

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	
<p>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.</p>							Left hand:		Right hand:		
Rating points of 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

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.

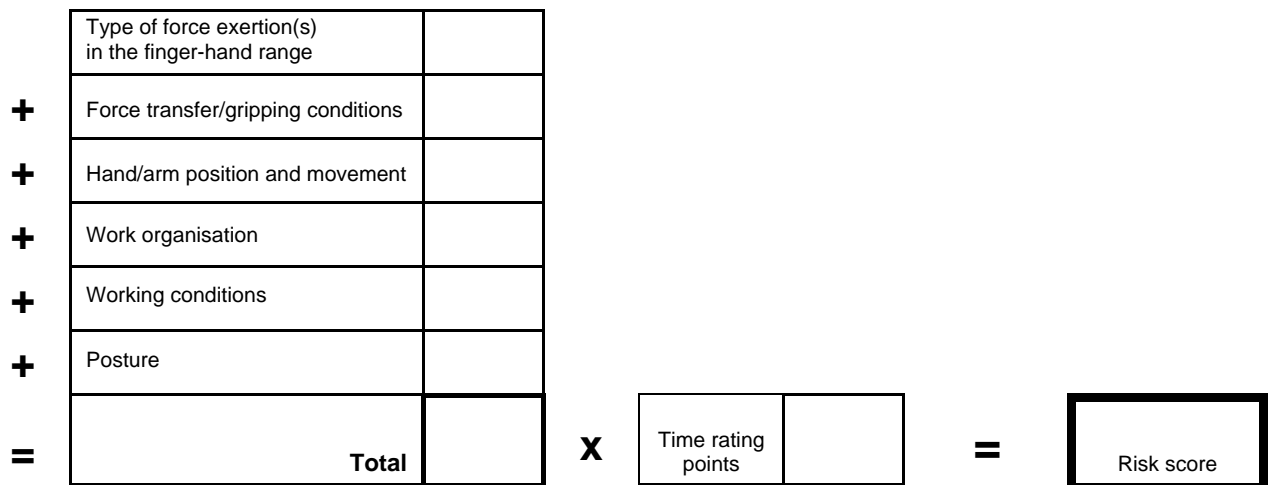
Work organisation	Rating points
Frequent variation of load situation due to other activities / a number of work operations / adequate opportunity for recuperation	0
Rare variation of load situation due to other activities / few work operations / recuperation times adequate	1
No/hardly any variation of 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
<i>Features not mentioned in the table are to be taken into account accordingly.</i>	

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 workload situations

Detailed 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

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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

Level	Description, typical examples	Holding		Moving		Rating points								
		average holding time (secs per minute)	average movement frequencies (number per minute)	60-31	30-15	15-4	<4	<1	1-4	5-15	16-30	31-60	>60	
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	High force e.g. pulling / pushing / packaging / grasping / holding or joining parts / pressing in / rolling Working with small powered hand tools	8	4	2	0.5	1	2	4	8	13				
	Very high force e.g. cutting involving major element of force / working with small force tools / moving or rolling parts or tools	12	6	3	1	1	3	6	12	21				
	Peak force e.g. loosening, loosening bolts / separating / pressing in	19	9	4	1	2	4	9	19	33				
high	Striking with ball of the thumb, palm of the hand or fist	-	-	-	1	1	3	6	12	21				

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
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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

Typical postures 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
Nonhardly 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

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Good: reliable recognition of detail / no dazzle / good climatic conditions		0
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Typical postures are to be taken into account. Rare deviations can be ignored.

Form LMM MA

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 range				
+ Force transfer/gripping conditions				
+ Hand/arm position and movement				
+ Work organisation				
+ Working conditions				
+ Posture				
=	Total		X	Time rating points
				= 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 <25	Moderate load situation, physical overload is possible for less resilient persons. For this group redesign of workplace is helpful.
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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 musculo-skeletal system increases.

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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.

The work is mostly performed while seated or standing with minor movements of the trunk and legs. Occasional walking, bending or overhead working is possible.

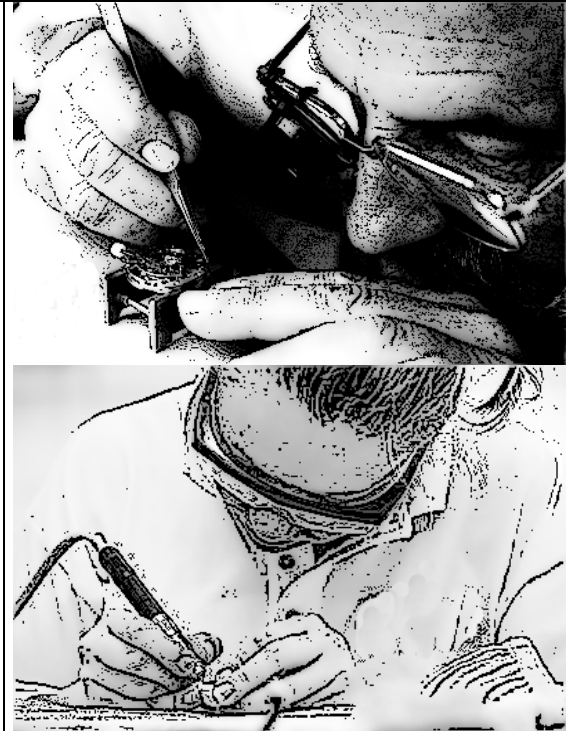
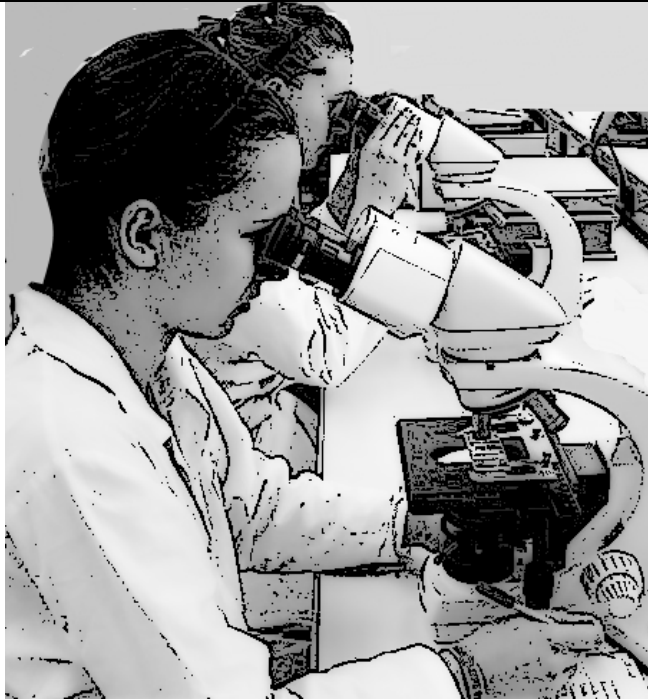
Basically manual work processes can be classified in terms of four categories. Each of these categories is characterised by typical requirement/load situation patterns.

