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JAPANESE INDUSTRIAL STANDARD

Vibration testing methods for automobile parts

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In the event of any doubt arising,
the original Standard in Japanese is to be final authority.

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Vibration testing methods for automobile parts

D 1601-1995

1. Scope This Japanese Industrial Standard specifies the vibration testing methods for automobile parts (hereafter referred to as "parts").

2. Classification of tests The tests shall be classified as follows:

(1) Resonance frequency detection test This test is designed to determine the resonance frequency of each part.

(2) Vibration function test This test is designed to check the function of each part under vibrational conditions.

(3) Vibration endurance test This test is designed to determine the durability of each part against the vibration of a constant frequency.

(4) Sweep vibration endurance test This test is designed to determine the durability of each part against vibration, the frequency of which is increased and decreased continuously at a constant rate.

3. Classification of vibrational conditions The vibrational conditions for the vibration function test and the vibration endurance test shall be classified as follows:

(1) The vibrational conditions for the parts shall be classified as follows by type of automobiles to which they are installed:

Type 1 : Those mainly for passenger car parts

Type 2 : Those mainly for bus parts

Type 3 : Those mainly for motortruck parts

Type 4 : Those mainly for motorcycle parts

(2) The vibrational conditions for the parts shall be classified as follows by position of installation:

Class A : Those for the parts to be installed on the body or on the springs of the suspension system, which are subject to a relatively low degree of vibration.

Class B : Those for the parts to be installed on the body or on the springs of the suspension system, which are subject to a relatively high degree of vibration.

Class C : Those for the parts to be installed on the engine structure, which are subject to a relatively low degree of vibration.

Class D : Those for the parts to be installed below the springs of the suspension system or on the engine structure, which are subject to a relatively high degree of vibration.

The examples of the products, to which the classification of vibrational conditions has been applied, are given in Informative reference Table 1.

4. Test conditions

4.1 Order of tests The tests shall be carried out in the order of the resonance frequency detection test, vibration function test, and vibration endurance test or sweep vibration endurance test. However, the resonance frequency detection test and vibration function test may be made simultaneously, or the resonance frequency detection test, vibration function test and sweep vibration endurance test may also be made so.

4.2 Mounting of the parts Each of the parts shall, as a rule, be mounted on the vibration base in a manner that approximates to its actual service.

4.3 Operation of the parts The tests shall be made under the actual operational conditions as a rule.

4.4 Application of vibration Simple harmonic motion shall be applied to the mounted part orthogonally in vertical, transverse and longitudinal directions in the order. However, the relative harmonic content (1) of the simple harmonic motion shall, as a rule, be 25 % or less in terms of vibration acceleration.

Note (1) Calculate the relative harmonic content of the simple harmonic motion as follows:

(1) The vibration acceleration $\pm a$ (m/s^2) caused by sine-wave vibration shall be calculated from the following formula:

$$a = Kf^2A \times 10^{-3}$$

where, $K = 2\pi^2 \fallingdotseq 19.74$

f : frequency (Hz)

A : total amplitude (mm)

(2) The relative harmonic content k (%) of the simple harmonic motion shall be calculated from the following formula:

$$k = \sqrt{\frac{a_2^2 + a_3^2 + a_4^2 \cdots\cdots}{a_1^2}} \times 100$$

where, a_1 : fundamental vibration wave acceleration (m/s^2)

$a_2, a_3, a_4 \cdots$: vibration acceleration of the second, third, fourth, ... vibration waves (m/s^2)

4.5 Detection of vibration acceleration The vibration acceleration of the parts shall, as a rule, be detected at the actual positions of service. However, the measurement may be taken on the vibration base.

5. Testing methods

5.1 Resonance frequency detection test method The resonance frequency of part shall be detected by continuously increasing and decreasing the frequency at a constant rate within the frequency range chosen from Table 1 in accordance with the type of the part to be tested.

Table 1. Frequency range division

Division	Frequency range (2) Hz	Informative reference (4)		
		Period (3) min	Vibration acceleration m/s^2	Total amplitude mm (max.)
50	5 to 50	10	5 to 45	0.4
100	5 to 100			
200	5 to 200			
400	5 to 400			
1000	5 to 1000			
2000	5 to 2000			

Notes (2) The lower limit of frequency may be agreed upon between the parties concerned with delivery.

