

Key indicator method for assessing physical workload during manual handling operations

If a number of different tasks are performed within one one working day, they must be recorded separately.


task

Version 2012





1st step: Determination of time rating points

Total duration of this activity per shift [up to ... hours]	1	2	3	4	5	6	7	8	9	10
Time rating points	1	1.5	2	2.5	3	3.5	4	4.5	5	5.5

2nd step: Determination of the rating points for the type of force exertion, gripping conditions, work organisation, working conditions, posture and hand/arm position and movement

Type of force exertion(s) in the finger-hand area		Holding				Moving														
		average holding time [secs per minute]				average movement frequencies [number per minute]														
		60-31	30-16	15-4	<4	<1	1-4	5-15	16-30	31-60	>60									
		Rating points																		
 <p>low</p> <p>high</p>	Very low forces e.g. button actuation / shifting / ordering											2	1	0.5	0	0	0.5	1	2	3
	Low forces e.g. material guidance / insertion											3	1.5	1	0	0	1	1.5	3	5
	Moderate forces e.g. gripping / joining small work pieces by hand or with small tools											5	2	1	0	0.5	1	2	5	8
	High forces e.g. turning / winding / packaging / grasping / holding or joining parts / pressing in / cutting/ Working with small powered hand tools											8	4	2	0,5	1	2	4	8	13
	Very high forces e.g. cutting involving major element of force / working with small staple guns / moving or holding parts or tools											12	6	3	1	1	3	6	12	21
	Peak forces e.g. tightening, loosening bolts / separating / pressing in											19	9	4	1	2	4	9	19	33
Hitting with ball of the thumb, palm of the hand or fist											-	-	-	1	1	3	6	12	21	
The work cycle must be observed and the rating points for the force categories marked. Added together (left and right hands separately) these produce the force rating point. To calculate the total point rating values the higher figure must be used.							Rating points of force exertion:		Left hand:		Right hand:									





Force transfer / Gripping conditions	Rating points
Optimum force transfer/application / working objects are easy to grip (e.g. bar-shaped, gripping grooves) / good ergonomic gripping design (grips, buttons, tools)	0
Restricted force transfer/application / greater holding forces required / no shaped grips	2
Force transfer/application considerably hindered / working objects hardly possible to grip (slippery, soft, sharp edges) / no grips or only unsuitable ones	4

Hand/arm position and movement ^{*)}	Rating points
 <p>Good: position or movements of joints in the medium (relaxed) range / only rare deviations</p>	0
 <p>Restricted: occasional positions or movements of the joints at the limit of the movement ranges</p>	1
 <p>Unfavourable: frequent positions or movements of the joints at the limit of the movement ranges</p>	2
 <p>Poor: constant positions or movements of the joints at the limit of the movement ranges / enduring static holding of the arms without hand-arm support</p>	3

^{*)} Typical positions are to be considered. Rare deviations can be ignored.

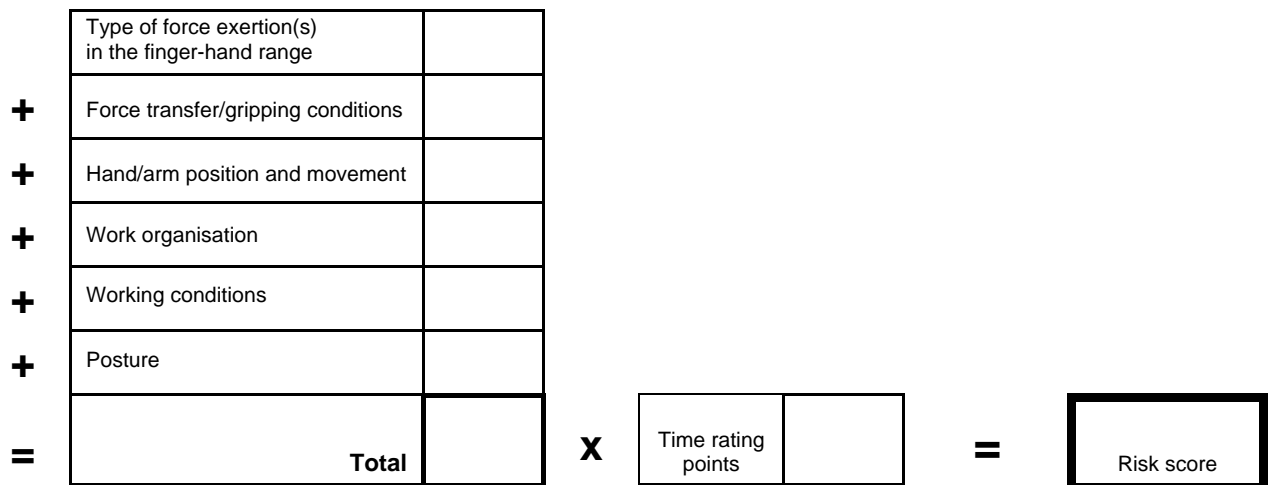
Work organisation	Rating points
Frequent variation of load situation due to other activities / a number of work operations / adequate opportunity for recuperation	0
Rare variation of load situation due to other activities / few work operations / recuperation times adequate	1
No/hardly any variation of load situation due to other activities / few single movements per operation / high working rate due to high line balancing and/or high piece-work output / uneven work sequence with concurrent high load peaks / too little or too short recuperation times	2
Features not mentioned in the table are to be taken into account accordingly.	