Category A

Precision work involving high visual acuity requirements

Examples

- Goldsmith work
- Clock and clockwork assembly
- Manufacture of small medical devices
- Assembly of components for fibre optic technology
- Work on microscopes



Physical requirements and load situations

- Precision work involving very small action forces
- Work performed exclusively when seated
- Static load on the back, shoulders and the neck
- Tension due to high visual acuity requirements and concentration
- Lack of movement

Possibilities for prevention

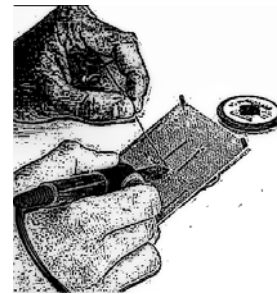
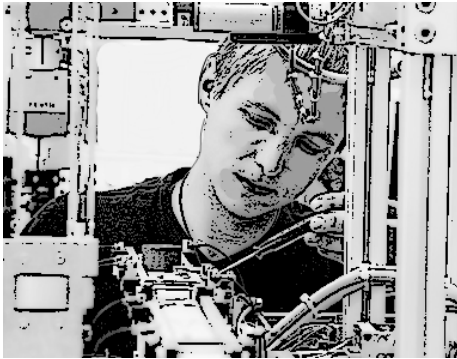
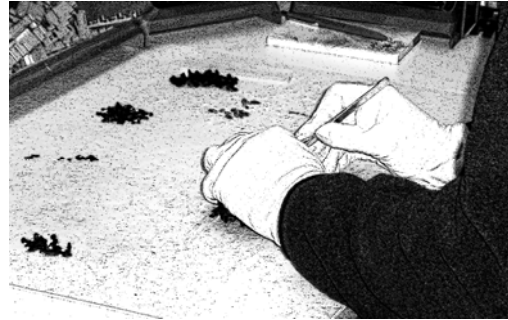
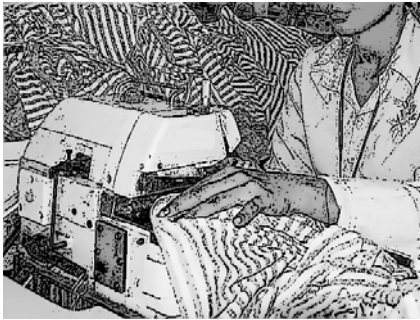
- Individual adaptation of the workplace
- Regular opportunities to move
- Optimum workplace lighting
- Arm rests

Category B

Fine motor work involving high visual acuity requirements

Examples

- Sewing work
- Assembly of small electrical devices, electronic plug-in connections
- Manual assembly of printed circuit boards
- Assembly of display and sensor systems



Physical requirements and load situations

- Precision work with small action forces
- Work performed almost entirely while seated
- Static load on the back, shoulders and the neck
- Static load on the arms due to unfavourable positions
- Lack of movement

Possibilities for prevention

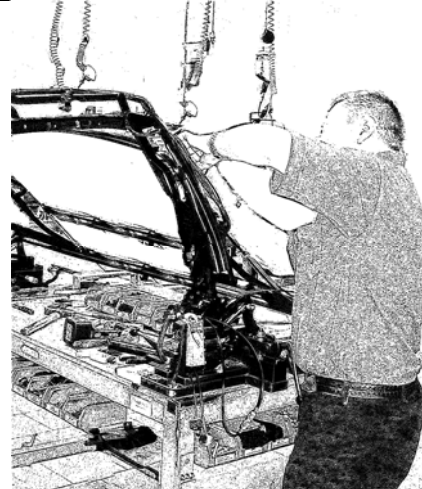
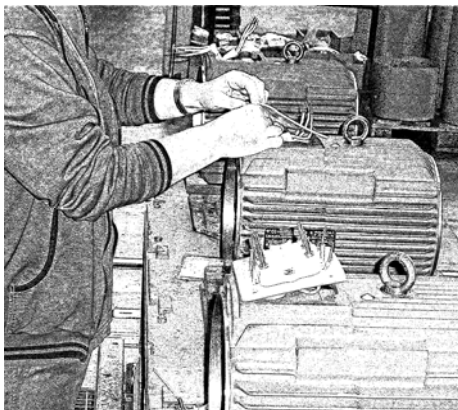
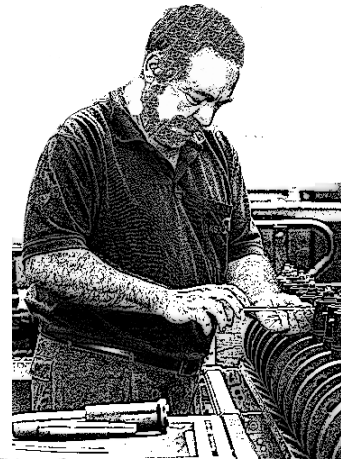
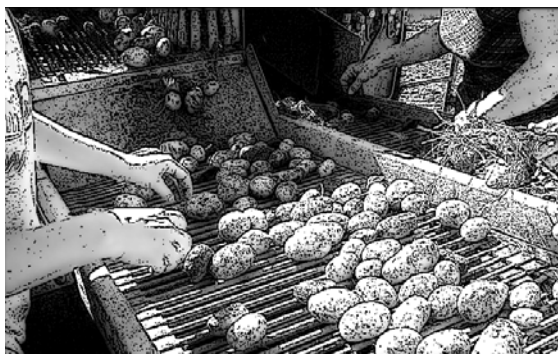
- Individual adaptation of the workplace
- Regular opportunities to move
- Optimum workplace lighting
- Systematic variation of activities to equalise the load situations

