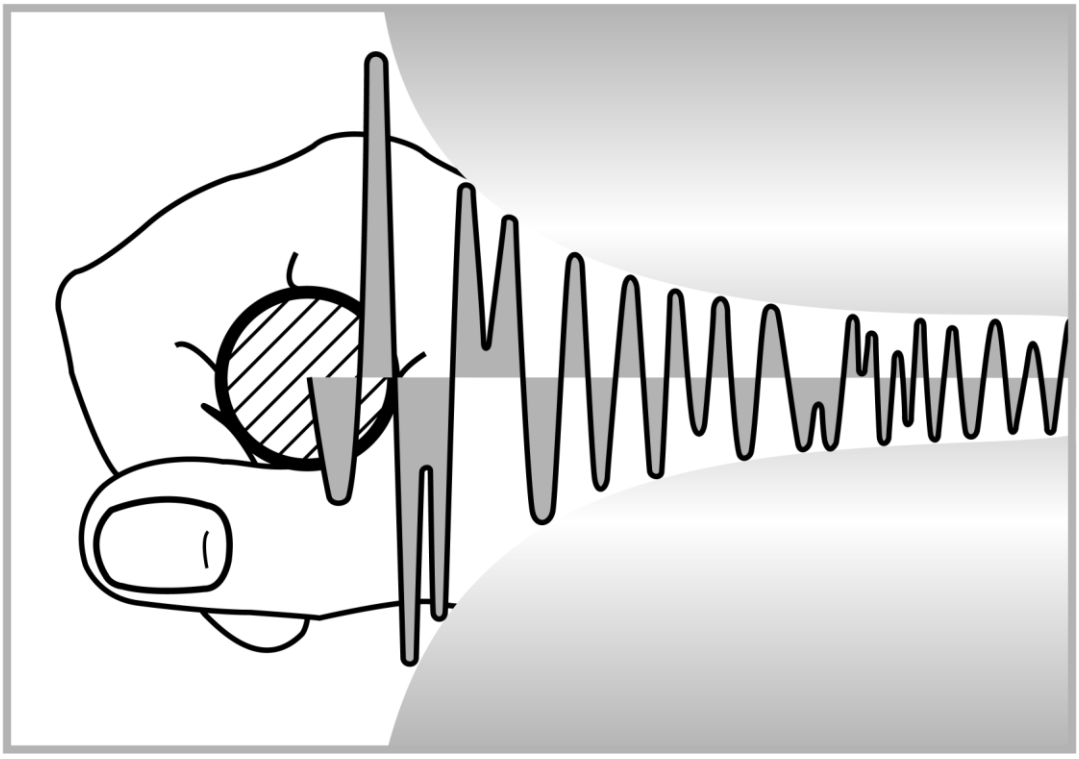

Hand - Arm Vibrations
GUIDE FOR EMPLOYERS

Last updated 2024-02-07

Implementation of the European "Vibrations" Directive (2002/44/EC)

This guideline describes important requirements from the EU "Vibrations" Directive (2002/44/EC) for hand-arm vibrations and its implementation by employers.

The EU Directive 2002/44/EC requires a risk analysis from employers regarding the exposure of employees to vibrations. This guide provides a simplified method of risk analysis for the employer. This method is based on the technical report of CEN/TC 231 in implementation of Directive 2002/44/EC. Together with EUROMOT, the European Association of Internal Combustion Engine Manufacturers, manufacturers of handheld machines have created the present guide. It is intended to improve communication between employers and manufacturers of hand tools with regard to fulfilling the Directive 2002/44/EC and to support employers in the obligatory risk analysis. This guide relates exclusively to the trigger and limit values set out in Directive 2002/44/EC. Should national laws deviate from it, then this guide cannot be applied.

