Job Strain Index (JSI)

Moore, J.S. and Garg, A. (1995) American Industrial Hygiene Journal 56:443-58.

JSI Ratings

1. Intensity of Exertion
2. Duration of Exertion
3. Efforts per Minute
4. Hand/Wrist Posture
5. Speed of Work
6. Duration of Task per Day

Moore, J.S. and Garg, A. (1995) American Industrial Hygiene Journal 56:443-58.

1. Intensity of Exertion

An estimate of the strength required to perform the task one time. Guidelines for assigning a rating criterion are presented in the following table.

Rating Criterion	% MS[A]	Borg Scale[B]	Perceived Effort
Light	<10%	<=2	barely noticeable or relaxed effort
Somewhat Hard	10%-29%	3	noticeable or definite effort
Hard	30%-49%	4-5	obvious effort; unchanged facial expression
Very Hard	50%-79%	6-7	substantial effort; changes facial expression
Near Maximal	>=80%	>7	uses shoulder or trunk to generate force

[A]Percentage of maximal strength

[B]Compared to the Borg CR-10scale[76]

Moore, J.S. and Garg, A. (1995) American Industrial Hygiene Journal 56:443-58.

2. Duration of Exertion

Duration of Exertion is calculated by measuring the duration of all exertions during an observation period, then dividing the measured duration of exertion by the total observation time and multiplying by 100.

$$\% \text{ Duration of Exertion} = \frac{100 \times \text{duration of all exertions (sec)}}{\text{total observation time (sec)}}$$

Moore, J.S. and Garg, A. (1995) American Industrial Hygiene Journal 56:443-58.

3. Efforts per Minute

Efforts per Minute are measured by counting the number of exertions that occur during an observation period, then dividing the number of exertions by the duration of the observation period, measured in minutes.

$$\text{Efforts per Minute} = \frac{\text{number of exertions}}{\text{total observation time (min)}}$$

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4. Hand/Wrist Posture

Hand/Wrist Posture is an estimate of the position of the hand or wrist relative to neutral position. Guidelines for assigning a rating criterion are presented in the following table.

Rating Criterion	Wrist Extension[A]	Wrist Flexion[A]	Ulnar Deviation[A]	Perceived Posture
Very Good	0°-10°	0°-5°	0°-10°	perfectly neutral
Good	11°-25°	6°-15°	11°-15°	near neutral
Fair	26°-40°	16°-30°	16°-20°	nonneutral
Bad	41°-55°	31°-50°	21°-25°	marked deviation
Very Bad	>60°	>50°	>25°	near extreme

[A] From derived from data.

Moore, J.S. and Garg, A. (1995) American Industrial Hygiene Journal 56:443-58.

5. Speed of Work

Speed of Work is an estimate of how fast the worker is working. Guidelines for assigning a rating criterion are presented in the following table.

Rating Criterion	Compared to MTM-1[A]	Perceived Speed
Very Slow	<=80%	extremely relaxed pace
Slow	81-90%	"taking one's own time"
Fair	91-100%	"normal" speed of motion
Fast	101-115%	rushed, but able to keep up
Very Fast	>115%	rushed and barely or unable to keep up

[A]The observed pace is divided by MTM-1's predicted pace and expressed as a percentage of predicted.

Moore, J.S. and Garg, A. (1995) American Industrial Hygiene Journal 56:443-58.

6. Duration of Task per Day

Duration of Task per Day is either measured or obtained from plant personnel.

Moore, J.S. and Garg, A. (1995) American Industrial Hygiene Journal 56:443-58.

Job Stress Index

Rating	Intensity of Exertion (IE)	Duration of Exertion (DE)	Efforts/ Minute (EM)	Hand/Wrist Posture (HWP)	Speed of Work (SW)	Duration per Day (DD)
1	Light (1)	<10% (0.5)	<4 (0.5)	Very good (1)	Very slow (1)	<1 (.25)
2	Somewhat hard (3)	10-29% (1)	4-8 (1)	Good (1)	Slow (1)	1-2 (.5)
3	Hard (6)	30-49% (1.5)	9-14 (1.5)	Fair (1.5)	Fair (1)	2-4 (.75)
4	Very hard (9)	50-79% (2)	15-19 (2)	Bad (2)	Fast (1.5)	4-8 (1)
5	Near maximal (13)	80-100% (3)	>=20 (3)	Very bad (3)	Very fast (2)	>=8 (1.5)

JSI = IE x DE x EM x HWP x SW x DD

Moore, J.S. and Garg, A. (1995) American Industrial Hygiene Journal 56:443-58.

Job Stress Index Worksheet

	Intensity of Exertion (IE)	Duration of Exertion (DE)	Efforts/ Minute (EM)	Hand/Wrist Posture (HWP)	Speed of Work (SW)	Duration per Day (DD)
Exposure data						
Ratings						
Multipliers						
SI Scores						

JSI = IE x DE x EM x HWP x SW x DD

Moore, J.S. and Garg, A. (1995) American Industrial Hygiene Journal 56:443-58.

Job Stress Index Worksheet Example

	Intensity of Exertion (IE)	Duration of Exertion (DE)	Efforts/ Minute (EM)	Hand/Wrist Posture (HWP)	Speed of Work (SW)	Duration per Day (DD)
Exposure data	Somewhat hard	60%	12	fair	fair	4-8
Ratings	2	4	3	3	3	4
Multipliers	3.0	2.0	1.5	1.5	1.0	1.0

