



**Assessment of the occupational risks in the  
workplace (multiplicative method):  
Appendix 3 - Ergonomic risk**

	<b>Group guide and manual</b>		
	Assessment of the occupational risks in the workplace (multiplicative method): ergonomic risk (Appendix 3)		
<b>PSR/HSE Division</b>	HSE		GM-GR-HSE-300 Rev. No.: 01 Date: 17/06/2020

<b>Foreword</b>	This English version is translated from the original French reference version.
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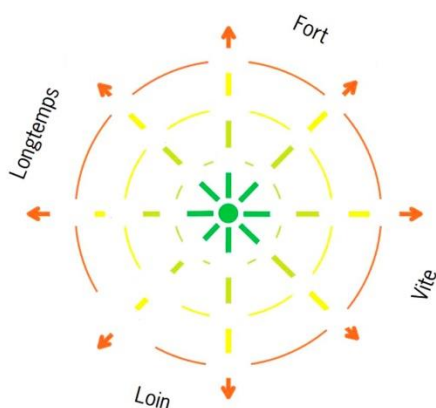
## Contents

1	Dynamic work.....	4
1.1	Manual load handling: unit mass and tonnage .....	4
1.1.1	Severity rating G.....	4
1.1.2	Potential exposure probability rating P.....	4
1.1.3	Residual potential exposure probability rating P' .....	4
1.2	Manual load handling: pushing/pulling .....	5
1.2.1	Severity rating G.....	5
1.2.2	Potential exposure probability rating P.....	5
1.2.3	Residual potential exposure probability rating P' .....	6
1.3	Posture strains: work postures.....	6
1.3.1	Severity rating G.....	6
1.3.2	Potential exposure probability rating P.....	7
1.3.3	Residual potential exposure probability rating P': .....	8
1.4	Repetitive movements.....	8
1.4.1	Severity rating G.....	9
1.4.2	Potential exposure probability rating P.....	9
1.4.3	Residual potential exposure probability rating P' .....	10
2	Static work (work at screen, seated work to work accurately) .....	11
2.1	Severity rating G.....	11
2.2	Potential exposure probability rating P.....	11
2.3	Residual potential exposure probability rating P' .....	11
3	Work atmosphere (inside).....	12
3.1	Severity rating G.....	12
3.2	Potential exposure probability rating P.....	12
3.3	Residual potential exposure probability rating P' .....	13
4	Terms and definitions.....	13
5	Reference documents.....	14
6	Bibliography .....	14

	<b>Group guide and manual</b>		
	Assessment of the occupational risks in the workplace (multiplicative method): ergonomic risk (Appendix 3)		
<b>PSR/HSE Division</b>	HSE		GM-GR-HSE-300 Rev. No.: 01 Date: 17/06/2020


The potential severity rating associated with ergonomic risks covers two types of activity: dynamic work and static work.

- Dynamic work: rhythmic alternation of contractions and extensions, tension and relaxation of muscles
- Static work: prolonged state of muscle contraction that is generally applied to maintain a posture.



*Diagram 1: TROP circle (source: INRS ED 6161).*

INRS simplifies the assessment of the severity of the physical exertion of a situation by referring to four types of constraint: excesses of force, posture, speed and duration of exposure (green zones: acceptable; yellow zones: conditionally tolerable; orange zone: unacceptable).

	<b>Group guide and manual</b>		
	Assessment of the occupational risks in the workplace (multiplicative method): ergonomic risk (Appendix 3)		
PSR/HSE Division	HSE		GM-GR-HSE-300 Rev. No.: 01 Date: 17/06/2020

## 1 DYNAMIC WORK

### 1.1 Manual load handling: unit mass and tonnage

This concerns any activity that demands human strength to lift, lower, transport, move or hold an object or person in any way.

