Chapter 14 – Ergonomics

Introduction

1. General

This chapter is intended to provide a general overview and assist the Industrial Hygienist (IH) with evaluating, documenting, and controlling ergonomic hazards. Ergonomics is the science of fitting the workplace to the worker to prevent injuries and improve productivity. When there is a mismatch between the physical requirements of a job and the physical capacity of the worker, it can lead to ergonomic hazards. This chapter aims to present effective methods to evaluate and control ergonomic hazards by utilizing assessment tools and surveys. Many of these tools can be found in DOEHRS-IH.

2. Definitions

a. **Ergonomic Risk Factors:** Ergonomic hazards are results of exposures to these common types of ergonomic risk factors which include but are not limited to:
b. **Awkward or Static Postures:** Holding the body in a position that deviates significantly from a natural posture for an extended period. This includes twisting, reaching, pulling, lifting, and bending.
c. **Repetitive Motion:** Performing the same movements repeatedly over a prolonged period, leading to muscle fatigue and potential nerve damage.
d. **Forceful Exertions:** The need to use excessive effort for tasks such as lifting, pushing, pulling, or gripping objects.
e. **Contact Stress:** Occurs when a part of the body, like knees or wrists, repeatedly touches or rubs against a hard or sharp surface.
f. **Vibration:** Exposure to vibration from power tools or heavy equipment.
g. **Extreme Temperatures:** Working in environments that are excessively hot or cold can increase fatigue and reduce blood flow, heightening injury risk.
h. **Poorly Designed Workstations and Equipment:** Workspaces, chairs, and tools that are not adapted to the ergonomic needs of employees can force them into uncomfortable and harmful positions.

3. Ergonomic Assessment Protocol

An ergonomic assessment protocol is a structured, multi-step process designed to identify, analyze, and mitigate workplace risk factors (such as awkward postures, excessive force, and high repetition) to prevent musculoskeletal disorders (MSDs). Effective protocols involve reviewing injury data, observing employee tasks, conducting physical measurements of workstations, and implementing ergonomic controls.

Key Components of an Ergonomic Assessment Protocol

a. Data Review and Preparation**.** Analyze existing incident reports, first aid logs, and worker compensation claims to identify high-risk areas or departments.

b. Initial Screening/Observation. Conduct a 10–15-minute walk-through to observe employee posture, movement, and interaction with equipment.
c. Physical Measurements and Assessment. Use tools like checklists or, for high-risk, specialized biomechanical modeling to measure workstation heights, reaching distances, and screen positions.
d. Employee Feedback. Engage employees directly to understand discomfort, pain points, and task-specific challenges.
e. Implementation of Controls. Apply ergonomic improvements based on the hierarchy of controls (engineering controls, administrative, PPE).
f. Monitoring and Review. Regularly reassess to ensure improvements are effective and that new risks haven't been introduced.

4. Ergonomic Assessment Tools and Surveys

Ergonomic assessment tools are essential for identifying, evaluating, and prioritizing ergonomic risks to create a safer work environment. These tools can be broadly categorized into qualitative and quantitative methods. Some tools can use both methods to assess a work environment.

a. **Qualitative Tools (Checklists and Screening Tools)** These tools are designed for initial hazard identification and are generally simpler to use with minimal training. They are effective for quickly screening the workplace to prioritize more in-depth analysis.
b. **Quantitative Tools (Objective Assessment Tools)** These are more popular and comprehensive tools that provide a detailed and objective evaluation of specific risk factors. They are particularly useful for analyzing high-risk tasks and for designing workplace improvements. Some examples of tools include but are not limited to the Quick Exposure Checklist, Rapid Entire Body Assessment, The Rapid Upper Limb Assessment, NIOSH Lifting Equation, ACGIH Hand Activity, and Illumination Survey Assessment.