Working conditions	Rating points
Good: reliable recognition of detail / no dazzle / good climatic conditions	0
Restricted: impaired detail recognition due to dazzle or excessively small details / draughts / cold / wet / disturbed concentration due to noise	1
<i>Features not mentioned in the table are to be taken into account accordingly. Under highly unfavourable conditions rating point 2 can be assigned.</i>	

Posture ^{**)}	Rating points
 <p>Good: alternation of sitting and standing is possible / alternation of standing and walking / dynamic sitting is possible / hand-arm rest possible as required / no twisting / head posture variable / no gripping above shoulder height</p>	0
 <p>Restricted: trunk with slight inclination of the body towards the area of action / predominant sitting with occasional standing or walking / occasional gripping above shoulder height</p>	1
 <p>Unfavourable: trunk clearly inclined forward and/or twisted / head posture for detail recognition specified / restricted freedom of movement / exclusive standing without walking / frequent gripping above shoulder height / frequent gripping at a distance from the body</p>	3
 <p>Poor: trunk severely twisted and inclined forward / body posture strictly fixed / visual check of action through magnifying glasses or microscopes / severe inclination or twisting of the head / frequent bending / constant gripping above shoulder height / constant gripping at a distance from the body</p>	5
^{**)} Typical postures are to be taken into account. Rare deviations can be ignored.	

3rd step: Evaluation

Enter the rating points applicable for the activities and calculate the risk score in the diagram.



On the basis of the risk score calculated and the table below it is possible to make a rough evaluation.

Risk range ^{***)}	Risk score	Description
1	<10	Low load situation, health risk from physical overload is unlikely to appear.
2	10 to <25	Moderate load situation, physical overload is possible for less resilient persons. For this group redesign of workplace is helpful.
3	25 to <50	Increased load situation, physical overload also possible for normally resilient persons. Redesign of workplace should be reviewed.
4	≥50	High load situation, physical overload is likely to appear. Workplace redesign is necessary.

^{***)} 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 as the number of risk scores rises, so the risk of overloading the muscular-skeletal system increases.

Risk assessment of physical work load situations

Brief instructions for the application of the Key Indicator Method Manual Handling Operations (KIM MO)

Published by the Federal Institute for Occupational Safety and Health 2012

Form KIM MO

Key indicator method for assessing physical workload during manual handling operations
If a number of different tasks are performed within one working day, they must be recorded separately.