#### 1.1.1 Severity rating G

Severity G	Unit mass (kg)	Total tonnages by unit of time for a distance less than or equal to 2m								
		1 min	1 hour	2 hours	3 hours	4 hours	5 hours	6 hours	7 hours	8 hours
15	> 25kg	> 140kg	> 4t	> 5.3t	> 6.6t	> 8t	> 9t	> 10t	> 11t	> 12t
7	15- 25kg	90- 140kg	2.5-4t	3.4- 5.3t	4.2- 6.6t	5-8t	5.6-9t	6.2-10t	6.8-11t	7.5-12t
3	5-15kg	30-90kg	1-2.5t	1.3- 3.4t	1.6- 4.2t	2-5t	2.2- 5.6t	2.5- 6.2t	2.8- 6.8t	3-7.5t
1	< 5kg	< 30kg	< 1t	< 1.3t	< 1.6t	< 2t	< 2.2t	< 2.5t	< 2.8t	< 3t

Table 1: Matrix - Severity G.

Depending on the following strain factors - height at which the load is picked up/put down, distance moved when carrying the load, other conditions in which the task is performed (pulled/pushed, environment and organization) - the assessment group may decide in their expert opinion to go for a higher rating than the reference values in table 1 suggest. See NFX 35 109.


#### 1.1.2 Potential exposure probability rating P

The potential exposure probability P of exposure to ergonomic factors during handling is 10.

#### 1.1.3 Residual potential exposure probability rating P'

Reduction of P	Means/measures of prevention/protection (handling)
-1	<b><u>At least two procedural or organizational measures from:</u></b> <ul style="list-style-type: none"> <li>- Do warm-up exercises</li> <li>- Follow acts and posture training</li> <li>- Limit handling, take breaks, draw up a roster, etc.</li> <li>- Improve grip, transport distance, etc.</li> </ul>
-2	<b><u>Technical adaptation of the workplace to significantly reduce the ergonomic strains:</u></b> <ul style="list-style-type: none"> <li>- Provide load-handling assistance systems to reduce the weight of the load (hand-trucks, trans-pallets, dolly carts, cable reels, etc.)</li> <li>- Reduce the weight of the packaging, etc.</li> </ul>
-3	<b><u>Technical adaptation of the workplace to drastically reduce the ergonomic strains:</u></b> <ul style="list-style-type: none"> <li>- Put in place a mechanical load handling system, forklift, electric cart, etc.</li> </ul>

Table 2: Matrix - Reduction in potential exposure probability P.

	<b>Group guide and manual</b>		
	Assessment of the occupational risks in the workplace (multiplicative method): ergonomic risk (Appendix 3)		
PSR/HSE Division	HSE		GM-GR-HSE-300 Rev. No.: 01 Date: 17/06/2020

## 1.2 Manual load handling: pushing/pulling

**Initial or stopping force (daN):** Force applied to an object to move it or stop it.

**Sustained force (daN):** Force applied to keep an object moving (i.e. at a more or less constant speed).

daN = decanewton = 10 Newtons (1kg/f)

### 1.2.1 Severity rating G

Rating G	Initial force (daN)	Sustained force (daN)	Orders of magnitude (the force varies, primarily based on the type of ground and the slope)
15	> 24	> 15	Pull a hose full of fuel ( $\geq 35$ kg) over more than 20 meters
7	19-24	9-15	
3	10-19	6-9	Pull a hose full of fuel (18kg to 27kg) over 10-15 metres
1	< 10	< 6	


*Table 3: Matrix - Severity G.*

Examples (results from actual measurements):

Move a manual trans-pallet		
Load in kg	Initial force in daN	Sustained force in daN
300	18	7
500	24	10
700	30	13
900	38	17
Move a four-wheel cart in good condition on a smooth, clean floor		
Load in kg	Initial force in daN	Sustained force in daN
100	11	5
200	16	7
300	22	10
550	32	14
800	39	19

### 1.2.2 Potential exposure probability rating P

The potential exposure probability P of exposure to ergonomic factors during pulling or pushing is **10**.

	<b>Group guide and manual</b>		
	Assessment of the occupational risks in the workplace (multiplicative method): ergonomic risk (Appendix 3)		
PSR/HSE Division	HSE		GM-GR-HSE-300 Rev. No.: 01 Date: 17/06/2020

