

## Ergonomic Assessment Worksheet v1.3.6

Plant	Gender of operator    m <input type="checkbox"/> f <input type="checkbox"/>	Body height
Line	MTM Analysis	Analyst
Task / Workplace	Task duration [s]	Observation <input type="checkbox"/> Planning <input type="checkbox"/>
Date		

**Result of overall evaluation:** Calculate the total score of whole body and compare it to the UL score. The overall result is determined by the higher value and the appropriate traffic light is checked. Anyway, interpretation should take into account both values.

<input type="checkbox"/> Green <input type="checkbox"/> Yellow <input type="checkbox"/> Red	<b>Whole Body</b>	=	<b>Postures</b>	+	<b>Forces</b>	+	<b>Loads</b>	+	<b>Extra</b>	<b>Upper Limbs</b>
		=		+		+		+		

<b>EAWs evaluation</b>	0-25 Points	Green	Low risk: recommended; no action is needed
	>25-50 Points	Yellow	Possible risk: not recommended; redesign if possible, otherwise take other measures to control the risk
	>50 Points	Red	High risk: to be avoided; action to lower the risk is necessary

Extra points "Whole body" (per minute / shift)						Extra points		
0a	Adverse effects by working on moving objects	0	3	8	15	Intensity		
		none	middle	strong	very strong			
0b	Accessibility (e.g. entering motor or passenger compartment)	0	2	5	10	Status		
		good	complicated	poor	very poor			
0c	Countershocks, impulses, vibrations 	0	1	2	5	Intensity x frequency		
		light	visible	heavy	very heavy			
		0 [n]	1 1 - 2	2,5 4 - 5	4 8 - 10		6 18 - 20	8 > 20
0d	Joint position (especially wrist) 	0	1	3	5	Intensity x duration or frequency		
		neutral	~ 1/3 max	~ 2/3 max	maximal			
		0 [s]	2 3	2,5 10	4 20		6 40	8 60
		[n]	1	8	11		16	20
[%]	5	17	33	67	100			
0e	Other physical work load (please describe in detail)	0	5	10	15	Intensity		
		none	middle	strong	very strong			

<b>Extra = ∑ lines 0a – 0e</b>	note: Max. score = 40 (line 0c, 0d); Max. score = 15 (line 0a, 0e); Max. score = 10 (line 0b)	note: correct evaluation, if duration of evaluation ≠ 60 s	=
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Lines 0a-b mainly relate to the Automotive Industry, for other sectors additional elements may be necessary. For details see the EAWS manual.



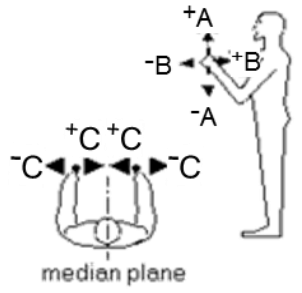



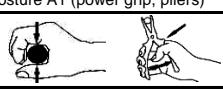
For scoring of repetitive tasks only:		
Description	Formula	Result
Real shift duration [min]		
Lunch break [min]	-	
Other official pauses [min]	-	
Non repetitive tasks (i.e. cleaning, supplies, etc) [min]	-	
Net duration of repetitive task/s (a) [min]	=	
No. of real units (or cycles) (b)		
Net cycle time [s]	(a/b × 60) =	
Idle Time [s]		