Version 2012										
1st step: Determination of time rating points										
Total duration of this activity per shift (in h - min):										
Time rating points	1	2	3	4	5	6	7	8	9	10
	1	1.5	2	2.5	3	3.5	4	4.5	5	5.5
2nd step: Determination of the rating points for the type of force exertion, gripping conditions, work organisation, working conditions, posture and hand/arm position and movement										
Type of force exertion(s) in the finger-hand-arm area	Intensity (N)		Frequency (times per minute)		Average movement frequency (number per minute)		Rating points			
Level	Description, typical examples	10-20	20-30	30-40	40-50	50-60	60-70	70-80	80-90	90-100
low	Light force e.g. pushing, pulling, carrying, opening	2	1	0.5	0	0	0.5	1	2	3
medium	Moderate force e.g. manual force insertion	3	1.5	1	0	0	1	1.5	2	3
high	High force e.g. pushing/pulling small work pieces to hand or with tool	5	2	1	0	0.5	1	2	3	5
very high	Very high force e.g. pushing/pulling major element of force - working with tool, e.g. hammer, chisel, chisel, etc.	8	4	2	0.5	1	2	4	8	13
extremely high	Extremely high force e.g. carrying/lifting major element of force - working with tool, e.g. hammer, chisel, chisel, etc.	12	6	3	1	1	3	6	12	21
		19	9	4	1	2	4	9	19	33
		-	-	-	1	1	3	6	12	24
The risk score must be calculated on the basis of the rating points for the force exertion, posture and movement, work organisation, working conditions, posture and hand/arm position and movement.										
Rating points of force exertion										
Rating points of posture										
Rating points of work organisation										
Rating points of working conditions										
Rating points of hand/arm position and movement										
Rating points of posture										
Total										
Risk score										

Working conditions		Rating point
Good: relative recognition of detail / no clutter / good climatic conditions		0
Restricted: impaired detail recognition due to clutter or excessively small details / draughts / cold / wet / disturbed concentration due to noise		1
Features not mentioned in the table are to be taken into account accordingly. Under highly unfavourable conditions rating point 2 can be assigned.		
Posture		Rating point
Good: alternation of sitting and standing is possible / alternation of standing and walking / dynamic sitting is possible / hand/arm rest possible as required / no leaning / head posture variable / no gripping above shoulder height		0
Restricted: trunk with slight inclination of the body towards the area of action / predominant sitting with occasional standing or walking / occasional gripping above shoulder height		1
Unfavourable: trunk clearly inclined forward and/or twisted / head posture for detail recognition restricted / restricted freedom of movement / exclusive standing without walking / frequent gripping above shoulder height / frequent gripping at a distance from the body		3
Poor: trunk severely twisted and inclined forward / body posture stability fixed / visual check of action through magnifying glasses or microscopes / severe inclination or twisting of the head / frequent bending / constant gripping above shoulder height / constant gripping at a distance from the body		5
Typical postures are to be taken into account. Rare deviations can be ignored.		
3rd step: Evaluation		
Enter the rating points applicable for the activities and calculate the risk score in the diagram.		
Type of force exertion(s) in the finger-hand-arm area		
Force exertion/gripping conditions		
maintain posture and movement		
work organisation		
working conditions		
Posture		
Total	X	= Risk score
On the basis of the risk score calculated and the table below it is possible to make a rough evaluation.		
Risk range	Risk score	Description
1	< 10	Low load situation, health risk from physical overload is unlikely to appear
2	10 to < 20	Moderate load situation, physical overload is possible for less resilient persons. For this group redesign of workplace is helpful.
3	20 to < 50	Increased load situation, physical overload also possible for normally resilient persons. Redesign of workplace should be reviewed.
4	> 50	High load situation, physical overload is likely to appear. Workplace redesign is necessary.
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. Specially it must be assumed that as the number of risk score rises, so the risk of overloading the musculo-skeletal system increases.		
Published by the Federal Institute for Occupational Safety and Health 2011 www.baua.de		

What are the activities where this method can be applied?

This method serves to assess activities involving predominant load on the finger-hand-arm area when working on objects (manual jobs). Typical indicators of these activities are frequent repetitions of identical or similar manual operations and requirements regarding dexterity or the recognition of small details.

What are the activities where this method cannot be applied?

- Activities involving the manual handling of loads (transport of loads with weights in excess of 5 kg). For these there are two further key indicator methods:
 - Lifting, holding and carrying loads
 - Pulling and pushing during the transport of loads using hand-operated industrial trucks
- Activities involving high energy requirements due to whole-body work and high exertion of action forces (e.g. rising, climbing, machine assembly)
- Activities involving long-lasting, forced postures (e.g. kneeling, bending, lying)

How is the analysis conducted?

