KTH Teknik och hälsa

User guide for the assessment tool RAMP II

Risk **A**ssessment and **M**anagement tool for manual handling **P**roactively

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Revised version after Linda Rose (2014, KTH STH)

Foreword

This user guide has been prepared by Carl Lind, PhD student at KTH Royal Institute of Technology, School of Technology and Health, Unit of Ergonomics. The text is partly based on a draft by Linda Rose (Rose, 2014).

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Introduction - general presentation of the RAMP tool

The RAMP tool is a risk management tool targeted at physical ergonomic risks related to manual handling in the manufacturing and logistics industries. It consists of two assessment methods (RAMP I, II and RAMP), a results module and an action module (Figure 1).

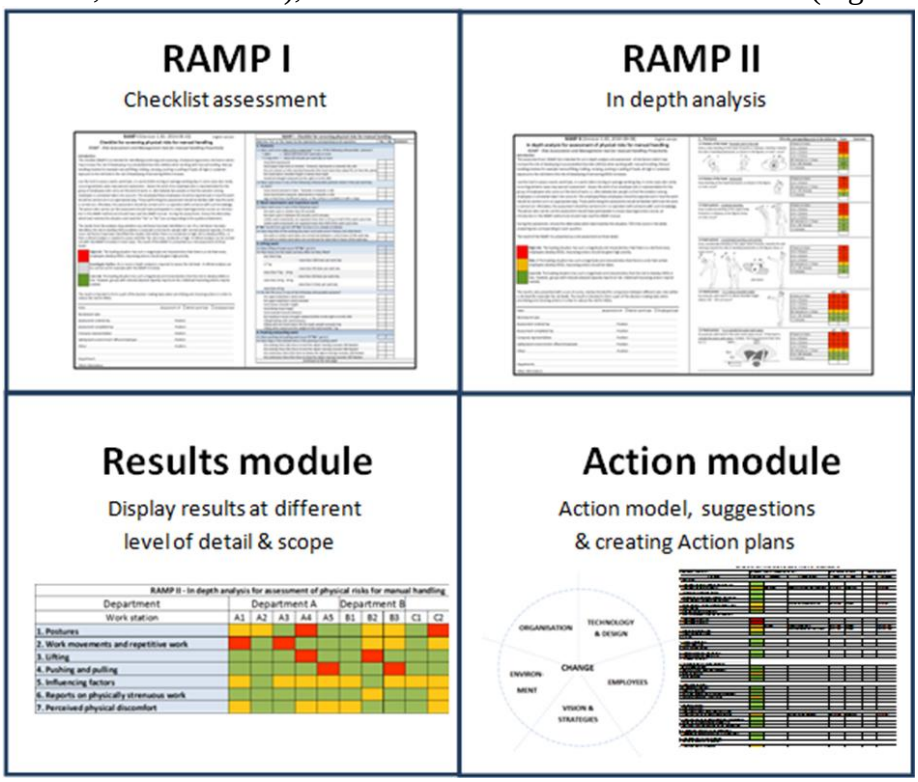


Figure 1: Schematic illustration of the four modules: RAMP I, RAMP II, Results Module and Action Module.

The RAMP I module is designed for identifying and assessing risk factors at work that involves manual handling and which can increase the risk of musculoskeletal disorders. It is' a checklist where the assessor chooses "Yes" and "No" options when answering questions about seven areas: 1. Postures, 2. Work movements and repetitive work, 3. Lifting work, 4. Pushing and pulling work, 5. Influencing factors, 6. Reports of physically strenuous work, and 7. Perceived physical discomfort. It is intended to be used to screen for the risk of developing musculoskeletal disorders and requires no expert knowledge in ergonomics. In order to use the method in an appropriate way, however, it is recommended that those doing the analysis have undergone basic training in ergonomics, completed an introduction to the RAMP method.

The RAMP II module is designed for a more in-depth assessment (compared with RAMP I) of risk factors at work which involves manual handling. RAMP II allows an in-depth analysis of several risk factors included in *RAMP I* and is divided into the same seven areas as *RAMP I*. In order to make an analysis using RAMP II, the assessor should have more advanced knowledge than is recommended for RAMP I. In addition, the assessor should have been trained in the RAMP method and read the RAMP II manual (i.e. this manual).

The Results module is designed to communicate the results of the RAMP analysis. This can be done at several levels of detail: a detailed level where all assessed risk factors are recognized, a danger zone level where risks are reported for the 7 above mentioned risk areas, and a general level where only the number of green, gray / yellow and red are presented. The

results can also be presented with various degrees - from covering a single or several workstations, a department or a whole organization.

The Action Module is designed to support the improvement process and consists of three parts:

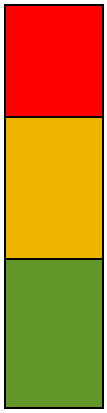
i) an *Action Model* which provides support for the development within the company of suggestions for actions. This can be used by the company as a means to develop suggestions for action. In the model it is proposed that those working with suggestion-development prepare suggestions for action within five areas: Technology & Design, Organization, Employees, Vision and Strategies, and Environment.

ii) an *Action Suggestions* part generated by the RAMP tool based on the specific case assessed. For the risk factors assessed as red in the RAMP I, or as yellow or red in RAMP II, this part of the Action Module provides automatic suggestions for possible action in the above-mentioned five areas.

iii) a structure for the development of an *Action Plan*. This shows the results of a completed assessment at a detailed level, and provides a template for structured development of an Action Plan. This includes the actions planned, when they will be implemented, who is responsible for them, when they will be completed and when a follow-up is scheduled, filled in a template.

RAMP II - Results

The result of an assessment is presented at three risk/action-levels:



High risk. The loading situation has such a magnitude and characteristics that many employees are at an increased risk of developing musculoskeletal disorders. Improvement measures should be given high priority.

Risk. The loading situation is of such a magnitude and characteristic that certain employees are at an increased risk of developing musculoskeletal disorders. Improvement measures should be taken.

Low risk. The loading situation is of such a magnitude and characteristic that most employees are at a low risk of developing musculoskeletal disorders. However, individuals with reduced physical capacity may be at risk. Individually tailored improvement measures may be needed.

The main result of the RAMP II is the assessment of risk/action-levels (green, yellow, red). As a complement, and in order to compare different assessments, the RAMP II risk assessment also displays a scoring system. The score can be used for comparisons before and after an intervention has been carried out. The score is more sensitive than the risk level and can detect smaller changes (i.e. the duration). Note that the scoring system is subordinate to the risk/action-level.

How to perform an assessment using RAMP II

This tool can be used to assess a job, work task, or a work station during an average work day. In some cases, rarely occurring extreme cases may warrant assessment. Assessment of the work of an employee who is representative for the group of employees who carry out this kind of work, or, alternatively two people, allows for the variation among employees to be somewhat taken into account. This employee/these employees should be experienced in how the work should be carried out in an appropriate way (this type of "ideal" situation shows the potential for an employee who is working with the proper work technique and not necessarily those risks related to the common work technique). Those performing the assessment should

be familiar with how the work is carried out. Otherwise, the assessment should be carried out in co-operation with someone with such knowledge.

Recommended procedure when conducting an assessment using RAMP II:

1. Fill in the details of the case to be assessed (Figure 2). It includes the date of the assessment, who ordered and conducted the assessment, if the assessment applies to a job, work task or an employee's work load.
2. Assess risk factors at work (or worker's load) under RAMP, see Chapter 1.1-7.2.
3. Fill in the outcome of the assessment of the performance (Appendix 2).

Date:_____ Assessment of: ☐ Work/ work task ☐ Employee load

Work/work task: _____

Assessment ordered by: _____ Position_____

Assessment completed by: _____ Position_____

Company representative: _____ Position_____

Safety/work environment officer/employee:_____ Position_____

Other:_____ Position_____

_____

Department:_____

Other information:_____

Figure 2. Background information about the work

How to choose the color and the score on the assessments in the RAMP II?

In the assessment, the option that best fits the situation can be selected. The score is entered into the box that accompanies each question. This score is linked to a risk level (green, yellow and red). Notes regarding the case can be specified in the comments field.

Limitations

The RAMP tool is primarily intended for assessment of ergonomic risks in manual handling (of physical objects, i.e. not patient transfers) with high physical load. The main focus is on reducing the physical load. However, several occupations with low physical loads may benefit from a temporary increase in physical load, primarily via the introduction of more variation. Generally, these types of jobs are outside the scope of the RAMP tool. RAMP II is intended to be one part of an assessment but should also be complemented with expert judgments, interviews and possibly other assessment tools. Several potential risks are not included in the tool e.g. carrying of loads, climbing stairs/ladders or jumping down from heights. The same goes for work requiring high precision, manual handling with limited space (e.g. a low ceiling), use of protective equipment that hinders the work, monotonous work (mentally) or where social support is perceived as low. However, these and other factors may in part be captured in section 7 (Perceived physical discomfort). The assessments of postures are intended for postures without support. Even if support exists, the load due to a bent posture may still result in increased load (Damecour et al., 2010) which may affect the risk of musculoskeletal disorders. These and similar cases require expert judgment. The RAMP method offers no guidance for how these situations should be assessed; the same applies for one-handed lifting using the other hand as support. The RAMP method is intended primarily for the assessment of standing work, which may result in that some factors, i.e. rotation of the trunk, should be judged more conservatively than if the employee is sitting down. Expert

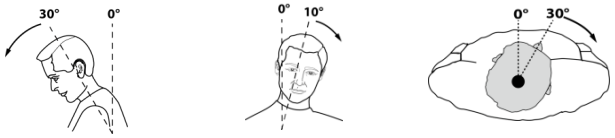
assessment is also recommended if the employee, for example, wears a helmet. The extra load on the neck caused by the helmet is not captured through the RAMP method. The same goes for a static and strongly flexed (loaded) posture without support. Generally, these risks are not well covered by the RAMP tool and may involve physical discomfort or pain after relatively short periods (Harms-Ringdahl and Ekholm, 1986).

Checkpoints

1. Postures

1.1 Posture of the head - forwards and to the side

1. Postures	Fill in the corresponding score in the white box	Score:	Comment:
1.1 Posture of the head - forwards and to the side Does a clear bending of the head forwards or to the side, or twisting to the side occur, as shown in the figures, or more?	4 hours or more	7	
	3 to < 4 hours	5	
	2 to < 3 hours	3	
	1 to < 2 hours	2	
	30 minutes to < 1 hour	1	
	5 to < 30 minutes	0,5	
	< 5 minutes	0	



Assessment

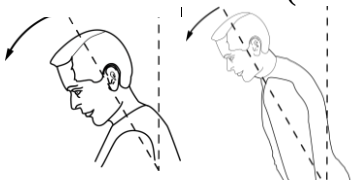
Assess the total time (per workday) that the head (neck) is in a non-neutral posture corresponding to the extent shown in the figures or greater.

Example 1.1a: A person works with his head twisted to one side (30°) for 20 minutes and later that day with his head bent forward (40°) for 20 minutes. In this example, the durations should be summed (20 + 20 minutes = 40 minutes). Enter "1" in the white response box to indicate a low risk level (green color code).

Example 1.1b: A person works with his head twisted to one side (30°) for 20 minutes and at the same time bends his head forward (40°). The total duration in this example is 20 minutes (or 0.5 points, green)

Comment

- Bending or inclining refers to the vertical line of gravity.
- Inclination should (here) be assessed as bending. This means that the head is usually inclined when the trunk is bent forward (see image below).