(3) The period of time required to reciprocate once between the minimum frequency and the maximum frequency.

(4) The numerical values of the period, the vibration acceleration and the total amplitude, when being too great or too small, will make the detection of resonance difficult. These values, therefore, are given here for informative reference only.

5.2 Vibration function test method The frequency of vibration shall be within the same vibration range as that of Table 1 and the function of parts shall be tested at the vibration acceleration of the stage selected from Table 2. However, when deemed necessary, the vibration acceleration may be agreed upon between the parties concerned with delivery.

Table 2. Vibration acceleration stage division

Stage	Vibration acceleration (5) m/s²	Type 1				Type 2				Type 3				Type 4			
		A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D
5	5	○				○				○							
10	10	○				○				○							
20	20	○				○				○							
30	30	○	○			○	○			○				○			
45	45		○	○			○			○	○			○			
70	70			○				○			○	○		○			
90	90				○				○				○	○			
110	110				○				○				○	○			
150	150				○				○				○	○			
200	200				○				○				○	○	○		
250	250				○				○				○		○		
300	300				○				○				○		○	○	○
400	400				○										○	○	○
500	500														○	○	○

Note (5) The test of 5.4 in the range of vibration exceeding 10 mm in amplitude shall be carried out with taking the amplitude as 10 mm and keeping it constant.

5.3 Vibration endurance test method The vibration endurance test of the parts shall be carried out in accordance with the type of automobile and the position of their actual service and with the 14 stages of testing as given in Table 2. The tests shall be conducted by making distinction between where there is no resonance and where there is resonance.

Furthermore, the Table 2 shall apply to the classification of vibration conditions, as a rule. However, when deemed necessary, the vibration direction and the testing time may be determined by the agreement between the parties concerned with delivery.

(1) Where there is no resonance The vibration endurance test shall be carried out in accordance with Table 3.

Table 3. Vibration endurance test condition where there is no resonance

Stages	Frequency Hz	Vibration acceleration m/s^2	Testing time h		
			Vertical	Transverse	Longitudinal
5	33 or 67	5	4	2	2
10	33 or 67	10			
20	33 or 67	20			
→ 30	33 or 67	30			
45	33 or 67	45			
70	33 or 67	70			
90	33, 67 or 133	90			
110	67 or 167	110			
150	67 or 167	150			
200	67 or 200	200			
250	67 or 200	250			
300	67, 200 or 400	300			
400	200 or 400	400			
500	200 or 400	500			

(2) Where there is resonance The vibration endurance test shall be carried out at the resonance frequency (6) of the part and at the amplitude specified in Attached Fig. 1, Attached Fig. 2, Attached Fig. 3, Attached Fig. 4, Attached Fig. 5 or Attached Fig. 6 with the vertical vibration applied for 1 h and the transverse and longitudinal vibrations for 0.5 h, respectively. Then the tests as specified in Table 4 shall be carried out.

Note (6) Where there are two or more resonance frequencies, the major resonance frequency shall be used.

Remarks: For instance, where the part scheduled to be tested (vibration endurance test) on stage 20 at the frequency of 33 Hz has resonance at the frequency of 50 Hz, read in Attached Fig. 1 the total amplitude on ordinate of 0.40 mm, where the resonance frequency on abscissa of 50 Hz crosses the line of stage 20 (see formula in 4.4).

