Preliminary version 2 of the User Manual for the Risk Management Tool RAMP 2.0©

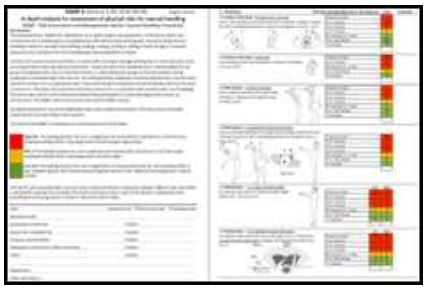
– Risk Assessment and Management tool for manual work Proactively –

RAMP I

Checklist for screening

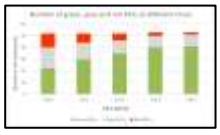
RAMP II

In depth analysis



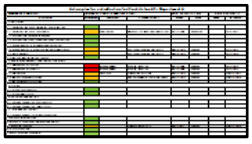
Risk Management Support

Results at different detail & scope level
Key Performance Indicators



Action Module

Action model, Action suggestions
& Action plans



KTH Royal Institute of Technology
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Foreword

Many thanks to everyone who has worked on the RAMP projects and to those who have assisted in preparing this user manual for the RAMP 2.0 tool. We also thank to the financiers, primarily AFA Försäkring (AFA Insurance) and also thank all practitioners who have used the RAMP tool and provided valuable feedback

This is the Preliminary version 2 of the User Manual for the Risk Management Tool RAMP 2.0©, (© Linda Rose, Carl Lind & Mikael Forsman, 2024). It is a further development of the User Manual for the Risk Management Tool RAMP© by Linda Rose and Carl Lind (KTH, 2017).

We are grateful to receive feedback on the preliminary RAMP 2.0 version and this second preliminary User manual until September 30 2024. Based on user feedback, we plan to update the programs and manual and launch the RAMP 2.0 (version 2.01).

We welcome your reflections at the RAMP support email address: ramp-support@cbh.kth.se.

Stockholm, August 2024

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Content

Main new features in RAMP 2.0

We are happy to announce that as of January 2024, KTH Ergonomics Division has launched the preliminary English version of the Excel programs for the new version of the RAMP tool: the "RAMP 2.0". The Swedish version's launch is planned for later during 2024. From the official RAMP website *ramp.proj.kth.se* you can download all three of the new RAMP 2.0 programs and the User Manual, all free of charge.

The main new features in RAMP 2.0 are:

- **Enhanced application range:** This is accomplished mainly with the new Hand model. The RAMP tool can now also be used for MSD risk assessment and risk management of work tasks with repeated force exertion by the hand or fingers (Assessment items 2.3 & 2.4 in RAMP I and 2.6 in RAMP II), and tasks where the hand is exposed to impact, reaction load, or shock (Assessment item 5.1.d).

- **Updated RAMP abbreviation:** The enhanced application range, from manual handling to also include work where the hands are used much, is reflected in the new version of what the abbreviation RAMP stands for, which in RAMP 2.0 is "*Risk Assessment and Management tool for manual work Proactively."*

- **Key Performance Indicators (KPIs):** KPIs, based on RAMP results, can be used to identify and visualize trends in effects of the systematic MSD risk management work and be a support for management teams as part of their basis for informed decision-making and for business management.

- **Risk Management Support module:** This consists of three parts: one about risk management processes, one where RAMP results from several assessments can be aggregated and visualized at different level of detail (the previous "Results module"), and the part with KPIs.

- **Increased usability in the RAMP II Excel program**: The main update here is that the assessments are entered directly for each assessment item in the corresponding Risk category sheet and are automatically transferred to the Results section.

- **Changed figure in RAMP II:** One of the figures (bending backwards) in Assessment item 1.4 is corrected.

- **Changes in comment boxes**: The textboxes for user comments have been made larger, so longer comments can be added. Further, for clarity, the text box "Other information" in the Input data sheet is renamed as "General comments" and the text box "Other comments" in the Results sheet is renamed as "Assessment comments".

- **Web-based version:** To improve the RAMP tool's usability further, a web-based version has been developed. We are now (in August 2024) working on its refinements and opt at launching it in the near future.

For the main new or rewritten sections in the User Manual, (corresponding Assessment items in brackets), please see:

- RAMP I's Hand model (2.3 and 2.4): "RAMP I's Hand model" in chapter 2.2.2
- RAMP II's Hand model (2.6): "RAMP II's Hand model" in chapter 3.2.2
- RAMP II's Back posture (1.4): (1.4) in chapter 3.2.2
- Impact, reaction load or shock (5.1d) (5.1d) in chapters 2.2.2 and 3.2.2
- RAMP's Risk Management Support: Chapter 4
- RAMP's Action Module: Chapter 5

1. Introduction

1.1 How this user manual is organised

This user manual for the risk management method RAMP©, version 1.02, is made up as follows:

Section 1
Here, a summary of the RAMP tool and programs is given and when the various programs can be used. There is also brief information about the area of application, use of the tool and intended users.

Section 2
This section describes RAMP I and how assessments are made, as well as the various parts of the RAMP I program.

Section 3
This section describes RAMP II and how assessments are made, as well as the various parts of the RAMP II program.

Section 4
This section describes the Risk Management Support module and the Risk Management Support program.

Section 5

This section describes the Action module and how it can be used.

References: Literature references are listed here

Appendix 1: Explanations of terms can be found here

Appendix 2: This is a "paper" version of the RAMP I checklist

Appendix 3: This is a "paper" version of the RAMP II in-depth analysis

Appendix 4: Measurements of working heights and working distances in RAMP

Appendix 5: An example of an Action plan

1.2 General presentation of the RAMP method

RAMP© – *Risk Assessment and Management tool for manual handling Proactively* – is a risk management tool that has been developed for identification, analysis, action and following up of physical ergonomic risks related to manual handling, primarily in the manufacturing, transport and logistics industries. The method consists of four modules: two assessment methods (RAMP I and RAMP II), a Risk Management Support module and an Action module (Figure 1).

RAMP I is intended for identification (screening) and initial assessment of risk factors in work that involves manual handling. RAMP I consists of a checklist for assessing the occurrence (Yes or No) of potential risk factors in the 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.* To be able to make an analysis with RAMP I the assessor (the person making the assessment) should have undergone basic training in physical ergonomics and in the RAMP method, for example through Massive Open Online Courses (MOOC courses) on RAMP, which can be followed on edx.org via KTH from the autumn 2017, as well as reading the RAMP user manual.

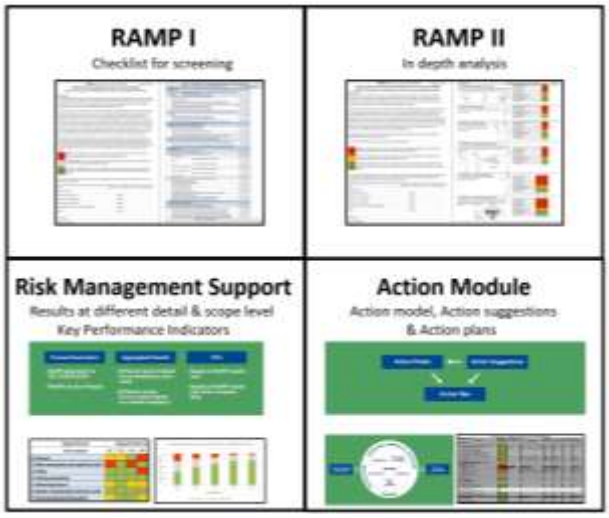


Figure 1: Schematic illustration of the RAMP tool, which consists of four modules: RAMP I, RAMP II, the Results module and the Action module.

RAMP II is designed for a more in-depth analysis and assessment (compared with RAMP I) of risk factors in work involving manual handling. RAMP II allows an in-depth analysis of many risk factors that are included in RAMP I and is divided into the corresponding 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.* To be able to perform an analysis with RAMP II the assessor should have more in-depth knowledge than is recommended for RAMP I, which can be obtained, for example, by following the MOOC courses on RAMP (see above).

The Risk Management Support module is intended to developed to support communication of the results of RAMP analyses within an organisation and to support managements to follow the effects of the systematic risk management work using Key Performance Indicators (KPIs). It consists of three parts: Process Description, Aggregated Results and Key Performance Indicators (KPIs). The Process Description. The results can visualized at several levels of detail: a detailed level where all assessed risk factors are reported, one where only the risk levels for the risk categories are reported and an overview/general level where only the number of green, grey/yellow and red assessments is presented. The results can also be presented to various extents or scope - from covering one or more workstations or departments to a whole workplace or group of companies.

The Action module is designed to support change work and consists of three parts:

i) An **Action module**, which provides support for the development of suggestions for actions in five areas: Technology & Design, Organisation, Employees, Vision and Strategies, and the Environment.

ii) Based on these five areas, the RAMP tool presents a number of **Action Suggestions** for the factors that are assessed as red (RAMP I) or yellow or red (RAMP II).

iii) A template for preparing an **Action Plan,** based on the assessment results, where information related to for example planed action, responsibilities and schedules for follow up is included.

1.3 General presentation of the RAMP programs

RAMP© is available in the form of four computer programs that can be downloaded free from the KTH website. Excel 2010 is required to use the programs. They contain the following:

The RAMP I program consists of:

- RAMP I checklist for assessment
- Detailed results from assessment
- The Action module with the Action model, automatically generated Action suggestions, and a template for an Action plan for the assessed case.

The RAMP II program consists of:

- RAMP II in depth analysis for assessment
- Detailed results from assessment
- The Action module with the Action model, automatically generated Action suggestions, and a template for an Action plan for the assessed case.

The RAMP Risk Management Support program consists of:

- Process Description,
- Aggregated Results
- Key Performance Indicators (KPIs).

1.4 How the RAMP tool can be used

Figure 2 shows which program should be used, depending on what you wish to do.

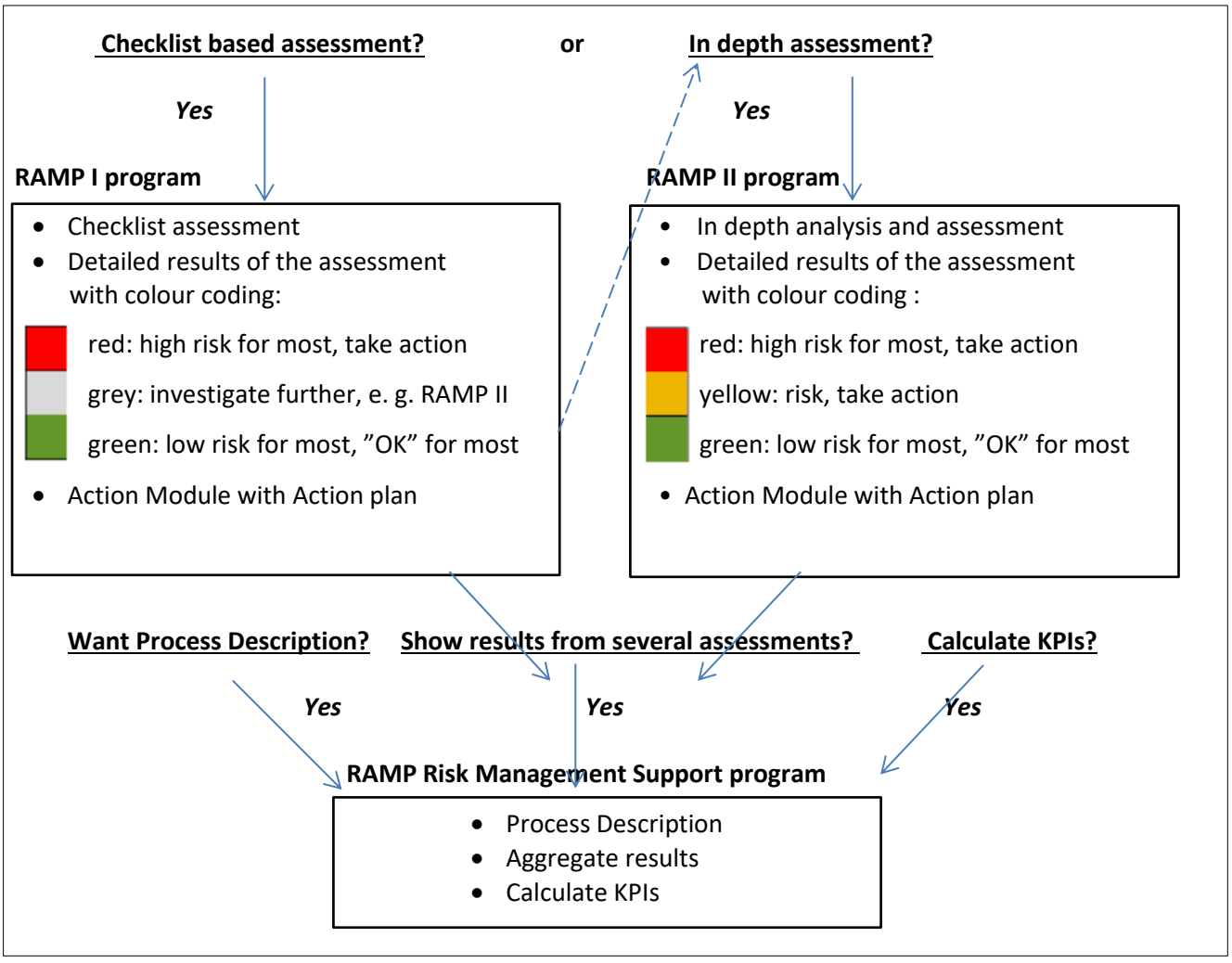


Figure 2: Illustration of which RAMP program you should use, depending on what you wish to do.

1.5 Brief introduction to RAMP's areas of application, use and limitations

RAMP has been developed for the assessment and handling of risks in work involving manual handling. Examples of such work include warehouse work, picking and packing, refilling materials in machines, loading and unloading and transport of materials. It has been developed primarily for work that is done standing or walking.

Results from RAMP should be seen as *assessments,* not an absolute prediction. RAMP has been developed for assessment at group level and is not intended for risk assessment at individual level. The load on employees during a working day can however be assessed.

The RAMP method is primarily intended for assessing physical ergonomic risks in manual handling (of physical objects, i.e. not the movement of people) with high physical loads and focuses on reducing these. In trades and professions with a low physical load there may however be reason to increase the physical load, such as with increased variation. Such trades and professions with a low physical load are generally outside the focus of the method. RAMP can be used as part of a combined assessment that is supplemented, for example, with interviews, expert assessment and other assessment methods. The method does not generally embrace work in which an employee, for example, carries a load, climbs a ladder/stairs or jumps from a height. The same applies to work that demands high precision, is performed in a confined space (such as a low ceiling) or requires the use of protective equipment that makes working more difficult. However, such factors are captured to a certain extent under risk category "6. Reports of physically strenuous work" and *"7.* Perceived physical discomfort". A few work organisation and psychosocial factors are assessed in RAMP.

Assessments of posture are based on postures without support. Even though support may be available, for the trunk for example, an action such as bending the trunk forward may involve increased load, which could affect the risk of developing physical disorders, such as musculoskeletal disorders, MSDs. In such cases no guidance is given as to how this should be assessed with the RAMP method, but it should be assessed by expert assessment, by an ergonomist for example. The same applies to 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 if the employee is sitting down. Expert assessment is also recommended if the employee, for example, wears a helmet. The same applies to a static and strongly flexed (loaded) postures without support. Generally, these risks are not well covered by the RAMP method and may involve physical discomfort or pain after relatively short periods.

The intended users of the RAMP tool and its results are mainly people whose function is in the following three areas:

- Those who currently perform ergonomic risk analysis assessments - such as *supervisors, managers, safety officers, operators and company health care providers*
- People with production responsibilities who also have a responsibility for, or are dependent upon, a good working environment - such as *production technicians, project managers and first line managers*
- Those responsible for the working environment and decision makers in a company - such as *departmental managers and decision makers for investments and strategic commercial decisions.*

Please note

Note! In RAMP, pushing and pulling forces shall be measured with a dynamometer. This is described in more detail in the section on pushing and pulling work in 2.2.2 and 3.2.2.

Note! It is advisable for information about loads to be documented and saved and that the work being analysed is documented with video. This is to make assessment easier, as well as providing a baseline that can be used for comparisons and follow up.

Note! In RAMP it is primarily the work and workstations that are assessed. If you wish to assess the load on an employee, exposure to each factor over the working day must be added together.

Note! In **RAMP 2.0's Hand model** the force used refers to **the force exerted by the hand or fingers**, for example when gripping a tool, not to the force exerted by the arm.

2. RAMP I and the RAMP I program

This section starts with a description of the RAMP I program's structure (2.1). Then follows a description of RAMP I and an explanation of how to assess the various risk factors in the checklist, as well as some examples (2.2). The section concludes with an example of the results presentation, automatically generated action suggestions, and part of an action plan, as well as a reference to where to read more about the Action module (2.3).
Note! Appendix 2 has a printout of a PDF file of the RAMP I checklist. This can be used as support during the actual assessment of a task (out at a service workshop for example). However, in order **to get the results of the assessment, the "Checklist" sheet in the RAMP I program must be filled in.** When this is done, the results can be seen on the "Results" sheet in the RAMP I program.

2.1 The RAMP I program's structure

In the RAMP I program there are seven sheets:
The "Introduction" sheet: This has a general presentation of RAMP, an introduction to RAMP I and instructions for the Excel program, see Figure 3. It is important to read the information on this sheet.

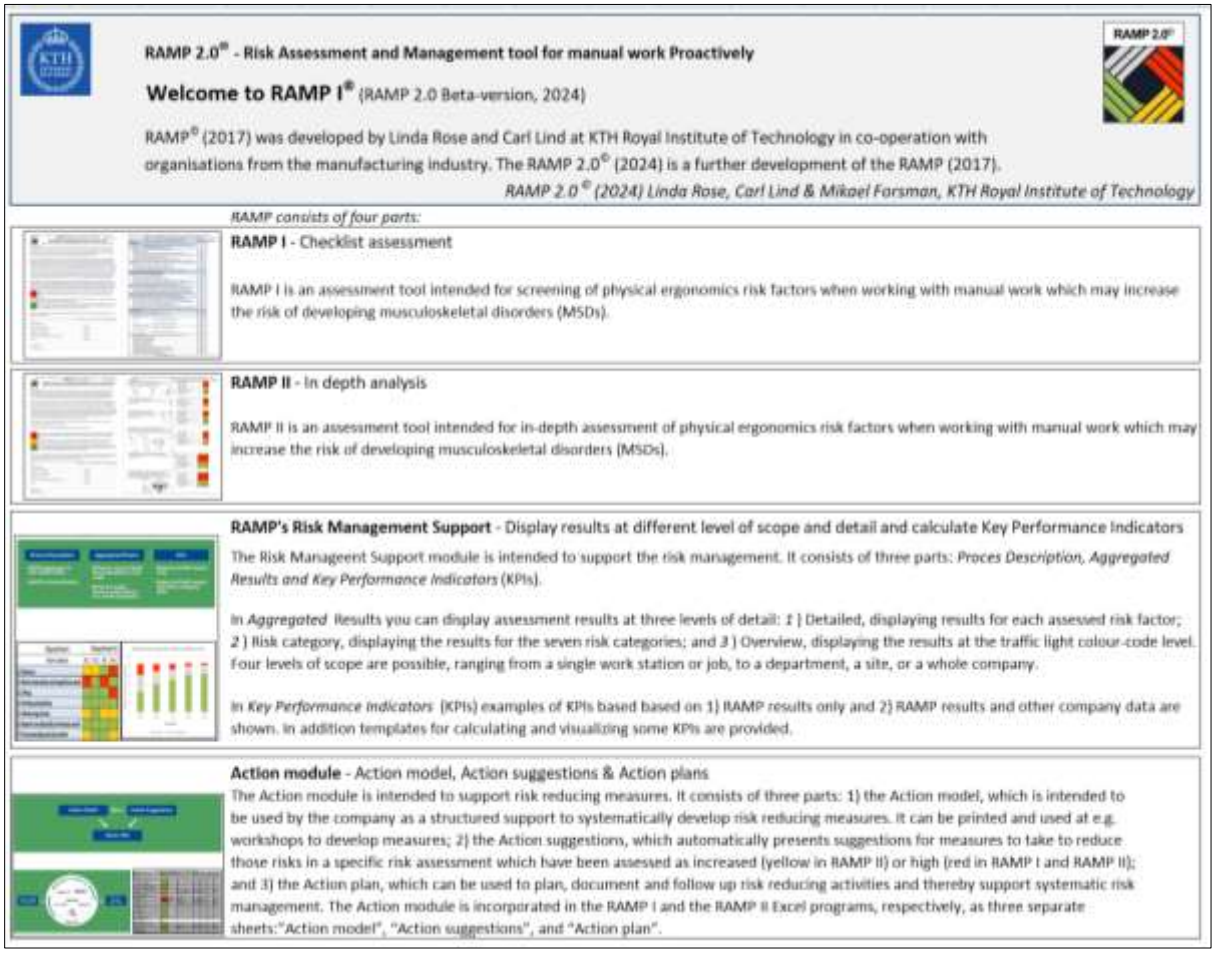


Figure 3: Part of the interface on the "Introduction" sheet in the RAMP I program.

The "Input data" sheet: This has a table to be filled in with information about the work to be assessed, see Figure 4.

Input data for assessment with RAMP I

Fill in the white areas below:			*Write an "x" on either work/work task or employee load*			
Date:	2024-01-18	Assessment of:	x	Work/work task		Employee load
Work/Work task:		A7_Service on DF				
Work station/Employee load:		A7 Service task		Department:	DF	
Site:		Stockholm		Country:	Sweden	
Assessment ordered by:		K Bengtsson		Position:	Site manager	
Assessment completed by:		B Nordin		Position:	Ergonomics manager	
Company representative:		P Palm		Position:	Technical manager	
Safety/work environment personnel:		R Olsson		Position:	Safety officer	
Other:				Position:		
General comments (if any, please write below):						

Figure 4: The table on the ”Input data” sheet in the RAMP I program.

The ”Checklist” sheet: This is a checklist to be filled in to obtain a RAMP I assessment. Questions about different risk factors are grouped into seven risk categories. Figure 5 shows part of the Checklist, the whole of which can be found in Appendix 2.

Note! If you cross off both “Yes” and “No” for any question/statement (also called “assessment items”), both crosses (x) in the checklist will be automatically marked in red indicating the error.

RAMP I - Checklist for screening physical risks for manual handling			
Note! Write an "x" (small x) in each " Yes" or "No" statement box under each question.	**Yes**	**No**	**Comment:**
1. Postures			Write your comments, if any, in the white fields below:
1.1 Does work occur often or for a long time* in any of the following unfavourable postures? ** often = about 100 times per work day or more* ** a long time = about 30 minutes per work day or more*			
a head bent backwards	x		
b back/upper body bent or twisted - forwards, backwards or towards the side	x		
c arm almost or fully stretched forwards (the hand more than about 45 cm from the spine)		x	
d hand above shoulder height or below knee height		x	
e hand/arm brought outwards to the side (to the right or to the left)			
1.2 Does work occur in any of the following unfavourable postures about 1 hour per work day or more?			
a head clearly twisted or bent - forwards or towards a side		x	
b hand clearly bent upwards, downwards or towards a side		x	
c legs or feet have insufficient space, or the surface is unstable or with a slope		x	
2. Work movements and repeated work	**Yes**	**No**	
2.1 Does work occur in any of the following ways?			
a the work cycle is shorter than 30 seconds	x		
b the work cycle is between 30 seconds and 5 minutes		x	
c similar work movements are repeated more than 1/10 up to half of the work cycle time		x	
d similar work movements are repeated more than half of the work cycle time		x	
If "No" on all in 2.1, go to 2.3. If "Yes" on any in 2.1, answer 2.2 below.			
2.2 How long time of the working day does such work occur? Choose one alternative.			
a the work or similar work tasks are carried out between 1 and 4 hours of the work day	x		
b the work or similar work tasks are carried out for more than 4 hours of the work day		x	

Figure 5: Part of the checklist on the ”Checklist” sheet in the RAMP I program.

The ”Results” sheet: This presents the work that has been assessed as well as the results of the RAMP I assessment. The result of the assessment of *risk and priority level* is given on a three-grade colour scale, where *green* signals low risk for most employees, although individual improvement action may be needed, *grey* means investigate further, while *red* means a high risk for most employees and that improvement measures should be given a high priority. This is described in more detail in 2.2. Beneath this there is also a presentation of results at an overview level, showing the number of green, grey and red assessments. Figure 6 shows part of the Results sheet.

Results of the RAMP I analysis			
Date:	2024-01-18	*Assessment of:*	Work/work task
Work/Work task:	A7 _ Service on DF		
Work station/Employee load:	A7 Service task	*Department:*	DF
Site:	Stockholm	*Country:*	Sweden
Assessment ordered by:	K Bengtsson	*Position:*	Site manager
Assessment completed by:	B Nordin	*Position:*	Ergonomics manager
Company representative:	P Palm	*Position:*	Technical manager
Safety/work environment personnel:	R Olsson	*Position:*	Safety officer
Other:		*Position:*	
General comments:			

RAMP I assessment	Assessment	User comments
1. Postures		
1.1 Does work occur often or for a long time in any of the following unfavourable postures?		
a head bent backwards		
b back/upper body bent or twisted - forwards, backwards or towards the side		
c arm almost or fully stretched forwards (the hand more than about 45 cm from the spine)		
d hand above shoulder height or below knee height		
e hand/arm brought outwards to the side (to the right or to the left)		
1.2 Does work occur in any of the following unfavourable postures about 1 hour per work day or more?		
a head clearly twisted or bent - forwards or towards a side		
b hand clearly bent upwards, downwards or towards a side		
c legs or feet have insufficient space, or the surface is unstable or with a slope		
2. Work movements and repated work		
2.1 & 2.2 Work cycles, movements & similar work		
2.3 & 2.4 Repeated force exertion by the hand or fingers		
3. Lifting work		
3.1 Does lifting of loads occur?		
3.2 How heavy are the loads and how often are they lifted?		
a less than 3 kg more than 100 times per work day		
b 3-7 kg more than 40 times per work day		
c more than 7 kg -14 kg more than 20 times per work day		
d more than 14 kg -25 kg more than 5 times per work day		
e more than 25 kg		

Figure 6: Part of the results on the ”Results” sheet in the RAMP I program.

The ”Action model” sheet: This has the Action model with instructions. This can be printed out and used by the company to help in developing suggestions for reducing risks. Figure 7 shows part of the Action model sheet.

Figure 7: Part of the Action model and its instructions on the ”Action model” sheet in the RAMP I program.

The ”Action suggestions” sheet: This shows automatically generated action suggestions for the risk factors that were assessed as red, see Figure 8.

Note! The risk factors that were assessed as grey need to be investigated further before an assessment of risk level can be made. For this reason there are no action suggestions for these.

3. Lifting work *Page 3*

3.1 Lifted load exceeds 25 kg

Type of action	*Examples of suggestions for solutions*
T&D	Aim at eliminating manual lifts where the lifted objects weight exceed 25 kg, e.g. by total or part atomization. Introducing lifting and rotating lifting tables and suchlike may be adequate solutions.
T&D	Introduce technical aids to reduce the magnitude of the load handled by the employees, or designed supports which reduce the employees strain level when handling objects. Load carriers such as carts or forklifts may be appropriate to use, or re-design how the work is carried out, e.g. by designing equipment/machinery/aids where the objects are pushed, pulled or slided instead on low friction surfaces and if possible with technical support equipment.

Figure 8: An example of automatically generated action suggestions shown on the "Action suggestions" sheet in the RAMP I program.

The "Action plan" sheet: This shows a template for an action plan, based on the assessment results. Figure 9 shows an example of part of what the template for an Action plan looks like. The left-hand side of the template is filled in automatically with the assessment results. The Action plan for reducing risks contains planned measures, when they should be performed, who is responsible and planned follow-up.

Figure 9: An example of part of the template for an action plan based on the results of an assessment on the "Action plan" sheet in the RAMP I program.

2.2 RAMP I and how to assess risk factors

2.2.1 Introduction to RAMP I

RAMP I is designed for identifying and assessing ergonomic risk factors in work that involves manual handling that may increase the risk of musculoskeletal disorders, MSDs. Manual handling involves, for example, lifting, pushing or pulling a load manually. High or long-term exposure to the risk factors increases the risk of MSDs developing or becoming worse.

Assess a type of work or a task during an average working day. Sometimes extreme cases that rarely occur may need to be assessed. Base the assessment on an employee who is representative for the task in question, or alternatively two persons, so that so that the variation among employees is somewhat taken into account. The person(s) should have good experience in how to perform the work in an appropriate way. Those who perform the assessment should be familiar with how the

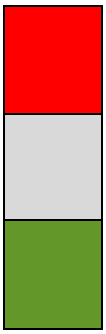
work is performed. Otherwise, the assessment should be performed in consultation with a person who has such competence. The person making the assessment should have undergone basic training in ergonomics and an introduction to the RAMP method and read through the RAMP manual.

The procedure for a RAMP I assessment

1. Begin the RAMP I analysis by filling in information about the case to be analysed on the "Input data" sheet in the RAMP I program, see Figure 4. Alternatively, this information can be entered on page 1 of the paper version of the checklist that can be found in Appendix 2 if you choose to fill this in before entering the data into the program. Here, you enter the date of the analysis, information about the work (workplace etc.) as well as whether the analysis relates to a working operation or task that is performed throughout the working day or whether the analysis intends to assess an employee's work during a working day. You also enter here information about who ordered the RAMP assessment and who is performing it.

2. Assess the risk factors by placing a cross in the most appropriate option on the "Checklist" sheet in the RAMP I program. When assessing, choose the option that best agrees with the situation and check (put a small "x" in) the "Yes" or "No" box for the question or statement. Comments specific to the actual case can be entered in the "User comments" field on the right. These will then be shown on the "Results" sheet of the RAMP I program. In RAMP I expressions about postures (in 1.1, 1.2, 2.2. 3.3) mean that you must observe whether they occur. There is no lower limit here: if you can decide that the posture referred to occurs, then you check the "Yes" box. For example: If you can observe that work occurs with a twisted upper body or back (3.3), then you check the "Yes" option.
Note! Pushing and pulling forces must be measured when using RAMP I. This is described in more detail in section "4. Pushing and pulling work in RAMP I" in 2.2.2.

3. The results are shown on the "Results" sheet in the RAMP I program. The result of the assessment of *risk and priority levels* is shown according to the three grade colour scale described in Figure 10. This shows whether any risk factors have been identified or not. If no risk factors have been identified, the risk of developing MSDs is assessed as low for persons with normal physical capacity. If one or more risk factors have been identified, this means that either there is a high risk of developing a musculoskeletal disorder or that there is a need for an in-depth analysis to assess the risk. An in depth analysis can be made with RAMP II in most cases.



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.

