# Man/vrouw in de risicoanalyse ergonomie

Ergoday inclusieve ergonomie

02/06/2022

VerV

Hendrik Mortier

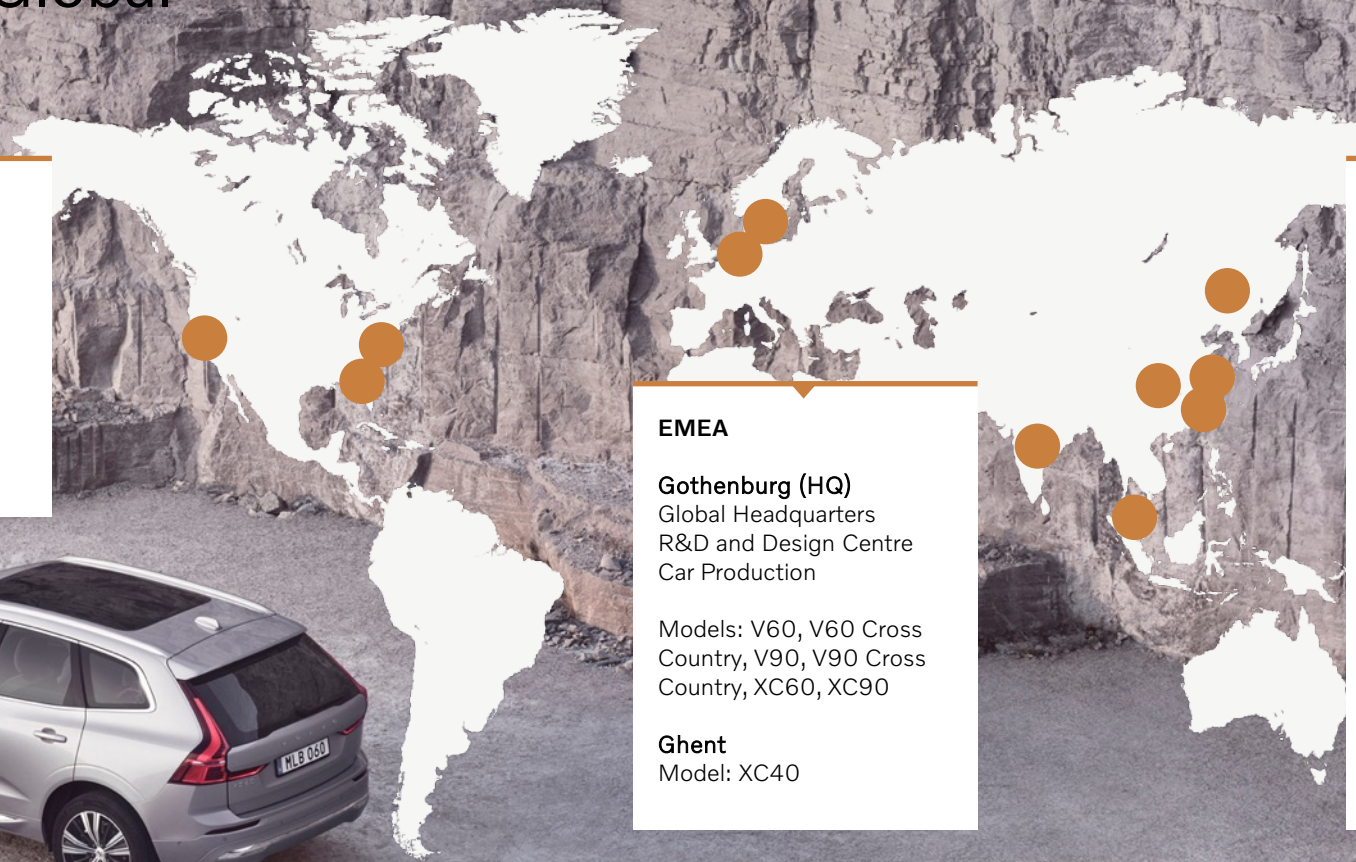
- Sedert 1993 tewerkgesteld bij Volvo Car Gent
  - Supervisor
  - ISO-coördinator
  - Manufacturing Engineering
    - Commodity (Göteborg)
    - Core (Göteborg)
    - Tooling & Equipment
  - Preventiedienst
    - Preventieadviseur Niveau 1
    - Preventieadviseur Ergonomie
- Werkend lid Van VerV in de werkgroep “Industrie”

# Kernbegrippen

- Verschillen man vrouw doorheen de tijd…
- … en in verschillende organisatiemodellen
- Werkwijze Volvo

