

Key Indicator Method for assessing and designing physical workloads with respect to Whole-Body Forces

KIM-BF

Overview of Key Indicator Methods:

Key Indicator Method for assessing and designing physical workloads ...

- with respect to manual Lifting, Holding and Carrying of loads (KIM-LHC)
- with respect to manual Pushing and Pulling of loads (KIM-PP)
- during Manual Handling Operations (KIM-MHO)
- **with respect to Whole-Body Forces (KIM-BF)**
- with respect to Awkward Body Postures (KIM-ABP)
- with respect to Body Movement (KIM-BM)

as well as the respective **Extended** versions in a spreadsheet program (e.g. KIM-BF-E)



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Scope of the Key Indicator Method (KIM-BF)

- Exerting considerable forces when processing large workpieces, when operating machines, when positioning working objects, when manually moving persons or when using tools, fittings and devices irrespective of the body posture with mostly stationary force application.
- Application of force predominantly via hands, transmission via shoulders, back, legs and feet possible.
- The forces required are so high that this activity can usually no longer be carried out in a sitting position.
- **Typical activities:** Fitting in piece-by-piece production, moving gate valves, work with winches/pulleys, work with levers, crowbars or handspikes, coupling railway vehicles, removing concrete, work with pneumatic hammers, work with chainsaws, installing windows, transferring/positioning patients (care activities), assembly work with predominantly high forces, screwing large components, powerful hitting with the hand, using heavy hammers (e.g. sledgehammer), operating (hand-lever) presses, shovelling, work with manipulators and comparable technical means or moving loads on roller tracks/ball tracks with little body movement, mooring (in ports)

Distinction from other Key Indicator Methods

- If the sub-activity includes lifting, relocating, lowering, holding, carrying, pulling and/or pushing loads ≥ 3 kg, the types of physical workload "Lifting, Holding and Carrying" and/or "Pushing and Pulling" must also be considered.
- If the sub-activity includes uniform, short-cycle work with predominantly low forces and small tools, the type of physical workload "Manual Handling Operations" must also be taken into consideration.
- If several different sub-activities take place per working day, they must be recorded and assessed separately (e.g. using KIM-BF-E). The probability of physical overload can only be assessed if all physical workloads occurring during a working day are assessed.

Form including brief instructions

KIM for assessing and designing physical workloads with respect to Whole-Body Forces (KIM-BF)

Workplace/sub-activity:			
Duration of the working day:		Evaluator:	
Duration of the sub-activity:		Date:	

1st step: Determination of time rating points

Total duration ¹⁾ [up to ... minutes] and/or repetitiveness ²⁾ of the sub-activity per working day:	up to 1	> 1 - 5	> 5 - 10	> 10 - 20	> 20 - 30	> 30 - 45	> 45 - 60	> 60 - 100	> 100 - 150	> 150 - 210	> 210 - 270	> 270 - 360	> 360 - 480
Time rating points	1	1.5	2	2.5	3	3.5	4	5	6	7	8	9	10

¹⁾ For continuous sub-activities, ²⁾ for discontinuous sub-activities. For explanations in this respect: See guideline.
Please note: If finger-hand forces are applied predominantly, the sub-activity must also be evaluated using the KIM-MHO!

2nd step: Determination of the rating points for other indicators

Force exertion within a standard minute for continuous sub-activities and/or per sub-activity for discontinuous sub-activities		Holding ³⁾			Moving			
		average holding time [seconds]			average movement frequencies [number]			
Level	typical examples as classification aid for orientation purposes	31 - 45 ³⁾	16 - 30	≤ 15	< 5	5 - 15	16 - 30	31 - 45 ⁵⁾
	Low forces Whole-Body Forces with low forces cannot occur by definition. Where applicable, these sub-activities must be assessed using the KIM-MHO.	-	-	-	-	-	-	-
	Moderate forces (up to 30 % F _{max} M) Work with hand-guided tools, such as angle grinders, small chainsaws, hedge trimmers or impact drills < 3 kg / moving loads on roller tracks < 20 kg	18	12	6	1.5	6	12	18
	High forces (up to 50 % F _{max} M) Work with heavy hand-guided tools, such as angle grinders, large chainsaws, hammer drills 3-8 kg / operating high-pressure cleaners or sandblasters/shovelling loads < 4 kg / moving loads on roller tracks 20-50 kg / throwing loads < 3 kg up to max. 5 metres	25	17	8	2	8	17	25
	Very high forces (up to 80 % F _{max} M) Work with heavy hand-guided tools, such as pneumatic hammers (≥ 8 kg) / shovelling loads 4-8 kg / moving loads on roller tracks > 50-100 kg / throwing loads < 3 kg up to max. 10 metres or 3-5 kg max. 5 metres	100	32	15	4	15	32	100
	Peak forces⁴⁾ (more than 80 % F _{max} M) Pulsed exertion of force such as when working with crowbars, sledgehammers / tipping heavy drums (> 200 kg), transporting heavy pieces of furniture / shovelling loads > 8 kg / moving loads on roller tracks > 100 kg / throwing loads < 3 kg more than 10 metres or ≥ 3 kg more than 5 metres	100	25	6	25	50	100	100
The sub-activity must be observed and the rating points for the force categories marked. The sum represents the total force rating point.		Total force rating point:						
		For women x 1.5:						

³⁾ The amount of time of holding work is only considered as such in the assessment if one arm is held continuously statically for at least 4 seconds!
⁴⁾ These forces might not be exerted at all or might no longer be exerted reliably. This applies to women in particular.
⁵⁾ In case of even higher frequencies/holding times, the resulting risk score must be extrapolated linearly or the E version (KIM-BF-E) must be applied.