The determined results represent only reference values and cannot replace individual risk analyses. In particular, further circumstances such as working methods, temperature, climate and other factors need to be taken into account in the assessment. EUROMOT accepts no liability for the correctness of the results and estimations determined with this method in specific individual cases. In individual cases and if there any additional questions, a suitable expert from professional associations or the like should be consulted for the risk analysis. If necessary, further information, including from the manufacturers of the affected machines, is available.

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1. What's new?

The EC Directive "Vibrations" directly references the ISO 5349-1:2001 and ISO 5349-2:2001 standards, which represent the status of findings via the measurement and assessment of oscillations or vibrations in the workplace.

Several updates and modifications for operations are the result of this and the provisions of the EC Directive. These include the stipulation to determine and assess risks (article 4), to instruct employees (article 6) and to establish a vibration minimization program (article 5).

According to applicable measurement standards, the measured frequency-assessed accelerations at the grips of the tool are used.

The assessment of the extent of exposure takes place using the calculation of the standardized daily vibration load A(8) over a reference period of eight hours. Information on measurement is attached to the EC Directive. A simplified method is explained in the final part of this brochure.

The measures in the respective articles are to be carried out contingent on the trigger and exposure limit values according to the EC Directive. The trigger values have a preventive character with the goal of avoiding the occurrence of vibration-related disorders.

If an employee exceeds the exposure limit, a significantly higher risk for the occurrence of vibration-related disorders is to be expected in the person operating a hand tool.

A separate, personal investigation, assessment and appraisal is a part of a risk assessment if an employee is exposed to a daily vibration load A(8) that exceeds the trigger value of 2.5 m/s².

Characteristic values for hand-arm vibrations

Exposure limit value A(8) = 5 m/s²

Trigger value A(8) = 2.5 m/s²

Vibration total value a_{hv}: To determine the daily vibration load A(8) weighted vibration total values a_{hv} are used, which combine all three vibration directions on each handle.
Equivalent vibration value $a_{hv,eq}$: Each application usually includes numerous operating conditions, such as idle or sawing at full throttle. These can be combined in an equivalent vibration value $a_{hv,eq}$
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2. Measures

As soon as the daily trigger value of 2.5 m/s² is exceeded, the employer must carry out a program with technical and organizational measures that takes into account the following individual measures in particular:

- Proper determination and assessment of risks (Article 4)
- Selection of suitable work equipment with the least possible vibrations (Article 5 (2)(b))
- Provision of suitable accessories and protective clothing, such as vibration-reducing handle systems, heated handles or protective gloves (Article 5 (2)((c)/(i))
- Appropriate maintenance programs for work equipment (Article 5(2)(d))
- Limitation of duration and intensity of vibrations (Article 5(2)(g)
- Adequate rest periods (Article 5(2)(h)
- Information and training (Article 6)
- Health monitoring (Article 8)

3. Need for action

Comparative values for typical vibration loads are available, e.g., in databases of the professional associations (VIBEX), in the KarLA database (Hand-Arm-Vibration - KARLA (karla-info.de)), in professional publications or from information from the manufacturer.
Of particular importance is the assessment of whether the comparative values:

- Were determined by valid measurement standards,
- Are based on the same measurement variables as the equivalent vibration value and
- Whether the data is reliable (data from official type examinations in recognized measurement labs are still the most appropriate).

If no usable values are available or the special working conditions of the employee significantly deviate from the standardized measurement conditions, then measurements are to be carried out at the respective workplace under representative operating conditions.

4. Implementation and practical information

Some practical information for implementing the EC Vibrations Directive:

- Hazards are to be determined or, if necessary, metrologically measured at the present time.
- The exposed employees are to be comprehensively instructed in the health risks due to hand-arm vibrations.
- Work equipment is to be serviced according to manufacturer specifications in order to maintain the performance of the machine.
- Blunt tools should be sharpened, repaired or no longer used.
- Vibration data should be determined from technical documents.
- If new equipment is acquired, machines with significantly lower vibration values are preferable, if the purchase criteria and technical features are the same or better.
- Vibration minimization programs and technical/organizational actions must be initiated.
- Personal protective equipment should be tested: This includes tested anti-vibration protective gloves or dry gloves when working in cold conditions.

