



**UNIVERSITI TUN HUSSEIN ONN MALAYSIA**

**FINAL EXAMINATION  
SEMESTER II  
SESSION 2023/2024**

- COURSE NAME : HUMAN FACTOR ENGINEERING
- COURSE CODE : BDD 41103
- PROGRAMME CODE : BDD
- EXAMINATION DATE : JULY 2024
- DURATION : 3 HOURS
- INSTRUCTION : 1. ANSWER ALL QUESTIONS  
2. THIS FINAL EXAMINATION IS CONDUCTED VIA  
 Open book  
 Closed book  
3. STUDENTS ARE **PROHIBITED** TO CONSULT THEIR OWN MATERIAL OR ANY EXTERNAL RESOURCES DURING THE EXAMINATION CONDUCTED VIA CLOSED BOOK

THIS PAPER CONSISTS OF **THIRTEEN (13)** PAGES

**PART A. Multiple Choice Questions (MCQ):** Answer all multiple-choice questions (MCQ) and mark one box only (either a/b/c/d) to indicate the correct answer you consider correct for each question. There are 30 questions in a question paper, each if the question carrying 2 marks (**60 marks**).

- Q1** Ergonomics is primarily concerned with:
- (a) The study of animal abilities and characteristics
  - (b) The study of plant abilities and characteristics
  - (c) The study of human abilities and characteristics
  - (d) The study of robot abilities and characteristics
- Q2** Why is ergonomics important?
- (a) It helps designers to create equipment that is not user-friendly
  - (b) It helps designers create equipment that is too heavy for humans to use
  - (c) It helps designers to create equipment, systems, and jobs that increase human performance and reduce the risk of injuries
  - (d) It has no impact on the design of equipment, systems, and jobs
- Q3** Which of the following factors is **NOT** included in the work factors of ergonomic considerations?
- (a) Physical factors - ambient conditions; objects (tools, furniture, etc.)
  - (b) Biological factors - body dimensions, body capabilities, physiological processes
  - (c) Psychological factors - mental workload, information processing, training, motivation
  - (d) Work factors - job demands (time, rate, etc.), job design
- Q4** Which type of measurement is used to assess the dimensions of the body and physical characteristics?
- (a) Anthropometrics
  - (b) Static measurement
  - (c) Dynamic measurement
  - (d) Both static and dynamic measurement
- Q5** Which of the following is **TRUE** about anthropometry?
- (a) It is not important in design considerations
  - (b) It is only relevant for certain industries
  - (c) It is crucial for designing products and workspaces
  - (d) It is only applicable to individual body measurements

- Q6** What may happen if designs are incompatible with normal anthropometric measurements?
- (a) The workforce may experience increased productivity
  - (b) The workforce may become more efficient
  - (c) The workforce may experience unwanted incidents
  - (d) The workforce may experience improved job satisfaction
- Q7** Why is it important to address ergonomics risk factors in the workplace?
- (a) To reduce workers' compensation costs
  - (b) To increase employee job satisfaction and motivation
  - (c) To enhance workplace aesthetics and design
  - (d) To prevent musculoskeletal disorders (MSDs) and improve worker health
- Q8** Which category of risk factors includes factors related to one's job or occupation?
- (a) Occupational (Work Related)
  - (b) Non-Work Related
  - (c) Environmental
  - (d) Medical
- Q9** What are some risk factors associated with manual material handling?
- (a) Ergonomic principles, machine operation, noise exposure
  - (b) Slips and falls, electrical hazards, toxic substances
  - (c) Lack of fitness, high temperatures, chemical exposure
  - (d) Awkward postures, heavy loads, repetitive motions
- Q10** Why is it important to ensure proper lifting techniques during manual material handling?
- (a) To increase productivity and efficiency
  - (b) To fulfill legal compliance and regulatory requirements
  - (c) To minimize the risk of musculoskeletal injuries
  - (d) To reduce the number of work-related accidents
- Q11** Which of the following is **NOT** a function of the musculoskeletal system?
- (a) Store nutrients and minerals
  - (b) Provide motion
  - (c) Generate heat for the body
  - (d) Support and protect the body and its organs
- Q12** What is the main function of the musculoskeletal system?
- (a) Provides movement
  - (b) Produces blood cells
  - (c) Carries nerve impulses
  - (d) Supports and binds tissues and organs together