5. Quick Exposure Check (QEC)

This Quick Exposure Checklist QEC is an observational tool used by health and safety practitioners to assess workers' exposure to risk factors for work-related musculoskeletal disorders (WMSDs). It is designed to be a quick, simple, and reliable method for identifying potential problems and evaluating the effectiveness of ergonomic interventions.

a. **Using the QEC** requires the following:
   (1) **Participatory Approach** The assessment involves two parts: an observer (e.g., an OSH practitioner) evaluates the worker's postures and movements, and the worker provides subjective feedback on factors like perceived load, stress, and work pace.
   (2) **Focus Areas** The QEC assesses exposure to four main body areas at risk of WMSDs: the back, shoulder/arm, wrist/hand, and neck.
   (3) **Risk Factors Assessed** Beyond physical postures and movements, the QEC considers other factors that contribute to WMSDs, including:
      (a) Maximum weight handled and hand force exertion

(b) Task duration and work pace
(c) Whole-body (e.g., from driving) and hand/arm vibration
(d) Visual demands of the task
(e) Job stress levels

(4) **Scoring System** The observer and worker responses are combined using a scoring matrix to generate exposure scores for each body area. These scores are categorized into four exposure levels: low, moderate, high, and very high.

(5) **Actionable Results** The resulting scores help prioritize areas for intervention. A higher score indicates a greater risk, prompting investigation and the implementation of ergonomic changes.

b. **How QEC Works**

(1) Identify the task(s) that need assessment.
(2) Observe the worker performing the task, focusing on "worst-case" scenarios for posture and movement.
(3) Complete the observer portion of the checklist.
(4) Ask the worker to answer the questions in the worker assessment section.
(5) Score the assessment using the provided QEC guide; see reference (14-1) or a digital calculator.
(6) Interpret the scores to determine the required actions or interventions.
(7) Reassess after implementing changes to evaluate their effectiveness.

QEC was adapted using the Robins Centre for Health Ergonomics Quick Exposure Checklist. QEC assesses the exposure of the four body areas at greatest risk to the most important risk factors for WMSDs. QEC allows physical work activities to be assessed in collaboration with the worker. QEC generates exposure scores for body areas and other factors as seen in **Appendix A**.

c. **QEC Scoring and Action Levels** Exposure scores are available in the QEC reference guide. The overall score for body areas should be compared to **Table 2**. For Moderate, High and Very High scores, the level of exposure should be reduced.

Table 2

Exposure level				
Score	**Low**	**Moderate**	**High**	**Very High**
Back (static)	8-15	16-22	23-29	29-40
Back (moving)	10-20	21-30	31-40	41-56
Shoulder/arm	10-20	21-30	31-40	41-56
Wrist/hand	10-20	21-30	31-40	41-56
Neck	4-6	8-10	12-14	16-18

The overall score for other factors should be compared to **Table 3**. For Moderate, High and Very High scores, the level of exposure should be reduced.

Table 3

Exposure level				
Score	**Low**	**Moderate**	**High**	**Very High**
Driving	1	4	9	-
Vibration	1	4	9	-
Work pace	1	4	9	-
Stress	1	4	9	16

6. Rapid Entire Body Assessment (REBA)

The REBA is an ergonomic tool that quickly assesses a worker's posture and movements during a task to identify the risk of musculoskeletal disorders (MSDs), assigning scores to body parts like the neck, trunk, arms, wrists, legs, and grip/force, then combining them into a final risk level (from negligible to very high) that indicates how urgently changes are needed to prevent injury. It uses simple worksheets or calculators, analyzing posture angles and adjustments for muscle activity, force, repetition, and coupling to guide workplace improvements. See reference 14-2 for a comprehensive review of REBA applications.

a. **How REBA Works**

(1) Observation & Task Selection. The assessor observes a worker performing a task, focusing on the most awkward postures or repetitive/forceful movements.

(2) Body Grouping. The body is split into two groups: Group A (neck, trunk, legs) and Group B (arms, forearms, wrists).

(3) Posture Scoring (Tables). Scores are assigned to the angles of the neck, trunk, upper arm, forearm, and wrist, considering bending, twisting, and side bending.

(4) Adjustment Factors. Scores are adjusted based on: Load/Force: Weight of objects handled.

(a) Grip/Coupling. Quality of hand-object interaction.

(b) Activity/Repetition. How often the movement occurs and if it's static or dynamic.