5. Simplified method for determining the daily vibration load

This section describes the simplified method for determining the daily vibration load A(8). It can be used at the point of measurements in the workplace, if conditions are present in the use of the tool or tools that correspond with those in the applicable measurement standards.

Prerequisites are:

1. The manufacturer of the relevant machine provides information that corresponds to the applicable standards (as evident in reference to a standard and technical specifications such as vibration total value a_{hv} or the equivalent vibration value $a_{hv,eq}$).
2. The working conditions at the location of the machine are the same or similar to those with which the manufacturer values were determined. (Check the manufacturer information for such specifications or, if in doubt, contact the manufacturer.)
3. The machine used by the employee is in good overall condition and has been serviced according to the manufacturer specifications.
4. The tools and extensions used are the same as or similar to those that the manufacturer used in the determination of the vibration values.

For the simplified determination of daily vibration load, in addition to the exposure times, the vibration values of the devices used by the employee are needed.

The exposure time is the duration of time in which the employee is exposed to a vibration transfer from the grips of the machine to their body. This duration is either to be determined in the place of work under representative conditions or from tables 1, 2 or 3 as standardized exposure time. The standardized exposure times were determined according to statistical methods in the field and represent the vast majority of typical use cases. If a certain machine category is not listed, estimations from related devices can be used.

The second required measured value is the equivalent vibration value $a_{hv,eq,}$ which includes all operating conditions of the machine and, as part of this risk assessment, represents the higher value of the grips on a machine.
If the manufacturer only provides vibration data from individual operating conditions, these can be weighted in relation to the overall exposure time. The technical report by CEN, CEN/TR 15350, includes references to vibration measurement standards, in which typical parts of operating conditions are listed.

Generally, only the risk class applicable to the respective employee will be of interest, as potentially necessary measures for the employer can be derived from this.
To avoid complex calculation methods, it is sufficient to read the applicable exposure point from table 4 based on the exposure time and equivalent vibration value.
If desired, you as employer can convert these exposure points directly into the daily vibration load A(8) by using the diagram in figure 1.

Three alternatives are used:

a. The exposure point EP is under 100: No measures need to be initiated by the employer.
b. The exposure point EP is between 100 and 400: The device can be used with the measures described above.
c. The exposure point EP is over 400: The use of the device is only permissible if the exposure time is reduced and further precautionary actions are taken.

If the employee uses several devices at once, the exposure points can be individually determined and added to a total value. This total value is then to be assigned to one of the criteria above.

Table 1: Typical daily exposure times of representative hand tools (products with combustion engine)

Machine	Field of application	Worker	Skilled worker	Operator in production
Chainsaw for tree maintenance	tree maintenance	-	-	2.4 h (145 min)
Chainsaw	Forestry, agriculture, green area maintenance	-	-	3.7 h (210 min)
Grass trimmer	Green area maintenance	1 h (60 min)	2 h (120 min)	4 h (240 min)
Clearing saw	Maintenance of road adjoining surfaces, green area maintenance	1 h (60 min)	2 h (120 min)	3.5 h (210 min)
Hedge trimmer	Green area maintenance	0.9 h (55 min)	1.9 h (115 min)	3.5 h (210 min)
Long shaft hedge trimmer	Green area maintenance, municipal services	0.6 h (35 min)	1.3 h (80 min)	2 h (120 min)
Blower (back-pack motor)	Municipal services	0.6 h (35 min)	1.2 h (70 min)	3 h (180 min)
Blower (compact device)	Municipal services	0.3 h (20 min)	0.6 h (35 min)	1.5 h (90 min)
Vacuum	Municipal services	0.3 h (20 min)	0.6 h (35 min)	1 h (60 min)
Lawn edge cutter	Green area maintenance	1 h (60 min)	2 h (120 min)	3 h (180 min)
Pole pruners	tree maintenance	0.2 h (10 min)	0.4 h (25 min)	0.5 h (30 min)
Sweeper Drum Assembly	Green area maintenance, construction	0.3 h (20 min)	0.6 h (35 min)	2 h (120 min)
Mistblower	Agriculture	0.25 h (15 min)	0.5 h (30 min)	1 h (60 min)
Harvester (with mallets)	Agriculture	0.75 h (45 min)	1.5 h (90 min)	3 h (180 min)
Harvester (with branch hook)	Agriculture	0.75 h (45 min)	1.5 h (90 min)	3 h (180 min)
Tiller	Agriculture	0.5 h (30 min)	1 h (60 min)	2 h (120 min)

