



AEROSPACE STANDARD

AS8617™

Issued 2020-08

Balancing Machines - Verification Test Requirements

RATIONALE

This standard serves to revise and consolidate the verification test sections formerly found in the following individual SAE Aerospace Recommended Practice (ARP) documents into one single SAE Aerospace Standard (AS) document:

ARP4048	Balancing Machines - Description and Evaluation, Horizontal, Two-Plane, Hard-Bearing Type for Gas Turbine Rotors
ARP4050	Balancing Machines - Description and Evaluation, Vertical, Two-Plane, Hard-Bearing Type for Gas Turbine Rotors
ARP5323	Balancing Machines - Description and Evaluation, Vertical, Single-Plane, Hard-Bearing Type for Gas Turbine Rotors
ARP6217	Balancing Machines - Description and Evaluation, Vertical, Single-Plane, Non-Rotating Type for Gas Turbine Rotors

INTRODUCTION

The verification testing outlined in all the various ARP documents all had similarities that promoted consolidation into a single standard. There were also various revisions to the testing that were required:

- Additional general requirements, such as determining machine class, adjustment limitations between testing, and electronic documentation.
- Machine setup testing requirements, such as run-to-run repeatability and setup verification tests.
- Removal of single test point failure on the e_{mar} and URR test acceptance criteria.
- Updated data tables and charts in the appendices.

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 © 2020 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 AS8617

For more information on this standard, visit
<https://www.sae.org/standards/content/AS8617/>

Documents
Document Sharing Hub

TABLE OF CONTENTS

1.	SCOPE	4
2.	REFERENCES	4
2.1	Applicable Documents	4
2.1.1	SAE Publications	4
2.1.2	ANSI Accredited Publications	4
3.	GENERAL REQUIREMENTS	5
3.1	Requirements for Tests	5
3.2	Requirements for Tie Bar Frame (Horizontal Machines Only)	5
3.3	Requirements for Machine Spindle Mounting Flange (Vertical Machines Only)	5
3.4	Machine Class	5
3.5	Proving Rotor	6
3.6	Balancing Speed	6
3.7	Direction of Rotation	6
3.8	Testing and Adjustments	6
3.9	Documentation	6
4.	GENERAL MACHINE SETUP	7
4.1	Data Log Setup	7
4.2	Machine Setup	7
4.3	Proving Rotor Residual Unbalance	8
4.4	Run-to-Run Repeatability	8
4.5	Initial Setup Response Check	8
5.	TEST FOR MINIMUM ACHIEVABLE RESIDUAL SPECIFIED SPECIFIC UNBALANCE (e_{mar} TEST)	8
5.1	Purpose	8
5.2	Performance Requirements	8
5.3	Test Procedure	9
5.4	Conformance Requirements	9
6.	TEST FOR UNBALANCE REDUCTION RATIO (URR Test)	9
6.1	Purpose	9
6.2	Performance Requirements	9
6.3	Test Procedure	9
6.4	Conformance Requirements	10
7.	TEST FOR COUPLE UNBALANCE INFLUENCE (SINGLE-PLANE MACHINES ONLY)	10
7.1	Purpose	10
7.2	Performance Requirements	10
7.3	Test Procedure	11
7.4	Conformance Requirements	11
8.	TEST FOR TOOLING COMPENSATION	11
8.1	Purpose	11
8.2	Performance Requirements	11
8.3	Test Procedure	11
8.4	Conformance Requirements	12
9.	NOTES	12
9.1	Revision Indicator	12

APPENDIX A	TEST SHEETS FOR INITIAL SETUP.....	13
APPENDIX B	TEST SHEETS FOR e_{mar} TESTING	15
APPENDIX C	TEST SHEETS FOR URR TESTING	17
APPENDIX D	TEST SHEET FOR COUPLE UNBALANCE INFLUENCE TESTING (SINGLE PLANE ONLY).....	20
APPENDIX E	TEST SHEET FOR TOOLING COMPENSATION TESTING (IF EQUIPPED).....	21
APPENDIX F	CONVERSION FROM A-UNITS TO UNITS OF UNBALANCE.....	22
Table 1		7

1. SCOPE

This document specifies instructions to verify proper calibration of all balancing machines used for processing gas turbine rotors. Detailed test procedures and test log samples are provided to evaluate the condition of the machine under test. These performance and test requirements may be used for new installations, periodic surveillance, or following repairs that may have affected machine performance.

Calibration of the balancing machine is an activity done prior to verification testing and is outside the scope of this document. Troubleshooting of difficulties during the verification tests is also outside the scope of this document; this document is purely an instructive procedure.

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.

ARP4048	Balancing Machines, Description and Evaluation - Horizontal, Two-Plane, Hard-Bearing Type for Gas Turbine Rotors
ARP4050	Balancing Machines, Description and Evaluation - Vertical, Two-Plane, Hard-Bearing Type for Gas Turbine Rotors
ARP5323	Balancing Machines, Description and Evaluation - Vertical, Single-Plane, Hard-Bearing Type for Gas Turbine Rotors
ARP6217	Balancing Machines, Description and Evaluation - Vertical, Single-Plane, Non-Rotating Type for Gas Turbine Rotors
ARP4162	Balancing Machine Proving Rotors
ARP4163	Balancing Machines: Tooling Design Criteria

2.1.2 ANSI Accredited Publications

Copies of these documents are available online at <http://webstore.ansi.org/>.