(5) Final Score Calculation. Scores for Group A and Group B are combined with adjustments to get a final REBA score, often using tables or a digital calculator

(6) Action Levels. The final score corresponds to an action level, from Level 1 (negligible risk, no action) to Level 4 (very high risk, immediate change needed).

b. REBA Scoring and Action Levels

Final Scoring	Risk/Recommendations
1	Negligible Risk. No change
2-3	Low Risk. Change may be needed.
4-7	Medium Risk. Further investigation. Change soon
8-10	High Risk. Investigate and implement change
11+	Very High Risk. Implement change

7. The Rapid Upper Limb Assessment (RULA)

The Rapid Upper Limb Assessment (RULA) is an ergonomic screening tool used to evaluate the postural and biomechanical stress placed on a worker's body, primarily focusing on the neck, trunk, and upper extremities (shoulders, arms, wrists, hands). It provides a quick and systematic method to identify potential risks of work-related musculoskeletal disorders and prioritize interventions. A RULA assessment divides the body into two main groups, each with its own scoring system:

(1) Group A (Arm and Wrist Analysis) Evaluates the position of the upper arm, lower arm, wrist, and wrist twist.

(2) Group B (Neck, Trunk, and Leg Analysis) Assesses the position of the neck, trunk, and legs.

a. **How RULA works** After scoring each body part's angle or position, adjustment scores for muscle use (static posture or repetitive action) and force/load are added. These scores are then compiled using lookup tables on the worksheet to generate a single final RULA score, ranging from 1 to 7.

b. **RULA Scoring and Action Levels** The final RULA score determines the level of risk and the urgency of intervention required:

Score	Action Level	Level of Risk	Indication for Action
1-2	Level 1	Negligible	Posture is acceptable if not maintained or repeated for long periods; no action needed.
3-4	Level 2	Low	Further investigation is needed, and changes may be required in the near future.

c. **Application and Limitations** RULA is a widely used and validated tool, particularly effective for tasks involving the upper body and static or repetitive motions, such as computer work, assembly line tasks, or laboratory work.

However, it has limitations: It primarily assesses posture at a single "snapshot" in time, so multiple assessments may be needed for varied tasks. It does not adequately consider the duration of a task, available recovery time, or whole-body movements (for which the REBA method, or Rapid Entire Body Assessment, might be more appropriate). It requires separate assessments for the left and right sides of the body. Reference (14-3) provides a comprehensive review of RULA.

8. The Revised NIOSH Lifting Equation (RNLE)

The RNLE created by National Institute for Occupational Safety and Health (NIOSH) is a mathematical model used by occupational health and safety professionals to evaluate the physical stresses associated with lifting and lowering tasks. Per reference (14-4), it helps determine a Recommended Weight Limit (RWL) for a specific task and a Lifting Index (LI) to assess the level of risk.

a. **How RNLE works** The RWL is calculated using a load constant (LC) of 51 pounds (representing ideal conditions) and six multipliers that account for specific task variables:
(1) H = Horizontal location of the object relative to the body.
(2) V = Vertical location of the object relative to the floor.
(3) D = Vertical distance the object is moved.
(4) A = Asymmetry angle or twisting requirement.
(5) F = Frequency and duration of lifting activity.
(6) C = Coupling or quality of the worker's grip on the object.

b. **RNLE Scoring and Action Levels** The Lifting Index (LI) is the ratio of the actual load weight to the calculated RWL. An LI of 1.0 or less is generally considered safe for most healthy workers, while a value greater than 1.0 indicates a higher risk of injury and the need for ergonomic redesign.

9. ACGIH Hand Activity

The ACGIH Hand Activity refers to the American Conference of Governmental Industrial Hygienists' Threshold Limit Value (TLV®) for Hand Activity. This is a widely used occupational health guideline to assess the risk of developing WMSDs, such as carpal tunnel syndrome, in the hand and wrist due to repetitive, forceful tasks. The TLV is a guideline intended to represent conditions under which nearly all workers may be repeatedly exposed without adverse health effects. Exceeding the limits indicates an elevated risk of WMSDs, prompting the need for control measures (e.g., engineering or administrative controls) to reduce exposure.

a. **How Hand Activity Level Works**
(1) Assessment considers two main factors for mono-task jobs performed for four or more hours daily:
(a) Hand Activity Level (HAL). A measure of the frequency and duration of hand exertions on a scale of 0 to 10. It can be estimated through observational methods, lookup tables, or video analysis.
(b) Normalized Peak Force (NPF). An estimate of the maximum effort or force required for a task, typically rated using the Borg CR-10 scale or other subjective assessments.

b. **Hand Activity Scoring and Action Levels** The ACGIH TLV Guide uses a graph (or associated equations) that plots NPF against HAL to determine if a job's exposure level is below the Action Limit (AL), between the AL and the TLV, or above the TLV.
(1) Below AL (Green Zone). Moderate risk, generally acceptable.
(2) Between AL and TLV (Yellow Zone). Increased monitoring or surveillance is recommended.
(3) Above TLV (Red Zone). Risk is high, and interventions are necessary to reduce exposure.