Investigate further. An in more in depth analysis is required to assess the risk level. A refined analysis can be carried out for example with the RAMP II module.

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.

Figure 10: The three risk and priority areas in RAMP I.

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

2.2.2 How to make assessments of risk factors in RAMP I

1. Postures in RAMP I

In risk category "1. Postures" in RAMP I (see Figure 11) an assessment is made of postures that might lead to a risk of MSDs, as well as the exposure (time and number of repetitions) in these postures.

Note! Write an "x" (small x) in each " Yes" or "No" statement box under each question.	Yes	No
1. Postures		
1.1 Does work occur often or for a long time* in any of the following unfavourable postures? ** often = about 100 times per work day or more* ** a long time = about 30 minutes per work day or more*		
head bent backwards		
back/upper body bent or twisted - forwards, backwards or towards the side		
arm almost or fully stretched forwards (the hand more than about 45 cm from the spine)		
hand above shoulder height or below knee height		
hand/arm brought outwards to the side (to the right or to the left)		
1.2 Does work occur in any of the following unfavourable postures about 1 hour per work day or more?		
head clearly twisted or bent - forwards or towards a side		
hand clearly bent upwards, downwards or towards a side		
legs or feet have insufficient space, or the surface is unstable or with a slope		

Figure 11: "1. Postures" in RAMP I.

Assessment

In 1.1 you answer "Yes" if work in the relevant posture occurs *often* (about 100 times or more per working day) or *for a long time* (about 30 minutes or more per working day).

In 1.2 you answer "Yes" if work in the relevant statement occurs for about one hour or more per working day.

Other

1.1 and 1.2 about hand and arm: The assessment for hand and arm refers to the hand/arm that has the highest load.

1.2 about legs and feet: Examples of an unstable surface are unsteady, slippery or uneven surfaces that cause the surface to be perceived as unstable. Leg or foot operated pedal work can also be assessed here.

Example 1.1a: About bending the head backwards: If work occurs with the head bent backwards once per hour and lasts for about 5 seconds each time, this means that during a working day the work occurs about 8 times (which is fewer than 100 times) and lasts for a total of about 40 seconds (which is less than 30 minutes). Check "No" for the first statement in 1.1 about bending the head backwards.

Example 1.2a: About the head clearly twisted or bent forwards or towards a side: If a person works with the head clearly turned to the side for 20 minutes and simultaneously clearly bent forwards, the time is assessed as 20 minutes (which is less than 30 minutes). Check "No" for the first statement in 1.2 about the head clearly twisted or bent forwards or towards a side.

Example 1.2b: About hand posture: If a person works with a hand clearly bent upwards for 20 minutes and later in the day with the hand clearly bent downwards for 30 minutes and later still with the hand clearly bent to the side for 15 minutes, these times are added together (20 + 30 + 15 minutes = 65 minutes). Check "Yes" to the second statement in 1.2 about hand posture.

2. Work movements and repeated work in RAMP I

In risk category ”2. Work movements and repeated work” is assessed (see Figure 12a and Figure 12b). In 2.1 and 2.2 questions are answered about work movements and repetition.

2. Work movements and repeated work		Yes	No
2.1 Does work occur in any of the following ways?			
a	the work cycle is shorter than 30 seconds		x
b	the work cycle is between 30 seconds and 5 minutes	x	
c	similar work movements are repeated more than 1/10 up to half of the work cycle time		x
d	similar work movements are repeated more than half of the work cycle time	x	
If "No" on all in 2.1, go to 2.3. If "Yes" on any in 2.1, answer 2.2 below.			
2.2 How long time of the working day does such work occur? Choose one alternative.			
a	the work or similar work tasks are carried out between 1 and 4 hours of the work day	x	
b	the work or similar work tasks are carried out for more than 4 hours of the work day		x

Figure 12a: The first part of ”2. Work movements and repetitive work” in RAMP I. Here filled in according to Example 2.1a.

Assessment

In 2.1 there are statements about the length of the work cycle and how much of the work cycle is made up of similar tasks. If none of the statements in 2.1 is correct (i.e. if you answer “No” to all of them in 2.1), go on to ”3. Lifting work”. Otherwise, also answer 2.2.

Example 2.1a: A person stands at a packing station and lifts ready-packed food products from a moving belt and down into a crate. Each crate holds 20 ready-packed food products. When the crate is full the person lifts it onto a pallet. The person then lifts a new crate down from a storage shelf and places it at the packing station. The same working procedure then starts again.

This work cycle takes 1.5 minutes, of which filling the crate takes just over 1 minute. The person performs this work for 2 hours every working day. In this case the work cycle is assessed to be 1.5 minutes and that similar work movements are performed in more than half of the work cycle (at least 1 minute of the total 1.5 minutes). Check “No” for the first and third statements in 2.1 and “Yes” for the second and fourth statements in 2.1. Check “Yes” for statement 1 in 2.2 (work is performed for 2 hours per working day, which is more than 1 but less than 4 hours per working day) and “No” for the second statement in 2.2.

RAMP I’s Hand model

Assessment

2.3 and 2.4 constitute the RAMP 2.0 tools “**Hand model”** in RAMP I. Here questions are answered about work with repeated force exertion by the hand or fingers.

2.3 Does work occur with repeated force exertion by the hand or fingers (e.g. grip a tool / push a button)?		x	
If "No" on 2.3 go to 3. If "Yes" on 2.3, measure or assess the force and answer 2.4 below.			
2.4 Does the force exertion generally occur in any or some of the following ways?			
a	the force exertion is at least moderately strenuous (at least about 30% of max)		x
b	the force exertion is at least somewhat strongly strenuous (at least about 40% of max)		x
c	the force exertion occurs more often than once per minute	x	
d	the force exertion's duration is in average longer than 2 seconds	x	
e	the force exertion is generally carried out with clearly bent wrist upwards or downwards		x

Figure 12b: The second part of ”2. Work movements and repetitive work” in RAMP I. Here filled in according to Example 2.1a.

Note! In RAMP 2.0’s Hand model the force used refers to the force exerted by the hand or fingers, for example when gripping a tool, not to the force exerted by the arm. For example, when you are pulling a load carrier towards you, using the strength of your arms and other body parts and maybe

also the weight of some body parts and friction to the surface you are standing on, **the force in the Hand model to measure or assess is the gripping force around the handle,** not the pulling force to move a load carrier. Many pushing and pulling work tasks can be assessed in RAMP's Risk category 4, that is, Pushing and pulling work.

In 2.3 you answer "Yes" if work with repeated force exertion by the hand or fingers occurs.

2.4 addresses risk factors considered to have a large impact on developing MSDs in manual work where work with repeated force exertion by the hand or fingers occurs: force, frequency, duration and wrist angle. Answer "Yes" if these factors occur as stated.

Note! Preferably, measure the force exerted by the hand and or fingers. If that is not possible, we suggest that you let five employees (or if less than five know the work, as many as you can find), who are experienced in carrying out the work task to be assessed, assess the force exertion and calculate the mean value of their force assessments. It is good to ask more than one person, to get a more reliable assessment. In RAMP II a force-matching method is used to estimate hand forces. Should you want to use that when deciding the force input data in RAMP I's Hand model, please check 2.6 in RAMP II (i.e. RAMP II's Hand model) and this User manual's chapter 3.2.1 about the assessment item 2.6.

Example 2.3a: A person works with repetitive meat cutting, using a knife with their right hand. The gripping force around the knife is 30 N when they work with the meat cutting, which is less than 30 % of their maximum force generating capacity. They change grip about 6.3 times per minute and hold the knife approximately 8 seconds, in average, in one grip during the dynamic cutting work, before they change grip or change knife and continue cutting the meat. Generally, their wrist is not clearly bent, but rather in a neutral position while working with the knife.

In this case, check "Yes" on 2.3, since the employee works with repeated force exertion by the hand (the right hand in this case). Since the force is less than 30 % of his maximum force generating capacity in this posture and with this grip, check "No" on the first two assessment items in 2.4.

The Screenshot of the checklist part with this assessment is shown above in Figure 12b. Since they change their grip of the knife, or change to gripping another knife in their meat cutting work about 6.3 times per minute (which is more often than once per minute), and do so for approximately 8 seconds in average (which is longer than 2 seconds) each time in their meat cutting work tasks, check "Yes" on the third and fourth assessment item in 2.4. Since the wrist is not generally bent during the force exertions (the meat cutting), check "No" on the last assessment item in 2.4.

Intended use and non-use of RAMP 2.0's Hand model

RAMP's Hand model **is intended** for assessing MSD risks in work tasks with repeated force exertion by the hand or fingers, where the forces exerted are at least 5% of the typical workers' maximal force in the specific grip or contact area for the work task to be analysed.
RAMP's Hand model **is not intended** for assessing MSD risks for:

- computer work, or
- other actions that involve only low forces (< 5 % of maximum)

Please note! In RAMP 2.0's Hand model the force used refers to the force exerted by the hand or fingers, for example when gripping a tool, not to the force exerted by the arm, shoulder or back.

An example is when analysing a work task where the force measured is not the force exerted by the hand or fingers, but includes contributions of forces generated by other sources. Such sources can

e.g. be forces originating from arm muscles, as for example when using the whole arm and maybe also the upper body and the friction against the surface to push something forward. In such cases, you may want to check if it would be suitable to use the pushing-and-pulling part in the fourth Risk category in RAMP II.

3. Lifting work in RAMP I

In risk category ”3. Lifting work” in RAMP I (see Figure 13) lifting work is assessed.

Assessment

In 3.1 an assessment is made regarding whether lifting work occurs. If it does not occur, check “No” for 3.1 and go straight to ”4. Pushing and pulling work”. Otherwise, fill in questions 3.2 and 3.3 of the checklist.

In 3.2 you can check several options if lifting of loads occurs in more than one of the weight ranges. In each weight range there is also a statement about how often the lift occurs.
In 3.2 you answer statements about whether lifting work occurs in any of the unfavourable posture mentioned.

3. Lifting work	**Yes**	**No**
3.1 Does lifting of loads occur? If "No", go to 4.	x	
3.2 How heavy are the loads and how often are they lifted?		
less than 3 kg	x	
- more than 100 times per work day		x
3-7 kg		x
- more than 40 times per work day		x
more than 7 kg - 14 kg	x	
- more than 20 times per work day	x	
more than 14 kg - 25 kg		x
- more than 5 times per work day		x
more than 25 kg		x
3.3 Do the lifts generally occur in any of the following unfavourable postures?		
back/upper body clearly bent	x	
back/upper clearly twisted		x
hand above shoulder height		x
hand below knee height		x
hand outside forearm distance		x
arm clearly brought outward (to the right or to the left)		x
lifting/holding with overhand grip (palm facing downward)		x
one-hand lift where the load exceeds 6 kg		x
lifting while seated where the load exceeds 7 kg		x

Figure 13: ”3. Lifting work” in RAMP I, filled in according to Example 3a.

Example 3a: A working operation consists of lifting two types of loads, loads that weigh 2.8 kg 10 times an hour and loads that weight 8 kg 4 times an hour, and the 8 kg lift is done with a bent upper body.

In this case you complete the checklist as follows: ”Less than 3 kg” is answered with “Yes” (2.8 kg is less than 3 kg). The next statement, ”- more than 100 times a day”, should be answered with “No”(10 times an hour gives 80 times a day, which is less than 100 times per working day). The next two statements are answered with “No” because no loads weighing 3-7 kg are handled. Answer the statement “more than 7 kg – 14 kg” with “Yes” (8 kg weights are lifted) and the next statement “- more than 20 times per working day” with “Yes”(4 times an hour for 8 hours means it is done 32 times per working day). The remaining statements in 2.1 are answered with “No” because no loads weighing more than 8 kg are being lifted. Check “Yes” for the first statement in 2.2 because the 8 kg lift is done with a bent upper body and “No” for the others.

4. Pushing and pulling work in RAMP I

In risk category ”4. Pushing and pulling work” in RAMP I (see Figure 14) pushing and pulling work is assessed. Pushing and pulling involves moving an object that entirely or partly rests on a surface or is suspended, e.g. in an overhead transporter (Swedish Work Environment Authority, 2012, p 28).

Assessment

In 4.1 an assessment is made of whether pushing and pulling work occurs. If it does not occur, check “No” for 4.1 and go straight to ”5. Influencing factors”. Otherwise, fill in questions 4.2- 4.4 of the checklist.

In 4.2 you check whether the measured force exceeds the stated limit values or not. In 4.3 you answer whether pushing and pulling work is performed in any of the unfavourable postures mentioned and in 4.4 whether the person performing the work must bear part of the load.

4. Pushing and pulling work		**Yes**	**No**
4.1 Does pushing and pulling work occur? If "No", go to 5.		x	
4.2 How large is the exerted force in the pushing or pulling work?			
	the starting force (the force to start the object moving) exceeds 150 Newton	x	
	the starting force (the force to start the object moving) exceeds 300 Newton		x
	the continuous force (the force to keep the object moving) exceeds 100 Newton	x	
	the continuous force (the force to keep the object moving) exceeds 200 Newton		x
4.3 Does the pushing and pulling work generally occur in any of the following unfavourable conditions?			
	the gripping height clearly deviates from elbow height	x	
	the work is carried out with the back/upper body clearly twisted		x
	the force is exerted towards the side or upwards (i.e. not straight forwards or backwards)		x
	the force is exerted with one hand		x
	the pushing or pulling is carried out often (approx. more than 100 times per work day)		x
	the pushing or pulling distance exceeds 30 meters		x
4.4	Are load carriers with 1-2 wheels (e.g. two-wheel cart) or similar used, under the following condition?		
	the employee bares the whole or part of the load, and the load weight exceeds 100 kg		x

Figure 14: ”4. Pushing and pulling work” in RAMP I, filled in as in Example 4a.

Other

Pushing and pulling forces must be measured with a dynamometer. If a load is pushed or pulled for less than 5 seconds, only measure the force used to get it moving. If a load is pushed or pulled for 5 seconds or more, measure both the force used to get it moving (the starting force) and also the continuous force during the move. When measuring forces, apply the dynamometer to the place where one normally places the hand(s) and pushes or pulls the load carrier (trolley or similar) that is to be moved. Try to recreate the development of forces that occurs in reality. Do not get the load into motion with a jerk! Repeat the measurement five times and take the median as the value of the force. This applies when measuring both types of force - pushing and pulling. The median value of a number of figures is the middle value by size. For the figures 1, 2, 5, 7, 9, it is 5 that is the median value. With an even number, the average of the two middle values is taken as the media.

The situation where forces are measured must resemble the development of forces that occurs in reality with regard, for example, to weight of load, underlying surface, speed/acceleration, type of load carrier and its condition, direction of force and handle height.

Example 4a: Part of a job consists of pushing a trolley to a “train” that is then driven onward automatically in a production system. The handle height of the trolleys being pushed is above shoulder height. The starting force has been measured and the median value is 250 Newtons (N) and since pushing goes on for about 10 seconds the continuous force has also been measured. Its median value was measured as 200 N. Check “Yes” for 4.1 because pushing work occurs.

Check “Yes” for the first statement in 4.2, since 250 N is more than 150 N and “No” for statement two, since 250 N is less than 300 N. Check “Yes” for statement three in 4.2 since 200 N is more than 100 N and “No” for the fourth statement, since 200 N is not more than 200 N but exactly 200 N. In 4.3 the first statement is answered with “Yes” because the handle height is above axle height, which clearly differs from elbow height. Check “No” for the other statements in 4.3.

5. Influencing factors in RAMP I

In risk category ”5. Influencing factors in RAMP I (see Figure15) questions are answered about whether any of the influencing factors occur. These factors are divided into ”5.1 Influencing physical factors hand/arm”, ”5.2 Other physical factors” and ”5.3 Work organisational and psychosocial factors”. The assessment of these is described in more detail below.

	5. Influencing factors	Yes	No
5.1 Influencing physical factors hand/arm - do the following occur? The times refer to "per work day".			
a	the employee is exposed to hand-arm vibrations more than 20 minutes (10 for strongly vib)		x
b	the employee is exposed to hand-arm vibrations more than 90 minutes (60 for strongly vib)		x
c	warm or cold objects are handled manually	x	
d	the hand is exposed to impact, reaction load or shock (e.g. as an impact tool) often or a long time*		x
e	holding hand tools weighing more than 2.3 kg for more than 30 minutes		x
f	holding precision tools weighing more than 0.4 kg for more than 30 minutes		x
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	x	
b	the employee is exposed to whole-body vibrations more than 6 hours		x
c	the visual conditions are insufficient for the task		x
d	the work is carried out in hot or cold temperatures or in draughty environments		x
e	standing or walking on a hard surface more than half of the work day		x
f	prolonged sedentary work without possibility to change to do the work standing up		x
g	prolonged standing work without possibility to change to do the work sitting down		x
h	kneeling/squatting more than 30 times or more than 30 minutes	x	
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	x	
b	there is no possibility to influence the work setting or how the work shall be carried out		x
c	it is often difficult to keep up with the work tasks		x
d	the employees often work rapidly in order to be able to take a longer break		x
e	there is no possibility for recovery time during the work (other than formal breaks)		x

Figure 15: “5. Influencing factors” in RAMP I, filled in according to example 5a.

Example 5a: A person works at a machine for 4 hours per day and stands on a platform that vibrates and picks finished products. The products come on a moving belt at what the person perceives to be a rapid tempo. The person places them in a carton and when this is full places it on an EU pallet, picks up a new carton and begins to fill this with products from the moving belt. The products have a temperature of 4 degrees Celsius.

5.1 Influencing physical factors hand/arm

The employee is exposed to hand-arm vibrations

5. Influencing factors		Yes	No
5.1 Influencing physical factors hand/arm - do the following occur? The times refer to "per work day".			
	the employee is exposed to hand-arm vibrations more than 20 minutes (10 for strongly vib)		
	the employee is exposed to hand-arm vibrations more than 90 minutes (60 for strongly vib)		

Assessment

Assess the total time the employee is exposed to hand-arm vibrations and whether this is powerful.

Other

A powerfully vibrating tool is one that has a vibration level over 10 m/s^2.
Vibrations that are transferred to the hands, such as from vibrating tools, can lead to MSDs. If vibrations occur it is recommended that the situation in the particular case is analysed in more depth, for example by going into the Vibration Database (http://www.av.se/teman/vibration/poangmetoden/handvibrationer/), or by taking measurements and comparing with the Vibration Directive. There is also more information on the Swedish Work Environment Authority website (http://www.av.se).

Manual handling of warm and cold objects

warm or cold objects are handled manually		

Assessment

Assess whether objects that are warm or cold are handled manually.

Other

Objects colder than 10°C are here counted as cold and objects hotter than 43°C are counted as hot (Lindqvist & Skogsberg, p. 93, 2007).

Example 5a continued: Check "Yes" for the third statement in 5.1 ("objects that are hot or cold are handled manually"), since the objects handled have a temperature of 4 °C, which is colder than 10°C.

The hand is exposed to impact, reaction load or shock

the hand is exposed to impact, reaction load or shock (e.g. as an impact tool) often or a long time*		

Assessment

Assess whether or not the hand is exposed to impact, reaction load or shock often or for a long time.

Other

Please note! In RAMP 2.0, assessment item 5.1d has been changed from the previous, RAMP 1.0 version, as part of the enhancement of the RAMP tools application range.

Here *"often"* means about 100 times a working day or more and *"for a long time"* means for about 30 minutes or more per working day.

Holding hand tools including precision tools

	holding hand tools weighing more than 2.3 kg for more than 30 minutes		
	holding precision tools weighing more than 0.4 kg for more than 30 minutes		

Assessment

Assess whether a hand tool weighing more than 2.3 kg is held for more than a total of 30 minutes per working day.

Assess whether a precision tool weighing more than 0.4 kg is held for more than a total of 30 minutes per working day.

5.2 Other physical factors

Whole-body vibrations

5.2 Other physical factors - do the following occur? The times refer to "per work day".		
the employee is exposed to whole-body vibrations more than 1 hour		
the employee is exposed to whole-body vibrations more than 6 hours		

Assessment

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

Other

Whole-body vibrations that for example are transferred when sitting or standing on a vibrating surface can lead to an increased risk of low back conditions. If vibrations occur it is recommended that the situation in the particular case is analysed in more depth, for example by going into the Vibration Database (http://www.vibration.db.umu.se/), or by taking measurements and comparing with the Vibration Directive. There is also more information on the Swedish Work Environment Authority website (http://www.av.se).

Example 5a continued: Check "Yes" for the first statement in 5.2 ("employee exposed to whole-body vibrations for more than 1 hour"), and "No" for the second statement in 5.2 ("employee exposed to whole-body vibrations for more than 6 hours"), since the employee is exposed to whole- body vibrations for 4 hours.

Visual conditions

the visual conditions are insufficient for the task		

Assessment

Assess whether visual conditions are insufficient for the work from a visual ergonomics perspective.

Other

This means that visual conditions are insufficient to be able to perform the work from a visual ergonomics perspective. The reasons for this may include unsuitable lighting, glare, weak contrast, poor sharpness, how the workplace is arranged in relation to the light and the employee's own visual ability in combination with any aids to vision. Poor visual conditions can also give rise to unfavourable postures in an attempt to see better, which can affect the risk of MSDs.

Ambient climate (cold, heat and draught)

the work is carried out in hot or cold temperatures or in draughty environments		

Assessment

Assess whether the work is performed in hot or cold conditions or in a draught.

Other

Here a cold environment means that the air temperature is less than 10°C and a warm environment usually means that the air temperature is over 25 °C (Bohgard et al. p. 195, 2010).

Hard surface

standing or walking on a hard surface more than half of the work day		

Assessment

Assess whether the work is performed standing or walking on a hard surface for more than half of the working day.

Other
This may require expert assessment in which various properties of the surface and footwear are considered together. Concrete is an example of a hard surface. Here parquet floors and mats are not generally counted as hard surfaces. However, consideration should be given to the employee's perception. Also, note that a surface that is very soft can have a tiring effect on the employee.

Prolonged sedentary work or standing

	prolonged sedentary work without possibility to change to do the work standing up		
	prolonged standing work without possibility to change to do the work sitting down		

Assessment
Assess whether the work is performed with prolonged sitting without an opportunity to change to standing work.

Assess whether the work is performed with prolonged standing without an opportunity to change to sitting work.

Other
Firstly assess whether the work is performed sitting (or standing) still or not. If for example there is a great deal of variation between walking and standing, then the work is not assessed as prolonged standing still.

To assess whether a person works in prolonged standing (still) postures, you must assess whether the person is working standing with no opportunity to sit. Standing work that has variety, such as changing to walking at times, is assessed as not prolonged standing.

Kneeling and squatting

	kneeling/squatting more than 30 times or more than 30 minutes		

Assessment
Assess whether the work involves kneeling or squatting/crouching more than 30 times or for more than 30 minutes.

Example 5b: An employee works kneeling for 20 minutes in the morning and for 25 minutes in the afternoon. Calculation: 20 + 25 minutes = 45 minutes, that is more than 30 minutes. Check "Yes".

5.3 Work organisational and psychosocial factors
Influence over work pace and set-up of work

5.3 Work organisational and psychosocial factors - do the following occur?			
	there is no possibility to influence at what pace the work is performed		
	there is no possibility to influence the work setting or how the work shall be carried out		

Assessment
Assess whether or not there is a possibility to influence the pace (tempo) at which the work is performed.

Assess whether there is no possibility to influence how the work is set up or how it is performed.

Other
Here, "*there is no possibility to influence at what pace the work is performed*" means that the tempo is controlled by someone other than the person doing the work. This means that there are few or no opportunities to vary the work tempo or perform the work at one's own pace.

Here, "*there is no possibility to influence the work setting or how the work shall be carried out*" refers to the decision latitude of the employee performing the work, for example if the employee has the chance to participate and influence how the work is performed and organised.

Preferably ask several (for instance 3-5) persons in assessing these risk factors.

Example 5a continued: Check "Yes" for the first statement in 5.3 *" there is no possibility to influence at what pace the work is performed*", since the moving belt in this case feeds the products at a relatively high and fixed tempo.

Work tempo/pace

it is often difficult to keep up with the work tasks		
the employees often work rapidly in order to be able to take a longer break		

Assessment
Assess whether it is difficult to get the work done in the time.
Assess whether the employees often work quickly (make up time) so as to take longer breaks.

Other
Preferably ask several (for instance 3-5) persons in assessing this risk factor.

Recovery during work (other than formal breaks)

there is no possibility for recovery time during the work (other than formal breaks)		

Assessment
Assess whether there is no opportunity for recovery time during the course of the work other than in breaks.

Other
Preferably ask several (for instance 3-5) persons in assessing this risk factor.

6. Reports of physically strenuous work in RAMP I

The risk category "6. Reports of physically strenuous work" in RAMP I (see Figure16) deals with whether there is documented reporting of physically strenuous work in the performance of the task.

Assessment
Investigate whether there is documented reporting (such as incident reporting) of physically strenuous work in the performance of the task.

Other
Here reports of physically strenuous work refers, for example, to reporting in the form of records in the company health service, notes on risk analyses, incident reporting, records of safety inspections and similar.

6. Reports on physically strenuous work	Yes	No
6.1 Do documented reports exist on physically strenuous tasks (near misses, incident reports, journal notes, or other) when carrying out the work task?	x	
6.2 If "Yes" on 6.1 , what type of work that has led to this? If "No", go to 7.		
lifting	x	
holding/carrying		
pushing/pulling		
pushing with hand or fingers		
other: (if any, please replace this text)		

Figure 16: "6. Reports of physically strenuous work" in RAMP I, filled in as in Example 6.2a

Example 6.2a: A person who does servicing work at a service workshop has been examined by the company health service for shoulder and knee problems. The problems have been related to a task in which the person performs heavy lifting in a squatting/crouching position.
Check "Yes" for 6.1 and "Yes" for "lifting" in 6.2.

7. Perceived physical discomfort in RAMP I

In risk category "7. Perceived physical discomfort" in RAMP I (see Figure17) questions are answered on whether employees assess that there are aspects of the work being assessed that lead to physical discomfort.

7. Perceived physical discomfort. Ask five people who perform this work task	Yes	No
7.1 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.	x	
7.2 If "Yes" on question 7.1, which is the worst task?		
Person 1 Picking product item B7 from 190 cm		
Person 2 Picking product item B7 from 190 cm		
Person 3 Picking product item B7 from 190 cm		
Person 4 Picking product item B7 from 190 cm		
Person 5 Picking product item B7 from 190 cm		

Figure 17: "7. Perceived physical discomfort" in RAMP I, filled in as in Example 7.2a.

Assessment

Investigate whether employees assess that there are aspects of the work that lead to physical discomfort (e.g. to muscles or joints).

Other

Ask five employees if there are aspects of the work that lead to physical discomfort (e.g. to muscles or joints) during the working day. If fewer than five persons perform the work, ask all of them. If one or more employees answer "Yes" to the question, check "Yes" for 7.1 and ask them what they consider to be the worst aspect of the work. Enter this information in 7.2.

This type of information, i.e. whether the employees perceive physical discomfort that they judge to be connected to the work, can be important information that can help to identify a working environment problem that can lead to MSDs. It can be used in the work of improving the working environment and reducing personal injury risks.

This question can also be viewed as an extra check that can capture work environment problems that the rest of the RAMP I checklist may not. There is research that shows that perceived discomfort in the body ca be an early predictor of MSDs.

Example 7.2a: At a warehouse five employees are asked this question. They all say that they perceive physical discomfort that they mainly connect with picking a special product item called "B7" from a height of 190 cm. 7.1 is answered with "Yes" and for all of them "Picking product item B7 from 190 cm" is entered in 7.2.

2.3 Example of the Results and Action modules in RAMP I

In this section an example is given of the detailed results presentation that can be found on the "Results" sheet in the RAMP I program and in the three sheets that contain the Action module in the program. For a more detailed description of the Action module, see section 5. Section 4 describes the Results program, which can be used to compare the results from several assessments and present them at different levels of detail.

2.3.1 Example of the Results sheet after a RAMP I assessment

On the "Results" sheet in the RAMP I program, results are given at a detailed level of the assessment performed in RAMP I. Figure 18 shows an example.

At the top information that was entered on the "Input data" sheet is shown. Then come the assessment and the user comments that were entered during assessment. At the bottom is a compilation of the results, how many risk factors have been assessed as green, grey and red. See section 2.2 of this user manual for what the different colours represent.

Results of the RAMP I analysis

Date:	2024-01-24	*Assessment of:*	Work/work task
Work/Work task:	A9 _ Service on DF		
Work station/Employee load:	A7 Service task	*Department:*	DF
Site:	Stockholm	*Country:*	Sweden
Assessment ordered by:	K Bengtsson	*Position:*	Site manager
Assessment completed by:	B Nordin	*Position:*	Ergonomics manager
Company representative:	P Palm	*Position:*	Technical manager
Safety/work environment personnel:	R Olsson	*Position:*	Safety officer
Other:		*Position:*	
General comments:			

RAMP I assessment	Assessment	User comments
1. Postures		
1.1 Does work occur often or for a long time in any of the following unfavourable postures?		
a head bent backwards		
b back/upper body bent or twisted - forwards, backwards or towards the side		
c arm almost or fully stretched forwards (the hand more than about 45 cm from the spine)		
d hand above shoulder height or below knee height		
e hand/arm brought outwards to the side (to the right or to the left)		
1.2 Does work occur in any of the following unfavourable postures about 1 hour per work day or more?		
a head clearly twisted or bent - forwards or towards a side		
b hand clearly bent upwards, downwards or towards a side		
c legs or feet have insufficient space, or the surface is unstable or with a slope		
2. Work movements and repated work		
2.1 & 2.2 Work cycles, movements & similar work		
2.3 & 2.4 Repeated force exertion by the hand or fingers		
3. Lifting work		
3.1 Does lifting of loads occur?		
3.2 How heavy are the loads and how often are they lifted?		
a less than 3 kg more than 100 times per work day		
b 3-7 kg more than 40 times per work day		
c more than 7 kg -14 kg more than 20 times per work day		
d more than 14 kg -25 kg more than 5 times per work day		
e more than 25 kg		About twice per day
3.3 Do the lifts generally occur in any of the following unfavourable postures?		
a back/upper body clearly bent		
b back/upper body clearly twisted		
c hand above shoulder height		
d hand below knee height		
e hand outside forearm distance		
f arm clearly brought outward (to the right or to the left)		
g lifting/holding with overhand grip (palm facing downward)		
h one-hand lift where the load exceeds 6 kg		
i lifting while seated where the load exceeds 7 kg		
4. Pushing and pulling work		
4.1 Does pushing and pulling work occur?		
4.2 How large is the exerted force in the pushing or pulling work?		
a & b the starting force		
c & d the continuous force		
4.3 Does the pushing and pulling work generally occur in any of the following unfavourable conditions?		
a the gripping height clearly deviates from elbow height		
b the work is carried out with the back/upper body clearly twisted		
c the force is exerted towards the side or upwards (i.e. not straight forwards or backwards)		
d the force is exerted with one hand		
e the pushing or pulling is carried out often (approx. more than 100 times per work day)		
f the pushing or pulling distance exceeds 30 meters		
4.4 Load carriers with 1-2 wheels (e.g. two-wheel cart) or similar with load weight > 100 kg?		
5. Influencing factors		
5.1 Influencing physical factors hand/arm - do the following occur? The times refer to "per work day".		
a+b the employee is exposed to hand-arm vibrations		
c warm or cold objects are handled manually		
d the hand is exposed to impact, reaction load or shock (e.g. as an impact tool) often or a long time		
e holding hand tools weighing more than 2.3 kg for more than 30 minutes		
f holding precision tools weighing more than 0.4 kg for more than 30 minutes		
5.2 Other physical factors - do the following occur? The times refer to "per work day".		
a+b the employee is exposed to whole-body vibrations		
c the visual conditions are insufficient for the task		
d the work is carried out in hot or cold temperatures or in draughty environments		
e standing or walking on a hard surface more than half of the work day		
f prolonged sedentary work without possibility to change to do the work standing up		
g prolonged standing work without possibility to change to do the work sitting down		
h kneeling/squatting more than 30 times or more than 30 minutes		
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		
b there is no possibility to influence the work setting or how the work shall be carried out		
c it is often difficult to keep up with the work tasks		
d the employees often work rapidly in order to be able to take a longer break		
e there is no possibility for recovery time during the work (other than formal breaks)		
6. Reports on physically strenuous work		
6.1 Do documented reports exist on physically strenuous tasks when carrying out the work task?		
6.2 **If "Yes"** on 6.1 , what type of work that has led to this?		
lifting	x	
holding/carrying		
pushing/pulling		
pushing with hand or fingers		
7. Perceived physical discomfort **Ask five people who perform this work task**		
7.1 Are there parts of the work which lead to physical discomfort (e.g. in muscles or joints) during the work day?		
7.2 **If "Yes"** on question 7.1, which is the worst task?		
Person 1 Picking work from high hights		
Person 2 Picking work from high hights		
Person 3 Picking work from high hights		
Person 4 Picking work from high hights		
Person 5 Picking work from high hights		
Assessment comments (below):		

Results summary:	
Number of red assessments (high risk)	**3**
Number of grey assessments (investigate further)	**11**
Number of green assessments (low risk)	**38**

Figure 18: Example of the detailed results that are shown on the ”Results” sheet in RAMP I.