Table 4. Vibration endurance test condition where there is resonance

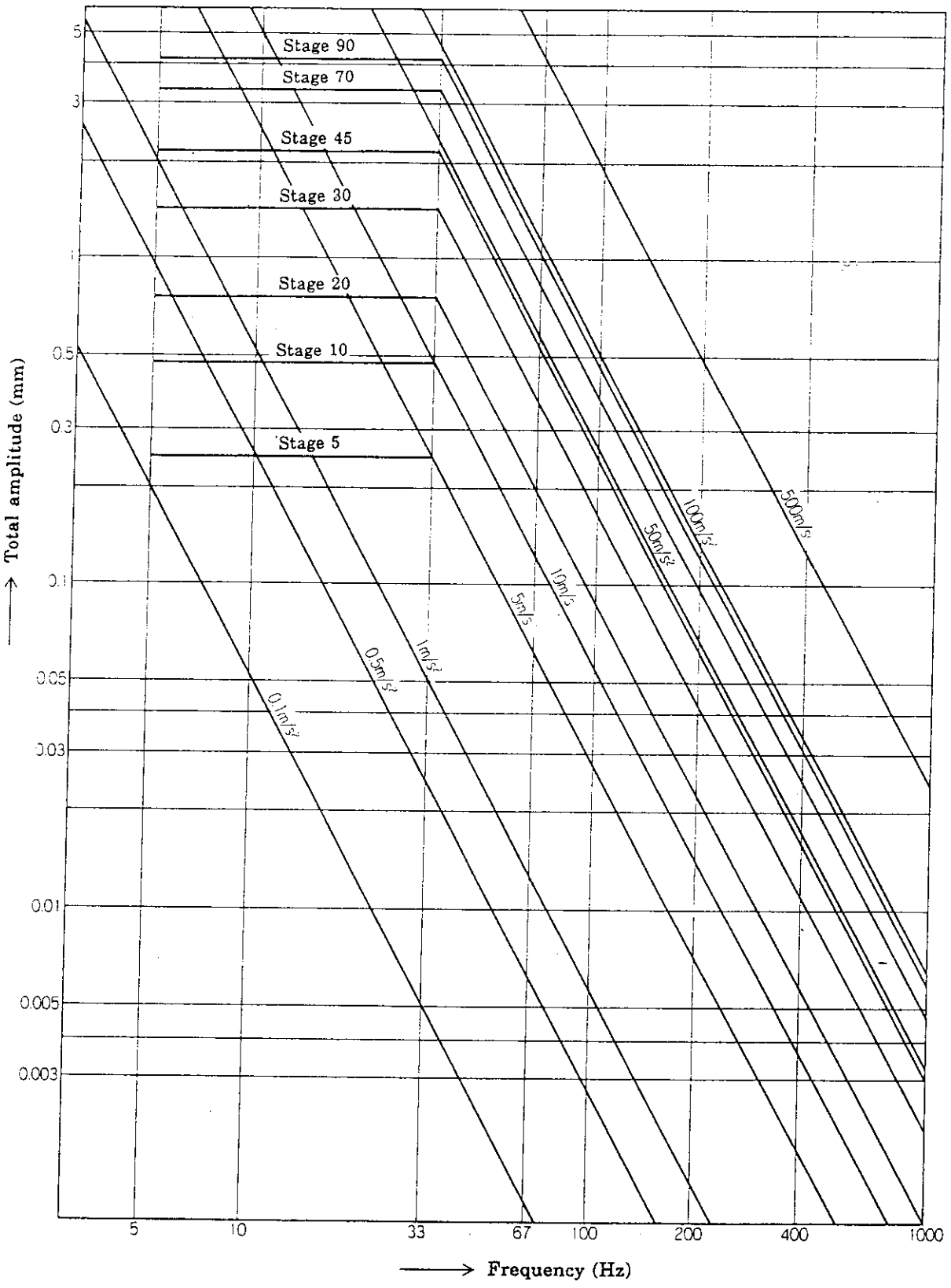
Stages	Frequency (7) Hz	Vibration acceleration m/s^2	Testing time h		
			Vertical	Transverse	Longitudinal
5	33 or 67	5	3	1.5	1.5
10	33 or 67	10			
20	33 or 67	20			
30	33 or 67	30			
45	33 or 67	45			
70	33 or 67	70			
90	33, 67 or 133	90			
110	67 or 167	110			
150	67 or 167	150			
200	67 or 200	200			
250	67 or 200	250			
300	67, 200 or 400	300			
400	200 or 400	400			
500	200 or 400	500			

Note (7) Where the resonance frequency coincides with the frequency given in Table 4, the frequency of Table 4 may be changed according to the agreement between the parties concerned with delivery.