Category C

Work involving moderate force exertion and normal visual acuity requirements

Examples

- Manufacture of instrument fittings
- Manufacture of household appliances
- Assembly of hand drills
- Packaging of foodstuffs
- Work on sorting belts
- Production of pastries



Physical requirements and load situations

- Work involving small to moderate action forces
- Work performed mostly while standing
- Static load on legs and back due to standing
- Static load on the back and shoulders due to unfavourable arm positions
- Load on the hand-arm muscles due to repetitive force exertions

Possibilities for prevention

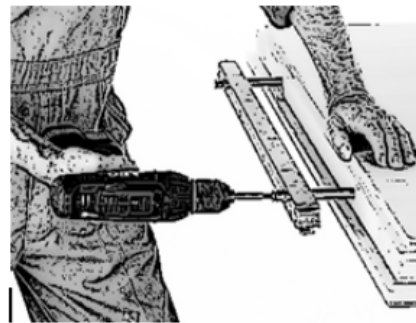
- Systematic variation of activities to equalise the load situation
- Optimisation of tools
- Optimisations of workplace dimensions

Category D

Work involving increased force exertion and normal visual acuity requirements

Examples

- Upholsterers, saddlers
- Screw connections involving high torques
- Gear assembly
- Meat cutting
- Furniture manufacture



Physical requirements and load situations

- Work involving moderate to great action forces in the finger, hand and/or arm area
- Work nearly always performed while standing
- Static load on legs and back due to standing
- Static load on the back and shoulders due to unfavourable arm positions
- Load on hand-arm muscles due to elevated action forces
- Additional load situations due to lifting, holding and carrying

Possibilities for prevention

- Systematic variation of activities to equalise load
- Optimisation of tools
- Optimisation of workplace dimensions

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

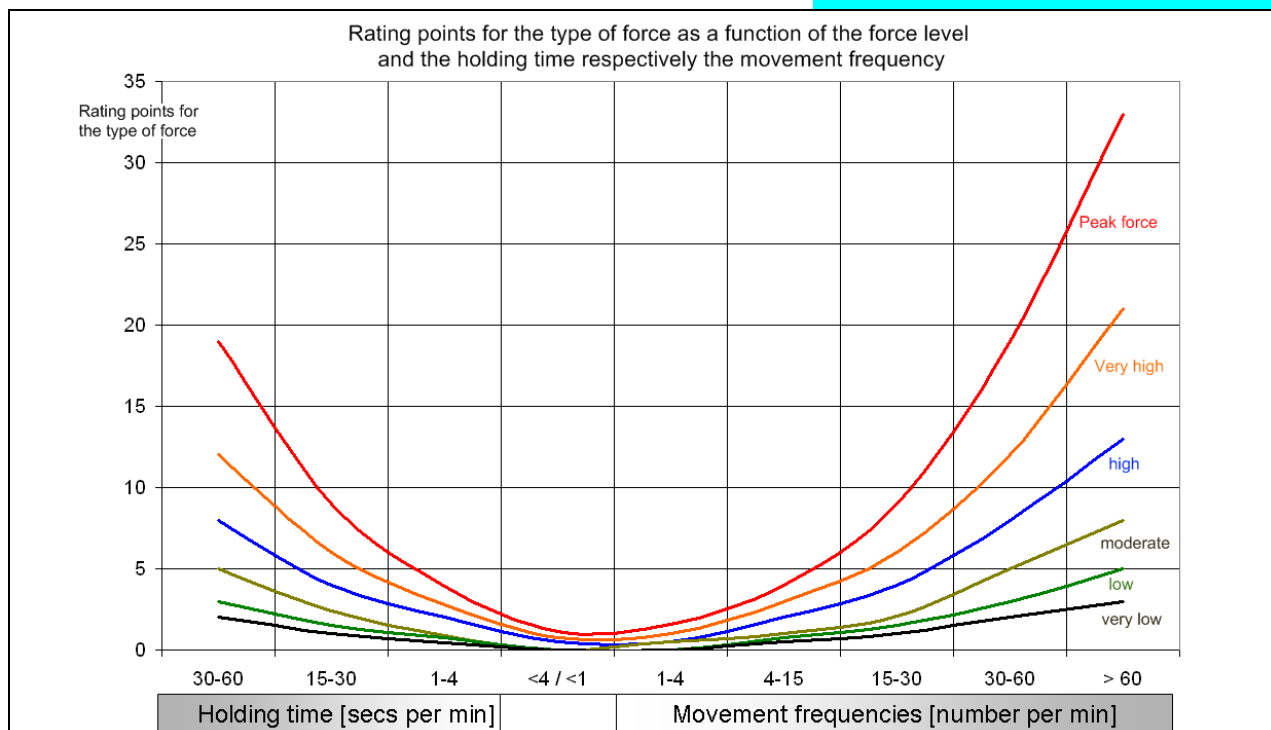
The time rating points are assigned on the basis of the table. The duration of the activity being assessed must be taken into account. Tooling times, distribution times and other jobs are not considered.