Handheld drill	Agriculture	0.25 h (15 min)	0.5 h (30 min)	1 h (60 min)
Earth augur	Agriculture, municipal	0.75 h (45 min)	1.5 h (90 min)	3 h (180 min)
Cut-off machine (handheld)	Construction	0.3 h (20 min)	0.6 h (35 min)	1 h (60 min)
Cut-off machine (hand-operated)	Construction	-	-	2.5 h (150 min)
Note: The specified daily exposure times were determined under representative conditions. In 90% of all inspected application cases, the exposure time was shorter than the typical daily exposure time given above. In the remaining 10% of all application cases, a longer exposure time is to be expected; in these cases a workplace-specific inspection must be carried out.				

Table 2: Typical daily exposure times of representative hand tools (line-powered products)

Machine	Field of application	Worker	Skilled worker	Operator in production
Hedge trimmer	Green area maintenance	0.75 h (45 min)	1.5 h (90 min)	-
Blower (compact device)	Municipal services	0.25 h (15 min)	0.5 h (30 min)	-
Grass trimmer	Green area maintenance	0.5 h (30 min)	1 h (60 min)	-
Pole pruners	tree maintenance	0.1 h (5 min)	0.2 h (10 min)	-
Long shaft hedge trimmer	Green area maintenance, municipal services	0.5 h (30 min)	1 h (60 min)	-
Chainsaw	Forestry, Agriculture, Green area maintenance	0.5 h (30 min)	1 h (60 min)	2.5 h(150 min)
Vacuum	Municipal services	0.25 h (15 min)	0.5 h (30 min)	-
Note: The specified daily exposure times were determined under representative conditions. In 90% of all inspected application cases, the exposure time was shorter than the typical daily exposure time given above. In the remaining 10% of all application cases, a longer exposure time is to be expected; in these cases a workplace-specific inspection must be carried out.				

Table 3: Typical daily exposure times of representative hand tools (battery-operated products)

Machine	Field of application	Worker	Skilled worker	Operator in production
Chainsaw for	tree maintenance	-	-	1.6 h (100 min)

tree maintenance				
Chainsaw	Forestry, Agriculture, Green area maintenance	0.5 h (30 min)	1 h (60 min)	2.5 h (150 min)
Grass trimmer	Green area maintenance	0.5 h (30 min)	1 h (60 min)	2 h (120 min)
Clearing saw	Maintenance of road adjoining surfaces, Green area maintenance	0.5 h (30 min)	1 h (60 min)	1.8 h (110 min)
Hedge trimmer	Green area maintenance	0.75 h (45 min)	1.5 h (90 min)	2.8 h (170 min)
Long shaft hedge trimmer	Green area maintenance, Municipal services	0.5 h (30 min)	1 h (60 min)	1.6 h (95 min)
Blower (compact device)	Municipal services	0.25 h (15 min)	0.5 h (30 min)	1.3 h (80 min)
Pole pruners	tree maintenance	0.1 h (5 min)	0.2 h (10 min)	0.3 h (20 min)
Olive harvester (with mallets)	Agriculture	0.75 h (45 min)	1.5 h (90 min)	2.6 h (155 min)
Cut-off machine (handheld)	Construction	0.25 h (15 min)	0.5 h (30 min)	0.9 h (55 min)
Note: The specified daily exposure times were determined under representative conditions. In 90% of all inspected application cases, the exposure time was shorter than the typical daily exposure time given above. In the remaining 10% of all application cases, a longer exposure time is to be expected; in these cases a workplace-specific inspection must be carried out.				