# Situering Global

## Global Presence With Sales in Over 100 Countries



### AMERICAS

**California**
R&D and Design Centre

**Charleston**
Models: S60

**New Jersey**
Americas Headquarters

### EMEA

**Gothenburg (HQ)**
Global Headquarters
R&D and Design Centre
Car Production

Models: V60, V60 Cross Country, V90, V90 Cross Country, XC60, XC90

**Ghent**
Model: XC40

### APAC

**Bangalore**
Models: S90, XC60, XC90

**Kuala Lumpur**
Models: S60, V60, S90, XC60, XC90

**Chengdu**
Models: XC60

**Luqiao**
Model: XC40

**Shanghai**
APAC Headquarters
R&D and Design Centre

**Daqing**
Models: S60, S90

VOLVO

Volvo 2020

# VOLVO CARS AT A GLANCE 2020

**661,700**
**CARS SOLD**

**39,000**
**EMPLOYEES**

**SEK 263BN**
**REVENUE**

**SEK 8.5BN**
**EBIT**

# Man/vrouw doorheen de tijd (cijfers voor België)

## Tabel 1: werkgelegenheidsgraad en voltijds / deeltijds werk bij loontrekkenden volgens geslacht (1983 en 2020)

| Belangrijke arbeidsmarktevoluties 1983-2020 | 1983 | 2020 | % evolutie 1983-2020 |
|---|---|---|---|
| Werkgelegenheidsgraad 15-64-jarigen - mannen + vrouwen | 52,6% | 64,7% | +23,0% |
| Werkgelegenheidsgraad 15-64-jarigen - mannen | 68,8% | 68,4% | -0,6% |
| Werkgelegenheidsgraad 15-64-jarigen - vrouwen | 36,3% | 61,0% | +68,0% |
| Aantal loontrekkende mannen + vrouwen | 2.819.074 | 4.095.480 | +45,3% |
| Aantal loontrekkende mannen | 1.858.653 | 2.095.410 | +12,7% |
| Aantal loontrekkende vrouwen | 960.421 | 2.000.071 | +108,2% |

STATBEL
België in cijfers

# NIOSH

LC = 23kg

Psychofysisch criterium:

Aanvaardbaar voor 99% mannelijke en 75% vrouwelijke werknemers bij 50/50 verdeling = 90% van de beroepsbevolking

ERGONOMICS, 1993, VOL. 36, NO. 7, 749–776

*Rapid Communication*

**Revised NIOSH equation for the design and evaluation of manual lifting tasks**

THOMAS R. WATERS‡, VERN PUTZ-ANDERSON‡, ARUN GARG¶, and LAWRENCE J. FINE‡

‡ National Institute for Occupational Safety and Health, 4676 Columbia Parkway, Cincinnati, OH 45226, USA
¶ Department of Industrial and Systems Engineering, University of Wisconsin–Milwaukee, WI 53201, USA

*Keywords*: Low back pain; Prevention and control; Evaluation methodology; Lifting.

# Situatie VCG

1993

- (Bijna) geen vrouwen
- Geen ergonomie
- (Bijna) geen rotatie
- +/- 2500 WN
- Voldoende keuze op de arbeidsmarkt

2022

- 15% vrouwen
- Sedert ‘98: ergonomische screenings
- Rotatie binnen de teams
- +/- 6500 WN
- Krapte op de arbeidsmarkt

# Invloed van de werkorganisatie

Traditioneel: informele organisatie, directe controle door de WG

Tayloristic: werk opgesplitst in kleine taken en strikt getimed

Lean: alle verliezen wegwerken, teamwerk, diepgaande analyses (Toyota)

Reflexive: Individuele verantwoordelijkheid bij de WN (Uddevalla)

Maria Cristina Migliore et al., Impact of different work organizational models on gender differences in exposure to psychosocial and ergonomic hazards at work and in mental and physical health, International Archives of Occupational and Environmental Health (2021) 94:1889–1904

| Resultaten EWCS 2015 | Reflexive | Lean | Taylor | Trad. | |
|---|---|---|---|---|---|
| TEAM WERK | -- | ++ | | | 1. Gebruik van teamwork |
| JOB ROTATIE | -- | ++ | | | 2. Gebruik van jobrotatie |
| METHODE AUTONOMIE | ++ | | -- | -- | 3. Autonomie op het werk in de gebruikte methodes |
| TEMPO AUTONOMIE | | ++ | -- | -- | 4. autonomie op het werk wat betreft het tempo waarin het werk wordt uitgevoerd |
| AUTOMATISCHE BEPERKINGEN | -- | | ++ | | 5. "Automatische" beperkingen in verband met het tempo waarin apparatuur wordt gebruikt of een product in de productiestroom wordt verplaatst |
| QUANTITATIEVE NORMBEPERKINGEN | -- | + | ++ | -- | 6. Normgebaseerde beperkingen, gekoppeld aan de aanwezigheid van kwantitatieve productienormen |
| HIERARCHISCHE BEPERKINGEN | | + | | | 7. "Hiërarchische" beperkingen, die verband houden met de directe controle door directe superieuren |
| HORIZONTALE BEPERKINGEN | -- | + | ++ | -- | 8. "Horizontale" beperkingen, die verband houden met de afhankelijkheid van iemands werk van het werk van collega's |
| REPETITIVITEIT | -- | | ++ | + | 9. Taakherhalingen |
| MONOTONIE | -- | | ++ | + | 10. Waargenomen taak monotonie |
| KWALITEITSNORMEN | -- | + | | | 11. Aanwezigheid van nauwkeurige kwaliteitsnormen |
| INDIVIDUELE KWALITEITSBEOORDELING | ++ | ++ | | | 12. Individuele verantwoordelijkheid voor kwaliteitscontrole |
| COMPLEXITEIT | | ++ | | | 13. Complexiteit van de taken |
| LEARNING NEW THINGS | | | -- | -- | 14. Nieuwe dingen leren in het werk |
| PROBLEM SOLVING | ++ | ++ | -- | -- | 15. Probleemoplossende activiteit |