JSI = IE x DE x EM x HWP x SW x DD

JSI = 3.0 x 2.0 x 1.5 x 1.5 x 1.0 x 1.0

JSI = 13.5

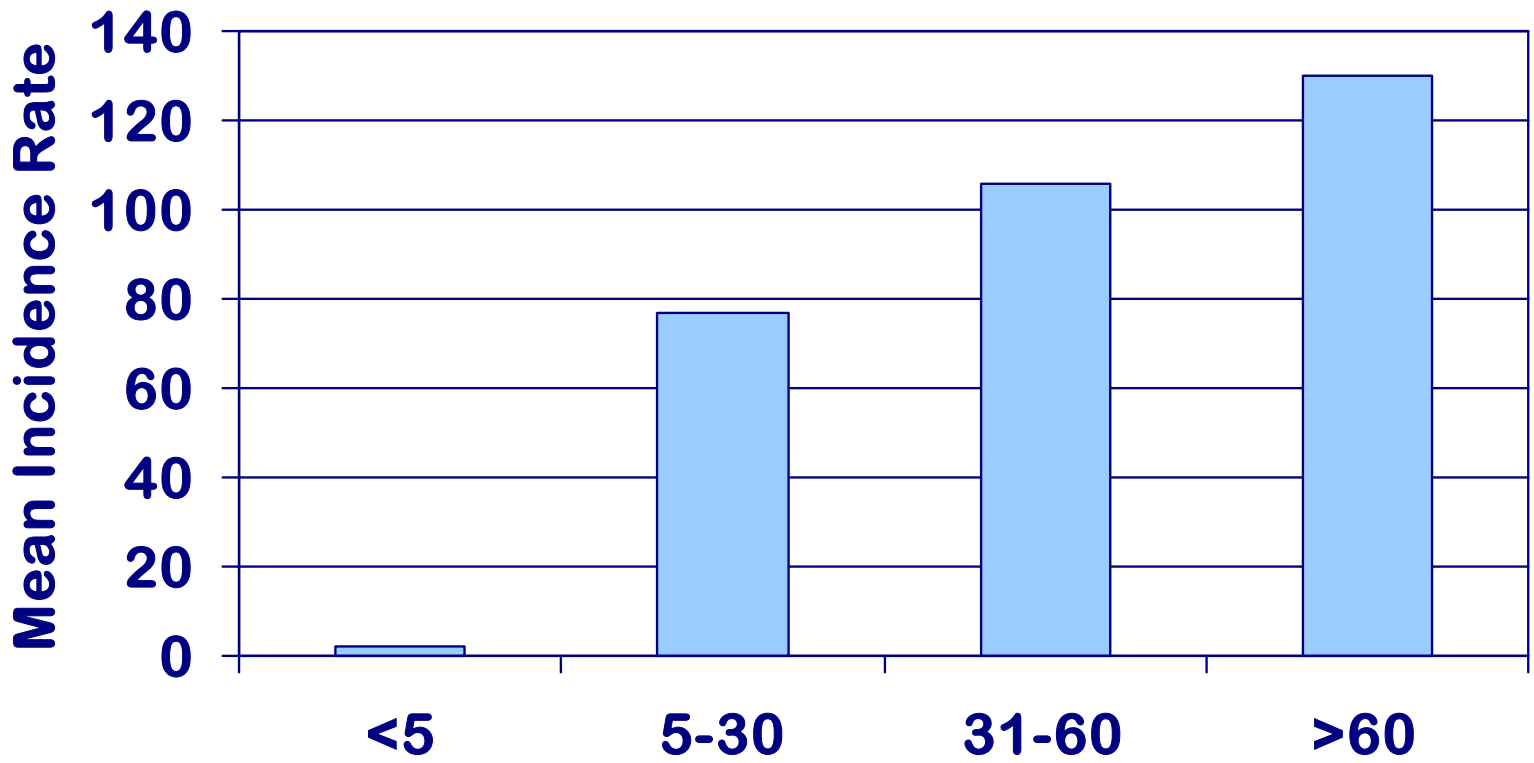
Moore, J.S. and Garg, A. (1995) American Industrial Hygiene Journal 56:443-58.

Job Strain Index

- Preliminary testing has revealed that jobs associated with distal upper extremity disorders had SI Scores greater than 5.
- SI Scores less than or equal to 3 are probably safe.
- SI Scores greater than or equal to 7 are probably hazardous.
- The Strain Index does not consider stresses related to localized mechanical compression. This risk factor should be considered separately.

Moore, J.S. and Garg, A. (1995) American Industrial Hygiene Journal 56:443-58.

JSI: Sensitivity Analysis



Mean Incidence Rate = # MSD injuries/100 workers/Year

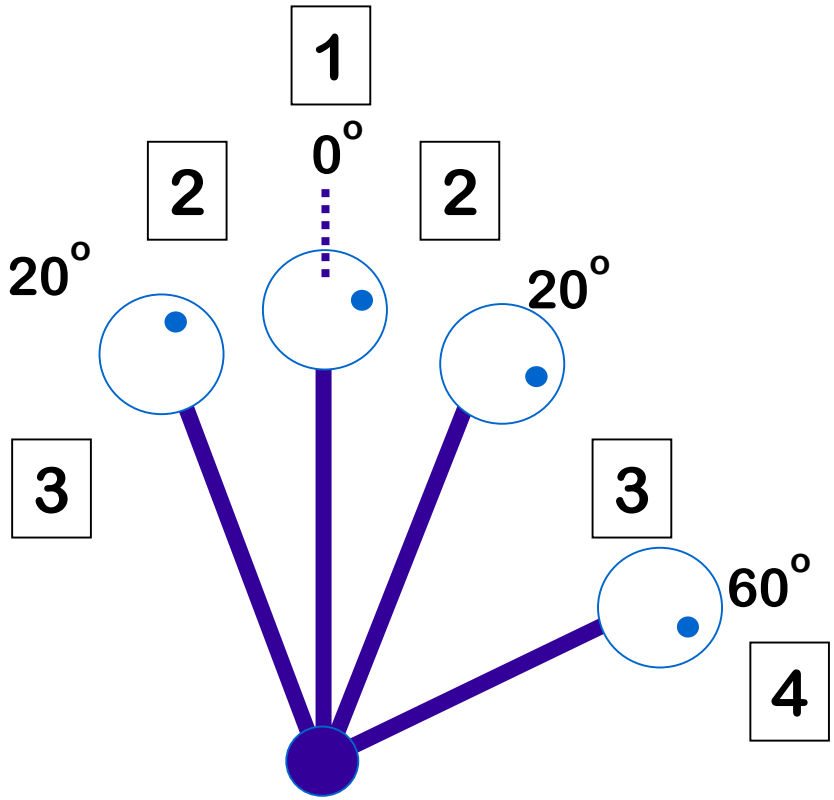
Moore, J.S. and Garg, A. (1995) American Industrial Hygiene Journal 56:443-58.

Rapid Entire Body Assessment: (REBA)

Source: Hignett, S., McAtamney, L. (2000) Applied Ergonomics, 31, 201-5.