The total duration of the activity per shift is obtained from the duration and frequency of the work cycles analysed per shift.

Example 1: The work cycle under analysis consists of inserting a part in a machine and lasts in each case 6 seconds. This cycle is repeated 3000 times per shift. This means a total duration for the activity per shift of $3000 \times 6 \text{ s} = 5 \text{ hours}$. The time rating point is 3.

Examples 2: The work cycle under analysis consists of the complete assembly of a product and lasts in each case 5 minutes. This cycle is repeated 30 times per shift. This means a total duration for the activity per shift of $30 \times 5 \text{ min} = 2.5 \text{ hours}$. The (interpolated) time rating point is 1.75.

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
	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	
	High Hitting with ball of the thumb, palm of the hand or fist	-	-	-	1	1	3	6	12	21	
<p>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.</p>		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 for the left hand and the right hands in the time rating points table. The higher of the two values is to be used as the total rating point. Both the type of the force exertion (lines) and the frequency/duration (columns) are taken into account.

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.

In the column

<4	<1
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 rare and/or brief force exertions can be recorded. This is important for cycles which last substantially longer than 60 seconds.

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.

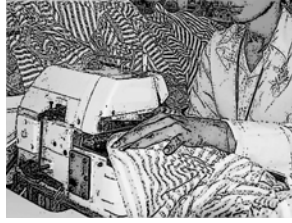
Reference examples for the assignment of rating points for force exertion

Category A Precision work involving high visual acuity requirements

	<p>Type of force exertion(s) in the finger-hand area</p> <table border="1"> <thead> <tr> <th>Level</th> <th>Description, typical examples</th> </tr> </thead> <tbody> <tr> <td>low</td> <td>Very low forces e.g. button actuation / shifting / ordering</td> </tr> <tr> <td></td> <td>Low forces e.g. material guidance / insertion</td> </tr> <tr> <td></td> <td>Moderate forces e.g. gripping / joining small work pieces by hand or with small tools</td> </tr> <tr> <td></td> <td>High forces e.g. turning / winding / packaging / grasping / holding or joining parts / pressing in / cutting / Working with small powered hand tools</td> </tr> <tr> <td></td> <td>Very high forces e.g. cutting involving major element of force / working with small staple guns / moving or holding parts or tools</td> </tr> <tr> <td></td> <td>Peak forces e.g. tightening, loosening bolts / separating / pressing in</td> </tr> <tr> <td>high</td> <td>Hitting with ball of the thumb, palm of the hand or fist</td> </tr> </tbody> </table> <p><i>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.</i></p>	Level	Description, typical examples	low	Very low forces e.g. button actuation / shifting / ordering		Low forces e.g. material guidance / insertion		Moderate forces e.g. gripping / joining small work pieces by hand or with small tools		High forces e.g. turning / winding / packaging / grasping / holding or joining parts / pressing in / cutting / Working with small powered hand tools		Very high forces e.g. cutting involving major element of force / working with small staple guns / moving or holding parts or tools		Peak forces e.g. tightening, loosening bolts / separating / pressing in	high	Hitting with ball of the thumb, palm of the hand or fist	<table border="1"> <thead> <tr> <th colspan="5">Holding</th> <th colspan="5">Moving</th> </tr> <tr> <th colspan="5">average holding time [secs per minute]</th> <th colspan="5">average movement frequencies [number per minute]</th> </tr> <tr> <th>60-31</th> <th>30-16</th> <th>15-4</th> <th><4</th> <th><1</th> <th>1-4</th> <th>5-15</th> <th>16-30</th> <th>31-60</th> <th>>60</th> </tr> </thead> <tbody> <tr> <td colspan="10" style="text-align: center;">Rating points</td> </tr> <tr> <td>2</td> <td>1</td> <td>0.5</td> <td>0</td> <td>0</td> <td>0.5</td> <td>1</td> <td>2</td> <td>3</td> <td></td> </tr> <tr> <td>3</td> <td>1.5</td> <td>1</td> <td>0</td> <td>0</td> <td>1</td> <td>1.5</td> <td>3</td> <td>5</td> <td></td> </tr> <tr> <td>5</td> <td>2</td> <td>1</td> <td>0</td> <td>0.5</td> <td>1</td> <td>2</td> <td>5</td> <td>8</td> <td></td> </tr> <tr> <td>8</td> <td>4</td> <td>2</td> <td>0.5</td> <td>1</td> <td>2</td> <td>4</td> <td>8</td> <td>13</td> <td></td> </tr> <tr> <td>12</td> <td>6</td> <td>3</td> <td>1</td> <td>1</td> <td>3</td> <td>6</td> <td>12</td> <td>21</td> <td></td> </tr> <tr> <td>19</td> <td>9</td> <td>4</td> <td>1</td> <td>2</td> <td>4</td> <td>9</td> <td>19</td> <td>33</td> <td></td> </tr> <tr> <td>-</td> <td>-</td> <td>-</td> <td>1</td> <td>1</td> <td>3</td> <td>6</td> <td>12</td> <td>21</td> <td></td> </tr> </tbody> </table> <p>Rating points of force exertion:</p> <table border="1"> <tr> <td>Left hand:</td> <td>Right hand:</td> </tr> <tr> <td>0,5</td> <td>0,5</td> </tr> </table>	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										2	1	0.5	0	0	0.5	1	2	3		3	1.5	1	0	0	1	1.5	3	5		5	2	1	0	0.5	1	2	5	8		8	4	2	0.5	1	2	4	8	13		12	6	3	1	1	3	6	12	21		19	9	4	1	2	4	9	19	33		-	-	-	1	1	3	6	12	21		Left hand:	Right hand:	0,5	0,5
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Category B