Other: The duration should be further reduced in the instance of external loads (i.e. use of helmets). Expert judgment is recommended.

1. Postures

1.2 Posture of the head - backwards

1.2 Posture of the head - backwards Does bending of the head backwards occur, as shown in the figure, or more?	2 hours or more	10	
	1 to < 2 hours	6	
	30 minutes to < 1 hour	3	
	5 to < 30 minutes	1,5	
	< 5 minutes	0	

Assessment

Assess the total time (per workday) that the head (neck) is in bent backwards corresponding to the figure or greater.

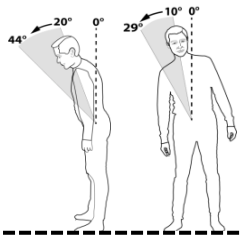
Comment

Other: The duration should be further reduced in the instance of external loads (i.e. use of helmets). Expert judgment is recommended.

1. Postures

1.3 Back posture - moderate bending

1.3 Back posture - moderate bending
Does moderate bending of the upper body forwards or to the side occur, as shown in the figures, or more?



4 hours or more	7
3 to < 4 hours	5
2 to < 3 hours	3
1 to < 2 hours	2
30 minutes to < 1 hour	1
5 to < 30 minutes	0
< 5 minutes	0

Assessment
Assess the total time (per workday) that the trunk is in a non-neutral posture corresponding to the extent shown in the figures or greater.

Comment

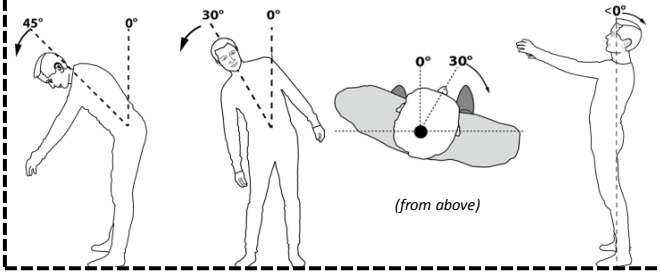
- Calculate the total duration according to the same principle as in Example 1.1.
- Bending or inclining refers to the vertical line of gravity.

Other: The assessment relates to duration without support.

1. Postures

1.4 Back posture - considerable bending and twisting

1.4 Back posture - considerable bending and twisting
Does considerable bending of the upper body forwards or to the side, twisting or bending backwards occur, as shown in the figures, or more?



4 hours or more	10
3 to < 4 hours	7
2 to < 3 hours	5
1 to < 2 hours	3
30 minutes to < 1 hour	2
5 to < 30 minutes	1
< 5 minutes	0

Assessment
Assess the total time (per workday) that the trunk is in a non-neutral posture corresponding to the extent shown in the figures or greater.

Comment

- Calculate the total duration according to the same principle as in Example 1.1.
- Bending or inclining refers to the vertical line of gravity.

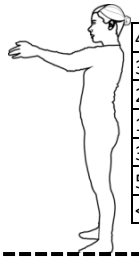
Other: The assessment relates to duration without support.

1. Postures

1.5 Upper arm posture - hand in or above shoulder height

1.5 Upper arm posture - hand in or above shoulder height

Is work perfomed with the hand at or above shoulder height? (about 130 - 150 cm)



	Left	Right
4 hours or more	10	10
3 to < 4 hours	7	7
2 to < 3 hours	5	5
1 to < 2 hours	3	3
30 minutes to < 1 hour	2	2
5 to < 30 minutes	1	1
< 5 minutes	0	0

Assessment

Assess the total time (per workday) that the hand (or arm) is at or above shoulder height.

Comment

- The assessment refers to loading to the shoulder and neck.
- The assessment refers to the arm that receives the highest load. If you are unsure which arm this is, assess both arms. When summarizing the Risk Scores, only the arm with the highest score is used.
- The assessment relates to the total time the hand, forearm or upper arm is at or above shoulder height.

Other: The assessment relates to duration without support.

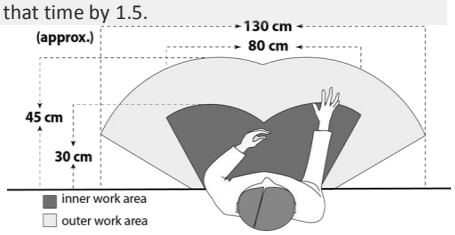
1. Postures

1.6 Upper arm posture - hand in or outside the outer work area

1.6 Upper arm posture - hand in or outside the outer work area

Is work perfomed with the hand in the outer work area?

If the hand is outside the outer work area (white area), multiply the time-points for that time by 1.5.



	Left	Right
4 hours or more	10	10
3 to < 4 hours	7	7
2 to < 3 hours	5	5
1 to < 2 hours	3	3
30 minutes to < 1 hour	2	2
5 to < 30 minutes	1	1
< 5 minutes	0	0

Assessment

Assess the total time (per workday) that the hand (or upper arm) is outside the inner work area. If the hand (or upper arm) is located first in the outer work area and then outside the outer work area the duration of these should be added (see example below). The duration when the hand (or upper arm) is outside the outer work area (white area) should be multiplied by 1.5.

Comment

- The assessment refers to loading to the shoulder and neck (due to upper arm flexion or abduction).
- The assessment refers to the arm that receives the highest load (highest score). If you are unsure which arm this is, assess both arms. When summarizing the Risk Scores, only the arm with the highest score is used.

Example 1.6a: The right hand is held for 45 minutes in the outer work area (2 points, yellow).

Example 1.6b: The right hand is held for 45 minutes in the outer work area and then for 20 minutes outside the outer work area (white area). Calculate the duration as: 45 minutes + 1.5 * 20 minutes = 45 + 30 = 75 minutes (3 points, red).

Comment

- Outer work area = approximately equal to forearm grip distance (forward), see Appendix 3.
- Outside outer work area = approximately equal to ¾ arm grip distance (forward), see Appendix 3.
- The distances shown in the figure are approximate.

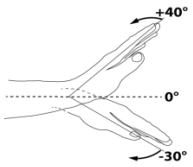
Other: The assessment refers to postures without support.

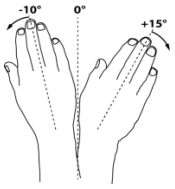
1. Postures

1.7 Wrist posture

1.7 Wrist posture

Is work performed with clearly bent wrist, as shown in the figures, or more?





	Left	Right
4 hours or more	7	7
3 to < 4 hours	5	5
2 to < 3 hours	3	3
1 to < 2 hours	2	2
30 minutes to < 1 hour	1	1
5 to < 30 minutes	0	0
< 5 minutes	0	0

Assessment

Assess the total time (per workday) that the wrist is in a bent posture corresponding to the extent shown in the figures or greater.

Comment

- Sum the times with a bent wrist according to the same principle as in example 1.1.
- The assessment refers to the hand that has the highest score. If you are unsure which hand this is, assess both hands. When summing the Risk Scores, only the hand with the highest score is used.

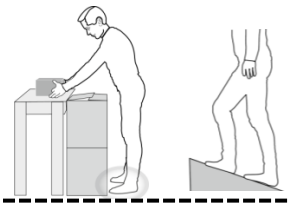
Other:

1. Postures

1.8 Leg and foot space and surface

1.8 Leg and foot space and surface

Is there a lack of space for the legs or for the feet, or is the surface unstable or sloping?



4 hours or more	3
3 to < 4 hours	2
2 to < 3 hours	1,5
1 to < 2 hours	1
30 minutes to < 1 hour	0,5
5 to < 30 minutes	0
< 5 minutes	0

Assessment

Assess the total time (per workday) when there is insufficient space for the legs or feet or when the ground is unstable or sloping.

Comment

- Example: floors or surfaces that are slippery or uneven and are judged to be unstable.
- Calculate the total duration according to the same principle as in example 1.1.
- In addition, leg- or foot-operated pedal work can be assessed under this paragraph.

Other:

2. Work movements and repetitive work

2.1 Movements of the arm (upper and lower arm)

2.1 Movements of the arm (upper and lower arm)

How are the movements of the arm generally?

	Left	Right
Constant movements mainly without pause	5	5
Frequent movements with some pauses	2	2
Varied movements, movement now and then (up to 2/min)	0	0

Assessment

Assess arm movements and recovery patterns that generally occur during the work day according to the table above.

Comment

- The assessment refers to the arm that has the highest score. If you are unsure which arm this is, assess both arms. When summarizing the Risk Scores, only the arm with the highest score is used.

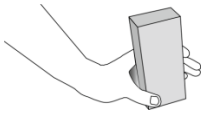
Other:

2. Work movements and repetitive work

2.2 Movements of the wrist

2.2 Movements of the wrist

Do similar movements of the wrist occur?



	Left	Right
More than 20 times per minute	5	5
11 - 20 times per minute	3	3
6 - 10 times per minute	1	1
Up to 5 times per minute	0	0

Assessment

Assess the frequency of similar wrist motions that generally occur during the work day according to the table above.

Example 2.2a: The hand is clearly bent upwards (extension) from the neutral position and then back (= one movement).

Example 2.2b: The hand is clearly bent upwards (extension) from the neutral position and then back, then clearly bent down (flexion) from the neutral position and back (= two movements).

Comment

- This factor may require expert assessment.
- Similar movements refer to loading of the same body structures in similar ways.
- The assessment refers to the hand that has the highest score. If you are unsure which hand this is, assess both hands. When summarizing the Risk Scores, only the hand with the highest score is used.

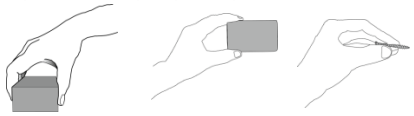
Other:

2. Work movements and repetitive work

2.3 Type of grip - frequency

2.3 Type of grip - frequency

Is overhand grip (palm facing downward), wide finger grip or pinch grip used while lifting or holding objects weighing 0.5 kg or more?



	Left	Right
More than 200 times per day	4	4
101 - 200 times per day	2	2
50 - 100 times per day	1	1
Less than 50 times per day	0	0

Assessment

Assess the total time per workday that objects weighing 0.5 kg or more are handled, using an over-hand grip (palm facing downward), wide finger grip, pinch grip or similar loading grips.

Example 2.3a: A worker lifts 60 objects (1 kg each) with an over-hand grip (using the right hand) and thereafter lifts 80 objects (1.5 kg each) with a wide finger grip (using the right hand), and finally lifts 200 objects (0.4 kg each) with a pinch grip (using the right hand). In addition, the worker lifts 110 objects with the left hand (1 kg each).

Calculate the score for the right hand as: 140 objects weighing at least 0.5 kg (60+80) is equal to a yellow risk level (score of 2). Calculate the score for the left hand as: 110 objects weighing at least 0.5 kg is equal also to a yellow risk level (score of 2). Note that only one of these will be used when the total scores are summed up.

Comment

- The assessment refers to the hand that has the highest score. If you are unsure which hand this is, assess both hands. When summarizing the Risk Scores, only the hand with the highest score is used.

Other:

2. Work movements and repetitive work

2.4 Shorter recovery/variation during work (mainly regarding the neck, the arms and the back)

2.4 Shorter recovery/variation during work (mainly regarding the neck, the arms and the back)

Assessment of whether or not the work enables sufficient variation or breaks so that muscle groups under strain are given time to recover. The variation or break has to be at least 5 seconds at a time to be eligible.

Approximately, how much of the working time consists of such variation or breaks generally?