REBA: Trunk Score

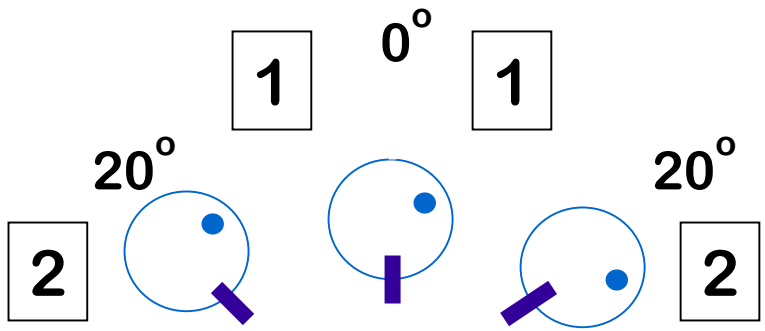
Movement	Score	Change Score
Upright	1	+1 if twisting or side flexed
0°-20° flexion 0°-20° extension	2	
20°-60° flexion >20° extension	3	
> 60° flexion	4	



Source: Hignett, S., McAtamney, L. (2000) Applied Ergonomics, 31, 201-5.

REBA: Neck Score

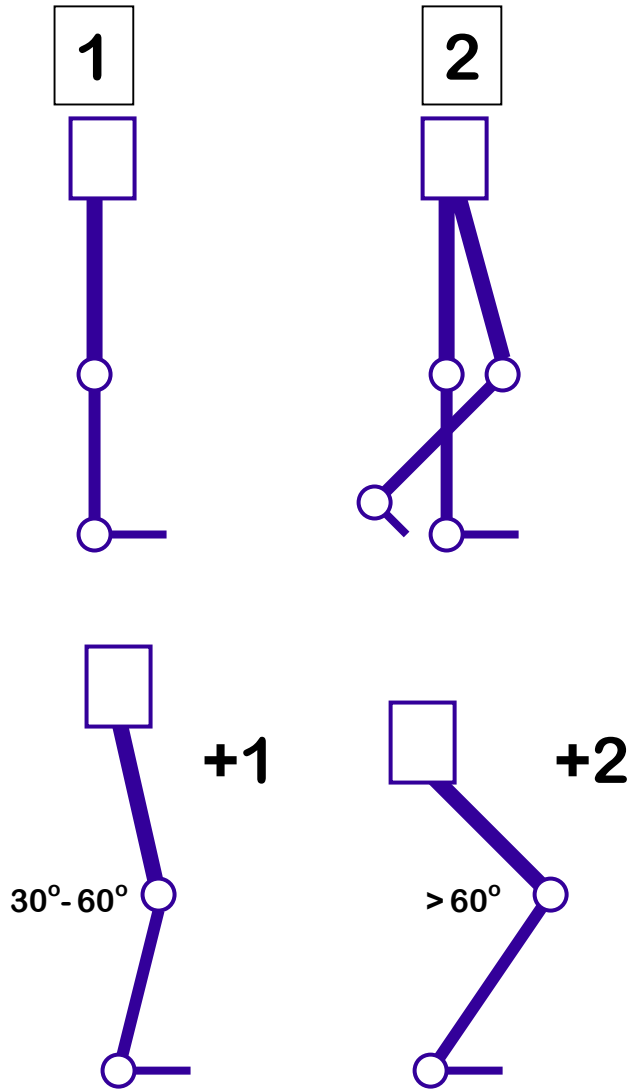
Movement	Score	Change score:
0°- 20° flexion	1	+1 if twisting or side flexed
>20° flexion or >20° extension	2	



Source: Hignett, S., McAtamney, L. (2000) Applied Ergonomics, 31, 201-5.

REBA: Legs Score

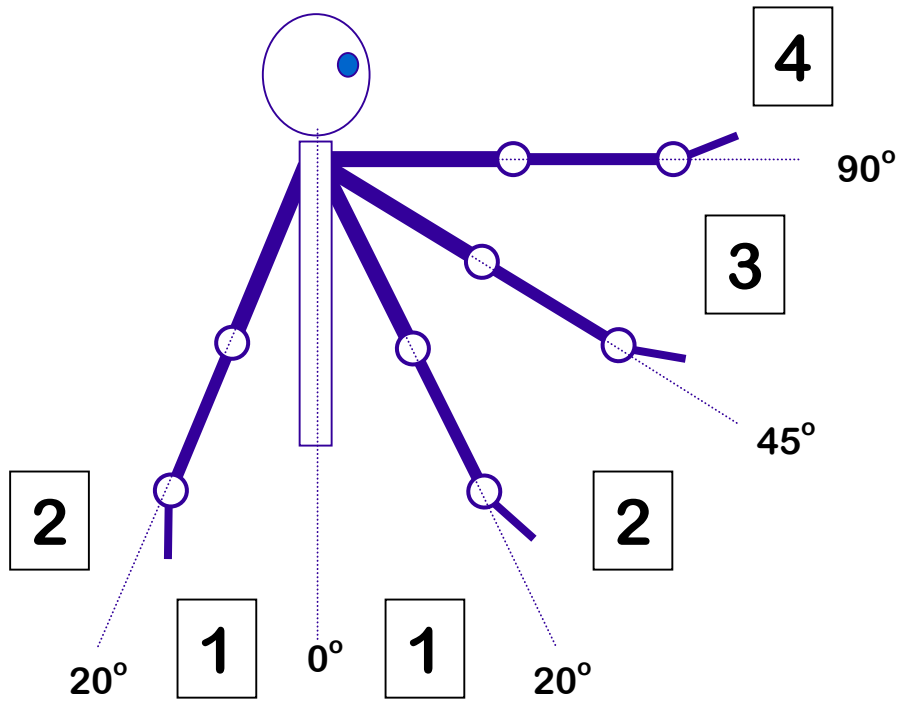
Position	Score	Change score
Bilateral weight bearing, walking or sitting	1	+1 if knees between 30° - 60° flexion
Unilateral weight bearing Feather weight bearing or an unstable posture	2	+2 if knees >60° flexion (n.b. Not for sitting)



Source: Hignett, S., McAtamney, L. (2000) Applied Ergonomics, 31, 201-5.

REBA: Upper Arms

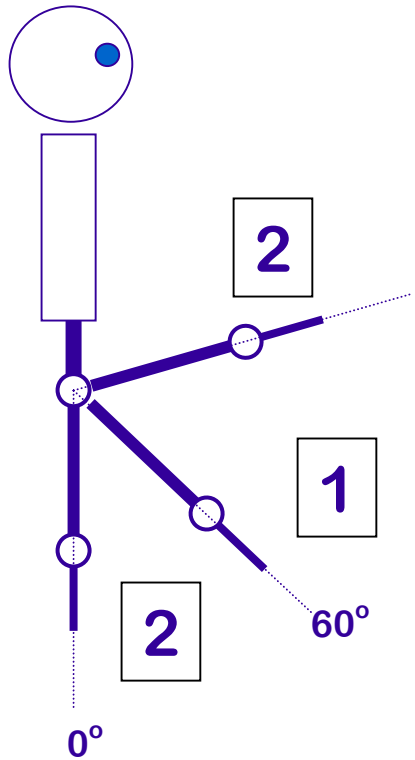
Position	Score	Change score
20° extension to 20° flexion	1	+1 if arm is abducted or rotated +1 if shoulder is raised -1 if leaning, supporting weight of arm or if posture is gravity assisted
>20° extension 20° - 45° flexion	2	
45° - 90° flexion	3	
>90° flexion	4	



Source: Hignett, S., McAtamney, L. (2000) Applied Ergonomics, 31, 201-5.