Symmetry of the application of force	Rating points
Force is applied with both hands and symmetrically	0
Force is applied temporarily with one hand and/or asymmetrically: uneven force distribution between the two hands	2
Force is applied predominantly with one hand, uneven distribution or direction of forces of both hands	4

Body posture ⁶⁾	Rating points
 <ul style="list-style-type: none"> - Standing upright up to a position with the trunk being slightly inclined forward (< 20°) - No twisting 	0
 <ul style="list-style-type: none"> - Standing, trunk being more severely inclined forward (20-60°) - Occasional twisting and/or lateral inclination of the trunk identifiable - Hands occasionally above shoulder level / at a distance from the body 	3
 <ul style="list-style-type: none"> - Standing, trunk being severely inclined forward (> 60°) or backward - Frequent twisting and/or lateral inclination of the trunk identifiable - Hands frequently above shoulder level / at a distance from the body - Work in a lying position with hands above/below the body 	6
 <ul style="list-style-type: none"> - Combination of more severe forward or backward inclination and lateral inclination/torsion - Constant twisting and/or lateral inclination of the trunk identifiable - Work in a squatting or kneeling position - Hands constantly above shoulder level / at a distance from the body 	9 ⁷⁾

⁶⁾ Typical body postures are to be taken into account. Rare deviations can be ignored.
⁷⁾ Please note: If this category was chosen, it is recommended to evaluate this sub-activity also using the KIM-ABP!

Unfavourable working conditions (specify only where applicable) Note: Here, additional points (intermediate rating points) can be assigned for unfavourable working conditions.		Intermediate rating points (IRP)	Σ IRP
Hand/arm position and movement: 	occasionally at the limit of the movement ranges	1	
	frequently/constantly at the limit of the movement ranges	2	
Force transfer/application restricted working objects/tools difficult to grip / greater holding forces required / no shaped grips		1	
Force transfer/application considerably hindered working objects/tools hardly possible to grip / slippery, soft, sharp edges / no or unsuitable grips		2	
Adverse ambient conditions: exposure to heat, cold and/or vibration ⁸⁾		1	
Ambient conditions unfavourable: Exposure to extreme heat, cold and/or vibration ⁸⁾		2	
Increased effort caused by restricted spatial conditions Restricted stability and/or restricted space for movement, e.g. height too low or work area of less than 1.5 m ² / floor a little bit slippery, slight inclination (up to 5°), obstacles in the work area		1	
Significantly increased effort caused by unfavourable spatial conditions Significantly restricted stability and/or freedom of movement, e.g. when working in very confined spaces / floor is very slippery/uneven, stronger inclination (> 5°)		2	
Clothes: additional physical workload due to restrictive and heavy protective clothes/equipment (PPE) (e.g. heat protection suits, chemical protection suits, heavy respiratory protective equipment (group 3))		2	
None: there are no unfavourable working conditions		0	

Indicators not mentioned in the tables are to be taken into account accordingly. Rare deviations can be ignored.

⁸⁾ Please note: If there are physical workloads due to vibrations, they are to be evaluated separately! See <http://www.baua.de/vibration/>

Work organisation / temporal distribution	Rating points
Good: frequent variation of the physical workload situation due to other activities (including other types of physical workload) / without a tight sequence of higher physical workloads within one type of physical workload during a single working day.	0
Restricted: rare variation of the physical workload situation due to other activities (including other types of physical workload) / occasional tight sequence of higher physical workloads within one type of physical workload during a single working day.	2
Unfavourable: no/hardly any variation of the physical workload situation due to other activities (including other types of physical workload) / frequent tight sequence of higher physical workloads within one type of physical workload during a single working day with concurrent high load peaks.	4

3rd step: Evaluation and assessment

	M	W	
Force exertion			
Symmetry of the application of force +			
Body posture +			
Unfavourable working conditions (Σ IRP) +			
Work organisation / temporal distribution +			
Time rating points	X	Total of indicator rating points:	=
		M	W

The risk score calculated and the table below can be used as the basis for a rough evaluation:

Risk	Risk range	Intensity of load ⁷⁾	a) Probability of physical overload b) Possible health consequences	Measures	
	1	< 20 points	low	a) Physical overload is unlikely. b) No health risk is to be expected.	None
	2	20 - < 50 points	slightly increased	a) Physical overload is possible for less resilient persons. b) Fatigue, low-grade adaptation problems which can be compensated for during leisure time	For less resilient persons, workplace redesign and other prevention measures may be helpful.
	3	50 - < 100 points	substantially increased	a) Physical overload is also possible for normally resilient persons. b) Disorders (pain), possibly including dysfunctions, reversible in most cases, without morphological manifestation	Workplace redesign and other prevention measures should be considered.
	4	≥ 100 points	high	a) Physical overload is likely. b) More pronounced disorders and/or dysfunctions, structural damage with pathological significance	Workplace redesign measures are necessary. Other prevention measures should be considered.

