MILITARY SPECIFICATION

POWER PLANT VIBRATION ISOLATOR: DESIGN AND INSTALLATION REQUIREMENTS

1. SCOPE

1.1 This specification establishes the requirements for the design and installation of power-plant vibration isolators.

2. APPLICABLE DOCUMENTS

2.1 The following specifications and publications, of the issue in effect as determined by the aircraft detail specification or other governing contractual document, shall form a part of this specification to the extent specified herein:

SPECIFICATIONS

Federal

QQ-P-416-1	Plating, Cadmium (Electrodeposited)
QQ-Z-325	Zinc Plating (Electrodeposited)

Military

MIL-A-8625(ASG)	Anodic-Coatings, for Aluminum and Aluminum Alloys
MIL-P-6871	Plating, Chromium
MIL-P-6859	Plating, Nickel
MIL-B-5087	Bonding; Electrical (For Aircraft)
MIL-C-8678(Aer)	Cooling Requirements of Power Plant Installations
MIL-A-8629(Aer)	Airplane Strength and Rigidity

Publications

ANC-12	Vibration and Flutter Prevention Handbook

2.2 Copies of this specification and applicable documents may be obtained upon application to the Commanding Officer, U. S. Naval Air Station, Johnsville, Pennsylvania, attention Technical Records Division.

3. REQUIREMENTS

3.1 General. - Procurement and satisfactory installation of the vibration isolators is the responsibility of the aircraft contractor.

3.2 Natural Frequency Requirements. - Conformance of the power plant installation with the pertinent natural frequency requirements outlined in this section shall be demonstrated in accordance with ANC-12. Frequencies recommended by the aircraft contractor may be allowed subject to the approval of the procuring activity. The natural vibration frequencies in all modes of motion of the flexibly supported system shall result in no condition of excessive vibration amplitude in the range of operating speeds, or at the idling speed.

3.2.1 Airplane Installations

3.2.1.1 Reciprocating Engines. - The natural frequency of the engine in the torsional mode shall be less than 30% of engine speed at normal rated power. For all other modes capable of

being excited by engine vibratory forces, the natural frequencies shall not exceed 70% of the propeller speed at normal rated engine power. When the engine and the unit to which the propeller is attached are effectively mounted as separate units, each component shall be elastically mounted, preferably by a mode-decoupling suspension, so as to isolate those modes capable of being excited by the existing vibratory forces.

3.2.1.2 Turbo-jet Engines. - Adequate space shall be reserved on all prototype aircraft for the inclusion of vibration isolators and for motion of the power plant due to isolator flexibility. If the requirements of paragraph 3.9.1 of MIL-A-8629(Aer) can be met without flexible mountings, the use of engine isolators will be considered unnecessary. If flexible mountings are incorporated, the natural frequencies of the jet engine in all modes shall be as approved by the procuring activity.

3.2.1.3 Turbo-propeller Engines. - When the gas turbine and propeller units are mounted essentially as a single unit, the natural frequencies in all modes of motion (except fore-and-aft translation) shall be less than 70% of the propeller speed at normal rated power. When the propeller and turbine units are mounted as separate units, the installation shall be as approved by the procuring activity.

3.2.2 Helicopter Installations. - There shall be no resonance between the natural frequencies of vibration of the engine, drive shaft and rotors, and the principal disturbing frequencies within the operating range of the helicopter.

3.2.3 Airship Installations. - The requirements of 3.2.1.1 shall apply.

3.3 Strength. - Limit, yield, and ultimate strength consistent with the structural design requirements for the aircraft shall be provided for flight, ground and water loads, including:

a. Inertia loads at the center of gravity of the power plant system due to translational and rotational accelerations of the aircraft.

b. Power plant thrust.

c. Power plant torque.

d. Gyroscopic moment.

e. Applied air loads, if applicable.

f. Vibratory loads.

3.4 Durability. - Power plant isolators shall have durability to last for the period of the normal time interval between engine overhauls but not less than 800 hours of power plant operation, provided that the isolators are put into service within 60 months of the date of manufacture and that they have been stored under proper conditions and in original packing containers during the period of shelf storage.