REBA: Lower arms

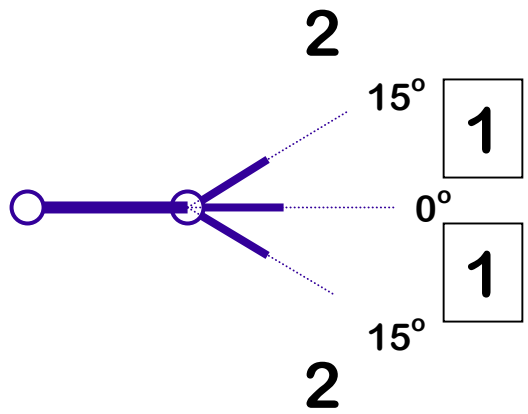
Movement	Score
60°-100° flexion	1
<60° flexion or >100° flexion	2



Source: Hignett, S., McAtamney, L. (2000) Applied Ergonomics, 31, 201-5.

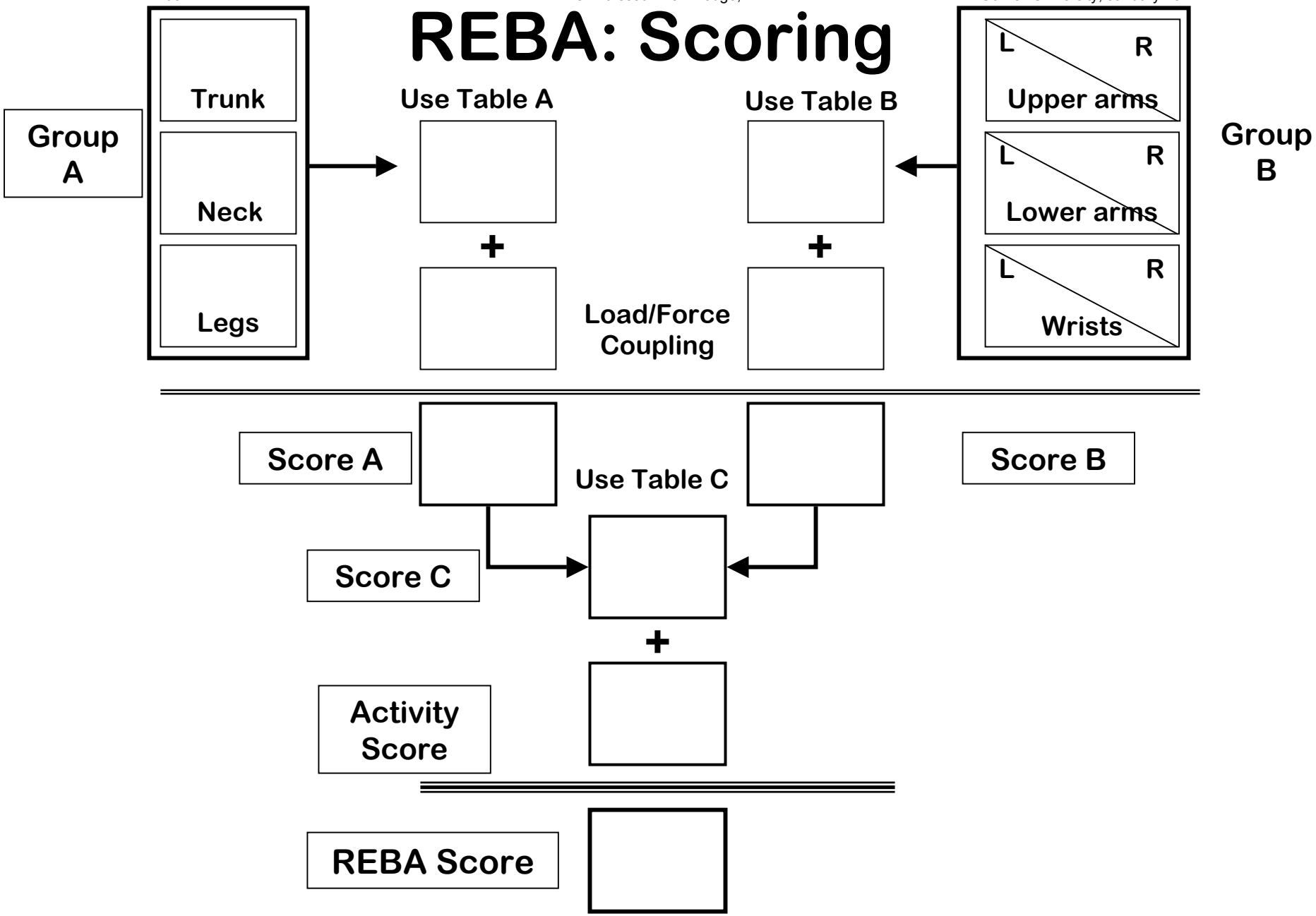
REBA: Wrists

Movement	Score	Change score:
0°-15° flexion or extension	1	+1 if wrist is deviated or twisted
>15° flexion or > 15° extension	2	



Source: Hignett, S., McAtamney, L. (2000) Applied Ergonomics, 31, 201-5.

REBA: Scoring



Source: Hignett, S., McAtamney, L. (2000) Applied Ergonomics, 31, 201-5.

Table A and Load

Trunk		Neck											
		1				2				3			
	Legs	1	2	3	4	1	2	3	4	1	2	3	4
1		1	2	3	4	1	2	3	4	3	3	5	6
2		2	3	4	5	3	4	5	6	4	5	6	7
3		2	4	5	6	4	5	6	7	5	6	7	8
4		3	5	6	7	5	6	7	8	6	7	8	9
5		4	6	7	8	6	7	8	9	7	8	9	9

Load/Force			
0	1	2	+1
< 10 lb (<5 kg)	10-20 lb (5-10 kg)	>20 lb (>10 kg)	Shock or rapid build up of force

Source: Hignett, S., McAtamney, L. (2000) Applied Ergonomics, 31, 201-5.

