Wind Tunnel Division

Procedural Requirement

Quality Manual Annex

NASA Ames Research Center

Wind Tunnel Division

Revision 8

June, 2009

Document Number: WTPR 1280.1

(formerly 53.FO.0001)

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Prepared for the

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Document Control Procedures, A027-9991-XR1

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RECORD of CHANGES

Change	Date	Change Description	Initiator
Original	1 Nov. 1999	Initial issue.	H. Finger
Revision 1	March 2000	Removed references and reference documents dealing with Design Control (6.4), Receiving (6.10.1 & 6.12.1) and Internal Audits (6.17) Removed Internal Audit Team responsibilities (Section 5) and Inspection Records (6.10.4). Corrected Custodian of Calibration Records Modified Customer Supplied Product (6.7), Final Inspection (6.10.3), Nonconforming Product (6.13) [CR #1690]	H. Finger
Revision 2	September 2000	Revised to reference new Document Control Procedures (6.5) [DCR #0002]	H. Finger
Revision 3	September 2000	Revised 6.18 to reflect consolidation of Quality Records Matrices in one for the division (6.16) [DCR #0003].	H. Finger
Revision 4	April 2001	5.1.7 Corrected reference for NCR 6.13.2 Moved two sentences to 6.13.2.3 (last paragraph) to remove confusion 8.0 Revised to show <u>only</u> combined FO QRM Ref. Docs. Added FAR and NFS References [DCR #0038]	H. Finger
Revision 5	August 2001	Remove reference documents of individual branch Quality Records Matrices [CR #1824]	H. Finger
Revision 6	December 2002	Updated in Preparation for re-scope back to FO Title Changed to reflect 1st level document [CR #2865]	H. Finger
Revision 7	June 2005	Adopted new AMS document numbers and calibration process Removed flight simulation from manual [CR #3043]	J. Holmberg
Revision 8	June 2009	Major Revision to conform to AS9100 Standard Sections changed to match AS9100 format References change toward Ames Management System Significant rewrite (no change tracking marks)	H. Finger

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List of Effective Pages

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1 General

1.1 Background

The Wind Tunnel Division operates several premier high-speed wind tunnels at the NASA Ames Research Center. The 11-Foot Transonic, 9x7 Foot Supersonic, 8x7 Foot Hypersonic, and the 12-Foot Pressurized Wind Tunnel provide aeronautical and space customers with world-class testing facilities including high quality aerodynamic expertise and research support. In addition, the Division provides Aeronautical Engineering, Principal Investigator assistance to programs and project testing in the facilities. Finally, Division staff develop and/or refine advanced test techniques, such as pressure sensitivity paint, that advance the art of wind tunnel testing and data collection.

Customers may bring their own wind tunnel models to the facilities, contract with third party manufacturing companies, or include the development and manufacture of a model in its request for service from the Division.

The Division consists of three branches –the Wind Tunnel Systems Branch, the Wind Tunnel Operations Branch, and the Experimental Aero-Physics Branch. The former two are responsible for the operations and maintenance of the wind tunnel facilities, while the latter develops advanced testing techniques and conducts aeronautical research and analysis for NASA programs.

In May 1998, the Division received ISO 9000:1994 certification and maintained this certification until October 1999, when its certification was merged with the Ames, which had been similarly ISO Certified in April 1999. In 2003, NASA Ames dropped its ISO Certification in favor of a more appropriate Ames Management System, yet the Wind Tunnel Division has continued to operate in an ISO-compliant manner.

1.2 Purpose

This document is intended to define a Wind Tunnel Quality Management System to be an annex to the Ames Management System and that is compliant with SAE Aerospace Standard AS-9100 (rev. B) issued 2004-01. The purpose is to set a new baseline that is compatible with the Agency's direction toward AS-9100 compliance. The document, and associated policies and procedures, should provide evidence to Wind Tunnel Division customers of our dedication to providing the highest level of quality in the services and results provided.

In addition, this Quality Management System is fully in compliance with the requirements of the Ames Management System that defines the Center's overriding policy.

The specific details and references for the Quality Management System are described in Section 4 through 8 of this document.

1.3 Scope

This quality manual annex applies to all Wind Tunnel Division Civil Service and contractor personnel whose efforts directly or indirectly affect the quality of data provided to our customers.

1.3.1 Inclusions

This annex applies to all aspects of wind tunnel testing.

1.3.2 Exclusions

This annex excludes independent research activities and analysis as well as test techniques development efforts prior to acceptance and operational readiness.

1.4 Vision, Mission, and Quality Policy

1.4.1 Vision

Our organizations lead the world in cost-effective aeronautical facility operation. We develop wind tunnel testing technology that enables our customers to improve America's competitive position in aeronautics.

1.4.2 Mission

Our mission is to:

- Operate, maintain, and develop wind tunnel facilities.
- Develop, verify, and transfer advanced aeronautics testing technologies to other US government organizations and industry.
- Set the standard for the efficient, safe, and effective operation of national aerospace facilities.
- Encourage and support creativity, initiative, and teamwork in our work environment.
- Lead by example and continuously improve our processes through measurable and definable goals.

