COMMONWEALTH OF AUSTRALIA

DEPARTMENT OF NATIONAL DEVELOPMENT

BUREAU OF MINERAL RESOURCES, GEOLOGY AND GEOPHYSICS

Record No. 1969 / 52

Vibration Tests at the CSIRO Laboratories,

Canberra 1969

by

R.J. Whiteley

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SUMMARY

Tests were carried out to determine the vibration level in the vicinity of a mass spectrometer operated by the Commonwealth Scientific and Industrial Research Organization at their Division of Entomology building in Canberra, A.C.T. It is desired to operate the spectrometer at increased sensitivity, but structural vibrations of the laboratory containing the instrument affect its resolution.

The tests indicated that the vibration level in the spectrometer room exceeds the acceptable level specified by the manufacturer for operation at the increased sensitivity.

1. INTRODUCTION

The Commonwealth Scientific and Industrial Research Organization (CSIRO) is attempting to increase the resolution of a mass spectrometer housed in the Division of Entomology building in Canberra. Structural vibrations affect the sensitivity of this instrument, and to obtain the resolution desired these vibrations must be below certain defined levels.

At the request of the CSIRO the Bureau of Mineral Resources, Geology and Geophysics, carried out tests to determine the floor vibration level in the spectrometer room. A plan of the room is shown in Plate 1. The tests were carried out by a geophysical party consisting of R.J. Whiteley and M.S. Jones during January 1969.

2. METHODS AND EQUIPMENT

A three-component system using Willmore Mk2 seismometers was used to carry out the tests. The two horizontal components were oriented parallel to the walls of the room and the third component was oriented vertically.

The paper speed of the Willmore Seismograph Recorder was increased to 3 mm/s (three times normal speed) but, even so, frequencies greater than about 15 Hz were difficult to resolve. To obtain additional frequency information the output of the vertical component seismometer was coupled to a high-speed (100 cm/s) chart recorder through an amplifier (BMR Model SWA2). The amplifier was adjusted to have a uniform response to well beyond the frequency range of interest.

Only background vibration levels were measured with the three-component arrangement. The vertical component/chart recorder arrangement was used in a number of tests with various instruments in the spectrometer room turned off.

Records from the chart recorder were digitised and Fourier-analysed in an attempt to distinguish the frequency contributions of machinery in the vicinity of the spectrometer.

The period of the seismometers was adjusted to about 1.3 seconds and actual ground displacements were obtained using the standard magnification curves supplied by the manufacturer.

3. RESULTS

Three-component seismometer arrangement

The results of the background vibration tests are shown in Table 1.

Table 2 (see pages 4 and 5) shows the frequency components present for each of the tests. This table also lists the frequency constituents expressed as a percentage of the most predominant frequency component in each test. This was 24 Hz in all five tests. Frequencies less than 10% of the most predominant frequency were not considered in the analysis.

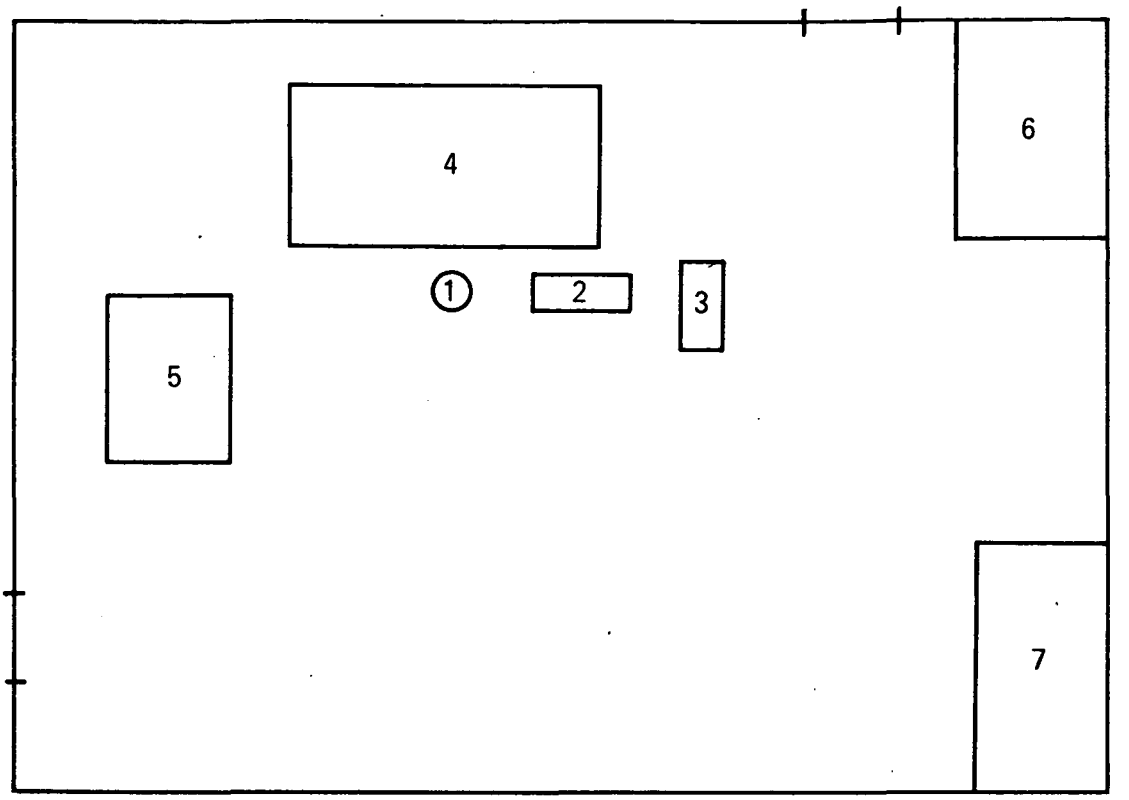
The frequency spectra obtained reveal a complex mixture of frequencies which are not easy to interpret. The 24-Hz component is by far the most dominant frequency. This would probably be caused by rotor vibrations of four-pole induction machines (synchronous mechanical frequency 25 Hz).

There does not appear to be any significant absence or enrichment in particular frequencies in successive tests. This probably indicates that sources external to the room are contributing significantly to the vibration pattern. The similarity between tests 1 and 4 also suggests the intermittent action of external machinery.

4. CONCLUSIONS

The vibration level of the spectrometer room was found to exceed the acceptable level specified by the manufacturer for operation of the mass spectrometer at the desired sensitivity and resolution. Sources external to the room appear to contribute largely to the vibration level.

Test 1		Test 2		Test 3		Test 4		Test 5	
All machinery on		Spectrometer off		Consol off		Air conditioner off		Fume cupboards off	
Frequency (Hz)	Percentage	Frequency (Hz)	Percentage	Frequency (Hz)	Percentage	Frequency (Hz)	Percentage	Frequency (Hz)	Percentage
				52	16	52	16		
54	17								
57	15	57	20	57	12	57	34	57	32
59	26	59	16	59	17	59	24	59	15
						63	20		
						67	18	67	11
						69	15		
74	24								



1. VERTICAL SEISMOMETER
2. NORTH–SOUTH HORIZONTAL SEISMOMETER
3. EAST–WEST HORIZONTAL SEISMOMETER
4. MASS SPECTROMETER
5. CONSOL
6. AIR CONDITIONER
7. FUME CUPBOARDS

PLAN OF SPECTROMETER ROOM
CSIRO DIVISION OF ENTOMOLOGY
CANBERRA, A.C.T.