Fine motor work involving high visual acuity requirements



Type of force exertion(s) in the finger-hand area

Level	Description, typical examples
low	Very low forces e.g. button actuation / shifting / ordering
	Low forces e.g. material guidance / insertion
	Moderate forces e.g. gripping / joining small work pieces by hand or with small tools
	High forces e.g. turning / winding / packaging / grasping / holding or joining parts / pressing in / cutting/ Working with small powered hand tools
	Very high forces e.g. cutting involving major element of force / working with small staple guns / moving or holding parts or tools
	Peak forces e.g. tightening, loosening bolts / separating / pressing in
high	Hitting with ball of the thumb, palm of the hand or fist

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.

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									
2	1	0.5	0	0	0.5	1	2	3	
3	1.5	1	0	0	1	1.5	3	5	
5	2	1	0	0.5	1	2	5	8	
8	4	2	0.5	1	2	4	8	13	
12	6	3	1	1	3	6	12	21	
19	9	4	1	2	4	9	19	33	
-	-	-	1	1	3	6	12	21	
Rating points of force exertion:						Left hand:	Right hand:		
						3	3		

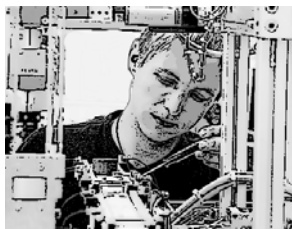


Type of force exertion(s) in the finger-hand area

Level	Description, typical examples
low	Very low forces e.g. button actuation / shifting / ordering
	Low forces e.g. material guidance / insertion
	Moderate forces e.g. gripping / joining small work pieces by hand or with small tools
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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									
2	1	0.5	0	0	0.5	1	2	3	
3	1.5	1	0	0	1	1.5	3	5	
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8	4	2	0.5	1	2	4	8	13	
12	6	3	1	1	3	6	12	21	
19	9	4	1	2	4	9	19	33	
-	-	-	1	1	3	6	12	21	
Rating points of force exertion:						Left hand:	Right hand:		
						1,5	2,5		



Type of force exertion(s) in the finger-hand area

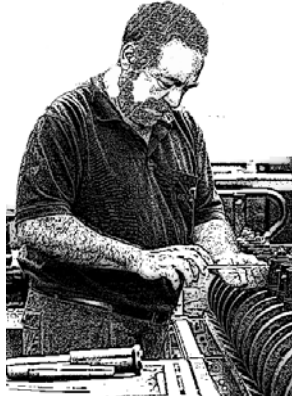
Level	Description, typical examples
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high	Hitting with ball of the thumb, palm of the hand or fist

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.

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									
2	1	0.5	0	0	0.5	1	2	3	
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19	9	4	1	2	4	9	19	33	
-	-	-	1	1	3	6	12	21	
Rating points of force exertion:						Left hand:	Right hand:		
						2,5	3		

Category C

Work involving moderate force exertion and normal visual acuity requirements

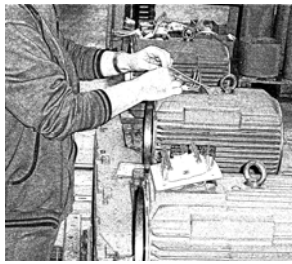


Type of force exertion(s) in the finger-hand area	
Level	Description, typical examples
low	Very low forces e.g. button actuation / shifting / ordering
	Low forces e.g. material guidance / insertion
	Moderate forces e.g. gripping / joining small work pieces by hand or with small tools
	High forces e.g. turning / winding / packaging / grasping / holding or joining parts / pressing in / cutting/ Working with small powered hand tools
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	Peak forces e.g. tightening, loosening bolts / separating / pressing in
high	Hitting with ball of the thumb, palm of the hand or fist

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.

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									
2	1	0.5	0	0	0.5	1	2	3	
3	1.5	1	0	0	1	1.5	3	5	
5	2	1	0	0.5	1	2	5	8	
8	4	2	0.5	1	2	4	8	13	
12	6	3	1	1	3	6	12	21	
19	9	4	1	2	4	9	19	33	
-	-	-	1	1	3	6	12	21	

Rating points of force exertion: Left hand: 4, Right hand: 6



Type of force exertion(s) in the finger-hand area	
Level	Description, typical examples
low	Very low forces e.g. button actuation / shifting / ordering
	Low forces e.g. material guidance / insertion
	Moderate forces e.g. gripping / joining small work pieces by hand or with small tools
	High forces e.g. turning / winding / packaging / grasping / holding or joining parts / pressing in / cutting/ Working with small powered hand tools
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	Peak forces e.g. tightening, loosening bolts / separating / pressing in
high	Hitting with ball of the thumb, palm of the hand or fist

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.

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									
2	1	0.5	0	0	0.5	1	2	3	
3	1.5	1	0	0	1	1.5	3	5	
5	2	1	0	0.5	1	2	5	8	
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12	6	3	1	1	3	6	12	21	
19	9	4	1	2	4	9	19	33	
-	-	-	1	1	3	6	12	21	

Rating points of force exertion: Left hand: 3, Right hand: 3



Type of force exertion(s) in the finger-hand area	
Level	Description, typical examples
low	Very low forces e.g. button actuation / shifting / ordering
	Low forces e.g. material guidance / insertion
	Moderate forces e.g. gripping / joining small work pieces by hand or with small tools
	High forces e.g. turning / winding / packaging / grasping / holding or joining parts / pressing in / cutting/ Working with small powered hand tools
	Very high forces e.g. cutting involving major element of force / working with small staple guns / moving or holding parts or tools
	Peak forces e.g. tightening, loosening bolts / separating / pressing in
high	Hitting with ball of the thumb, palm of the hand or fist

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.