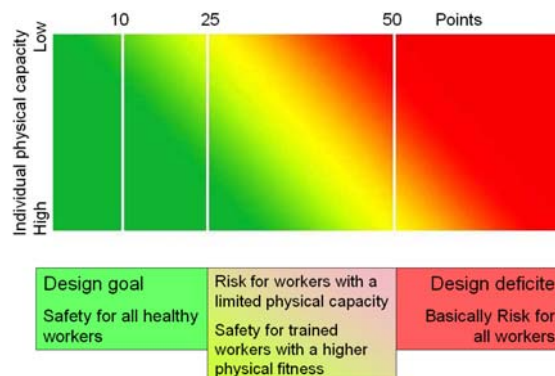
With the KIM MO an evaluation is conducted of

1. The most important work requirements (key indicators) rated apart and
2. The level of the total physical load situation.

To reduce the increments in the rating points of the key indicators and to avoid incorrect assessments in the boundary areas between these increments it is recommended that interpolated intermediate point rating values be used for all indicators.

What is evaluated?

With the LMM MA the probability of a physical overload is evaluated. It is assumed that if the 25-risk score limit is adhered to, the activity can be carried out by all workers without any risk of a physical overload. For trained persons with good physical fitness it is acceptable to exceed the 25-risk score limit. Above 50 risk scores, however, there is a risk for all workers of physical overload, in which case consequences for health can be expected. The limits of 25 and 50 risk scores should be taken as an orientation. Basically it must be assumed that as the risk scores rise the load on the muscular-skeletal system will increase.



Sequence of the risk assessment

Basically sub-activities are assessed. If the type and frequency of movements vary within the sub-activity, average values must be formed.

If a **number of sub-activities** with substantially different indicators arise within a working day, they must be **estimated** and documented **separately**.

A summarised assessment is not possible with the form LMM MA. For this the computer-aided extended analytical procedure **LMM MA E** must be used.

An absolute prerequisite is a sound knowledge of the sub-activity being assessed. If this is not available it is not permitted to conduct an assessment. Rough estimates or assumptions lead to false results.




Time rating points

Total duration of this activity per shift [up to ... hours]	1	2	3	4	5	6	7	8	9	10
Time rating points	1	1.5	2	2.5	3	3.5	4	4.5	5	5.5

The time rating points are assigned on the basis of the table. Account must be taken the duration of the activity being assessed. Tooling times, distribution times and other jobs are not considered.

Rating points for force exertion

Type of force exertion(s) in the finger-hand area		Holding					Moving				
		average holding time [secs per minute]					average movement frequencies [number per minute]				
Level	Description, typical examples	60-31	30-16	15-4	<4	<1	1-4	5-15	16-30	31-60	>60
 low high	Very low forces e.g. button actuation / shifting / ordering	2	1	0.5	0	0	0.5	1	2	3	
	Low forces e.g. material guidance / insertion	3	1.5	1	0	0	1	1.5	3	5	
	Moderate forces e.g. gripping / joining small work pieces by hand or with small tools	5	2	1	0	0.5	1	2	5	8	
	High forces e.g. turning / winding / packaging / grasping / holding or joining parts / pressing in / cutting / Working with small powered hand tools	8	4	2	0.5	1	2	4	8	13	
	Very high forces e.g. cutting involving major element of force / working with small staple guns / moving or holding parts or tools	12	6	3	1	1	3	6	12	21	
	Peak forces e.g. tightening, loosening bolts / separating / pressing in	19	9	4	1	2	4	9	19	33	
	Hitting with ball of the thumb, palm of the hand or fist	-	-	-	1	1	3	6	12	21	
The work cycle must be observed and the rating points for the force categories marked. Added together (left and right hands separately) these produce the force rating point. To calculate the total point rating values the higher figure must be used.		Rating points of force exertion:					left hand: 6		Right hand: 5.5		

Example for completed form

Manual operation processes are almost always a sequence of different actions. Repetitive manual operations are just as possible as extended holding and far-reaching arm movements. For the analysis, all major actions are marked separately in the rating points table for the left and right hands and added separately. The higher of the two values is to be used as the total rating points. Both the type of force exertion (lines) and the frequency/duration (columns) are considered. For the purpose of classification it is helpful if the user tests the force exertion himself.

The **type of force exertion** is recorded by estimation after observation and if necessary by a worker survey. The description and the examples serve as a classification aid.