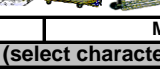

Comments / proposals for improvements

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Basic Positions / Postures and movements of trunk and arms (per shift)											Postures																
(incl. loads of <3 kg, forces onto fingers of <30 N and whole body forces of <40 N)  Static postures: ≥ 4 s  High frequency movements: Trunk bendings (> 60°) ≥ 2/min Kneeling/crouching ≥ 2/min Arm liftings (> 60°) ≥ 10/min											Symmetric										Asymmetric						
											Evaluation of static postures and/or high frequency movements of trunk/arms/legs										Sum of lines	Trunk Rotation 1)		Lateral Bending 1)		Far Reach 2)	
											Duration [s/min] = $\frac{\text{duration of posture [s]} \times 60}{\text{Task duration [s]}}$											int	dur	int	dur	int	dur
[%]	5	7,5	10	15	20	27	33	50	67	83																	
[s/min]	3	4,5	6	9	12	16	20	30	40	50																	
[min/8h]	24	36	48	72	96	130	160	240	320	400																	
Standing (and walking)																											
1		Standing & walking in alteration, standing with support	0	0	0	0	0,5	1	1	1	1,5	2															
2		Standing, no body support (for other restrictions see Extra Points)	0,7	1	1,5	2	3	4	6	8	11	13															
3		a Bent forward (20-60°)	2	3	5	7	9,5	12	18	23	32	40															
		b with suitable support	1,3	2	3,5	5	6,5	8	12	15	20	25															
4		a Strongly bent forward (>60°)	3,3	5	8,5	12	17	21	30	38	51	63															
		b with suitable support	2	3	5	7	9,5	12	18	23	31	38															
5		a Elbow at/above shoulder level	3,3	5	8,5	12	17	21	30	38	51	63															
		b With certif. exoskeleton	2,2	3,4	5,7	8,0	11,8	14,6	20,8	26,0	35,0	43,0															
6		a Hands above head level	5,3	8	14	19	26	33	47	60	80	100															
		b With certif. exoskeleton	3,7	5,6	10,0	13,4	18,0	23,0	33,0	42,0	56,0	70,0															
Sitting																											
7		Upright with back support slightly bent forward or backward	0	0	0	0	0	0,5	1	1,5	2																
8		Upright no back support (for other restriction see Extra Points)	0	0	0,5	1	1,5	2	3	4	5,5	7															
9		Bent forward	0,7	1	1,5	2	3	4	6	8	11	13															
10		a Elbow at / above shoulder level	2,7	4	7	10	13	16	23	30	40	50															
		b With certif. exoskeleton	1,6	2,4	4,2	6,0	7,8	9,6	13,8	18,0	24,0	30,0															
11		a Hands above head level	4	6	10	14	20	25	35	45	60	75															
		b With certif. exoskeleton	2,4	3,6	6,0	8,4	12,0	15,0	21,0	27,0	36,0	45,0															
Kneeling or crouching																											
12		Upright	3,3	5	7	9	12	15	21	27	36	45															
13		Bent forward	4	6	10	14	20	25	35	45	60	75															
14		a Elbow at / above shoulder level	6	9	16	23	33	43	62	80	108	135															
		b With certif. exoskeleton	4,9	7,4	13,2	19,0	27,8	36,6	52,8	68,0	92,0	115															
Lying or climbing																											
15		(Lying on back, breast or side) arms above head	6	9	15	21	29	37	53	68	91	113															
16		Climbing	6,7	10	22	33	50	66																			
1) Trunk			0	1	3	5																					
int			slightly	medium	strongly	extreme																					
dur			≤10°	15°	25°	≥30°																					
0%			0	1,5	2,5	3																					
6%			never	4 s	10 s	≥ 13 s																					
15%			0%	6%	15%	≥ 20%																					
≥ 20%																											
2) Far Reach			0	1 (0,7)	3 (2)	5 (3,3)																					
int			close	60%	80%	arm stretched																					
dur			0	1	1,5	2																					
never			0%	6%	15%	≥ 20%																					
4 s																											
10 s																											
≥ 13 s																											
Σ																											
Σ (max.=15)																											
Σ (max.=15)																											
Σ (max.=10)																											
Σ (max. = 40)																											
(a)																											
(b)																											
note: Max. duration of evaluation = duration of task or 100%!											note: correct evaluation, if task duration ≠ 60 s																
<b>Postures = Σ lines 1 - 16</b>			(a)			+			(b)			=															

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Action forces (per minute)										Forces											
17		Forces onto fingers (e.g. clips, plugs)	Int		0	7	15	25	50	Intensity x Duration											
					16,7% F <sub>max</sub>	33,3% F <sub>max</sub>	50,0% F <sub>max</sub>	66,7% F <sub>max</sub>	F <sub>max</sub>												
			Duration stat		0	1	1	1,5	2			3,5	7								
			Duration dyn		[s]	3	6	9	12			20	30								
		[%]		5	10	15	20	33	50												
		[n]		0	1,5	2	2,5	3													
		[n]		4	10	15	20														
18		Forces onto arms / whole body forces	Int		0	6	15	25	50	Intensity x Duration											
					16,7% F <sub>max</sub>	33,3% F <sub>max</sub>	50,0% F <sub>max</sub>	66,7% F <sub>max</sub>	F <sub>max</sub>												
			Duration stat		0	1	1	1,5	2			4	8,5								
			Duration dyn		[s]	3	6	9	12			20	30								
		[%]		5	10	15	20	33	50												
		[n]		0	1	2	3	4,5	6,5	10											
		[n]		1	3	6	8	10	12												
Forces F <sub>max</sub> onto arms / whole body forces M for males & F for females			ST Upright		M	F	ST Bent		M	F	ST Above head		M	F	Finger forces F <sub>max</sub> (F=Female M=Male)						
 <p style="text-align: center;">median plane</p> <p style="text-align: center;">Data based on the "Assembly specific force atlas" (Wakula, Berg, Schaub, Glitsch, Ellegast 2009)</p>					+A	480	315			+A	435	285			+A	430	280	 <p style="text-align: center;">Posture A1 (power grip, pliers)</p>			
					+B	320	210			+B	400	260			+B	305	200			F <sub>max</sub>	
					+C	290	185			+C	310	200			+C	210	140			M	F
			-B		+B		-C		+C		-C		+C		-C		+C		-C		
			-A		+A		-B		+B		-C		+C		-C		+C		-C		
			+A		-A		+B		-B		+C		-C		+C		-C		+C		
			-B		+B		-C		+C		-C		+C		-C		+C		-C		
			+C		-C		+C		-C		+C		-C		+C		-C		+C		
			-C		+C		-C		+C		-C		+C		-C		+C		-C		
			+C		-C		+C		-C		+C		-C		+C		-C		+C		
			-C		+C		-C		+C		-C		+C		-C		+C		-C		
			Action forces = ∑ lines 17 - 18			note: correct evaluation, if task duration ≠ 60s								=							

