AEROSPACE INFORMATION REPORT

AIR1147™	REV. B

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Superseding AIR1147A

Electromagnetic Interference on Aircraft from Jet Engine Charging

RATIONALE

This document has been superseded by ARP5672.

CANCELLATION NOTICE

This Technical Report has been declared “CANCELLED” as of January, 2022 and has been superseded by ARP5672. By this action, this document will remain listed in the respective index, if applicable. Cancelled Technical Reports are available from SAE.

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RATIONALE

AIR1147A has been reaffirmed to comply with the SAE five-year review policy.

1. SCOPE:

   Engine charging of aircraft has been observed for many years. This SAE Aerospace Information Report (AIR) reviews the history of observations, physical characteristics, and possible techniques for minimizing the effects.

2. REFERENCES:

   1. R. G. Stimmel, E. H. Rogers, F. E. Waterfall and R. Gunn: "Electrification of Aircraft Flying in Precipitation Areas," Proc. IRE, Vol. 34, 1. 176, April 1946.

   2. T. Lyle Harlor, A. R. Jordan, and D. G. Murcray: "Development of Aircraft Discharge Methods," Final Report covering the period May 1952 to April 15, 1956, Denver Research Institute, University of Denver, Denver, Colorado, April 15, 1956.

   3. M. M. Newman, J. R. Stahmann, J. D. Robb, and E. O. Nestvolt: "Aircraft Protection from Atmospheric Electrical Hazards," Interim Report covering the period January through March 1959, Contract AF 33 (616) - 3991, LTRI Report #357, Lightning & Transients Research Institute, Minneapolis, Minnesota, April 1959.

   4. R. L. Tanner and J. E. Nanevicz: "Precipitation Charging and Corona-Generated Interference in Aircraft," Technical Report 73, SRI Project 2494, Contract AF 19 (604) - 3458, Stanford Research Institute, Menlo Park, California, AFCRL 336 (April 1961) AD 261 029.

   5. J. B. Chown and M. G. Keenan: "Study of the Effects of Environmental Conditions on the Breakdown of Antennas at Low Pressures on a Supersonic Vehicle," Final Report, SRI Project No. 2879, Contract AF 19 (604) - 5483, Stanford Research Institute, Menlo Park, California, AFCRL 940, September 1961.

2. (Continued):

6. J. E. Nanevicz, E. F. Vance, R. L. Tanner, G. R. Hilbers: "Development and Testing of Techniques for Precipitation Static Interference Reduction," Final Report, SRI Project 2848, Contract AF 33 (616) - 6561, Stanford Research Institute, Menlo Park, California, ASD-TDR-62-38 (January 1962), AD 272 807.

7. J. E. Nanevicz, E. F. Vance, S. Serebreny: "Correlation Between Clean-Air Turbulence and Aircraft Electrical Activity," Final Report covering the period October 1963 to August 1965, SRI Project 4690, Contract AF 19 (628) - 3308, Stanford Research Institute, Menlo Park, California, AFCRL-65-614, October 1965.

8. E. F. Vance, J. E. Nanevicz: "Rocket Motor Charging Experiments," Scientific Report 2, SRI Project 5359, Contract AF 19 (628) - 4800, Stanford Research Institute, Menlo Park, California, AFCRL 66-497, June 1966.

9. D. R. Fitzgerald: "Flight Measurements of Engine Charging Effects on Turbojet and Turboprop Aircraft," Report in process of publication (March 1970) Air Force Cambridge Research Center, Dr. D. R. Fitzgerald, CRHC, Cambridge, Mass.

3. Engine charging of aircraft has been observed for many years, with documentation dating back to the 1946 Army-Navy Precipitation Static Project reports in which it was noted that selective operation of either the inboard or outboard engines on a four-engine aircraft resulted in a slightly different discharge rate or discharge time constant. This was attributed to ion recombination in the exhaust stacks or, more properly, lack of it. This was considered primarily a curiosity of interest in relation to the basic discharge mechanisms of the aircraft, but for the earlier piston aircraft to be of no particular importance as a source of precipitation static radio interference. However, with the introduction of jet engines having large exhaust nozzles and high flow volumes at very high velocities, engine charging has become a significant problem requiring definite provisions for discharge. The basic mechanism is assumed to be charge separation occuring through the ionization disassociation, etc., of the molecules in the high temperature flame in which ions are selectively captured by the walls of the exhaust nozzle as determined by the individual exhaust nozzle geometry, the fuel types, and flow rate.

   Charging as high as 800 microamps with water injection (Nanevicz, et al, AFAL-TR-65-239, p. 48, December 1965) has been observed with maximum takeoff power on the large jet engines of turbo-jet transport aircraft. In general, the effects on the aircraft communication system are similar to those from charging by frictional contact of the aircraft with atmospheric particles and as such can be handled by use of static wick dischargers.