**HYGIENE STANDARD FOR VIBRATION GENERATING SITES**
**2600SEG250**

## 1.0 PURPOSE

The purpose of this standard is to regulate activities where vibrations are generated which may affect the health of Panama Canal Authority (ACP) employees and establish practices and controls at work sites where equipment that transmits or produces vibrations is operated.

## 2.0 BACKGROUND

There is no background of procedures for vibrations at work sites.

## 3.0 SCOPE

This standard applies to all Panama Canal Authority personnel, contractors, and third parties performing work in facilities, industrial shops, and areas under ACP responsibility.

## 4.0 LEGAL FOUNDATION

This Standard is established pursuant to Agreement No. 12 of the Board of Directors of the Panama Canal Authority, Hazard Control and Occupational Health Regulations, Chapter 1, Articles 8 and 16; Resolution No. 505 of October 6, 1999, of the Ministry of Commerce and Industries, Industrial Standards and Technology, Technical Regulations DGNTI – COPANIT 45 – 2000, Industrial Hygiene and Safety, Hygiene and Safety Conditions in Working Environments where Vibrations are Generated.

## 5.0 DEFINITIONS

The following definitions are established for the purposes of this standard:

**5.1** Acceleration: The rate of change in velocity over a unit of time. It is the most used measurement of vibration magnitude, because velocity and displacement can be estimated in meters per second (m/s).

**5.2** Displacement: The distance between the normal repose position of an object and its position at each moment of the vibration cycle.

**5.3** Vibration: The oscillation movement of particulates of solid bodies with respect to a referenced position, in relation to time. The number of times per second that a full cycle is completed is known as frequency, which is measured in Hertz (Hz).

**5.4** General vibration is the vibration transmitted to the entire body through its support surfaces such as those of the feet or gluteus areas.

**5.5** Local Vibration: The vibration applied to specific parts of the body, such as hands and arms.

## 6.0 GENERAL

### 6.1 GENERAL REQUIREMENTS

**6.1.1** Surveillance shall be conducted at facilities, equipment, and tools at industrial shops and other areas under ACP responsibility where vibrations capable of affecting the health of workers are generated and/or transmitted.

**6.1.2** All supervisors of ACP employees who perform work where vibrations capable of affecting their health are generated shall be trained on the basic procedures mentioned in this standard.

## 6.2 WORK PROCEDURES

### 6.2.1 Measurement of Vibrations and Analysis of Exposure

**6.2.1.1** The areas and sources of emissions shall be identified, the areas with exposure hazards shall be marked, and the method to evaluate the work areas shall be selected, as well as the instruments to be used according to the selected method.

### 6.2.2 Evaluation of Vibrations

**6.2.2.1** For the evaluation of general vibrations, the analysis will be conducted both in wide band as well as narrow band, if the activity performed so requires it.

**6.2.2.2** In the case of vibrations on hands and arms, the evaluation shall be done in octave thirds or octaves between 1 and 1000 Hz.

### 6.2.3 Vibration Control

**6.2.3.1** When the magnitude of the vibration level can affect the health of workers according to the maximum permissible exposure levels to which this standard refers, a vibration protection program shall be established and the following measures shall be taken:

- All equipment and tools causing vibrations shall be equipped with vibration absorbent material that reduces vibration transmission.

- Establish preventive maintenance mechanisms for such equipment, in order to keep vibration absorbent material always over the surfaces with which they come into direct contact.

- Prescribe administrative measures for the control of hazardous exposure to vibrations at work sites.

- Recommend the use of vibration abatement equipment and materials for equipment and machinery that show vibration levels that may affect health.

- Prescribe the application of vibration damping film.

- Replace equipment with vibration problems.

- Include the use of damping film and maximum structural acceleration limits in the specifications for the procurement of heavy and floating equipment.

- Prescribe modifications to existing heavy and floating equipment to control or eliminate vibration.

- Include exposed workers in periodic medical monitoring to detect musculoskeletal irregularities.

### 6.2.4 Tables of Admissible Vibration Exposure Levels

**6.2.4.1** Appendix A. Table of admissible levels for general Z-axis vibrations.

**6.2.4.2** Appendix B. Table of admissible levels for general X and Y-axis vibrations.

**6.2.4.3** Appendix C. Table of admissible levels for local vibrations in the various octave bands.

### 6.3 MEDICAL EVALUATION

**6.3.1** Medical observation shall be provided to employees exposed to hazards.

### 6.4 TRAINING

**6.4.1** Divisions shall provide training through the Industrial and Safety Training Unit (RHSI) to employees who perform work where vibrations capable of affecting their health are transmitted.

