TRAINING ON ANTAM STANDARD CODE
For TESTING OF KNAPSACK MISTERS CUM DUSTERS

Theory 11: Measurement of Vibration- procedure

(Test Code Section IV(4) and D-8, of Annex D)

2nd Training of Trainers on ANTAM Codes
16 - 28 October2016, Nanjing China

Vibration and the Human Body

Hand-arm vibration (HAV) is vibration transmitted to a person's hand and arm when using hand-held power tools. HAV can occur when using hand-guided plant like powered lawn-mowers and while holding materials being processed by plant. HAV is commonly experienced by people who use jack-hammers, chainsaws, grinders, drills, riveters and impact wrenches

Terminology

- **Competent person** means a person who has acquired through training, qualification or experience the knowledge and skills to carry out the task.
- **Daily vibration exposure** A(8) means the quantity of HAV a worker is exposed to during a working day, normalised to an eight hour reference period, which takes account of the magnitude and duration of vibration. Daily vibration exposure is derived from the magnitude of the vibration (vibration total value) and the daily exposure duration.
- **Exposure action value** means the level of daily vibration exposure to HAV for a worker above which steps should be taken to minimise exposure.
- **Exposure limit** value means the level of daily vibration exposure to HAV for a worker which should not be exceeded.

Standard Procedure

- Exposure to HAV should be evaluated using the method in ISO 5349-1:2013: *Mechanical vibration – Measurement and evaluation of human exposure to hand-transmitted vibration – Part 1: General requirements.*
- Detailed practical guidance on this is available in ISO 5349 2:2013: *Mechanical vibration – Measurement and evaluation of human exposure to hand-transmitted vibration – Part 2: Practical guidance for measurement at the workplace.*

The daily vibration exposure A(8) for a worker carrying out one process or operating one tool can be calculated from magnitude and exposure time using the equation:

$$A(8) = a_{hv}\sqrt{\frac{T}{T_0}}$$

where:

A_{hv} is the vibration magnitude (in m/s ²)

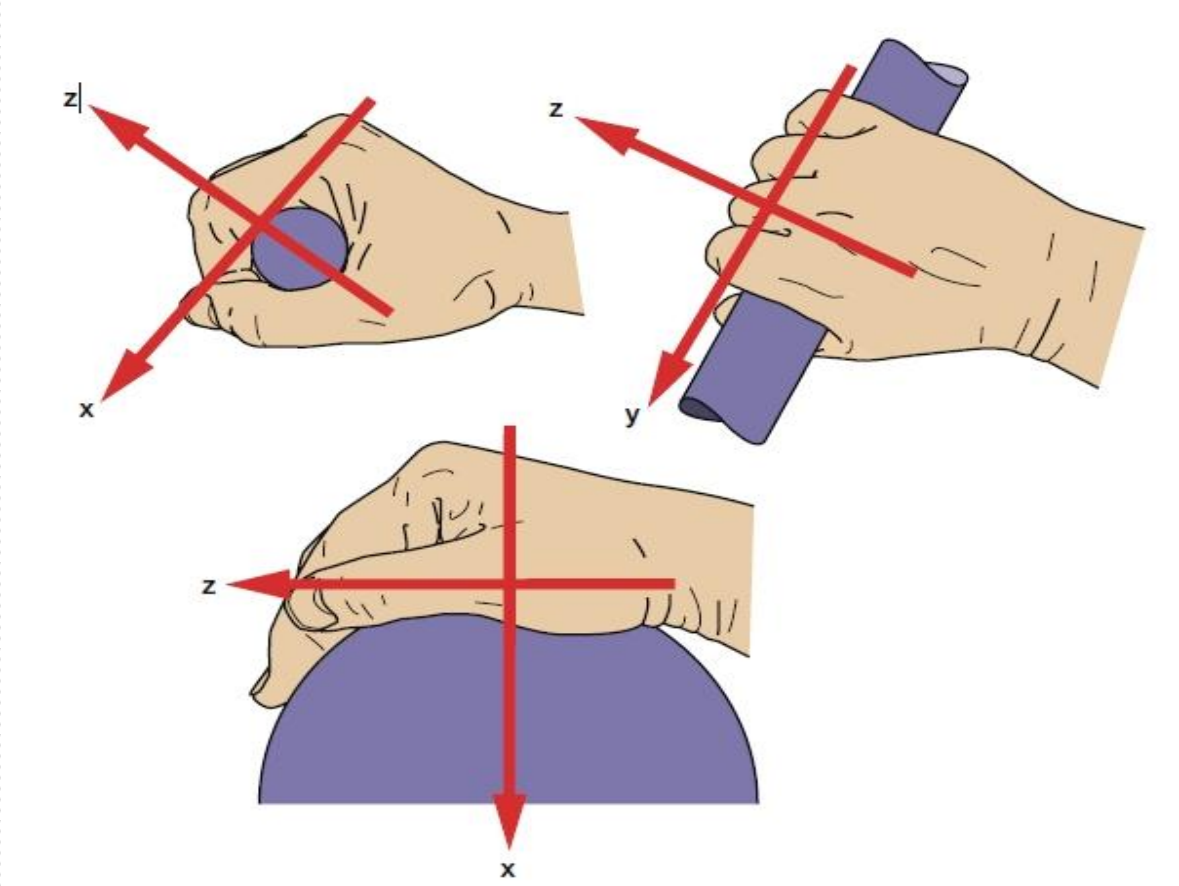
T is the actual duration of exposure and