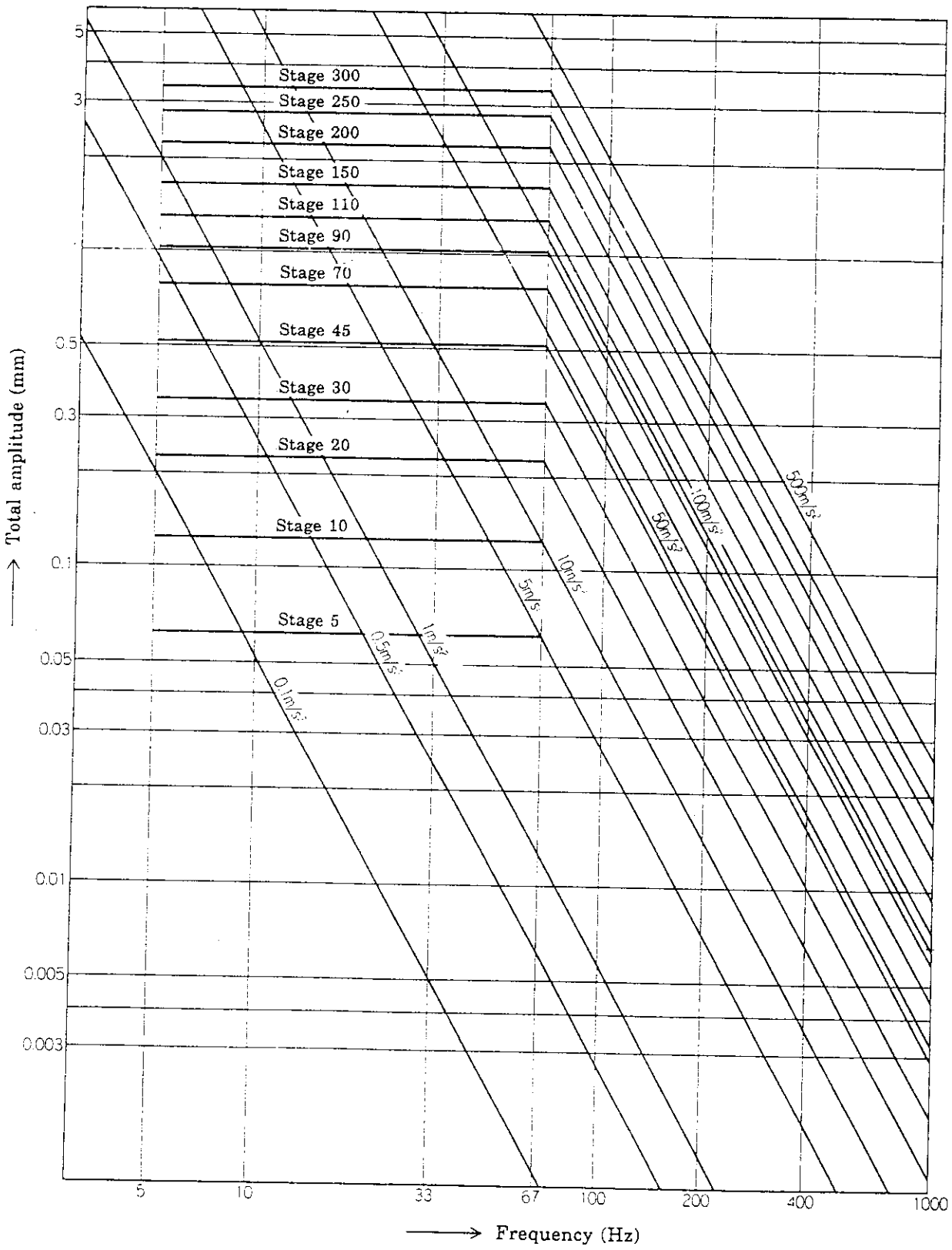
Remarks: Before the vibration endurance test of Table 4 takes place, an endurance test at resonance frequency shall be carried out.

5.4 Sweep vibration endurance test method The sweep vibration endurance test shall be carried out by combination selected from the division (frequency range) of Table 1 and the stage (vibration acceleration) of Table 2. However, the stage to be applied, division to be chosen, direction of vibration and testing time shall be determined by the agreement between the parties concerned with delivery.