30 seconds or less per 10 minutes work	10
Between 30 and 90 seconds per 10 minutes work	4
90 seconds or more per 10 minutes work	0

Assessment

Assess whether or not the work, in general, enables sufficient variation or breaks so that muscles under strain are given time for recovery. Assess the total time for recovery (at least 5 consecutive seconds) per 10 minutes of work that generally occurs. The variation or break has to be at least 5 consecutive seconds to be eligible.

Comment

Other: *

2. Work movements and repetitive work

2.5 Longer recovery/variation during work (not breaks, e.g. task rotation that gives sufficient recovery)

2.5 Longer recovery/variation during work (not breaks, e.g. task rotation that gives sufficient recovery)

Assessment of whether or not the work enables sufficient variation or breaks so that muscle groups under strain are given time to recover. The variation or break has to be at least 5 minutes when totalled together to be eligible.

Approximately, how often does such variation or breaks occur during the work generally?

Every 4 hours or less frequently	10
Every 3 hours	6
Every second hour	3
Every hour	0

Assessment

Assessment of the total time for recovery that generally occurs. Assess whether or not the work enables sufficient variation or breaks so that muscles under strain are given time to recover.

Comment

To assess the time for recovery, add separate time periods together. Those time periods should be at least 5 consecutive seconds to be eligible.

Other: *

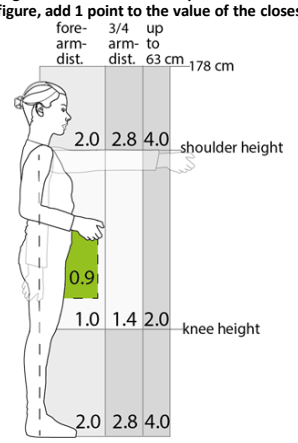
***** One of the most important factors to decrease the risk of developing musculoskeletal disorders is to ensure that the muscles are used in a way so that they are able to recover between muscle contractions (the more a muscle is strained, the more contracted it is). It is important that the muscle can become oxygenated and waste products from the muscles transported away by the blood. For this to happen, the circulation in the muscle needs to function. The more one strains a muscle statically, the greater the reduction in the circulation and the longer one performs static muscle work, the greater the accumulation of waste products (known as acidic metabolites) in the muscle and the less oxygen is supplied to the muscle. These two phenomena lead to muscle fatigue and discomfort and are assumed to eventually lead to MSDs. In dynamic work, oxygenation is made possible to a greater extent during the work and waste products are transported away efficiently. To reduce the risk of MSDs, it is considered essential that the work offers sufficient variation in order for the muscle groups under strain can recover, primarily during static load – i.e. oxygenation can occur and waste products be transported away. This can be accomplished, following a period of work where some muscles have been strained, by undertaking tasks where those muscles are not strained significantly, and are thus abled to recover. For muscle recovery to take place, one can vary the work during a work shift. (Rose, 2014).

3. Lifting work

Table 1: Frequency-and-weight factor.

	Number of lifts per day	≤ 12	13 - 24	25 - 60	61 - 96	97 - 240	241 - 480	481 - 960	961-1920	1921-2880	2881-3840	3841-4800
	Equals number of lifts per hour	≤ 1.5	1.6 - 3	3.1 - 7.5	7.6 - 12	13 - 30	31 - 60	61 - 120	121 - 240	241 - 360	361 - 480	481 - 600
Weight	over 25 kg - 30 kg	**6.5**	**6.5**	**7.0**	**7.6**	**8.0**	**8.6**	**9.9**	**14.3**	**23.9**	**35.9**	**49.7**
	over 20 kg - 25 kg	**5.4**	**5.4**	**5.8**	**6.3**	**6.6**	**7.1**	**8.3**	**12.0**	**19.9**	**29.9**	**41.4**
	over 15 kg - 20 kg	**4.3**	**4.4**	**4.7**	**5.1**	**5.3**	**5.7**	**6.6**	**9.6**	**15.9**	**23.9**	**33.1**
	over 10 kg - 15 kg	**3.2**	**3.3**	**3.5**	**3.8**	**4.0**	**4.3**	**5.0**	**7.2**	**12.0**	**17.9**	**24.8**
	over 7 kg - 10 kg	**2.2**	**2.2**	**2.3**	**2.5**	**2.7**	**2.9**	**3.3**	**4.8**	**8.0**	**12.0**	**16.6**
	over 5 kg - 7 kg	**1.5**	**1.5**	**1.6**	**1.8**	**1.9**	**2.0**	**2.3**	**3.3**	**5.6**	**8.4**	**11.6**
	over 3 kg - 5 kg	**1.1**	**1.1**	**1.2**	**1.3**	**1.3**	**1.4**	**1.7**	**2.4**	**4.0**	**6.0**	**8.3**
	1 kg - 3 kg	**0.6**	**0.6**	**0.7**	**0.8**	**0.8**	**0.9**	**1.0**	**1.4**	**2.4**	**3.6**	**5.0**

Table 2: Lifting area factor. If the lift is performed outside the shaded area in the figure, add 1 point to the value of the closest cell.



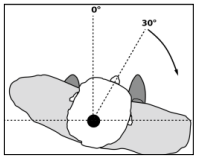


Figure: Torso twisted 30°.

Table 3: Calculation of Risk score.	Factor	Possible worst case Factor
Frequency-and-weight factor from Table 1.		
Lifting area factor from Table 2.		
Do the following factors occur in the majority of lifts? If no, insert the value 1.0 to the right, else the stated value:		
☐ Lift with one hand. If yes, insert the factor 1.7.		
☐ Torso twisted more than 30° (see the figure to the right above). If yes, insert the factor 1.3.		
☐ Poor grip. If yes, insert the factor 1.1.		
☐ Hot environment 27-32°. If yes, insert the factor 1.1.		
☐ Two people lift the load. If yes, insert the factor 0.6.		
Risk score (multiply the factors in each column)		

Comment:

Score	Colour
≥ 5	
3- 4,9	
< 3	

Risk score 1:

Risk score 2:

Assessment

1. The assessment applies only for load weights of 1 kg or more.
2. Assess both "*the average case"* and *"the worst case"*. The worst case may, for example, consist of a single lift of a heavy object or an object that is lifted with several aggravating factors.
3. Assess the weight of the load and how frequently it is lifted (Table 1).
4. Assess the horizontal and vertical distances at the origin and destination (or between the origin and destination). Choose the task/lift with the highest score.
5. Calculate the risk score (Table 3) by multiplying factors from Table 1 and 2 with possible influencing factors. Insert the risk scores for *the average case (*Risk score 1) and *worst case* (Risk score 2). The table at the bottom of the figure shows if the risk score corresponds to green, yellow or red level of risk/action level.
6. If no *worst cas*e occurs (i.e., the score from *the worst case* is lower than *the average case*), then insert the score for *the average case* in both Risk scores 1 and 2.

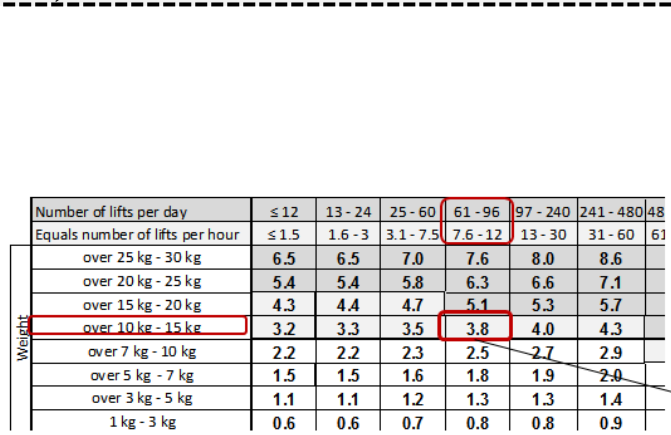
Example 3.a: A person lifts two different types of Container (A and B) per work day. All lifts occurs within a forearm's length (horizontal distance) and are initiated at floor height (handles located at about 10 cm above floor level) and ends at waist height. Container A weighs on average 12 kg and is on average lifted 12 times/hour per eight-hour work day. Container B is lifted once per work day. No further aggravation/influencing factors are present.

Assessment of ***the average case (***risk score 1): As the heavy box is lifted infrequently, only assess the other

box (12 kg). "Frequency and weight factor" (3.8) and "Lifting area factor" (2.0) obtained from the figures. Risk score 1 = 7.6 points (3.8*2.0) red risk/action level.

Assessment of ***the worst case (***risk score 2): Assess the lifting of the heavy (25 kg) box. "Frequency and weight factor" (5.4) and "Lifting area factor" (2.0) obtained from the figures. Risk score 2 = 10.8 (5.4*2.0) red risk/action level.

Example 3.b: Calculate the "Frequency and weight factor". A person lifts 10 kg 120 times per work day and 5 kg 60 times per work day. The total number of lifts per day equals 180 (120 + 60). Total weight per day equals 1500 kg (10 * 120 + 5 * 60 = 1200 + 300). Average weight is 8.3 kg (total weight / number of lifts = 1500/180).



Number of lifts per day	≤ 12	13 - 24	25 - 60	61 - 96	97 - 240	241 - 480	48
Equals number of lifts per hour	≤ 1.5	1.6 - 3	3.1 - 7.5	7.6 - 12	13 - 30	31 - 60	61
over 25 kg - 30 kg	6.5	6.5	7.0	7.6	8.0	8.6	
over 20 kg - 25 kg	5.4	5.4	5.8	6.3	6.6	7.1	
over 15 kg - 20 kg	4.3	4.4	4.7	5.1	5.3	5.7	
over 10 kg - 15 kg	3.2	3.3	3.5	3.8	4.0	4.3	
over 7 kg - 10 kg	2.2	2.2	2.3	2.5	2.7	2.9	
over 5 kg - 7 kg	1.5	1.5	1.6	1.8	1.9	2.0	
over 3 kg - 5 kg	1.1	1.1	1.2	1.3	1.3	1.4	
1 kg - 3 kg	0.6	0.6	0.7	0.8	0.8	0.9	

Weight

Worst case

Average case

Table 3: Calculation of Risk score.	Factor	Possible worst case Factor
Frequency-and-weight factor from Table 1.	3.8	5.4
Lifting area factor from Table 2.	2.0	2.0
Do the following factors occur in the majority of lifts? If no, insert the value 1.0 to the right, else the stated value:		
☐ Lift with one hand. If yes, insert the factor 1.7.	1	1
☐ Torso twisted more than 30° (see the figure to the right above). If yes, insert the factor 1.3.	1	1
☐ Poor grip. If yes, insert the factor 1.1.	1	1
☐ Hot environment 27-32°. If yes, insert the factor 1.1.	1	1
☐ Two people lift the load. If yes, insert the factor 0.6.	1	1
Risk score (multiply the factors in each column)	7.6	10.8

Example 3.c: Calculate the "Lifting area factor". A person lifts 10 kg at elbow height. Half of the lift occurs within forearm grip distance (factor = 1.0) and the other half occurs at ¾ arm grip distances (factor = 1.4). The average scores from these are 1.2 ((1.0 + 1.4) / 2 = 1.2). "Lifting area factor" will then be 1.2.

Example 3.d: Calculations of the "Frequency and weight factor" if the load exceeds 30 kg. In this example, a box weighing 35 kg is lifted 24 times per day. The increase in the "Frequency and weight factor" from 25 kg to 30 kg is 1.1 (6.5 to 5.4 = 1.1) for 24 lifts per day. Therefore, add 1.1 to 6.5 (= 7.6).