3.5.1 Deterioration of Metallic Elements. - Metals used in the construction of vibration isolators shall be of corrosion-resisting type or shall be suitably finished to resist corrosion. The use of metals which will result in dissimilar metal contacts (isolator part to isolator part, power plant part to isolator part, or isolator part to airframe part) is not acceptable. However, metal plating or metal spraying or dissimilar base metals is permitted. The use of dissimilar metals separated by suitable insulating material or coating is also permitted. Non-corrosion resisting steels shall be chromium, nickel, zinc, or cadmium plated, and aluminum alloys shall be anodized, in accordance with the applicable specification of paragraph 2.1. Where plating is detrimental to the bond or elastomer, a suitable protective coating shall be supplied.

3.5.2 Deterioration of Non-Metallic Elements. - Adequate provision shall be made in the isolator design and installation for the prevention of deterioration requiring replacement of non-metallic materials due to high or low temperatures or deleterious action of oil, grease, or gasoline encountered in the normal operation of the aircraft within the 800-hour period specified in paragraph 3.4. The material and design of the isolator shall be such that excessive drift shall not result, within the life of the isolator, from static and vibratory loads of the magnitude to be expected in service and at ambient temperatures in the region of the isolator

which will be encountered in operation. Excessive drift is defined as any drift which will, within the life of the isolator, cause snubbing of the isolator under any operating condition with the exception of abnormally high, momentary, non-recurring shock loads. The non-metallic resilient material of the isolator shall have sufficient strength at temperatures down to minus 65°F., to withstand without failure loads which may be encountered while the aircraft is on the ground with the engine inoperative. This material shall also withstand without failure, at temperatures down to minus 40°F., any loads which may be encountered when the engine is started and until the isolators have been raised to normal operating temperatures by the heat of the engine. Temperatures of the metal isolator housing at any point in contact with the rubber shall not exceed the allowable temperature for the elastomer used, for continuous operation of the aircraft under conditions set forth in Specification MIL-C-8678(Aer). The allowable temperature for natural rubber, or comparable elastomers, shall be 170°F. The allowable temperature for installations involving special high-temperature elastomers, such as silicones, shall be as approved by the procuring activity.

3.5.3 Date of Manufacture and Installation. - The non-metallic elements of power plant vibration isolators shall bear a mold imprint showing the month and year of manufacture. If possible, this imprint shall be so located that it is visible when the core is assembled in its metallic housing. If the design of the vibration isolator makes this impossible, the date of manufacture shall also be indelibly marked on the metallic housing. In addition, the date of installation shall be indelibly marked on the metallic housing. In the event of subsequent overhaul of the isolator assembly, the "Date of Manufacture" shall be indelibly overstamped to correspond with that of the non-metallic element and the "Date of Installation" shall be indelibly overstamped to show the date of overhaul installation.

3.6 Miscellaneous Design Requirements.

3.6.1 Mode Decoupling. - Power plant vibration isolators shall be of the mode decoupling type, unless it is shown conclusively that the vibration-isolating requirements can be met by some other device which may be more practicable for a particular aircraft that is under consideration.

3.6.2 Motion-Limiting Stops. - Isolators shall be provided with motion-limiting stops which will limit the relative motion of the power plant to a magnitude corresponding to the allowance made in the power plant controls and other connections between the power plant and the aircraft structure. It is desirable also that no metal to metal contact occur when the isolators are in the stopped condition. If metal to metal contact occurs, suitable damping shall be provided to minimize resonant bouncing across the stops.

3.6.3 Mechanical Lock. - Means shall be provided to prevent the complete separation of the power plant from the aircraft structure in case of failure of the isolator elastic material or its bonding. It is also required that in case of such failure the displacement of the power plant shall not be sufficient to break fuel or oil lines.

3.6.4 Torsional Clearance. - Initial offset or other means shall be provided in the isolator installation so that the torsional freedom of motion of the power plant between snubbing devices or stops shall be adequate in both directions under normal operating conditions.

3.6.5 Electrical Bonding. - A suitable means shall be provided for the incorporation of electrical bonding between the power plant installation and the airframe, in accordance with the requirements of MIL-B-5087.

4. SAMPLING, INSPECTION, AND TEST PROCEDURE. - Not applicable.

5. PREPARATION FOR DELIVERY. - Not applicable.

6. NOTES. - Not applicable.

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