

How the Industrial Ergonomics Software Calculates MSD Risk

VelocityEHS Industrial Ergonomics assesses the magnitude of the primary MSD risk factors—**force**, **posture**, **duration**, and **frequency**—to calculate an overall risk priority score for a task being assessed. The Advanced Whole-Body Assessment uses 3D motion capture technology to analyze human body postures, and duration and frequency of those postures, in a video of an operator performing the task. It combines this information with force data to determine the overall risk priority score.

Force, posture, duration, and frequency are scored for each of nine individual body regions based on the thresholds described in the following sections. These scores are added together to provide a score for each **body region (0-11)**.

The body region scores are then added together to produce an overall **risk priority score for the job (0-99)**.


One (1) additional point is added to the overall score if vibration is present, for a **maximum score of 100**.


Advanced Whole-Body Assessment

Switch to Manual Whole-Body Assessment

Advanced Tool Priority Score

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Advanced Tool Assessment

	Hands/Wrists		Elbows		Shoulders		Neck	Back	Legs
	Left	Right	Left	Right	Left	Right			
Score ▲	3	3	5	6	6	8	0	0	0
Force	2	2	3	3	3	3	0	0	0
Posture	1	1	2	2	2	3	0	0	0
Duration	0	0	0	0	0	1	0	0	0
Frequency	0	0	0	1	1	1	0	0	0
Risk Rating	Mod	Mod	High	High	High	Higher	Lower	Lower	Lower

Risk score calculation example in Industrial Ergonomics



Force (Measured)

Each body region (including left and right sides for the upper limbs) receives a **Force** score (0 – 4) based on the highest risk force recorded for the task. Different forces can affect different, and multiple, body regions. For *measured* hand/wrist-only forces (pinch grip, finger press, power grip), if force is present on both sides of the body, the full force value is applied to both hands/wrists. For *measured* elbow/shoulder forces, if force is present on both sides of the body, the force value is divided in half between the left and right sides. **Note:** Metric values are approximate; all metric weight values entered into the software are first converted to pounds (0.45 kg = 1 lb) to determine body region scores and risk levels.

Risk Category	Score	Hands/Wrists	Elbows/Shoulders (Unilateral)	Neck	Back	Legs
High Forces	0	Below thresholds				
	1	Pinch grip ≥ 3 lb (1 kg) Finger press ≥ 3 lb (1 kg) Power grip ≥ 13 lb (6 kg)	Press down ≥ 6 lb (3 kg) Lift/lower ≥ 4 lb (2 kg) Pull across ≥ 3 lb (1 kg) Push out (shoulder) ≥ 7 lb (3 kg) Pull in (elbow) ≥ 7 lb (3 kg) Pull down ≥ 9 lb (4 kg)	PPE ≥ 2 lb (1 kg)	(Stoop or squat) lift/lower (2 hands) ≥ 25 lb (11 kg) Whole-body push/pull (2 hands) ≥ 50 lb (23 kg)	Squat lift/lower (2 hands) ≥ 25 lb (11 kg)
	2	Pinch grip ≥ 5 lb (2 kg) Finger press ≥ 5 lb (2 kg) Power grip ≥ 19 lb (9 kg)	Press down ≥ 10 lb (5 kg) Lift/lower ≥ 6 lb (3 kg) Pull across ≥ 5 lb (2 kg) Push out (shoulder) ≥ 10 lb (5 kg) Pull in (elbow) ≥ 11 lb (5 kg) Pull down ≥ 13 lb (6 kg)	PPE ≥ 4 lb (2 kg)	(Stoop or squat) lift/lower (2 hands) ≥ 33 lb (15 kg) Whole-body push/pull (2 hands) ≥ 57 lb (26 kg)	Squat lift/lower (2 hands) ≥ 33 lb (15 kg)
	3	Pinch grip ≥ 8 lb (4 kg) Finger press ≥ 9 lb (4 kg) Power grip ≥ 32 lb (9 kg)	Press down ≥ 15 lb (7 kg) Lift/lower ≥ 10 lb (5 kg) Pull across ≥ 8 lb (4 kg) Push out (shoulder) ≥ 17 lb (8 kg) Pull in (elbow) ≥ 19 lb (9 kg) Pull down ≥ 22 lb (10 kg)	PPE ≥ 8 lb (4 kg)	(Stoop or squat) lift/lower (2 hands) ≥ 42 lb (19 kg) Whole-body push/pull (2 hands) ≥ 64 lb (29 kg)	Squat lift/lower (2 hands) ≥ 42 lb (19 kg)
	4	Pinch grip ≥ 10 lb (5 kg) Finger press ≥ 11 lb (5 kg) Power grip ≥ 41 lb (19 kg)	Press down ≥ 21 lb (9 kg) Lift/lower ≥ 12 lb (6 kg) Pull across ≥ 11 lb (5 kg) Push out (shoulder) ≥ 22 lb (10 kg) Pull in (elbow) ≥ 24 lb (11 kg) Pull down ≥ 29 lb (13 kg)	PPE ≥ 16 lb (7 kg)	(Stoop or squat) lift/lower (2 hands) ≥ 50 lb (23 kg) Whole-body push/pull (2 hands) ≥ 71 lb (32 kg)	Squat lift/lower (2 hands) ≥ 50 lb (23 kg)