REBA: Table B and Coupling

		Lower arm					
Upper arm		1			2		
	Wrist	1	2	3	1	2	3
1		1	2	3	1	2	3
2		1	2	3	2	3	4
3		3	4	5	4	5	5
4		4	5	5	5	6	7
5		6	7	8	7	8	8
6		7	8	8	8	9	9

Coupling			
0 - Good	1 - Fair	2 - Poor	3 - Unacceptable
Well-fitted handle with a mid-range power grip	Hand hold acceptable but not ideal or coupling is acceptable via another part of the body	Hand hold not acceptable although possible	Awkward, unsafe grip, no handles. Coupling is unacceptable using other parts of the body

Source: Hignett, S., McAtamney, L. (2000) Applied Ergonomics, 31, 201-5.

REBA: Table C and Activity Score

	Score B											
Score A		1	2	3	4	5	6	7	8	9	10	11
	1	1	1	1	2	3	3	4	5	6	7	7
	2	1	2	2	3	4	4	5	6	6	7	7
	3	2	3	3	3	4	5	6	7	7	8	8
	4	3	4	4	4	5	6	7	8	8	9	9
	5	4	4	4	5	6	7	8	8	9	9	9
	6	6	6	6	7	8	8	9	9	10	10	10
	7	7	7	7	8	9	9	9	10	10	11	11
	8	8	8	8	9	10	10	10	10	10	11	11
	9	9	9	9	10	10	10	11	11	11	12	12
	10	10	10	10	11	11	11	11	12	12	12	12
	11	11	11	11	11	12	12	12	12	12	12	12
	12	12	12	12	12	12	12	12	12	12	12	12

Activity Score		
+1 = 1 or more body parts are static, e.g. held for longer than 1 minute	+1 = repeated small range actions, e.g. repeated more than 4 times per minute (excluding walking)	+1 = action causes rapid large range changes in posture or an unstable base

Source: Hignett, S., McAtamney, L. (2000) Applied Ergonomics, 31, 201-5.

REBA: Action Levels

Action level	REBA score	Risk level	Action (including further assessment)
0	1	Negligible	None necessary
1	2-3	Low	May be necessary
2	4-7	Medium	Necessary
3	8-10	High	Necessary soon
4	11-15	Very high	Necessary NOW

Source: Hignett, S., McAtamney, L. (2000) Applied Ergonomics, 31, 201-5.

Rapid Upper Limb Assessment (RULA) Method

RULA Source: McAtamney, L. and Corlett, E.N. (1993) Applied Ergonomics, 24 (2), 91-9.

What is RULA

- RULA is a quick survey method for use in ergonomic investigations of workplaces where MSDs are reported.
- RULA is a screening tool that assesses biomechanical and postural loading on the whole body.
- RULA focuses on the neck, trunk and upper limbs, and is ideal for sedentary workers e.g. computer workplaces.
- RULA has been validated on groups of computer users and sewing machine operators.
- RULA is quick and easy to complete.
- RULA scores indicate the level of intervention required to reduce MSD risks.
- RULA compliments other ergonomic methods.

1. Observing and selecting the posture(s) to assess

- RULA assesses postural loading at a specific moment in the work cycle. It is important to assess the highest risk posture being adopted. Selecting the appropriate stage of the work cycle for assessment requires some previous observation.

- The highest risk posture for analysis may be chosen based on the duration of the posture (e.g. longest held) or the degree of postural deviation (e.g. worst posture).

- Right or left sides of the body can be assessed independently.

- For long work cycles posture can be assessed at regular intervals.

- When assessments are taken at set intervals over the working period the proportion of time spent in the various postures should also be evaluated.

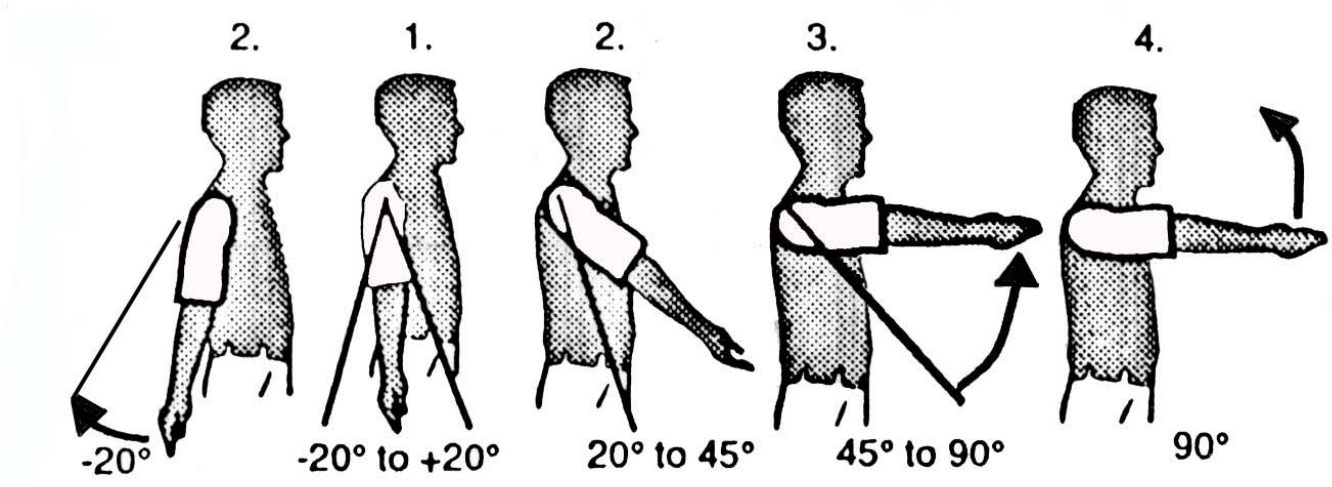
2. Scoring and recording the posture

- Decide on the stage of the work cycle to be assessed
- Decide whether the left, right or both upper arms are to be assessed.
- Score the posture of each body part using the RULA worksheet.
- Review the scoring and make any adjustments if required.
- Use the tables to calculate the grand RULA score.

3. Action Level

- Compare the grand RULA score to the Action Level List to determine the risks.
- Review the body segment scores for any undesirable postural deviations that need correction.
- Review possibilities for further ergonomic actions to improve posture where necessary, and thereby reduce risks.
- If changes are made, evaluate their success by performing additional RULA evaluations.