10. Illumination Survey Assessment

Illumination survey measurements primarily involve measuring illuminance (light falling on a surface) and luminance (light reflected or emitted from a surface) to ensure a space is appropriately lit for its intended use. These measurements use specific units and equipment and must follow standardized procedures. For specific task illumination requirements, see reference (14-6). Reference (14-7) provides more comprehensive information.

a. **Key Measurement Metrics.**

Metric	Unit (SI/Metric)	Unit (Imperial)	Description	Tool Used
Illuminance	Lux (lx) (lumens/m²)	Foot-candle (fc) (lumens/ft²)	The amount of light that falls on the surface. This is the most common measurement in general surveys.	Lux meter / Illuminance meter
Luminance	Candela/m² (cd/m²)	Foot-lambert (fL)	The brightness of a surface as perceived by the human eye; light emitted or reflected from a surface.	Luminance meter
Luminous Flux	Lumen (lm)		The total amount of visible light emitted by a source.	
Luminous Intensity	Candela (cd)		The luminous intensity in a specific direction.	

b. **How to Perform Illumination Surveys.**

(1) Preparation. Ensure the artificial lighting system has been on long enough to stabilize its output. Block any daylight to measure the artificial light levels accurately.

(2) Define Measurement Points. Divide the area into a grid pattern. Measurements should not be taken too close to walls or obstructions (typically within 0.5m).

(3) Take Readings.

(a) Use a light meter (lux meter) with its sensor placed flat on the work surface, typically at desk height (around 0.75m from the floor).

(b) The person taking the measurement must avoid blocking light from reaching the sensor.

(c) Allow the reading on the meter to stabilize before recording.

(4) Record Data. Document the measured values, along with other relevant information like the date, time, location, lighting fixture details, and the task performed in the area.

c. **Illumination Scoring and Action Levels Analysis.** Calculate the average illuminance and uniformity of light distribution. Compare the results with recommended lux levels for the specific activity or environment to ensure adequacy and compliance with safety regulations or standards.

11. Hand-Arm Vibration (HAV) and Whole-Body Vibration (WBV)

1. General

A HAV and WBV survey and assessment is a process used to identify, measure, and evaluate employee exposure to mechanical vibration in the workplace to prevent health issues like Hand-Arm Vibration Syndrome (HAVS) and back pain. Review the Human Vibration Guide for more comprehensive information on health effects, measurement procedures, and control methods (reference 14-9).

2. Definitions

a. Hand-Arm Vibration (HAV): Vibration transmitted from work processes or equipment into an operator's hands and arms, often from using power tools. Prolonged exposure can lead to HAVS, which causes permanent damage to the vascular, neurological, and musculoskeletal systems.

b. Whole-Body Vibration (WBV): Vibration transmitted through the seat or feet of workers operating mobile machinery or vehicles, especially over rough surfaces. This type of exposure is associated with health risks including back pain and spinal problems.

See reference (14-9) for more comprehensive information on vibration.

3. Assessment Process

A vibration assessment is conducted to quantify employee exposure to HAV or WBV. The assessment involves the following steps:

a. Hazard Identification: Identifying which operations, tools (e.g., power tools for HAV), or vehicles (e.g., forklift trucks, dozers for WBV) might expose workers to significant vibration.

b. Exposure Measurement and Assessment:

(1) Using calibrated specialized equipment, such as triaxial accelerometers, measure the vibration levels (magnitude) at the point of contact (tool handle or vehicle seat).

(2) Determine the total daily duration of exposure (e.g., trigger time, etc.) for each task

(3) Calculate the daily 8-hour time-weighted average exposure value, A(8), expressed in meters per second squared (m/s^2). Detailed calculation procedures are found in the Human Vibration Guide (Reference 14-9). Comparison with Standards: The calculated A(8) exposure shall be compared to the OELs specified in Section XX of this chapter.

4. Vibration Assessment Records

As a minimum, vibration assessment records must be documented on a vibration sample survey (see reference 14-8) and be maintained in DOEHRS-IH.

a. Identification of the tool, vehicle, or process being assessed.

b. Identification of personnel or Similar Exposure Group (SEG) evaluated.

c. Type, model, and serial number of measurement equipment and calibrator.

d. Measurement location (e.g., tool handle, seat pad) and axis orientation.

e. The measured vibration magnitude and the total daily exposure duration ("trigger time").

f. The calculated 8-hour TWA exposure, A(8).

g. Name and signature of the person(s) who performed the survey.

