

# 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 Tool Priority Score |                |                     |                 |               |
|------------------------------|----------------|---------------------|-----------------|---------------|
| Lower<br>0 - 9               | Low<br>10 - 19 | Moderate<br>20 - 29 | High<br>30 - 49 | Higher<br>50+ |


| Body Area Score |          |               |               |              |
|-----------------|----------|---------------|---------------|--------------|
| Lower<br>0 - 1  | Low<br>2 | Moderate<br>3 | High<br>4 - 6 | Higher<br>7+ |


Score key

Advanced Whole-Body Assessment
[Switch to Manual Whole-Body Assessment](#)

Advanced Tool Priority Score

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|             | Hands/Wrists |       | Elbows |        | Shoulders |        | Neck  | Back | Legs  |
|-------------|--------------|-------|--------|--------|-----------|--------|-------|------|-------|
|             | Left         | Right | Left   | Right  | Left      | Right  |       |      |       |
| Score ▲     | 3            | 3     | 6      | 7      | 7         | 9      | 0     | 2    | 0     |
| Force       | 2            | 2     | 4      | 4      | 4         | 4      | 0     | 2    | 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   | Higher | Higher    | Higher | Lower | Low  | 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)<br>Finger press ≥ 3 lb (1 kg)<br>Power grip ≥ 13 lb (6 kg)*    | Press down ≥ 6 lb (3 kg)<br>Lift/lower ≥ 4 lb (2 kg)<br>Pull across ≥ 3 lb (1 kg)<br>Push out (shoulder) ≥ 7 lb (3 kg)<br>Pull in (elbow) ≥ 7 lb (3 kg)<br>Pull down ≥ 9 lb (4 kg)          | PPE ≥ 2 lb (1 kg)  | (Stoop or squat) lift/lower (2 hands) ≥ 25 lb (11 kg)<br>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)<br>Finger press ≥ 5 lb (2 kg)<br>Power grip ≥ 19 lb (9 kg)*    | Press down ≥ 10 lb (5 kg)<br>Lift/lower ≥ 6 lb (3 kg)<br>Pull across ≥ 5 lb (2 kg)<br>Push out (shoulder) ≥ 10 lb (5 kg)<br>Pull in (elbow) ≥ 11 lb (5 kg)<br>Pull down ≥ 13 lb (6 kg)      | PPE ≥ 4 lb (2 kg)  | (Stoop or squat) lift/lower (2 hands) ≥ 33 lb (15 kg)<br>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)<br>Finger press ≥ 9 lb (4 kg)<br>Power grip ≥ 32 lb (14 kg)*   | Press down ≥ 15 lb (7 kg)<br>Lift/lower ≥ 10 lb (5 kg)<br>Pull across ≥ 8 lb (4 kg)<br>Push out (shoulder) ≥ 17 lb (8 kg)<br>Pull in (elbow) ≥ 19 lb (9 kg)<br>Pull down ≥ 22 lb (10 kg)    | PPE ≥ 8 lb (4 kg)  | (Stoop or squat) lift/lower (2 hands) ≥ 42 lb (19 kg)<br>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)<br>Finger press ≥ 11 lb (5 kg)<br>Power grip ≥ 41 lb (19 kg)* | Press down ≥ 21 lb (9 kg)<br>Lift/lower ≥ 12 lb (6 kg)<br>Pull across ≥ 11 lb (5 kg)<br>Push out (shoulder) ≥ 22 lb (10 kg)<br>Pull in (elbow) ≥ 24 lb (11 kg)<br>Pull down ≥ 29 lb (13 kg) | PPE ≥ 16 lb (7 kg) | (Stoop or squat) lift/lower (2 hands) ≥ 50 lb (23 kg)<br>Whole-body push/pull (2 hands) ≥ 71 lb (32 kg) | Squat lift/lower (2 hands) ≥ 50 lb (23 kg) |

\* For any unilateral lift/lower, pull across, pull in, or pull down force ≥ 13 lb (6 kg), a power grip is assumed, and a force score is applied to the hands/wrists according to the power grip thresholds. Example: For a right-hand pull in force of 15 lb (7 kg), power grip force of ≥ 13 lb (6 kg) is assumed, resulting in a force score of 1 for the right hand/wrist.

## 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, right sides for 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 | 0     | Below thresholds         |                                      |                                  |                           |  |   |
|                  | 1     | Any bending ≥ 20°        | Elbow angle (flexion) > 45° to 65°   | Shoulder raised (flexion) ≥ 45°  | Forward bend ≥ 25°        | Forward bend (flexion) ≥ 30°<br>Backward angle (flexion) ≤ -10°<br>Backward angle (flexion), seated jobs only ≥ -15°<br>Twist (rotation) ≥ 30°<br>Lateral bend ≥ 15° | Knee angle ≥ 45°<br>Knee angle, seated jobs only ≥ 95°  |
|                  | 2     | Any bending ≥ 45°        | Elbow angle (flexion) > 20° to ≤ 45° | Shoulder raised (flexion) ≥ 90°  | Forward bend ≥ 45°        | Forward bend (flexion) ≥ 60°<br>Backward angle (flexion) ≤ -15°<br>Backward angle (flexion), seated jobs only ≥ -40°<br>Twist (rotation) ≥ 45°<br>Lateral bend ≥ 30° | Knee angle ≥ 60°<br>Knee angle, seated jobs only ≥ 105° |
|                  | 3     | Any bending ≥ 60° to 90° | Elbow angle (flexion) -5° to ≤ 20°   | Shoulder raised (flexion) ≥ 120° | Forward bend ≥ 65° to 80° | Forward bend (flexion) ≥ 90°<br>Backward angle (flexion) ≤ -20°<br>Backward angle (flexion), seated jobs only ≥ -60°<br>Twist (rotation) ≥ 90°<br>Lateral bend ≥ 45° | Knee angle ≥ 90° to 150°                                |

\* Elbow posture is scored only when shoulder angle > 60°

## 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 | 0     | Below thresholds  |
|               | 1     | The percent of time in <b>high-risk postures (with scores of 2 or 3)</b> 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 | 0     | Below thresholds   |   |
|                | 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 |