2.3.2 Examples of the three Action module sheets after a RAMP I assessment

The last three sheets in the RAMP I program show the three parts of the Action module, which is described in more detail in section 5.

The Action model

The RAMP I method's Action model is shown on the sheet "Action model". It is intended that this can be printed out and used by the company when developing solution suggestions for actions that are tailored to the problem in hand. On the "Action model" sheet is the model illustrated in Figure 19, a brief description and Table 1, which gives suggestions for action.

Figure 19: Illustration of the Action model in RAMP.

The Action suggestions

On the "Action suggestions" sheet are automatically produced action suggestions for the risk factors that were assessed as red in RAMP I. Note! No suggestions are given for grey assessments, because an in-depth analysis needs to be done before the risk and priority level can be determined. Figure 20 gives an example of such a table, in this case for lifting work where the weight exceeds 25 kg.

The Action plan

The "Action plan" sheet gives a template for an action plan. Here the results of the assessment are filled in and it can be used to formulate action plans including what measures are planned, when they are to be performed, who is responsible and when follow up is to be done, see Figure 21.

3. Lifting work

Page 3

3.1 Lifted load exceeds 25 kg

Type of action	*Examples of suggestions for solutions*
T&D	Aim at eliminating manual lifts where the lifted objects weight exceed 25 kg, e.g. by total or part atomization. Introducing lifting and rotating lifting tables and suchlike may be adequate solutions.
T&D	Introduce technical aids to reduce the magnitude of the load handled by the employees, or designed supports which reduce the employees strain level when handling objects. Load carriers such as carts or forklifts may be appropriate to use, or re-design how the work is carried out, e.g. by designing equipment/machinery/aids where the objects are pushed, pulled or slided instead on low friction surfaces and if possible with technical support equipment.
T&D	Introduce technical aids to transport or present the objects so that the magnitude of exerted force and the time when the object is handled by the employee is reduced. Another suggestion is to secure that it is easy to visually inspect or physically feel that the work is performed correctly.
T&D	Consider reducing the weight of the objects handled. This can be achieved e.g. by reducing the number of components in each object. Another way is to increase the weight of the objects handled so that lifting aids definitively are needed.
ORG	Mandate the use of lifting devices. These should be designed so that they are user friendly and not seen as a hindrance. One way of achieving this is to engage the users in the design and implementation process.
ORG	Consider work organisational changes, e.g. job enrichment, job enlargement, job rotation. One possibility is to require that heavy lifts are carried out by two employees. Investigate the work flow and aim at eliminating unnecessary material handling and material transports. Also consider reducing the working pace.
EMPL	Inform, educate and train the employees and secure knowledge.
V&S	Work with aims, visions and strategies for decreasing the MSD risks.
ENV	Aim at smooth logistics access, a layout that enables easy movements and good flow and also consider physical (e.g. noise), thermal (cold/heat) and chemical factors.

Figure 20: Example of automatically generated Action suggestions on the "Action suggestions" sheet in the RAMP I program. I this case for lifting work where the weight handled exceeds 25 kg.

Action plan based on RAMP I assessment. Note that for the risk factors assessed as grey, further investigation is needed to assess the risk level and form suggested actions.

Date of assessment: 2024-01-24	Work/Employee load: Work/work task			Department: DF			
Work/Work task: A9 _ Service on DF	Site: Stockholm			Country: Sweden			
Ordered by:	Formed by:		Date (Action plan):	Note:			
Risk factor	Assessment	User comments	Planned actions	When	By whom	Ready (date)	Follow up
1. Postures							
1.1 Does work occur often or for a long time?							
a. Head bent backwards							
b. Back/upper body bent or twisted - forwards, backwards or towards the side							
c. Arm almost or fully stretched forwards							
d. Hand above shoulder height or below knee height							
e. Hand/arm brought outwards to the side (to the right or to the left)							
1.2 Work in unfavourable postures about 1 hour or more?							
a. Head clearly twisted or bent - forwards or towards a side							
b. Hand clearly bent upwards, downwards or towards a side							
c. Legs or feet have insufficient space, or the surface is unstable or with a slope							
2. Work movements and repeated work							
2.1&2.2 Work cycles, movements & similar work							
2.1&2.4 Repeated force exertion by the hand or fingers							
3. Lifting work							
3.1 Does lifting of loads occur?							
3.2. How heavy are the loads and how often are they lifted?							
a. Less than 3 kg more than 100 times per work day							
b. 3-7 kg more than 40 times per work day							
c. More than 7 kg - 14 kg more than 20 times per work day							
d. More than 14 kg - 25 kg more than 3 times per work day							
e. More than 25 kg		About twice per day					
3.3 Unfavourable postures?							
a. Back/upper body clearly bent							
b. Back/upper body clearly twisted							
c. Hand above shoulder height							
d. Hand below knee height							
e. Hand outside forearm distance							
f. Arm clearly brought outward (to the right or to the left)							
g. Lifting/holding with overhand grip (palm facing downward)							
h. One-hand lift where the load exceeds 0 kg							
i. Lifting while seated where the load exceeds 7 kg							
4. Pushing and pulling work							

Figure 21: Example of part of an Action plan in which the results of the RAMP I assessment have already been automatically entered.

3. RAMP II and the RAMP II program

This section begins with a description of the RAMP II program's structure (3.1). There is then a description of RAMP II and an explanation of how to assess the various risk factors, as well as some examples (3.2). The section concludes with an example of results presentation and automatically generated action suggestions for action and part of an action plan, as well as a reference to where you can read more about the Action module (3.3).

Note! Appendix 3 has a printout of the PDF file of the RAMP II form for in-depth analysis. This can be used for support during the actual assessment of a task, for example out at a service workshop

3.1 The RAMP II program's structure

The RAMP II program has 13 sheets:

The sheet "Introduction": This gives a general presentation of RAMP, an introduction to RAMP II and instructions for the Excel program, see Figure 22. It is important to read the information on this sheet.

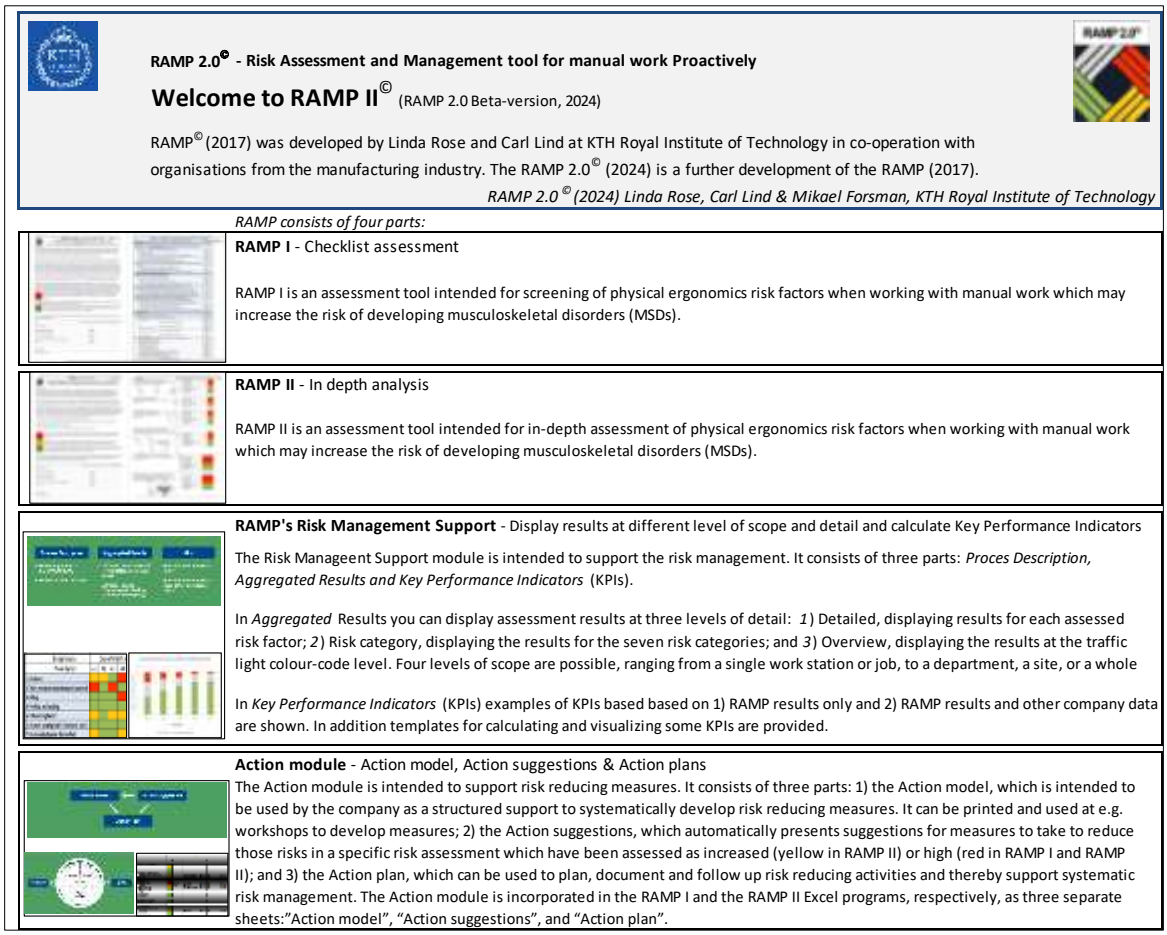


Figure 22: Part of the interface on the "Introduction" sheet in the RAMP II program.

The sheet "Input data": This has a table to be filled in with information about the work to be assessed, see Figure 23.

Input data for assessment with RAMP II					
Fill in the white areas below:			*Write an "x" on either work/work task or employee load*		
Date:	2024-01-18	Assessment of:		Work/work task	Employee load
Work/Work task:		A7_Service on DF			
Work station/Employee load:		A7 Service task	Department:	DF	
Site:		Stockholm	Country:	Sweden	
Assessment ordered by:		K Bengtsson	Position:	Site manager	
Assessment completed by:		B Nordin	Position:	Ergonomics manager	
Company representative:		P Palm	Position:	Technical manager	
Safety/work environment personnel:		R Olsson	Position:	Safety officer	
Other:			Position:		
General comments e.g. information about handled weights, forces, frequencies, etc. If any, please write below:					

Figure 23: The table on the ”Input data” sheet in the RAMP II program.

The ”1. Postures” to “7. Perceived physical discomfort” sheets: These present the seven risk categories, one in each sheet with the risk factors (also called “assessment items**”**) that are to be assessed. Figure 24 shows part of the sheet “1. Postures”.

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	

Figure 24: Part of the sheet ”1. Postures” in the RAMP II program.

The sheet ”Results”: On this sheet you enter the various Risk scores that each risk factor was assessed with, apart from risk category “3. Lifting work” and ”4. Pushing and pulling work”, which are filled in automatically on the Results sheet if the tables on these sheets have been filled in. The results of the assessment are also shown on the Results sheet. In addition, to Risk scores, the result of the assessment of *risk and priority level* is given on a three grade colour scale, where *green* signals low risk for most employees, although individual improvement actions may be needed, *yellow* means a risk for some employees and that improvement measures should be taken, while *red* means a high risk for most employees and that improvement measures should be given a high priority. This is described in more detail in 3.2. Beneath this there is also a presentation of results at an overview level, showing the number of green, yellow and red assessments. Figure 25 shows part of the Results sheet.

Results of the RAMP II analysis

Date: 2024-01-18	*Assessment of:*
Work/Work task: A7_Service on DF	
Work station/Employee load: A7 Service task	*Department:* DF
Site: Stockholm	*Country:* Sweden
Assessment ordered by: K Bengtsson	*Position:* Site manager
Assessment completed by: B Nordin	*Position:* Ergonomics manager
Company representative: P Palm	*Position:* Technical manager
Safety/work environment personnel: R Olsson	*Position:* Safety officer
Other:	*Position:*

General comments:

RAMP II assessment	Assessment	Score	User comments
1. Postures			Write your comments in the white fields below
1.1 Posture of the head - forwards and to the side		1,0	
1.2 Posture of the head - backwards		3,0	
1.3 Back posture - moderate bending		2	
1.4 Back posture - considerable bending and twisting		3	
1.5 Upper arm posture - hand in or above shoulder height*		5	
1.6 Upper arm posture - hand in or outside the outer work area*		2	
1.7 Wrist posture*		2	
1.8 Leg and foot space and surface		2,0	
2. Work movements and repeated work			
2.1 Movements of the arm (upper and lower arm)*		2	
2.2 Movements of the wrist*		1	
2.3 Type of grip - frequency*		2	
2.4 Shorter recovery/variation during work (mainly regarding the neck, the arms and the back)		4	
2.5 Longer recovery/variation during work (not breaks, e.g. task rotation that gives sufficient recovery)		3	
2.6 Work with repeated force exertion by the hand or fingers (average case)		2,7	
2.6 Work with repeated force exertion by the hand or fingers (worst case)		6,9	

Figure 25: Part of the results on the ”Results” sheet in the RAMP II program.

The sheet ”Action model”: This has the action model with instructions. This can be printed out and used by the company to help in developing suggestions for reducing risks. Figure 26 shows part of the Action model sheet.

Figure 7: (again) Part of the Action model sheet in the RAMP II program.

The sheet ”Action suggestions”: This shows automatically generated action suggestions for the risk factors that were assessed as yellow or red, see Figure 26.

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1.2 Posture of the head - backwards

Type of action	*Examples of suggestions for solutions*
T&D	Investigate the visual conditions and secure that the lighting is appropriate for the work that is carried out (e.g. illuminance, glare, and contrast) and that the work area is arranged in an appropriate way to the light. See visual ergonomics guidelines. Maybe the employees visions need to be checked and visual aids obtained.
T&D	Redesign the work/work area, also considering the visual design, so that the unfavourable postures are eliminated or reduced. For example, adjustable surfaces may be needed. Lowered shelf heights or tilted surfaces to improve vison and access may be appropriate solutions, or secure that it is easy to visually inspect or physically feel that the work is performed correctly.
ORG	Consider work organisational changes, e.g. job enrichment, job enlargement, and job rotation.
EMPL	Inform, educate and train the employees and secure knowledge.
V&S	Work with aims, visions and strategies for decreasing the MSD risks.
ENV	Aim at smooth logistics access, a layout that enables easy movements and good flow and also consider physical (e.g. noise), thermal (cold/heat) and chemical factors.

Figure 26: An example of automatically generated Action suggestions shown on the ”Action suggestions” sheet in the RAMP II program.

The sheet ”Action plan”: This shows a template for an action plan, based on the assessment results. Figure 27 shows an example of part of what the template for an action plan for an assessment looks like. The template, which is partly filled in automatically, can be used to create an action plan for reducing risks and can contain planned measures, when they should be performed, who is responsible and planned follow up.

Action plan based on RAMP II assessment								
Date of assessment: 2024-01-18	**Work/Employee load:**				**Department: DF**			
Work/Work task: A7_Service on DF	**Site: Stockholm**				**Country: Sweden**			
Ordered by:	**Formed by:**			**Date of action plan:**		**Note:**		
Risk factor	**Assessment**	**Score**	**User comments**	**Planned actions**	**When**	**By whom**	**Ready (date)**	**Follow-up**
1. Postures								
1.1 Posture of the head - forwards and to the side		1						
1.2 Posture of the head - backwards		3						
1.3 Back posture - moderate bending		2						
1.4 Back posture - considerable bending and twisting		3						
1.5 Upper arm posture - hand in or above shoulder height*		5						
1.6 Upper arm posture - hand in or outside the outer work area*		2						
1.7 Wrist posture		2						
1.8 Leg and foot space and surface		2						
2. Work movements and repeated work								
2.1 Movements of the arm (upper and lower arm)*		2						
2.2 Movements of the wrist*		1						
2.3 Type of grip - frequency*		2						
2.4 Shorter recovery/variation during work		4						
2.5 Longer recovery/variation during work		3						
2.6 Work with repeated force exertion by the hand or fingers (averege case)		2,70						
2.6 Work with repeated force exertion by the hand or fingers (worst case)		6,94						

Figure 27: An example of part of the template for an action plan based on the results of an assessment on the ”Action plan” sheet in the RAMP II program.

3.2 RAMP II and how to assess risk factors

3.2.1 Introduction to RAMP II

RAMP II is designed to provide an in-depth analysis and assessment of ergonomic risk factors in work that involves manual handling that may increase the risk of MSDs. Manual handling involves, for example, lifting, pushing or pulling a load manually. High or long-term exposure to the risk factors increases the risk of MSDs developing or becoming worse.

Assess a type of work or a task during an average working day. Sometimes extreme cases that rarely occur may need to be assessed. Base the assessment on an employee who is representative for the

task in question, or alternatively two persons, so that so that the variation among employees is somewhat taken into account. The person(s) should have good experience in how to perform the work in an appropriate way. Those who perform the assessment should be familiar with how the work is performed. Otherwise, the assessment should be performed in consultation with a person who has such competence. The person making the assessment should have undergone basic training in ergonomics and an introduction to the RAMP method and read through the RAMP manual.

The procedure for a RAMP II assessment

1. Begin the RAMP II analysis by filling in information about the case to be analysed on the "Input data" sheet in the RAMP II program, see Figure 23. Alternatively, this information can be entered on page 1 of the paper version of RAMP II that can be found in Appendix 3 if you choose to fill this in before entering the data into the program. Here, you enter the date of the analysis, information about the work (workplace etc.) as well as whether the analysis relates to a working operation or task that is performed throughout the working day or whether the analysis intends to assess an employee's work during a working day. You also enter here information about who ordered the RAMP assessment and who is performing it.

2. Assess the risk factors by filling in the most suitable Risk scores in the white box associated with each assessment item in the RAMP II program. When assessing, choose the option that best agrees with the situation and fill in Risk score for the question or statement (/assessment item). Comments specific to the actual case can be entered in the "User comments" field on the right.

Note! Pushing and pulling forces must be measured when using RAMP II. This is described in more detail in section "4. Pushing and pulling work in RAMP II" in 3.2.2.

3. The results are shown on the "Results" sheet in the RAMP II program. The main result of the assessment of *risk and priority levels* is shown according to the three grade colour scale described in Figure 28.

To supplement this, there is a score system which allows for comparison of a task (or the loads on an employee) before and after a working environment measure where the risk and priority level is unchanged. It also allows for comparison of the risks of different tasks within a risk level (in the red level for example) and a risk factor (such as upper arm posture). The score system is subordinate to the risk and priority level.

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.

Figure 28: The three risk and priority areas in RAMP II.

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.

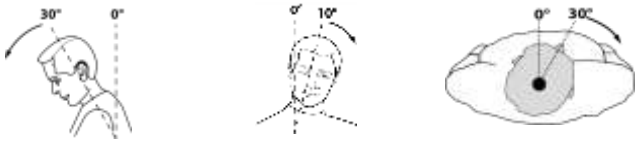
3.2.2 How to make assessments of risk factors in RAMP II

1. Postures in RAMP II

I risk category "1. Postures" in RAMP II (see Figure 11) an assessment is made of postures that might lead to a risk of MSDs, as well as the time worked in these postures. Times refer to times per working day. Enter the relevant Risk scores in the relevant white boxes.

1.1 Posture of the head – forwards and to the side

1. Postures	Fill in the corresponding score in the white box	Score:
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 during which the head (neck) is in stressful postures that correspond to the figures or more.

Other
Bending or inclination is from the vertical.

Inclination of the head is also assessed as bending. For example, forward inclination of the head can occur when working with the upper body bent forward, even if the neck is not bent (see the figures below).

With external loads, such as when wearing a helmet in stressful postures, the time in the stressful postures should be reduced still further. Expert assessment is recommended in such and similar cases. The assessment refers to time without support for the head.

Example 1.1a: If a person works with the head turned to the side (30°) for 20 minutes and then later in the day works with the head bent forward (40°) for 20 minutes, these times must be added together (20+20 minutes = 40 minutes). Give this case score 1. This score means that in this case the risk level is assessed as low and is coded green.

Example 1.1b: If a person works for 20 minutes with the head turned to the side (30°) and simultaneously bent forward (40°) the time is instead assessed as 20 minutes (i.e. score 0.5, green).

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

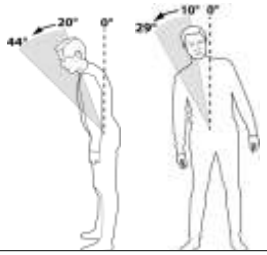
Assessment
Assess the total time the head (neck) is bent backwards corresponding to the figures or more.

Other
Bending is from the vertical.

With external loads, such as when wearing a helmet in stressful postures the duration in stressful postures should be reduced still further. In such and similar cases expert assessment is recommended. The assessment refers to time without support.

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 during which the back is in a stressful posture that corresponds to the figures.

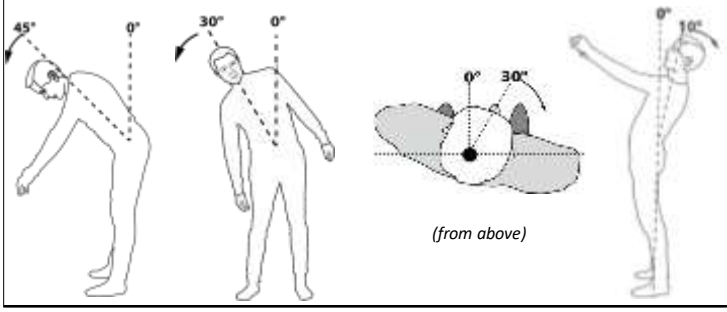
Other
Bending is from the vertical.

The assessment refers to time without support, (i.e. bending over while resting the arms on a table).

Add the times in stressful postures in the same way as in Examples 1.1a and 1.1b.

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?



(from above)

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 during which the back is in a stressful posture that corresponds to the figures or more.

Other
Please note! In RAMP 2.0, the backwards bending figure and angle in assessment item 5.1d has been corrected from the previous, RAMP 1.0 version.

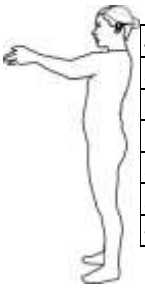
Bending is from the vertical.

The assessment refers to time without support for body parts.

Add the times in stressful postures in the same way as in Examples 1.1a and 1.1b.

1.5 Upper arm posture - hand at 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 during which the hand (or upper arm) is above shoulder height. Assess both arms.

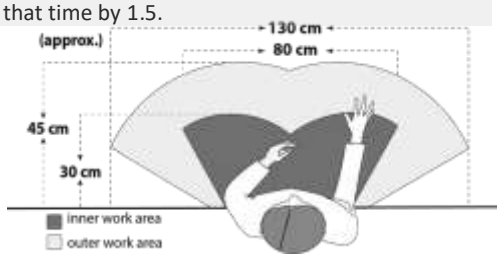
Other
The question refers to loads on the elbow, shoulder and neck and focuses on loads due to the upper arm position. Generally speaking, there is a connection between the positions of the upper arm and hand, e.g. if the hand is at shoulder height, then the upper arm is often in a stressful posture (for example flexion or abduction).

Assessment item 1.5 refers to time without support to the arms.

In the Results section the arm that has the higher risk is reported.

1.6 Upper arm posture - hand in or outside outer working 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 during which the hands (or upper arm) are outside the inner working area (dark grey). If the hands are both in the outer working area (light grey) and outside the outer working area (white), the times for these count the same (see Examples 1.6a and 1.6b). Time outside the outer working area (i.e. white area in neither the inner nor the outer working area) is multiplied by 1.5. Assess both hands.

Other
The assessment refers to loads on the elbow, shoulder and neck due to flexed or abducted upper arm. Inner working area = approximately lower arm distance to grip (forward). The inner working area on average is approximately 33 cm for women (50th percentile) and approximately 36 cm for men (50th percentile) (see Appendix 3).

Outer working area = approximately ¾ arm's length to grip (forward). The outer working area on average is approximately 45 cm for women (50th percentile) and approximately 50 cm for men (50th percentile) (see Appendix 3).

Assessment item 1.6 refers to time without support for the arms.

In the Results section the arm that has the higher risk is reported.

Example 1.6a: An employee works for 45 minutes with the right hand in front of the body at about ¾ arm's length. This is assessed as being in the outer working area and is assessed with Risk score 2, i.e. the assessment will be yellow.

The left hand mainly rests in the inner work area and is active around 10 minutes, resulting in Risk score 1 and a green assessment.

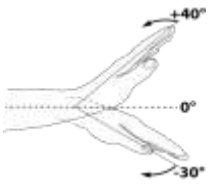
Example 1.6b: An employee works for 45 minutes with the right hand in the outer working area and then for 20 minutes outside the outer working area. Calculation of duration: 45 minutes + 1.5 x 20 minutes = 45+30 = 75 minutes, which corresponds to Risk score 3, i.e. the assessment will be red.

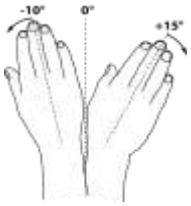
The left hand is used for work tasks about 25 minutes in the outer work area, resulting in Risk score 1 and a green assessment.

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 during which the wrist is in a stressful posture that corresponds to the figures or more. Assess both hands.

Other

Add the times in stressful postures in the same way as in Examples 1.1 a and 1.1a.

In the Results section the wrist that has the higher risk is reported.

1.8 Leg and foot space and underlying 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 during which there is insufficient space for the legs or feet or the surface is unstable or sloping.

Other
Examples of an unstable surface are unsteady, slippery or uneven surfaces that cause the surface to be perceived as unstable.

Add the times for unfavourable conditions relating to the surface or space for the legs or feet in the same way as in Examples 1.1a and 1.1b.

Foot- and leg-operated pedal work can be assessed here, since 1.8 is largely based on the Swedish Work Environment Authority's AFS 2012:02 (Posture p.37).

2. Work movements and repetitive work in RAMP II

In risk category "2. Work movements and repetitive work" in RAMP II an assessment is made of the arm and wrist movements, grip type, repetition and short or long recovery time or variation during the work.

2.1 Movements of the arm (upper and lower arm)

2.1 Movements of the arm (upper and lower arm)		Left	Right
How are the movements of the arm generally? 	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 being assessed according to the table above. Assess both arms.

Other
Make a general assessment of the arms' working movements as they occur during a representative working day.

In the assessment item 2.1 'pause' means an opportunity for recovery for the shoulder area during work, not scheduled work breaks (e.g. lunch break).

In the Results section the arm that has the higher risk is reported.

2.2 Movements of the wrist

2.2 Movements of the wrist		Left	Right
Do similar movements of the wrist occur? 	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 number of wrist movements per minute during a representative working day according to the table above. Assess both wrists.

Other
Make a general assessment of how often wrist movements generally occur during a representative working day.

'Similar movements' means working movements that load the same bodily structure in a similar way.

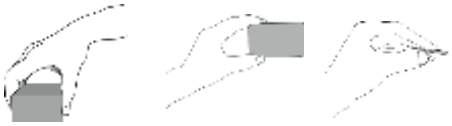
In the Results section the wrist that has the higher risk is reported.

Example 2.2a: The hand is moved clearly upwards (extension) from the neutral position and then back. This is assessed as one movement.

Example 2.2b: The hand is moved clearly upwards (extension) from the neutral position and then back. It is then moved clearly downwards (flexion) and back. This is assessed as two movements.

2.3 Grip type - 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 number of handlings per working day of objects that weigh 0.5 kg or more and that are lifted or held with an overhand grip (palm down), wide finger grip, pincer grip (see figure above) or equivalent loaded grip. Assess both hands.

Other
Assess the total handling in one of the grip types or equivalent loaded grip.

In the Results section the side that has the higher risk is reported.

Example 2.3a: During a normal working day an employee lifts 60 (1 kg) items with an overhand grip with the right hand, then 80 (1.5 kg) items with a wide finger grip with the right hand and then 200 (0.4 kg) items with a pincer grip with the right hand. The person then lifts 110 (1 kg) items with the left hand.

Assessment for the right hand: 140 items (60 + 80) weighing at least 0.5 kg are lifted. This is in the range 101-200 times per day and is assessed with Risk score 2, i.e. the assessment will be yellow.
Assessment for the left hand: 110 items weighing at least 0.5 kg are lifted. This is in the range 101-200 times per day and is assessed with Risk score 2, i.e. the assessment will be yellow.

Assessment: The assessment that is higher of the right or left hand is to be chosen. Since in this case they are the same, Risk score 2 is entered for one of them on the "Results" sheet in the results table.