1.4.3 Quality Policy

The Wind Tunnel Division fully embraces the Ames Quality Policy found in APR 1280.1, Section 4.

The Wind Tunnel Division is committed to provide **quality products and services that meet or exceed customers' requirements.**

1.4.4 Wind Tunnel Division Quality Objectives

The Wind Tunnel Division supports the relevant Center Level Management Objectives and Metrics (CLeMOs) [see

http://server-mpo.arc.nasa.gov/Services/AMS/STAR_MOA/MOA.tml]. Division level objectives and metrics are listed at http://server-mpo.arc.nasa.gov/Services/AMS/STAR_PR/Oprs.taf .

2 Normative References

- APR 1280.1, Ames Quality Management System
- All associated APDs and APRs located at http://server-mpo.arc.nasa.gov/Services/CDMSDocs/Centers/ARC/
- SAE Aerospace Standard, AS9100B 2004-01, Quality Management System – Aerospace - Requirements

3 Terms, Definitions, and Acronyms

- APR: Ames Procedural Requirement
- APD: Ames Policy Directive
- NPD: NASA Policy Directive

4 Quality Management System

4.1 General Requirements

Ames Procedural Requirement APR 1280.1 describes the overarching requirements for quality management and continual improvement. This document and the referenced subordinate documents provide detail on the specific implementation of the Ames Management System (and in turn, AS9100B) for the Wind Tunnel Division.

4.2 Documentation Requirements

4.2.1 General

In accordance with APR 1280.1 (para. 7.2), division and branch level documents and are managed within the Wind Tunnel Division.

4.2.2 Quality Manual

This Wind Tunnel Division Quality Manual annex adheres to requirements defined in the Ames Quality Manual (APR 1280.1). As an annex to the Ames Quality Manual, any conflicts between the document and APR 1280.1, the APR takes precedent.

4.2.3 Control of Documents

All quality system documents shall be controlled consistent with APR 1280.1 (para. 7.2). Wind Tunnel Division quality system documents (Level 6 documents according to APD 1410.1) shall adhere to Wind Tunnel Division Document Control Procedures (A027-9991-XR1).

Current quality system documents shall be maintained at http://ao.arc.nasa.gov/FO_Docs/ISO.html

The Wind Tunnel Operations Division will use the Center's document control system for posting of its policies and procedures.

4.2.4 Control of Records

Quality Records shall be managed in according with the Wind Tunnel Division Quality Records Matrix (A027-9891-XV2).

4.3 Configuration Management

Hardware configurations and Control System Software shall be managed in accordance with the Wind Tunnel Division Configuration Management Procedures (A027-9391-XB4).

SDS Software configurations shall be managed using the Clear Case tool installed in conjunction with the SDS Development System.

Final data deliverables shall be managed in accordance with the Post Test Data Transmittal Procedure (A006-9891-XM4).

5 Management Responsibility

5.1 Management Commitment

The Wind Tunnel Division Chief shall:

- Communicate and ensure the visibility and understanding of the Center's quality policy throughout the organization.
- Ensure that all Division employees have access to this document and APR 1280.1 and that requirements and responsibilities set forth therein are implemented.
- Ensure that the managers of each project, or facility undertake quality planning in accordance with this document and APR 1280.1.
- Ensure regular management reviews of the quality system and the Division's Quality Objectives.
- Ensure that personnel, skills, training, and material resources are available to implement and maintain the quality system.

5.2 Customer Focus

The Wind Tunnel Division Chief and his/her NASA and contract managers shall ensure that customer requirements are properly determined and are met in accordance with this document and APR 1280.1 and detailed in the Test Process Manual (A027-9791-XB4). Customer satisfaction, as well as specific

positive and negative comments, shall be recorded and reviewed at the end of each wind tunnel test.

5.3 Quality Policy

The ARC Management Policy as well as the Wind Tunnel Division Quality Objectives (Section 1.4) have set the framework for all processes and procedures detailed in the Wind Tunnel Division ISO document matrix. Wind Tunnel Division managers shall conduct periodic review of the Division's Quality Objectives as well as the lower level documents to ensure their continued applicability. Managers shall confirm adherence to the processes and procedures identified in the Wind Tunnel Division ISO document matrix.

The Wind Tunnel Division Chief shall ensure that a method for continual improvement is functioning and that corrective actions are implemented in a timely manner.

5.4 Planning

5.4.1 Quality Objectives

Objectives for the Wind Tunnel Division shall be set annually in accordance with APD 1210.1

5.4.2 Quality Management System Planning

Wind Tunnel Division Managers, including contract managers, shall review the Division's specific quality process and procedures including the Quality Objectives in accordance with APR 1280.1.

Wind Tunnel Division Managers, including contract managers, shall review customer feedback after each test in accordance with A027-9791-XB4, Test Process Manual.

5.5 Responsibility, Authority, and Communication

5.5.1 All Wind Tunnel Division Managers, including contract managers, shall adhere to APR 1280.1, Section 10.2.

5.5.2 All Wind Tunnel Division Personnel, including contract staff, shall adhere to APR 1280.1, Section 10.6.

5.5.3 Internal Communication

All managers shall ensure that branch/group meeting agendas include discussion of the Division Quality Management System and results from customer surveys. As a minimum the following topics shall be covered.