Comment

- Poor grip means that it is difficult to obtain an adequate grip for the hand and fingers, or that the grip surface is slippery or has sharp edges, or that the center of gravity is not centered, or that the content is unstable or moving, or that the grip does not otherwise meet requirements for a good grip.
- Good grip. To qualify as a good grip all of the following criteria must be met (if these are not met, the grip is classified as poor). Handles or cutouts which allow for a comfortable and secure grip for the fingers/hand; grip surface should not be slippery; the center of gravity must be centered and be between the hands, or in the middle of the hand for hand grip; the length of the handle (or cut out) should be at least 11.5 cm and, for the handle, the grip diameter should be between 2 and 4 cm.
- Trunk twist. Assess the twist (rotation) between the shoulders and the feet. This means that also knee, hip and trunk rotation is included.
- If lifts occur outside the ten lift zones, add one additional score (+1) to the nearest zone's value.
- Lifts performed at shoulder height should be given the same score as a lift above shoulder height (up to 178 cm).

- If lifting occurs at or above shoulder height (of the person) when working in a kneeling/squatting position then the lift should be interpreted as lifting at or above shoulder height, although the lift height corresponds to waist height if the person were standing up.
- Lifting in a kneeling or squatting posture. Gallagher and Unger (1990) found that the lifting capacity is reduced by about 15-20% if lifts are performed in a kneeling posture (compared to in a stooped posture). Based on this study, an additional multiplier of 1.25 may be used to compensate for the reduced capacity if lifts are performed in a kneeling or squatting posture. Note that a larger multiplier (above 1.25) may be needed to take into account the increased load, especially if lateral bending of the trunk occurs (lateral flexion). Expert judgments are recommended for this assessment.
- At temperatures of more than 32° C reduce the lifting capacity even further. Requires expert assessment.

Other:

- The values of the "Frequency and weight factor" are based on the highest values in the intervals. It is possible to interpolate between these values to obtain a more precise value for the weights and frequencies within these intervals.
- The model can be used to assess lifting and lowering (if significant control is required) similar to the 1991 NIOSH lifting Equation (Waters et al., 1993) although the spinal load and physiological load can differ significantly (Founooni-Fard and Mital, 1993; Davis et al., 1998; Marras, 2007).The model assumes up to eight hours of work. For longer durations, reduction of the load is needed (see e.g. Mital et al., 1997). Note that the frequency per hour is superordinate to the frequency per work day.

4. Pushing and pulling work

Table 4: Frequency and force factor for initial force (starting force).

	Times per day	≤ 1	2 - 16	17 - 96	97 - 240	241-480	481-1920
	Times per hour		≤ 2	2.1 - 12	13 - 30	31 - 60	61 - 240
Force value	501 - 600 N	8.5	10	10.5	14	14.5	24
	451 - 500 N	7.5	9	9.5	12.5	13	22
	401 - 450 N	6.5	8	8.5	11	11.5	20
	351 - 400 N	6	7	7.5	9.5	10	18
	301 - 350 N	5	6	6,5	8	8,5	16
	251 - 300 N	4	5	5	5	7	14
	201 - 250 N	3	4	4	4	5	12
	151 - 200 N	2.5	2.5	3	3	4	5
	101 - 150 N	2	2	2.5	2.5	3	4
	51 - 100 N	1.5	1.5	2	2	2.5	2.5

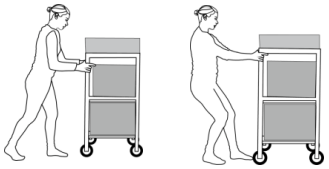


Figure: Pushing and pulling work.

Table 5: Frequency and force factor for continuous force.

Up to 8 meters: Use the force values in the table.
9 -30 meters: Add 50 N to the measured force to calculate the force value.
31-60 meters: Add 100 N to the measured force to calculate the force value.

	Times per day	≤ 1	2 - 16	17 - 96	97 - 240	241-480	481-1920
	Times per hour	hour	≤ 2	2.1 - 12	13 - 30	31 - 60	61 - 240
Force value	501 - 600 N	10.5	12	12.5	17	19	30
	451 - 500 N	9.5	11	11.5	15.5	17.5	28
	401 - 450 N	8.5	10	10.5	14	16	26
	351 - 400 N	7.5	9	9.5	12.5	14.5	24
	301 - 350 N	6.5	8	8.5	11	13	22
	251 - 300 N	6	7	7.5	9.5	11.5	20
	201 - 250 N	5	6	6.5	8	10	18
	151 - 200 N	4	5	5	5	8.5	16
	101 - 150 N	3	4	4	4	5	14
	51 - 100 N	2.5	2.5	2.5	3	4	12

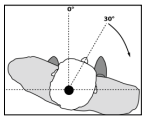


Figure: Torso twisted 30°.

Table 6: Calculation of Risk score.	Factor Initial force	Factor Conti-nuous force	If any, worst ca-se Factor Initial force	If any, worst ca-se Factor Conti-nuous force
Frequency and force factor from Table 4, and, if applicable, from Table 5.				
Do the following factors occur <u>in the majority</u> of the pushes and pulls? If no, insert the value 1 to the right, else the stated value:				
☐ Pushing/pulling with one hand or sideways. If yes, insert the factor 1.7.				
☐ Gripping height: If the gripping height is below knee height or above shoulder height, insert the factor 2; if the gripping height deviates considerably from elbow height, insert the factor 1.2.				
☐ Torso twisted more than 30° (see the figure to the right above). If yes, insert the factor 1.3.				
☐ Poor grip. If yes, insert the factor 1.1.				
☐ Hot environment 27-32°. If yes, insert the factor 1.1.				
☐ Pushing/pulling work on slippery surface. If yes, insert the factor 1.7.				
☐ Two people perform the pushing/pulling. If yes, insert the factor 0.6.				
Risk score (multiply the factors in each column)				

Comment:

Score	Colour
≥ 5	
3- 4,9	
< 3	

Risk score 1:
Risk score 2:

Assessment

1. The assessment applies only for forces exceeding 50 Newton.
2. Assess (measure) both *"the average case"* and "*the worst case"*. The worst case may for example consist of a single exertion of high force or handling operations with several aggravating factors.
3. If the object is pushed or pulled for less than 5 seconds, only assess the initial force (Table 4). If the object is pushed/pulled for 5 seconds or longer, assess both the initial (Table 4) and the continuous force (Table 5).
4. Calculate the **Risk score** (Table 6) by multiplying factors from Table 4 (and possibly also Table 5) with possible influencing factors. Insert the Risk scores for the *average case (*Risk score 1) and *worst case* (Risk score 2). The table at the bottom of the figure shows if the risk score corresponds to green, yellow or red level of risk/action level.
5. If both initial and continuous forces are assessed, insert the one with the highest score in the table Risk Score 1 (*average case*) and Risk score 2 (*worst case*).
6. If no *worst cas*e occurs (i.e. the score from *the worst case* is lower than *the average case*), then insert the scores for *the average case* in both Risk scores 1 and 2.

Example 3.a: Two workers push a trolley for two meters, both using both their hands. The grip is good and at about elbow height and no other influencing factors are present. Each push (task) takes about four seconds and is repeated on average 28 times/hour per eight-hour work day. The median initial force is 225 N, and the

continuous force is 80 N. In addition, one of the workers pushes the same trolley 12 meters which takes about 20 seconds (per push).

Assessment of the **average case** (risk score 1): The average task takes less than 5 seconds, therefore only the initial force needs to be assessed. See figure below for the calculation. Risk score 1 = 2.4 points (green).

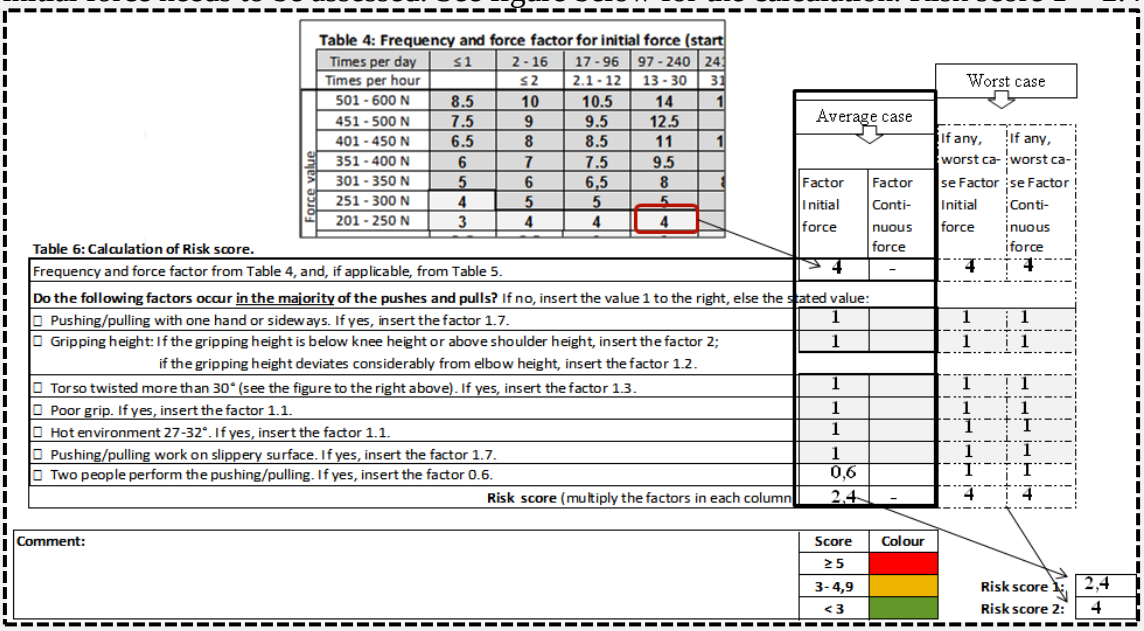


Table 4: Frequency and force factor for initial force (start

Force value	Times per day	≤ 1	2 - 16	17 - 96	97 - 240	24
	Times per hour		≤ 2	2.1 - 12	13 - 30	3
	501 - 600 N	8.5	10	10.5	14	1
	451 - 500 N	7.5	9	9.5	12.5	
	401 - 450 N	6.5	8	8.5	11	1
	351 - 400 N	6	7	7.5	9.5	
	301 - 350 N	5	6	6,5	8	
	251 - 300 N	4	5	5	5	
	201 - 250 N	3	4	4	4	

Table 6: Calculation of Risk score.