RULA: Upper Arms



ADD 1 if:

- Shoulder is raised

ADD 1 if:

- Upper arm is abducted

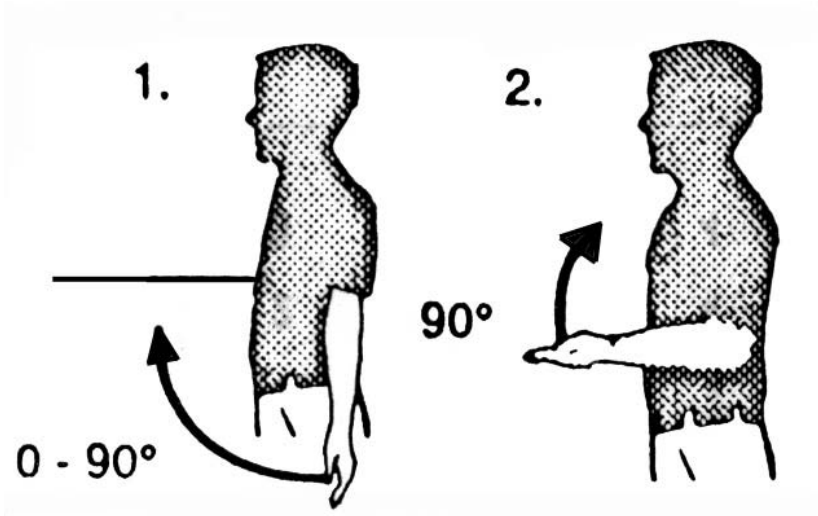
SUBTRACT 1

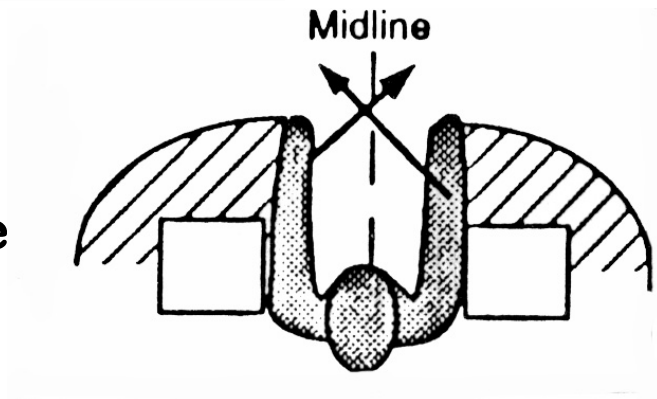
- If leaning or supporting the weight of the arm

RULA Source: McAtamney, L. and Corlett, E.N. (1993) Applied Ergonomics, 24 (2), 91-9.

Graphics source: K. Laeser, 1998, Cornell University

RULA: Lower Arms





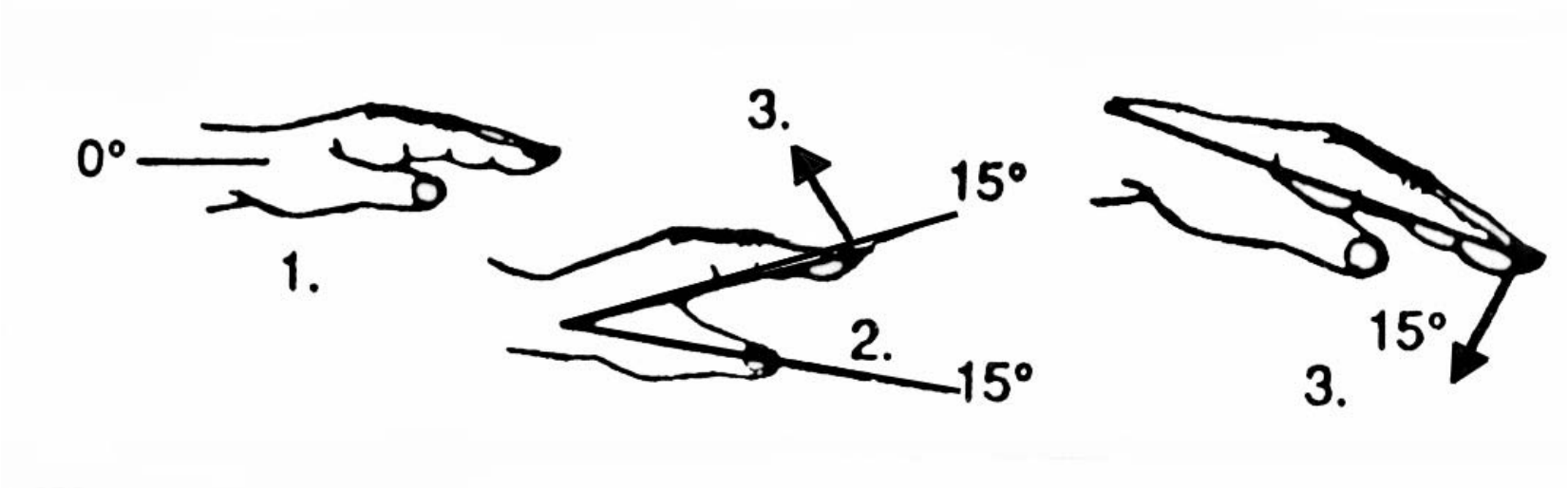
ADD 1 if:

- Working across midline of the body
- Working out to the side the body

RULA Source: McAtamney, L. and Corlett, E.N. (1993) Applied Ergonomics, 24 (2), 91-9.

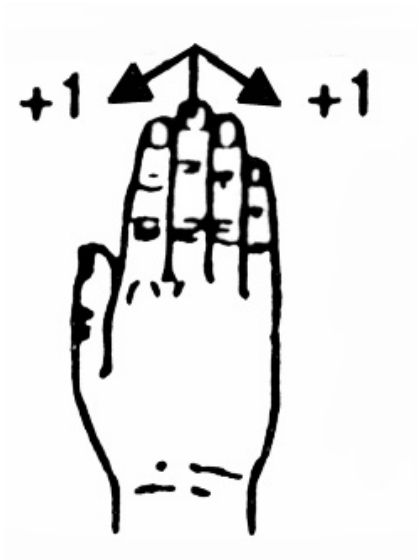
Graphics source: K. Laeser, 1998, Cornell University

RULA: Wrist posture



ADD 1 if:

- Wrist is bent away from midline



RULA Source: McAtamney, L. and Corlett, E.N. (1993) Applied Ergonomics, 24 (2), 91-9.