### 6.5 RECORDKEEPING AND ACCESS TO DATA

**6.5.1** The Health, Wellness and Labor Welfare Unit (RHSS) shall keep records of medical examinations.

**6.5.2** RHSH shall keep records of vibration readings.

**6.5.3** Records shall be kept available to employees according to ACP regulations.

## 7.0 RESPONSIBILITIES

The responsibilities for ensuring compliance with this Standard are described in the Occupational Health and Safety Management Standard 2600SEG101.

**7.1** Managers shall ensure that procurement specifications include equipment that does not generate vibrations that may affect the health of workers.

**7.2** The Inventory Control Section shall include the use of vibration suppression devices and maximum structural acceleration limits in its specifications for the procurement of vibration producing equipment.

**7.3** RHSH shall evaluate hazardous conditions and make the pertinent recommendations.

## 8.0 INQUIRIES

Any information or clarification of the content or application of this standard may be requested in writing to RHSH.

## 9.0 EXCEPTIONS

Any deviations or temporary exceptions to compliance with this standard may be requested in writing to RHSH.

## 10.0 TERM

This standard shall remain in force until revised or amended.

## 11.0 REFERENCES

**11.1** Record Retention Tables, Records Management Section, ACP.

**11.2** Technical Regulation DGNTI – COPANIT 45-2000 on Industrial Hygiene and Safety, Hygiene and Safety Conditions in Working Environments Where Vibrations are Generated.

**11.3** ANSI S3. 18-2002 Mechanical Vibration and Shock – Evaluation of Human Exposure to Whole-Body Vibration – Part 1: General Requirements.

**11.4** ANSI S3. 34-1986 Guide for the Measurement and Evaluation of Human Exposure to Vibration Transmitted to the Hand.

**11.5** ACGIH 2005 Threshold Limit Values for Chemicals Substances and Physical Agents & Biological Exposure Indices.

ANNEX № 1 Admissible Levels for General Z-Axis Vibrations

| Tertiary Band Median Frequency | Acceleration in m/s² Daily Exposure Time | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| (Hz) | 8 hrs. | 4 hrs. | 2 hrs. | 1 hrs. | 30 min. | 15 min. | 7.5 min. | <5 min. |
| 1.00 | 0.630 | 0.880 | 1.260 | 1.780 | 2.520 | 3.560 | 5.040 | 6.180 |
| 1.25 | 0.560 | 0.790 | 1.130 | 1.590 | 2.250 | 3.180 | 4.500 | 5.520 |
| 1.60 | 0.500 | 0.700 | 1.000 | 1.410 | 2.000 | 2.820 | 4.000 | 4.900 |
| 2.00 | 0.450 | 0.620 | 0.890 | 1.250 | 1.770 | 2.510 | 3.550 | 4.350 |
| 2.50 | 0.400 | 0.550 | 0.790 | 1.110 | 1.580 | 2.220 | 3.150 | 3.860 |
| 3.15 | 0.355 | 0.490 | 0.700 | 1.950 | 1.400 | 1.980 | 2.800 | 3.430 |
| 4.00 | 0.315 | 0.440 | 0.630 | 0.890 | 1.260 | 1.780 | 2.520 | 3.090 |
| 5.00 | 0.315 | 0.440 | 0.630 | 0.890 | 1.260 | 1.780 | 2.520 | 3.090 |
| 6.30 | 0.315 | 0.440 | 0.630 | 0.890 | 1.260 | 1.780 | 2.520 | 3.090 |
| 8.00 | 0.315 | 0.440 | 0.630 | 0.890 | 1.260 | 1.780 | 2.520 | 3.050 |
| 10.00 | 0.400 | 0.570 | 0.800 | 1.130 | 1.600 | 2.260 | 3.200 | 3.920 |
| 12.50 | 0.500 | 0.710 | 1.000 | 1.410 | 2.000 | 2.830 | 4.000 | 4.900 |
| 16.00 | 0.630 | 0.890 | 1.260 | 1.780 | 2.250 | 3.560 | 5.040 | 6.170 |
| 20.00 | 0.800 | 1.330 | 1.600 | 2.260 | 3.200 | 4.520 | 6.390 | 7.830 |
| 25.00 | 1.000 | 1.410 | 2.000 | 2.830 | 4.000 | 5.650 | 7.990 | 9.790 |
| 31.50 | 1.250 | 1.770 | 2.500 | 3.530 | 5.000 | 7.060 | 9.990 | 12.24 |
| 40.00 | 1.600 | 2.260 | 3.200 | 4.520 | 6.400 | 9.040 | 12.79 | 15.67 |
| 50.00 | 2.000 | 2.830 | 4.000 | 5.650 | 8.000 | 11.31 | 15.99 | 19.59 |
| 63.00 | 2.500 | 3.540 | 5.000 | 7.070 | 10.00 | 14.14 | 19.99 | 24.49 |
| 80.00 | 3.150 | 4.450 | 6.300 | 8.910 | 12.59 | 17.81 | 25.18 | 30.85 |