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 the total time for recovery generally during the work. Then assess the total time for recovery per 10 minutes work. Assess whether the work gives the opportunity for sufficient variation or interruption so that the muscle groups that are loaded have time for recovery. Recovery must be for at least 5 consecutive seconds in order to be counted. If the consecutive time is less than 5 seconds, it is not to be counted.

Other

To reduce the risk of MSDs, it is considered important to have variation in the work so that the muscle groups that are stressed (mainly during static load) have the opportunity for recovery – regarding sufficient oxygen levels and that waste products can be transported away, for example after a period of work when mostly certain muscles are strained, working on other tasks where these muscles have low strain and can recover. For muscle recovery to occur, one can thus vary the work during a task.

2.5 Longer recovery time/variation during work (not breaks)

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

Assess the total time for recovery generally during the work. Assess whether the work gives the opportunity for sufficient variation or interruption so that the muscle groups that are loaded have time for recovery. Add together the recovery times that are at least 5 consecutive seconds long. Thus, they do not need to be 5 consecutive minutes. Recovery means for example that the muscles that have been under load have the opportunity to recover, e.g. by using other parts of the body for a period. This means that total rest is not required.

Other

To reduce the risk of MSDs, it is considered important to have variation in the work so that the muscle groups that are stressed (mainly during static load) have the opportunity for recovery, especially sufficient oxygen levels and t waste products being transported away. This can be achieved by, after a period of work when mostly certain muscles are strained, working on other tasks where these muscles have little strain and can recover. For muscle recovery to occur, one can thus vary the work during a task.

RAMP II's Hand model

2.6 Work with repeated force exertion by the hand or fingers

In "2.6 Work with repeated force exertion by the hand or fingers" (also called RAMP II's "Hand Model") is assessed. If no such work occurs, assess the work as having Risk score 0 and enter the number "0" in the white box at the top right and then continue to "3. Lifting work".

In "2.6 Work with repeated force exertion by the hand or fingers" the text in the text box provides a brief instruction in nine steps of the procedure for how to make an assessment, using the Table A, Tables 7-9 and a figure of wrist postures for assessment, and calculate the result in Table 10, as the screen dump below illustrates.

2.6 Work with repeated force exertion by the hand or fingers — Fill in the corresponding score in the white box: Score

If no work occurs with the hand or fingers in repeated force exertions: Write "0" in the box on the right and go to 3. — No work with the hand in repeated force exertions: 0

Make the assessment for the hand with the highest exposure. If you are unsure which of the hands has the highest exposure, assess both hands. The Risk score for the hand with the highest exposure is displayed in the results. Make an assessment of an average case. Frequent handling of low forces (< 5 % of maximum) and computer work are not considered here.

1. Choose the suitable type of grip/contact area in Table 7. Measure the exerted force for that grip/contact area. (If you cannot measure this, mark the chosen grip/contact area type in Table A's drop-down list and measure five employees maximum exerted power grip force three times. Insert the highest of these values in Table A for each employee. Thereafter, let them assess the % of max force exerted in the case to be analysed and insert it in the Table A for each employee. An average, based on the inserted values, is calculated automatically and the force-interval cell to use is highlighted in Table 7.)
2. Assess how often the force is exerted.
3. Choose the grip/contact area in Table 7 which best matches the current case and follow that column down to the force interval cell which includes the current force.
4. Move towards the right in Table 7 to the cell including the frequency for the force exertion, to determine the Grip-force-and-frequency factor.
5. Based on the duration of each force exertion generally, determine the Duration-per-exertion factor in Table 8.
6. Assess the general wrist posture during the force exertions. Based on the posture (extension/flexion) in Table 9 showing the highest value, determine the Wrist-posture factor.
7. The Risk score is calculated in Table 10 by multiplying the four factors which you have determined above. This is done automatically in the digital model. The Risk score can also be calculated "by hand" if you do not have access to the digital version. The Risk score for the average case is displayed as "Risk score Average case" in the bottom right corner.
8. If single force exertions are performed which are perceived as particularly strenuous, these should be assessed separately. If so, do the same for that case, i.e. perform step 1-8.
9. If a worst case is analysed, the Risk score for this case is displayed as "Risk score Worst case" in the bottom right corner below. If no worst case is analysed, the "Risk score Average case" is also displayed in the "Risk score Worst case" box.

Table 7: Grip-, force-and-frequency factor.

Grip /contact area type												
Power grip	Thumb pinch / Thumb press	Three-finger grip[1]	Index pinch[2] / Index press	Exertions per:	Frequency Choose exertions per day, hour or minute.							
				day	≤ 96	97 - 479	480 - 959	960 - 1439	1440 - 1919	1920 - 2399	2400 - 2880	2881 - 3840	3841 - 4800	4801 - 9600	9601 - 14400
				hour	≤ 12	13 – 59	60-119	120-179	180--239	240 - 299	300 - 360	361 - 480	481 - 600	601 - 1200	1201 - 1800
				minute	≤ 0.2	0.3 – 0.9	1	2	3	4	5-6	7 - 8	9 - 10	11 – 20	21 – 30
Force [N]	> 220	> 54	> 60	> 43	8.5	13	20	34	48	65	99	131	162	308	440
	196 - 220	49 - 54	55 - 60	40 - 43	6.7	10	16	27	38	51	77	102	126	239	341
	176 - 195	44 - 48	49 - 54	36 - 39	5.1	7.9	12	21	29	39	59	78	97	184	263
	151 - 175	39 - 43	43 - 48	31 - 35	3.9	6.0	9.2	16	22	30	45	60	74	141	201
	131 - 150	33 - 38	37 - 42	27 - 30	3.0	4.6	7.0	12	17	23	34	46	57	107	153
	111 - 130	28 - 32	31 - 36	23 - 26	2.3	3.5	5.3	9.2	13	17	26	35	43	82	117
	89 - 110	23 - 27	25 - 30	18 - 22	1.7	2.7	4.1	7.0	9.9	13	20	27	33	62	89
	66 - 88	17 - 22	19 - 24	14 - 17	1.3	2.0	3.1	5.2	7.4	10	15	20	25	47	67
	46 - 65	12 - 16	13 - 18	9 - 13	1.0	1.5	2.3	3.9	5.5	7,4	11	15	18	35	49
	23 - 45	6 - 11	7 - 12	5 - 8	0.7	1.0	1.6	2.7	3.9	5.2	8	10	13	24	35
	12 - 22	4 - 5	4 - 6	3 - 4	0.4	0.6	1.0	1.6	2.3	3.1	4.7	6	8	15	21
	5 - 11	1 - 3	1 - 3	1 - 2	0.3	0.4	0.6	1.1	1.5	2.0	3.0	4.0	5	9.4	13

[1] = Palmar pinch, Tripod pinch grip, Chuck grip.
[2] = Tip pinch, Tip-to-tip, Pulp pinch.

Table A: Assessment of force (if you cannot measure it for the chosen grip /contact area type).

Choose Grip / Contact area type from the drop-down list:	Choose grip:					Average prower grip force & % max force for chosen grip	
	Person 1	Person 2	Person 3	Person 4	Person 5		
Insert five employees highest measured power grip force in [N]:							
Insert 5 empl. assessed % of max force exerted in the case in [%]:							

Table 8: Duration-per-exertion factor. Please state this for the general duration per exertion.

Duration of the force exertion [s]	≤ 0.2	0.3 – 0.9	1 – 2	2.1 - 3.4	3.5 – 5	6 – 10	11 – 20	21 – 30	31 – 60	61 – 90	91 – 120	121 – 240
	0.5	0.7	**1.0**	1.3	1.9	3.3	6.2	9	18	25	30	43

Table 9: Wrist-posture factor. Please state this for the general wrist posture during the force exertions.

Extension (wrist angle upwards)	0 – 45°	> 45°	
Flexion (wrist angle downwards)	0 – 15°	16 – 45°	> 45°
Factor	**1.0**	1.4	1.6

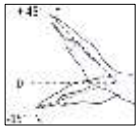


Table 10: Calculation of Risk score.

	Left Average case Factor	Right Average case Factor	Left Possible worst case Factor	Right Possible worst case Factor
Grip-, force-and-frequency factor from Table 7.				
Duration-per-exertion factor from Table 8.				
Wrist-posture factor from Table 9.				
Risk score (multiply the factors in each column)	0,0	0,0	0,0	0,0

Comment: (Start on the next row)

Score	Colour
≥ 5	
3 - 4.9	
< 3	

Risk score Average case:
Risk score Worst case:

If work occurs with repeated force exertion by the hand or fingers, then make an assessment of an *average case* and if there is a *worst case*, assess this as well. The worst case could for example consist of forcefully and frequently gripping a manually-powered tool, or be a case where the hand is used in a relatively low or a moderate force exertion but this is done with a long duration. Both of these scenarios may result in high risks of injury.

Make the assessment for the hand (i.e. left or right) with the highest exposure. If you are unsure which hand has the highest exposure, assess both hands. The Risk score for the hand with the highest exposure will be displayed in the results. Make an assessment of an average case. Frequent handling of low forces (< 5 % of maximum force) and computer work are not considered in RAMP's Hand model.

Assessment

The assessment is performed as follows: Begin by assessing an *average case*.

1. Choose the suitable type of grip/contact area in Table 7. Measure the exerted force for that grip/contact area. (If you cannot measure this, mark the chosen grip/contact area type in Table A's drop-down list and measure the maximum exerted power grip force [N] three times for each of up to five employees. Insert the highest of these values in Table A for each employee. Thereafter, let them assess the % of max force exerted in the case to be analysed and insert it in the Table A for each employee. An average based on the inserted values is calculated automatically and the force-interval cell to use is highlighted in Table 7).
2. Assess how often the force is exerted.
3. Choose the grip/contact area in Table 7 which best matches the current case and follow that column down to the force interval cell which includes the current force.
4. Move towards the right in Table 7 to the cell including the frequency for the force exertion, to determine the Grip-force-and-frequency factor.
5. Based on the duration of each force exertion generally, determine the Duration-per-exertion factor in Table 8.
6. Assess the general wrist posture during the force exertions. Based on the posture (extension/flexion) in Table 9 showing the highest value, determine the Wrist-posture factor.
7. The Risk score is calculated in Table 10 by multiplying the four factors which you have determined above. This is done automatically in the Excel version. The Risk score can also be calculated "by hand" if you do not have access to the digital version. The Risk score for the average case is displayed as "Risk score Average case" in the bottom right corner.
8. If single force exertions are performed which are perceived as particularly strenuous (i.e. 'worst case'), these should be assessed separately. If this is the case, perform step 1-7 as described above as a "Worst case".
   If a worst case is analysed, the Risk score for this case is displayed as "Risk score Worst case" in the bottom right corner below. If no worst case is analysed, the "Risk score Average case" is also displayed in the "Risk score Worst case" box.

The boxes "Risk score 1" and "Risk score 2" at the bottom right of the page are colour-coded according to the green-yellow-red assessment scale and show which risk and priority level the two Risk scores obtained.

Force assessment by force-matching

As described above, if it is not possible to measure the force exerted by the hand or fingers in the grip or on the contact area used in the work you want to assess, the newly developed force simulation ("force matching") method can be used to calculate the force with help of Table A in the RAMP II's Hand model. Here, an example of such assessment of force follows.

Table A: Assessment of force (if you cannot measure it for the chosen grip /contact area type).

Choose Grip / Contact area type from the drop-down list:	Three-finger grip			-		Average power grip force & % max force for chosen grip	Assessed equivalent Three-finger grip force (N)
	Person 1	Person 2	Person 3	Person 4	Person 5		
Insert five employees highest measured power grip force in [N]:	275	255	297	301	218	269	17
Insert 5 empl. assessed % of max force exerted in the case in [%]:	25	20	25	25	20	23	

Figure 29a: Table A in 2.6 Work with repeated force exertion by the hand or fingers" in RAMP II. This example illustrates an example where "Three-finger grip" is chosen.

Choose the grip type or contact are type in the drop-down menu in Table A. In the example in Figure 29a, the Three-finger grip is chosen in "Table A: Assessment of force".

Next, ask up to five employees who are used to performing the work to perform a maximum **power grip** on a force-measuring device (e.g. a Jamar force measurement device). Do this 3 times for each employee and note the highest value as the maximum force value for Person 1, Person 2, etc. in Table A Assessment of Force in 2.6. From these values the average max force value in Newtons [N] is calculated automatically and displayed towards the right in Table A. In the example in Figure 29a, the average max power grip force is 269 N.

After assessing employees maximum grip force let each of the up to five persons estimate how much of their maximum force in % they use in the work in the *current* case's grip/contact area. Insert also these values in the corresponding cells in Table A. The average value for % of the max for that grip/contact area for the group of up to 5 employees is calculated automatically and also displayed in Table A. In the example in Figure 29a for the Three-finger grip, the average assessed % of max is 23 %.

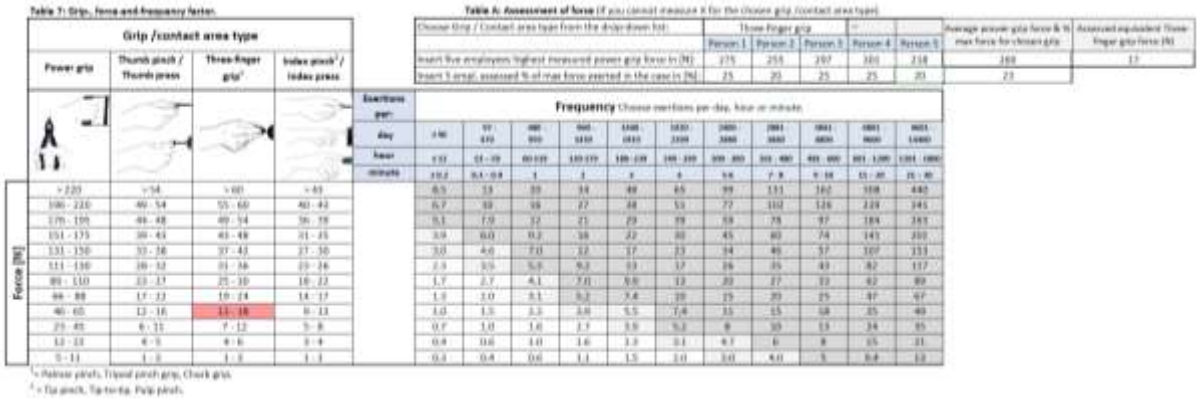


Figure 29b: Table 7 in "2.6 Work with repeated force exertion by the hand or fingers" in RAMP II, where the corresponding force interval to use is highlighted in red. In the case described above this is 13-18 N.

Based on this, the estimated force (in Newtons) developed in the current grip/contact is calculated by the program and displayed in the right-most cell in Table A. In the example in Figure 29a this is 17 N. The corresponding force interval cell is highlighted in red in the left part of Table 7 (see Figure 29b), in this case "13-18 N".

This calculation based on strength data for the various grip and contact areas based on the strength data of approximately 95 000 individuals, used as strength data in RAMP 2.0-'s Hand model. This method, which is a type of so-called force-matching, [Wiktorin et al., 1996; Li & Yu, 2011], enables measurement and simulating the force, which is more reliable than just estimating it [Wiktorin et al., 1996].

Intended use and non-use of RAMP 2.0's Hand model

RAMP's Hand model **is intended** for assessing MSD risks in work tasks with repeated force exertion by the hand or fingers, where the forces exerted are at least 5% of the typical workers' maximal force in the specific grip or contact area for the work task to be analysed.
RAMP's Hand model **is not intended** for assessing MSD risks for:

- computer work, or
- other actions that involve only low forces (< 5 % of maximum)

Please note! In RAMP 2.0's Hand model the force used refers to the force exerted by the hand or fingers, for example when gripping a tool, not to the force exerted by the arm, shoulder or back.

An example is when analysing a work task where the force measured is not the force exerted by the hand or fingers, but includes contributions of forces generated by other sources. Such sources can e.g. be forces originating from arm muscles, as for example when using the whole arm and maybe also the upper body and the friction against the surface to push something forward. In such cases, you may want to check if it would be suitable to use the pushing-and-pulling part in the fourth Risk category in RAMP II.

Which grip and contact area should be chosen?
For grips and contact areas similar to the examples provided in the RAMP II Hand model, Table 7, choose the most suitable. If you are unsure which of two grips or contact areas you should choose, we suggest that you choose the most conservative one, that is, the one that results in the highest Grip-, force-and-frequency factor of the two alternatives you are considering. An alternative way to come to this decision is to choose the grip / contact area, among the two alternatives you are considering, with the lowest force value in the first force row in the left-hand side in Table 7 (that is, the row with the values "> 220", "> 54", "> 60", and ">43" [N]).

If none of the grips or contact areas in RAMP II Hand model's Table 7 are close to the grip or contact area in the work task you want to analyse, we suggest you consider another risk assessment tool. An example of this a work task where a machine operator, pushes the package forward, with an open palm and all the hand's fingers, into the machine, most likely also using other structures than just those in the hand and fingers to exert the force. In this case we have two causes for not using the RAMP's Hand model for analysing the risk: *1*) The contact area with open palm and all the hands fingers is not similar to any of the grips or contact areas, and *2*) The force pushing the package forward is not only the force exerted by the hand or fingers, but at least involves part of the muscles in the arm.

However, you may want to consider to use the RAMP's Pushing-and-pulling work model (the fourth Risk category) to analyse the pushing and pulling work. Please note that using RAMP's Pushing-and-pulling work model would focus the analysis on risks connected to pushing-and-pulling work, not on the risks connected to the work where the hand or fingers are used in repeated force exertions.

Other
If an assessor wants to analyze a work task that includes several different grips / contact areas included in the RAMP Hand model, the question of how to choose grip/contact area may arise. This could be done in several ways. Some of the grips / pushes on contact areas engage different structures in the hand and this could be taken into account. However, this requires advanced knowledge regarding both the body and resources, e.g. reference materials. For simplicity, we suggest that the person or persons who perform the risk assessment choose the grip / contact area that they consider as having the highest risk. The choice can be based on e.g.:

- Already existing risk assessments or documented material, when available within the company (see also Risk category 6 in the RAMP tool) or "general" knowledge, e.g. from research publications. For example, if a risk is already documented for a part of the work task with a specific grip / contact area, that could be taken into account.
- The risk assessor's own competence and experience. Several practitioners suggest that after coming up with a suggestion on which grip to choose, to also consult those who have experience or knowledge about the work task before deciding on which grip to choose. Consider those who carry out the work (ask them which one they consider to have the highest risk) and managers who have insight into the work to be analyzed, e.g. line managers in a factory.
- A combination of the above.

Considering wise use of limited resources, several practitioners point out that the goal is to prioritize among problems to solve, and therefore opt at “catching” the highest risks, not at trying to assess all grips and their associated risks.

Another question that may arise is how to use the Hand model when you want to assess two or more grips / contact areas in a work task. There are several ways to approach this.

If you want to include two different grips /contact areas, we suggest for simplicity that you analyze one case as an ”Average case” and the other as a ”Worst case”. (Both the result for the ”Average case” and for the ”Worst case” are shown as results in the Hand model.) However, another way (although more complicated) is to assess them separately and calculate a time-weighed mean value (i.e. fraction of time) of the Risk Score and use that as the result for the ”Average case” and use the one with the highest Risk Score as the ”Worst case”.

If you want to include more than two different grips /contact areas in your assessment, one way could be to assess them separately and calculate a simple mean value of the Risk Score and use that as the result for the ”Average case” and use the one with the highest Risk Score as the ”Worst case”. (Both the result for the ”Average case” and for the ”Worst case” are shown as results in the Hand model.)

For MSD risk reduction, time aspects, such as duration, pause and repetition frequency are considered to play a major role; longer duration, higher repetition frequency and shorter pauses between the work tasks all increase the risk of injury. There is also an interactive effect between force and repetition. Typically, increased repetitions lead to modest increase of MSD risk with low force, but to rapid increase in MSD risks when there is high force. In situations where the combination of exerted force and repetition needs to be reduced, try to avoid high force levels at high frequencies. It may be better to design for low force levels and rather increase the frequency than the other way around. In addition, enabling work with the wrist posture as neutral as possible is also considered to reduce the risk.

Explanation of some terms used in risk category ”2.6 Work with repeated force exertion by the hand or fingers”:

Work tasks with 10 different Grips / Contact area types can be assessed with the RAMP II Hand Model (2.6) as shown in Table 7: Power grip, Thumb pinch, Thumb press, Palmar pinch, Tripod pinch grip, Chuck grip, Index pinch (Tip pinch, Pulp pinch), Tip-to-tip and Index press. The RAMP II’s Hand model with this variety of grips and contact area types opens up for a larger application range of the RAMP tool than the 2017-version of the RAMP tool. However, these grips can also be seen as a limitation of the Hand model, since RAMP II Hand model is not appropriate for assessing other kinds of grips.

The Duration-per-exertion factor is assessed based on the duration (how long time in seconds) in general the force is exerted by the hand or the fingers with the chosen grip or contact area, per exertion.

The Wrist-posture factor is assessed based on the general wrist posture during the force exertions, using Table) and the corresponding figure illustrating wrist extension and wrist flexion.

Example 2.6a (Same case as in Example 2.3a in RAMP I): A person works with meat cutting repeatedly, using a knife with his right hand. They use a power grip holding the knife. The gripping force around the knife is 30 N when they work with the meat cutting, which is less than 30 % of their maximum force generating capacity. They change grip about 6.3 times per minute and hold the knife approximately 8 seconds in average in one grip in the dynamic cutting work, before they change grip or change knife and continue cutting the meat. This work is carried out four hours a day, the rest of the time the employee does other work which is not suitable to assess with the Hand model. In addition, generally, their wrist is not clearly bent, but rather in a neutral posture while working with the knife.

Assessment of *average case:* We start using Table 7. Since the left hand is not mentioned, we assume that the right hand is the hand with the highest exposure. The grip type is a Power grip, (marked with a yellow box in our example in the figure below.

2.6 Work with repeated force exertion by the hand or fingers — Fill in the corresponding score in the white box — Score

If no work occurs with the hand or fingers in repeated force exertions: Write "0" in the box on the right and go to 3. — No work with the hand in repeated force exertions: 0

Make the assessment for the hand with the highest exposure. If you are unsure which of the hands has the highest exposure, assess both hands. The Risk score for the hand with the highest exposure is displayed in the results. Make an assessment of an average case. Frequent handling of low forces (< 5 % of maximum) and computer work are not considered here.

1. Choose the suitable type of grip/contact area in Table 7. Measure the exerted force for that grip/contact area. (If you cannot measure this, mark the chosen grip/contact area type in Table A's drop-down list and measure five employees maximum exerted power grip force three times. Insert the highest of these values in Table A for each employee. Thereafter, let them assess the % of max force exerted in the case to be analysed and insert it in the Table for each employee. An average based on the inserted values is calculated automatically and the force-interval cell to use is highlighted in Table 7.)
2. Assess how often the force is exerted.
3. Choose the grip/contact area in Table 7 which best matches the current case and follow that row down to the force interval cell which includes the current force.
4. Move towards the right in Table 7 to the cell including the frequency for the force exertion, to determine the Grip-force-and-frequency factor.
5. Based on the duration of each force exertion generally, determine the Duration-per-exertion factor in Table 8.
6. Assess the general wrist posture during the force exertions. Based on the posture (extension/flexion) in Table 9 showing the highest value, determine the Wrist-posture factor.
7. The Risk score is calculated in Table 10 by multiplying the four factors which you have determined above. This is done automatically in the digital model. The Risk score can also be calculated "by hand" if you do not have access to the digital version. The Risk score for the average case is displayed as "Risk score Average case" in the bottom right corner.
8. If single force exertions are performed which are perceived as particularly strenuous, these should be assessed separately. If so, do the same for that case, i.e. perform step 1-8.
9. If a worst case is analysed, the Risk score for this case is displayed as "Risk score Worst case" in the bottom right corner below. If no worst case is analysed, the "Risk score Average case" is also displayed in the "Risk score Worst case" box.

Table 7: Grip-, force-and-frequency factor.

Grip /contact area type				Exertions per:	Frequency Choose exertions per day, hour or minute.										
Power grip	Thumb pinch / Thumb press	Three-finger grip[1]	Index pinch[2] / Index press	day	≤ 96	97 - 479	480 - 959	960 - 1439	1440 - 1919	1920 - 2399	2400 - 2880	2881 - 3840	3841 - 4800	4801 - 9600	9601 - 14400
				hour	≤ 12	13 – 59	60-119	120-179	180--239	240 - 299	300 - 360	361 - 480	481 - 600	601 - 1200	1201 - 1800
				minute	≤ 0.2	0.3 – 0.9	1	2	3	4	5-6	7 - 8	9 - 10	11 – 20	21 – 30
Force [N]															
> 220	> 54	> 60	> 43		8.5	13	20	34	48	65	99	131	162	308	440
196 - 220	49 - 54	55 - 60	40 - 43		6.7	10	16	27	38	51	77	102	126	239	341
176 - 195	44 - 48	49 - 54	36 - 39		5.1	7.9	12	21	29	39	59	78	97	184	263
151 - 175	39 - 43	43 - 48	31 - 35		3.9	6.0	9.2	16	22	30	45	60	74	141	201
131 - 150	33 - 38	37 - 42	27 - 30		3.0	4.6	7.0	12	17	23	34	46	57	107	153
111 - 130	28 - 32	31 - 36	23 - 26		2.3	3.5	5.3	9.2	13	17	26	35	43	82	117
89 - 110	23 - 27	25 - 30	18 - 22		1.7	2.7	4.1	7.0	9.9	13	20	27	33	62	89
66 - 88	17 - 22	19 - 24	14 - 17		1.3	2.0	3.1	5.2	7.4	10	15	20	25	47	67
46 - 65	12 - 16	13 - 18	9 - 13		1.0	1.5	2.3	3.9	5.5	7,4	11	15	18	35	49
23 - 45	6 - 11	7 - 12	5 - 8		0.7	1.0	1.6	2.7	3.9	5.2	8	10	13	24	35
12 - 22	4 - 5	4 - 6	3 - 4		0.4	0.6	1.0	1.6	2.3	3.1	4.7	6	8	15	21
5 - 11	1 - 3	1 - 3	1 - 2		0.3	0.4	0.6	1.1	1.5	2.0	3.0	4.0	5	9.4	13

Table A: Assessment of force (if you cannot measure it for the chosen grip /contact area type).

Choose Grip / Contact area type from the drop-down list:	Choose grip:					Average prower grip force & % max force for chosen grip	
	Person 1	Person 2	Person 3	Person 4	Person 5		
Insert five employees highest measured power grip force in [N]:							
Insert 5 empl. assessed % of max force exerted in the case in [%]:							

[1]= Palmar pinch, Tripod pinch grip, Chuck grip.
[2] = Tip pinch, Tip-to-tip, Pulp pinch.

Table 8: Duration-per-exertion factor. Please state this for the general duration per exertion.

Duration of the force exertion [s]	≤ 0.2	0.3 – 0.9	1 – 2	2.1 - 3.4	3.5 – 5	6 – 10	11 – 20	21 – 30	31 – 60	61 – 90	91 – 120	121 – 240
	0.5	0.7	1.0	1.3	1.9	3.3	6.2	9	18	25	30	43

Table 9: Wrist-posture factor. Please state this for the general wrist posture during the force exertions.

Extension (wrist angle upwards)	0 – 45°	> 45°	
Flexion (wrist angle downwards)	0 – 15°	16 – 45°	> 45°
Factor	1.0	1.4	1.6

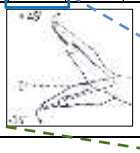


Table 10: Calculation of Risk score.

	Left Average case Factor	Right Average case Factor	Left Possible worst case Factor	Right Possible worst case Factor
Grip-, force-and-frequency factor from Table 7.		3,9		
Duration-per-exertion factor from Table 8.		3,3		
Wrist-posture factor from Table 9.		1,0		
Risk score (multiply the factors in each column):	0,0	12,9	0,0	0,0

Comment: (Start on the next row)

Score	Colour
≥ 5	
3 - 4.9	
< 3	

Risk score Average case: 12,9
Risk score Worst case: 12,9

We move downwards from this cell to determine the force interval cell. The exerted force of 30 N lies in the interval 23-45 N, so we choose this cell (marked with a lilac box in our example in the figure).

Example 2.6a Continues on next page!

Example 2.6a continued

The frequency is 6.3 times per minute and is carried out four hours per day. If the description above is representative for the work, the frequency over a work day is 6.3 times per minute * 60 minutes per hour * 4 hours per day = 1512 force exertions per day. Thus we choose the frequency interval cell 1440 – 1919 (marked in with a brown box in the figure). When we move to the right from our chosen force interval cell and move downwards from our chosen frequency cell these "lines" meet at the cell with the Grip-Force –and Frequency factor = 3.9 (marked in red in our example in the figure).

The duration of each grip with the force exertions is in average approximately 8 seconds. Therefore, In Table 8, we choose the Duration-per- exertion interval 6-10 seconds (marked with a blue box in the figure), leading to the Duration-per –exertion factor = 3.3.

Since the wrist is generally not clearly bent, but rather in a neutral posture during the force exertions, in Table 9 we choose the wrist angle interval between -15° flexion and + 45° extension (marked with a green box in the figure), which leads to the Wrist-posture factor =1.0.

The three factors are entered into Table 10 in the "Factor" column resulting that the assessment for "Risk score Average case" is 12. 9. This signals a red RPL.

Assessment of *worst case:* There is no information about any worst cases occurring in this work task. Therefore "Risk score Worst case" becomes set to the same value as risk score for the average case, that is 12.9 . This signals a red RPL.

3. Lifting work in RAMP II

In risk category "3. Lifting work" in RAMP II work lifting loads that weight 1 kg or more is assessed. Frequently recurring handling of light loads (< 1 kg) is analysed in other parts of RAMP II. If no lifts over 1 kg occur, assess the work as having Risk score 0 and enter the figure "0" in the white box at top right (see Figure 30) and then continue to "4. Pushing and pulling work".

If lifting of loads weighing 1 kg or more occurs, make an assessment of an *average case* and if there is a *worst case*, assess this as well. The worst case could for example consist of a heavy burden or a burden handled in an unfavourable working area or with a number of aggravating factors.
In risk category "3. Lifting work" there is a brief framed instruction in six steps of the procedure for assessment, as well as three tables and a figure that are used for assessment, see Figure 30.

Assessment

Assessment is performed as follows: Begin by assessing an *average case*.

1. Assess the weight of the burden and how often it is lifted and read off the relevant value for frequency and weight factor in Table 1.
2. Assess which working area the lift occurs in with the aid of Table 2 based on the position of the hands (height and distance) at the start and end of the lift. Use the greatest value (highest points) of these cases as the working area factor.
3. Assess the Risk score with the aid of Table 3. Enter the frequency and weight factor and the working area factor in the respective boxes in Table 3. If aggravating factors occur during most of the lifts, also enter these in the respective boxes in the table. The Risk score is calculated automatically (by multiplication of the column factors) and are shown at the bottom of Table 3 on the sheet "3. Lifting work".
4. The Risk score from the *average case* are entered automatically as "Risk score 1" at the bottom right of the sheet.
5. If there is a *worst case,* repeat steps 1-3 above with the values for the worst case. Risk score from the *worst case* is entered automatically as "Risk score 2" at the bottom right of the

page. If no *worst case* occurs, enter the score figure for "Risk score 1" in the box for "Risk score 2" also.