	Average case: Factor Initial force	Average case: Factor Continuous force	Worst case: If any, worst case Factor Initial force	Worst case: If any, worst case Factor Continuous force
Frequency and force factor from Table 4, and, if applicable, from Table 5.	4	-	4	4
Do the following factors occur in the majority of the pushes and pulls? If no, insert the value 1 to the right, else the stated value:				
☐ Pushing/pulling with one hand or sideways. If yes, insert the factor 1.7.	1		1	1
☐ Gripping height: If the gripping height is below knee height or above shoulder height, insert the factor 2; if the gripping height deviates considerably from elbow height, insert the factor 1.2.	1		1	1
☐ Torso twisted more than 30° (see the figure to the right above). If yes, insert the factor 1.3.	1		1	1
☐ Poor grip. If yes, insert the factor 1.1.	1		1	1
☐ Hot environment 27-32°. If yes, insert the factor 1.1.	1		1	1
☐ Pushing/pulling work on slippery surface. If yes, insert the factor 1.7.	1		1	1
☐ Two people perform the pushing/pulling. If yes, insert the factor 0.6.	0,6		1	1
Risk score (multiply the factors in each column)	2,4	-	4	4

Comment:

Score	Colour
≥ 5	
3 - 4,9	
< 3	

Risk score 1: 2,4
Risk score 2: 4

Assessment of **the worst case** (risk score 2): In this case, the handling by a single worker is the worst case. Assess both the initial and sustained force (see figure below). Since the distance of 12 meters is between 9-30 meters, add 50 N to the measured continuous force. The continuous force is 130 N (80 + 50). Both the initial and sustained force end up with a total score of 4 (yellow)

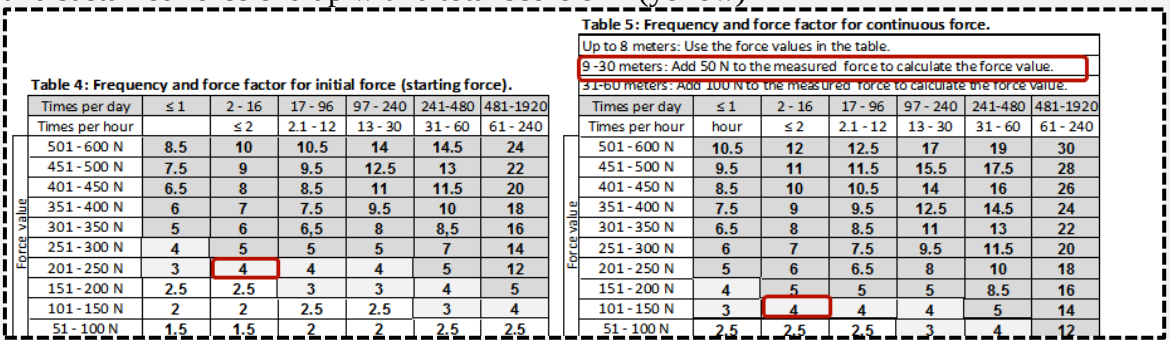


Table 4: Frequency and force factor for initial force (starting force).

Force value	Times per day	≤ 1	2 - 16	17 - 96	97 - 240	241-480	481-1920
	Times per hour		≤ 2	2.1 - 12	13 - 30	31 - 60	61 - 240
	501 - 600 N	8.5	10	10.5	14	14.5	24
	451 - 500 N	7.5	9	9.5	12.5	13	22
	401 - 450 N	6.5	8	8.5	11	11.5	20
	351 - 400 N	6	7	7.5	9.5	10	18
	301 - 350 N	5	6	6,5	8	8,5	16
	251 - 300 N	4	5	5	5	7	14
	201 - 250 N	3	4	4	4	5	12
	151 - 200 N	2.5	2.5	3	3	4	5
	101 - 150 N	2	2	2.5	2.5	3	4
	51 - 100 N	1.5	1.5	2	2	2.5	2.5

Table 5: Frequency and force factor for continuous force.

Up to 8 meters: Use the force values in the table.
9 -30 meters: Add 50 N to the measured force to calculate the force value.
31-60 meters: Add 100 N to the measured force to calculate the force value.

Force value	Times per day	≤ 1	2 - 16	17 - 96	97 - 240	241-480	481-1920
	Times per hour	hour	≤ 2	2.1 - 12	13 - 30	31 - 60	61 - 240
	501 - 600 N	10.5	12	12.5	17	19	30
	451 - 500 N	9.5	11	11.5	15.5	17.5	28
	401 - 450 N	8.5	10	10.5	14	16	26
	351 - 400 N	7.5	9	9.5	12.5	14.5	24
	301 - 350 N	6.5	8	8.5	11	13	22
	251 - 300 N	6	7	7.5	9.5	11.5	20
	201 - 250 N	5	6	6.5	8	10	18
	151 - 200 N	4	5	5	5	8.5	16
	101 - 150 N	3	4	4	4	5	14
	51 - 100 N	2.5	2.5	2.5	3	4	12

Comment

- If pushing/pulling occurs to the side using one hand, then add 2.89 points in the table (i.e. 1.7 * 1.7 = 2.89).
- A slippery surface means (here) that the static coefficient of friction (SCOF) is less than 0.5 between the shoe sole and the ground/floor. If the friction is less than 0.2 ("very slippery"), the ability to exercise force is further reduced. Therefore, a further increase of the multiplier is recommended based on expert judgment. See e.g. Kroemer et al. (1971, pp 31-33 http://www.dtic.mil/dtic/tr/fulltext/u2/720252.pdf) for examples of SCOF for different shoe sole and floors.
- Force measurements shall, as far as possible, represent the work situation in terms of load weight, surface/floor, speed/acceleration, force direction, type and condition of the carrier, position (direction) of the wheels and grip height (to mention a few).
- Distance refers to the continuous distances of a push/pull-task and not the sum of several tasks.

Other: Median refers to "the middle value" where values are ordered by magnitude (for example: 1, 2, **5**, 7, 19). If the total number of values is even then the median is the mean value of the two middle values. The model assumes up to eight hours of work. For longer durations, further reduction of the force is needed (see e.g. Mital et al., 1997). Note that the frequency per hour is superordinate to the frequency per work day.

5. 1 Influencing physical factors hand/arm

5.1 a+b Hand-arm vibrations (HAV)

a. The employee is exposed to hand-arm vibrations more than 20 minutes (10 for strongly vib).	2	0	
b. The employee is exposed to hand-arm vibrations more than 90 minutes (60 for strongly vib).†	4	x	

Assessment

Assess the duration (per day) that the employee is exposed to hand-arm vibrations and if the vibration emission exceeds 10 m/s^2 (strongly vibrating).

Comment

Other: If vibrations occur, a more thorough assessment than the RAMP tool is recommended.

5. 1 Influencing physical factors hand/arm

5.1c Manual handling of warm or cold objects

c. Warm or cold objects are handled manually.	2	0	

Assessment

Assess if warm (≥43°C) or cold objects (<10°C) are handled manually (Rose, 2014; Lindqvist, 2007).

Comment

Other:

5. 1 Influencing physical factors hand/arm

5.1d The hand is used as an impact tool

d. The hand is used as an impact tool often or a long time*.	2	0	

Assessment

Assess if the hand is used as an impact tool often or a long time.

Comment

"Often" means about 100 times per working day or more and "a long time" is about 30 minutes per work day or more.

Other:

5. 1 Influencing physical factors hand/arm

5.1 e+f Hand tools

e. Holding hand tools weighing more than 2.3 kg for more than 30 minutes .	2	0	
f. Holding precision tools weighing more than 0.4 kg for more than 30 minutes.	2	0	

Assessment

e. Assess whether the tools weighing more than 2.3 kg are held for more than 30 minutes in total per work day. Assess whether precision tools weighing more than 0.4 kg are held for more than 30 minutes in total per work day.

Comment

Other:

5.2 Other physical factors

5.2 a+b Whole-body vibrations (WBV)

a. The employee is exposed to whole-body vibrations more than 1 hour.	2	0	
b. The employee is exposed to whole-body vibrations more than 6 hours.†	4	x	

Assessment

Assess the total time that the worker is exposed to whole-body vibrations.

Comment

Other: If vibrations occur, a more thorough assessment, than the RAMP tool, is recommended.

5.2 Other physical factors

5.2 c Visual conditions

c. The visual conditions are insufficient for the task.	2	0	

Assessment

Assess if the visual conditions are insufficient for the task.

Comment

An inadequate visual condition (for the task) means that the visual conditions are insufficient to perform the work well from an ergonomic perspective. The reasons for this may include inappropriate lighting e.g. glare and poor contrast. Poor visual conditions may also cause awkward postures in attempts to compensate for the poor visual conditions which may increase the risk of musculoskeletal disorders and/or pain. (Rose, 2014)

Other:

5.2 Other physical factors

5.2 d Ambient climate (cold, heat and draught)

d. The work is carried out in hot or cold temperatures or in draughty environments.	2	0	

Assessment

Assess if the work occurs in cold, heat and draught.

Comment

Other:

5.2 Other physical factors

5.2 e Standing or walking on a hard surfaces

e. Standing or walking on a hard surface more than half of the work day.	2	0	

Assessment

Assess if the worker stands or walks on a hard surface for more than half of the work day.

Comment

This paragraph may require expert judgment where various properties of the shoe-floor interaction are combined. An example of a hard surface is concrete. Parquet floors and carpets do not generally count as hard surfaces in this case. However, the employee's experience should be considered in the assessment. Note also that an overly soft surface may cause fatigue of the workers.

Other:

5.2 Other physical factors

5.2 f+g Prolonged sedentary work or standing

f. Prolonged sedentary work without possibility to change to do the work standing up.	2	0	
g. Prolonged standing work without possibility to change to do the work sitting down.	2	0	

Assessment

f. Assess if the worker has prolonged sedentary work without the possibility to do the work standing up.

g. Assess if the worker has prolonged standing work without the possibility to do the work sitting down.

Comment

- If the worker has the possibility to change position between sitting, standing and walking regularly, then the work should not be assessed as prolonged sedentary or prolonged standing.

Other:

5.2 Other physical factors

5.2 h Kneeling and squatting

h. Kneeling/squatting more than 30 times or more than 30 minutes.	2	0	

Assessment

Assess if the work involves kneeling or squatting more than 30 times or more than 30 minutes per work day.

Example: Working in a kneeling position in the morning (20 minutes) followed by 25 minutes squatting in the afternoon. Calculation: 20 + 25 minutes = 45 minutes (yellow, 2 points).

Comment

Other:

5.3 Work organisation and psychosocial factors

5.3 a+b Influence over work pace and work settings

a. There is no possibility to influence at what pace the work is performed.	2	0	
b. There is no possibility to influence the work setting or how the work shall be carried out.	2	0	

Assessment

a. Assess whether or not the employee can influence at which pace the work is performed.

b. Assess whether or not the employee can influence how the work is carried out.

Comment

- "There is no possibility to influence at what pace the work is performed" refers to e.g. if the pace is controlled by a machine or someone other than the person does the job. This means that there are few or no possibilities to vary the pace of work if needed, or to carry out the work at "their own pace".
- "There is no possibility to influence the work setting or how the work is carried out", refers to the decision latitude of the employee, e.g. whether the employee has participated in the planning of the work or can influence how the work is carried out.

Other: Preferably, ask three to five employees.

5.3 Work organisation and psychosocial factors

5.3 c+d Work pace

c. It is often difficult to keep up with the work tasks	2	0	
d. The employees often work rapidly in order to be able to take a longer break.	2	0	

Assessment

c. Assess whether it is often difficult to keep up with the work tasks.

d. Assess whether the employee often works rapidly in order to take a longer break.

Comment

Other:

6. Reports on physically strenuous work

6.1 Documented reporting on physically strenuous work

6.2 Type of work that has led to reporting

6.1 Documented reporting on physically strenuous work

Do documented reports exist of physically strenuous tasks (e.g. incident reports) when cayrrying out the work task?

	Yes	No	
Documented reporting	2	0	

6.2 Type of work that has led to reporting

If "Yes" on 6.1, mark (with an x) in the table below what type of work that has led to this. Else, go to 7.

lifting	
holding/carrying	
pushing/pulling	
pushing with hand or fingers	
other (please note)_____	

Assessment

Check for documented reporting (e.g. incident reports) of physically strenuous work.