ANNEX № 2 Admissible Levels for General X and Y-Axis Vibrations

| Tertiary Band Median Frequency | Acceleration in m/s² Daily Exposure Time | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| (Hz) | 8 hrs. | 4 hrs. | 2 hrs. | 1 hrs. | 30 min. | 15 min. | 7.5 min. | <5 min. |
| 1.00 | 0.224 | 0.317 | 0.448 | 0.630 | 0.900 | 1.270 | 1.790 | 2.190 |
| 1.25 | 0.224 | 0.317 | 0.448 | 0.630 | 0.900 | 1.270 | 1.790 | 2.190 |
| 1.60 | 0.224 | 0.317 | 0.448 | 0.630 | 0.900 | 1.270 | 1.790 | 2.190 |
| 2.00 | 0.224 | 0.317 | 0.448 | 0.630 | 0.900 | 1.270 | 0.790 | 2.190 |
| 2.50 | 0.240 | 0.400 | 0.560 | 0.790 | 1.120 | 1.580 | 2.240 | 2.740 |
| 3.15 | 0.555 | 0.500 | 0.710 | 1.000 | 1.420 | 2.010 | 2.840 | 3.480 |
| 4.00 | 0.450 | 0.640 | 0.900 | 1.270 | 1.800 | 2.540 | 3.600 | 4.410 |
| 5.00 | 0.560 | 0.790 | 1.120 | 1.580 | 2.240 | 3.170 | 4.480 | 5.480 |
| 6.30 | 0.710 | 1.000 | 1.420 | 2.010 | 2.840 | 4.010 | 6.670 | 6.950 |
| 8.00 | 0.900 | 1.270 | 1.800 | 2.540 | 3.600 | 5.090 | 7.190 | 8.810 |
| 10.00 | 1.120 | 1.580 | 2.240 | 3.170 | 4.480 | 6.330 | 8.950 | 10.97 |
| 12.50 | 1.400 | 1.980 | 2.000 | 3.960 | 5.600 | 7.910 | 11.95 | 13.71 |
| 16.00 | 1.800 | 2.540 | 3.600 | 5.090 | 7.200 | 10.17 | 14.39 | 17.62 |
| 20.00 | 2.240 | 3.170 | 4.480 | 6.330 | 8.950 | 12.66 | 17.90 | 21.93 |
| 25.00 | 2.800 | 3.960 | 5.560 | 7.920 | 11.19 | 15.83 | 22.38 | 27.42 |
| 31.50 | 3.550 | 5.020 | 7.100 | 10.04 | 14.19 | 20.07 | 28.37 | 34.76 |
| 40.00 | 4.500 | 6.360 | 9.000 | 12.72 | 17.99 | 25.44 | 35.97 | 44.06 |
| 50.00 | 5.600 | 7.920 | 11.20 | 15.83 | 22.39 | 31.65 | 44.76 | 64.83 |
| 63.00 | 7.100 | 10.04 | 14.20 | 20.07 | 28.38 | 40.13 | 56.75 | 69.52 |
| 80.00 | 9.000 | 12.73 | 17.99 | 25.44 | 35.98 | 50.87 | 71.93 | 88.12 |

## ANNEX № 3 Admissible Levels for Local Vibrations in the Various Octave Bands

| Frequency Band Center (Hz) | Admissible Value of Vibration Acceleration ($m/s^2$) |
|---|---|
| 8 | 1.4 |
| 16 | 1.4 |
| 31.5 | 2.7 |
| 63 | 5.4 |
| 125 | 10.7 |
| 250 | 21.3 |
| 500 | 42.5 |
| 1000 | 85.0 |