Force (Estimated)

Estimated force values are calculated by combining the Borg Perceived Exertion rating (0 – 10) and Operator Strength capability value (below average, average, or above average). The associated **Force** scores (0 – 4) are determined in the same way as for measured forces.

Risk Category	Score	Estimated Force Thresholds
High Forces	0	Below thresholds
	1	≥ 2.5
	2	≥ 3.5
	3	≥ 4.5
	4	≥ 7

Posture

Each body region (including left and right sides for the upper limbs) receives a **Posture** score (0 – 3), based on the highest risk posture that occurs during the video for that body region.

Risk Category	Score	Hands/Wrists	Elbows*	Shoulders	Neck	Back	Legs
Awkward Postures	1	Any bending $\geq 20^\circ$	Elbow angle (flexion) $> 45^\circ$ to 65°	Shoulder raised (flexion) $\geq 45^\circ$	Forward bend $\geq 25^\circ$	Forward bend (flexion) $\geq 30^\circ$ Backward angle (flexion) $\leq -10^\circ$ Twist (rotation) $\geq 30^\circ$ Lateral bend $\geq 15^\circ$	Knee angle $\geq 45^\circ$
	2	Any bending $\geq 45^\circ$	Elbow angle (flexion) $> 20^\circ$ to $\leq 45^\circ$	Shoulder raised (flexion) $\geq 90^\circ$	Forward bend $\geq 45^\circ$	Forward bend (flexion) $\geq 60^\circ$ Backward angle (flexion) $\leq -15^\circ$ Twist (rotation) $\geq 45^\circ$ Lateral bend $\geq 30^\circ$	Knee angle $\geq 60^\circ$
	3	Any bending $\geq 60^\circ$ to 90°	Elbow angle (flexion) -5° to $\leq 20^\circ$	Shoulder raised (flexion) $\geq 120^\circ$	Forward bend $\geq 65^\circ$ to 80°	Forward bend (flexion) $\geq 90^\circ$ Backward angle (flexion) $\leq -20^\circ$ Twist (rotation) $\geq 90^\circ$ Lateral bend $\geq 45^\circ$	Knee angle $\geq 90^\circ$ to 150°

* Elbow posture is scored only when shoulder angle $> 60^\circ$

Duration

Each body region (including left and right sides for the upper limbs) receives a **Duration** score (0 – 3).

Risk Category	Score	All Body Regions
Long Duration	1	The percent of time in high-risk postures (with scores of 2 or 3) is $\geq 10\%$ of the frames that have data for that body region
	2	$\geq 20\%$
	3	$\geq 30\%$

Frequency

Each body region (including left and right sides for the upper limbs) receives a **Frequency** score (0 – 1).

Risk Category	Score	Hands/Wrists	All Other Body Regions
High Frequency	1	More than 30 occurrences/minute (average) of any <i>combination</i> of postures scored 1 or higher	More than 3 occurrences/minute (average) of any <i>combination</i> of postures scored 1 or higher