Table 4: Determination of exposure points (EP) depending on equivalent vibration value and exposure duration [6]

Äquivalenter Schwingungswert $a_{hv,eq}$ [m/s²]	Expositionsdauer [hours]	0.1	0.2	0.5	1	2	3	4	5	6	8
	[min]	6	12	30	60	120	180	240	300	360	480
		Risikokennfaktoren									
2.5		1	3	6	13	25	38	50	63	75	100
3		2	4	9	18	36	54	72	90	108	144
3.5		2	5	12	25	49	74	98	123	147	196
4		3	6	16	32	64	96	128	160	192	256
4.5		4	8	20	41	81	122	162	203	243	324
5		5	10	25	50	100	150	200	250	300	400
5.5		6	12	30	61	121	182	242	303	363	484
6		7	14	36	72	144	216	288	360	432	576
6.5		8	17	42	85	169	254	338	423	507	676
7		10	20	49	98	196	294	392	490	588	784
7.5		11	23	56	113	225	338	450	563	675	900
8		13	26	64	128	256	384	512	640	768	1024
8.5		14	29	72	145	289	434	578	723	867	1156
9		16	32	81	162	324	486	648	810	972	1296
9.5		18	36	90	181	361	542	722	903	1083	1444
10		20	40	100	200	400	600	800	1000	1200	1600
10.5		22	44	110	221	441	662	882	1103	1323	1764
11		24	48	121	242	484	726	968	1210	1452	1936
11.5		26	53	132	265	529	794	1058	1323	1587	2116
12		29	58	144	288	576	864	1152	1440	1728	2304
12.5		31	63	156	313	625	938	1250	1563	1875	2500
13		34	68	169	338	676	1014	1352	1690	2028	2704
13.5		36	73	182	365	729	1094	1458	1823	2187	2916
14		39	78	196	392	784	1176	1568	1960	2352	3136
14.5		42	84	210	421	841	1262	1682	2103	2523	3364
15		45	90	225	450	900	1350	1800	2250	2700	3600
15.5		48	96	240	481	961	1442	1922	2403	2883	3844
16		51	102	256	512	1024	1536	2048	2560	3072	4096
16.5		54	109	272	545	1089	1634	2178	2723	3267	4356
17		58	116	289	578	1156	1734	2312	2890	3468	4624
17.5		61	123	306	613	1225	1838	2450	3063	3675	4900
18		65	130	324	648	1296	1944	2592	3240	3888	5184
18.5		68	137	342	685	1369	2054	2738	3423	4107	5476
19		72	144	361	722	1444	2166	2888	3610	4332	5776
19.5		76	152	380	761	1521	2282	3042	3803	4563	6084
20		80	160	400	800	1600	2400	3200	4000	4800	6400

Risikoklasse:

Risikokennfaktor: < 100	Tagesschwingungsbelastung < 2.5 m/² , Auslösewert nicht überschritten, keine Maßnahmen
Risikokennfaktoren 100-400:	Tagesschwingungsbelastung 2.5 - 5 m/² , Auslösewert überschritten, Maßnahmen erforderlich
Risikokennfaktor >400:	Tagesschwingungsbelastung > 5 m/² , Expositionsgrenzwert überschritten

Notes on using table 4:

1. Uneven exposure times

If the equivalent vibration value and the exposure time are known, go to the affected row and column, take the exposure point and compare it with the risk classes below table 4.
If the exposure time is not a straight numerical value, such as the standard exposure time of 3.7 hours for chainsaws with combustion engines, the exposure point can be determined by simple addition of individual, smaller exposure times.