T_0 is the reference duration of eight hours.

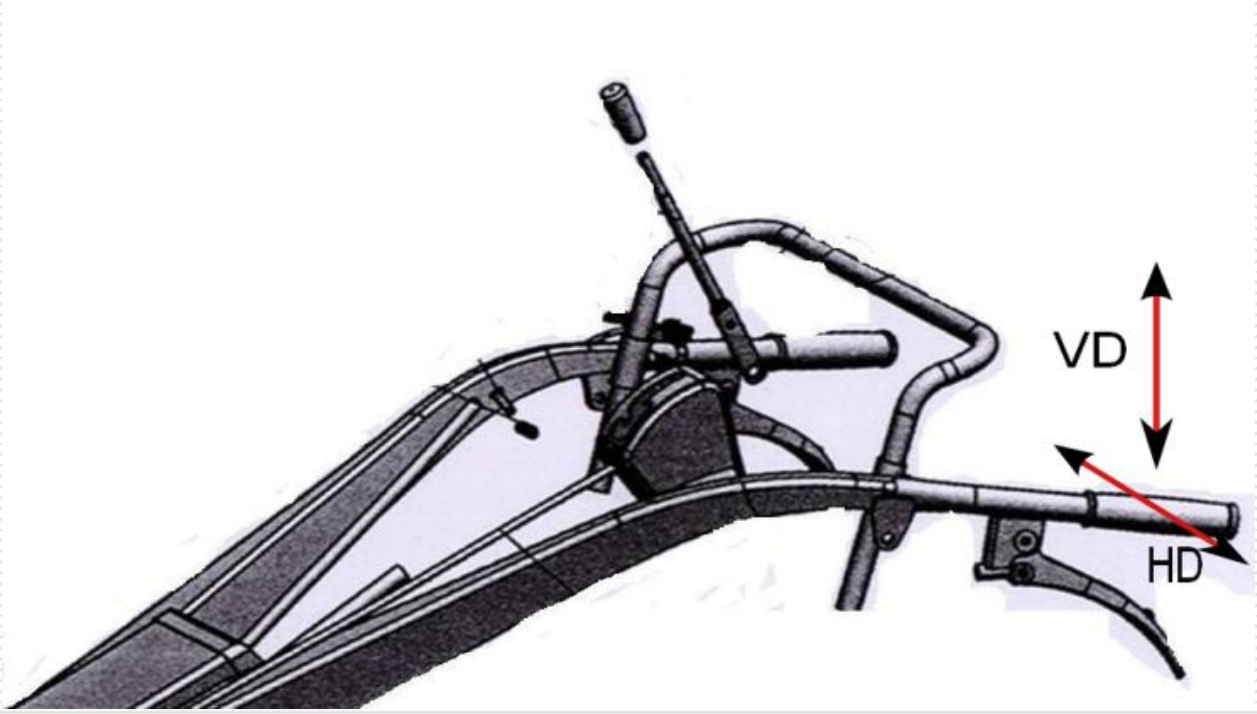
Like vibration magnitude, the daily vibration exposure has units of metres per second squared (m/s ²).