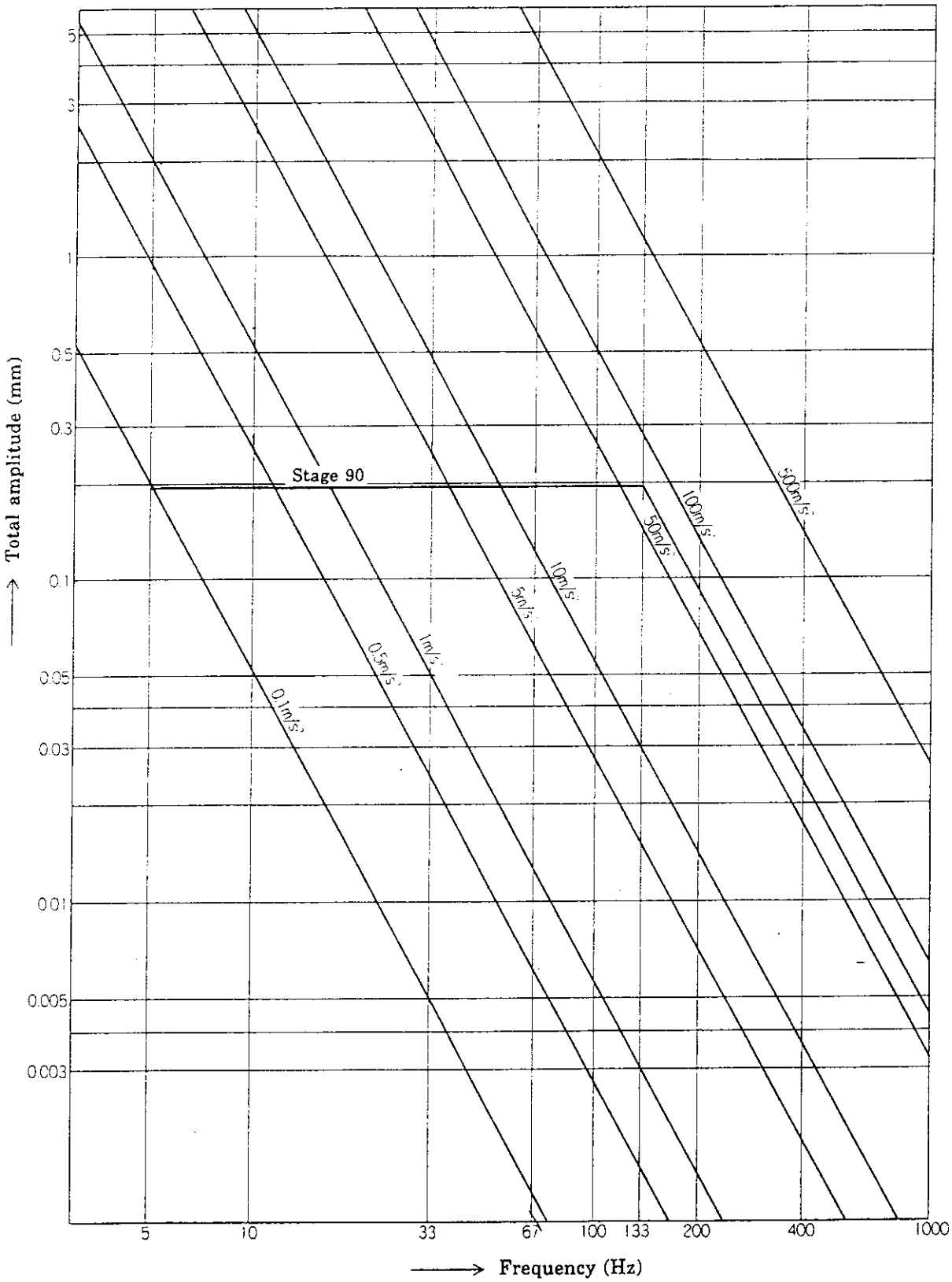
Attached Fig. 1. Amplitude in the case of 33 Hz in frequency