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									
2	1	0.5	0	0	0.5	1	2	3	
3	1.5	1	0	0	1	1.5	3	5	
5	2	1	0	0.5	1	2	5	8	
8	4	2	0.5	1	2	4	8	13	
12	6	3	1	1	3	6	12	21	
19	9	4	1	2	4	9	19	33	
-	-	-	1	1	3	6	12	21	

Rating points of force exertion: Left hand: 5, Right hand: 5



Type of force exertion(s) in the finger-hand area	
Level	Description, typical examples
low	Very low forces e.g. button actuation / shifting / ordering
	Low forces e.g. material guidance / insertion
	Moderate forces e.g. gripping / joining small work pieces by hand or with small tools
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high	Hitting with ball of the thumb, palm of the hand or fist

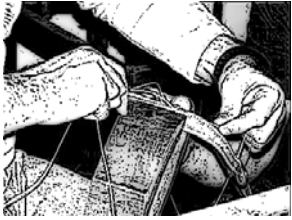
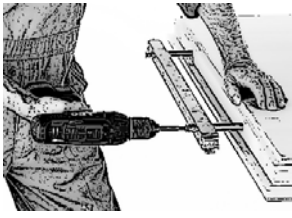

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Holding		Moving							
average holding time [secs per minute]		average movement frequencies [number per minute]							
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12	6	3	1	1	3	6	12	21	
19	9	4	1	2	4	9	19	33	
-	-	-	1	1	3	6	12	21	

Rating points of force exertion: Left hand: 5, Right hand: 4,5

Category D

Work involving increased force exertion and normal visual acuity requirements

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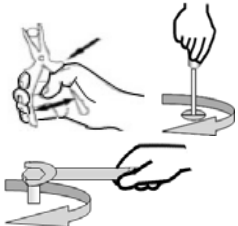



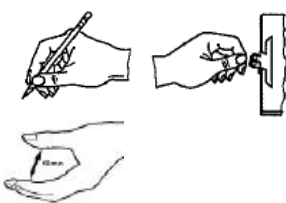
Rating points for force transfer / gripping conditions



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 indicator "force exertion" covered the level of action force and the indicator "force transfer/gripping conditions" covers the type of force transfer and additional forces. The following are important here:

- the relationship of the type of handle to the action force required,
- the type of force transfer by way of positive form locking or traction and
- the object surfaces.

The table below indicates the rating points for a number of possible combinations.




Type of handle, force transfer	Design of tool handle, contact points, objects	Gripping surface			
		dry, non-slip	dry, very smooth	moist	slippery
Power grip 	Well shaped ^{*)} , optimum size	0	1	2	3
	Not shaped	1	2	3	3
	Too big, too small	2	3	4	4
Contact grip 	Well shaped, optimum size	0	1	2	3
	Not shaped	1	2	3	3
	Too small	2	3	4	4
Palm grip 	Well shaped, optimum size	0	1	2	3
	Not shaped	2	3	4	4
Hook grip 	Well shaped, optimum size	0	0	1	2
	Not shaped	1	2	3	4
Pinch grip 	Well shaped, optimum size	0	1	2	3
	Not shaped	1	2	3	4
	Too small	2	3	4	4

Type of handle, force transfer	Design of tool handle, contact points, objects	Gripping surface			
		dry, non-slip	dry, very smooth	moist	slippery
Force transfer by traction 	Optimum size	1	2	3	4
	Too small	2	3	4	4
Object too small or too big 	Well shaped	1	2	3	4
	Not shaped	2	3	4	4

*) Well-shaped handles have a profile, are adapted to the shape of the hand and/or have gripping grooves.