### 1.2.3 Residual potential exposure probability rating P'


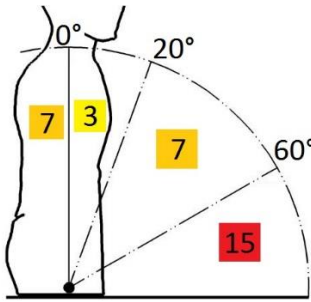
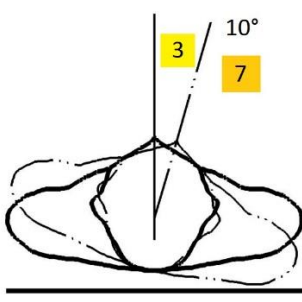
Reduction of P	Means/measures of prevention/protection (pulling/pushing)
-1	<b><u>At least two procedural or organizational measures from:</u></b> <ul style="list-style-type: none"> <li>- Organizational measures: reducing effort by working in twos, alternating tasks, breaks, limiting movements</li> <li>- Large-wheeled cart for transporting loads</li> <li>- Easier gripping</li> <li>- Training</li> <li>- Warm-up exercises, etc.</li> </ul>
-2	<b><u>Technical adaptation of the workplace to significantly reduce the ergonomic strains:</u></b> <ul style="list-style-type: none"> <li>- Reduction of parcel load, pallets</li> <li>- Use of assisted pipe unwinders</li> </ul>
-3	<b><u>Technical adaptation of the workplace to significantly reduce the ergonomic strains:</u></b> <ul style="list-style-type: none"> <li>- Mechanical load handling system, forklift, electric cart, etc.</li> </ul>


Table 4: Matrix - Reduction in potential exposure probability P.

## 1.3 Posture strains: work postures

Painful postures entail forced joint positions, mainly those that put the joints at extreme angles (e.g. arms above the shoulders). Prolonged extreme postures are MSD risk factors.

### 1.3.1 Severity rating G

<b>WORK POSTURES</b> (EN 1005-4)			
	Lateral bending	Anteroposterior bending	Torsion
TRUNK			
ARMS	Antepulsion / retropulsion	Abduction / Adduction	

	<b>Group guide and manual</b>		
	Assessment of the occupational risks in the workplace (multiplicative method): ergonomic risk (Appendix 3)		
PSR/HSE Division	HSE		GM-GR-HSE-300 Rev. No.: 01 Date: 17/06/2020

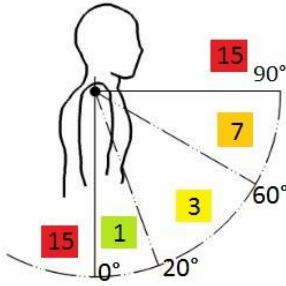
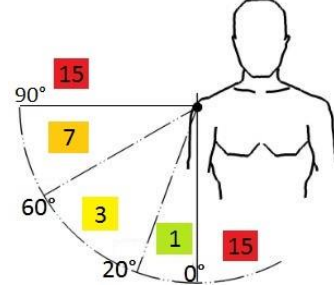
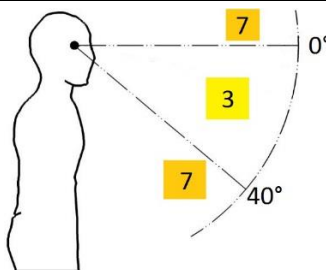
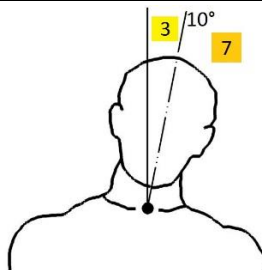
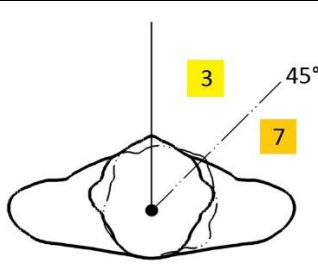
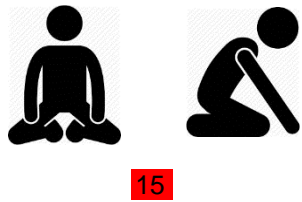


			
HEAD / SHOULDERS	Line of sight	Lateral bending	Rotation
			
KNEE	Working when kneeling	Working when crouching	-
			

Table 5: Matrix - *Severity G.*

### 1.3.2 Potential exposure probability rating P

The potential exposure probability P of exposure to ergonomic factors during a dynamic task is **10**.