The boxes "Risk score 1" and "Risk score 2" at the bottom right of the page are colour coded according to the green-yellow-red assessment scale and show what risk and priority level the two Risk scores obtained.

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**

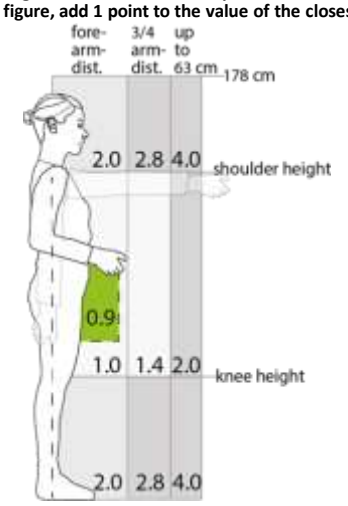
Make an assessment for an average case. Frequent handling of light loads (< 1 kg) is covered in other parts of RAMP II.

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.



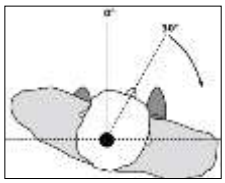


Figure: Torso twisted 30°.

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 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:

Figure 30: "3. Lifting work" in RAMP II.

Other
The frequency and weight factor values are based on the higher values in the range and it is possible to interpolate so as to obtain a more precise value within the range. Loads that are lowered with control are assessed as lifting work. The lifting part of RAMP II is based on lifting work that does not exceed eight hours. If the work exceeds eight hours, an adaptation of the assessment must be made (see for example Mital et al., 1997).

Explanation of some terms used in risk category "3. Lifting work":

Poor grip Poor grip means that it is difficult to get sufficient grip with the hand and fingers or that the grip surface is slippery or has sharp edges, or that the centre of gravity of the load is not centred, or that the contents are unstable or move around, or that the grip does not fulfil the requirement for a good grip.
Good grip To be classed as a good grip, all the following criteria must be fulfilled (if these are not fulfilled, class the grip as poor): handle or cut-outs that enable a comfortable and steady grip for the fingers/hand; grip surface must not be slippery; the centre of gravity of the load must be centred at be between the hands or in the centre of the hand for a one-handed grip; length of handle/cut-out must be at least 11.5 cm; and for handles the handle diameter must be between 2 and 4 cm.

Twisting of the trunk is assessed based on rotation (angle of rotation) between shoulders and feet and includes knee, hip and trunk rotation. See "Figure 30 ° trunk twist" in Figure 30.

With lifts outside the working area (the 10 different coloured zones) a further point is added to the value of the nearest box.

Lift at shoulder height is given the same score as above shoulder height.

If lifts occur kneeling/squatting (crouching) and handling occurs at the employee's shoulder level, this is interpreted as a lift to shoulder height even if the lift height in this case would be at waist height if the person stood up.

If lifts occur kneeling/squatting (crouching) lifting capacity is reduced by about 15-20% according to Gallagher and Unger (1990). We suggest using a multiplier of 1.25 (25% increase) when calculating the Risk score. Note that a higher multiplier (over 1.25) may be applied in expert assessment to take into account the increased loading when kneeling, especially if bending to the side (lateral flexion) occurs.

Example 3a: An employee lifts two different types of carton during a working day. All lifts occur within normal lower arm distance and from floor level to waist height (the handle is placed about 10 cm above floor level). One carton weighs an average of 12 kg and is lifted an average of 12 times per hour per working day (which is eight hours). The other weighs 25 kg and is lifted once per working day. No other aggravating/influencing factors arise, see Figure 31.

Assessment of *average case:* Since the heavy carton is rarely lifted, only the carton that weighs 12 kg is assessed. The frequency and weight factor is obtained from Table 1: 12 times per hour (lie in the range "7.6 – 12 times per hour") and 12 kg (lies in the range "over 10 kg – 15 kg") give *frequency and weight factor 3.8.* We find from Table 2 that the working area factor for lifting from floor level within working distance (2.0) is higher than that for lifting to waist height within lower arm length (0.9), which means that a *working area factor of 2.0* is selected. These two factors are entered in Table 3 in the "Factor" column and the assessment for "Risk score 1" is 7.6 and red.

Assessment of *worst case:* Assess the lift of the 25 kg carton, which is lifted once per working day. In this case the frequency and weight factor is 5.4 and the working area factor is 2.0. When these two factors are entered in Table 3 in the column "Possible worst case Factor" "Risk score 2" of 10.8 is obtained and is therefore red.

Example 3a Continues on next page!

Example 3a continued:

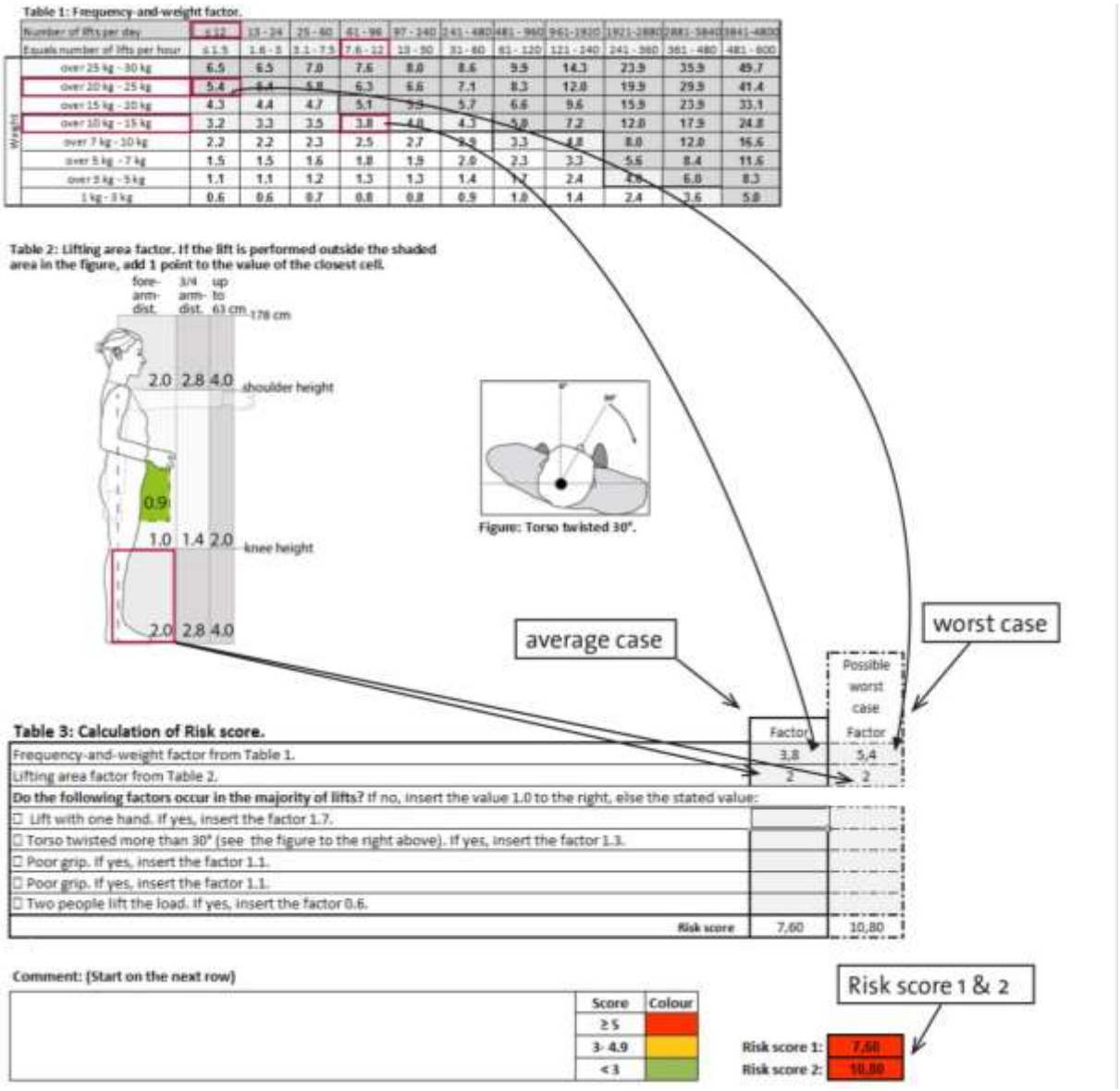


Figure 31: Example 3a, Red markings for assessment of *average* and *worst case* and calculation of Risk score 1 for *average case* and Risk score 2 for *worst case*.

Both these results, i.e. Risk score 1 and Risk score 2, are automatically entered in the results table under ”3. Lifting work” on the Results sheet in the RAMP II program.

Example 3b: Calculation of *frequency* and *average weight*. An employee lifts 10 kg 120 times per working day and 5 kg 60 times per working day. The *frequency* is 120 + 60 = 180 times per working day. Total weight per working day is 10 x 120 + 5 x 60 kg = 1200+300 kg = 1500 kg. The *average weight* is total weight/frequency = 1500/180 kg = 8.3 kg.

Example 3c: Summarising the working area. An employee lifts 10 kg to elbow height. Half the lift occurs within *lower arm distance* (factor = 1.0) and half is at *¾ arm's length* (factor =1.4). The working area factor is the average of these, (1.0+1.4)/2 =1.2.

Example 3d: Calculation of *frequency and weight factor* with load weights over 30 kg. A load of 35 kg is lifted 24 times per day. The increase of the *frequency and weight factor* from 25 to 30 kg is 1.1 (6.5-5.4 = 1.1) for 24 lifts per day. The frequency and weight factor is obtained by adding 1.1 to 6.5 = 7.6.

4. Pushing and pulling work in RAMP II

In risk category ”4 Pushing and pulling work” in RAMP II pushing and pulling work is assessed where the force exercised is over 50 Newtons [N]. Pushing and pulling involves moving an object that entirely or partly rests on a surface or is suspended, e.g. in an overhead transporter (Swedish Work Environment Authority, 2012, p 28). Frequently recurring handling of light loads (where the force exerted is < 50 N) is analysed in other parts of RAMP II. If no pushing and pulling work over 50 N occurs, assess the work as having Risk score 0 and enter the figure “0” in the white box at top right and then continue to ”5. Influencing factors”.

Note! Pushing and pulling forces must be measured with a dynamometer. See ”Other” below.

If pushing and pulling where the force developed is greater than 50 N occurs, make an assessment of an *average case* and if there is a *worst case*, assess this as well. The worst case may for example consist of individual handlings with high force, handlings with many repetitions or handlings with a number of aggravating factors.

In risk category “4 Pushing and pulling work” there is a brief framed instruction in six steps of the procedure for assessment, as well as three tables and two figures that are used for assessment, see Figure 32.

Assessment

Assessment is performed as follows: Begin by assessing an *average case*.

1. Measure the force that is exercised. If pushing or pulling work is performed continuously for 5 seconds or more, measure both the force used to get it moving (the initial or starting force) and also the continuous force during the move. Otherwise, only measure the initial force (<5 s).
2. Go to Table 4 (initial force used) and if the work is performed for 5 seconds or more also to Table 5 (continuous force) for the relevant frequency and force values and read off the frequency and force factor.
3. Assess the Risk score with the aid of Table 6. Enter the value for the frequency and force factor from Table 4 and if relevant from Table 5 in the relevant box(es) in Table 6. If aggravating factors occur during most of the pushing and pulling work, also enter these in the respective boxes in the table. The Risk score is calculated automatically (by multiplication of the column factors) and shown at the bottom of Table 6 on the RAMP II program’s sheet ”4. Pushing and pulling work”.
4. Risk scores from the *average case* are entered automatically as “Risk score 1” at the bottom right of the sheet. (This is the Risk score for the initial force (the force to start motion) or, if continuous force is also assessed, the higher of the two Risk scores calculated in the first two columns of the table).
6. If there is a *worst case,* repeat steps 1-3 above with the values for the worst case. The Risk score from the *worst case* is entered automatically as “Risk score 2” at the bottom right of the sheet. If no *worst case* occurs, enter the score figure for “Risk score 1” in the box for “Risk score 2” also.

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 continuous 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**

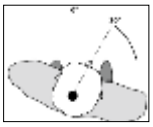


Figure: Torso twisted 30°.

Table 6: Calculation of Risk score.

	Factor Initial force	Factor Continuous force	If any, worst case Factor Initial force	If any, worst case Factor Continuous 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 had. If yes, insert the factor 1.7.				
☐ Pushing/pulling 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:

Figure 32: "4. Pushing and pulling work" in RAMP II

The boxes "Risk score 1" and "Risk score 2" at the bottom right of the page are colour coded according to the green-yellow-red assessment scale and show what risk level the two Risk scores obtained.

Other

When measuring forces, apply the dynamometer to the place where one normally places the hand(s) and pushes or pulls the load carrier (trolley or similar) that is to be moved. Try to recreate the development of forces that occurs in reality. Do not get the load into motion with a jerk! Repeat the measurement five times and take the median as the value of the force. This applies when measuring both types of force - pushing and pulling. The median value of a number of figures is the middle value by size. For the figures 1, 2, 5, 7, 9, it is 5 that is the median value. With an even number, the average of the two middle values is taken as the media.

The situation where forces are measured must resemble the development of forces that occurs in reality with regard, for example, to weight of load, underlying surface, speed/acceleration, type of load carrier and its condition, direction of force and handle height.

The continuous distance is assessed (i.e. do not add together smaller distances).
In the assessment the position of the wheels (when assessing trolleys) should correspond to the normal pattern. This can have a significant effect on the force measured.

The model for pushing and pulling work is based on eight hours work. If the work exceeds eight hours, an adaptation of the assessment must be made (see for example Mital et al., 1997). Note that the frequency is mainly governed by the average number of pushing and pulling tasks per hour.
Explanation of some terms used in risk category "4. Pushing and pulling work":

Poor grip Poor grip means that it is difficult to get sufficient grip with the hand and fingers or that the grip surface is slippery or has sharp edges, or that the centre of gravity of the load is not centred, or that the contents are unstable or move around, or that the grip does not fulfil the requirement for a good grip.

Good grip To be classed as a good grip, all the following criteria must be fulfilled (if these are not fulfilled, class the grip as poor): handle or cut-outs that enable a comfortable and steady grip for the fingers/hand; grip surface must not be slippery; the centre of gravity of the load must be centred at be between the hands or in the centre of the hand for a one-handed grip; length of handle/cut-out must be at least 11.5 cm; and for handles the handle diameter must be between 2 and 4 cm.

Twisting of the trunk is assessed based on rotation (angle of rotation) between shoulders and feet and includes knee, hip and trunk rotation. Se "Figure 30 ° trunk twist" in Figure 30.

A slippery surface refers to a static coefficient of friction between shoe sole and surface/floor that is lower than 0.5. If the friction is lower than 0.2 ("extremely slippery") the possibility of exercising a force deteriorates further. Further reduction is recommended from expert assessment. See for example Kroemer et al. (1971, p. 31-33 http://www.dtic.mil/dtic/tr/fulltext/u2/720252.pdf) for different surface combinations.

Example 4a: Two people push a trolley 2 meters with both hands. The grip is good and at elbow height, there are no further influencing factors. Each pushing task takes 4 seconds to perform and is repeated on average 30 times per hour per working day (which is eight hours). The median value for initial force is 225 N, and for the continuous force 80 N. Twice a day, one of the persons also pushes the same trolley alone 12 m ("worst case"), which takes 20 seconds each time. Other conditions are the same as above (see Figure 33 for calculation).

Assessment of *average case:* Since the pushing work takes less than 5 seconds, only the initial force is measured and assessed. The frequency and force factor is obtained from Table 4: 30 times per hour (lies in the range "13 - 30 times per hour") and 225 N (lies in the range"201 – 250 N)" gives the *Frequency and force factor* 4 (see also Figure 33).

This factor is entered in Table 4 in the column "Factor initial force". Since two people push the

Example 4a Continues on next page!

Example 4a continued:

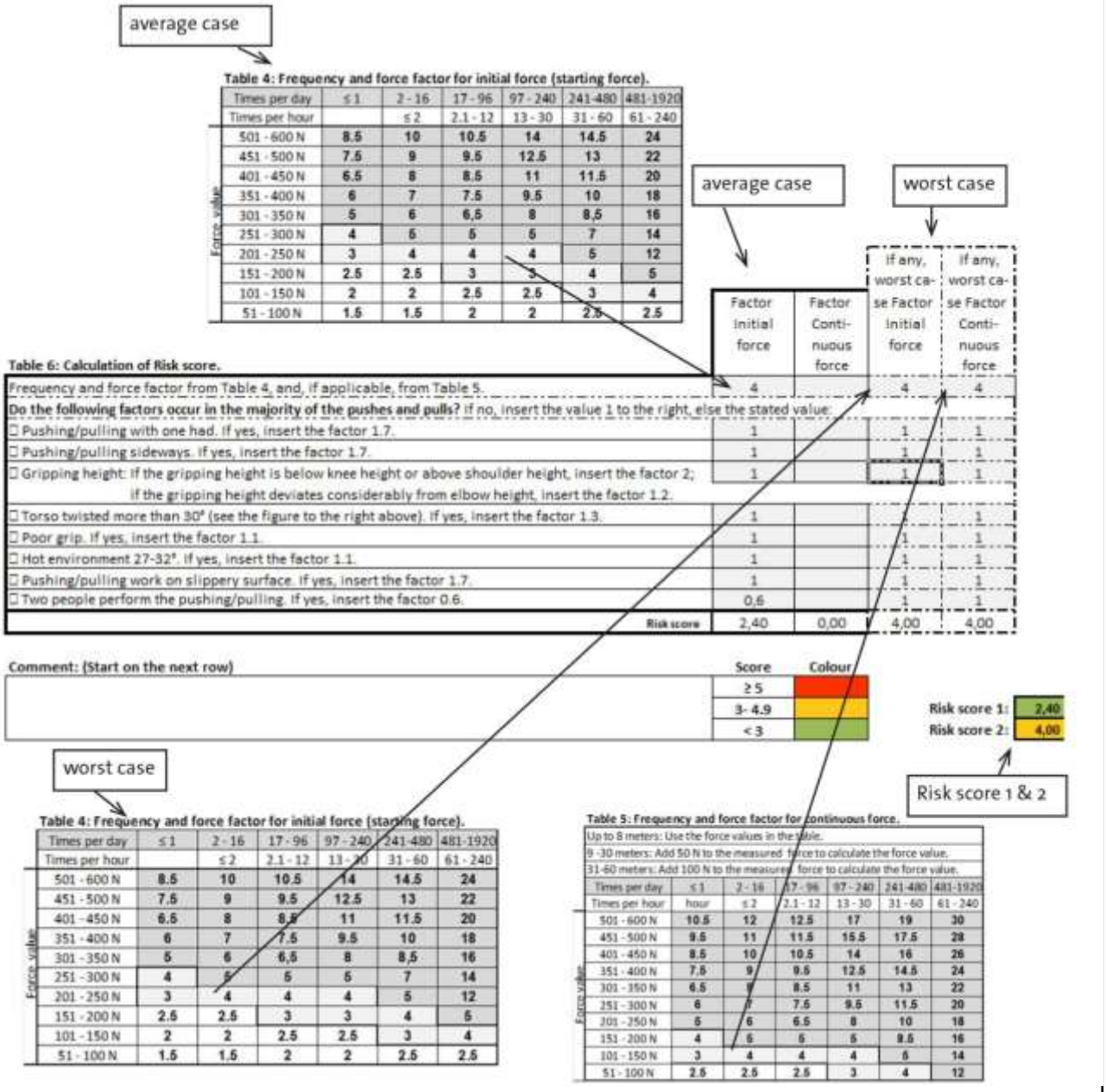


Figure 33: Example 4a, Red markings for assessment of *average* and *worst case* and calculation of Risk score 1 for *average case* and Risk score 2 for *worst case*.

trolley, 0.6 must also be entered in the table factor "Two persons push/pull a load" in the same column. The assessment of "Risk score 1" is 2.4 and green.

Assessment of *worst case:* The single pushing task that is performed by one employee is assessed here. Both initial and continuous force are measured (since 20 s > 5s) so that both columns on the far right of Table 6 are filled in.

Since the distance of 12 m is in the range 9-30 m, 50 N is added to the measured continuous force, 80 N. This gives 130 N as the median value for the continuous force that is to be used as the initial value for force in Table 5. The Risk scores for initial force and continuous force for the *worst case* are both 4, i.e. 4 is the greatest value (see the bottom of the two columns on the far right of Table 6). The assessment of "Risk score 2" is 4.0 and yellow.

Both these results, i.e. Risk score 1 and Risk score 2, are automatically entered in the results table under "4. Pushing and pulling work" on the Results sheet in the RAMP II program.

5. Influencing factors in RAMP II

In risk category ”5. Influencing factors” in RAMP II (see Figure 34) the stated influencing factors are assessed. These factors are divided into ”5.1 Influencing physical factors hand/arm”, ”5.2 Other physical factors” and ”5.3 Work organisational and psychosocial factors”. The assessment of these is described in more detail below. Times refer to times per working day.

5. Influencing factors	**Fill in the corresponding score in the white box**		**Score:**
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 exposed to impact, reaction load or shock (e.g. 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.**			

Figure 34: 5. ”Influencing factors” in RAMP II.

Example 5a: A person works at a machine for 4 hours per day and stands on a platform that vibrates and picks finished products. The products come on a moving belt at what the person perceives to be a rapid tempo. The person places them in a carton and when this is full places it on an EU pallet, picks up a new carton and begins to fill this with products from the moving belt. The products have a temperature of 4 degrees Celsius.

5.1 Influencing physical factors hand/arm

5.1 a+b The employee is exposed to hand-arm vibrations

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 total time the employee is exposed to hand-arm vibrations and whether this is powerful

Other

A powerfully vibrating tool is one that has a vibration level over 10 m/s^2. Vibrations that are transferred to the hands, such as from vibrating tools, can lead to MSDs. If vibrations occur it is recommended that the situation in the particular case is analysed in more depth, for example by going into the Vibration Database (http://www.vibration.db.umu.se/), or by taking measurements and comparing with the Vibration Directive. There is also more information on the Swedish Work Environment Authority website (http://www.av.se).

5.1c Manual handling of warm and cold objects

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

Assessment

Assess whether objects that are hot or cold are handled manually.

Other

Objects colder than 10°C are here counted as cold and objects hotter than 43°C are counted as hot (Lindqvist & Skogsberg, p. 93, 2007).

Example 5a continued: Since the object handled has a temperature of 4 °C, which is colder than 10°C, choose Risk score 2, which gives an assessment of yellow.

5.1d The hand is exposed to impact, reaction load or shock

d. The hand is exposed to impact, reaction load or shock (e.g. as an impact tool) often or a long time*	2	0	

Assessment

Assess whether or not the hand is exposed to impact, reaction load or shock often or for a long time.

Other

Please note! In RAMP 2.0, assessment item 5.1d has been changed from the previous, RAMP 1.0 version, as part of the enhancement of the RAMP tools application range.

Here *"often"* means about 100 times a working day or more and *"for a long time"* means for about 30 minutes or more per working day.

5.1e Holding hand tools including precision 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

Assess whether a hand tool weighing more than 2.3 kg is held for more than a total of 30 minutes per working day.

Assess whether a precision tool weighing more than 0.4 kg is held for more than a total of 30 minutes per working day.

5.2 Influencing physical factors, other

5.2 a Whole-body vibrations

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 the employee is exposed to whole- body vibrations.

Other

Whole-body vibrations that for example are transferred when sitting or standing on a vibrating surface can lead to an increased risk of low back conditions. If vibrations occur it is recommended that the situation in the particular case is analysed in more depth, for example by going into the Vibration Database (http://www.av.se/teman/vibration/poangmetoden/handvibrationer/), or by taking measurements and comparing with the Vibration Directive. There is also more information on the Swedish Work Environment Authority website (http://www.av.se).

Example 5a continued: Since the employee is exposed to whole-body vibrations for 4 hours per working day, which is more than one but less than 6 hours, choose Risk score 2, which gives an assessment of yellow.

5.2c Visual conditions

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

Assessment

Assess whether visual conditions are insufficient for the work from a visual ergonomics perspective.

Other

This means that visual conditions are insufficient to be able to perform the work from a visual ergonomics perspective. The reasons for this may include unsuitable lighting, glare, weak contrast, poor sharpness, how the workplace is arranged in relation to the light and the employee's own visual ability in combination with any aids to vision. Poor visual conditions can also give rise to unfavourable posture in an attempt to see better, which can affect the risk of MSDs.

5.2d 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 whether the work is performed in hot or cold conditions or in a draught.

Other

Here a cold environment means that the air temperature is less than 10°C and a warm environment usually means that the air temperature is over 25 °C (Bohgard et al. p. 195, 2010).

5.2e Hard surface

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

Assessment

Assess whether the work is performed standing or walking on a hard surface for more than half of the working day.

Other

This may require expert assessment in which various properties of the surface and footwear are considered together. Concrete is an example of a hard surface. Here parquet floors and mats are not generally counted as hard surfaces. However, consideration should be given to the employee's perception. Also, note that a surface that is very soft can have a tiring effect on the employee.

5.2f+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

Assess whether the work is performed with prolonged sitting without an opportunity to change to standing work.

Assess whether the work is performed with prolonged standing without an opportunity to change to sitting work.

Other

Firstly assess whether the work is performed sitting (or standing) still or not. If for example there is a great deal of variation between walking and standing, then the work is not assessed as prolonged standing still.

To assess whether a person works in prolonged standing (still) postures, you must assess whether the person is working standing with no opportunity to sit. Standing work that has variety, such as changing to walking at times, is assessed as not prolonged standing.

5.2h Kneeling and squatting

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

Assessment

Assess whether the work involves kneeling or squatting/crouching more than 30 times or for more than 30 minutes.

Example 5b: An employee works kneeling for 20 minutes in the morning and for 25 minutes in the afternoon. Calculation: 20 + 25 minutes = 45 minutes, which is more than 30 minutes. Chose Risk score 2, which gives an assessment of yellow.

5.3 Influencing organisation and psychosocial factors

5.3a+b Influence over work pace and set-up of work

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

Assess whether or not there is an opportunity to influence the tempo at which the work is performed.

Assess whether there is no opportunity to influence how the work is set up or how it is performed.

Other

Here, "*there is no possibility to influence at what pace the work is performed*" means that the tempo is controlled by someone other than the person doing the work. This means that there are few or no opportunities to vary the work tempo or perform the work at one's own pace.

Here, "*there is no possibility to influence the work setting or how the work shall be carried out*" refers to the decision latitude of the employee performing the work, for example if the employee has the chance to participate and influence how the work is performed and organised.

Preferably ask several (for instance 3-5) persons in assessing these risk factors.

Example 5a continued: Since in this case the moving belt feeds the products at a relatively high and fixed tempo, choose score 2 under *"5.3a There is no possibility to influence at what pace the work is performed "*, which gives an assessment of yellow.

5.3c+d Work tempo/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

Assess whether it is difficult to get the work done in the time.

Assess whether the employee often works quickly (makes up time) so as to take longer breaks.

Other

Preferably ask several (for instance 3-5) persons in assessing this risk factor.

6. Reports of physically strenuous work in RAMP II

The risk category ”6. Reports of physically strenuous work” in RAMP I (see Figure16) deals with whether there is documented reporting of physically strenuous work in the performance of the task.

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)_____	

Figure 35: ”6. Reports of physically strenuous work” in RAMP II

Assessment

Investigate whether there is documented reporting (such as incident reporting) of physically strenuous work in the performance of the task.

Other

Here reports of physically strenuous work refers, for example, to reporting in the form of records in the company health service, notes on risk analyses, incident reporting, records of safety inspections and similar.

Example 6.2a: A person who does servicing work at a service workshop has been examined by the company health service for shoulder and knee problems. The problems have been related to a task in which the person performs heavy lifting in a squatting/crouching position. Choose Risk score 2, which gives an assessment of yellow under 6.1 and check a “x” for “lift” in 6.2.

7. Perceived physical discomfort in RAMP II

In risk category ”7. Perceived physical discomfort” in RAMP I (see Figure17) questions are answered on whether employees assess that there are aspects of the work being assessed that lead to physical discomfort.

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:

Figure 36: ”7. Perceived physical discomfort” in RAMP II.

Assessment

Investigate whether employees assess that there are aspects of the work that lead to physical discomfort (e.g. to muscles or joints).

Other

Ask five employees if there are aspects of the work that lead to physical discomfort (e.g. to muscles or joints) during the working day. If fewer than five persons perform the work, ask all of them. If one or more employees answer “Yes” to the question, check “Yes” for 7.1 and ask them what they consider to be the worst aspect of the work. Enter this information in 7.2.

This type of information, i.e. whether the employees perceive physical discomfort that they judge to be connected to the work, can be important information that can help to identify a working environment problem that can lead to MSDs. It can be used in the work of improving the working environment and reducing personal injury risks.

This question can also be viewed as an extra check that can capture work environment problems that the rest of the RAMP I checklist may not. There is research that shows that perceived discomfort in the body ca be an early predictor of MSDs.

Example 7.2a: At a warehouse five employees are asked this question. They all say that they perceive physical discomfort that they mainly connect with picking a special product item called “B7” from a height of 190 cm. 7.1 is answered with “Yes”, i.e. choose Risk score 2, which gives an assessment of yellow, and for all of them ”Picking product item B7 from 190 cm” is entered in 7.2.

3.3 Example of the Results and Action modules in RAMP II

In this section an example is given of the detailed results presentation that can be found on the “Results” sheet in the RAMP II program and in the three sheets that contain the Action module in the program. For a more detailed description of the Action module, see section 5. Section 4 describes the Risk Management Support module. Its Aggregated Results part can be used to compare the results from several assessments and present them at different levels of detail.

3.3.1 Example of the Results sheet after a RAMP II assessment

On the “Results” sheet in the RAMP II program, results are given at a detailed level of the assessment performed in RAMP II. Figure 37 shows an example.

At the top information that was entered on the “Input data” sheet is shown. Then come the assessment and the comments that were entered during the assessment. At the bottom is a compilation of the results, how many risk factors have been assessed as green, yellow and red and the total Risk score. See section 3.2.1 of this user manual for what the different colours represent.