5. Vibration Criterion Levels

The requirement to implement control measures is based on the following criteria.

a. Hand-Arm Vibration OELs.

Risk Level	8 Hour OELs A(8)	Required Action
Low	< 2.5 m/s^2	No action required.
Moderate	2.5 m/s^2 to < 5.0 m/s^2	Exposure meets or exceeds the action level. Implement controls to reduce exposure. Medical surveillance required if exposed for 30 days or more per year.
High	≥ 5.0 m/s^2	Exposure meets or exceeds the OEL. Implement controls to reduce exposure below the OEL. Medical surveillance required if overexposed for 30 days or more per year.

a. Whole-Body Vibration OELs.

Risk Level	8 Hour Daily Exposure Limits A(8)	24 Hour Daily Exposure Limits A(8)	Required Action
Low	< 0.43 m/s	< 0.25 m/s	No action required.
Moderate	0.43 m/s^2 to < 0.87 m/s^2	0.25 m/s^2 to < 0.5 m/s^2	Exposure meets or exceeds the action level. Implement controls to reduce exposure. Medical surveillance required if exposed for 30 days or more per year.
High	≥ 0.87 m/s	≥ 0.5 m/s	Exposure meets or exceeds the OEL. Implement controls to reduce exposure below the OEL. Medical surveillance required if overexposed for 30 days or more per year.

6. Control Measures

When AL is met or exceeded, controls shall be implemented using the hierarchy of controls. The *Human Vibration Guide* shall be consulted for detailed examples of control strategies.

a. **Engineering Controls (Primary)**. Select low-vibration tools; install vibration-damping seats and mounts.

b. **Administrative Controls.** Limit daily exposure time through work-rest schedules or job rotation. Implement a "buy quiet/buy smooth" purchasing policy.

c. **Personal Protective Equipment (PPE).** Use of certified anti-vibration gloves (for HAV) may provide limited benefit and shall not be used as a substitute for engineering or administrative controls.

12. Ergonomic Corrective Actions

The preferred priority for corrective actions of ergonomic risk factors is listed in the following order:

(a) Eliminate the hazard.
(b) Substitute materials, tools, or equipment.
(c) Engineering controls (e.g. entail redesign of workstations, work methods, and tools to reduce the potential for injury).
(d) Improve work practices.
(e) Administrative controls, (e.g., lifting restrictions, rotating employees to jobs with dissimilar physical requirements, establishing work and rest schedules, and training employees to use appropriate work methods).
(f) Personal protective equipment (PPE)
NOTE: When implementing corrective actions to control ergonomic risk factors ensure that safety hazards are not introduced as a substitute. (e.g. acquiring anti-fatigue mats for welders that are not spark resistant). Seek alternative ergonomic controls when safety hazards arise from installing ergonomic corrective actions.

13. References

14-1. Quick Exposure Checklist (QEC)

14-2. Rapid Entire Body Assessment

14-3. Rapid Upper Limb Assessment

14-4. Revised NIOSH Lifting Equation

14-5. ACGIH Hand Activity

14-6. Department of Defense Design Criteria Standard Human Engineering, MIL-STD-1472 Series

14-7. Human Factors Engineering of Computer Workstations, ANSI/HFES 100 Series

14-8. Vibration Sample Survey

14-9. Human Vibration Guide

Appendix A

QEC Observer Assessment
Table 14A-1

Assessor	Body Region/Hazard	Question (Job Factor)	Answer (Code)
Observer	**Back**	A. When performing the task, is the back (select worse case situation):	Almost neutral? (A1) Moderately flexed or twisted or side bent? (A2) Excessively flexed or twisted or side bent? (A3)
	Back Static	B. For seated or standing stationary tasks. Does the back remain in a static position most of the time?	No (B1) Yes (B2)
	Back Dynamic	B. For lifting, pushing/pulling and carrying tasks (i.e. moving a load). Is the movement of the back:	Infrequent (around 3 times per minute or less)? (B3) Frequent (around 8 times per minute)? (B4) Very frequent (around 12 times per minute or more)? (B5)
	Shoulder/Arm	C. When the task is performed, are the hands (select worse case situation):	At or below waist height? (C1) At about chest height? (C2) At or above shoulder height? (C3)
	Shoulder/Arm	D. Is the shoulder/arm movement:	Infrequent (some intermittent movement)? (D1) Frequent (regular movement with some pauses)? (D2) Very frequent (almost continuous movement)? (D3)
	Wrist/Hand	E. Is the task performed with (select worse case situation):	An almost straight wrist? (E1) A deviated or bent wrist? (E2)
	Wrist/Hand	F. Are similar motion patterns repeated:	10 times per minute or less? (F1) 11 to 20 times per minute? (F2) More than 20 times per minute? (F3)
	Neck	G. When performing the task, is the head/neck bent or twisted?	No (G1) Yes, occasionally (G2) Yes, continuously (G3)

