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AEROSPACE INFORMATION REPORT

SAE AIR4869

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DESIGN CONSIDERATIONS FOR ENCLOSED TURBOFAN/TURBOJET ENGINE TEST CELLS

FOREWORD

One of the strongest motives for documenting the considerations which are judged important in the design of enclosed ground-level testing facilities for turbofan and turbojet engines as described in this work was the generally poor understanding of the aerodynamics associated with the test cell environment. In those instances where the understanding was not so poor, there sometimes remained a lack of appreciation for the fundamental importance of the aerodynamics of the engine testing environment. It is known that such a poor understanding or a lack of appreciation for the importance of the aerodynamics of the testing environment can and does lead to disastrous consequences. Recent research work has led to a much improved understanding and heightened awareness of the fundamental importance of the aerodynamics of the engine testing environment and has resulted in significantly improved engine test facilities now in use worldwide. This document is intended for individuals associated with the ground-level testing of large and small gas turbine engines and particularly those who might be interested in upgrading their existing or acquiring new test cell facilities.

Turbofan and turbojet engines operating in a ground-level test cell can encounter a number of problems which are directly attributable to the characteristics of the test cell environment. Some of the more important factors which must be considered in the development of test cell designs leading to desired engine operational stability, aerodynamic performance, and acoustic control are described. Test cell performance goals which typically might be used to define "excellent" cell performance are included. When these cell performance goals are achieved, stable and repeatable engine operation can be assured. Recent research conducted in scale model test studies, reinforced by results from a number of full-scale operational experiences, has assisted the evolution of engine test cell design and attacked the need for improved engine test facilities.

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SAE AIR4869

TABLE OF CONTENTS

1.	SCOPE.....	3
1.1	Purpose.....	3
2.	REFERENCES.....	3
2.1	Applicable Documents.....	3
2.2	Symbols and Abbreviations	5
2.2.1	Parameters.....	5
2.2.2	Abbreviations.....	5
2.2.3	Subscripts	6
3.	TECHNICAL BACKGROUND.....	6
4.	TEST CELL SYSTEM DESIGN CONSIDERATIONS	7
4.1	Inlet Plenum	8
4.2	Test Chamber	9
4.3	Augmentor/Diffuser	9
4.4	Exhaust Stack	10
5.	FACTORS FOR EVALUATING TEST CELL PERFORMANCE.....	11
5.1	Front Cell Velocity Distortion	11
5.2	Front Cell Airflow	11
5.3	Bellmouth Total Pressure Distortion	12
5.4	Cell Bypass Ratio	12
5.5	Cell Depression	14
6.	GENERAL TEST CELL REQUIREMENTS AND GOALS	14
7.	CONCLUSIONS	16
APPENDIX A	AIRFLOW EQUATIONS.....	17

SAE AIR4869**1. SCOPE:**

This SAE Aerospace Information Report (AIR) has been written for individuals associated with the ground-level testing of large and small gas turbine engines and particularly for those who might be interested in upgrading their existing or acquiring new test cell facilities.

1.1 Purpose:

There are several purposes served by this document:

- a. To provide guidelines for the design of state-of-the-art ground-level enclosed test facilities for turbofan and turbojet engine testing applications.
- b. To address the major test cell/engine aerodynamic and acoustic characteristics which can influence the operation of a gas turbine engine and its performance stability in a test cell.
- c. To consider acoustic environmental impact and methods to control it.

2. REFERENCES:**2.1 Applicable Documents:**

The following is a list of some applicable references and documents used in the preparation of this document:

- 2.1.1 Karamanlis, A. I., Sokhey, J. S., Dunn, T. C., and Bellomy, D. C.: "Theoretical and Experimental Investigation of Test Cell Aerodynamics for Turbofan Applications", AIAA Paper No. 86-1732, Paper presented to the AIAA/ASME/SAE/ASEE 22nd Joint Propulsion Conference, Huntsville, Alabama, June 16-18, 1986
- 2.1.2 Freuler, R. J., and Dickman, R. A.: "Current Techniques for Jet Engine Test Cell Modeling", AIAA Paper No. 82-1272, Paper presented to the AIAA/SAE/ASME 18th Joint Propulsion Conference, Cleveland, Ohio, June 21-23, 1982
- 2.1.3 Karamanlis, A. I., Freuler, R. J., Lee, J. D., Hoelmer, W., and Bellomy, D.C.: "A Universal Turbohaft Engine Test Cell -- Design Considerations and Model Test Results", AIAA Paper No. 85-0382, Paper presented to the AIAA 23rd Aerospace Sciences Meeting, Reno, Nevada, January 1985
- 2.1.4 Grunnet, J. L., and Ference, E.: "Model Test and Full-Scale Checkout of Dry-Cooled Jet Runup Sound Suppressors", AIAA Paper No. 82-1239, AIAA/SAE/ASME 18th Joint Propulsion Conference, Cleveland, Ohio, June 21-23, 1982