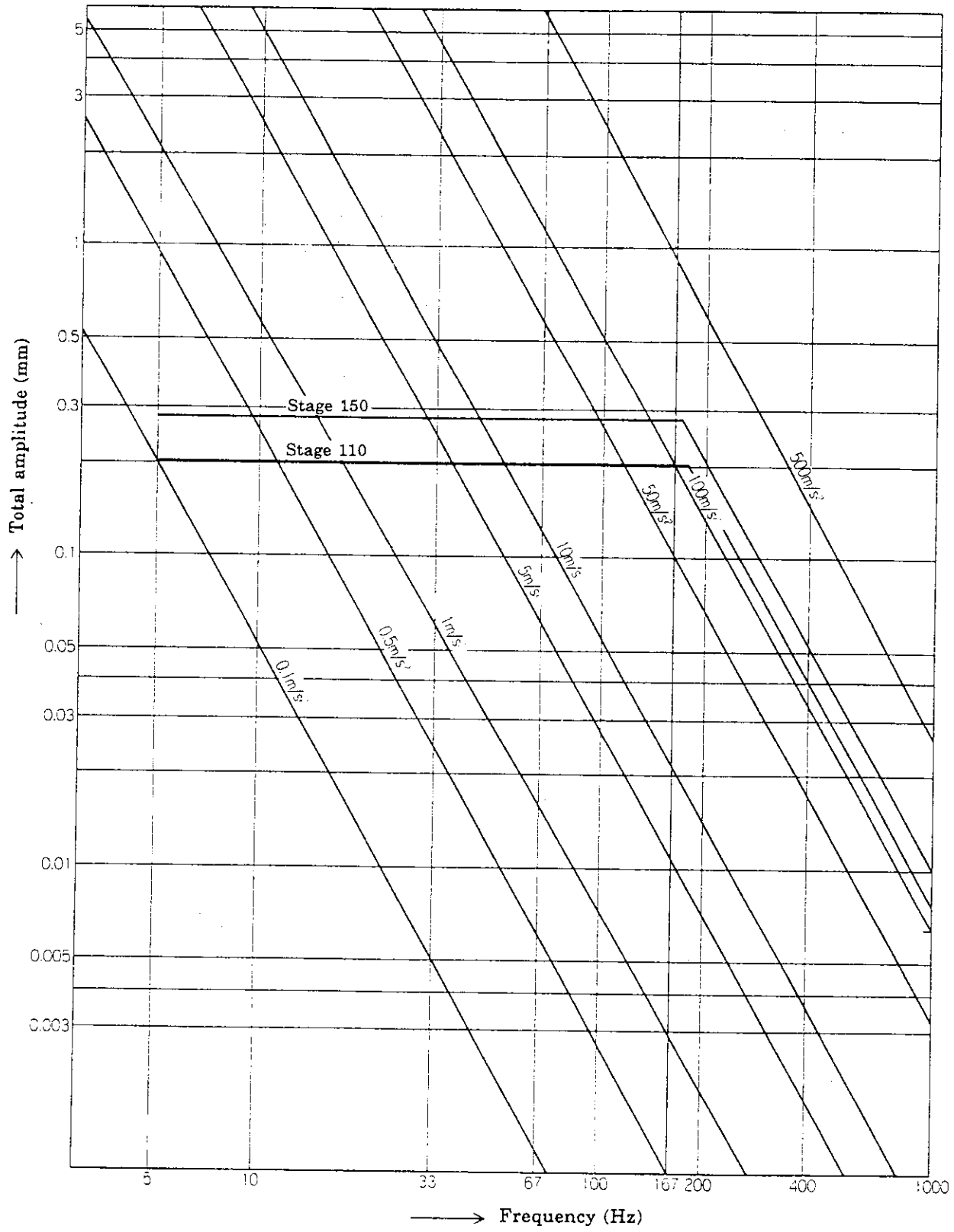
Attached Fig. 2. Amplitude in the case of 67 Hz in frequency