Results of the RAMP II analysis

Date:	2024-01-18	*Assessment of:*	
Work/Work task:	A7_Service on DF		
Work station/Employee load:	A7 Service task	*Department:*	DF
Site:	Stockholm	*Country:*	Sweden
Assessment ordered by:	K Bengtsson	*Position:*	Site manager
Assessment completed by:	B Nordin	*Position:*	Ergonomics manager
Company representative:	P Palm	*Position:*	Technical manager
Safety/work environment personnel:	R Olsson	*Position:*	Safety officer
Other:		*Position:*	

General comments :

RAMP II assessment	Asessment	Score	User comments
1. Postures			Write your comments in the white fields below:
1.1 Posture of the head - forwards and to the side		1,0	
1.2 Posture of the head - backwards		3,0	
1.3 Back posture - moderate bending		2	
1.4 Back posture - considerable bending and twisting		3	
1.5 Upper arm posture - hand in or above shoulder height*		5	
1.6 Upper arm posture - hand in or outside the outer work area*		2	
1.7 Wrist posture*		2	
1.8 Leg and foot space and surface		2,0	
2. Work movements and repeated work			
2.1 Movements of the arm (upper and lower arm)*		2	
2.2 Movements of the wrist*		1	
2.3 Type of grip - frequency*		2	
2.4 Shorter recovery/variation during work (mainly regarding the neck, the arms and the back)		4	
2.5 Longer recovery/variation during work (not breaks, e.g. task rotation that gives sufficient re		3	
2.6 Work with repeated force exertion by the hand or fingers (average case)		2,7	
2.6 Work with repeated force exertion by the hand or fingers (worst case)		6,9	
3. Lifting work			
3.1 Lifting work (average case)		5,0	
3.2 Lifting work (worst case)		7,0	
4. Pushing and pulling work			
4.1 Pushing and pulling work (average case)		2,9	
4.2 Pushing and pulling work (worst case)		3,4	
5. Influencing factors			
5.1 Influencing physical factors hand/arm - do the following occur? The times refer to "per work day".			
a+b. The employee is exposed to hand-arm vibrations		4	
c. Warm or cold objects are handled manually		0	
d. The hand is exposed to impact, reaction load or shock (e.g. as an impact tool) often or a long		2	
e. Holding hand tools weighing more than 2.3 kg for more than 30 minutes		0	
f. Holding precision tools weighing more than 0.4 kg for more than 30 minutes		0	
5.2 Other physical factors - do the following occur? The times refer to "per work day".			
a+b. The employee is exposed to whole-body vibrations		0	
c. The visual conditions are insufficient for the task		2	
d. Work in hot or cold temperatures or in draughty environments		0	
e. Standing or walking on a hard surface more than half of the work day		2	
f. Prolonged sedentary work without possibility to do the work standing up		0	
g. Prolonged standing work without possibility to do the work sitting down		0	
h. Kneeling/squatting more than 30 times or more than 30 minutes		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		0	
b. There is no possibility to influence the work setting or how the work shall be carried out		0	
c. It is often difficult to keep up with the work tasks		0	
d. The employees often work rapidly in order to be able to take a longer break		0	
6. Reports on physically strenuous work			
6.1 Do documented reports exist on physically strenuous tasks when carrying out the work task		2	
6.2 **If "Yes"** on 6.1, what type of work that has led to this (mark with an "x")? **If "No"**, go to 7.			
lifting		x	
holding/carrying		x	
pushing/pulling		x	
pushing with hand or fingers		x	
other:			
7. Perceived physical discomfort			
7.1 Are there parts of the work which lead to physical discomfort during the work day?		2	
7.2 **If "Yes"** on question 7.1, which is the worst task?			
Person 1	The pushing and pulling work and picking from high hights		
Person 2	Picking work from high hights		
Person 3	Picking work from high hights		
Person 4	Picking work from high hights		
Person 5	Picking work from high hights and twietd postures		

**Write the highest score from the assessment of the left and right hand/arm*

Assesment comments (Please write any other Assessment comments if you wish, here below):

Results summary:

Total risk score	73,94
Number of red assessments (high risk)	7
Number of yellow assessments (risk)	15
Number of green assessments (low risk)	15

Figure 37: Example of the detailed results that are shown on the "Results" sheet in RAMP II.

3.3.2 Examples of the three Action module sheets after a RAMP II assessment

The last three sheets in the RAMP II program show the three parts of the Action module, which is described in more detail in section 5.

The Action model

The RAMP I method's Action model is shown on the sheet "Action model". It is intended that this can be printed out and used by the company when developing solution suggestions for actions that are tailored to the problem in hand. On the "Action model" sheet is the model illustrated in Figure 38, a brief description and Table 1, which gives suggestions for action.

Figure 38. Illustration of the Action model in RAMP. (Same as Figure 19.)

The Action suggestions

On the "Action suggestions" sheet are automatically produced action suggestions for the risk factors that were assessed as yellow or red in RAMP II. Figure 39 gives an example of such a table, in this case for identified risk with bending the head backwards.

Page 3

1.2 Posture of the head - backwards

Type of action	*Examples of suggestions for solutions*
T&D	Investigate the visual conditions and secure that the lighting is appropriate for the work that is carried out (e.g. illuminance, glare, and contrast) and that the work area is arranged in an appropriate way to the light. See visual ergonomics guidelines. Maybe the employees visions need to be checked and visual aids obtained.
T&D	Redesign the work/work area, also considering the visual design, so that the unfavourable postures are eliminated or reduced. For example, adjustable surfaces may be needed. Lowered shelf heights or tilted surfaces to improve vison and access may be appropriate solutions, or secure that it is easy to visually inspect or physically feel that the work is performed correctly.
ORG	Consider work organisational changes, e.g. job enrichment, job enlargement, and job rotation.
EMPL	Inform, educate and train the employees and secure knowledge.
V&S	Work with aims, visions and strategies for decreasing the MSD risks.
ENV	Aim at smooth logistics access, a layout that enables easy movements and good flow and also consider physical (e.g. noise), thermal (cold/heat) and chemical factors.

Figure 39: Example of automatically generated "Action suggestions" in RAMP II for the risk factor "1.2 Posture of the head- backwards".

The Action plan

The "Action plan" sheet gives a template for an action plan. Here the results of the assessment are filled in and the idea is that this can be used to formulate action plans including what measures are

planned, when they are to be performed, who is responsible and when follow up is to be done, see Figure 40.

Action plan based on RAMP II assessment								
Date of assessment: 2024-01-18			**Work/Employee load:**			**Department: DF**		
Work/Work task: A7_Service on DF			**Site:** Stockholm			**Country: Sweden**		
Ordered by:		**Formed by:**		**Date of action plan:**		**Note:**		
Risk factor	**Assessment**	**Score**	**User comments**	**Planned actions**	**When**	**By whom**	**Ready (date)**	**Follow-up**
1. Postures								
1.1 Posture of the head - forwards and to the side		**1**						
1.2 Posture of the head - backwards		**3**						
1.3 Back posture - moderate bending		**2**						
1.4 Back posture - considerable bending and twisting		**3**						
1.5 Upper arm posture - hand in or above shoulder height*		**5**						
1.6 Upper arm posture - hand in or outside the outer work area*		**2**						
1.7 Wrist posture		**2**						
1.8 Leg and foot space and surface		**2**						
2. Work movements and repeated work								
2.1 Movements of the arm (upper and lower arm)*		**2**						
2.2 Movements of the wrist*		**1**						
2.3 Type of grip - frequency*		**2**						
2.4 Shorter recovery/variation during work		**4**						
2.5 Longer recovery/variation during work		**3**						
2.6 Work with repeated force exertion by the hand or fingers (averege case)		**2,70**						
2.6 Work with repeated force exertion by the hand or fingers (worst case)		**6,94**						
3. Lifting work								
3.1 Lifting work (average case)		**5**						
3.2 Lifting work (worst case)		**7**						
4. Pushing and pulling work								
4.1 Pushing and pulling work (average case)		**2,9**						
4.2 Pushing and pulling work (worst case)		**3,4**						
5. Influencing factors								
5.1 Influencing physical factors hand/arm								
a+b. Hand-arm vibrations		**4**						
c. Warm or cold objects are handled manually		**0**						
d. Hand is exposed to impact, reaction load or shock often or a long time		**2**						
e. Holding hand tools weighing more than 2.3 kg for more than 30 minutes		**0**						
f. Holding precision tools weighing more than 0.4 kg for more than 30 minutes		**0**						
5.2 Other physical factors								
a+b. Whole-body vibrations		**0**						
c. The visual conditions are insufficient for the task		**2**						
d. Work in hot or cold temperatures or in draughty environments		**0**						
e. Standing or walking on a hard surface more than half of the work day		**2**						
f. Prolonged sedentary work without possibility to do the work standing up		**0**						
g. Prolonged standing work without possibility to do the work sitting down		**0**						
h. Kneeling/squatting more than 30 times or more than 30 minutes		**0**						
5.3 Work organisational and psychosocial factors								
a. No possibility to influence at what pace the work is performed		**0**						
b. No possibility to influence the work setting/how the work shall be carried out		**0**						
c. It is often difficult to keep up with the work tasks		**0**						
d. The employees often work rapidly in order to be able to take a longer break		**0**						
6. Reports on physically strenuous work								
6.1 Documented reports on physically strenuous tasks		**2**	See "6" in the Results sheet					
7. Perceived physical discomfort								
7.1 Perceived physical discomfort		**2**	See "7" in the Results sheet					
Assessment comments (from 7. Perceived physical discomfort):								
General comments (from "Input data"):								

Figure 40. Example of an Action plan, including the RAMP II assessment results include automatically.

4 The Risk Management Support Module and Program

RAMP's Risk Management Support Module was mainly developed to support communication of the results of RAMP analyses within an organisation and to support managements to follow the effects of the systematic risk management work using Key Performance Indicators (KPIs).
Risk management is a process. Several methods on how to work with risk management exist. One of the most common ones is Shewhart's "Plan - Do - Check - Act" (PDCA) cycle, e.g. described by Deming (1993). If you have a well-functioning risk management process, there is no need to change to another one! If not, you may find use for the RAMP tools Risk Management Support and Action modules.

RAMP's Risk Management Support Module consists of three parts (see Figure 41): Process Description, Aggregated Results and Key Performance Indicators (KPIs). The Process Description (see 4.1 below, shows how RAMP is aligned to the ISO-standard 31000:2009 ("Risk management – Principles and guidelines").

Figure 41: RAMP's Risk Management Support Module. RAMP's Risk Management Support

4.1 Process Description

RAMP's alignment to the ISO-standard 31000:2009, "Risk management – Principles and guidelines"
RAMP was developed to be in alignment with the ISO-standard 31000:2009, which includes four main activities (I – IV):

I Communication and consultation

II Establishing context

III Risk assessment

A - Risk identification,
B - Risk analysis,
C - Risk evaluation and
D -Risk treatment

IV Monitoring and review

The activities I and IV can be viewed as activities ongoing throughout the whole process, surrounding the other activities. In the research article "*The RAMP package for MSD risk management – A tool and support for actions*" (Rose, et al, 2020) you can read more about RAMP's alignment to the ISO-standard and find examples of activities in RAMP in these four types of main activities in the risk management process.
In the User Manual's next chapter (Chapter 5) you can read more about the Action Module.

4.2 Aggregated Results

The Aggregated Results part was designed to communicate the results of the RAMP analysis. This can be done in several levels of detail:

- at detailed level where all assessed risk factors are reported,
- at risk category level where the risks for the seven risk categories are reported
- at overview level where only the number of green, grey/yellow and red assessments is presented.

The results can also be presented to different extents/scope: for a single workstation, for a department with many workstations, for a factory or workplace, for a country or for a whole group of companies. This design has been chosen to meet the different needs of different users of the results: Those who are responsible for the working environment and for ensuring that work at a workstation will function need detailed information about where risks are. A factory manager has a greater need for an overview of the company's risks, so as to be able to prioritise. In this case, a presentation at risk category level or overview level is better.
In the Risk Management Support Program eight sheets form the Aggregated Results part of the RAMP Risk Management Support Module, the first four for RAMP I results, and the other four for RAMP II results.

4.3 RAMP Key Performance Indicators

RAMP results can be used to form two types of Key Performance Indicators, KPIs:

1 KPIs based on RAMP results only
2 KPIs based on RAMP results and other company data

Both these types of Key Performance Indicators can support the systematic work- environment work and serve as support for management teams, are suggested in RAMP (see the last three sheets in the RAMP Risk Management Support Excel program):

1 Key Performance Indicators based solely on RAMP results. In RAMP 2.0, three types of Key Performance Indicators can be easily calculated (whereof two are illustrated in Figure 42):
   - The number of assessments on an RPL divided by the total number of assessments, e.g. at a department,
   - The number of assessments on an RPL divided by the number of assessments on the same RPL at a different time, e.g. at a factory,
   - The distribution between the three RPLs at different times, e.g. at a company.

2 Key Performance Indicators where RAMP results are combined with other company data. In RAMP 2.0, examples of a dozen such key figures are given, e.g. (Whereof two are illustrated in Figure 43):
   - The number of quality deficiencies in a department divided by the number of red RPLs at the department, e.g. over a five year period,
   - The number of assessments with elevated RPLs for which actions were taken and which have led to lower RPLs during a certain time divided by the number of elevated RPLs at a department for the same time,
- The number of red RPLs divided by the number of sick leave days at a department.

With Key Performance Indicators, you can easily visualize and follow trends over time, which is valuable for *employees* – so they are be able to follow work-environment improvements, e.g. at their work stations or department – , for *management team*s – e.g. as part of their decision base for informed decision making – and for *business management* - e.g. as a support to the company's management, especially, but not only, the management of the work environment's MSD risks.

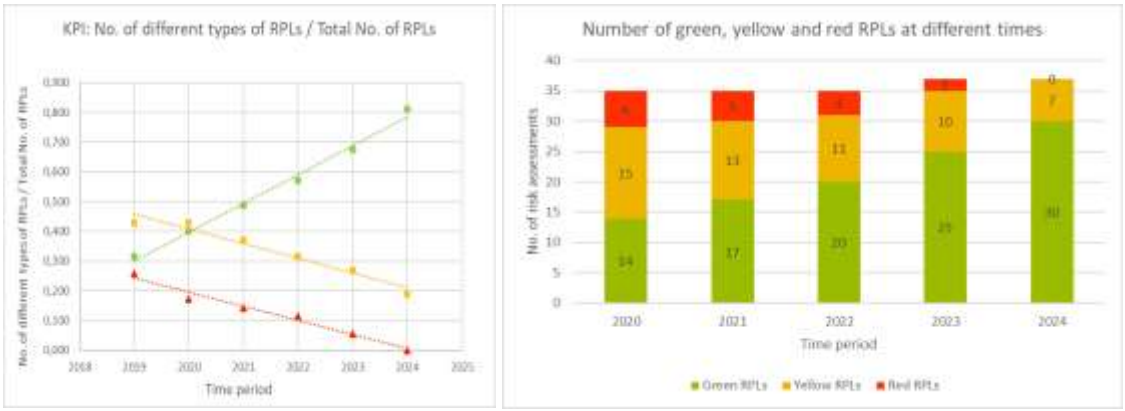


Figure 42: Two examples of KPIs based on RAMP II results: How the number of red, yellow and green RPLs, respectively, change over time. (Left:) as a KPI where the number of assessments with a specific colour coded RPL (e.g. green) is divided by the total number assessed of RPLs. (Right:) Displaying the number of green, yellow and red RPLs at different times. In these examples the number of elevated RPLs (red and yellow) decrease while the number of green RPLs increase over time. This indicates decreased risks.

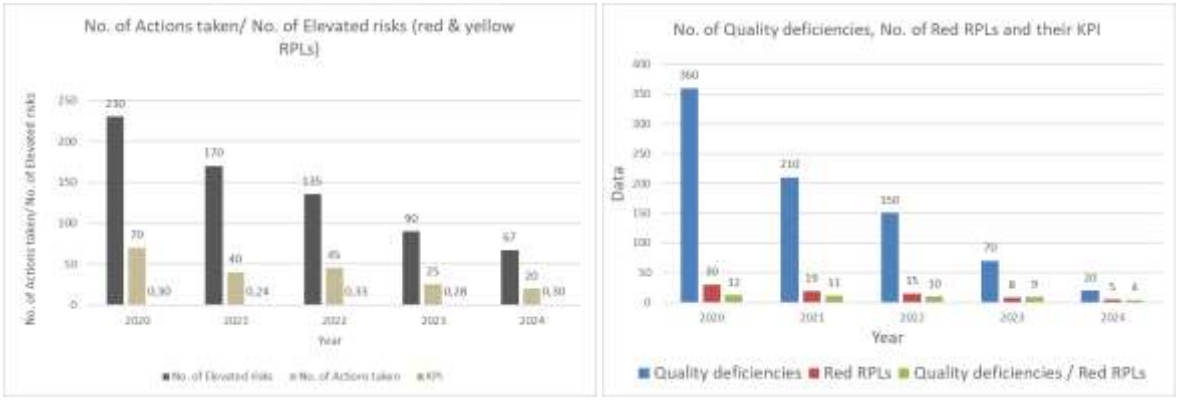


Figure 43: Two examples of KPIs based on RAMP II results and other company data over a five-year period. (Left:) The KPI displaying the number of actions taken divided by the number of assessed elevated risks (red and yellow RPLs), and (Right:), The displaying the KPI as the number of quality deficiencies divided by the number of red RPLs.

4.4 The RAMP Risk Management Support Program

4.4.1 Introduction

The sheet “Introduction” provides gives an introduction and description of how to summarise results from many different assessments, see Figure 44.

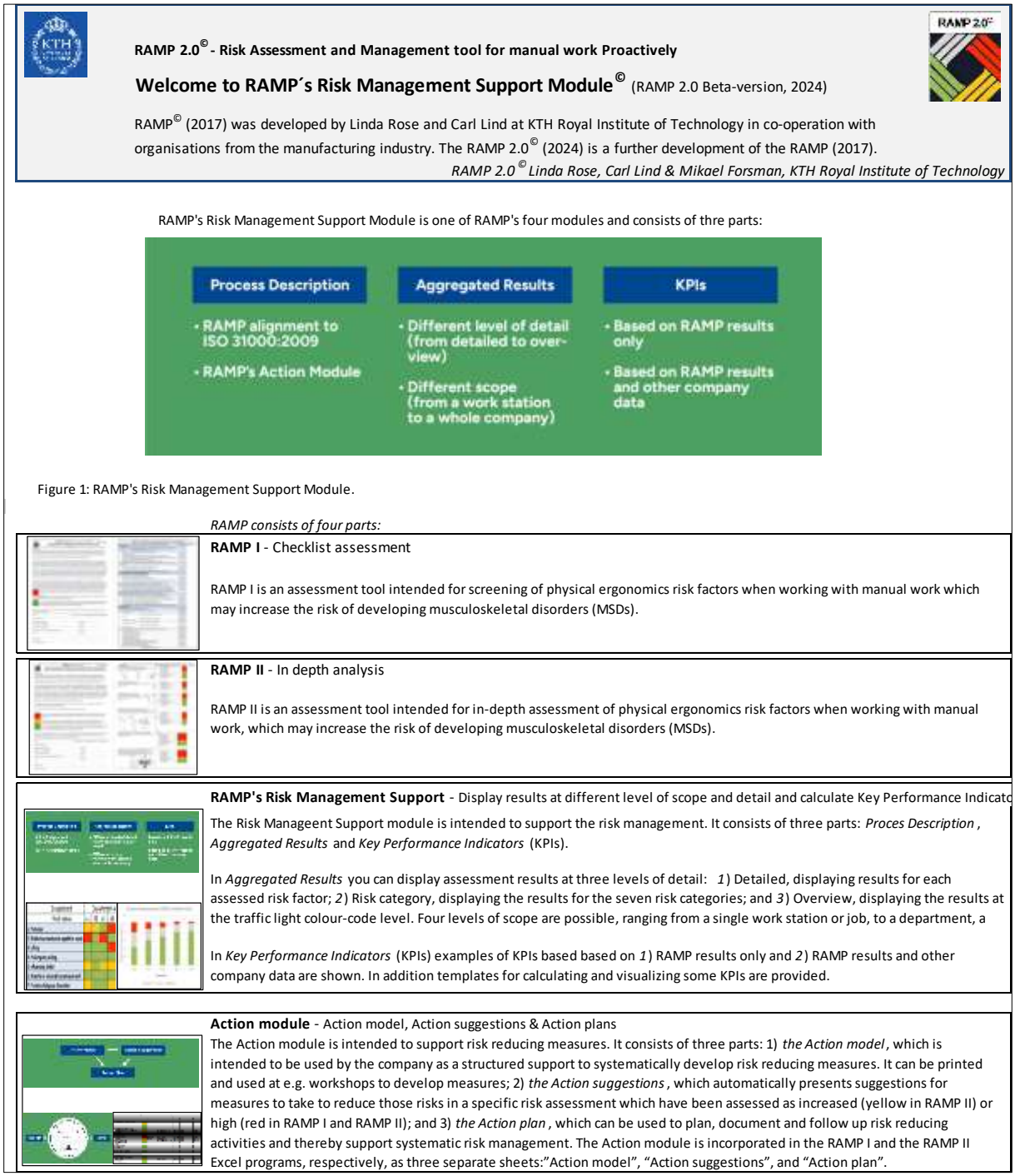


Figure 1: RAMP's Risk Management Support Module.

Figure 44: Part of the interface on the "Introduction" sheet in RAMP's Risk Management Support Program.

In the Risk Management Support Program 8 sheets form the Aggregated Results part in the RAMP Risk Management Support Module, the first four for RAMP I results, and the other four for RAMP II results.

4.4.2 Risk Management Processes

The sheet Risk Management Process (see Figure 45) provides a brief description of: risk management processes, RAMP's alignment to the ISO 31000:2009 standard, and of the RAMP Action module. In the "Aggregated Results" and "KPIs" sheets in the Excel program, you can read briefly about those parts.

Risk management processes and RAMP's Action module

This Excel sheet provides a brief description of: risk management processes, RAMP's alignment to the ISO 31000:2009 standard, and of the RAMP Action module. In the "Aggregated Results" and "KPIs" sheets in this Excel program, you can read briefly about those parts in this Risk Management Support Module.

Risk management processes

Risk management is a process. Several methods on how to work with risk management exist. One of the most common ones is Shewhart's "Plan - Do - Check - Act" (PDCA) cycle, e.g. described by Deming (1993). If you have a well-functioning risk management process, there is no need to change to another one! If not, you may find use for the RAMP tools Risk Management Support and Action modules.

The RAMP Risk Management Support Module consists of three parts (see Figure 1): *Process Description* , *Aggregated Results* and *Key Performance Indicators* (KPIs). The Process Description described in this Excel sheet, shows how RAMP is aligned to the ISO-standard 31000:2009 ("Risk management – Principles and guidelines").

The RAMP Action module is included in he RAMP I and RAMP II Excel programs, respctively, but here a brief description of it is given, since the Action module is part of the systematic risk management in RAMP.

Figure 1: RAMP's Risk Management Support Module.

Process Description

RAMP's alignement to the ISO-standard 31000:2009, "Risk management – Principles and guidelines"

RAMP was developed to be in alignment with the ISO-standard 31000:2009, which includes four main activities (I – IV):

I Communication and consultation
II Establishing context
II Risk assessment (A - Risk identification, B - Risk analysis, C - Risk evaluation and D -Risk treatment)
IV Monitoring and review

The activities I and IV can be viewed as activities ongoing throughout the whole process, surrounding the other activities.

In RAMP's User Guide you can read more about RAMP's alignment to the ISO-standard and find examples of how to use RAMP in these four types of activities inthe risk management process.

RAMP's Action Module

The RAMP tool includes an Action module, consisting of three parts, as illustrated in the figure (Figure 2) below:

- The Action model, with a structure for developing risk reduction measures, which the organisation can use as a support for deciding what actions to take for risk reduction in a specific case
- Automatically generated Action suggestions for assessment items with elevated risk and priority level (RPL) assessments. These can serve as inspiration for developing the case-specific suggestions, when using the Action model.
- The Action plan template, to form as a support in the systematic risk management process. It includes planned risk reduction actions, who is responsible for taking the measures as well as a time plan and planned follow-ups.

Figure 45: Part of the interface on the "Risk Management support " sheet in RAMP's Risk Management Support Program.

4.4.3 Aggregated Results

As mentioned in 4.4.1 The aggregated results part of the Risk Management Support Module consists of four sheets for RAMP I and four sheets for RAMP II. In the User Manual only the part with aggregated results from RAMP II assessments are described. However, the process to aggregate results in The RAMP Risk Management Support Excel-program Excel program

Aggregated Results from RAMP II Assessments

The sheet ”Input data” for RAMP II

Note! It is the results from the ”Action plan” sheet in the RAMP II program that should be used, not those from the “Results” sheet where the data is brought together.

The sheet ”Results at detailed level”

As with the RAMP I Results program, here results are presented at a detailed level, i.e. at the same level as in the RAMP II program’s “Results” sheet. Figure 46 shows part of the detailed results in a summary from three departments of a factory with an extract for risk categories ”1. Postures” and ”2. Work movements and repetitive work”. This shows that at a number of workstations increased or high risk have been identified for “Head posture” (1.1 and 1.2) and in area “2. Work movements and repetitive work” for ”2.1 Movements of the arm” and ”2.2 Movements of the wrist”. The results can also form a basis for planning work rotation. The results show that you should not rotate between for example workstations A3 and B2, since both are assessed as having high risk for both “1.2 Posture of the head -backwards” and arm and wrist movements (2.1 and 2.2).

Results of the RAMP II analysis at detailed level	Date: 2017-03-31									
Country	Sweden									
Site	Sthlm									
Department	A					B			C	
Work station ID	A1	A2	A3	A4	A5	B1	B2	B3	C1	C2
1.1. 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 or above shoulder height*										
1.6 Upper arm posture - hand in or outside the 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 (upper and lower arm)*										
2.2 Movements of the wrist*										
2.3 Type of grip - frequency*										
2.4 Shorter recovery/variation during work										
2.5 Longer recovery/variation during work										

Figure 46: Example of part of the results at detailed level from RAMP II assessments from three departments. This shows an extract for the risk categories “1. Postures” and ”2. Work movements and repetitive work”.

The sheet “Results at risk category level”

As in the RAMP I Results program, results are presented here at risk category level. The figures show how many assessments within a risk category have the most serious assessment. Figure 47 shows the results from three departments. This shows that the first workstation assessed A1 (the results column far left) has one risk factor assessed as red in risk category “1. Postures” which means that other risk factors have been assessed as yellow or green. It also shows that one risk factor in risk category ”5. Influencing factors” has been assessed as yellow, which means that others have been assessed as green. The figure shows that many workstations have increased or high identified risks in the three first risk categories, “1. Postures”, 2. Work movements and repetitive work” and “3. Lifting work”.

The bottom of the table shows the number of green, yellow and red assessments for each workstation, i.e. at overview level.

Results of the RAMP II analysis at risk category level	Date: 2017-03-31									
Country	Sweden									
Site	Sthlm									
Department	A					B			C	
Work station ID	A1	A2	A3	A4	A5	B1	B2	B3	C1	C2
1. Postures	1		1	1	3	2	2		1	
2. Work movements and repetitive work	1	1	2	1	1	1	2	1	2	
3. Lifting work	1	2	2	2	2	1	1		1	1
4. Pushing and pulling work						2	2	2		
5. Influencing factors	1	2	1	1	3	1	6	6	6	
6. Reports on physically strenuous work				1		1	1	1		
7. Perceived physical discomfort			1	1	1	1	1	1		
Results summary:										
Number of red assessments (high risk)	3	1	5	4	6	2	4	0	2	0
Number of yellow assessments (risk)	4	6	4	4	5	12	11	11	12	1
Number of green assessments (low risk)	28	28	26	27	24	21	20	24	21	34

Figure 47: Results at risk category level from RAMP II assessments.

The sheet "Results at overview level"

As in the RAMP I Results program, the "Overview results" sheet makes it possible for the company to tailor the display of results at overview level. Here the user chooses which results are to be aggregated in each column. For this reason there is no automatic summary of results in this sheet. Figure 48 below shows how RAMP II results for a whole group of companies can be presented. The results are presented here at overview level, with only the number of green, yellow and red assessments for each workstation. This shows that several departments in G:A in Gothenburg has a high proportion of red and yellow assessments, which signals that changes should be prioritised in this department. Generally, Attention should also be given to a high number of yellow assessments.

Results of the RAMP II analysis at overview leve	Date: 2017-06-13									
Country	Sweden					Canada				
Site	Stockholm			Gothenburg		Toronto			Montréal	
Department	S:A	S:B	S:C	G:A	G:B	T:A	T:B	T:C	M:A	M:B
Results summary:										
Number of red assessments (high risk)	6	3	10	30	10	10	20	8	15	12
Number of yellow assessments (risk)	16	10	20	60	15	18	35	14	30	20
Number of green assessments (low risk)	148	191	242	182	145	176	149	148	227	138

Figure 48: Results at overview level from RAMP II assessments.

5. The Action module in RAMP

The Action module in RAMP is intended to help in change work to reduce the risk of developing MSDs. Figure 49 illustrates the Action module', which consists of three parts:
i) an *Action model* which gives the company support in developing solution suggestions for risk reducing measures. This includes a figure that illustrates the model as a circle that is divided into five areas. Technology and design, Organisation, Employees, Vision and strategies and the Environment, and the model divides these with lines so as to form a pie chart. However there are not always clear boundaries between these areas and suggested solutions may lie within more than one of these areas. That is why lines in the model are dotted. It is suggested that that action suggestions are developed in all five areas, not just one or two. To support the development of measures suggestions there is a "Description of actions in the RAMP Action model" that also addresses that change work is dependent on context.
ii) a section with *automatically generated Action suggestions* for the risk categories assessed as red in a RAMP I assessment or as yellow or red in a RAMP II assessment. For each risk factor assessed as yellow or red, suggestions for possible measures are given in the five areas mentioned above (Technology and design, Organisation, Employees, Vision and strategies and the Environment).
iii) a template for the design of *Action plans*. The template is intended to support risk management in a structured manner. This shows the results of an assessment as well as a structure in which you can fill in planned measures, when they are to be performed, who is responsible, when they are "ready" and when follow up is planned. The idea is that those who are working on reducing the risk of developing MSDs for a specific workstation or a specific task use the results from *i*) and *ii*) above to prepare an action plan. Appendix 5 has an example of an action plan.