The **duration/frequency** of the individual actions is recorded by analysing a number of work cycles. A work cycle is taken to be a cohesive time phase in which a work process takes place. This may be a few seconds (e.g. inserting a part in a machine) or several minutes (e.g. complete assembly of a product). It is important that representative values are identified by counting and measuring time. Experience shows that for cycle times of up to 60 s an analysis of 5 to 10 cycles is sufficient. For larger cycle times 10 to 15 cycles have to be analysed. The total frequencies counted or total durations measured are then to be divided by the number of minutes observed. From this it is possible to calculate the average holding times and average movement frequencies. For complex sub-activities it is recommended that a video recording be made and assessed at leisure. What forces arise, and which forces can be combined to form a group? Does holding last 4 or more seconds? Then enter frequencies and holding times for the different load situations.

The method does not distinguish between right-handers and left-handers because the activity is being evaluated and not the individual worker.



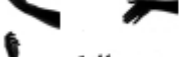

The action level and limit values for exposure to damaging hand-arm vibration are almost always reliably adhered to with the tools commonly used. However if tools which generate substantially greater vibrations are used, a separate risk assessment must be conducted under the respective vibration occupational safety and health regulations.

Rating points for force exertion

Force transfer / Gripping conditions	Rating points
Optimum force transfer/application / working objects are easy to grip (e.g. bar-shaped, gripping grooves) / good ergonomic gripping design (grips, buttons, tools)	0
Restricted force transfer/application / greater holding forces required / no shaped grips	2
Force transfer/application considerably hindered / working objects hardly possible to grip (slippery, soft, sharp edges) / no grips or only unsuitable ones	4

The rating points for force transfer/gripping conditions are assigned on the basis of the indicators in the table. The classification is to be applied according to their effects on the physical load situation, especially with respect to increased finger and hand-closing forces. For the purpose of classification it is helpful if the user tests the force transfer himself. If work is performed without handles (e.g. with direct material contact as when components are being assembled) this does not automatically mean rating points 4, but the force transfer to the material body must be evaluated. If the material is easy to grip the rating points 0 can even be attained without grips.

Rating points for the hand/arm position

Hand/arm position and movement ¹⁾	Rating points
 Good: position or movements of joints in the medium (relaxed) range / only rare deviations	0
 Restricted: occasional positions or movements of the joints at the limit of the movement ranges	1
 Unfavourable: frequent positions or movements of the joints at the limit of the movement ranges	2
 Poor: constant positions or movements of the joints at the limit of the movement ranges / enduring static holding of the arms without hand-arm support	3

¹⁾ Typical positions are to be considered. Rare deviations can be ignored.

The rating points for the hand/arm position and movement are assigned on the basis of the indicators in the table. The extent of the movement and the frequency must be considered. For the purpose of classification it is helpful if the assessor himself tries out the movements.

Movements in the medium movement range and occupational utilisation of the active movement to the limit are non-critical. More frequent movement and holding of joints at the limit of the movement range may lead to complaints.

Rating points for work organisation

Work organisation	Rating points
Frequent variation of load situation due to other activities / a number of work operations / adequate opportunity for recuperation	0
Rare variation of load situation due to other activities / few work operations / recuperation times adequate	1
No/hardly any variation of load situation due to other activities / few single movements per operation / high working rate due to high line balancing and/or high piece-work output / uneven work sequence with concurrent high load peaks / too little or too short recuperation times	2
<i>Features not mentioned in the table are to be taken into account accordingly.</i>	

The rating points for the work organisation are assigned on the basis of the indicators in the table. These are only an aid to classification. The prime consideration is the question as to whether the load situations for the workers are very one-sided and there are only limited possibilities for recovery, or whether an alternation of load situation, e.g. by other activities or long cycle times with different requirements, can occur and body regions subject to load situations can recover.

Since the indicators given in the table may arise in different combinations and with differing intensity a schematic assignment of the individual indicators to the rating points value by calculation would exceed the possibilities of the orientation analysis. The classification is therefore to be applied according to their effect on the physical load situation, especially with respect to the one-sidedness and the lack of recovery possibilities.