	<b>Group guide and manual</b>		
	Assessment of the occupational risks in the workplace (multiplicative method): ergonomic risk (Appendix 3)		
PSR/HSE Division	HSE		GM-GR-HSE-300 Rev. No.: 01 Date: 17/06/2020

### 1.3.3 Residual potential exposure probability rating P':

Reduction of P	Means/measures of prevention/protection (posture strains)
-1	<b><u>At least two procedural or organizational measures from:</u></b> <ul style="list-style-type: none"> <li>- Alternate tasks, take regular breaks to relax muscles, etc.</li> <li>- Warm-up and warm-down exercises, good acts and postures training</li> <li>- Avoid twisting by arranging the workplace (e.g. multiple screens, desk at an angle when the screen is lateral (due to the lighting), cash register with equipment not positioned practically/logically, etc.</li> </ul>
-2	<b><u>Technical adaptation of the workplace to significantly reduce the ergonomic strains:</u></b> <ul style="list-style-type: none"> <li>- Improve the workplace so that the arms are not raised above the chest and the trunk is straighter: improve the height at which work is done, gripping distances, provide adapted tools, etc.</li> <li>- Arrange the workspace: avoid differences in level, ladders, stairs, movements, handling, etc.</li> </ul>
-3	<b><u>Technical adaptation of the workplace to drastically reduce the ergonomic strains:</u></b> <ul style="list-style-type: none"> <li>- Mechanical assistance to relieve the operator significantly, etc.</li> </ul>

*Table 6: Matrix - Reduction in potential exposure probability P.*


## 1.4 Repetitive movements

If there is too great a strain on the joints or bodily segments of the individual upper limbs (frequency and rate) and the recovery time is too short, repetitive work can lead to identifiable, irreversible and lasting damage to health.

The strain can be assessed by observing similar repeated movements of the part of the body in question (joint, tendon, etc.). It is expressed in the number of technical actions over a given period (cycle time). Calculation example: one task (one cycle) consisting of putting an object in a bag with the right hand (one technical action), placing it in a tub on the worktop (one technical action), hitting it three times on top with a hammer (three technical actions);  $1+1+3 = 5$  technical actions.

- The cycle time can be defined by a machine (e.g. more than 15 technical actions in 30 seconds).
- The cycle time can be undefined (the time between each cyclical task changes each time due to the variability of products) or unidentifiable (the pieces file past on a conveyor belt).



	<b>Group guide and manual</b>		
	Assessment of the occupational risks in the workplace (multiplicative method): ergonomic risk (Appendix 3)		
PSR/HSE Division	HSE		GM-GR-HSE-300 Rev. No.: 01 Date: 17/06/2020


#### 1.4.1 Severity rating G

Rating G	Repetitive movements	Examples of repetitive movements
15	Presence of repetitive movements during the whole job. More than 6 hours per job.	
7	Presence of repetitive movements with absence of regular breaks and forced rate. 4-6 hours per job.	Making sandwiches. Working at the cash register in a very busy service station. Manually wrapping small packages. Manually filling boxes (opening boxes, filling boxes, putting them on a pallet). Filling LPG bottle on carrousel. Filling LPG bottle manually. Putting on tops (taking and placing the tops manually before tightening). Manually putting LPG bottles onto pallets and taking them off.
3	Presence of repetitive movement, but with interruption associated with other activity and adapted breaks. 2-4 hours per job.	Restocking shelves at a service station. Working at the cash register in a service station. Preparing packaging (supply and preparation of packaging - bottles and boxes), labelling of boxes. Small packaging (manual filling of bottles, operation of the pedal, placing empty bottles...).
1	Everyday movements without particular strain. Less than 2 hours per job.	-

Table 7: Matrix - Severity G.

#### 1.4.2 Potential exposure probability rating P


The potential exposure probability P of exposure to ergonomic factors during a repetitive task is **10**.