Example for a prescribed equivalent vibration value of 7.5 m/s:
3 hours ⇒-EP = 338
0.5 hours ⇒ EP = 56
0.1 hours ⇒ EP = 11
0.1 hours ⇒ EP = 11
TOTAL: 3.7 hours ⇒ EP = 416
This exposure point would show that the exposure limit value has been exceeded.

2. Unknown exposure time

Table 4 can also be used to determine a permissible exposure time. The equivalent vibration value is known, and the permissible exposure time should be determined for the permissible exposure limit value
(5 m/s² or EP 400).

Example for a prescribed equivalent vibration value of 7.5 m/s:
EP = 338 ⇒ The exposure time is 3 hours.
EP = 56 Þ The exposure time is 0.5 hours.
Total EP = 394, i.e. under 400 ⇒ The permissible exposure time is 3.5 hours.

3. Use of numerous hand tools in one day

If numerous hand tools are successively used in one working day, the exposure point is calculated from the addition of the individual factors of each tool used. After the exposure duration and the equivalent vibration value of each tool have been determined from available documents, the exposure point for each tool is determined from Table 4. These are added to a total exposure point.

Example 1: Four different tools were used on the same day.

EP from Table 4:

	$a_{hv,eq}$	t	EP
Tool 1	12.0 m/s²	6 min	29
Tool 2	8.0 m/s²	12 min	26
Tool 3	6.0 m/s²	12 min	14
Tool 4	5.0 m/s²	30 min	25
Total EP:			**94**

Result: The exposure point of all tools is below 100, therefore the trigger value is not exceeded. No measures for minimizing the vibration risk need to be undertaken.

Example 2: Four different tools were used on the same day.

EP from Table 4:

	$a_{hv,eq}$	t	EP
Tool 1	6.0 m/s²	6 min	7
Tool 2	8.0 m/s²	12 min	26
Tool 3	3.5 m/s²	60 min	25

Tool 4	13.0 m/s²	30 min	169
Total EP:			**227**

Result: The exposure point of all tools is above 100, therefore the trigger value is exceeded. Measures for minimizing the vibration risk have to be undertaken.

Example 3: Three different tools were used on the same day.

EP from Table 4:

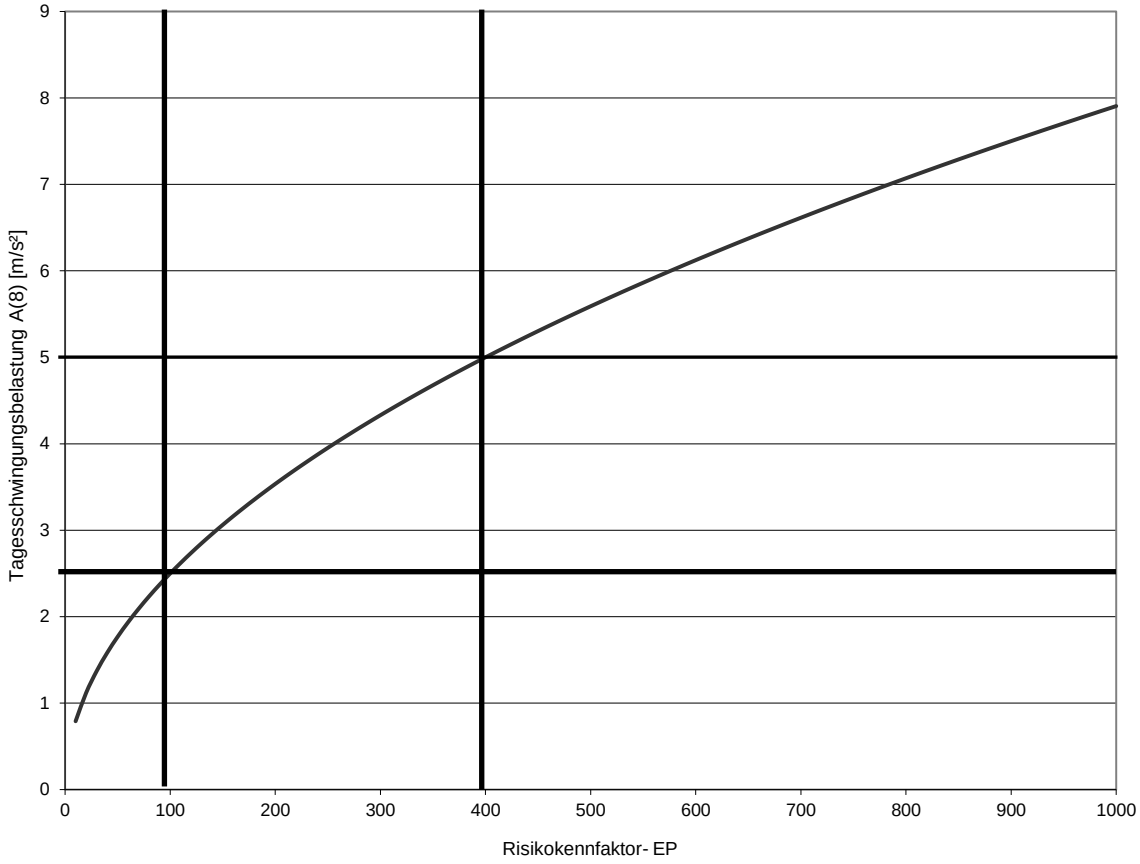
	$a_{hv,eq}$	t	EP
Tool 1	12.0 m/s²	60 min	288
Tool 2	8.0 m/s²	120 min	256
Tool 3	11.0 m/s²	30 min	121
Total EP:			**665**

Result: The exposure point of all tools is above 400, therefore the exposure limit value is exceeded. The devices are not suitable for use in the workplace under the current conditions.

Conversion of the exposure point to the daily vibration load A(8)

It can sometimes be useful to convert the exposure point, defined as an auxiliary value, into the realistic daily vibration load, for example, in order to check where the vibration load lies in relation to the trigger or exposure limit value. The exposure point EP is drawn on the horizontal axis. From the known EP go upward to the curve and from that intersection go to the left. The daily vibration load A(8) can be read on the vertical axis.

Figure 1 – Conversion of exposure points into the daily vibration load A(8)



List of sources or additional information:

[1] 2002/44/EC, Directive of the European Parliament and of the Council of June 25, 2002 on the minimum health and safety requirements regarding the exposure of workers to the risks arising from physical agents (vibration) (sixteenth individual Directive within the meaning of Article 16(1) of Directive 89/391/EEC)
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[2] Overview of determination and assessment of vibration loads (BIA report 2/2003, P. 224 – 233)
[3] VDI 2057 Sheet 2 *Effect of mechanical vibrations on people, hand-arm vibrations*
[4] EN ISO 5349-1:2001 Mechanical vibration — Measurement and evaluation of human exposure to hand-transmitted vibration — Part 1: General requirements (ISO 5349-1:2001)
[5] EN ISO 5349-2:2001 Mechanical vibration — Measurement and evaluation of human exposure to hand-transmitted vibration — Part 2: Practical guidance for measurement at the workplace (ISO 5349-2:2001)
[6] "Vibrations" risk assessment with hand-operated and hand-held work machines: Information on use of manufacturer specifications from operating instructions: Vibrations (dguv.de)
[7] CR 1030-1:1995; CR 1030-2:1995 Hand-arm vibration — Guidelines for vibration hazards reduction — Part 1: Engineering methods by design of machinery; Part 2: Management measures at the workplace
[8] Christ, E.: Influence of vibrations in the workplace – risk assessment and prevention. In: "Die BG", issue 5/2002
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