Measurement Axes

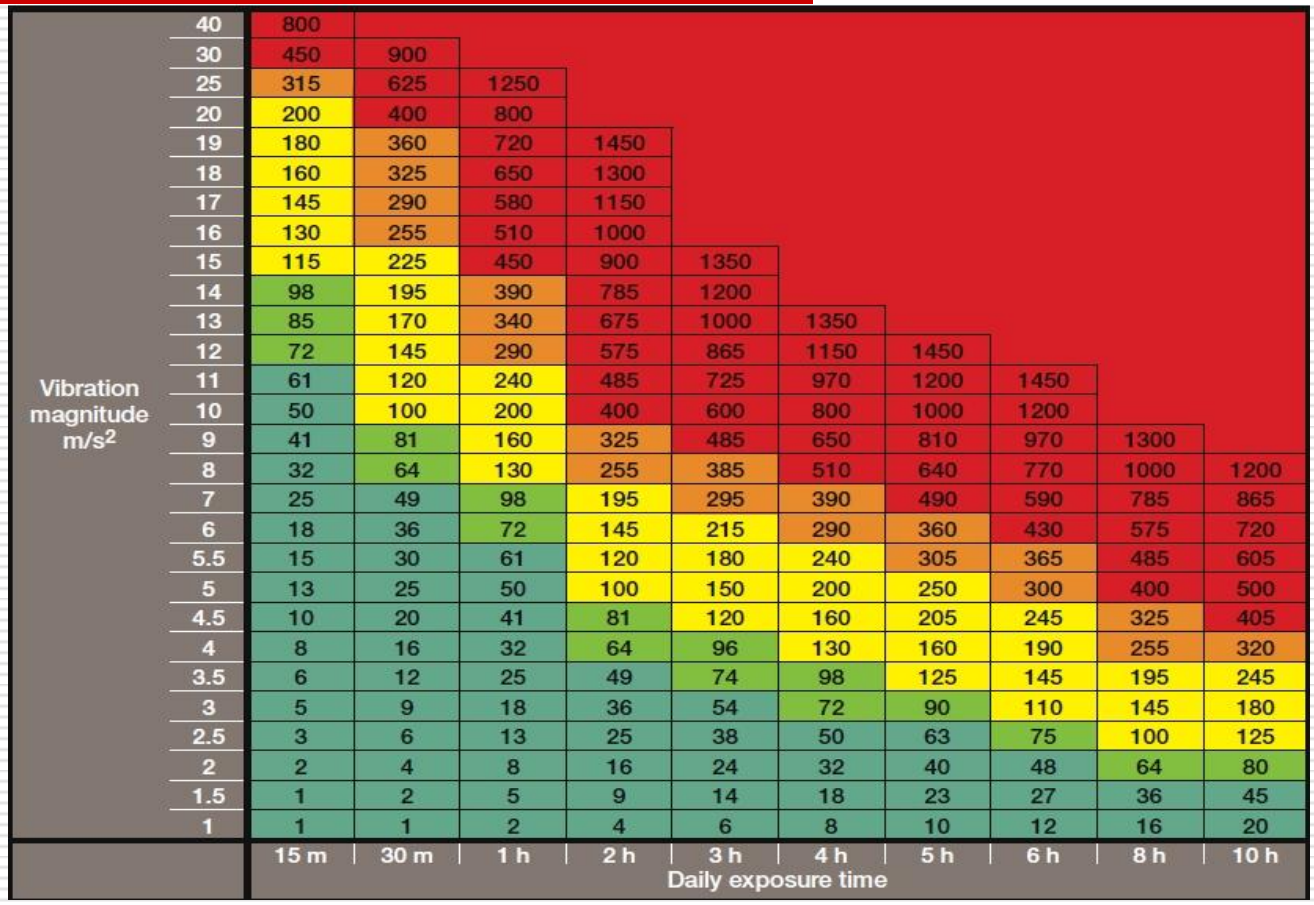
- For HAV the triaxial sum of the acceleration experienced by the worker in the three axes(x,y and z) as shown in Figure is used in calculation of the daily vibration exposure A(8). This is different from whole-body vibration (WBV) where the axis with the highest average root mean square (RMS) acceleration is used in calculation of the daily vibration exposure A(8).


