



AEROSPACE INFORMATION REPORT

AIR5509™**REV. A**

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Superseding AIR5509

Using Engine Test Data to Model Engine Performance

RATIONALE

An accurate engine system model is required to support engine and aircraft system development.

This SAE Aerospace Information Report (AIR) documents the process of matching an engine cycle model to test data and identifies common terminology to facilitate communication among all interested parties.

Revision A includes material re-distributed from ARP1210, which has since been cancelled.

AIR5509A has been reaffirmed to comply with the SAE Five-Year Review policy.

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1. SCOPE

This document defines the process steps involved in collecting and processing engine test data for use in understanding engine behavior. It describes the use of an aero-thermal cycle model for reduction and analysis of those data. The analysis process may include the calculation of modifiers to match the model to measured data and prediction of engine performance based on that analysis.

1.1 Purpose

The purpose of this AIR is to define common terminology for the processes used to collect and analyze engine test data.

1.2 Overview

In order to meet engine system and aircraft related requirements, gas turbine engines must demonstrate certain capabilities, such as:

- Predefined thrust, shaft torque, or power
- Non-exceedance of prescribed mechanical limits within the operating envelope
- Fuel efficiency level
- Performance in various configurations

Engine test data reduction programs may range from programs that are limited to calculation of external performance, e.g., thrust, fuel flow, and airflow, to those that include an analysis of component performance for consistency checks. Validation of engine capabilities typically employs specialized engine performance models that may be adjusted to match test data and then used to verify conformance. In order to reproduce the test data, the engine performance program will typically modify internal component representations by applying scalars and adders to adjust efficiencies and flow capacities from nominal design values. The significant advantage of these programs is that thermodynamically correct methods are employed and are thus valid over a much greater range than without adders and scalars. Numerous test data points are needed to fully characterize engine operation over the full flight envelope.

Once the engine model is matched to steady-state data, it may be necessary to characterize transient engine operation. Therefore, additional dynamic effects may be applied to characterize transient operation.

The calibrated version of the model is then used to simulate operation of the engine elsewhere in the operating envelope. Specific conditions must often be validated with test data, but it is extremely difficult to obtain flight test data at exactly the desired conditions. Flight conditions always vary from the desired conditions; therefore, a means of referring test data from actual conditions to desired conditions is necessary.

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.