use, as determined by the tire manufacturer.

Py: Tire tread contact pressure distribution in the lateral or y-direction.

Px: Tire tread contact pressure distribution in the longitudinal or x-direction.

PLYSTEER: The turning moment produced from the tire in straight roll. This is created by the construction of the tire.

3. TIRE PREPARATION

3.1 Tire Conditioning

Before break-in, a tire is conditioned by mounting it on a suitable rim, inflating it to the unloaded rated inflation pressure, and allowing it to remain in this condition for 24 hours at ambient temperature, between 60 °F (15 °C) and 100 °F (38 °C).

3.2 Break-in Procedure

After conditioning, a tire is subjected to taxi rolls to perform “break-ins.” The test tire is inflated to the unloaded rated inflation pressure, and then rolled at taxi speeds for a one-mile taxi roll, followed by a two-mile taxi roll. Each taxi is performed at the tire’s rated, or usage load. The taxi speed is typically 20 to 40 mph (32 to 64 kph). The tire is cooled to ambient before starting any of the taxi break-in rolls.

3.3 Tire Inflation

During tire wear testing the inflation pressure is set to either a rated or a field usage pressure. Typically, the tire pressure is not corrected for flywheel curvature, and the footprint contact pressure on the internal drum is similar to a flat plate contact pressure.

4. MECHANICAL PROPERTIES

Mechanical property tests are conducted on each of the tire designs that are to be tested.

4.1 Mechanical Properties - Dynamometer

Sinusoidal yaw sweeps (described in 4.1.1) and brake sweeps (described in 4.1.2) are performed using the internal drum dynamometer prior to conducting wear testing. The resulting data is input into the wear energy model, as described in Section 7, and the dynamometer surface is prepared as described in Section 6. Figures 1 and 2 show the coordinate system used throughout dynamometer testing. Figure 3 shows an example of the collected data. The linear regression equation is utilized in generating the wear model.