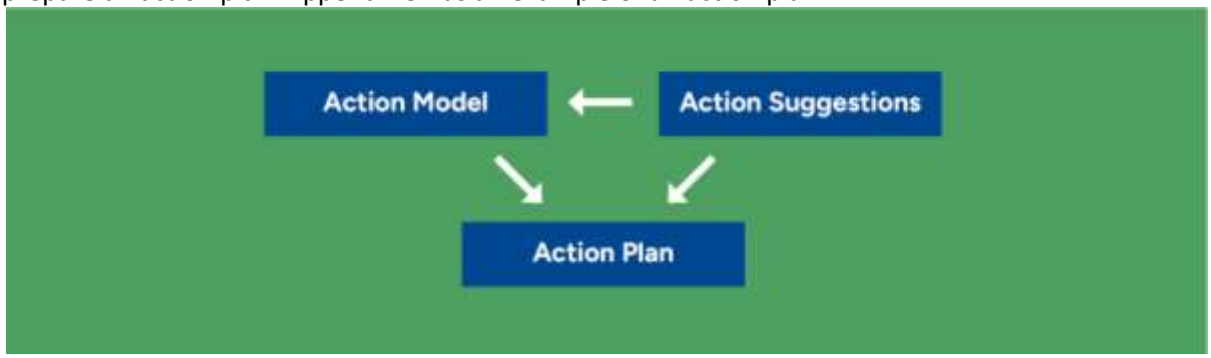


Figure 49: Schematic illustration of the Action module and its three parts.

5.1 The Action model

In cases where the RAMP analysis shows that there is an increased risk of employees developing MSDs, action should be taken to reduce the risks. The actions may be changes of various kinds: they may be of a *technical* nature (development of a machine), *organisational* (e.g. work expansion, the opportunity of the individual or group to influence work planning, work planning with rotation schemes or how the work is arranged from a time perspective), they can be about *environmental factors,* such as the environment and physical factors (e.g. lighting and noise) and *human* (e.g. the employees' competence and training), but they may also concern the company's or employees' *visions* (for example company goals and working environment work) and also depend on the *context* (e.g. which industry the company belongs to). Figure 50 below illustrates RAMP's Action model for how changes to bring about improvements can be structured.

Figure 50: Illustration of the Action model in RAMP. (Same as Figure 19.)

The Action model's Figure 1 illustrates:

- Five areas to consider when developing risk reduction suggestions tailored to meet the needs in a specific case: Technology & Design, Organisation, Employees, Environment, and Vision & Strategies.

- Three phases in part of the risk management phase spanning over the activities from when the risk and priority levels (RPLs) are established and risk reduction measures have been implemented and evaluated: the Investigating, the Fixing and the Evaluating phases.

- Four activities inspired by the ISO standard ISO 31000:2009: Communicate, Consult, Monitor and Review. These activities are suggested to be ongoing throughout the whole risk management process and can be viewed as embedding the other activities.

While the circle and its interior Figure 1 illustrate detailed activities connected to the operational problem solving of specific problems and as being part of the continuous problem solving, the outer part in Figure 1 with its two text boxes illustrate and concern parts of the organisation's and management's continuous operations.

Some advice on how to use the Action model

For risk management, opt at eliminating the risk, for example by seeking technical solutions or changed work technique or work organisation. If this is not doable, due to technical, organisational, financial or suchlike reasons, work with reducing the risk to low risk level ("green" level). Different types of actions are likely needed to reduce the risk and successful improvements mostly involve work in several areas. Work, preferably in hierarchical order, within each of the five areas. Creativity and openness for change and new ideas are often required to derive at good solutions. Some changes can lead to effects after a short time, others can lead to effects in a long time perspective. The injury risk is affected by the load (such as exerted force, force direction, and posture) and time aspects (such as duration, recovery time, and frequency). Avoid transferring a risk from one employee to another and try to avoid introducing new risks when changes are introduced. New solutions should also be assessed from a risk perspective.

Changes are context dependent, which can be described consisting of different parts: Economic context (e.g. economic cycle); Regulatory context (e.g. depending on which country the company is operating in); Sectorial context (e.g. technology level, competition situation and profit margins in the sector); Societal context (e.g. climate, culture, standards and practice in the society the company is active in); and Company context (e.g. culture, standards and practice within the company).

In the Investigating phase, investigate:

What is the problem?

Identify what the problem is. This can for example be the risk of developing neck pain among employees working at a work-station, which may lead to sick-leave due to the neck pain and an injury as well as quality deficiencies in the products produced there. In part, this information can be found in the RAMP assessment results. Internal reports may also be useful in defining the problem.

Once you have identified what the problem is, continue investigating what causes it:

What is the root cause of the problem?

There may be one or several contributing root causes to the problem. e.g.:

- What you are working on (products)
- What you are working with (tools)
- The work-place design (heights, etc.)
- The organisational management, including organisation, leadership and climate (e.g. lack of social support from managers and colleagues)
- The work organisation (time aspects, etc.)
- Materials used (e.g. their hardness or fragility)
- The supply and logistics processes (materials' transport)
- Other

Methods that can be useful for identifying the causes of the problem include "The Five Whys Tool" and the "Ishikawa Fishbone Diagram Method". Once you have identified the root causes, move on to the Implementation phase.

In the Fixing phase, develop solution suggestions, prepare for and implement the solutions:

Develop solution suggestions:

Use the results from the investigating phase (what the root causes are) as a base for developing solutions within the five areas "Technology & Design", "Organisation", "Employees", "Environment", and "Vision & Strategies". Develop solution suggestions that eliminate or at least reduce the root causes (and the risks of injury). Here different methods, such as traditional brain storming techniques and the 6-5-3 technique be useful.

Encourage collaboration with and collaborate with others, and seek advice from experts (e.g. experienced workers and specialists in different fields, such as product developers and ergonomics experts. Maybe hiring an engineer or an organisational consultant can contribute to developing solutions. Don't stay on the immediate limitations, widen the gaze and seek solutions in larger or other perspectives. Yet, don't let the perfect stand in the way for the good.

Prepare for implementing suggested solutions:

For systematic risk management the organisation needs to have a process, preferably with specific activities planned at reoccurring times and dedicated roles with means and responsibilities to manage the risks. Secure that those working with the implementation have sufficient knowledge and time for the implementation. Having someone leading and being responsible for the implementation is often beneficial.

Implement the suggested solutions:

If possible, implement the new solution in one part of the organisation. Such a "pilot case", which is followed during the implementation process, can be helpful to gain knowledge and experiences for future implementation. Gathering information of what goes smoothly and what does not, can be very valuable. Identifying factors and circumstances influencing the implementation can be of great support.

In the Evaluation phase, evaluate:
Evaluate what the organisation considers important to evaluate! The focus and methods of the evaluation differs between organisations, depending several factors, which include needs, knowledge and resources, as well as vision and strategies. Comparing the RPL-levels before and after the implementation of actions aimed at risk reduction is one common part of the evaluation. Others can be surveys for evaluating how employees and managers perceive the new work environment and organisation compared to before the change. Evaluating complaints, sick-leave, personnel turnover and quality and productivity deficiencies before and after the change can also be relevant.

It takes time to get new routines and methods in place, so let at around six months or longer pass before evaluating the effects. Having someone accountable for reaching the risk management goals is often beneficial.

Examples of possible actions within the five areas “Technology & Design”, “Organisation”, “Employees”, “Environment”, and “Vision & Strategies”

Table 1 gives examples of possible actions within the five areas "Technology & Design" that are added to the Action model's of possible actions with examples (Table 2) included in the 2017-version of the RAMP tool. You can use these examples to inspire your work developing risk reduction suggestions tailored to your special case.

Table 1: Examples of possible actions to improve the work environment and to reduce the risks of developing MSDs.

Technology & Design
Three of the main types of physical injury risk factors are force, postures and time aspects. Generally, opt at designing work where high forces carried out in adverse postures with high repetition or long duration. Generally higher force exertion results in higher exposure on the employee and increases the risk of injury. Postures where the body joints can be in neutral positions (and not close to their maximum range of motion), where work is carried
Time aspects, such as duration, pause and repetition frequency play a major role. Longer duration, higher repetition frequency and shorter pauses between the work tasks all increase the risk of injury. There is an interactive effect between force and repetition. Typically, increased repetitions lead to modest increase of MSD risk with low force, but to rapid increase in MSD risks with high force. In situations where the combination of
Consider new or redesign of products, systems etc. Also, investigate / benchmark how others have solved the same or similar issues. Where possible, introduce technical solutions, e.g. which fixate the objects on which the employee works and exerts force on.
Organisation
Opt at clear, well documented, and systematic decision and implementation processes for work environment improvements and secure that these are communicated with all employees affected.
Opt at involving the employees and their representatives in the Health & Safety work and work environment improvement processes.
Develop reoccurring Ergonomics / Human Factors /Health & Safety/ audits and engage employees in the work environment improvement work.
Medical checks can be relevant as physical problems may be detected and the work environment changed before an injury develops.
Employees
Organise education, training and relevant information transfer of employees, supervisors and managers and secure knowledge about ergonomics principles and safety rules.
Tailor specialized training for employees, focussing on work technique training at the employees' specific work place and their specific work tasks. E.g. educate and train the employees in how to correctly use the tool and inform them about the risks of using it in an inappropriate way (e.g. working too long time per day with vibrating tools).
Also consider implementing "work environment ambassadors" or suchlike.
Environment
Make demands on material and produt proviers and delivering companies on the format of the deliveries, so that foor exampls heavy lifts in akward postures are avoided in the logistics processes.
Vision & Strategies
Develop and articulate clear aims, visions and strategies on Health & Safety and MSD reduction at company management level and include these in the management processes.
Opt at clear, well documented, and systematic decision and implementation processes for work environment improvements and secure that these are communicated with all employees affected.
Take proactive measures e.g. by analysing and acting on previous work environment incidents and injuries.
Consider regular health checks.
Consider articulating specific work environment improvements goals, e.g. to reduce the number of "red" assessments with a certain amount annually.
Make demands on manufacturers and suppliers regarding tools, materials, products and systems design and functionality for good work environment and efficiency.

Table 2 in the RAMP Action model: Complement to the RAMP Action model (see figure above) with more detailed information about possible action in the five areas Technology and design, Organisation, Employees, Vision and strategies and the Environment.

Areas and actions	*Examples*
Technology & Design	
Eliminate the risk	change the workplace design, introduce other techniques or automation
Substitute technology and/or system	new or further development, purchase of new equipment, new systems, new aids
Design/introduce engineering controls	development of protective solutions and routines
Introduce signs and warnings	signs showing how to and how not to perform the work
Introduce personal protective equipment	hearing protection, glasses, gloves, shoes with vibration insulating soles, ergonomically adequate welding visors, etc
Secure good workplace design	work heights and distances, lighting, layout, etc
Secure good support functions	technical support, information technology, logistics, service and maintenance service
Enable individual adjustments	new/adequate working technique and equipment, e.g. height adjustable work surface
Organisation	
Work with job enhancement/enrichment	include a wider range of duties in the job which require a variety of skills and qualifications, e.g. add work planning, inspection of work results or customer contacts
Work with job diversification/enlargement	include several different tasks, e.g. include supplementary duties, such as maintenance and cleaning
Work with job rotation	design the job so that the employee can alternate between different tasks to enable variation and recovery for strained body parts
Work with decision latitude	work to reach an adequate job decision latitude, e.g. by letting the employee being able to influence the arrangement and conduct of her/his own work
Document the risk management work	store risk assessments, risk management plans and follow-ups systematically
Include risk management when designing work	take the outcome from the risk assessments, management plans and results into account when designing work, e.g. by avoiding identified high work surface levels
Secure knowledge about MSDs and their prevention	inform, educate, train, and control knowledge
Account for individual prerequisites	aim at adjustability, e.g. by height adjustable work surfaces
Work with other organisational questions	the organisational structure, management, culture, processes, formal and informal networks and decision making
Work with the psychosocial work environment	e.g. on how the work shall be carried out, demands- control-support, expectations, requirements, etc. See also under "Employees".
Work with job design from organisational perspectives	design the work so that recovery is possible during work shifts, consider how work can be scheduled from both system and human perspectives, etc
Employees	
Inform	inform about MSD risks and their management
Educate and train the employees on the job	educate and train on how the job shall be performed with adequate job techniques
Secure knowledge on how the job should be performed	inform, educate, train, and control knowledge
Secure sufficient variation in work movements	use ergonomics recommendations, ergonomic experts and/or RAMP II tables as a basis
Work with awareness	arrange meetings for information, education and discussions
Work with participation	support dialogue within the company between different stakeholders and actors and enable employees to influence their working conditions to some extent
Work with willingness to change and motivation	support dialogue within the company between different stakeholders and actors

Continuation of Table 2 in the RAMP Action model, see next page!

Table 2 in the RAMP Action model, *continued*: Complement to the RAMP Action model (see figure above) with more detailed information about possible action in the five areas Technology and design, Organisation, Employees, Vision and strategies and the Environment.

Environment	
Work with the external environment	plan for smooth logistics access
Work with premises and buildings	consider ergonomics in the (re)design of premises and buildings
Work with space	layout, enough movement space, flow
Work with the physical environment	physical environment and physical (e.g. noise), thermal (cold/heat), chemical (chemical substances) factors
Vision & Strategies	
Work with aims, visions, and strategies	work meetings focusing on existing and desirable goals and visions, work to form strategies which can be used for developing action plans and management processes
Stimulate creativity	creativity supportive activities such as brainstorming meetings for improvements, suggestion boxes for ideas, etc.
Secure facts-based decision bases	Key Performance Indicator analysis, follow trends over time, long-time strategic work
Develop good safety and health culture	conduct situation analysis of the state of knowledge of and the conditions for good health and safety culture and work together on its development

5.2 Action suggestions

In cases where risk factors are assessed to have a high risk in RAMP I (i.e. “red”) or assessed to have an increased risk or high risk in RAMP II (i.e. “yellow” or “red”), some examples of action suggestions are automatically given in the five areas Technology and design, Organisation, Employees, Vision and strategies and the Environment on the “Action suggestions” sheet in the RAMP I or RAMP II program. These are examples of suggestions and are intended to help in developing improvement suggestions in order to reduce risk in the case in question.

On the “Action suggestions” sheet, at the top is a statement of which work the analysis and action suggestion applies to, alike that given in 5.1 in this user manual (see Figure 51 for an example of part of the interface). There are then suggestions for the risk factors that were assessed as increased or high in the relevant analysis. Figure 52 shows examples of how some of the action suggestions are presented for fields reported in Figure 37 in section 3.3.1 of this user manual.

Action suggestions for RAMP II

Date:	2016-03-23		
Work/work task:	A7_ Provide/Serve DF		
Work station:	A7_ Serving task	*Department:*	DF
Site:	Stockholm	*Country:*	Sweden

If the action suggestions for a section are empty, then no actions are considered necessary regarding the specific risk area. Print the pages which show action suggestions. The page number is visible on each section. Always print page 1 which contains general information.

Page 1

Opt at eliminating the risk, for example by seeking technical solutions or changed work technique. If this is not doable, due to technical, organisational, financial or suchlike reasons, work with reducing the risk, preferably to low risk ("green") level. Different types of actions are likely needed to reduce the risk and successful improvements mostly involve work in several areas. Creativity and openness for change and new ideas are often required to derive at good solutions. Some changes can lead to effects after a short time, others can lead to effects in a long time perspective. The injury risk is affected by the load (such as exerted force, force direction, and posture) and time aspects (such as duration, recovery time, and frequency). Avoid transferring a risk from one employee to another and try to avoid introducing new risks when changes are introduced. New solutions should also be assessed from a risk perspective.

Changes are context dependent, which can be described consisting of different parts: Economic context (e.g. economic cycle); Regulatory context (e.g. depending on which country the company is operating in); Sectorial context (e.g. technology level, competition situation and profit margins in the sector); Societal context (e.g. culture, standards and practice in the society the company is active in); and Company context (e.g. culture, standards and practice within the company).

RAMP's Action model (see the sheet "Action model") gives an overview of how changes can be achieved at the company within the five areas Technology & Design, Organisation, Employees, Environment, and Vision and Strategies. It is suggested to work, preferably in hierarchical order, within each of the five areas. Here below, examples of action suggestions, which could be applicable in the specific situation to reduce the risk assessed in RAMP II, are

Figure 51: A screen dump from the introduction on the "Action suggestions" sheet in the RAMP II program.

1. Postures

1.1 Posture of the head – forwards and to the side

Page 3

1.2 Posture of the head - backwards

Type of action	*Examples of suggestions for solutions*
T&D	Investigate the visual conditions and secure that the lighting is appropriate for the work that is carried out (e.g. illuminance, glare, and contrast) and that the work area is arranged in an appropriate way to the light. See visual ergonomics guidelines. Maybe the employees visions need to be checked and visual aids obtained.
T&D	Redesign the work/work area, also considering the visual design, so that the unfavourable postures are eliminated or reduced. For example, adjustable surfaces may be needed. Lowered shelf heights or tilted surfaces to improve vison and access may be appropriate solutions, or secure that it is easy to visually inspect or physically feel that the work is performed correctly.
ORG	Consider work organisational changes, e.g. job enrichment, job enlargement, and job rotation.
EMPL	Inform, educate and train the employees and secure knowledge.
V&S	Work with aims, visions and strategies for decreasing the MSD risks.
ENV	Aim at smooth logistics access, a layout that enables easy movements and good flow and also consider physical (e.g. noise), thermal (cold/heat) and chemical factors.

Figure 52: Part of the automatically generated Action suggestions in RAMP II. In this case (see also Figure 37 in 3.3.1) no action is assessed as necessary for 1.1 for which reason the action suggestion field for this area is empty. For 1.2 the risk has been assessed as high ("red") and here action suggestions are given in the five areas Technology and design, Organisation, Employees, Vision and strategies and the Environment.

Note! If the action suggestion field for an area is empty, as with "Page 2" in Figure 52 above, no action is assessed as being necessary for that specific risk factor.

5.3 Action plans

Those who work on reducing the risks of developing MSDs for a specific workstation or a specific task can use the suggestions developed by the organisation itself with the aid of the Action model and the automatically generated Action suggestions in order to decide what measures are to be implemented to reduce the risk(s) in the case in question. The template for the Action plan that can be found in both RAMP I and RAMP II can be used to prepare an Action plan for this in a structured manner.

At the top of the table header some information about the case is filled in automatically, including what work has been assessed and when the assessment was done. You then fill in the rest of the table header with who ordered the action plan, who formulated it and its date. There is then a presentation of the assessment results in the first three columns in the next rows. The last five columns are filled in by the person(s) preparing the action plan. There is an opportunity to write comments at the bottom. Figure 53 shows an example of the action plan and this figure can also be found in a larger size in Appendix 5.

Action plan based on RAMP II assessment								
Date of assessment: 2017-05-03			**Work task/Employee load: WST 1**		**Department: KG**			
Work/Work task: Packaging at WST			**Site: Sala**		**Country: Sweden**			
Ordered by: S Borg			**Formed by: S Borg, L Kerr & J Andersson**	**Date of action plan: 2017-05-12**		**Note: High priority**		
Risk factor	**Assessment**	**Score**	**User comments**	**Planned actions**	**When**	**By whom**	**Ready (date)**	**Follow-up**
1. Postures								
1.1 Posture of the head - forwards and to the side		**1**						
1.2 Posture of the head - backwards		**1,5**	Poor lightning	Improve visual cond, Low shelf	June 2, 2017	J Andersson		Oct 31, 2017
1.3 Back posture - moderate bending		**0**						
1.4 Back posture - considerable bending and twisting		**1**						
1.5 Upper arm posture - hand in or above shoulder height*		**1**						
1.6 Upper arm posture - hand in or outside the outer work area*		**2**		Redesign work area & task	July 29, 2017	P Kempe		Oct 31, 2017
1.7 Wrist posture*		**2**		Redesign work area & task	July 29, 2017	P Kempe		Oct 31, 2017
1.8 Leg and foot space and surface		**0**						
2. Work movements and repetitive work								
2.1 Movements of the arm (upper and lower arm)*		**5**	Old equipment	Technical redesign	August 23, 2017	P Kempe		Oct 31, 2017
2.2 Movements of the wrist*		**5**	Old equipment	Technical redesign	August 23, 2017	P Kempe		Oct 31, 2017
2.3 Type of grip - frequency*		**2**	Pinch grip	Introduce fixture	August 23, 2017	P Kempe		Oct 31, 2017
2.4 Shorter recovery/variation during work		**4**		Job enlargement & grip fixture	August 23, 2017	P Kempe		Oct 31, 2017
2.5 Longer recovery/variation during work		**0**						
3. Lifting work								
3.1 Lifting work (average case)		**2,7**						
3.2 Lifting work (worst case)		**2,9**						
4. Pushing and pulling work								
4.1 Pushing and pulling work (average case)		**2,5**						
4.2 Pushing and pulling work (worst case)		**2,75**						
5. Influencing factors								
5.1 Influencing physical factors hand/arm								
a+b. Hand-arm vibrations		**0**						
c. Warm or cold objects are handled manually		**0**						
d. The hand is used as an impact tool often or a long time		**2**		Introduce technical aid	July 29, 2017	P Kempe		Oct 31, 2017
e. Holding hand tools weighing more than 2.3 kg for more than 30 minutes		**0**						
f. Holding precision tools weighing more than 0.4 kg for more than 30 minutes		**0**						
5.2 Other physical factors								
a+b. Whole-body vibrations		**0**						
c. The visual conditions are insufficient for the task		**0**						
d. Work in hot or cold temperatures or in draughty environments		**0**						
e. Standing or walking on a hard surface more than half of the work day		**2**		Shoes with cushoning soles	June 2, 2017	P Kempe		Oct 31, 2017
f. Prolonged sedentary work without possibility to do the work standing up		**0**						
g. Prolonged standing work without possibility to do the work sitting down		**0**						
h. Kneeling/squatting more than 30 times or more than 30 minutes		**0**						
5.3 Work organisational and psychosocial factors								
a. No possibility to influence at what pace the work is performed		**2**		Decision latitude workshop	June 29, 2017	J Andersson		Oct 31, 2017
b. No possibility to influence the work setting/how the work shall be carried out		**0**						
c. It is often difficult to keep up with the work tasks		**0**						
d. The employees often work rapidly in order to be able to take a longer break		**0**						
6. Reports on physically strenuous work								
6.1 Documented reports on physically strenuous tasks		**0**						
7. Perceived physical discomfort								
7.1 Perceived physical discomfort		**2**	See "?" in the Results sheet	Expert evaluation of work task	June 2, 2017	J Andersson		Oct 31, 2017
Other comments (below):								

Figure 53: Example of an action plan that can be designed in RAMP II. The first three columns are filled in automatically depending on the results of the assessment. The last five columns are filled in by the person(s) preparing the action plan.

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Appendix 1: Explanation of terms in RAMP

This appendix explains terms that are used in the RAMP method.

* =From AFS 2012:2 Belastningsergonomi (Physical Ergonomics); ** = From the Swedish Work Environment Authority website (2017-03-30, 15:30) on the knowledge summary *"Bra samspel och samverkan skapar säkerhet"* (2010).

Bending the head backwards In RAMP all bending of the head backwards from the neutral position is regarded as unfavourable, even if the bending is small.

Cycle time In RAMP cycle time means the time from when an action begins until the same action recurs, i.e. when the cycle is complete.

Force The unit of force is the Newton [N] and force is measured with a dynamometer.

Force measurements Pushing and pulling forces must be measured with a dynamometer. If a load is pushed or pulled for less than 5 seconds, only measure the force used to get it moving, that is, the "initial force" (the starting force). If a load is pushed or pulled for 5 seconds or more, measure both the initial force and also the continuous force during the move. When measuring forces, apply the dynamometer to the place where one normally places the hand(s) and pushes or pulls the load carrier (trolley or similar) that is to be moved. Do not get the load into motion with a jerk! Repeat the measurement five times and take the median as the value of the force (see the explanation of "Median value"). This applies to all measurements of initial and continuous force.

Good grip To be classified as a good grip all the following criteria must be fulfilled (if these are not fulfilled, the grip is classified as poor). Handle or cut-outs that enable a comfortable and steady grip for the fingers/hand; grip surface must not be slippery; the centre of gravity of the load must be centred at be between the hands or in the centre of the hand for a one-handed grip; length of handle/cut-out must be at least 11.5 cm; and for handles the handle diameter must be between 2 and 4 cm.

Hot or cold objects: Objects colder than 10°C are here counted as cold and objects hotter than 43°C are counted as hot (Lindqvist & Skogsberg, p. 93, 2007).

Hot or cold temperatures: Here a cold environment means that the air temperature is less than 10°C and a warm environment usually means that the air temperature is over 25°C (Bohgard et al., p. 195, 2010).

Long time In RAMP the expression "long time" means about 30 minutes or more per working day.

Manual handling* All kinds of transports or movements of loads where one or more employees lift, put down, push, pull, carry or move a load.

Median value The median value of a number of figures is the middle value when all the figures are arranged in order of size. For example, the median value of the figures 1, 2, 5, 7, 19 is the one that is in the middle position, or 5 in this case. With an even number of figures, the median value is the average of the two figures in the middle when they are arranged in order of size.

Musculoskeletal disorders, MSDs* Here refers to disorders in the organs of movement, i.e. all forms of ill health in the organs of movement that may be connected to conditions in the work. The disorder may be caused by the work or may be caused by something else and made worse by the work. The term includes everything from minor, temporary problems to lifelong injury. Musculoskeletal disorders is synonymous with physical disorders.

Neutral position Neutral position means that the joints of the body are in their position when the person stands upright in a relaxed position.

Often In RAMP the term "often" refers to about 100 times per working day.

Poor grip Poor grip means that it is difficult to get sufficient grip with the hand and fingers or that the grip surface is slippery or has sharp edges, or that the centre of gravity of the load is not centred, or

that the contents are unstable or move around, or that the grip does not fulfil the requirement for a good grip. (Se ”Good grip.)

Powerfully vibrating tool A powerfully vibrating tool is one that has a vibration level over 10 m/s^2.

Pushing and pulling force see ”Force measurements”.

Pushing and pulling work* involves moving an object that entirely or partly rests on a surface or is suspended, e.g. in an overhead transporter. The forces needed to set and keep an object in motion depend on how heavy the object is and how great the friction is between the object and the underlying surface, as well as the slope of the surface.

Recovery/variation. To reduce the risk of MSDs, it is considered important to have variation in the work so that the muscle groups that are stressed (mainly during static load) have the opportunity for recovery – regarding sufficient oxygen levels and that waste products can be transported away. This can be achieved by, after a period of work when mostly certain muscles are strained, working on other tasks where these muscles have little strain and can recover. For muscle recovery to occur, one can thus vary the work during a task and work shift.
Repetitive work* Work that involves repeating the same working movements over and over again. The time for each working action is short and the movements often occur to such an extent that the employee can suffer problems in the musculoskeletal/ locomotion organs/system.

Risk Risk means the general possibility of an undesired consequence. Here, risk means the risk of developing MSDs. Risk depends both on the probability of this occurring and also what consequences this would have.

Risk score setting in RAMP II The main results in RAMP are the assessment of risks into the risk levels (green, yellow, red). To complement this and to enable comparison of different assessments of the same risk factor, RAMP also has a Risk score system. The total Risk score for a completed analysis can be compared with an analysis of the same work after a measure to improve the working environment, or after other changes in the work. The Risk score system in RAMP has been produced in consultation with experts in ergonomics. The main result is the number of assessments in the different colours green, yellow and red. If the results of different assessments have the same number of red, yellow and green assessments, the total Risk score can be used for prioritising action. When comparing work/tasks the Risk scores between different RAMP assessments can also be compared, but such a comparison should not be given the same weight as the number of red, yellow and green assessments.

Safety culture ** is the common attitudes, values and perceptions that managers and employees have in relation to safety and the working environment. Good interaction and collaboration creates a good working environment and a high level of safety. What characterises a good safety culture in a workplace is that management prioritises and handles safety and working environment issues at all levels of the organisation and that this is part of the culture. Management has a great influence on the safety climate but does not “own” the culture; management is an important role model and guide.

Similar working movements In RAMP similar working movements refers to similar working movements performed with the body, such as when picking goods from a shelf and placing them in packaging or performing work at different workstations that loads the same bodily structure in a similar way.

Slippery surface Slippery surface (in 2.2 in RAMP 2) refers to a surface with a coefficient of friction of less than 0.5. If the friction is lower than 0.2 (”extremely slippery”) it is recommended that the work is also assessed by an expert.

Static load Static load refers to the exertion of force when the muscles are neither contracted nor extended but have a constant length, and cannot rest and therefore cannot take up oxygen. This differs from dynamic load, which refers to a load that leads to the muscles alternately extending and contracting during the work, enabling oxygen levels to adjust and waste products to be transported away from the muscles. With precision installation at chest height in front of the body, for example,

the load is static for the upper arm, which is held still, but dynamic for the hand that performs twisting movements.

Static posture In RAMP static posture refers to a posture that is held for more than 5 seconds without interruption.

< "Less than" sign, e.g. 3 < 5, i.e. 3 is less than 5.

≤ "Less than or equal to" sign, e.g. 3 ≤ 5, i.e. 3 is less than or equal to 5, and 5 ≤ 5, i.e. 5 is less than or equal to 5.

> "Greater than" sign, e.g. 5 > 3, i.e. 5 is greater than 3.

The load on the employee This means the load that an employee (who may work on different tasks during the working day, such as in different work situations) is exposed to during the working day.

Unfavourable postures Unfavourable postures refers to postures that give loads that have a negative effect on the body, such as on muscles and joints, and that can also affect health. Examples of unfavourable postures are when joints are close to their extreme positions, such as when the neck is greatly bent.

Vibration: Vibrations, both those transferred via the hands, such as through vibrating tools, and whole-body vibrations, such as are transferred when sitting or standing on a vibrating surface, can cause MSDs. If vibrations occur it is recommended that the situation in the particular case is analysed in more depth, for example by going into the Vibration Database (http://www.av.se/teman/vibration/poangmetoden/handvibrationer/), or by taking measurements and comparing with the Vibration Directive. There is also more information on the Swedish Work Environment Authority website (http://www.av.se). A "powerfully vibrating tool" is one that has a vibration level over 10 m/s^2.

Visual conditions are insufficient for the work: This means that visual conditions are insufficient to be able to perform the work from a visual ergonomics perspective. The reasons for this may include unsuitable lighting, glare, weak contrast, poor sharpness, how the workplace is arranged in relation to the light and the employee's own visual ability in combination with any aids to vision. Poor visual conditions can also give rise to unfavourable postures in an attempt to stand or sit so as to see better. These strained postures can lead to the development of MSDs.

Work cycle* The time from beginning to work on an object until the same moment recurs on the next object. It is not uncommon for the same working movements to be repeated several times within such a work cycle. There is no absolutely clear definition of work cycle – in some cases different parts of the work can be regarded as a work cycle. A work cycle may for example be represented by the actions that a person performs when the or she pulls forward a trolley from a staging point, transports it and picks items into it, pushes the trolley to a place where someone else takes over and then goes to the staging point for trolleys to collect a new trolley.

Working day* This normally refers to work for 8 hours a day.

Working distance In RAMP the working distance is measured from the centre of the spine, not the front of the stomach.