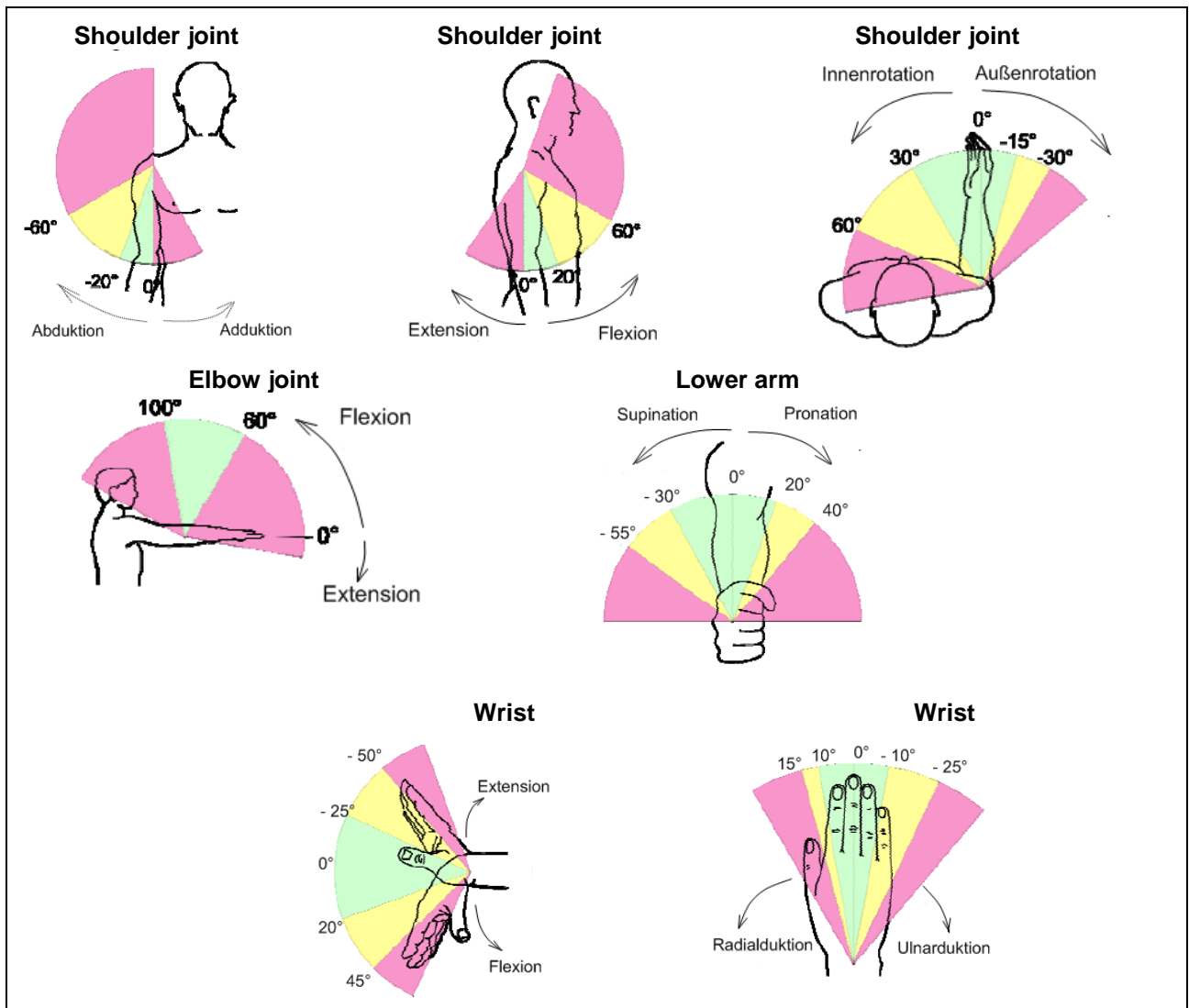


Rating points for the hand/arm position and movement

Hand/arm position and movement *)		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

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

The indicator "hand/arm position and movement" takes account of the load on the finger, hand, elbow and shoulder joints. Consideration must be given to the combination of frequency/duration and joint position. An exact determination of the joint load is only possible using laborious movement analyses. Attention must therefore be paid in the key indicator method to clearly evident deviations from the middle position. These are shown in red in the following figures.



Figures from "Evaluation of the risk factor of unfavourable postures and movements", extract from the Report 2/2007 of the Institute for Occupational Safety and Health of the German Social Accident Insurance.

In the form details can be documented. In view of the large number of joints involved which can move independently of one another, a separate point rating of the joints in the hand-arm area is not possible. A general overall estimation is therefore conducted.

Hand/arm position and movement ^{*)}		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
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^{*)} Typical positions are to be considered. Rare deviations can be ignored.

Example for completed form

Rating points for the 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 indicator "work organisation" takes into account in particular the risk of excessive muscular fatigue due to

- one-sided, identical load situation pattern,
- high work rate and
- inadequate breaks.

The consequences in the hand/arm area may be loss of force, irritation of the tendon and entheses, which lead in the long term to ailments if there is insufficient recuperation.

In the shoulder-nape and lumbar spine area muscular tension may develop from enduring static postures and lack of movement. Fatigue at the end of work is no problem, but it should have subsided overnight. The prime question here is whether the load situations are very one-sided for the workers and only very restricted possibilities for recuperation exist, and whether a variation of the load situation, e.g. through different activities or long cycle times with differing requirements, occurs and body regions subject to load situations can recuperate.

When classifying, the criteria given in the table must be rated in their combination.

Classification instructions

- Work design conducted according to the ergonomic based industrial engineering procedures could basically be point rated as 0 since the requisite recuperation times have been considered here. But where relevant higher piece-work rates must be considered, which may yield different rating points.
- Where there are linked workplaces it is hardly possible to synchronise them all evenly. There will therefore be workplaces with differing intensity and hence different rating points. With a corresponding change of the load situation (rotation) a summarised point rating is applied by the formation of average values.

In the form details can be documented. Summarised point rating is applied.

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>	

Example of completed form

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 indicator "working conditions" covers interfering factors in the performance of work. The points of reference here are

- restricted visual conditions,
- cold, draughts, wet and
- interfering noises.

Restricted visual conditions may lead to unfavourable postures with small objects. Inadequate lighting is compensated for by a reduced seeing distance and dazzle by different head positions. Both leads to unfavourable head positions with additional load on the muscles in the nape of the neck.

Cold, draughts and wet can lead to partial cooling and hence to a reduced co-ordination of movements and additional load on the joints.





Interfering noises (not to be mistaken for noise impact) may in particular lead to muscular tension in the shoulder-nape area, especially with high concentration requirements.

In the form details can be documented. A summarised point rating is applied.

