



AEROSPACE INFORMATION REPORT

AIR6197™

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Site Selection Considerations for New Re-Located Gas Turbine Engine Test Facilities

RATIONALE

AIR6197 has been reaffirmed to comply with the SAE Five-Year Review policy.

1. PURPOSE AND SCOPE

This document discusses, in broad and general terms, the effects of various natural and man-made influences on the design, construction, equipping, operation and long term supportability of gas turbine engine test facilities. It will assist existing or future operators of gas turbine engine test facilities in making informed decisions regarding the siting, design, construction or long term support of their facilities.

This document is intended to aid operators in understanding the basic terms and concerns regarding gas turbine engine test facility site selection. It is not intended that this document be an exhaustive design guide such that any operator or contractor could accomplish the task of gas turbine test facility site selection independently and without further specialist advice or assistance. To this end it is suggested that this document be read in conjunction with other SAE International specialist ARP and AIR documents and in association with other industry experts from the OEM's, test facility specialist design houses, architects with specialised knowledge or independent consultants (SME's) within the field.

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2. APPLICABLE DOCUMENTS AND REFERENCES

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 the 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 SAE Publications

Available from SAE International, 400 Commonwealth Drive, Warrendale, PA 15096-0001, Tel: 877-606-7323 (inside USA and Canada) or 724-776-4970 (outside USA), www.sae.org.

AIR4869 Design Considerations for Enclosed Turbofan/Turbojet Engine Test Cells

AIR4989 Design considerations for Enclosed Turboshift Engine Test Cells

2.2 ISO Publications

Available from International Organization for Standardization, 1, rue de Varembe, Case postale 56, CH-1211 Geneva 20, Switzerland, Tel: +41-22-749-01-11, www.iso.org.

ISO7196 Acoustics – Frequency-Weighting Characteristic for Infrasound Measurement.

3. DEFINITIONS

AIR: Aerospace information report

ARP: Aerospace recommended practice

CBR: California bearing ratio. Penetration test for evaluation of the mechanical strength of road subgrades and basecourses.

Correlation: The comparison of gas turbine engine performance parameters measured on a common engine tested in two test facilities, where one facility is the reference.

DAS: Data acquisition system.

DBG: scale for the measurement of very low frequency noise.

EMI: Electro magnetic interference.

FOD: Foreign object damage (to engine).

GSE: Ground support equipment.

HGI: Hot gas ingestion.

HVAC: Heating ventilation and air conditioning.

ISA: International standard atmospheres.

ISO: International standards organisation.

IT: Information technology.

MAX: Maximum

MRO: Maintenance repair and overhaul.

OEM: Original Equipment Manufacturer of respective Gas Turbine Engine

RFI: Radio Frequency Interference

SLS: Sea level static.

SME: Subject matter expert.

Test Facility: An area in which a gas turbine engine is operated.

UV: Ultra violet.

%: Percentage

< : Less than

°C: Degree celsius.

4. GEOGRAPHICAL AND GROUND CONDITIONS

4.1 Altitude

Definition of altitude – ‘Elevation above Mean Sea Level (MSL)’

Where possible gas turbine engine test facilities should be located close to sea level, this is due to the fact that as altitude increases the properties of air change. This change in air properties has the effect of decreasing the developed thrust of engines due to a decrease in air density and a reduction in oxygen levels.

Although Performance Engineers attempt to correct all gas turbine engine testing data back to International Standards Atmosphere (ISA) day conditions (15 °C) at Sea Level Static (SLS – 1013mbar) these corrections and extrapolations can cause difficulties in achieving a successful correlation with a master test facility that is closer to sea level. These difficulties would be increased in regions where large temperature or humidity variations from the master test facility location produce additional variables.

This inherent level of measurement uncertainty at the time of the correlation could potentially cause errors in the final pass off data for each subsequent engine tested.

To avoid this uncertainty a significant amount of engineering time and effort can be spent by the engine OEM developing analytical engine performance models to recreate and understand the altitude effects, however, these models are expensive to produce and validate and unless created perfectly could have levels of uncertainty themselves due to calculation errors.

These uncertainties could lead to engines that should have passed test failing or more worryingly engines that should have failed test passing and being released into service.

It should be noted that although it is more challenging to correlate test facilities at higher altitudes, facilities have been successfully established and validated in high altitude areas such as Johannesburg (1694m) and Addis Ababa (2300m).