Comment

Other:

7. Perceived physical discomfort

7.1 Perceived physical discomfort

7.2 The worst task

Preferably ask five people who perform this work task.

7.1 Perceived physical discomfort

Are there parts of the work which lead to physical discomfort (e.g. in muscles or joints) during the work day?

Answer "Yes" if any employee experiences such discomfort.

	Yes	No	
Discomfort in muscles or joints	2	0	

7.2 If "Yes" on 7.1, which is the worst task?

Preferably state answers from five employees in the table below.

Person 1:_____
Person 2:_____
Person 3:_____
Person 4:_____
Person 5:_____

Assessment

Check whether tasks causing physical discomfort (e.g. in muscles or joints) occur during the work day.

Comment

- Preferably, ask five employees.
- If any of the employees answers “yes” to the question, the result is yellow (score 2).

Other:

References

Swedish Work Environment Authority. 2012. Provision AFS 2012:2 Belastningsergonomi. ISBN 978-91-7930-565-9.

Damecour, C., M. Abdoli-Eramaki, A. Ghasempoor, and W. P. Neumann. 2010. Comparison of two heights for forward-placed trunk support with standing work. Applied Ergonomics 41 (4):536-541

Davis, K. G., W. S. Marras, and T. R. Waters. 1998. Evaluation of spinal loading during lowering and lifting. Clinical Biomechanics 13 (3):141-152.

Founooni-Fard, H., and A. Mital. 1993. A psychophysiological study of high and very high frequency manual materials handling: Part I - Lifting and lowering. International Journal of Industrial Ergonomics 12 (1-2):127-141.

Gallagher, S., W. S. Marras, and T. G. Bobick. 1988. Lifting in stooped and kneeling postures: Effects on lifting capacity, metabolic costs, and electromyography of eight trunk muscles. International Journal of Industrial Ergonomics 3 (1):65-76.

Gallagher, S., and R. L. Unger. 1990. Lifting in four restricted lifting conditions. Psychophysical, physiological and biomechanical effects of lifting in stooped and kneeling postures. Applied Ergonomics 21 (3):237-245.

Hanson, L., L. Sperling, G. Gard, S. Ipsen, and C. Olivares Vergara. 2009. Swedish anthropometrics for product and workplace design. Applied Ergonomics 40 (4):797-806.

Harms-Ringdahl, K., and J. Ekholm. 1986. Intensity and character of pain and muscular activity levels elicited by maintained extreme flexion position of the lower-cervical-upper-thoracic spine. Scandinavian Journal of Rehabilitation Medicine 18 (3):117-126.

Lindqvist, B. 2007. Power Tool Ergonomics Evaluation of Power Tools. Atlas Copco.

Marras, W. S. 2007. The Working Back: A Systems View, The Working Back: A Systems View.

Mital, Anil, Andrew S. Nicholson, and Moh M. Ayoub. 1997. A guide to manual materials handling. London: Taylor & Francis.

Pheasant, Stephen, and Christine M. Haslegrave. 2006. Bodyspace : anthropometry, ergonomics and design of work. London: Taylor & Francis.

Rose, L. 2014. User's manual for the risk management tool RAMP: – Risk Assessment and Management tool for manual handling Proactively. Unpublished draft KTH STH.

Appendix 1: RAMP II paper version (English version 1.00, 2014)

RAMP II (Version 1.00, 2014) English version

In depth analysis for assessment of physical risks for manual handling

RAMP - Risk Assessment and Management tool for manual handling Proactively

Introduction

This assessment tool (RAMP II) is intended for an in depth analysis and assessment of physical ergonomics risk factors when working with manual handling which may increase the risk of developing musculoskeletal disorders (MSDs). Manual handling involves for example manual lifting, holding, pushing or pulling of loads. At high or sustained exposure to the risk factors the risk of developing of worsening MSDs increases.

Use this tool to assess a work, work task, or a work station during an average work day. In some cases also rarely occurring extreme cases may warrant assessment. Assess the work of an employee who is representative for the group of employees who carry out this kind of work, or, alternatively two people so that the variation among employees is somewhat taken into account. This employee/these employees should be experienced in how the work should be carried out in an appropriate way. Those performing the assessment should be familiar with how the work is carried out. Otherwise, the assessment should be carried out in co-operation with someone with such knowledge. The person who carries out the assessment should have participated in a basic physical ergonomics course, an introduction in the RAMP-method and should have read the RAMP manual.

During the assessment, choose the alternative which best matches the situation. Fill in the score in the white answering box corresponding to each question.

The result of the RAMP II assessment is presented as a risk assessment at three levels:

High risk. The loading situation has such a magnitude and characteristics that many employees are at an increased risk of developing musculoskeletal disorders. Improvement measures should be given high priority.

Risk. The loading situation has such a magnitude and characteristics that certain employees are at an increased risk of developing musculoskeletal disorders. Improvement measures should be taken.

Low risk. The loading situation has such a magnitude and characteristics that most employees are at a low risk of developing musculoskeletal disorders. However, individuals with reduced physical capacity may be at risk. Individually tailored improvement measures may be needed.

The result is also presented with a sum of scores, mainly intended for comparison between different jobs risks within a risk level (for example the red level). The result is intended to form a part of the decision making basis when prioritizing and choosing actions in order to reduce the risk for MSDs.

Date:_____ Assessment of: ☐ Work/ work task ☐ Employee load

Work/work task:_____

Assessment ordered by:_____ Position_____

Assessment completed by:_____ Position_____

Company representative:_____ Position_____

Safety/work environment officer/employee:_____ Position_____

Other:_____ Position_____

_____

Department:_____

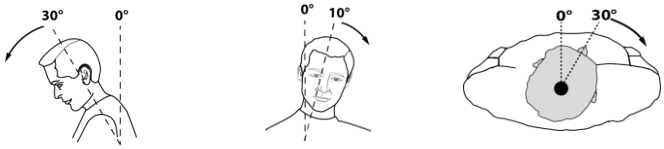
Other information:_____

1. Postures

Fill in the corresponding score in the white box | **Score:** | **Comment:**

1.1 Posture of the head - forwards and to the side

Does a clear bending of the head forwards or to the side, or twisting to the side occur, as shown in the figures, or more?



4 hours or more	7
3 to < 4 hours	5
2 to < 3 hours	3
1 to < 2 hours	2
30 minutes to < 1 hour	1
5 to < 30 minutes	0,5
< 5 minutes	0

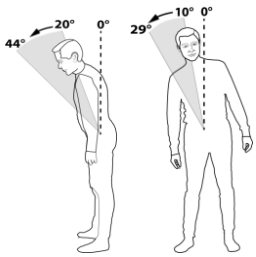
1.2 Posture of the head - backwards

Does bending of the head backwards occur, as shown in the figure, or more?

2 hours or more	10
1 to < 2 hours	6
30 minutes to < 1 hour	3
5 to < 30 minutes	1,5
< 5 minutes	0

1.3 Back posture - moderate bending

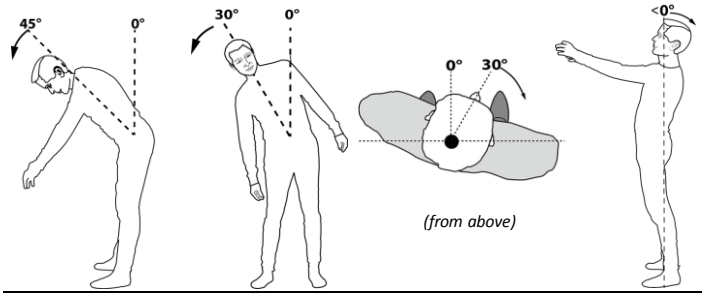
Does moderate bending of the upper body forwards or to the side occur, as shown in the figures, or more?



4 hours or more	7
3 to < 4 hours	5
2 to < 3 hours	3
1 to < 2 hours	2
30 minutes to < 1 hour	1
5 to < 30 minutes	0
< 5 minutes	0

1.4 Back posture - considerable bending and twisting

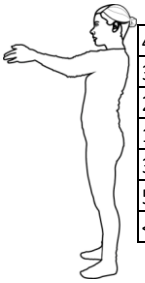
Does considerable bending of the upper body forwards or to the side, twisting or bending backwards occur, as shown in the figures, or more?



4 hours or more	10
3 to < 4 hours	7
2 to < 3 hours	5
1 to < 2 hours	3
30 minutes to < 1 hour	2
5 to < 30 minutes	1
< 5 minutes	0

1.5 Upper arm posture - hand in or above shoulder height

Is work perfomed with the hand at or above shoulder height? (about 130 - 150 cm)

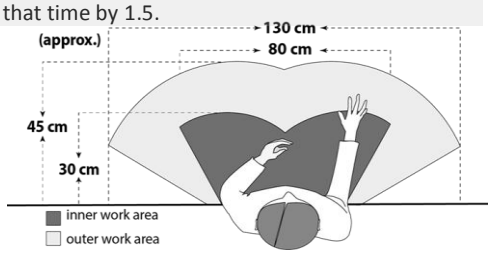


	Left	Right
4 hours or more	10	10
3 to < 4 hours	7	7
2 to < 3 hours	5	5
1 to < 2 hours	3	3
30 minutes to < 1 hour	2	2
5 to < 30 minutes	1	1
< 5 minutes	0	0

1.6 Upper arm posture - hand in or outside the outer work area

Is work perfomed with the hand in the outer work area?

If the hand is outside the outer work area (white area), multiply the time-points for that time by 1.5.

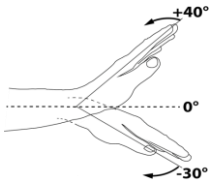


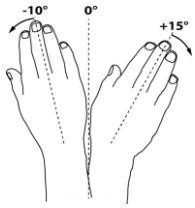
	Left	Right
4 hours or more	10	10
3 to < 4 hours	7	7
2 to < 3 hours	5	5
1 to < 2 hours	3	3
30 minutes to < 1 hour	2	2
5 to < 30 minutes	1	1
< 5 minutes	0	0

Fill in the corresponding score in the white box **Score:** **Comment:**

1.7 Wrist posture

Is work performed with clearly bent wrist, as shown in the figures, or more?

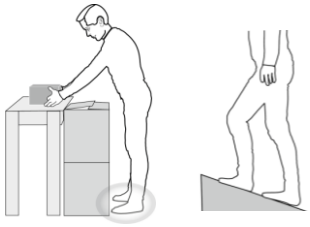




	Left	Right
4 hours or more	7	7
3 to < 4 hours	5	5
2 to < 3 hours	3	3
1 to < 2 hours	2	2
30 minutes to < 1 hour	1	1
5 to < 30 minutes	0	0
< 5 minutes	0	0

1.8 Leg and foot space and surface

Is there a lack of space for the legs or for the feet, or is the surface unstable or sloping?



4 hours or more	3
3 to < 4 hours	2
2 to < 3 hours	1,5
1 to < 2 hours	1
30 minutes to < 1 hour	0,5
5 to < 30 minutes	0
< 5 minutes	0

2. Work movements and repetitive work

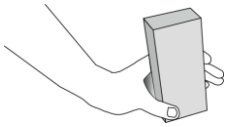
2.1 Movements of the arm (upper and lower arm)

How are the movements of the arm generally?