ISO 21940-2 Mechanical Vibration - Rotor Balancing - Part 2: Vocabulary

3. GENERAL REQUIREMENTS

3.1 Requirements for Tests

3.1.1 To verify the claimed performance of a balancing machine, the following separate tests are required:

- A. Minimum achievable residual specific unbalance (e_{mar})
- B. Unbalance reduction ratio (URR)
- C. Couple unbalance influence (single-plane machines only)
- D. Tooling compensation (as equipped)

Tests A and B represent a minimum test procedure designed to establish essential compliance with the requirements for minimum achievable residual unbalance repeatability, combined accuracy of unbalance and angle indication, and, in the case of a two-plane machine, plane separation.

Test C, which applies to single-plane machines only, establishes compliance with the requirements that the balancing machine shall sufficiently suppress the effects of the couple unbalance from the resultant (static) unbalance indication.

Test D is required if the machine is equipped with electronic tooling compensation.

3.1.2 The test procedure will not prove compliance with all the requirements over the full range of variables, nor will it define the exact reason in case the machine fails to comply.

3.1.3 Equipment parameters, including physical inspection of various dimensions, features, instrumentation, tooling, and accessories, shall be verified.

3.1.4 The performance and test requirements have been written in terms of minimum achievable specific unbalance (e_{mar}) and A-units rather than fixed physical values; i.e. gram, millimeter, ounce, inch (refer to ISO 21940-2).

3.2 Requirements for Tie Bar Frame (Horizontal Machines Only)

3.2.1 If crowned roller bearings are installed in saddle supports, the saddle bearing in one support must be rigidly connected to the saddle bearing in the other support during the following tests (refer to ARP4163).

3.3 Requirements for Machine Spindle Mounting Flange (Vertical Machines Only)

3.3.1 The drive spindle mounting flange shall be designed in accordance with corresponding ARP documents for the type and class of balancing machine (refer to ARP4050, ARP5323, and ARP6217) to accommodate the required proving rotor flange in accordance with ARP4162.

3.4 Machine Class

3.4.1 The machine class determines the proving rotor and test speed requirements of the machine and are listed in Table 1.

3.4.2 If the machine class is unknown, it can be determined through machine load capacities from the manufacturer or the user load capacities during operation.

NOTE: Further clarification on machine class requirements can be obtained through the machine manufacturer.

3.5 Proving Rotor

- 3.5.1 The appropriate proving rotor requirements are described in ARP4162 and referenced in Table 1. Proving rotors and test masses used for testing shall be certified and traceable.

3.6 Balancing Speed

- 3.6.1 The balancing speed for tests must fall within the range specified in Table 1, with the exception of non-rotating machine testing.

3.7 Direction of Rotation

- 3.7.1 Machines that are capable of operating in both directions shall require calibration and verification testing in both directions.

3.8 Testing and Adjustments

- 3.8.1 Calibration adjustments are permitted prior to testing on new installations or where “as found” conditions are not required.
- 3.8.2 Calibration and/or repairs are permitted to be made to the machine when it fails any verification tests listed in this document.
- 3.8.3 The machine shall be completely retested after any adjustments outside normal operating parameters are completed to correct test failures. The adjustments can be in the form of, but not limited to, repairs, hardware replacements, software changes, and machine reinstallation.
- 3.8.4 The machine is not considered acceptable until all tests are completed successfully.

3.9 Documentation

- 3.9.1 All required documentation of these verification tests can be recorded in the specified data logs listed throughout this document and located in Appendices A through E, or recorded electronically with software that is proven to produce equal or more accurate test results and documentation.

Table 1

Vertical Balancing Machine						
Machine Class	25	50	100	250	500	1000
Load Capacity (pounds)	25	50	100	250	500	1000
Required e_{mar} (μin)	30	30	30	50	50	50
Proving Rotor (refer to ARP4162)	V-8	V-25	V-25	V-80	V-250	V-250
Test Speed (rpm)	N/A	900-1300	800-1100	800-1000	800-1000	600-900
Horizontal Balancing Machine						
Machine Class	30	100	300	1000	3000	
Load Capacity (pounds)	60	150	450	1500	4500	
Required e_{mar} (μin)	10	10	10	15	15	
Proving Rotor (refer to ARP4162)	H-11	H-50	H-50	H-150	H-500	
Test Speed (rpm)	1500-2000	1000-1600	1000-1600	800-1200	700-1000	

4. GENERAL MACHINE SETUP

NOTE: The general requirements and checks in this section are only recommendations to ensure proper machine setup to successfully complete the following verification testing. Unsatisfactory results of any check can be corrected through mechanical setup adjustment and testing may proceed with any minor deviations as deemed acceptable.

4.1 Data Log Setup

4.1.1 Enter all the requested data in the log(s) provided in Appendix A.

4.1.2 Record the machine test conditions by entering the required data in Table A1.

4.2 Machine Setup

4.2.1 Perform the required mechanical adjustments and setup programming for the proving rotor specified in Table 1.

4.2.2 Further detail on proving rotor setup requirements are referenced in ARP4162.

4.2.3 Proving rotors on vertical balancing machines require runout inspections on various critical surfaces to ensure proper machine flange mounting conditions are completed.

NOTE: Refer to ARP4162 for critical surface identification and inspection limits.

4.2.4 Alignment of machine 0 degrees indication to proving rotor 1A location is critical for proper setup and testing.