Rating points for the working conditions

Working conditions	Rating points
Good: reliable recognition of detail / no dazzle / good climatic conditions	0
Restricted: impaired detail recognition due to dazzle or excessively small details / draughts / cold / wet / disturbed concentration due to noise	1
<i>Features not mentioned in the table are to be taken into account accordingly. Under highly unfavourable conditions rating point 2 can be assigned.</i>	

The rating points for the working conditions are assigned on the basis of the indicators in the table. The working conditions that predominate in terms of time must be taken as a basis. The indicators given in the table serve as a classification aid. Since they can occur in different combinations and with differing intensity, a schematic assignment of the individual indicators to the rating points value by calculation would exceed the possibilities of the orientation analysis. The classification is therefore to be applied according to the effect on the physical load situation, especially if the performance of work is obstructed and the tension increases. The rating points 2 can be assigned if the conditions are particularly unfavourable.

Occasional or safety defects which are insignificant with regard to the physical load situation should not be considered here.

Rating points for posture

Posture ^{*)}	Rating points
 <p>Good: alternation of sitting and standing is possible / alternation of standing and walking / dynamic sitting is possible / hand-arm rest possible as required / no twisting / head posture variable / no gripping above shoulder height</p>	0
 <p>Restricted: trunk with slight inclination of the body towards the area of action / predominant sitting with occasional standing or walking / occasional gripping above shoulder height</p>	1
 <p>Unfavourable: trunk clearly inclined forward and/or twisted / head posture for detail recognition specified / restricted freedom of movement / exclusive standing without walking / frequent gripping above shoulder height / frequent gripping at a distance from the body</p>	3
 <p>Poor: trunk severely twisted and inclined forward / body posture strictly fixed / visual check of action through magnifying glasses or microscopes / severe inclination or twisting of the head / frequent bending / constant gripping above shoulder height / constant gripping at a distance from the body</p>	5
<p>^{*)} Typical postures are to be taken into account. Rare deviations can be ignored.</p>	

A rough overall estimation is conducted. For the purpose of classification the typical, longest enduring posture is taken as a basis. Occasional unfavourable postures are not considered. If indicators from two categories arise, e.g. "alternation of sitting and standing" and "frequent gripping at a distance from the body" the evaluation is to be interpolated between the rating points".

Evaluation

	Type of force exertion(s) in the finger-hand range			
+	Force transfer/gripping conditions			
+	Hand/arm position and movement			
+	Work organisation			
+	Working conditions			
+	Posture			
=	Total		X	Time rating points
			=	Risk score

Each sub-activity is evaluated on the basis of an **activity-related risk score**. This is calculated by adding the rating points for the key indicators and multiplying this with the time rating points.

Risk range ***)	Risk score	Description
1	<10	Low load situation, health risk from physical overload is unlikely to appear.
2	10 to <25	Moderate load situation, physical overload is possible for less resilient persons. For this group redesign of workplace is helpful.
3	25 to <50	Increased load situation, physical overload also possible for normally resilient persons. Redesign of workplace should be reviewed.
4	≥50	High load situation, physical overload is likely to appear. Workplace redesign is necessary.

The evaluation basis is the type and form of requirements imposed on the workers. The frequency, duration, force and posture on the one hand and the framework conditions on the other are taken into account. It basically applies that as the requirements become more rigorous, so the probability of a physical overload increases. High risk scores are an indication of a critical situation which increases the possibility of complaints.

A differentiated consideration of the individual rating points makes it possible to identify regions of the body which are under load. For example high rating points for the exertion of force due to frequent, high-force cutting is an indication of increased load on the lower-arm muscles and tendons and on the nerves in the wrist area. High rating points due to hammering is an indication of a mechanical damage of soft tissue. High rating points due to body posture is an indication of a possible overload of the trunk muscles and spine, especially in the area of the neck.

Design needs which can be concluded

From this risk estimation it is possible to identify immediately design needs and approaches. Basically the causes of high rating points should be eliminated as a first step.

Where there are **uncertainties in the evaluation** more extensive analyses are required. The perception of load and/or health disorders on the part of workers are important indicators of the workload.

More extensive indications and recommendations for action are available in:

Detailed Instructions for the Application of the Key Indicator Method Manual Handling Operations (KIM MO)

www.baua.de/leitmerkmalmethoden

Notes