# Voorkomen in Europa...

| Resultaten EWCS 2015 | Reflexive | Lean | Taylor | Trad. |
|---|---|---|---|---|
| Voorkomen in Europa [%] | | | | |
| Anglo-Saxon | 22,5% | 43,1% | 23,2% | 11,2% |
| Continental | 32,1% | 35,7% | 19,5% | 12,3% |
| Eastern | 24,9% | 30,9% | 26,9% | 17,4% |
| Scandinavia | 35,7% | 44,6% | 12,2% | 7,4% |
| Southern | 22,5% | 32,9% | 27,7% | 16,9% |
| Non-EU | 23,3% | 33,7% | 26,8% | 16,2% |
| Prevalentie M [%] - F [%]- M/F PR | | | | |
| High Job strain | 16,2 - 18,0 - 1,14 | 12,9 - 17,9 - 1,43 | 62,0 - 70,8 - 1,16 | 55,0 - 57,9 - 1,09 |
| Hight effort - reward imbalance | 21,9 - 22,0 - 1,19 | 23,7 - 31,4 - 1,31 | 40,4 - 50,5 - 1,24 | 32,1 - 35,6 - 1,14 |
| Tiring of painfull postures | 17,8 - 19,2 - 1,26 | 21,2 - 26,2 - 1,4 | 31,9 - 38,4 - 1,29 | 21,3 - 23,3 - 1,14 |
| Carrying or moving heavy loads | 14,4 - 8,2 - 0,73 | 18,6 - 15,5 - 0,99 | 27,9 - 17,8 - 0,62 | 19,9 - 9,1 - 0,44 |
| Repetitive hand or arm movements | 34,4 - 46,9 - 1,56 | 42,2 - 58,8 - 1,47 | 55,9 - 66,3 - 1,21 | 37,4 - 50,4 - 1,39 |
| Low mental well being | 13,6 - 15,1 - 1,49 | 12,5 - 17,6 - 1,39 | 20,8 - 24,5 - 1,23 | 18,1 - 18,2 - 1,13 |
| Back MSD | 41,5 - 46,1 - 1,12 | 45,3 - 48,2 - 1,09 | 50,5 - 56,5 - 1,12 | 37,4 - 41,6 - 1,22 |
| Upper Limb MSD | 38,7 - 44,5 - 1,33 | 42,8 - 54,1 - 1,33 | 49,0 - 59,5 - 1,15 | 37,1 - 40,5 - 1,18 |

In alle systemin ligt de man/vrouw ratio boven 1, behalve bij dragen van zware lasten.

| Resultaten EWCS 2015 | Reflexive | Lean | Taylor | Trad. |
|---|---|---|---|---|
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| High Job strain | 16,2 - 18,0 - 1,14 | 12,9 - 17,9 - 1,43 | 62,0 - 70,8 - 1,16 | 55,0 - 57,9 - 1,09 |
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| Carrying or moving heavy loads | 14,4 - 8,2 - 0,73 | 18,6 - 15,5 - 0,99 | 27,9 - 17,8 - 0,62 | 19,9 - 9,1 - 0,44 |
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| Back MSD | 41,5 - 46,1 - 1,12 | 45,3 - 48,2 - 1,09 | 50,5 - 56,5 - 1,12 | 37,4 - 41,6 - 1,22 |
| Upper Limb MSD | 38,7 - 44,5 - 1,33 | 42,8 - 54,1 - 1,33 | 49,0 - 59,5 - 1,15 | 37,1 - 40,5 - 1,18 |

Our results suggest that employment in workplaces characterized by lower monotony, repetitiveness, and production constraints may contribute to reduce exposure to job strain among working women.

| Resultaten EWCS 2015 | Reflexive | Lean | Taylor | Trad. | |
|---|---|---|---|---|---|
| TEAM WERK | -- | ++ | | | 1. Gebruik van teamwork |
| JOB ROTATIE | -- | ++ | | | 2. Gebruik van jobrotatie |
| METHODE AUTONOMIE | ++ | | -- | -- | 3. Autonomie op het werk in de gebruikte methodes |
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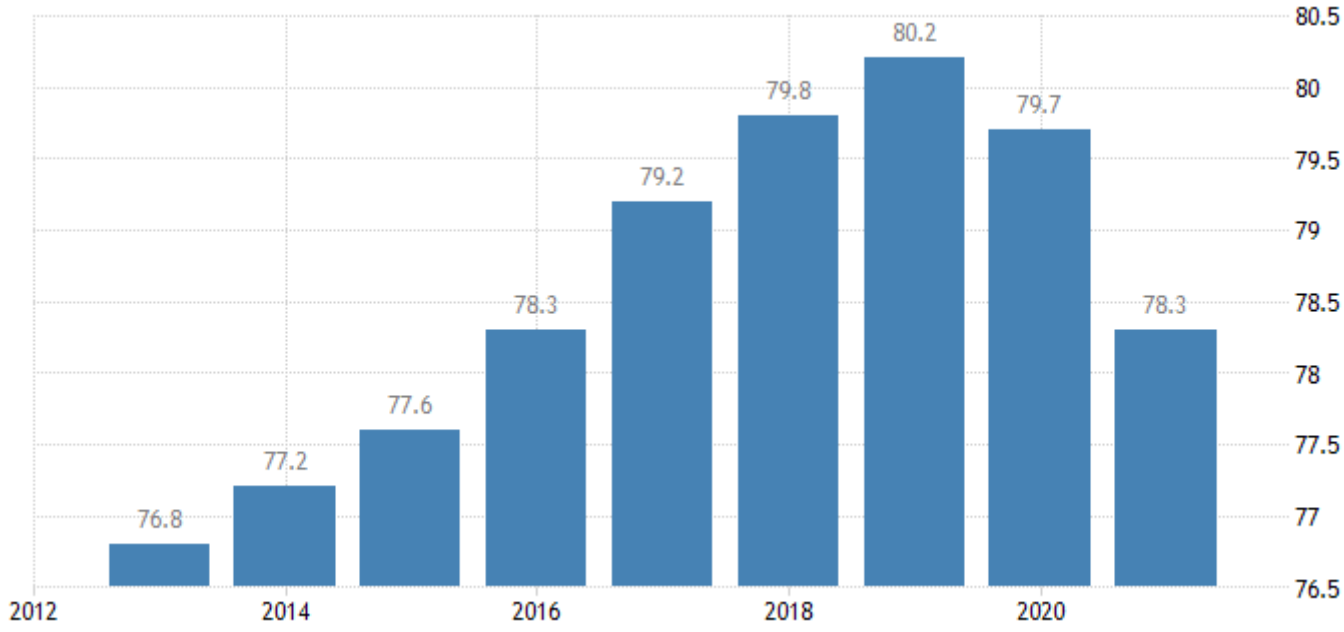
| PROBLEM SOLVING | ++ | ++ | -- | -- | 15. Probleemoplossende activiteit |

