# Vibrations of a magnetometer

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# TECHNICAL NOTE

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SUBJECT VIBRATIONS OF A MAGNETOMETER

The Geomagnetic Division of the Department of Mines and Technical Surveys operates a magnetometer at the Prescott Highway Laboratory for the purpose of determining the magnetic properties of geological specimens. The magnetometer was placed directly on the floor slab of the Laboratory, and occasionally it was impossible to record readings from the instruments because of ground vibrations that caused a galvanometer-type suspension, with a natural period of 20 sec, to oscillate; the optical path of the recorder was 5 metres, and the oscillations on the scale were often of the order of 2 cm (peak to peak). Two possible sources of the ground vibration were traffic on the Prescott Highway, about 500 ft away, and the blasting operations for the tunnel under Dow's Lake, about half a mile from the Laboratory.

The Geomagnetic Division will move the magnetometer to a new location in Blackburn in 1967, and they wished to compare the existing site and the new location with regard to ground vibrations. At the same time, they wished to determine a tolerable level of vibration for the operation of such an instrument.

Velocity-sensitive transducers were used to measure the ground vibrations at the Laboratory and at the new site. Both vertical and horizontal components of the vibration were measured at the Laboratory, but only the horizontal component was recorded at the new site. In both cases, the horizontal component was

measured perpendicular to the roads passing near the sites.

The results obtained at the Laboratory are shown in Table I, and those for the new site in Table II. At Blackburn, recordings were taken on the foundation slab of a derelict house approximately 50 ft from the road, and on the ground 50 and 150 ft from the road. The values of the frequencies quoted in Tables I and II are only approximate.

At the Prescott Highway location, the maximum recorded velocities were associated with a lower frequency than the background vibrations, and it was these lower frequency vibrations that seemed to be responsible for the oscillations of the magnetometer suspension. It was observed that the magnetometer performed satisfactorily when the vertical component was 0.006 in./sec peak to peak at 35 cps, but it was not quite satisfactory when the vertical component was 0.003 in./sec peak to peak at 10 cps.

The scale reading on the magnetometer oscillated with an approximate peak-to-peak amplitude of 2 mm when the vertical component of the ground motion was 0.002 in./sec peak to peak and an approximate frequency of 10 cps. This was considered to be a tolerable level of vibration, but it would perhaps be more satisfactory to specify that the ground vibrations should not exceed 0.001 in./sec peak to peak for the probable range of frequencies due to local disturbances (above 5 cps).

A comparison of the vibration environments shown in Tables I and II indicates that, at the moment, Blackburn is a quieter location, seismically, than the Prescott Highway Laboratory. Because the magnetometer is to be placed 900 to 1000 ft from the road at Blackburn, and because it will also be placed on an anti-vibration mount, there should be no difficulty in obtaining a vibration level that is below the tolerance level of 0.001 in./sec peak to peak.

TABLE I

VIBRATION ENVIRONMENT AT THE
PRESCOTT HIGHWAY LABORATORY

| Type of Vibration | Vertical Component, in./sec peak to peak | Horizontal Component, in./sec peak to peak |
|---|---|---|
| Background | 0.0005 (20-30 cps) | 0.0005 (20-30 cps) |
| Man jumping in laboratory | 0.006 (35 cps) | - |
| Maximum vibration recorded due to traffic or blasting | 0.003 (10 cps) | 0.002 (5 cps) |

TABLE II

VIBRATION ENVIRONMENT AT BLACKBURN
(NUMBERS GIVEN ARE PEAK-TO-PEAK VALUES)

| Location where measurements were made | Cause of Vibration | | | |
|---|---|---|---|---|
| | Background | Car travelling at 20 mph | Car travelling at 40 mph | Truck moving along the road |
| On basement slab 50 ft away from the road | 0.0003 in./sec (15 cps) | 0.0008 in./sec (10 cps) | 0.0007 in./sec | 0.003 in./sec (20 cps) |
| On soil 50 ft off the road | 0.0002 in./sec (15-20 cps) | 0.0005 in./sec (10 cps) | 0.0005 in./sec (15 cps) | 0.001 in./sec (15 cps) |
| On soil 150 ft off the road | 0.0001 in./sec (15 cps) | 0.0002 in./sec (15 cps) | 0.0004 in./sec (15 cps) | - |