- Customer feedback numbers and, as appropriate, comments on recent tests

- New findings and their corrective actions and status
- Introduction of any new process or procedures
- Opportunity for questions regarding the Division's Quality Management System.

5.6 Management Review

Management review shall be conducted in accordance with the Ames Quality Manual (APR-1280.1).

6 Resource Management

6.1 Provision of Resources

Wind Tunnel Division managers (both Civil Servant and contractor) are responsible for provisioning the proper resources, including personnel, equipment, software, and facilities, for each and every test, consistent with APD 3410.1, Employee Training, and APR 7120.5, Program and Project Management for Space Flight Systems.

6.2 Human Resources

6.2.1 General

Management shall, in accordance with APD 3410.1, para. 5.2, ensure that sufficient qualified staff are assigned to each wind tunnel test.

6.2.2 Competence, Awareness, and Training

Management shall ensure that all wind tunnel staff is properly trained. The Wind Tunnel Division's training processes are described in:

- A027-9891-XB1, Wind Tunnel Operator & Engineer Training & Certification,
- A027-9861-XR1, IE & IT Training and Qualification, and
- A027-9891-XR2, Software Programming Operations Staff Training and Qualifications Plan.

6.3 Infrastructure

Requirements for each test are established in accordance with the Test Process Manual (A027-9791-XB4). Requirements for support outside the Wind Tunnel Division shall be in accordance with APR 7120.5 (para. 8.1.8)

6.4 Work Environment

Wind tunnel operations involve many high-energy resources. As such, safety of personnel and equipment are paramount to accomplishing a successful test. Test dependent safety requirements and procedures are defined in the Test Process Manual (A027-9791-XB4). General safety requirements are

defined in the Wind Tunnel Division's Safety Manual (A027-9991-XS1) and the Ames Health & Safety Procedural Requirements (APR 1700.1).

7 Product Realization

APR 8800.7, R&D Facilities Services Core Process, and APR 8060.1, Product Development are the overriding procedural requirement documents for this section.

All aspects of wind tunnel testing shall be in accordance with A027-9791-XB4, Test Process Manual. Additional requirements are noted below.

7.1 Planning of Product Realization

None.

7.2 Customer Related Processes

None.

7.3 Design and Development

7.3.1 Design and Development Planning

None.

7.3.2 Design and Development Inputs

None.

7.3.3 Design and Development Outputs

None.

7.3.4 Design and Development Review

None.

7.3.5 Design and Development Verification

Prior to the wind tunnel test, a test case may be provided to verify the data. During model prep activities through the early "wind-on" stages of a test, Check Points are calculated in parallel by the assigned Data Engineer. Using formulas and parameters independently provided by the customer to the Data Engineer and entered into Excel along with standard facility computations, output results as compared with those computed by the wind tunnel data system. If discrepancies arise, the Data Engineer and the Computations Group review the results in detail to resolve the variances.

7.3.6 Design and Development Validation

Validation of results occur before and during the test. Prior to model installation, Test Engineers prepare a Test Installation Plan that defines

the necessary processes required to install the test beginning in the prep room and completing in the test section. Part of this plan defines measurements, initial conditions requirements to be taken and any validation processes required to validate the test instrumentation. These may include balance check loads, angle check, and weight tare checks. Check Loads are made on the Balance prior to model attachment and a Single Point Check Load is made once the model installation is complete. This Single Point Check Load is repeated when the model is installed in the tunnel.

Angle of attack computations are initialized with either the Knuckle-Sleeve Zero process or the Turntable sight-in process. Angle checks are performed against a calibrated standard.

During the entire test phase required wind off initial conditions defined by the data reduction requirements (Zeros and Cals, for example) are taken prior to and immediately after every "data" series. Before and after values are compared to further validate the data. The effect of model weight measured by the balance wind-off is removed using a Weight Tare initial condition sequence. The weight tare correction is verified for the model over its expected angle range. Any discrepancies must be review by the Test Engineer and the Customer before the test can proceed. The Test Manager performs a final check to verify all the initial conditions applied correctly.

7.3.7 Control of Design and Development Changes

None.

7.4 Purchasing

The following requirements apply only to purchases that have a direct or indirect effect on data quality.

- APR 8060.1 ¶ 5.3, Product Development
- APR 5100.1 ¶ 5.1, Procurement Initiator's Guide
- SB01-001, Jacobs ATOM/Ames Procurement Manual

7.5 Production and Service Provision

None.

7.6 Control of Monitoring and Measuring Devices

The following requirements apply only to purchases that have a direct or indirect effect on data quality.

- APR 8730.1, Metrology/Calibration
- A307-9865-XM1, SOP for the Balance Calibration Lab

8 Measurement, Analysis, and Improvement

See Ames Quality Manual APR 1280.1 with the exception of

8.2.1 Customer Satisfaction

Customer feedback shall be obtained in accordance with A027-9791-XB4, Test Process Manual