⁷⁾ The boundaries between the risk ranges are fluid because of the individual working techniques and performance conditions. The classification may therefore only be regarded as an orientation aid. Basically, it must be assumed that the probability of physical overload will increase as the risk scores rise.

Guideline for the Key Indicator Method for assessing and designing physical workloads with respect to Whole-Body Forces

KIM-BF

Objective of the Key Indicator Method:

The objective of the KIMs is to document the main physical workload indicators as easily as possible, make correlations clear to the user and allow for a rough evaluation of the probability of physical overload. Possible consequences for health as well as the need for action resulting from that may be derived from this.

Please note:

This method serves to assess the working conditions with respect to whole-body forces for orientation purposes. When determining the time rating points as well as the rating points for the key indicators (force exertion, symmetry of the application of force, work organisation / temporal distribution, unfavourable working conditions and body posture), sound knowledge of the sub-activity being assessed is nevertheless an absolute prerequisite. Without such knowledge, it is not permitted to conduct an assessment. Rough estimates or assumptions lead to false results.

Procedure:

Basically, assessment is carried out for sub-activities. If minor deviations, e.g. with respect to the level of force exertion, direction of force and/or body postures, arise within a sub-activity, average values must be formed. If a number of sub-activities with substantially different conditions are carried out within a working day or extremely varying conditions occur within a sub-activity, they must be estimated and documented separately. The probability of physical overload can only be assessed if all physical workloads occurring during a working day are assessed. For a summarised assessment of substantially different physical workloads caused by whole-body forces, the KIM-BF-E, for example, can be used. In case of overlaps with other types of physical workload, it is to be examined whether other KIMs must also be used (in this respect, see https://www.baua.de/EN/Topics/Work-design/Physical-workload/Key-indicator-method/Key-indicator-method_node.html).

The assessment requires 3 (or possibly 4) steps to be carried out:

1. Determination of time rating points
2. Determination of the rating points for key indicators and
3. Evaluation/assessment. As a result, it may be
4. necessary to carry out a step which includes the derivation and implementation of workplace redesign measures and precautions.

It is generally allowed to form useful intermediate steps (interpolation) when determining the rating points.

Time rating points < 1 may not be assigned, as the time rating point is always at least 1!

Carrying out the documentation and evaluation/assessment:

1st step: Determination of time rating points

The time rating points are determined on the basis of the table depending on the total duration and/or the repetitiveness of the sub-activity per working day. The figures in this table can reflect the total duration or the repetitiveness:

- For **continuous sub-activities**, which may last from several minutes up to several hours (such as shovelling, work with chainsaws, hedge trimmers, high-pressure cleaners or the like, where usually not more than moderate to high forces are exerted), the documentation is performed by considering the force exertion within a standard minute: The total number of minutes of this sub-activity per working day represents the amount of time to be considered in the assessment.
- For **discontinuous sub-activities**, which temporarily require very high to peak forces, usually last less than 1 minute and are interrupted by rest periods (such as tipping heavy drums, strapping or lashing containers, transferring patients), the documentation is performed by considering the force exertion in this sub-activity even if it lasts less than one minute. The repetitiveness of the sub-activity per working day represents the amount of time to be considered in the assessment.

2nd step: Determination of the rating points for other indicators

- The rating points for the key indicators are determined on the basis of the categories and explanations in the corresponding tables.
- A distance between the chest and middle of the hand of more than 17 cm (5% percentile, European value) is considered to be gripping at a distance from the body.

3rd step: Evaluation and assessment

Each sub-activity is evaluated on the basis of an activity-related risk score (calculated by adding the rating points for the key indicators and multiplying this by the time rating points). This risk score can be assigned to a risk range relating to this sub-activity and, based on this, the probability of physical overload and possible consequences for health as well as the need for action resulting from that can be derived.

4th step: Workplace redesign and preventive occupational medical care

In addition to the prevention measures derived on the basis of the risk assessment, the following applies:

- From risk range 3 "substantially increased", workplace redesign measures as well as further collective and individual prevention measures are usually necessary. In Germany, preventative occupational medical care in accordance with *ArbMedVV* [German Ordinance on Occupational Health Care] is advisable^{*)}.
- Workplace redesign and prevention measures for groups of particularly vulnerable employees (e.g. young people or people with altered performance) must be considered irrespective of the intensity of load and on a case-by-case basis where appropriate, e.g. if employees demand preventive occupational medical care.
- By examining the highest risk scores of the key indicators, the causes of increased physical workloads can be identified and changes initiated. The need for a redesign should also be considered if individual indicators reach the maximum rating points. Where appropriate, indications to restrictions of the feasibility with respect to the rating points for individual indicators must be considered.

^{*)} based on *ArbMedVV* [German Ordinance on Occupational Health Care], as of June 2019