z
x
z
y
z
x

Measuring Hand transmitted vibration in Power tiller

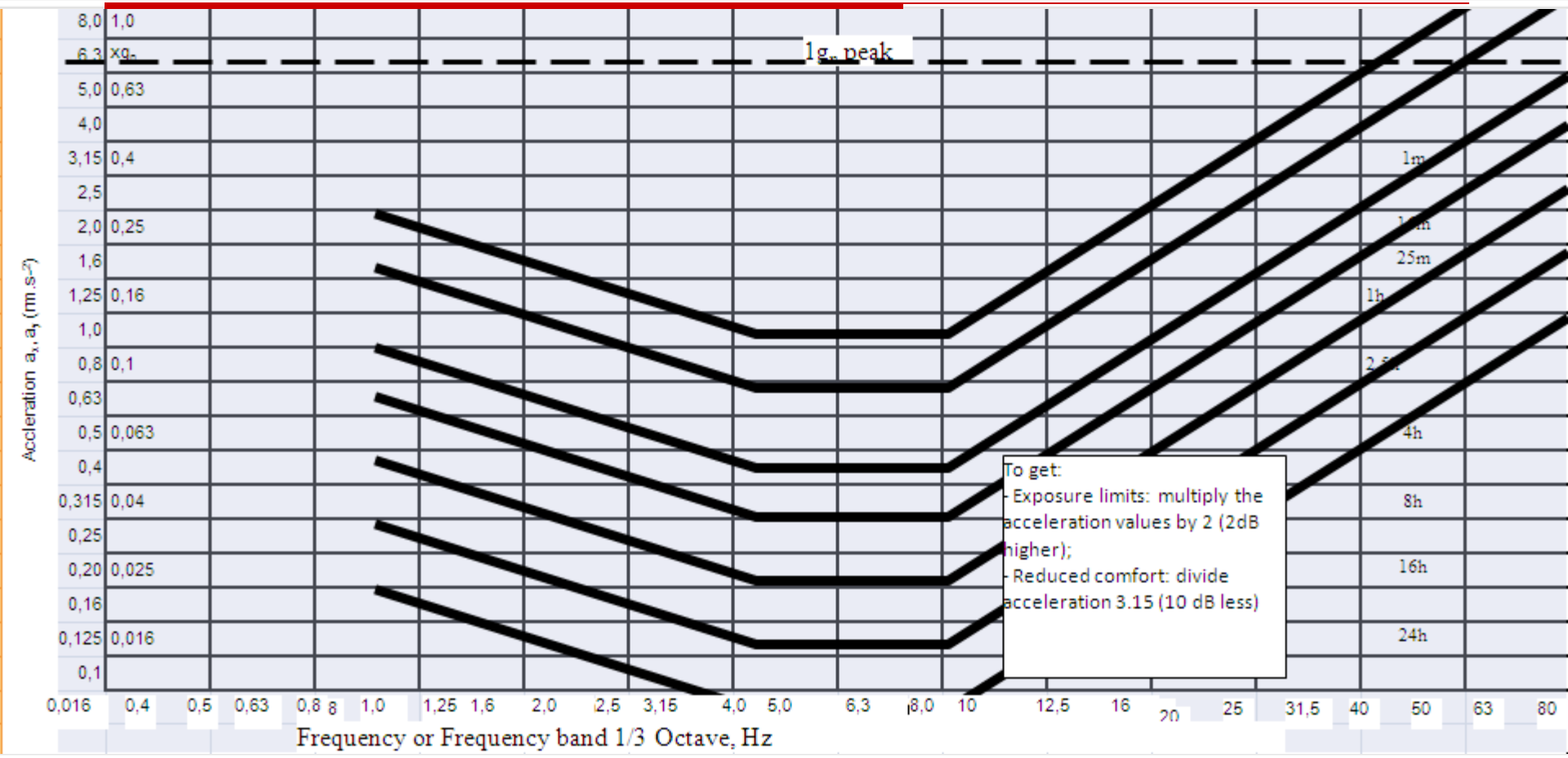


Exposure Point Scale

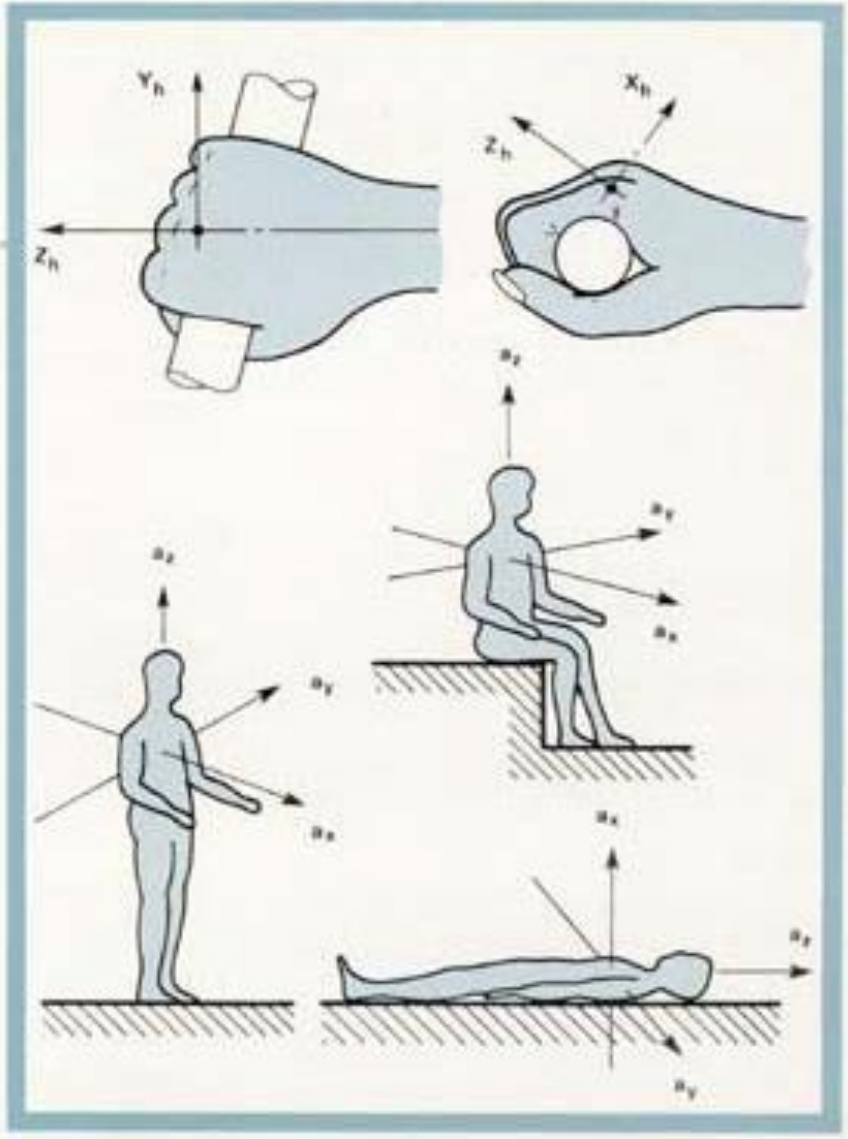


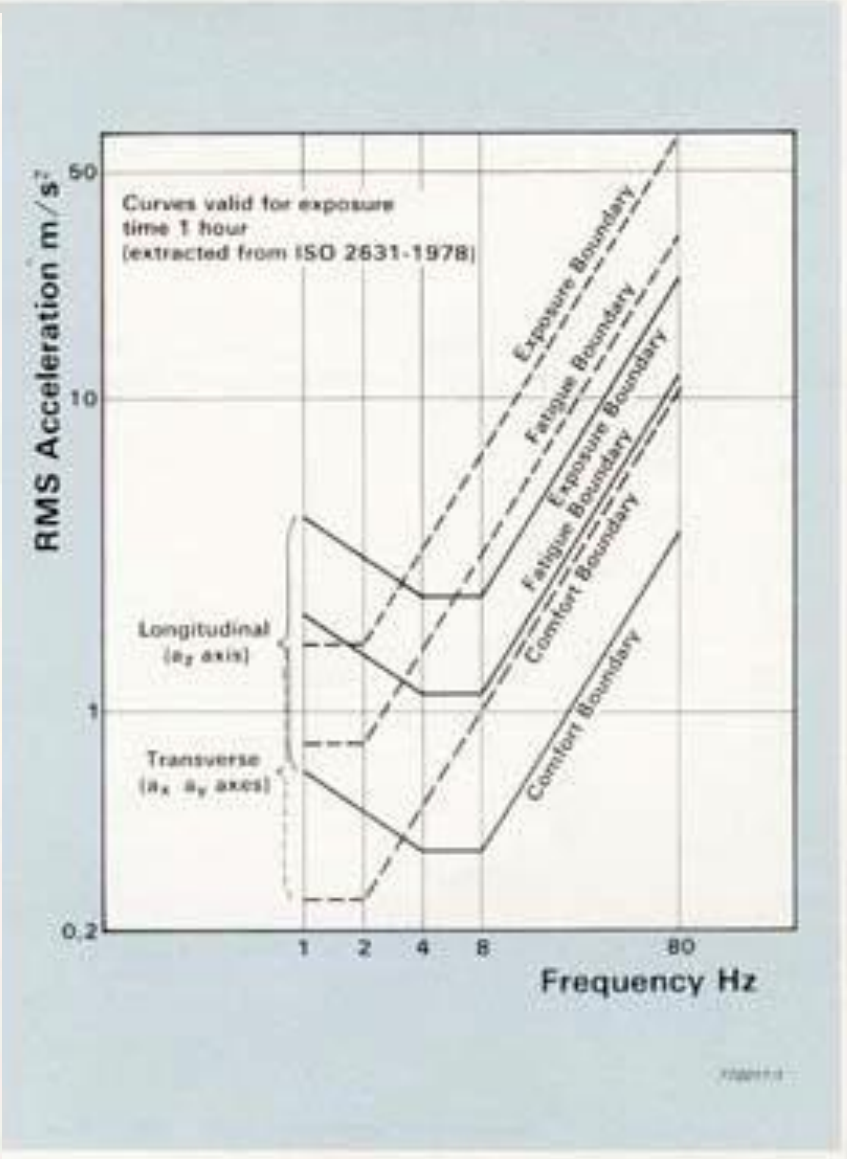
Vibration magnitude m/s²	15 m	30 m	1 h	2 h	3 h	4 h	5 h	6 h	8 h	10 h
40	800									
30	450	900								
25	315	625	1250							
20	200	400	800							
19	180	360	720	1450						
18	160	325	650	1300						
17	145	290	580	1150						
16	130	255	510	1000						
15	115	225	450	900	1350					
14	98	195	390	785	1200					
13	85	170	340	675	1000	1350				
12	72	145	290	575	865	1150	1450			
11	61	120	240	485	725	970	1200	1450		
10	50	100	200	400	600	800	1000	1200		
9	41	81	160	325	485	650	810	970	1300	
8	32	64	130	255	385	510	640	770	1000	1200
7	25	49	98	195	295	390	490	590	785	865
6	18	36	72	145	215	290	360	430	575	720
5.5	15	30	61	120	180	240	305	365	485	605
5	13	25	50	100	150	200	250	300	400	500
4.5	10	20	41	81	120	160	205	245	325	405
4	8	16	32	64	96	130	160	190	255	320
3.5	6	12	25	49	74	98	125	145	195	245
3	5	9	18	36	54	72	90	110	145	180
2.5	3	6	13	25	38	50	63	75	100	125
2	2	4	8	16	24	32	40	48	64	80
1.5	1	2	5	9	14	18	23	27	36	45
1	1	1	2	4	6	8	10	12	16	20
	Daily exposure time									

ISO Limits for Whole Body Vibration



longitudinal acceleration limit (z) as a function of frequency and time of exposure to low level of efficiency (fatigue).