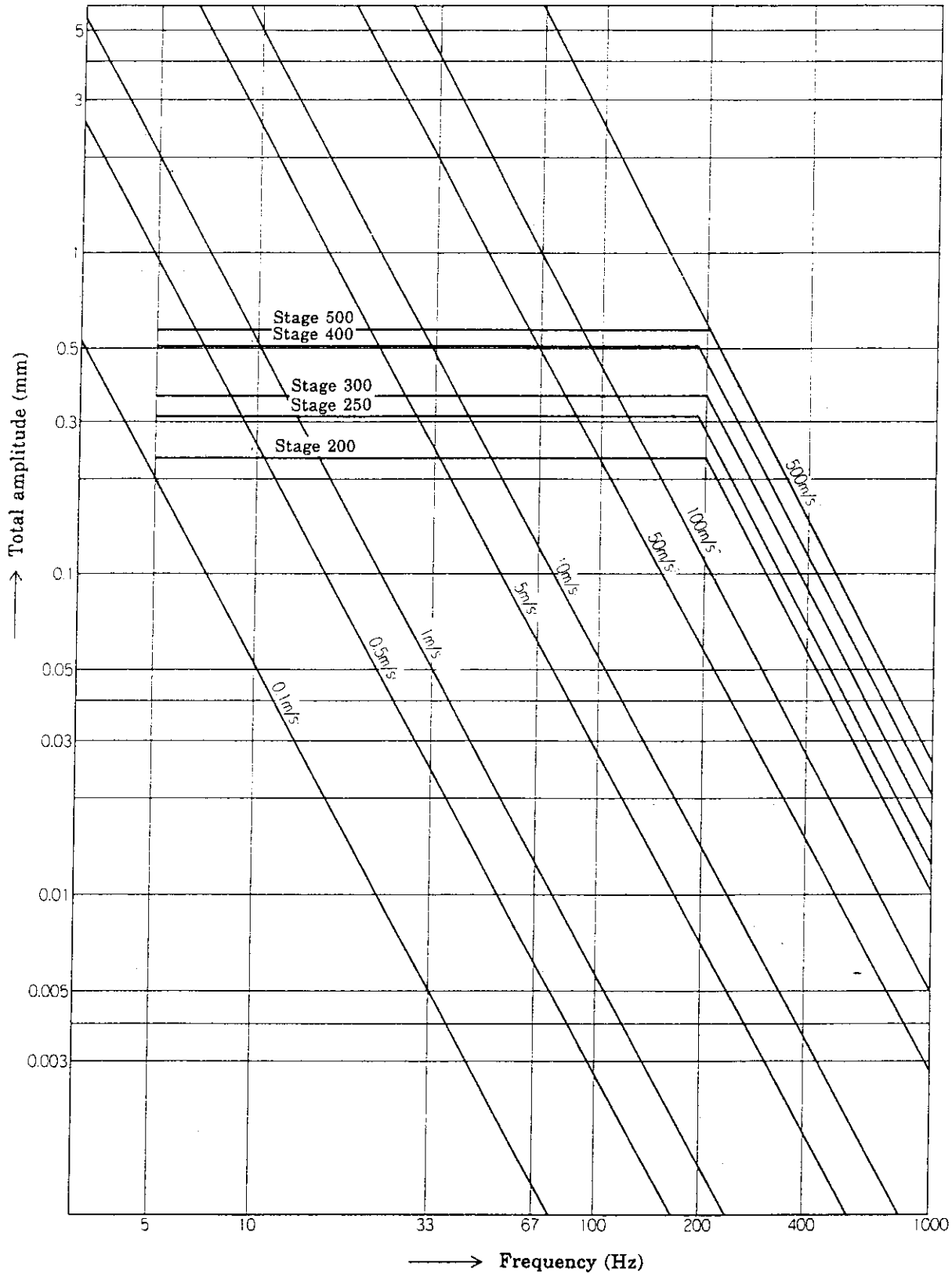
Attached Fig. 3. Amplitude in the case of 133 Hz in frequency