Graphics source: K. Laeser, 1998, Cornell University

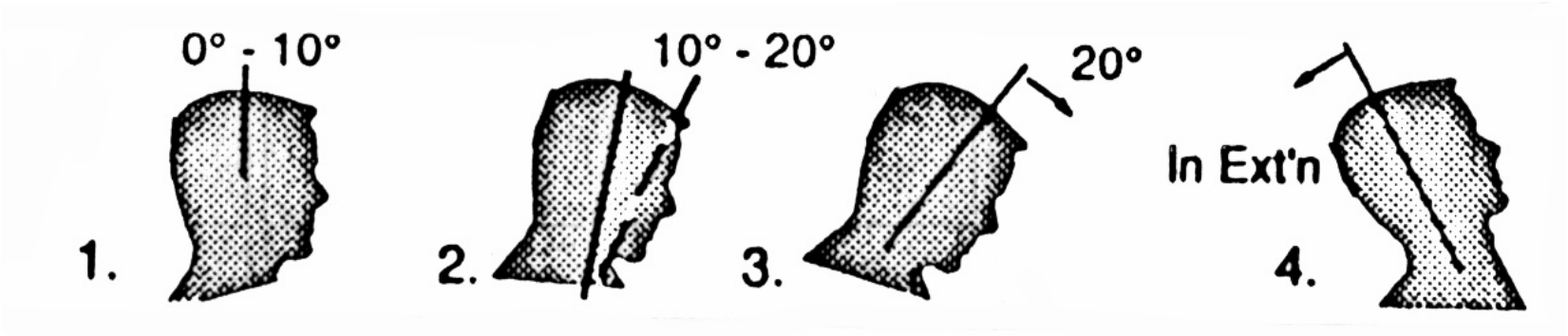
RULA: Wrist Twist

1. Mainly in mid-range of twist

2. At or near end of twisting range

RULA Source: McAtamney, L. and Corlett, E.N. (1993) Applied Ergonomics, 24 (2), 91-9.

RULA: Neck



ADD 1 if:

- **Neck is twisting**

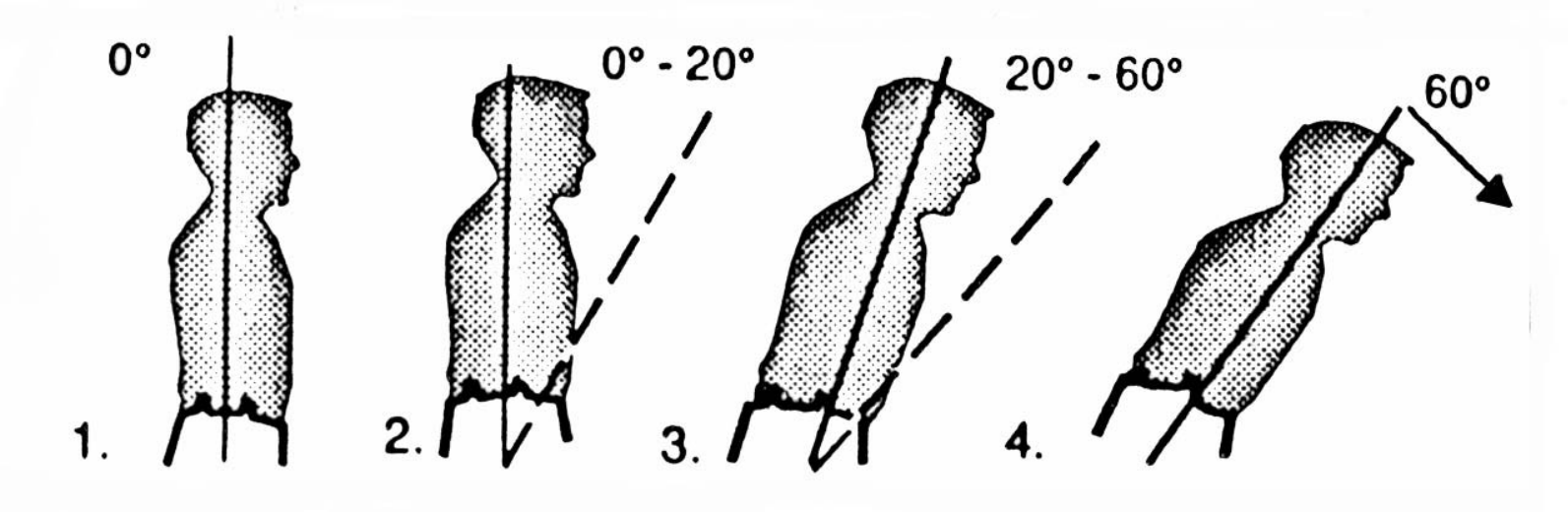
ADD 1 if:

- **Neck is side-bending**

RULA Source: McAtamney, L. and Corlett, E.N. (1993) Applied Ergonomics, 24 (2), 91-9.

Graphics source: K. Laeser, 1998, Cornell University

RULA: Trunk



ADD 1 if:

- **Trunk is twisting**

ADD 1 if:

- **Trunk is side-bending**

RULA Source: McAtamney, L. and Corlett, E.N. (1993) Applied Ergonomics, 24 (2), 91-9.

Graphics source: K. Laeser, 1998, Cornell University

RULA: Legs

1. Legs and feet are well supported and in an evenly balanced posture.

2. Legs and feet are NOT well supported and/or NOT in an evenly balanced posture.

RULA Source: McAtamney, L. and Corlett, E.N. (1993) Applied Ergonomics, 24 (2), 91-9.

RULA: Muscle Use Score

- **RAISE THE SCORE by 1 if the posture is:**
  - **Mainly static, e.g. held for longer than 1 minute**
  - **Repeated more than 4 times per minute**