# Employment rate females in Sweden




Trading Economics provides the current actual value, an historical data chart and related indicators for Sweden - Employment rate: Females - last updated from the EUROSTAT on May of 2022.

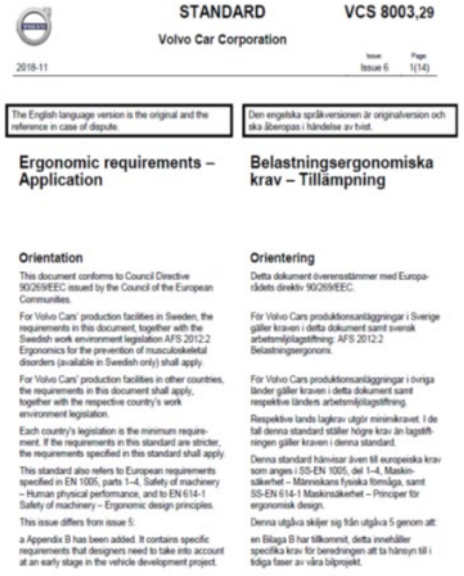
# Risico-analyse

Steeds met de vrouwelijke WN in het achterhoofd.

Reeds in 1998 heeft de Zweedse regelgever rekening gehouden met de vrouwelijke wn.

De basis van de risico-screening is onze standaard VCS8003,29.

De basis voor onze risico-analyse is RAMP II



STANDARD VCS 8003,29

Volvo Car Corporation

2018-11 Issue: Issue 6 Page: 1(14)

The English language version is the original and the reference in case of dispute.

Den engelska språkversionen är originalversion och ska åberopas i händelse av tvist.

**Ergonomic requirements – Application**

**Belastningsergonomiska krav – Tillämpning**

**Orientation**

This document conforms to Council Directive 90/269/EEC issued by the Council of the European Communities.

For Volvo Cars' production facilities in Sweden, the requirements in this document, together with the Swedish work environment legislation AFS 2012:2 Ergonomics for the prevention of musculoskeletal disorders (available in Swedish only) shall apply.

For Volvo Cars' production facilities in other countries, the requirements in this document shall apply, together with the respective country's work environment legislation.

Each country's legislation is the minimum requirement. If the requirements in this standard are stricter, the requirements specified in this standard shall apply.

This standard also refers to European requirements specified in EN 1005, parts 1–4, Safety of machinery – Human physical performance, and to EN 614-1 Safety of machinery – Ergonomic design principles.

This issue differs from issue 5:

a Appendix B has been added. It contains specific requirements that designers need to take into account at an early stage in the vehicle development project.

**Orientering**

Detta dokument överensstämmer med Europarådets direktiv 90/269/EEC.

För Volvo Cars produktionsanläggningar i Sverige gäller kraven i detta dokument samt svensk arbetsmiljölagstiftning: AFS 2012:2 Belastningsergonomi.

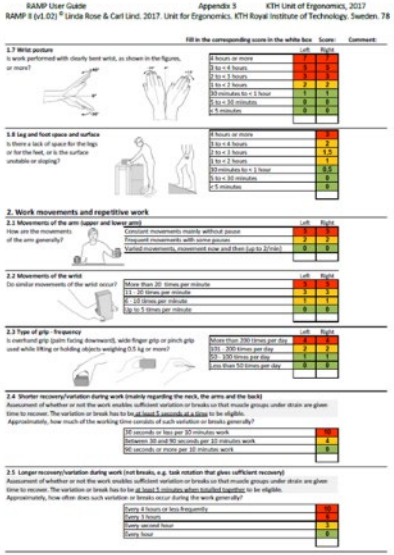
För Volvo Cars produktionsanläggningar i övriga länder gäller kraven i detta dokument samt respektive länders arbetsmiljölagstiftning.