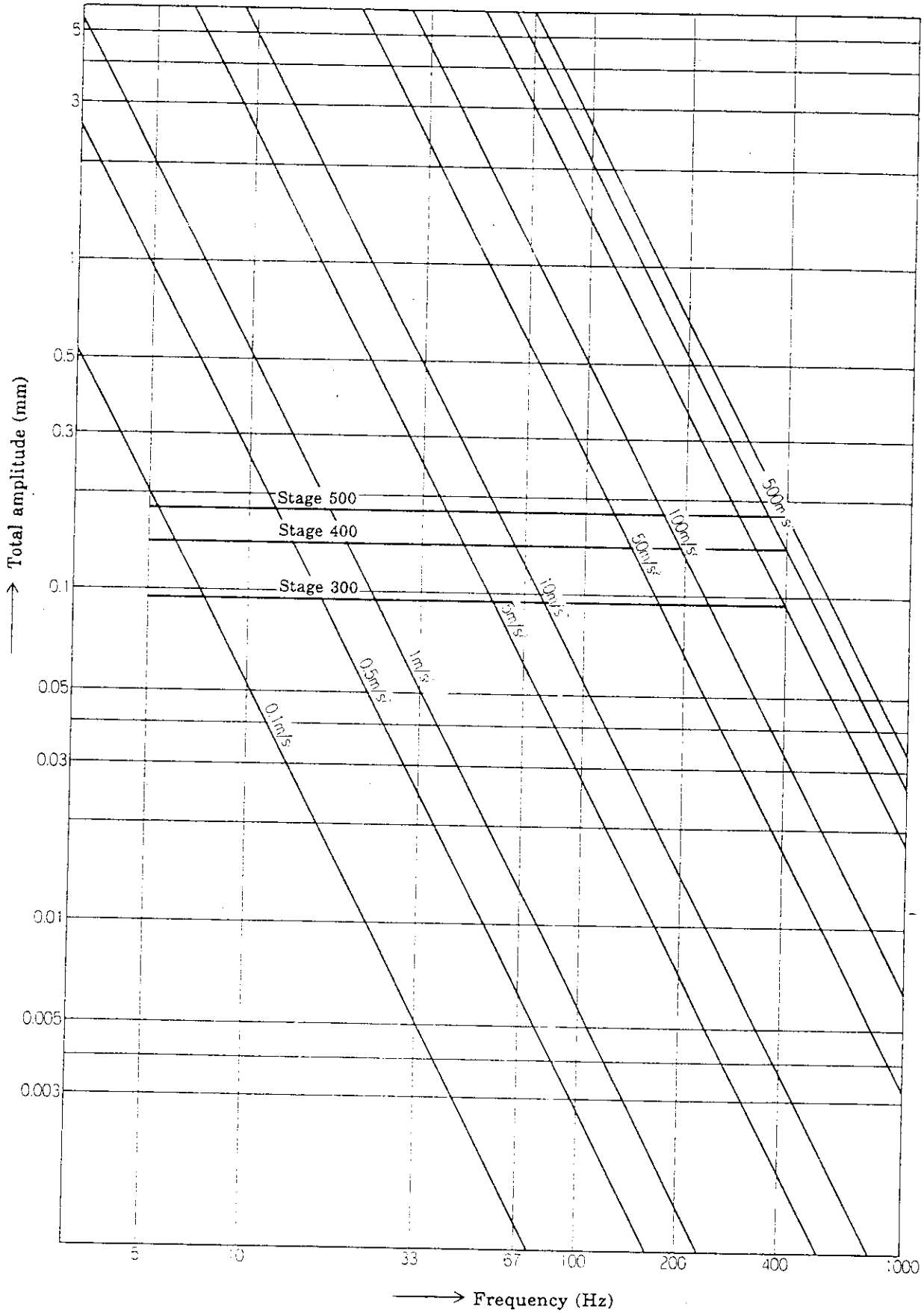
Attached Fig. 4. Amplitude in the case of 167 Hz in frequency



Attached Fig. 5. Amplitude in the case of 200 Hz in frequency



Attached Fig. 6. Amplitude in the case of 400 Hz in frequency



Informative reference Table 1. JIS D 1601 Examples of products applied with classification of vibration testing methods for automobile parts

Classification		Places to be fitted (example)	Example of products
Class A	Case where the parts are fitted on the body or on the spring of the suspension system and the vibration is relatively small	Indoor	Meter, clock and watch, switch, ashtray, fuse, cigarette lighter, control unit mirror, lamp, audio, air conditioning motor, relay
Class B	Case where the parts are fitted on the body or on the spring of the suspension system and the vibration is relatively large	Outdoor	Lamp, wiper, mirror
		Engine room	Washer, horn, flasher, relay, radiator, actuator for constant speed travelling apparatus, ignition coil
Class C	Case where the parts are fitted to the engine and the vibration is relatively small	Engine	Carburetor, ignition coil, pulse generator, thermo-switch
Class D	Case where the parts are fitted under the spring of the suspension system, and case where the parts are fitted to the engine and the vibration is comparatively large	Under the spring	Brake gear, brake tube
		Engine	Carburetor, air cleaner, exhaust pipe, fuel pump, valve for EGR, oil cleaner, starter, distributor, ignition coil, alternator, various meters and sensor for monitor, sensor for exhaust temperature, switch (vacuum switch), oil filter for power steering system, clutch parts

Related standards:

ISO 2041 Vibration and shock — Vocabulary

IEC Publication 68-2-6 (1982) Basic environmental testing procedures. Part 2: Tests. Test FC and guidance: Vibration (sinusoidal)

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