QEC Worker Assessment
Table 14A-2

Assessor	Body Region/ Hazard	Question (Job Factor)	Answer (Code)
Worker	**Weight**	H. Is the maximum weight handled MANUALLY BY YOU in this task?	Light (5 kg or less/10 lbs. or less) (H1) Moderate (6 to 10 kg/11 to 20 lbs.) (H2) Heavy (11 to 20 kg/21 to 45 lbs.) (H3) Very heavy (more than 20 kg/more than 45 lbs.) (H4)
	Duration	J. On average, how much time do you spend per day on this task?	Less than 2 hours (J1) 2 to 4 hours (J2) More than 4 hours (J3)
	Force	K. When performing this task, is the maximum force level exerted by one hand?	Low (e.g. less than 1 kg/less than 2 lbs.) (K1) Medium (e.g. 1 to 4 kg/2 to 10 lbs.) (K2) High (e.g. more than 4 kg/more than 10 lbs.) (K3)
	Visual Demand	L. Is the visual demand of this task:	Low (almost no need to view fine details)? (L1) High (need to view some fine details)? (L2)
	Whole Body Vibration (WBV)	M. At work do you drive/ride in a moving vehicle (any/all vehicles, including any aircraft) for:	Less than one hour per day or Never? (M1) Between 1 and 4 hours per day? (M2) More than 4 hours per day? (M3)
	Hand/Arm Vibration (HAV)	N1. At work do you fire weapons or munitions for:	Less than one hour per day or Never? (N1-1) Between 1 and 4 hours per day? (N1-2) More than 4 hours per day? (N1-3)
	Hand/Arm Vibration (HAV)	N2. At work do you use impact wrenches, carpet strippers, chain saws, percussive tools (jack hammers, scalers, riveting or chipping hammers) or other hand tools that typically have high vibration levels?	Not at all? (N2-1) Less than or equal to 30 mins total per day? (N2-2) More than 30 mins total per day? (N2-3)
	Hand/Arm Vibration (HAV)	N3. At work do you use grinders, sanders, jig saws or other hand tools that typically have moderate vibration levels?	Not at all? (N3-1) Less than or equal to 2 hrs. total per day? (N3-2) More than 2 hrs. total per day? (N3-3)
	Work Pace	P. Do you have difficulty keeping up with this work?	Never (P1) Sometimes (P2) Often (P3)
	Stress	Q. In general, how do you find this job:	Not at all stressful? (Q1) Mildly stressful? (Q2) Moderately stressful? (Q3) Very stressful? (Q4)
	Contact Stress	R. At work, do you have any prolonged body contact with hard surfaces or edges, or surfaces that are cold?	Less than one hour per day or Never? (R1) Between 1 and 4 hours per day? (R2) More than 4 hours per day? (R3)
	Impact/Jolt/ Jarring (WBV)	S1. At work do you use vehicles that cause repeated jolts or impact forces (examples: ATVs, Rhib boats, UTVs) for:	Less than one hour per day or Never? (S1-1) Between 1 and 4 hours per day? (S1-2) More than 4 hours per day? (S1-3)
	Impact/Jolt/ Jarring (HAV)	S2. At work do you use tools that cause repeated jolts or impact forces (cartridge hammers, bucking bars, road breakers) for:	Less than one hour per day or Never? (S2-1) Between 1 and 4 hours per day? (S2-2) More than 4 hours per day? (S2-3)
	Energy Expenditure	T. Please rate your perceived exertion from 1-10 while completing this task.	Common Scale of 1 through 4 (T1) Common Scale of 5 through 7 (T2) Common Scale of 8 through 10 (T3)