Y_h
Z_h
X_h
Z_h
a_z
a_y
a_x
a_z
a_y
a_x
a_x
a_z
a_y


RMS Acceleration m/s²
50
10
1
0.2
Curves valid for exposure time 1 hour (extracted from ISO 2631-1978)
Exposure Boundary
Fatigue Boundary
Exposure Boundary
Fatigue Boundary
Comfort Boundary
Comfort Boundary
Longitudinal (a_z axis)
Transverse (a_x a_y axes)
1
2
4
8
80
Frequency Hz

Whole body vibration limits according to ISO 2631

The recommendation concerned with vibration and the human body is ISO 2631 — 1978 which sets out limitation curves for exposure times from 1 minute to 12 hours over the frequency

range in which the human body has been found to be most sensitive, namely 1 Hz to 80 Hz. The recommendations cover cases where the human body as a whole is subjected to vibration in three supporting surfaces, namely the feet of a standing person, the buttocks of a seated person and the supporting area of a lying person

Three severity criteria are quoted:

1. boundary of reduced comfort, applicable to fields such as passenger transportation etc.
2. A boundary for fatigue-decreased efficiency, that will be relevant to vehicle drivers and machine operators, and
3. The exposure limit boundary, which indicates danger to health.

It is interesting to note that in the longitudinal direction,
that is feet to head, the human body is most sensitive to
vibration in the frequency range 4 to 8 Hz. While in the
transverse direction, the body is most sensitive to vibration
in the frequency range 1 to 2 Hz.

Procedure as per Indian standard (IS 9935:2002)

The amplitude of mechanical vibration of components/assemblies of the power tiller shall be measured with the help of suitable vibration measuring device on the components listed in Annex F. 14.2 The power tiller shall be parked on a level concrete surface and tyres inflated according to off field pressure recommended for road work. The power tiller and its rotovator shall be operated at rated engine speed at no-load. The maximum horizontal displacement (HD) and vertical displacement (VD) in microns shall be measured by mounting the measuring device in related positions.

Procedure

ANTAM 1001-2016

The acceleration of mechanical vibration of components/assemblies of the power tiller shall be measured with the help of suitable vibration measuring device on the components listed in Annex D-8(IS 9935:2002).

The power tiller shall be parked on a level concrete surface and tyres inflated according to off field pressure recommended for road work. The power tiller and its rotary tiller attachment (if recommended by manufacturer) shall be operated at rated engine speed at no-load(IS 9935:2002).

The data shall be recorded in accordance with Annex D-8.

Data to be recorded

D-8 TEST DATA FOR VIBRATION MEASUREMENT

D-8.1 Date of test

D-8.2 Type of instrument

D-8.3 Location of test

D-8.4 Type of power tiller (tilling or pull)

S.No.	Measuring points		Vibration (Hz) Acceleration (m/s^2)	
(1)	(2)		(3)	
			HD	VD
1	Steering handle	Left arm grip		
		Right arm grip		
2	Operator's seat (without operator)			
3	At main frame where engine mounted			

* HD: Horizontal direction VD: Vertical direction

References

Measuring vibration ,Bruel& Kjaer http://www.bksv.com/doc/br0094.pdf

John e. Judd 2005 Basics Of Acceleration Measurements-mechanical Failure Prevention Technology 59th MFPT forum MFPT April 19, 2005

Guia para avaliação da exposição humana à vibrações de corpo inteiro

Guide for evaluation of human exposure to whole-body vibration

Segunda edição – 15/01/78 International Organization For Standardzation – Organisation Internationale De Normalisation Whole-body Vibration – Review Of Australian And International Standards And The Future

Scott J. Monaghan(1), Darren C. van Twest(1) (1) Vipac Engineers and Scientists Ltd, Brisbane, Australia