Respektive lands lagkrav utgör minimikravet. I de fall denna standard ställer högre krav än lagstiftningen gäller kraven i denna standard.

Denna standard hänvisar även till europeiska krav som anges i SS-EN 1005, del 1–4, Maskinsäkerhet – Människans fysiska förmåga, samt SS-EN 614-1 Maskinsäkerhet – Principer för ergonomisk design.

Denna utgåva skiljer sig från utgåva 5 genom att:

en Bilaga B har tillkommit, detta innehåller specifika krav för beredningen att ta hänsyn till i tidiga faser av våra bilprojekt.



RAMP User Guide Appendix 5 KTH Unit of Ergonomics, 2017

RAMP II (v1.02) © Linda Rose & Carl Lind. 2017. Unit for Ergonomics. KTH Royal Institute of Technology. Sweden. 78

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 | 2 |
| 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 | 3 | 3 |
| Frequent movements with some pause | 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?

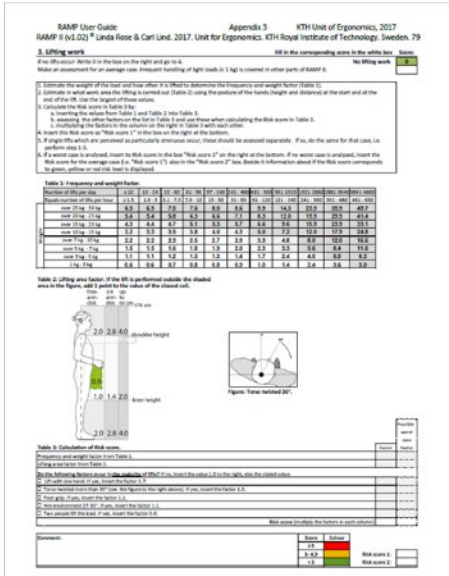
| | Left | Right |
|---|---|---|
| More than 200 times per day | 2 | 2 |
| 101 - 200 times per day | 2 | 2 |
| 50 - 100 times per day | 1 | 1 |
| Less than 50 times per day | 0 | 0 |

**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 on 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?

| | |
|---|---|
| 90 seconds or less per 30 minutes work | 4 |
| Between 30 and 90 seconds per 30 minutes work | 2 |
| 90 seconds or more per 30 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 on 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 | 4 |
| Every 3 hours | 3 |
| Every second hour | 2 |
| Every hour | 0 |



RAMP User Guide Appendix 3 KTH Unit of Ergonomics, 2017

RAMP II (v1.02) © Linda Rose & Carl Lind. 2017. Unit for Ergonomics. KTH Royal Institute of Technology. Sweden. 79

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

No lifting work: 0

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 those 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 | ≤ 10 | 11 - 24 | 25 - 60 | 61 - 90 | 91 - 240 | 241 - 480 | 481 - 960 | 961 - 1920 | 1921 - 2880 | 2881 - 4640 | 4641 - 6400 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Roughly number of lifts per hour | ≤ 1.5 | 1.6 - 3 | 3.1 - 7.5 | 7.6 - 10 | 11 - 30 | 31 - 60 | 61 - 120 | 121 - 240 | 241 - 360 | 361 - 480 | 481 - 600 |
| over 23 kg - 30 kg | 6.5 | 6.5 | 7.0 | 7.6 | 8.9 | 8.6 | 9.9 | 14.3 | 21.9 | 30.5 | 49.7 |
| over 20 kg - 23 kg | 5.4 | 5.4 | 5.8 | 6.3 | 6.8 | 7.1 | 8.3 | 11.9 | 18.3 | 25.3 | 41.4 |
| over 17 kg - 20 kg | 4.3 | 4.4 | 4.7 | 5.1 | 5.5 | 5.7 | 6.6 | 9.6 | 15.3 | 21.3 | 35.1 |
| over 10 kg - 17 kg | 3.2 | 3.3 | 3.5 | 3.8 | 4.0 | 4.3 | 5.0 | 7.2 | 12.0 | 17.9 | 28.8 |
| over 7 kg - 10 kg | 2.2 | 2.3 | 2.5 | 2.6 | 2.7 | 2.9 | 3.3 | 4.8 | 8.0 | 12.0 | 22.5 |
| over 3 kg - 7 kg | 1.5 | 1.5 | 1.6 | 1.8 | 1.9 | 2.0 | 2.3 | 3.3 | 5.6 | 8.4 | 15.6 |
| over 1 kg - 3 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 - 7 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.**

| | | 25 cm behind the arm | 0 cm arm's distance | 25 cm in front of the arm | 50 cm arm's distance | 75 cm in front of the arm | 176 cm |
|---|---|---|---|---|---|---|---|
| | | | | | | | shoulder height |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | knee height |
| | | | | | | | |



Figure: Torso twisted 30°.