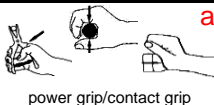
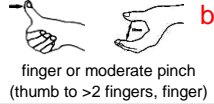

Manual Material Handling (per shift)										Loads							
<b>Weights of loads [kg] for repositioning (lifting / lowering), carrying and holding as well as pushing and pulling</b>																	
	Reposition, carrying & holding	Male	3	10	15	20	25	30	35	40	>40						
		Female	2	5	7	10	12	15	20	25	>25						
Load points			1	1,5	2	3	4	5,5	7	8,5	25						
+	Pushing and pulling	M1 		Male		<50	75	100	150	200	250						
		Female		<40	60	80	115	155	195								
		M2 		Male		<50	75	100	150	250	350	550					
		Female		<40	60	80	115	195	270	425							
		M3 		Male		<50	75	150	250	350	500	600	800	1250			
		Female		<40	60	115	195	270	385	460	615	960					
Load points			Means of transport			0,5	1	1,5	2	3	4	5	6	8			
<b>Posture, position of load (select characteristic posture)</b>																	
+																	
	trunk upright and / or not twisted			little trunk bending or twisting; load at or close to the body			bending trunk deep or far forward; little trunk bending forward and trunk twisting simultaneously; load far from body or above shoulder level			bending trunk far forward and twisting; load far from the body; limited postural stability while standing; crouching or kneeling							
	Posture points			1	2	4				8							
<b>Working Conditions (pushing and pulling only)</b>																	
(+)	very low rolling resistance			trolley pushing / pulling on (very) slick floor			rough floor and above small gaps / edges			on structured sheet metal into / out of a track			trolleys have to be teared off when starting, strongly damaged floor			very high rolling resistance	
	Conditions points			0	1	3	5	6	8								
<b>Frequency of load manipulations [frequency/shift], holding time [min/shift] or travel distance [meter/shift]</b>																	
x	Frequency (#) of repositionings / pushing & pulling short					5	25	120	350	750	1000	1500	2000	2500	3000		
	Duration (holding time) [min]					2,5	10	37	90	180	≥240						
	Distance (carrying, pushing & pulling long) [m]					300	650	2500	6000	12000		≥16000					
	Duration points					1	2	4	6	8	10	11	13	14	15		
<b>Manual Material Handling (result)</b>																	
19	(Load + posture + (condition points)) × duration points		Repositioning 1)	( ) + ( )	=	Holding 1)	( ) + ( )	=	Carrying 1)	( ) + ( )	=	Pushing & Pulling short	( ) + ( ) + ( )	=	Pushing & Pulling long	( ) + ( ) + ( )	=
	Handling = ∑ line 19			1) Maximal cumulative duration points for all tasks of repositioning, holding, carrying as well as pushing & pulling all together = 15								=					

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## Upper limb load in repetitive tasks

## Upper Limbs

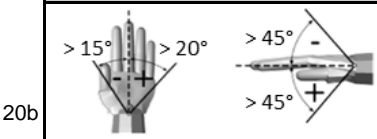
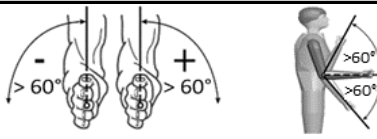
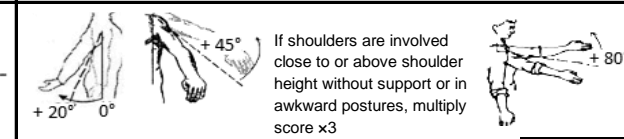
**Force & Frequency & Grip (FFG)** Basis: number of real actions per minute or percent static actions (analyze only the most loaded limb)