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>	

Example of completed form

Rating points for posture

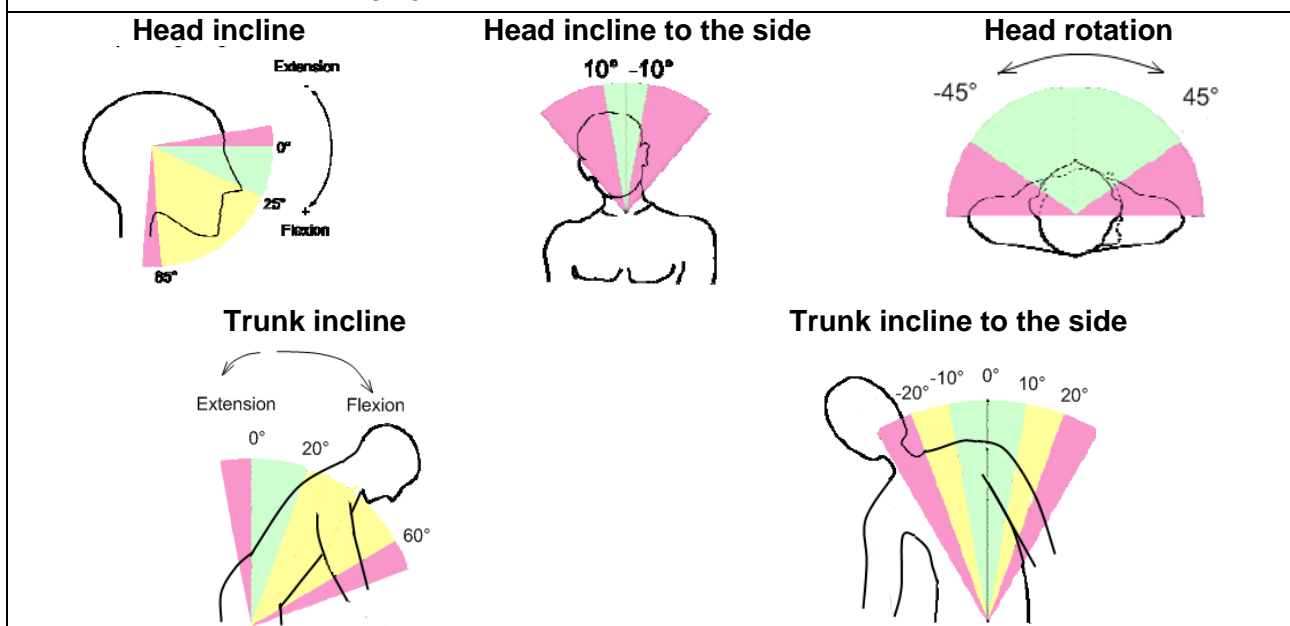
Posture ^{**)}	Rating points
 <p>Good: alternation of sitting and standing is possible / alternation of standing and walking / dynamic sitting is possible / hand-arm rest possible as required / no twisting / head posture variable / no gripping above shoulder height</p>	0
 <p>Restricted: trunk with slight 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

^{**)} Typical postures are to be taken into account. Rare deviations can be ignored.

The indicator "posture" covers the load on the nape of the neck, back and legs. The reference points are





- restricted possibilities for movement,
- work with static posture of the trunk and shoulder-nape muscles,
- unfavourable joint positions and
- standing for an extended period.

Exact determination of the posture is only possible by movement analyses. Attention is therefore paid in the key indicator method to clearly evident deviations from the middle position. These are shown in red in the following figures.



Figures from "Evaluation of the risk factor of unfavourable postures and movements", extract from the Report 2/2007 of the Institute for Occupational Safety and Health of the German Social Accident Insurance.

In the form details can be documented. In view of the large number of joints involved which can move independently of one another, a separate point rating of the joints in the hand-arm area is not possible. A general overall estimation is therefore conducted.

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.

Example of completed form

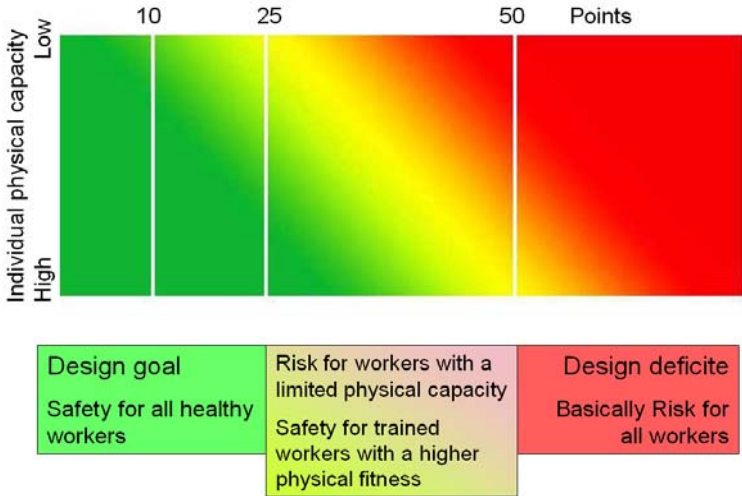
Evaluation

The evaluation is conducted on the basis of an **activity-related risk score**. This is calculated by adding the rating points for the key indicators and multiplying the result by the time rating points.

	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

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.



Using the MIM MO form the probability of physical overload is evaluated.

It is assumed here that if the 25-risk score limit is adhered to, the activity can be carried out by all workers without any risk of physical overload. For trained and physically more resilient persons it is acceptable to exceed the 25-risk score limit. Above 50 risk scores, however, there is for all workers a risk of physical overload which can be expected to have consequences for the health. The limits of 25 and 50 risk scores are to be regarded as an orientation.

Special account must be taken in this risk scores range of individual resilience. It depends on the sex, age and occupational experience. A differentiated prediction of individual resilience is not possible. Basically, however, it can be assumed that with increasing age physical strength will decline, that women will have about half the manual strength of men and that people with occupational experience will cope better with the requirements. Nevertheless the considerable spans of the differences in performance must be considered. There are women who have greater manual strength than men, there are older persons who perform better than young ones and there are persons with occupational experience who are unskilful in their work.

The basis for the evaluation is the type and form of the requirements imposed on workers. Frequency, duration, force and posture are considered as are the framework conditions. Basically it is a fact that as requirements become more rigorous the probability of physical overload will increase. High risk scores indicate a critical situation which increases the possibility of ailments developing. Differentiated consideration of the individual rating points makes it possible to identify body regions subject to load. For example, high rating points for force exertion due to frequent, high-force cutting indicate 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 for body posture indicate possible overload of the trunk muscles and spine, especially in the nape area.

Design needs which can be concluded from this

This risk estimation immediately makes evident 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.

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