



AEROSPACE RECOMMENDED PRACTICE

ARP1907™

REV. C

Issued 1988-06
Reaffirmed 2014-08
Revised 2016-01

Superseding ARP1907B

Automatic Braking Systems

RATIONALE

This SAE document is periodically reviewed to assure it reflects the latest direction within the industry. Changes were made to de-emphasize autobrake's role in safe operation.

TABLE OF CONTENTS

1.	SCOPE.....	3
1.1	Purpose	3
2.	REFERENCES.....	3
2.1	Applicable Documents	3
2.1.1	SAE Publications.....	3
2.1.2	U.S. Government Publications.....	3
2.1.3	RTCA Publications	4
3.	DESCRIPTION.....	4
4.	REQUIREMENTS	5
4.1	Functional.....	5
4.1.1	General.....	5
4.1.2	Flight Deck Configuration.....	6
4.1.3	Landing Autobrake System Operating Logic	7
4.1.4	RTO Autobrake System Operating Logic.....	9
4.1.5	Autobrake Logic and Control Inputs.....	10
4.1.6	Built-in Test Equipment (BITE)	11
4.1.7	Failure Modes	11
4.1.8	Status Indications.....	12
4.2	Design and Construction.....	12
5.	QUALIFICATION TEST	12
5.1	System Performance Tests.....	12
5.2	Component Tests.....	13
6.	INSTALLATION CONSIDERATIONS	13
6.1	Controls and Indications.....	13
6.2	Hydraulic	13

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 © 2016 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 ARP1907C

SAE values your input. To provide feedback
on this Technical Report, please visit
<http://www.sae.org/technical/standards/ARP1907C>

Documents

Document Sharing Hub

7.	LESSONS LEARNED	13
7.1	Computer Simulation.....	13
7.2	Aircraft Test.....	14
7.3	FAA Certification	14
7.4	Past Service Problems.....	14
8.	NOTES.....	15
8.1	Revision Indicator.....	15
FIGURE 1	TYPICAL AUTOBRAKE SYSTEM DIAGRAM WITH VARIOUS FLIGHT DECK DISPLAYS.....	5

1. SCOPE

This SAE Aerospace Recommended Practice (ARP) covers the functional, design, construction, and test requirements for Automatic Braking Systems. Installation information and lessons learned are also included.

1.1 Purpose

This ARP recommends minimum requirements for Automatic Braking Systems (Autobrake Systems)

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 +1 724-776-4970 (outside USA), www.sae.org.

ARP490	Electrohydraulic Servovalves
ARP1070	Design and Testing of Antiskid Brake Control Systems for Total Aircraft Compatibility
ARP926	Fault/Failure Analysis Procedure
ARP4102	Flight Deck Panels, Controls, and Displays
ARP4102/2	Automatic Braking System (ABS)
ARP4102/4	Flight Deck Alerting System (FAS)
AIR5372	Information on Brake-By-Wire (BBW) Brake Control Systems
AIR5451	A Guide to Landing Gear System Integration

2.1.2 U.S. Government Publications

Copies of these documents are available online at www.faa.gov.

Federal Aviation Regulations (FAR), Part 23, AIRWORTHINESS STANDARDS: NORMAL, UTILITY, ACROBATIC, AND COMMUTER CATEGORY AIRPLANES

FAA (Federal Aviation Administration) Advisory Circular AC 23.1309 - Equipment, Systems, and Installations in Part 23 Airplanes

FAA (Federal Aviation Administration) Advisory Circular AC 23-17 - Systems and Equipment Guide for Certification of Part 23 Airplanes and Airships

Federal Aviation Regulations, Part 25, Airworthiness Standards: Transport Category Airplanes

FAA Advisory Circular AC 25.1309-1A - System Design and Analysis

FAA Advisory Circular AC 25-7A - Flight Test Guide for Certification of Transport Category Airplanes

2.1.3 RTCA Publications

Available from RTCA, Inc., 1150 18th Street, NW, Suite 910, Washington, DC 20036, Tel: 202-833-9339, www.rtca.org.

RTCA DO-160 Environmental Conditions and Test Procedures for Airborne Equipment

RTCA DO-178B Software Considerations in Airborne Systems and Equipment Certification

RTCA DO-254 Design Assurance Guidance for Airborne Electronic Hardware

3. DESCRIPTION

The autobrake system is used at the pilot's option to initiate controlled ground braking automatically in either a landing or takeoff mode for the following benefits:

- a. Reduced pilot workload.
- b. Increased passenger comfort through controlled deceleration and smooth brake pressure application and release.
- c. Consistent and early brake application.
- d. Immediate full braking command during a rejected takeoff (RTO) condition.

A functional diagram of a typical autobrake system control system is shown in Figure 1. (This figure is just one example of many autobrake/braking systems.) The major autobrake system units are the control panel, Brake System Control Unit (BSCU) (box/board), brake control valves, and shuttle valves. This figure is functionally the same for an electric brake system. In an electric brake system, the brake control valves are electrical actuators - and obviously the hydraulic components are not applicable as well.