	<b>Group guide and manual</b>		
	Assessment of the occupational risks in the workplace (multiplicative method): ergonomic risk (Appendix 3)		
PSR/HSE Division	HSE		GM-GR-HSE-300 Rev. No.: 01 Date: 17/06/2020

#### 1.4.3 Residual potential exposure probability rating P'

Reduction of P	Means/measures of prevention/protection (repetitive movements)
-1	<b><u>At least two procedural or organizational measures from:</u></b> <ul style="list-style-type: none"> <li>- Organizational measures: adjusting the workplace, warming up before any physical task, taking regular breaks to relax the muscles, alternating tasks, limiting useless movements, etc.</li> <li>- Good acts and postures training</li> <li>- Improving grip, tools, etc.</li> </ul>
-2	<b><u>Technical adaptation of the workplace to significantly reduce the ergonomic strains:</u></b> <ul style="list-style-type: none"> <li>- Reduce the rate, etc.</li> <li>- Simplifying the operations, etc.</li> </ul>
-3	<b><u>Technical adaptation of the workplace to drastically reduce the ergonomic strains:</u></b> <ul style="list-style-type: none"> <li>- Automating, etc.</li> </ul>

Table 8: Matrix - Reduction in potential exposure probability P.

	<b>Group guide and manual</b>		
	Assessment of the occupational risks in the workplace (multiplicative method): ergonomic risk (Appendix 3)		
PSR/HSE Division	HSE		GM-GR-HSE-300 Rev. No.: 01 Date: 17/06/2020

## 2 STATIC WORK (WORK AT SCREEN, SEATED WORK TO WORK ACCURATELY)

### 2.1 Severity rating G

Rating G	Work at screen	Work position (body, arms, head)
7	-	<u>Strained body, arm or head position</u> : working on more than one screen, screen too high, etc.
3	More than 2 h per day continuously More than 4 hours per day in total	<u>Feeling of discomfort regarding the activity</u> : adjustment of worktop, seat, working on two screens, etc. Standing work more than 2 h per day continuously
1	Less than 2 hours per day continuously Less than 4 hours per day in total	Standing work less than 2 h per day continuously

Table 8: Matrix - Severity G.


### 2.2 Potential exposure probability rating P

The potential exposure probability P of exposure to ergonomic factors during a static task is **10**.

### 2.3 Residual potential exposure probability rating P'

Reduction of P	Means/asures of prevention/protection (static work)
-1	<b><u>At least two procedural or organizational measures from:</u></b> <ul style="list-style-type: none"> <li>- Footrest, wrist rest, etc.</li> <li>- Regular breaks to relax muscles, alternate tasks</li> <li>- Workplace adjustment training, etc.</li> </ul>
-2	<b><u>Technical adaptation of the workplace to significantly reduce the ergonomic strains:</u></b> <ul style="list-style-type: none"> <li>- Ergonomic seat, sitting/standing seat, height-adjustable desk etc. AND workplace adjustment (seat, desk and screen), etc.</li> <li>- Screen, desk orientation according to <b>GM-GR-HSE-404</b></li> <li>- Rationalization of the workplace based on the task to be performed, etc. (PRPA training).</li> </ul>
-3	-

Table 10: Matrix - Reduction in potential exposure probability P.

	<b>Group guide and manual</b>		
	Assessment of the occupational risks in the workplace (multiplicative method): ergonomic risk (Appendix 3)		
PSR/HSE Division	HSE		GM-GR-HSE-300 Rev. No.: 01 Date: 17/06/2020

### 3 WORK ATMOSPHERE (INSIDE)

#### 3.1 Severity rating G

This chapter handles the assessment of risks associated with the work atmosphere for static tasks. For the parameters associated with tasks necessitating physical activity, see annex 4 on the long-term physical risks of the **GM-GR-HSE-300** guide.

Rating G	Temperature (NFX 35-102)	Relative humidity (RH)	Noise (*)	Lighting (*) (EN 12464-1)
3	<u>Temperature:</u> < 20°C or > 26°C work by a window with exposure to sunrays, etc. <u>Draughts</u> , etc.	RH < 30%  RH > 70%	Discomfort related to background noise level	<u>Inappropriate lighting:</u> < 500 lux in office, laboratory, control room, etc. <u>Dazzle</u>
1	<u>Thermal comfort:</u> 20-24°C in winter 22-26°C in summer	30% < RH < 70% or little discomfort	-	-

(\*) Psycho-physiological effects of noise/light: e.g. concentration, tiredness, etc. The physiological effects associated to noise (loss of hearing, etc.) are taken into account in the long-term physical risks.