**Table 3: Calculation of Risk score.**

| | Factor | Risk factor |
|---|---|---|
| Frequency and weight factor from Table 1. | | |
| Lifting area factor from Table 2. | | |
| Do the following factors occur in the work lifts? If so, insert the value 1.5 to the right, else the stated value. | | |
| 1. Lift with one hand. If yes, insert the factor 1.5. | | |
| 2. Torso twisted more than 30° (see the figure to the right above). If yes, insert the factor 1.5. | | |
| 3. Poor grip. If yes, insert the factor 1.1. | | |
| 4. Hot environment (> 30 °C). If yes, insert the factor 1.1. | | |
| 5. Two people lift the load. If yes, insert the factor 0.6. | | |
| Risk score (multiply the factors in each column) | | |

Comment:

| Score | Colour |
|---|---|
| < 4 | |
| 4 - 6,5 | |
| > 6 | |

Risk score 1:
Risk score 2:

# Volvo Car Corporation Standard VCS 8003,29

## 1 Scope and field of application

The standard complies with current legislation and shall be used when planning new workplaces.

The term “ergonomics” in this standard shall be interpreted as “ergonomics for the prevention of musculoskeletal disorders”.

In case of doubt or difficulty of interpretation of this standard, contact an ergonomist within Volvo Cars.

### 1.1 Guidelines

In order to achieve ergonomically sound working conditions, physical freedom of movement together with a possibility of variation with respect to work content and movement pattern are required.

A workplace that is good from an ergonomic point of view places demands on the product, process, operator as well as on the organization.

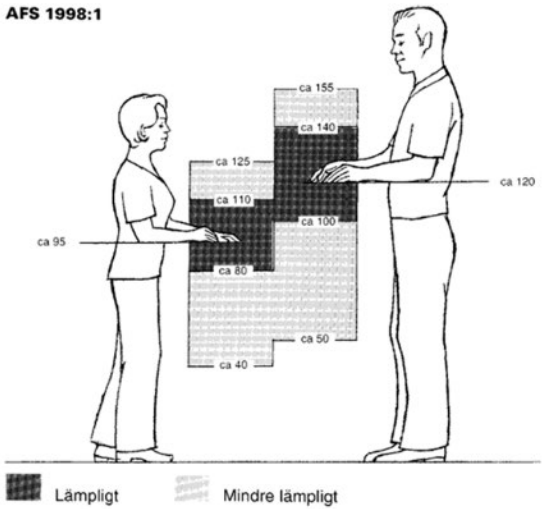
Ergonomic requirements shall be linked to the organizational and technical development at an early stage in projects. During the production-planning phase, an ergonomics risk analysis with respect to product, process and organization, respectively, shall be made. A final evaluation shall be made after start of production.

Work tasks and workplaces shall be so designed as to provide variation and job rotation/change of tasks.

People are different and have different capacities that can change. This means that the workplaces must be able to meet the different requirements and needs that exist due to age, sex and physical capacity.

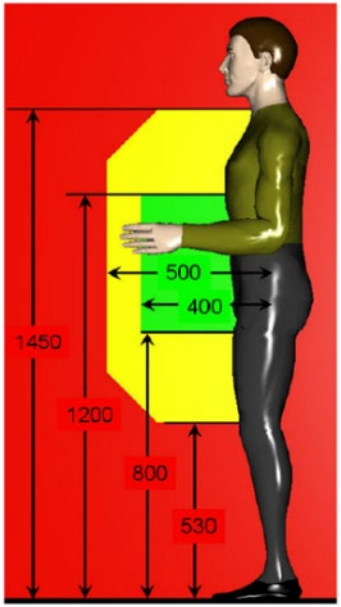
# Criteria voor risicoanalyse in Volvo

## AFS 1998:2




*Figur 3. Lämpliga arbetshöjder för en stor respektive en liten person. 95% av svenska män är mindre än mannen i figuren och 95% av svenska kvinnor är större än kvinnan. I normalfallet är arbetstagarens armbågshöjd den lämpligaste höjden. Mått i centimeter.*

