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VIBRATION AND SHOCK—MECHANICAL MOUNTING OF ACCELEROMETERS

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PREFACE

This standard was prepared by the Association's Committee on Vibration and Shock, at the request of various manufacturing and governmental organizations.

This standard is based on ISO/DIS 5348, Mechanical Mounting of Accelerometers (Seismic Pickups).

CONTENTS

STANDARDS ASSOCIATION OF AUSTRALIA

Australian Standard
for
VIBRATION AND SHOCK—MECHANICAL MOUNTING OF ACCELEROMETERS

FOREWORD

The type of transducer most commonly used in determining the vibratory motion of a structure or body is the accelerometer.

The method of connecting the accelerometer to the point of measurement is one of the most critical factors in obtaining accurate results from practical vibration measurements. This standard supplies the basic information necessary in order to achieve successful shock and vibration measurements by providing the user with general instructions for the mounting and connecting of accelerometers.

SPECIFICATION

1 SCOPE. This standard gives recommendations to the user concerning the mounting of accelerometers and lists the applicable characteristics to be specified by the manufacturer.

2 APPLICATION. This standard applies to electromechanical transducers but does not cover those transducers which permit measurement of the vibratory motion of the structure or body in relation to another structure taken as reference (such transducers are the relative motion transducers, some of which can be without mechanical contact with the structure).

3 REFERENCED DOCUMENTS. The following standards are referred to in this standard:

AS 2606 Vibration and Shock—Vocabulary

AS 2679 Vibration and Shock—Mechanical Vibration of Rotating and Reciprocating Machinery—Requirements for Instruments for Measuring Vibration Severity

4 DEFINITIONS. For the purpose of this standard, the definitions given in AS 2606 apply.

5 RECOMMENDATIONS FOR THE USER.

5.1 General. The considerations in mounting an accelerometer on a structure are as follows:

(a) That the accelerometer shall perform as nearly as possible the same motion as the relevant part of the structure under test.

(b) That the motion of the structure shall be changed as little as possible by the addition of the accelerometer.

(c) That the ratio of the signal from the accelerometer to its motion shall not be distorted by operating too near to its first mounted resonance frequency.

To approach the above ideals, it is necessary to ensure that—

(i) the accelerometer and its mounting are as rigid and firm as possible, i.e. the mounting surfaces shall be as clean, smooth and flat as possible;

(ii) the mounting introduces minimum distorting motions of its own, i.e. simple symmetrical mountings are best; and

(iii) the mass of the accelerometer and mounting are small in comparison with the structure under test (see AS 2679).

Where screw thread mounting is used, the mounting torque should be as recommended by the manufacturer, e.g. 1.8 N.m is often recommended for general purpose accelerometers using 10-32 UNF or M5 threads.

Loose cables may introduce tribo-electric effects both within the cable and the electrical connection and also cause base bending. To minimize these effects, cable fixing is recommended (see Fig. 1).

5.2 Use of an accelerometer well below its natural resonance frequency. If it is possible to use the manufacturer's recommended mounting, then operation at frequencies not greater than 20 percent of the quoted mounted resonance frequency should ensure in most cases that the mounted sensitivity deviates by only a few percent from the calibration factor. If an estimate of the approximate error is required, it may be made on the basis of an equivalent linear spring-mass system with a plausible value of damping.

5.3 Determination of the first mounted resonance frequency.

5.3.1 *General*. It is very useful, though at times difficult, in practice to determine accurately the first mounted resonance frequency of the accelerometer, mounted on the structure under test. The methods described in Clauses 5.3.2 and 5.3.3 may be of use in finding the approximate resonance, thus ensuring that an adequate margin exists between it and the highest test frequency.

5.3.2 *Vibration excitation method* (see Fig. 2). The use of a simple reference steel block with well-defined shape and surface finish is recommended (a stainless steel block of 180 g mass has often been used). The motion of the reference block is monitored close to the mounting surface of the accelerometer under test using a reference accelerometer with a resonance frequency higher than the first bending mode of the steel block itself. The excitation force may be obtained electrodynamically. The influence of the quality of mounting surfaces and materials may be investigated by introduction of typical samples between the steel surface and the accelerometer under test. For typical mountings and mounted frequency curves, see Figs 3 to 8.

5.3.3 *Shock excitation methods.* The ballistic pendulum, the drop test and a simple hammer blow are three ways of using shock excitation. In the first, the accelerometer is attached to an anvil mass suspended as a pendulum, while a second hammer mass, similarly suspended, is used to provide the blow. In the drop test, the accelerometer is attached to a hammer which is guided in its vertical fall on to a stationary anvil to provide the shock. The attachment of the accelerometer to the mass should be similar to the actual test body attachment. While it may be impossible to represent the test body by the mass of the anvil or hammer, it should be of the same material and of sufficient size to be a reasonable representation of the test body with regard to stiffness. The hammer blow applied near the mounted accelerometer on the actual structure may provide the necessary information, if structural resonance in the measuring object can be disregarded.

The accelerometer output produced by the shock excitation under suitable conditions will have the resonant frequency superimposed (see Fig. 9). Some experimentation is required with energy of shock, i.e. height from which mass is released, and stiffness of impact surface, e.g. steel or lead lined to obtain a suitable period of impact to display the resonance effect. Care should also be taken to see that the lowest resonance is obtained. The use of a suitable single event recorder, e.g. storage oscilloscope, digital recorder or FFT frequency analyser, enables the frequency of the resonance ripple to be determined. These methods are particularly suited for high frequencies.

Repeated well-defined shocks may give additional information on the stability of the mounting.