The system is activated by the pilot, either on the ground prior to take-off or in the air prior to landing. The ability to arm the system is made contingent upon certain occurrences and specific inputs from other aircraft systems. The application and automatic control of brake pressure thereafter, to achieve a deceleration level pre-selected by the pilot, similarly depends on the same or additional inputs, or both, from other systems. The autobrake system receives aircraft deceleration from a linear accelerometer unit or from wheel speed sensors, for comparison with the pilot selected deceleration, and then supplies a control signal to a valve, which applies pressure to the brakes. The system may use an individual control valve between the hydraulic supply and each brake, which serves the brake control, antiskid, and autobrake functions; or it may incorporate a separate control valve that bypasses pressure around the pilot metering valves to all brakes. The disarming of the system is accomplished automatically by normal pilot procedures, fault detection, or manually by the pilot if he/she desires.

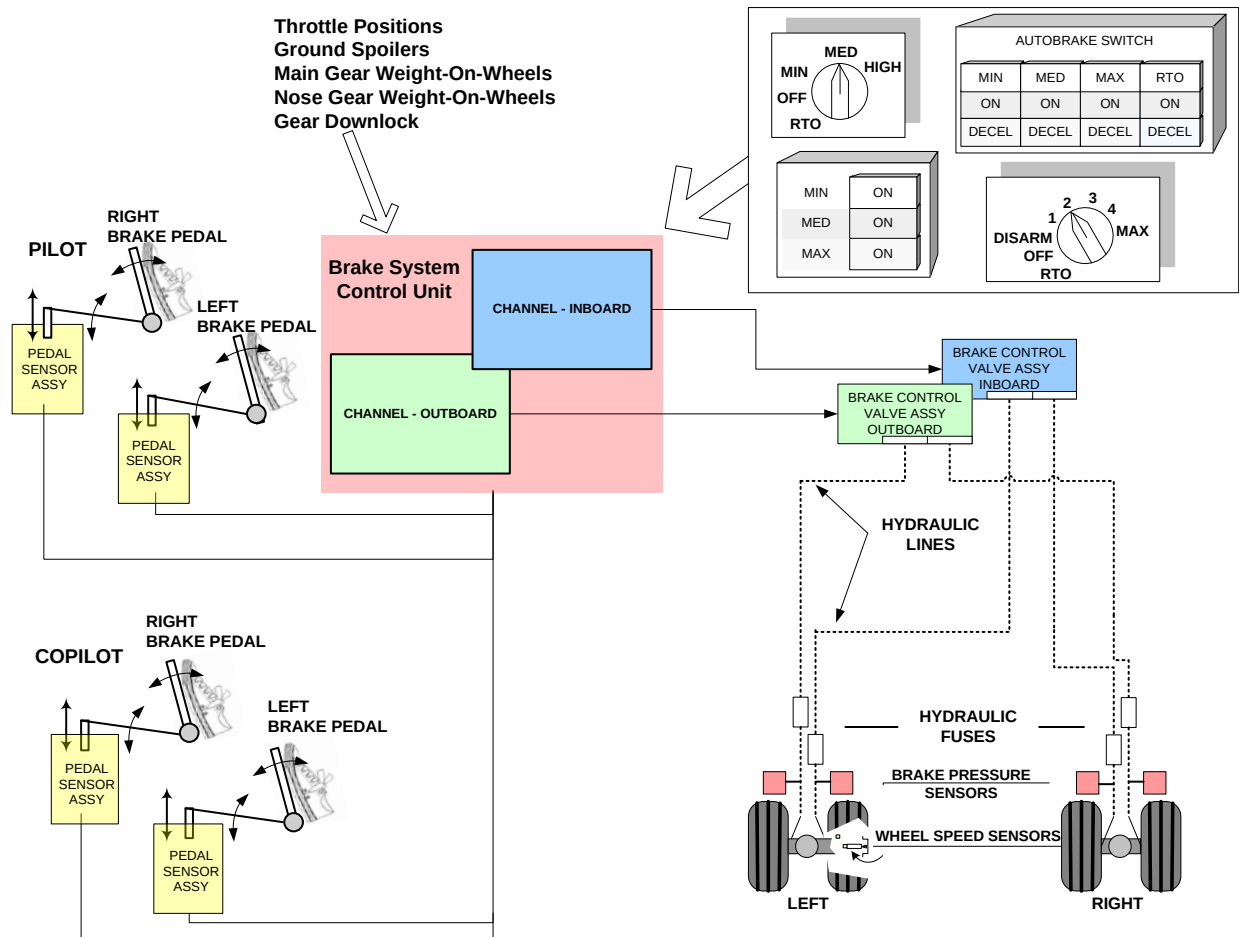


Figure 1 - Typical autobrake system diagram with various flight deck displays

4. REQUIREMENTS

These design requirements are for landing and Rejected Take-Off (RTO) automatic braking systems designed as an enhancement to manual braking and not for systems designed for use as the primary braking means (that is, certification performance basis). Systems designed for primary use must incorporate additional requirements related to insuring a high reliability of system operation during normal, adverse, and failure conditions.

In the Requirements section for the operating logic, there are two distinct subsections. First is the operating logic associated with landing followed by the operating logic for the RTO.

4.1 Functional

4.1.1 General

- The autobrake system should be a pilot-selectable feature that automatically applies RTO or landing brakes without a pilot pedal input.
- Autobrake braking should be applied equally to all active brakes. (The autobrake system may be designed so that not all brakes are active. The intent is that there should not be significant "unplanned" disparity of braking.)
- The autobrake system should not interfere with the pilot's ability to take over normal braking by application of his brake pedal(s).