



AEROSPACE RECOMMENDED PRACTICE

ARP8616™

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Balancing Machine Technology - Proper Use and Performance of Response Checks

RATIONALE

To evaluate whether a balancing system produces reliable unbalance indications, a calibration needs to be performed; however, this is quite an elaborate procedure (refer to AS8617) using special test rotors according to ARP4162, and will test for machine performance only. It will not show if the current task is set up correctly and produces valid unbalance indication. During production, a shortened validation procedure—called a response check—is a useful tool to confirm the actual performance of a balancing task when results are in doubt, or to validate a completed balancing process for a particular part or module. For any balancing process, it is a useful procedure to prove the final balancing results.

The purpose of this SAE Recommended Practice is to inform and guide the reader in conducting response checks to validate measurement results.

FOREWORD

Modern hard bearing balancing machines are calibrated using an SAE rotor configuration (refer to ARP4162). This is an ideal rotor configuration used to test machine performance to confirm the balancing machine is suitable for a wide variety of common rotor balancing tasks.

When balancing a specific rotor or module, many differences are often evident from the ideal geometry of a test rotor. These include geometry settings, narrow planes, an outboard rotor configuration, rotor mass, balancing speed, etc. To validate system performance for a specific rotor type using these settings, a response check is typically conducted. It can be used before beginning the balancing procedure to check the setup. More commonly, a response check is conducted following unbalance correction to validate the unbalance correction results have been achieved.

TABLE OF CONTENTS

1.	SCOPE	3
1.1	Practical Advice	3
1.2	Theory	3
1.3	Process Management, Audit and Control Recommendations.....	3
1.4	Limitations	3
1.5	Additional Considerations.....	3
1.6	Process Documentation	3
2.	REFERENCES	3
2.1	Applicable Documents	3
2.1.1	SAE Publications	3
2.1.2	ANSI Accredited Publications	4
2.2	Definitions	4
3.	THEORETICAL BACKGROUND	4

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Documents

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4.	APPLICATION IN PRACTICE	5
4.1	Who is Authorized to Perform a Response Check?	5
4.2	Trial Masses	5
4.3	File Setup Parameters.....	5
5.	ADDITIONAL CONSIDERATIONS	6
5.1	Predictable and Unpredictable Rotor Behavior	6
5.1.1	Rotor Components Subject to Free Motion	6
5.1.2	Sagging	6
5.1.3	Influences Resulting from Uneven Temperature Distribution	7
5.2	Documentation.....	8
5.3	Traceable Masses.....	8
6.	CONDUCTING THE PROCEDURE	8
6.1	Practical Example of an Effective Response Check.....	8
6.2	Sample Calculations and Figures	8
6.2.1	Procedure for Single Plane Balancing Setup	8
6.2.2	Simplified Procedure	12
7.	FAILING OF A RESPONSE CHECK	12
8.	SUMMARY	12
9.	NOTES	12
9.1	Revision Indicator	12
APPENDIX A		13
Figure 1	Polar display showing blade scatter.....	6
Figure 2	Polar display showing rotor shaft normalizing over time.....	7
Figure 4	Polar display for trial mass added in plane 1.....	11
Figure 5	Polar display for trial mass added in plane 2.....	11
Table 1	Two-plane response check.....	10

1. SCOPE

The scope of this SAE Recommended Practice includes practical applications, theory, process management, audit and control recommendations, limitations, additional considerations, and process documentation.

1.1 Practical Advice

Before starting or after completing a balancing process for a specific part or module, a commonly recommended practice is to conduct a response check validating the unbalance measurements. This ensures the complete balancing system (comprising machine, tooling, and measuring instrumentation) has been validated to complete the specific balancing task.

1.2 Theory

When starting a balancing procedure or after achieving an “in tolerance” measuring result, the results must be verified using the complete balancing system. This is an abbreviated and direct verification process referred to as validation. Multiple runs using traceable trial masses permit observation of the change in unbalance measurement.

1.3 Process Management, Audit and Control Recommendations

Caution should be exercised regarding who is authorized to perform a response check. Operators as well as quality control personnel can be authorized, depending upon the established policy at each particular company.

1.4 Limitations

A response check will demonstrate the true accuracy of unbalance indication in amount and angle. It will not identify and quantify tooling error; only very serious repeatability issues are identified.

1.5 Additional Considerations

For rotor assemblies with loose components (e.g., blades, blade dampers, and other components that are free to move), the process will benefit from an averaged measurement based upon unbalance data from multiple runs. For unusual rotor behaviors (e.g., flexible shaft bending or a missing key), the response check will benefit from further compensation and characterization of these types of rotor behaviors. The objective is to integrate these considerations into the response check procedure to enhance its value toward process validation.

1.6 Process Documentation

All process parameters are best recorded and traceable to a known calibrated source. All critical data necessary to validate results contained in the report of the balancing process should be fully documented.

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.

AIR6966 Conducting Measurement Systems Analysis for Rotor Balancing Tasks

AIR6975 Hard Bearing Balancing Machine Technology - Proper Use of Rotor Type-Specific Calibration

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
ARP4162	Balancing Machine Proving 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
AS8617	Balancing Machines - Verification Test Requirements

2.1.2 ANSI Accredited Publications

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

ISO 21940-2:2017 Mechanical Vibration - Rotor Balancing - Part 2: Vocabulary

ISO 21940-21:2012 Mechanical Vibration - Balancing Machines - Description and Evaluation

2.2 Definitions

AVERAGING OVER TIME: Cumulative mean over time of unbalance indications.

CROSS EFFECT: When placing a test weight to one plane during calibration, the unbalance change reflected in the other plane is called cross effect or plane influence.

FILTER WINDOW: Time span used for averaging using a specific frequency bandwidth selection during rotation.

RESPONSE CHECK: Other wording used is pull check or simple validation.

TRIAL MASS, TRIAL WEIGHT, TEST MASS, TEST WEIGHT: Mass or weight temporarily installed upon the rotor to generate a known unbalance change.

UNBALANCE INDICATION: Single sampling of the unbalance signal in any moment during measurement.

UNBALANCE MEASUREMENT: Averaged unbalance indication samples over a period of time.

3. THEORETICAL BACKGROUND

Balancing systems are tested using a process similar to that used during a machine calibration. Trial masses are installed at accurately placed locations, i.e., the radial, axial, and angular positions are well defined. The procedure for a two-plane unbalance measurement is:

- a. First or initial run: No trial mass installed at the rotor.
- b. Second run: Trial mass installed at plane 1 only.
- c. Third run: Trial mass installed at plane 2 only.

The measuring result for each run is recorded.