*Table 11: Matrix - Severity G.*

Reminder: the minimum recommended task-specific lighting levels are:

* Selected reference values for lighting (EN 12464-1 and -2)							
Internal locations				External locations			
Reception	Archives, canteen, locker rooms, bathrooms	Stairways Loading bays	Corridors, stores Roads	Pedestrians, loading and unloading of vehicles	Regular vehicle traffic	Vehicle traffic areas	Pedestrian-only paths
300 lux	200 lux	150 lux	100 lux	50 lux	20 lux	10 lux	5 lux

#### 3.2 Potential exposure probability rating P

The potential exposure probability P of exposure to ergonomic factors when working in these conditions is **10**.

	<b>Group guide and manual</b>		
	Assessment of the occupational risks in the workplace (multiplicative method): ergonomic risk (Appendix 3)		
PSR/HSE Division	HSE		GM-GR-HSE-300 Rev. No.: 01 Date: 17/06/2020

### 3.3 Residual potential exposure probability rating P'

Reduction of P	Means/measures of prevention/protection		
	Ambient temperature and relative humidity	Noise	Lighting
-1	<ul style="list-style-type: none"> <li>- Blind</li> <li>- Hot/cold water fountain</li> <li>- Ventilator</li> <li>- Adjustable heating for the offices, etc.</li> </ul>	<ul style="list-style-type: none"> <li>- Noise-cancelling headphones</li> <li>- Have the occupants set the rules in an open-plan office</li> <li>- Make spaces available for phoning, meetings in an open-plan office, etc.</li> </ul>	<ul style="list-style-type: none"> <li>- Blind</li> <li>- Additional light, etc.</li> </ul>
-2	<ul style="list-style-type: none"> <li>- Locations of thermal radiation sources away from employees, etc.</li> </ul>	<ul style="list-style-type: none"> <li>- Acoustic partition in open-plan office</li> <li>- Spacing of workspaces</li> <li>- Remoteness of noisy machines, etc.</li> </ul>	<ul style="list-style-type: none"> <li>- Restriction of radiating surfaces (screens, surface treatment, blinds, appropriate colours, etc.)</li> <li>- Moving disturbing sources of light</li> <li>- Introduction of supplementary light sources, etc.</li> </ul>
-3	<ul style="list-style-type: none"> <li>- Insulation/weather stripping, air-conditioning, enclosure, elimination of leaks that can create humidity, etc.</li> </ul>	<ul style="list-style-type: none"> <li>- Partitions</li> <li>- Enclosing noisy machines, etc.</li> </ul>	-

Table 12: Matrix - Reduction in potential exposure probability.

## 4 TERMS AND DEFINITIONS

### Technical action

Technical action is characterized by easily observable and identifiable action verbs: grip, position, place, insert, push, press, screw, pull, hit, cut, remove, lower, clip, paste, wrap...

### Forced rate

If the employee is unable to avoid the work situation without a loss for production (demands of a task, time taken for a task, mass production rate, etc.), the service or the employee and his or her colleagues.

### Mp type


Means/measures of prevention/protection type These are defined in paragraph 3.9 "Calculation of residual risk R" of the **GM-GR-HSE-300** guide.

### PRPA

Prevention of risks associated with the physical activity

### MSD

Musculoskeletal disorders

	<b>Group guide and manual</b>		
	Assessment of the occupational risks in the workplace (multiplicative method): ergonomic risk (Appendix 3)		
<b>PSR/HSE Division</b>	HSE		GM-GR-HSE-300 Rev. No.: 01 Date: 17/06/2020

## 5 REFERENCE DOCUMENTS

Reference	Title - Group documents
CR-GR-HSE-405	Industrial hygiene
GM-GR-HSE-404	Preventing ergonomic risks associated with monitor work

## 6 BIBLIOGRAPHY

### International

ISO 6385: Ergonomic principles in the design of work systems

ISO 11228-2: Ergonomics — Manual handling — Part 2: Pushing and pulling

### Europe

EN 1005-1 to 5: Safety of machinery - Human physical performance.

EN 12464-1 to 2: Light and lighting. Lighting of work places - Part 1: Indoor work places - Part 2: Outdoor work places.

### France

ED 6161: Analyse de la charge physique de travail – INRS.

NF X35-109: Manutention manuelle de charge pour soulever, déplacer et pousser/tirer - Méthodologie d'analyse et valeurs seuils – AFNOR.