## VCS 8003,29

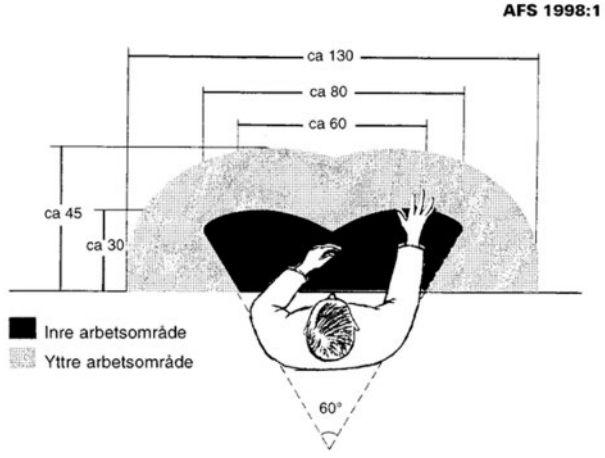



## VERA (RAMPII)

**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)

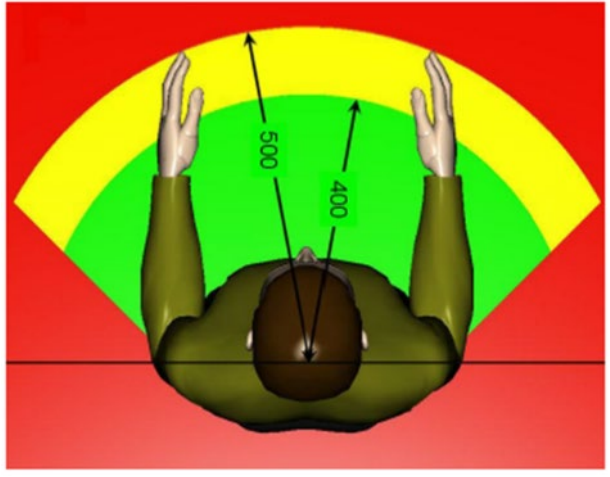
# Criteria voor risicoanalyse in Volvo

AFS 1998:2

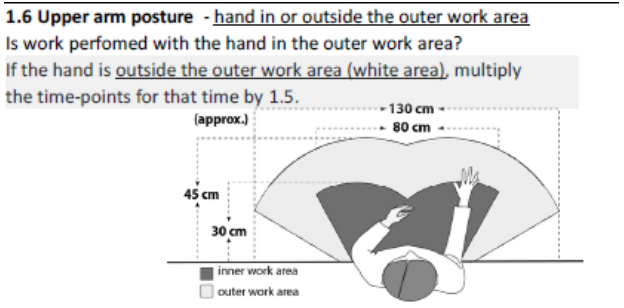



*Figur 5. Arbetsområden för händerna. Mått i centimeter.*

VCS 8003,29



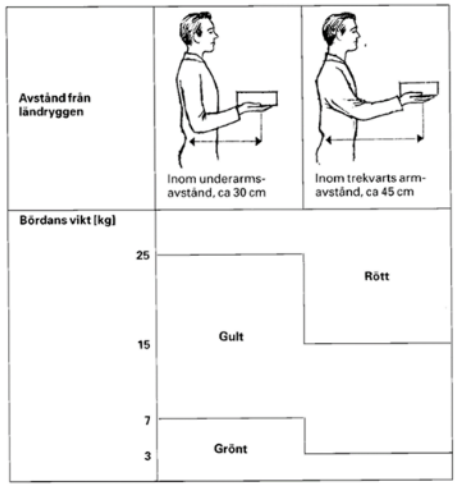

VERA (RAMPII)



# Criteria voor risicoanalyse in Volvo

## AFS 1998:2

terande bedömningar. Modellen gäller för både män och kvinnor.




Modell för bedömning av ett symmetriskt lyft med två händer i stående under idealiska förhållanden. Horisontellt avstånd = avståndet mellan ländryggen och bördans tyngdpunkt vid lyftet.

**En slutsats av modellen är att det i de flesta fall är olämpligt att hantera bördor tyngre än 25 kg.**

## VCS 8003,29

Tabell 1 **Lifting diagram*) **)**

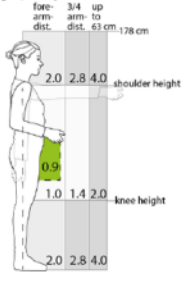
| Lifting area | Lifting frequency times/hour | | | |
|---|---|---|---|---|
| | 1-10 | 10 -30 | 30 - 60 | 60 -120 |
| A | 12,0 | 7 | 3 | 2 |
| B | 7,0 | 5 | 2 | 1 |

## VERA (RAMPII)

**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.**



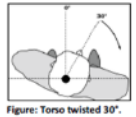




**Figure: Torso twisted 30°.**

EN 1005-2:2003+A1:2008 (E)

NBN EN 1005-2+A1 (2009)

**Table 1 — Reference mass ($M_{ref}$) taking into consideration the intended user population**

| Field of application | $M_{ref}$ [kg] | Percentage of | | | Population group | |
|---|---|---|---|---|---|---|
| | | F and M | $F_{emales}$ | $M_{ales}$ | | |
| Domestic use[a] | 5 | Data not available | | | Children and the elderly | Total population |
| | 10 | 99 | 99 | 99 | General domestic population | |
| Professional use (general)[b] | 15 | 95 | 90 | 99 | General working population, including the young and old | General working population |
| | 25 | 85 | 70 | 90 | Adult working population | |
| Professional use (exceptional)[c] | 30<br>35<br>40 | Data not available | | | Special working population | Special working population |

[a] When designing a machine for domestic use, 10 kg should be used as a general reference mass in the risk assessment. If children and elderly are included in the intended user population, the reference mass should be lowered to 5 kg.

[b] When designing a machine for professional use, a reference mass of 25 kg should not be exceeded in general.

[c] While every effort should be made to avoid manual handling activities or reduce the risks to the lowest possible level, there may be exceptional circumstances where the reference mass might exceed 25 kg (e.g. where technological developments or interventions are not sufficiently advanced). Under these special conditions other measures have to be taken to control the risk according to EN 614-1 (e.g. technical aids, instructions and / or special training for the intended operator group).

ISO 11228-1:2003(E)

## Annex C
(informative)

## Reference mass

rence mass taking into consideration different populations.

**Table C.1 — Reference mass ($m_{ref}$) for different populations**

| Percentage of user population protected | | | Population group | |
|---|---|---|---|---|
| F and M[a] | F | M | | |
| Data not available | | | Children and the elderly | Total population |
| 99 | 99 | 99 | General domestic population | |
| 95 | 90 | 99 | General working population, including the young and old | General working population |
| 85 | 70 | 95 | Adult working population | |
| See NOTE | | | Specialized working population | Specialized working population under special circumstances |

nces. While every effort should be made to avoid manual-handling activities or reduce the risks to the may be exceptional circumstances where the reference mass may exceed 25 kg (e.g. where technological s are not sufficiently advanced). In these exceptional circumstances, increased attention and consideration ation and training of the individual (e.g. specialized knowledge concerning risk identification and risk tions which prevail and the capabilities of the individual.