	Left	Right
Constant movements mainly without pause	5	5
Frequent movements with some pauses	2	2
Varied movements, movement now and then (up to 2/min)	0	0

2.2 Movements of the wrist

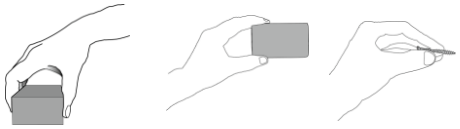
Do similar movements of the wrist occur?



	Left	Right
More than 20 times per minute	5	5
11 - 20 times per minute	3	3
6 - 10 times per minute	1	1
Up to 5 times per minute	0	0

2.3 Type of grip - frequency

Is overhand grip (palm facing downward), wide finger grip or pinch grip used while lifting or holding objects weighing 0.5 kg or more?



	Left	Right
More than 200 times per day	4	4
101 - 200 times per day	2	2
50 - 100 times per day	1	1
Less than 50 times per day	0	0

2.4 Shorter recovery/variation during work (mainly regarding the neck, the arms and the back)

Assessment of whether or not the work enables sufficient variation or breaks so that muscle groups under strain are given time to recover. The variation or break has to be at least 5 seconds at a time to be eligible.

Approximately, how much of the working time consists of such variation or breaks generally?

30 seconds or less per 10 minutes work	10
Between 30 and 90 seconds per 10 minutes work	4
90 seconds or more per 10 minutes work	0

2.5 Longer recovery/variation during work (not breaks, e.g. task rotation that gives sufficient recovery)

Assessment of whether or not the work enables sufficient variation or breaks so that muscle groups under strain are given time to recover. The variation or break has to be at least 5 minutes when totalled together to be eligible.

Approximately, how often does such variation or breaks occur during the work generally?

Every 4 hours or less frequently	10
Every 3 hours	6
Every second hour	3
Every hour	0

3. Lifting work

Fill in the corresponding score in the white box **Score:**

If no lifts occur: Write 0 in the box on the right and go to 4. **No lifting work** **0**

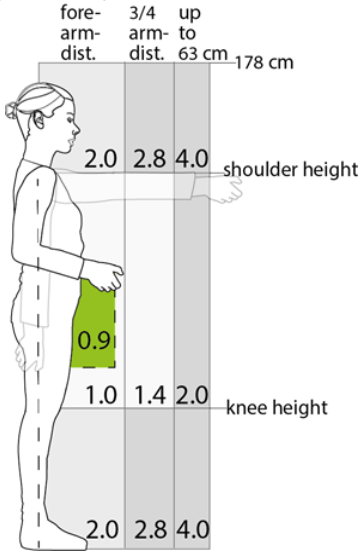
Make an assessment for an average case. Frequent handling of light loads (< 1 kg) is covered in other parts of RAMP II.

1. Estimate the weight of the load and how often it is lifted to determine the Frequency-and-weight factor (Table 1).
2. Estimate in what work area the lifting is carried out (Table 2) using the posture of the hands (height and distance) at the start and at the end of the lift. Use the largest of these values.
3. Calculate the Risk score in Table 3 by:
   a. inserting the values from Table 1 and Table 2 into Table 3.
   b. assessing the other factors on the list in Table 3 and use these when calculating the Risk score in Table 3.
   c. multiplying the factors in the column on the right in Table 3 with each other.
4. Insert this Risk score as "Risk score 1" in the box on the right at the bottom.
5. If single lifts which are perceived as particularly strenuous occur, these should be assessed separately. If so, do the same for that case, i.e. perform step 1-3.
6. If a worst case is analysed, insert its Risk score in the box "Risk score 2" on the right at the bottom. If no worst case is analysed, insert the Risk score for the average case (i.e. "Risk score 1") also in the "Risk score 2" box. Beside it information about if the Risk score corresponds to green, yellow or red risk level is displayed.

Table 1: Frequency-and-weight factor.

	Number of lifts per day	≤ 12	13 - 24	25 - 60	61 - 96	97 - 240	241 - 480	481 - 960	961-1920	1921-2880	2881-3840	3841-4800
	Equals number of lifts per hour	≤ 1.5	1.6 - 3	3.1 - 7.5	7.6 - 12	13 - 30	31 - 60	61 - 120	121 - 240	241 - 360	361 - 480	481 - 600
Weight	over 25 kg - 30 kg	**6.5**	**6.5**	**7.0**	**7.6**	**8.0**	**8.6**	**9.9**	**14.3**	**23.9**	**35.9**	**49.7**
	over 20 kg - 25 kg	**5.4**	**5.4**	**5.8**	**6.3**	**6.6**	**7.1**	**8.3**	**12.0**	**19.9**	**29.9**	**41.4**
	over 15 kg - 20 kg	**4.3**	**4.4**	**4.7**	**5.1**	**5.3**	**5.7**	**6.6**	**9.6**	**15.9**	**23.9**	**33.1**
	over 10 kg - 15 kg	**3.2**	**3.3**	**3.5**	**3.8**	**4.0**	**4.3**	**5.0**	**7.2**	**12.0**	**17.9**	**24.8**
	over 7 kg - 10 kg	**2.2**	**2.2**	**2.3**	**2.5**	**2.7**	**2.9**	**3.3**	**4.8**	**8.0**	**12.0**	**16.6**
	over 5 kg - 7 kg	**1.5**	**1.5**	**1.6**	**1.8**	**1.9**	**2.0**	**2.3**	**3.3**	**5.6**	**8.4**	**11.6**
	over 3 kg - 5 kg	**1.1**	**1.1**	**1.2**	**1.3**	**1.3**	**1.4**	**1.7**	**2.4**	**4.0**	**6.0**	**8.3**
	1 kg - 3 kg	**0.6**	**0.6**	**0.7**	**0.8**	**0.8**	**0.9**	**1.0**	**1.4**	**2.4**	**3.6**	**5.0**

Table 2: Lifting area factor. If the lift is performed outside the shaded area in the figure, add 1 point to the value of the closest cell.



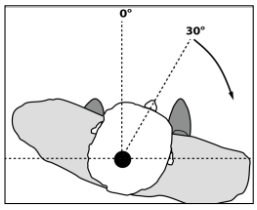


Figure: Torso twisted 30°.

Table 3: Calculation of Risk score.

	Factor	Possible worst case Factor
Frequency-and-weight factor from Table 1.		
Lifting area factor from Table 2.		
Do the following factors occur in <u>the majority</u> of lifts? If no, insert the value 1.0 to the right, else the stated value:		
☐ Lift with one hand. If yes, insert the factor 1.7.		
☐ Torso twisted more than 30° (see the figure to the right above). If yes, insert the factor 1.3.		
☐ Poor grip. If yes, insert the factor 1.1.		
☐ Hot environment 27-32°. If yes, insert the factor 1.1.		
☐ Two people lift the load. If yes, insert the factor 0.6.		
Risk score (multiply the factors in each column)		

Comment:

Score	Colour
≥ 5	
3- 4,9	
< 3	

Risk score 1:

Risk score 2:

4. Pushing and pulling work

Fill in the corresponding score in the white box **Score:**

If no pushing and pulling work occurs: Write 0 in the box on the right and go to 5. **No pushing and pulling work** **0**

Make an assessment for an average case. Frequent handling of light loads (exerted forces < 50 N) is covered in other parts of RAMP II.

If the load is pushed or pulled for less than 5 seconds, only assess the initial force (the force to set an object in motion, sometimes called starting force) using Table 4. If it is pushed or pulled for 5 seconds or longer, assess both the initial and the continuous force (i.e. also Table 5).

1. Measure the exerted force.
2. Enter Table 4/Table 5 at the relevant frequency and force level to find the corresponding Frequency-and-force factor.
3. Calculate the Risk score in Table 6 by:
   a. inserting the values from Table 4 and when applicable from Table 5 into Table 6.
   b. assessing the other factors on the list in Table 6 and use these when calculating the Risk score in Table 6.
   c. multiplying the factors in the column for initial force with each other. Do the same for continuoius force if also such an analysis is carried out.
4. Insert the Risk score for the initial force, or if also continuous force is assessed, the highest Risk score of these two as ”Risk score 1”.
5. If single pushing and pulling tasks which are perceived as particularly strenuous occur, these should be assessed separately. If so, do the same for that case of those cases, i.e. perform step 1-3.
6. If one or two worst cases (initial and continuous force) are analysed insert the highest of these two Risk scores in the box ”Risk score 2”. Else, insert the Risk score from "Risk score 1" also in the box for "Risk score 2". Beside it information about if the Risk score corresponds to green, yellow or red risk level is displayed.

Table 4: Frequency and force factor for initial force (starting force).

	Times per day	≤ 1	2 - 16	17 - 96	97 - 240	241-480	481-1920
	Times per hour		≤ 2	2.1 - 12	13 - 30	31 - 60	61 - 240
Force value	501 - 600 N	8.5	10	10.5	14	14.5	24
	451 - 500 N	7.5	9	9.5	12.5	13	22
	401 - 450 N	6.5	8	8.5	11	11.5	20
	351 - 400 N	6	7	7.5	9.5	10	18
	301 - 350 N	5	6	6,5	8	8,5	16
	251 - 300 N	4	5	5	5	7	14
	201 - 250 N	3	4	4	4	5	12
	151 - 200 N	2.5	2.5	3	3	4	5
	101 - 150 N	2	2	2.5	2.5	3	4
	51 - 100 N	1.5	1.5	2	2	2.5	2.5

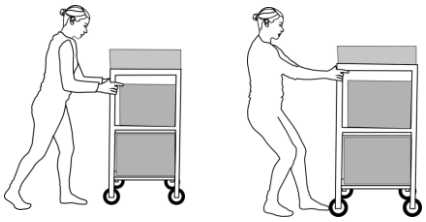


Figure: Pushing and pulling work.

Table 5: Frequency and force factor for continuous force.

Up to 8 meters: Use the force values in the table.
9 -30 meters: Add 50 N to the measured force to calculate the force value.
31-60 meters: Add 100 N to the measured force to calculate the force value.

	Times per day	≤ 1	2 - 16	17 - 96	97 - 240	241-480	481-1920
	Times per hour	hour	≤ 2	2.1 - 12	13 - 30	31 - 60	61 - 240
Force value	501 - 600 N	10.5	12	12.5	17	19	30
	451 - 500 N	9.5	11	11.5	15.5	17.5	28
	401 - 450 N	8.5	10	10.5	14	16	26
	351 - 400 N	7.5	9	9.5	12.5	14.5	24
	301 - 350 N	6.5	8	8.5	11	13	22
	251 - 300 N	6	7	7.5	9.5	11.5	20
	201 - 250 N	5	6	6.5	8	10	18
	151 - 200 N	4	5	5	5	8.5	16
	101 - 150 N	3	4	4	4	5	14
	51 - 100 N	2.5	2.5	2.5	3	4	12

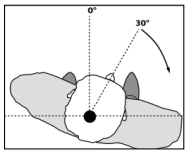


Figure: Torso twisted 30°.

Table 6: Calculation of Risk score.