Work performed in warm or cold temperatures or in a draught What temperature is appropriate depends on the nature of the work, for example if the work is performed standing still or not and whether the objects handled are heavy or light. Other factors such as heat radiating sources in the room, humidity and clothing affect what is an appropriate working temperature. Two temperature recommendations are *i*) work in cold premises means that the work is performed when the temperature is below +16 degrees C *(*AFS 2012:2) and *ii*) work at over 27 degrees C increases the risk of injury (Mital et al.,1997*).*

Work/task Here the assessment is based on work or a task (that is performed at a workstation for example) as if it were to be performed for a whole working day (i.e. 8 hours).

Appendix 2: RAMP I© (Preliminary version, 2024)

RAMP I© (RAMP 2.0 Preliminary version, 2024)

Checklist for screening physical risks for manual work

RAMP - Risk Assessment and Management tool for manual work Proactively

Introduction

This checklist (RAMP I) is intended for identifying (screening) and assessing physical ergonomics risk factors when working with manual work which may increase the risk of developing musculoskeletal disorders (MSDs). Manual work involves for example manual lifting, pushing or pulling of loads and working with hand-held tools. At high or sustained exposure to the risk factors the risk of developing or worsening MSDs increases.

Use this tool to assess a work, work task, or a work station during an average 8 hour 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 and mark the "Yes" or "No" box corresponding to the question/statement.

The results from the analysis show whether any risk factor has been identified or not. If no risk factor has been identified, the risk to develop MSD problems is assessed to be low for people with normal physical capacity. If one or more risk factors have been identified this implies that either there is a high risk to develop MSDs, or that a refined analysis is needed to assess whether the risk is low, moderate or high. A refined analysis can be carried out with the RAMP II module in most cases. The result of the RAMP I assessment is presented at three risk and priority 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.

Investigate further. An in more in depth analysis is required to assess the risk level. A refined analysis can be carried out for example with the RAMP II module.

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 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: _____

Note! Write an "x" (small x) in each " Yes" or "No" statement box under each question.	Yes	No	Comment:
1. Postures			
1.1 Does work occur often or for a long time* in any of the following unfavourable postures? ** often = about 100 times per work day or more* ** a long time = about 30 minutes per work day or more*			
a head bent backwards			
b back/upper body bent or twisted - forwards, backwards or towards the side			
c arm almost or fully stretched forwards (the hand more than about 45 cm from the spine)			
d hand above shoulder height or below knee height			
e hand/arm brought outwards to the side (to the right or to the left)			
1.2 Does work occur in any of the following unfavourable postures about 1 hour per work day or more?			
a head clearly twisted or bent - forwards or towards a side			
b hand clearly bent upwards, downwards or towards a side			
c legs or feet have insufficient space, or the surface is unstable or with a slope			
2. Work movements and repeated work	**Yes**	**No**	
2.1 Does work occur in any of the following ways?			
a the work cycle is shorter than 30 seconds			
b the work cycle is between 30 seconds and 5 minutes			
c similar work movements are repeated more than 1/10 up to half of the work cycle time			
d similar work movements are repeated more than half of the work cycle time			
If "No" on all in 2.1, go to 2.3. If "Yes" on any in 2.1, answer 2.2 below.			
2.2 How long time of the working day does such work occur? Choose one alternative.			
a the work or similar work tasks are carried out between 1 and 4 hours of the work day			
b the work or similar work tasks are carried out for more than 4 hours of the work day			
2.3 Does work occur with repeated force exertion by the hand or fingers (e.g. grip a tool or push a button)?			
If "No" on 2.3 go to 3. If "Yes" on 2.3, measure or assess the force and answer 2.4 below.			
2.4 Does the force exertion generally occur in any or some of the following ways?			
a the force exertion is at least moderately strenuous (at least about 30% of max)			
b the force exertion is at least somewhat strongly strenuous (at least about 40% of max)			
c the force exertion occurs more often than once per minute			
d the force exertion's duration is in average longer than 2 seconds			
e the force exertion is generally carried out with clearly bent wrist upwards or downwards			
3. Lifting work	**Yes**	**No**	
3.1 Does lifting of loads occur? If "No", go to 4.			
3.2 How heavy are the loads and how often are they lifted?			
a less than 3 kg			
- more than 100 times per work day			
b 3-7 kg			
- more than 40 times per work day			
c more than 7 kg - 14 kg			
- more than 20 times per work day			
d more than 14 kg - 25 kg			
- more than 5 times per work day			
e more than 25 kg			
3.3 Do the lifts generally occur in any of the following unfavourable postures?			
a back/upper body clearly bent			
b back/upper body clearly twisted			
c hand above shoulder height			
d hand below knee height			
e hand outside forearm distance			
f arm clearly brought outward (to the right or to the left)			
g lifting/holding with overhand grip (palm facing downward)			
h one-hand lift where the load exceeds 6 kg			
i lifting while seated where the load exceeds 7 kg			

Continued on the next page

Continued RAMP I – Checklist for screening physical risks for manual work

	Yes	No	Comment:
4. Pushing and pulling work			
4.1 Does pushing and pulling work occur? If "No", go to 5.			
4.2 How large is the exerted force in the pushing or pulling work?			
a the starting force (the force to start the object moving) exceeds 150 Newton			
b the starting force (the force to start the object moving) exceeds 300 Newton			
c the continuous force (the force to keep the object moving) exceeds 100 Newton			
d the continuous force (the force to keep the object moving) exceeds 200 Newton			
4.3 Does the pushing and pulling work generally occur in any of the following unfavourable conditions?			
a the gripping height clearly deviates from elbow height			
b the work is carried out with the back/upper body clearly twisted			
c the force is exerted towards the side or upwards (i.e. not straight forwards or backwards)			
d the force is exerted with one hand			
e the pushing or pulling is carried out often (approx. more than 100 times per work day)			
f the pushing or pulling distance exceeds 30 meters			
4.4 Are load carriers with 1-2 wheels (e.g. two-wheel cart) or similar used, under the following condition?			
the employee bares the whole or part of the load, and the load weight exceeds 100 kg			
5. Influencing factors	**Yes**	**No**	
5.1 Influencing physical factors hand/arm - do the following occur? The times refer to "per work day".			
a the employee is exposed to hand-arm vibrations more than 20 minutes (10 for strongly vib)			
b the employee is exposed to hand-arm vibrations more than 90 minutes (60 for strongly vib)			
c warm or cold objects are handled manually			
d the hand is exposed to impact, reaction load or shock (e.g. as an impact tool) often/long time*			
e holding hand tools weighing more than 2.3 kg for more than 30 minutes			
f holding precision tools weighing more than 0.4 kg for more than 30 minutes			
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			
b the employee is exposed to whole-body vibrations more than 6 hours			
c the visual conditions are insufficient for the task			
d the work is carried out in hot or cold temperatures or in draughty environments			
e standing or walking on a hard surface more than half of the work day			
f prolonged sedentary work without possibility to change to do the work standing up			
g prolonged standing work without possibility to change to do the work sitting down			
h kneeling/squatting more than 30 times or more than 30 minutes			
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			
b there is no possibility to influence the work setting or how the work shall be carried out			
c it is often difficult to keep up with the work tasks			
d the employees often work rapidly in order to be able to take a longer break			
e there is no possibility for recovery time during the work (other than formal breaks)			
6. Reports on physically strenuous work	**Yes**	**No**	
6.1 Do documented reports exist on physically strenuous tasks (near misses, incident reports, journal notes, or other) when carrying out the work task?			
6.2 If "Yes" on 6.1 , what type of work that has led to this? If "No", go to 7.			
lifting			
holding/carrying			
pushing/pulling			
pushing with hand or fingers			
other: (if any, please replace this text)			

Continued on the next page

Continued RAMP I – Checklist for screening physical risks for manual work

7. Perceived physical discomfort. Ask five people who perform this work task	**Yes**	**No**	
7.1 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.			
7.2 If "Yes" on question 7.1, which is the worst task?			
Person 1			
Person 2			
Person 3			
Person 4			
Person 5			
Assessment comments (if any, please write below):			

Appendix 3: RAMP II© (Preliminary version, 2024)

RAMP II © (Preliminary version, 2024)

In depth analysis for assessment of physical risks for manual work

RAMP - Risk Assessment and Management tool for manual work 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 work which may increase the risk of developing musculoskeletal disorders (MSDs). Manual work involves for example manual lifting, pushing or pulling of loads and working with hand-held tools. 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 8 hour 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 at three risk and priority 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: _____

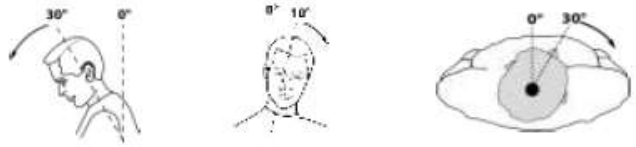
Other information: _____

1. Postures

Fill in the corresponding score in the white box

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?



	Score:	Comment:
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	

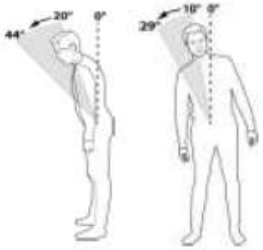
1.2 Posture of the head - backwards

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

	Score:	Comment:
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

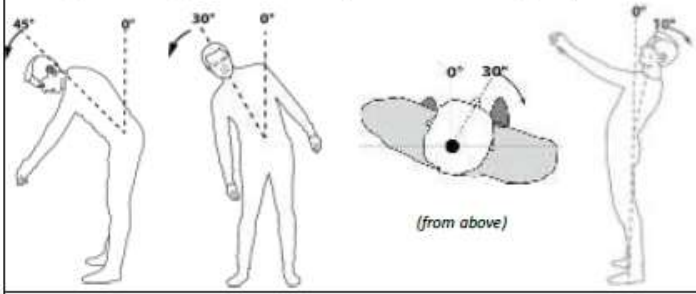
Does moderate bending of the upper body forwards or to the side occur, as shown in the figures, or more?



	Score:	Comment:
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?



	Score:	Comment:
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	

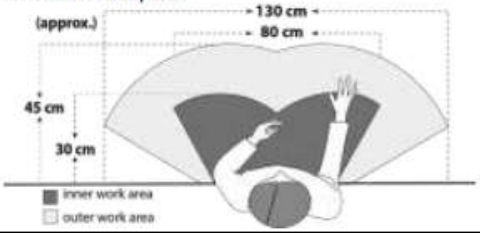
1.5 Upper arm posture - hand in or above shoulder height

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.

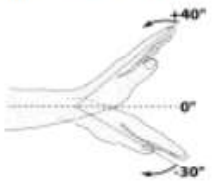


	Left	Right
4 hours or more	10	10
3 to < 4 hours	7	7
2 to < 3 hours	5	5
1 to < 2 hours	3	3
30 minutes to < 1 hour	2	2
5 to < 30 minutes	1	1
< 5 minutes	0	0

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

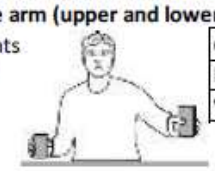
Is there a lack of space for the legs or for the feet, or is the surface unstable or sloping?

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

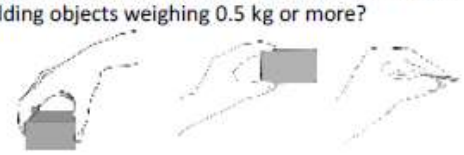
2.2 Movements of the wrist

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

RAMP II® (Preliminary version, 2024). ® Linda Rose, Carl Lind & Mikael Forsman. 2024. KTH Royal Institute of Technology. Sweden **4**

2.6 Work with repeated force exertion by the hand or fingers

Beta-version for ACE2023. Do not disseminate.

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

If no work occurs with the hand or fingers in repeated force exertions: Write "0" in the box on the right and go to 3. | **No work with the hand in repeated force exertions** | 0

Make the assessment for the hand with the highest exposure. If you are unsure which of the hands has the highest exposure, assess both hands. The Risk score for the hand with the highest exposure is displayed in the results. Make an assessment of an average case. Frequent handling of low forces (< 5 % of maximum) and computer work are not considered here.

1. Choose the suitable type of grip/contact area in Table 7. Measure the exerted force for that grip/contact area. (If you cannot measure this, mark the chosen grip/contact area type in Table A and measure five employees maximum exerted power grip force [N] three times. Insert the highest of these values in Table A for each employee. Thereafter, let them assess % of max force exerted in the case to be analysed and insert it in the Table A for each emplo An average based on the inserted values is calculated automatically and the cell to use is highlighted in Table 7.)
2. Assess how often the force is exerted.
3. Choose the grip/contact area in Table 7 which best matches the current case and follow that row down to the force interval cell which includes the current force.
4. Move towards the right in Table 7 to the cell including the frequency for the force exertion, to determine the Grip-force-and-frequency factor.
5. Based on the duration of each force exertion generally, determine the Duration-per-exertion factor in Table 8.
6. Assess the general wrist posture during the force exertions. Based on the posture (extension/flexion) in Table 9 showing the highest value, determine the Wrist-posture factor.
7. The Risk score is calculated in Table 10 by multiplying the four factors which you have determined above. This is done automatically in the digital model. The Risk score can also be calculated "by hand" if you do not have access to the digital version. The Risk score for the average case is displayed as "Risk score 1" in the bottom right corner.
8. If single force exertions are performed which are perceived as particularly strenuous, these should be assessed separately. If so, do the same for that case, i.e. perform step 1-8.
9. If a worst case is analysed, the Risk score for this case is displayed as "Risk score 2" in the bottom right corner below. If no worst case is analysed, the Risk score for the average case (i.e. "Risk score 1") is also displayed in the "Risk score 2" box. (In a later version, the result will also display if the Risk scores correspond to green, yellow, or red Risk-and-Priority levels.)

Table 7: Grip-, force-and-frequency factor.

Force [N]	Grip /contact area type: Power grip	Thumb pinch / Thumb press	Three-finger grip[1]	Index pinch[2] / Index press	Exertions per:	Frequency: Choose exertions per day, hour or minute.										
					day	≤ 96	97 - 479	480 - 959	960 - 1439	1440 - 1919	1920 - 2399	2400 - 2880	2881 - 3840	3841 - 4800	4801 - 9600	9601 - 14400
					hour	≤ 12	13 – 59	60-119	120-179	180–239	240 - 299	300 - 360	361 - 480	481 - 600	601 - 1200	1201 - 1800
					minute	≤ 0.2	0.3 – 0.9	1	2	3	4	5-6	7 - 8	9 - 10	11 – 20	21 – 30
	> 220	> 54	> 60	> 43		8.5	13	20	34	48	65	99	131	162	308	440
	196 - 220	49 - 54	55 - 60	40 - 43		6.7	10	16	27	38	51	77	102	126	239	341
	176 - 195	44 - 48	49 - 54	36 - 39		5.1	7.9	12	21	29	39	59	78	97	184	263
	151 - 175	39 - 43	43 - 48	31 - 35		3.9	6.0	9.2	16	22	30	45	60	74	141	201
	131 - 150	33 - 38	37 - 42	27 - 30		3.0	4.6	7.0	12	17	23	34	46	57	107	153
	111 - 130	28 - 32	31 - 36	23 - 26		2.3	3.5	5.3	9.2	13	17	26	35	43	82	117
	89 - 110	23 - 27	25 - 30	18 - 22		1.7	2.7	4.1	7.0	9.9	13	20	27	33	62	89
	66 - 88	17 - 22	19 - 24	14 - 17		1.3	2.0	3.1	5.2	7.4	10	15	20	25	47	67
	46 - 65	12 - 16	13 - 18	9 - 13		1.0	1.5	2.3	3.9	5.5	7,4	11	15	18	35	49
	23 - 45	6 - 11	7 - 12	5 - 8		0.7	1.0	1.6	2.7	3.9	5.2	8	10	13	24	35
	12 - 22	4 - 5	4 - 6	3 - 4		0.4	0.6	1.0	1.6	2.3	3.1	4.7	6	8	15	21
	5 - 11	1 - 3	1 - 3	1 - 2		0.3	0.4	0.6	1.1	1.5	2.0	3.0	4.0	5	9.4	13

[1] = Palmar pinch, Tripod pinch grip, Chuck grip.

[2] = Tip pinch, Tip-to-tip, Pulp pinch.

Table A: Assessment of force (if you cannot measure it for the chosen grip /contact area type).

Choose Grip / Contact area type from the drop-down list:	Choose grip:				
	Person 1	Person 2	Person 3	Person 4	Person 5
Insert five employees highest measured power grip force in [N]:					
Insert 5 empl. assessed % of max force exerted in the case in [%]:					

Table 8: Duration-per-exertion factor. Please state this for the general duration per exertion.

Duration of the force exertion [s]	≤ 0.2	0.3 – 0.9	1 – 2	2.1 - 3.4	3.5 – 5	6 – 10	11 – 20	21 – 30	31 – 60	61 – 90	91 – 120	121 – 240
	0.5	0.7	1.0	1.3	1.9	3.3	6.2	9	18	25	30	43

Table 9: Wrist-posture factor. Please state this for the general wrist posture during the force exertions.

Extension (wrist angle upwards)	0 – 45°	> 45°	
Flexion (wrist angle downwards)	0 – 15°	16 – 45°	> 45°
Factor	1.0	1.4	1.6

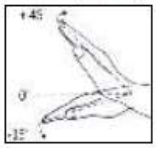


Table 10: Calculation of Risk score.

	Left Average case Factor	Right Average case Factor	Left Possible worst case Factor	Right Possible worst case Factor
Grip-, force-and-frequency factor from Table 7.				
Duration-per-exertion factor from Table 8.				
Wrist-posture factor from Table 9.				
Risk score (multiply the factors in each column)	0,0	0,0	0,0	0,0

Comment: (Start on the next row)

Score	Colour
≥ 5	
3 - 4.9	
< 3	

Risk score Average case:

Risk score Worst case:

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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

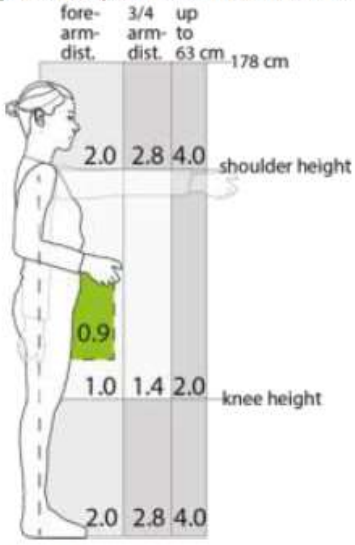
Make an assessment for an average case. Frequent handling of light loads (< 1 kg) is covered in other parts of RAMP II.

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.



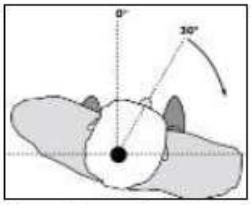


Figure: Torso twisted 30°.

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:

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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

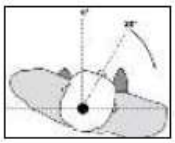


Figure: Torso twisted 30°.

Table 6: Calculation of Risk score.

	Factor Initial force	Factor Continuous force	If any, worst case Factor Initial force	If any, worst case Factor Continuous 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 had. If yes, insert the factor 1.7.				
☐ Pushing/pulling 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:

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 exposed to impact, reaction load or shock (e.g. 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.**

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:_____

Assessment comments (if any, please write below):

Appendix 4: Measurements of working heights and working distances in RAMP

The figure below gives measurements for working distances (for hand grip) and working heights for the 5th, 50th and 95th percentile of the adult Swedish population, divided into women and men. The measurements are based on calculations from Hanson et al. (2009) and Pheasant & Haslegrave (2006) and include a show height of 2.5 cm.

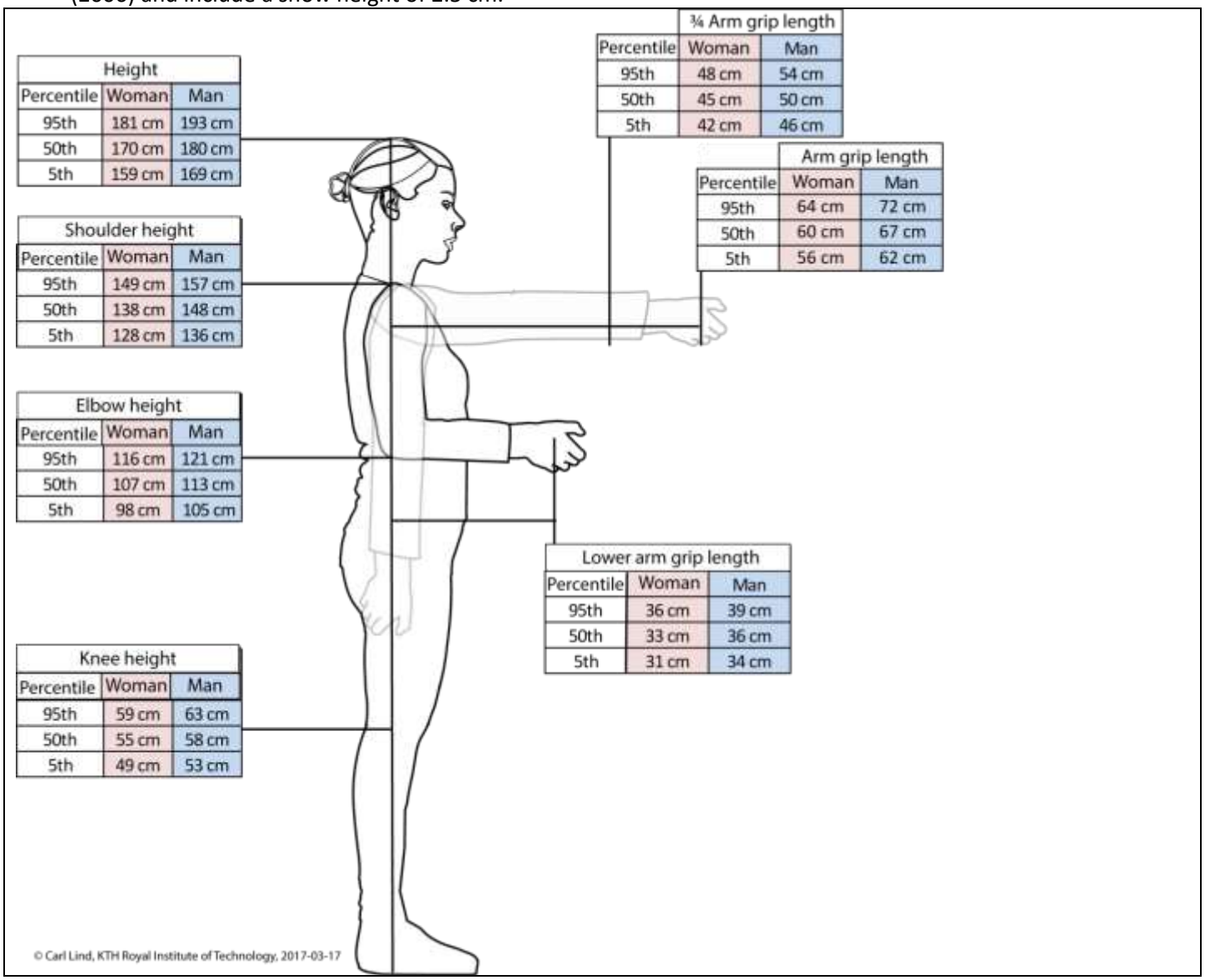


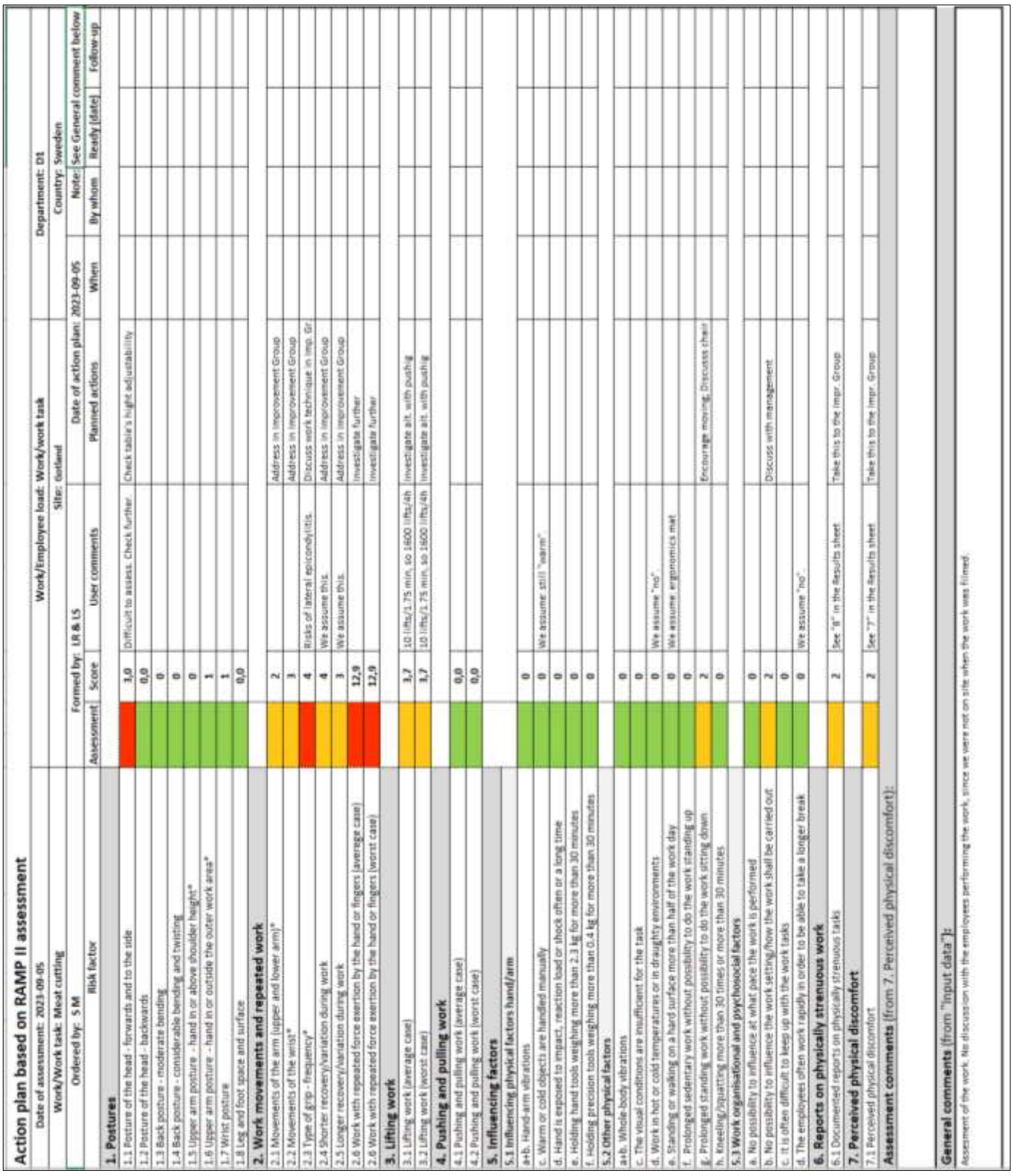
Figure A4-1: Measurements for working distances (for hand grip) and working heights for the 5th, 50th and 95th percentile of the adult Swedish population, divided into women and men. The measurements are based on calculations from Hanson et al. (2009) and Pheasant & Haslegrave (2006) and include a show height of 2.5 cm.

References

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.

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

Appendix 5: Example of Action plan in RAMP



Action plan based on RAMP II assessment

Date of assessment: 2023-09-05 | Work/Employee load: Work/work task | Department: 01

Work/Work task: Meat cutting | Site: Gotland | Country: Sweden

Ordered by: S M | Formed by: LR & LS | Date of action plan: 2023-09-05 | Note: See General comment below

Risk factor	Assessment	Score	User comments	Planned actions	When	By whom	Ready (date)	Follow-up
1. Postures								
1.1 Posture of the head - forwards and to the side		3,0	Difficult to assess. Check further.	Check table's hight adjustability				
1.2 Posture of the head - backwards		0,0						
1.3 Back posture - moderate bending		0						
1.4 Back posture - considerable bending and twisting		0						
1.5 Upper arm posture - hand in or above shoulder height*		0						
1.6 Upper arm posture - hand in or outside the outer work area*		1						
1.7 Wrist posture		1						
1.8 Leg and foot space and surface		0,0						
2. Work movements and repeated work								
2.1 Movements of the arm (upper and lower arm)*		2		Address in improvement Group				
2.2 Movements of the wrist*		3		Address in improvement Group				
2.3 Type of grip - frequency*		4	Risks of lateral epicondylitis.	Discuss work technique in imp. Gr				
2.4 Shorter recovery/variation during work		4	We assume this.	Address in improvement Group				
2.5 Longer recovery/variation during work		3	We assume this.	Address in improvement Group				
2.6 Work with repeated force exertion by the hand or fingers (average case)		12,9		Investigate further				
2.6 Work with repeated force exertion by the hand or fingers (worst case)		12,9		Investigate further				
3. Lifting work								
3.1 Lifting work (average case)		3,7	10 lifts/1.75 min, so 1600 lifts/4h	Investigate alt. with pushig				
3.2 Lifting work (worst case)		3,7	10 lifts/1.75 min, so 1600 lifts/4h	Investigate alt. with pushig				
4. Pushing and pulling work								
4.1 Pushing and pulling work (average case)		0,0						
4.2 Pushing and pulling work (worst case)		0,0						
5. Influencing factors								
5.1 Influencing physical factors hand/arm								
a+b. Hand-arm vibrations		0						
c. Warm or cold objects are handled manually		0	We assume still "warm"					
d. Hand is exposed to impact, reaction load or shock often or a long time		0						
e. Holding hand tools weighing more than 2.3 kg for more than 30 minutes		0						
f. Holding precision tools weighing more than 0.4 kg for more than 30 minutes		0						
5.2 Other physical factors								
a+b. Whole-body vibrations		0						
c. The visual conditions are insufficient for the task		0						
d. Work in hot or cold temperatures or in draughty environments		0	We assume "no".					
e. Standing or walking on a hard surface more than half of the work day		0	We assume ergonomics mat					
f. Prolonged sedentary work without possibility to do the work standing up		0						
g. Prolonged standing work without possibility to do the work sitting down		2		Encourage moving. Discuss chair				
h. Kneeling/squatting more than 30 times or more than 30 minutes		0						
5.3 Work organisational and psychosocial factors								
a. No possibility to influence at what pace the work is performed		0						
b. No possibility to influence the work setting/how the work shall be carried out		2		Discuss with management				
c. It is often difficult to keep up with the work tasks		0						
d. The employees often work rapidly in order to be able to take a longer break		0	We assume "no".					
6. Reports on physically strenuous work								
6.1 Documented reports on physically strenuous tasks		2	See "6" in the Results sheet	Take this to the Impr. Group				
7. Perceived physical discomfort								
7.1 Perceived physical discomfort		2	See "7" in the Results sheet	Take this to the Impr. Group				
Assessment comments (from 7. Perceived physical discomfort):								

General comments (from "Input data"):

Assessment of the work. No discussion with the employees performing the work, since we were not on site when the work was filmed.

Figure A5-1: Example of an Action Plan in RAMP II.