[a] F: Female, M: Male

In order to lower the risk for people at work, particularly those with less physical capability, the recommended limit for mass should not exceed 15 kg. This will increase the level of health protection afforded to the working population by up to 95 %. In this instance, a reference mass of 15 kg instead of 25 kg should be used in Equation (A.1) (see A.7.2).

# Criteria voor risicoanalyse in Volvo

## AFS 1998:2

**AFS 1998:1**

**Modell för bedömning av skjuta- och dra-arbete**

| Kraft [N] | Röd | Gul | Grön |
|---|---|---|---|
| Igångsättning | >300 | 300–150 | <150 |
| Kontinuerligt | >200 | 200–100 | <100 |

Modellen ovan avser bra ergonomiska förhållanden, dvs. symmetriskt tvåhandsgrepp, väl utformade handtag placerade i lämplig höjd och under goda omgivningsbetingelser. Om objektet t.ex. skall förflyttas långt, momentet upprepas ofta eller länge, grepphöjden avviker påtagligt från ungefärlig armbågshöjd så bör värdena i modellen reduceras i motsvarande grad, liksom om arbetet utförs enbart med en hand. Flertalet av de påverkande faktorerna i bedömningsmodellen för lyftarbete är även tillämpliga vid skjuta- och dra-arbete.

Enheten för kraft är Newton [N] och mäts med dynamometer.

## VCS 8003,29

| Force (N) | red | yellow | green |
|---|---|---|---|
| Start | > 300 (approx. 30 kP) | 300-150 | < 150 |
| Continuously | > 200 | 200-100 | < 100 |

## VERA (RAMPII)

**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 |

**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.

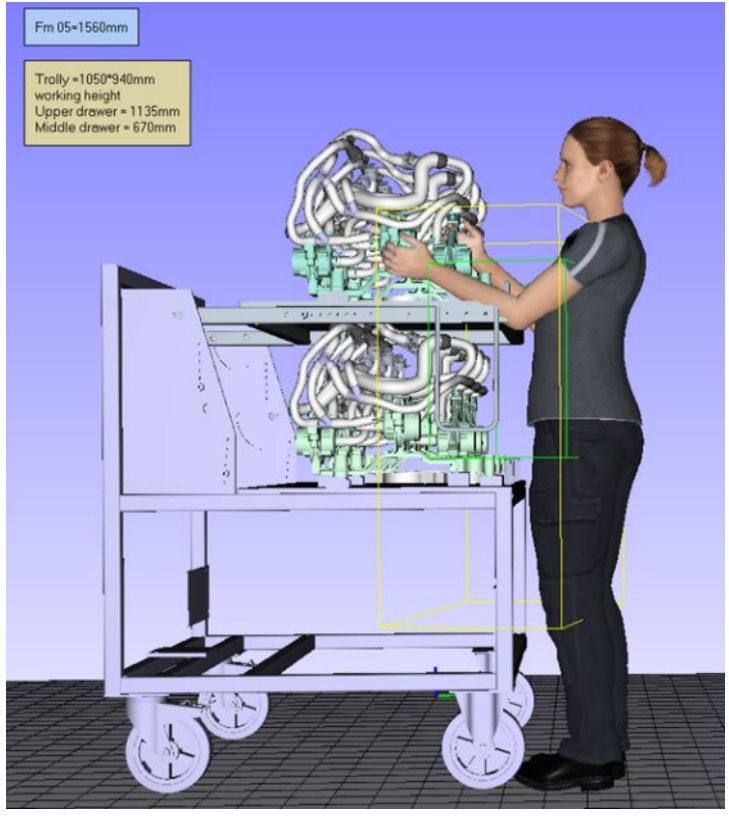
| | Times per day | ≤ 1 | 2 - 16 | 17 - 96 | 97 - 240 | 241-480 | 481-1920 |
|---|---|---|---|---|---|---|---|
| | Times per hour | hour | ≤ 2 | 2.1 - 12 | 13 - 30 | 31 - 60 | 61 - 240 |
| Force value | 501 - 600 N | 10.5 | 12 | 12.5 | 17 | 19 | 30 |
| | 451 - 500 N | 9.5 | 11 | 11.5 | 15.5 | 17.5 | 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 |

# Virtual simulation with mannikins

Ook in ontwerpfase worden de vrouwelijke medewerkers meegenomen in de beoordeling van het werkstation.

Aan de hand van verschillende “mannikins” kunnen de werkhoudingen in verschillende stations en operaties reeds in een vroege fase beoordeeld worden.

Deze mannikins vertegenwoordigen o.a. verschillende percentielen, geslachten en bevolkingsgroepen van de werknemers.



# Andere

Bij gebruik van andere methoden wordt er steeds rekening gehouden met de criteria voor de vrouwen:

KIM, SNOOK, ...

Bij de keuze van PBM's wordt er steeds gezocht naar specifieke PBM's voor mannen én vrouwen (geen unisex).

Ook wordt steeds rekening gehouden met de risico's voor (zwangere) vrouwen.

chemische stoffen

heffen/tillen

...

# Volgende uitdaging:

Tool 1: Employment (total, female, male, youth and senior), 2009-2021
(% of the population aged 20 to 64)
*Source:* Eurostat

# Bedankt !

VerV

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