	Factor Initial force	Factor Conti-nuous force	If any, worst ca-se Factor Initial force	If any, worst ca-se Factor Conti-nuous force
Frequency and force factor from Table 4, and, if applicable, from Table 5.				
Do the following factors occur in the majority of the pushes and pulls? If no, insert the value 1 to the right, else the stated value:				
☐ Pushing/pulling with one hand or sideways. If yes, insert the factor 1.7.				
☐ Gripping height: If the gripping height is below knee height or above shoulder height, insert the factor 2; if the gripping height deviates considerably from elbow height, insert the factor 1.2.				
☐ Torso twisted more than 30° (see the figure to the right above). If yes, insert the factor 1.3.				
☐ Poor grip. If yes, insert the factor 1.1.				
☐ Hot environment 27-32°. If yes, insert the factor 1.1.				
☐ Pushing/pulling work on slippery surface. If yes, insert the factor 1.7.				
☐ Two people perform the pushing/pulling. If yes, insert the factor 0.6.				
Risk score (multiply the factors in each column)				

Comment:

Score	Colour
≥ 5	
3- 4,9	
< 3	

Risk score 1:

Risk score 2:

6. Reports on physically strenuous work

6.1 Documented reporting on physically strenuous work

Do documented reports exist of physically strenuous tasks (e.g. incident reports) when cayrrying out the work task?

	Yes	No	
Documented reporting	2	0	

6.2 Type of work that has led to reporting

If "Yes" on 6.1, mark (with an x) in the table below what type of work that has led to this. Else, go to 7.

lifting	
holding/carrying	
pushing/pulling	
pushing with hand or fingers	
other (please note)_____	

7. Perceived physical discomfort

Preferably ask five people who perform this work task.

7.1 Perceived physical discomfort

Are there parts of the work which lead to physical discomfort (e.g. in muscles or joints) during the work day?
Answer "Yes" if any employee experiences such discomfort.

	Yes	No	
Discomfort in muscles or joints	2	0	

7.2 If "Yes" on 7.1, which is the worst task?

Preferably state answers from five employees in the table below.

Person 1:_____
Person 2:_____
Person 3:_____
Person 4:_____
Person 5:_____

5. Influencing factors

Fill in the corresponding score in the white box **Score:** **Comment:**

5.1 Influencing physical factors hand/arm - do the following occur? The times refer to "per work day".

	Yes	No	
a. The employee is exposed to hand-arm vibrations more than 20 minutes (10 for strongly vib).	2	0	
b. The employee is exposed to hand-arm vibrations more than 90 minutes (60 for strongly vib).†	4	x	
c. Warm or cold objects are handled manually.	2	0	
d. The hand is used as an impact tool often or a long time*.	2	0	
e. Holding hand tools weighing more than 2.3 kg for more than 30 minutes .	2	0	
f. Holding precision tools weighing more than 0.4 kg for more than 30 minutes.	2	0	

5.2 Other physical factors - do the following occur? The times refer to "per work day"

a. The employee is exposed to whole-body vibrations more than 1 hour.	2	0	
b. The employee is exposed to whole-body vibrations more than 6 hours.†	4	x	
c. The visual conditions are insufficient for the task.	2	0	
d. The work is carried out in hot or cold temperatures or in draughty environments.	2	0	
e. Standing or walking on a hard surface more than half of the work day.	2	0	
f. Prolonged sedentary work without possibility to change to do the work standing up.	2	0	
g. Prolonged standing work without possibility to change to do the work sitting down.	2	0	
h. Kneeling/squatting more than 30 times or more than 30 minutes.	2	0	

5.3 Work organisational and psychosocial factors - do the following occur?

a. There is no possibility to influence at what pace the work is performed.	2	0	
b. There is no possibility to influence the work setting or how the work shall be carried out.	2	0	
c. It is often difficult to keep up with the work tasks	2	0	
d. The employees often work rapidly in order to be able to take a longer break.	2	0	

† If you want to answer "No" on 5.1b or 5.2b, enter an "x" in the white answering box to the right.
*** Here "often" means about 100 times per working day or more and "a long time" about 30 minutes per work day or more.**

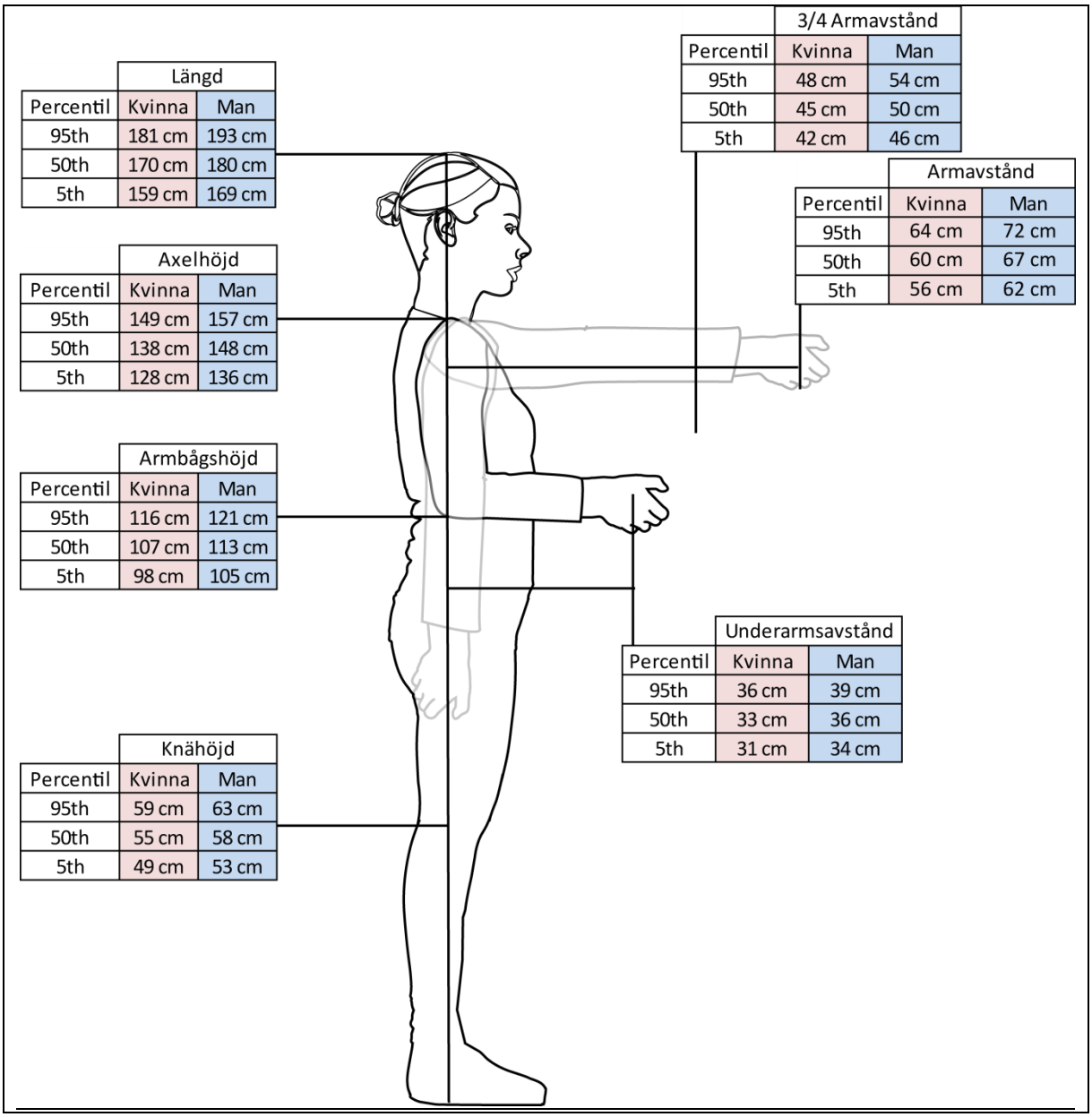
Appendix 2: RAMP II results paper version 1.00, 2014

Results - RAMP II (Version 1.00, 2014)_english version			
Ordered by:	**Date:**		
Assessed by:	**Risk/action level and score**		
Assessment of:	**Red=R Yellow=Y Green=G**	**Score**	**Comment**
1. Postures			
1.1 Posture of the head - forwards and to the side			
1.2 Posture of the head - backwards			
1.3 Back posture - moderate bending			
1.4 Back posture - considerable bending and twisting			
1.5 Upper arm posture - hand in/above shoulder height*			
1.6 Upper arm posture - hand in/outside outer work area*			
1.7 Wrist posture*			
1.8 Leg and foot space and surface			
2. Work movements and repetitive work			
2.1 Movements of the arm*			
2.2 Movements of the wrist*			
2.3 Type of grip*			
2.4 Shorter recovery/variation			
2.5 Longer recovery/variation			
3. Lifting			
3.1 Lifting (average case)			
3.1 Lifting (worst case)			
4. Pushing and pulling			
4.1 Pushing and pulling (average case)			
4.2 Pushing and pulling (worst case)			
5. Influencing factors			
5.1 Influencing physical factors hand/arm			
a+b. Hand-arm vibrations			
c. Manually handling of warm or cold object			
d. Hand used as impact tool			
e. Holding hand-tools weighing > 2.3 kg, > 30 min.			
f. Holding precision tools weighing > 0.4 kg > 30 min.			
5.2 Other physical factors			
a+b. Whole body vibrations			
c. Insufficient visual conditions			
d. Hot, cold or draughty environment			
e. Prolonged standing or walking on hard surfaces			
f. Prolonged sitting			
g. Prolonged standing			
h. Kneeling/squatting			
5.3 Work organizational and psychosocial factors			
a. No possibility to influence the work pace			
b. No possibility to influence the work setting			
c. Difficulties in keep up with the work tasks			
d. Employees work rapidly in order to take longer breaks			
6. Reports on physically strenuous work			
6.1 Documented reporting on physically strenuous work			
6.2 Type of work that has led to reporting:			
7. Perceived physical discomfort			
7.1 Perceived physical discomfort			
7.2 The worst task:			
**Insert the highest score from left or right side (hand/arm)*			
Summary of the assessment			
Number of red assessments - High risk/action level			
Number of yellow assessments - Risk/action level			
Number of green assessments - Low risk/action level			
Total score			

Paper version
Version 2015-09-22 CL

Appendix 3: Vertical and horizontal distances in RAMP II (in Swedish).

Data based on Hanson et al. (2009) and Pheasant & Haslegrave (2006). Vertical heights include a shoe-sole height of 2.5 cm.



	Längd	
Percentil	Kvinna	Man
95th	181 cm	193 cm
50th	170 cm	180 cm
5th	159 cm	169 cm

	Axelhöjd	
Percentil	Kvinna	Man
95th	149 cm	157 cm
50th	138 cm	148 cm
5th	128 cm	136 cm

	Armbågshöjd	
Percentil	Kvinna	Man
95th	116 cm	121 cm
50th	107 cm	113 cm
5th	98 cm	105 cm

	Knähöjd	
Percentil	Kvinna	Man
95th	59 cm	63 cm
50th	55 cm	58 cm
5th	49 cm	53 cm

	3/4 Armavstånd	
Percentil	Kvinna	Man
95th	48 cm	54 cm
50th	45 cm	50 cm
5th	42 cm	46 cm

	Armavstånd	
Percentil	Kvinna	Man
95th	64 cm	72 cm
50th	60 cm	67 cm
5th	56 cm	62 cm

	Underarmsavstånd	
Percentil	Kvinna	Man
95th	36 cm	39 cm
50th	33 cm	36 cm
5th	31 cm	34 cm

References

Hanson L, Sperling L, Gard G, Ipsen S, Olivares Vergara C. Swedish anthropometrics for product and workplace design. Applied Ergonomics. 2009;40:797-806.

Pheasant S, Haslegrave CM. Bodyspace : anthropometry, ergonomics and design of work. 3. ed. ed. London: London : Taylor & Francis; 2006.