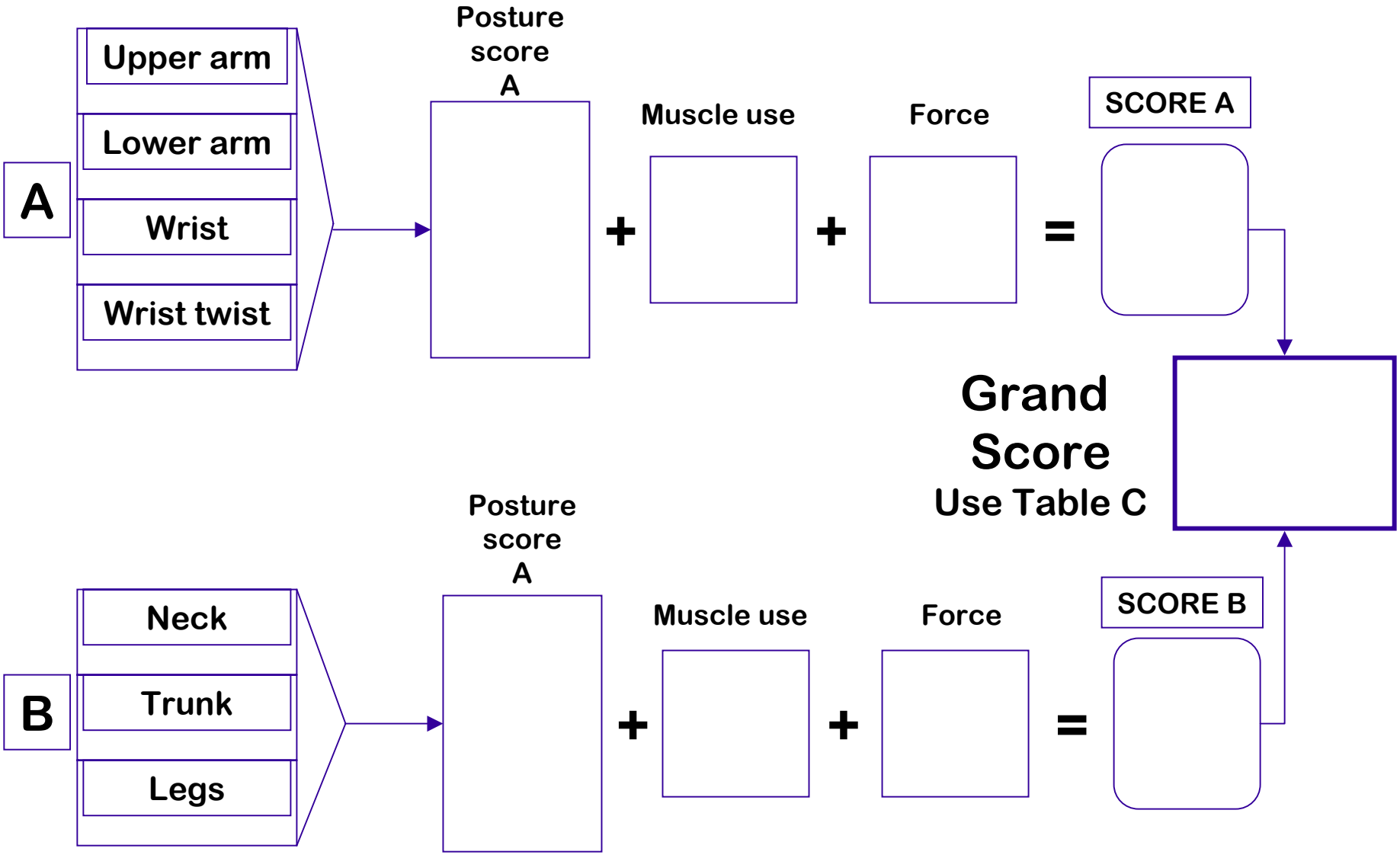
RULA Source: McAtamney, L. and Corlett, E.N. (1993) Applied Ergonomics, 24 (2), 91-9.

RULA: FORCES or LOAD Score

0.	1.	2.	3.
No resistance or less than 5 lb. (2 kg) intermittent load force	5-20 lb (2-10 kg) intermittent load or force	5-20 lb (2-10 kg) static or repeated load or force	More than 20 lb. (10kg) static or repeated loads or forces. Shock or forces with rapid build-up.

RULA Source: McAtamney, L. and Corlett, E.N. (1993) Applied Ergonomics, 24 (2), 91-9.

RULA Score Sheet



RULA Source: McAtamney, L. and Corlett, E.N. (1993) Applied Ergonomics, 24 (2), 91-9.

Graphics source: K. Laeser, 1998, Cornell University

Table A: Upper Limb Posture Score

UPPER ARM	LOWER ARM	WRIST							
		1		2		3		4	
		WRIST TWIST		WRIST TWIST		WRIST TWIST		WRIST TWIST	
		1	2	1	2	1	2	1	2
1	1	1	2	2	2	2	3	3	3
	2	2	2	2	2	3	3	3	3
	3	2	3	2	3	3	3	4	4
2	1	2	2	2	3	3	3	4	4
	2	2	2	2	3	3	3	4	4
	3	2	3	3	3	3	4	4	5
3	1	2	3	3	3	4	4	5	5
	2	2	3	3	3	4	4	5	5
	3	2	3	3	4	4	4	5	5
4	1	3	4	4	4	4	4	5	5
	2	3	4	4	4	4	4	5	5
	3	3	4	4	5	5	5	6	6
5	1	5	5	5	5	5	6	6	7
	2	5	6	6	6	6	7	7	7
	3	6	6	6	7	7	7	7	8
6	1	7	7	7	7	7	8	8	9
	2	7	8	8	8	8	9	9	9
	3	9	9	9	9	9	9	9	9

RULA Source: McAtamney, L. and Corlett, E.N. (1993) Applied Ergonomics, 24 (2), 91-9.

Table B: Neck, Trunk, Legs Posture Score

NECK POSTURE SCORE	TRUNK POSTURE SCORE											
	1		2		3		4		5		6	
	LEGS		LEGS		LEGS		LEGS		LEGS		LEGS	
	1	2	1	2	1	2	1	2	1	2	1	2
1	1	2	1	2	2	3	3	4	4	4	4	4
2	1	2	2	2	3	4	4	5	5	5	5	5
3	2	2	2	3	3	4	4	5	5	5	6	6
4	2	3	2	3	3	4	4	5	5	6	6	6
5	3	4	4	4	4	5	5	6	6	6	6	6

RULA Source: McAtamney, L. and Corlett, E.N. (1993) Applied Ergonomics, 24 (2), 91-9.

Table C: Grand Score Table

TABLE C		FINAL SCORE B (NECK, TRUNK, LEG)						
		1	2	3	4	5	6	7
FINAL SCORE B (UPPER LIMB SCORE)	1	1	2	3	3	4	5	5
	2	2	2	3	4	4	5	5
	3	3	3	3	4	4	5	6
	4	3	3	3	4	5	6	6
	5	4	4	4	5	6	7	7
	6	4	4	5	6	6	7	7
	7	5	5	6	6	7	7	7
	8+	5	5	6	7	7	7	7

Action level	Score	Action
1	1 or 2	Acceptable posture.
2	3 or 4	Further investigation needed; changes may be required.
3	5 or 6	Investigation and changes needed soon.
4	7	Investigation and changes required immediately.

RULA Source: McAtamney, L. and Corlett, E.N. (1993) Applied Ergonomics, 24 (2), 91-9.