<b>Legend</b>	<b>a</b>	 power grip/contact grip	%SA = Percentage of Static Actions	%DA = 100% - %SA
	<b>b</b>	 finger or moderate pinch (thumb to >2 fingers, finger)	FDS = Force-Duration Static	FFD = Force-Frequency Dynamic
	<b>c</b>	 strong pinch (thumb to 1 or 2 fingers)	GS' = Modified Grip Points Static (Grip x %SA)	GD = Grip Points Dynamic
			%FLS = Percentage of Static Actions at force level	%FLD = Percentage of Dynamic Actions at force level
			SC = Static Contribution	DC = Dynamic Contribution
		FDGS = Sum of Static Contributions	FFGD = Sum of Dynamic Contributions	

Force [N]	Calc Stat				Static actions (s/min)					Grip			Dynamic actions (real actions/min)							Calc Dyn					
	FDS	GS'	%FLS	SC	≥45	30	20	10	5	3	0	2	4	2-5	10	15	20	25	30	35	≥40	FFD	GD	%FLD	DC
0 – 5					1	1	0	0	0	0	abc			0	0	0	1	2	3	4	7				
> 5 – 20					4	2	1	1	0	0	ab	bc		0	0	1	2	3	4	6	9				
> 20 – 35					7	5	3	2	1	1	ab	b	c	0	1	2	3	4	6	8	12				
> 35 – 90					11	8	5	3	2	1	a	b	b	1	2	3	5	7	9	12	18				
> 90 – 135					16	11	7	4	3	2	a	ab	b	2	3	5	7	9	12	15	24				
> 135 – 225					21	14	10	6	4	3	a	a	b	4	5	6	8	11	14	20	32				
> 225 – 300					28	18	12	8	5	4	a	a	b	5	6	7	9	12	16	26	40				

20a  $FDGS = \sum SC_i$  100%  $FFG = FDGS + FFGD$  FFG  $\%DA = \sum FLD_j$   $FFGD = \sum DC_j$  %DA

### Hand / arm / shoulder postures (use duration for worst case of wrist / elbow / shoulder)

20b	Wrist (deviaton, flex./extens.)	Elbow (pron, sup, flex./extens.)	Shoulder (flexion, extension, abduction)				
							
	<b>Posture points</b>	10%	25%	33%	50%	65%	85%
Wrist/Elbow	0	0,5	1	2	3	4	
Shoulder	0	1,5	3	6	9	12	
	Shoulder w/exosk	0	1,2	2,4	4,8	7,2	9,6

### Additional factors

20c	Gloves inadequate (which interfere with the handling ability required) are used for over half the time	2	<input type="checkbox"/>
	Working gestures required imply a countershock. Frequency of 2 time per minute or more (i.e.: hammering over hard surface)	2	<input type="checkbox"/>
	Working gestures imply a countershock (using the hand as a tool) with freq. of 10 time per hour or more	2	<input type="checkbox"/>
	Exposure to cold or refrigeration (less than 0 degree) for over half the time	2	<input type="checkbox"/>
	Vibrating tools are used for 1/3 of the time or more	2	<input type="checkbox"/>
	Tools with a very high level of vibrations	4	<input type="checkbox"/>
	Tools employed cause compressions of the skin (rednesses, callosities, blebs, etc.)	2	<input type="checkbox"/>
	Precision tasks are carried out for over half the time (tasks over areas smaller than 2-3 mm)	2	<input type="checkbox"/>
More than one additional factor is present at the same time and overall occupy the whole of the time	3	<input type="checkbox"/>	
<b>Additional points (choose the highest value)</b>		=	AF

### Repetitive tasks duration

20d	Net Duration [min/shift]	< 60	90	180	300	420	> 480	+					
	<i>Duration Points</i>	1	1,5	3	5	7	10						
	Work Organization	Breaks are possible at every time		Breaks are possible at given conditions			Breaks lead to a stop of the process		+				
	<i>Work Organization Points</i>	(Cycle time longer than 10 minutes)		(Cycle time between 1 and 10 minutes)			(Cycle time shorter than 1 minute)						
	Breaks (≥ 8 min) [#shift]	0	1	2	3	4	5	6	≥7	+			
	<i>Break points</i>	3	2	1	0	-1	-2	-3	-4				
<b>Duration Points</b>		0		-0,5			-1		-1,5		-2	=	DP

### Upper limb load in repetitive tasks

20 ( (a) Force & Frequency & Grip  $FFG$  + (b) Postures  $PP$  + (c) Additional factors  $AF$  ) × (d) Duration  $DP$  = Upper Limbs