- Q13** What can cause Carpal Tunnel Syndrome?  
(a) A fracture in the wrist bone  
(b) Muscular dystrophy  
(c) Swelling and irritation of tendons and tendon sheaths  
(d) Genetic predisposition
- Q14** Which of the following is a symptom of Cumulative Trauma Disorder (CTDs)?  
(a) Dizziness  
(b) Blurred vision  
(c) Swelling  
(d) Breathlessness
- Q15** Which of the following is **NOT** a symptom of Cumulative Trauma Disorder (CTDs)?  
(a) Numbness  
(b) Tingling  
(c) Cracking or popping of joints  
(d) Clumsiness
- Q16** Which of the following actions are considered manual material handling?  
(a) Reading and writing  
(b) Calculating and analyzing  
(c) Sliding and stacking  
(d) Listening and talking
- Q17** What are some immediate effects of manual material handling?  
(a) Muscular strength  
(b) Poor posture  
(c) Chronic back pain  
(d) Accidental injuries and fatigue
- Q18** Which of the following is one of the long-term effects of manual material handling?  
(a) Fatigue  
(b) Muscle soreness  
(c) Accidental injuries  
(d) Chronic back pain
- Q19** Which classification of luminaires provides light only in a downward direction?  
(a) none of the above  
(b) direct-indirect lighting  
(c) direct lighting  
(d) indirect lighting
- Q20** Which factor refers to the movement of air in an environment?  
(a) Air flow (ventilation)  
(b) Thermal radiation  
(c) Humidity  
(d) Air temperature

- Q21** What is the definition of glare?
- (a) Excessive darkness in the field of vision
  - (b) Color distortion in the field of vision
  - (c) Indistinctness in the field of vision
  - (d) Excessive brightness in the field of vision
- Q22** Which classification of luminaires provides light in both upward and downward directions?
- (a) None of the above
  - (b) Direct lighting
  - (c) Direct-indirect lighting
  - (d) Indirect lighting
- Q23** Which of the following is **NOT** a recommended preventive measure for heat stress?
- (a) Get plenty of rest
  - (b) Allow the body to acclimate to heat
  - (c) Stay away from coffee, sodas, and salt tablets
  - (d) Take required recovery time when leaving a heat stress area
- Q24** Why is prolonged standing considered strainful for the body?
- (a) It puts excessive load on the body
  - (b) It leads to body fluid accumulation in the legs
  - (c) Introducing floor mats
  - (d) Shoes with cushioned soles
- Q25** What are the advantages of using a seated workplace for long-term duration jobs?
- (a) Easier maintenance, less strain on the body, better controlled arm movements
  - (b) Stronger sense of balance and safety, improved blood circulation, better controlled arm movements
  - (c) Easier maintenance, better controlled arm movements, improved blood circulation
  - (d) Less strain on the body, stronger sense of balance and safety, improved blood circulation
- Q26** What are some factors to consider when selecting hand tools?
- (a) Weight of tool, size of tool and hand anthropometrics, safety and protection features, power specs
  - (b) Color of tool, brand of tool, shape of tool, price of tool
  - (c) Weight of tool, texture of tool, material selection, power specs
  - (d) Size of tool and hand anthropometrics, safety and protection features, material selection, power specs

- Q27** What are some safety and protection features to consider when selecting hand tools?
- (a) Flange, safety latch, plastic guard
  - (b) Texture, color, weight
  - (c) Brand, shape, price
  - (d) Size, material, power specs
- Q28** Which of the following is a factor that affects how long a muscle is continuously contracted?
- (a) Oxygen requirements of work
  - (b) Strength of the muscle
  - (c) Duration
  - (d) Number of work cycles per unit time
- Q29** Which of the following injuries is **NOT** related to poor ergonomics in the workplace?
- (a) Carpal tunnel syndrome
  - (b) Shoulder sprain
  - (c) Back injury
  - (d) Eye strain
- Q30** Which of the following is **NOT** a common type of ergonomic assessment?
- (a) Quick Exposure Check
  - (b) RULA assessment
  - (c) NIOSH Lifting equation
  - (d) Financial Risk Assessment



**PART B**

Instructions: Answers any **TWO (2)** questions from **THREE (3)** questions only (40 marks).

**Q1**

It's common these days to see schoolchildren lifting and carrying around large, heavy school backpacks as shown in **Figure APPENDIX A.1**. Many are so large, in fact, that one can't help but wonder whether such a heavy backpack or school bag might not only be causing back pain, but could also result in other types of damage, including scoliosis or other spinal deformities. As an ergonomist, you are advised to assess the forceful exertion risk factors using the Manual Handling Chart (MAC) method. The MAC tool was developed to help the user identify high-risk workplace manual handling activities and can be used to assess the risks posed by lifting, carrying and team manual handling activities as shown in **Figure APPENDIX A.2**. **Table Q1.1** shows the data collection for each items of the lifting task.

**Table Q1.1:** Critical measurements of the lifting and carrying around large and heavy school backpacks

| Item                                   | Value  | Item                                   | Value  |
|--|--|--|--|
| Bag load weight (empty)                | 1250g  | Children weight                        | 32.5kg   |
| Minimum books load weight (inside bag) | 18000g   | Maximum books load weight (inside bag) | 46000g   |
| Minimum frequency lift                 | 12 lift per hour   | Maximum frequency lift                 | One lift every 14 seconds  |
| Hand distance from the lower back      | Torso bent forward   | Vertical lift zones                    | Hands at floor level or below  |
| Torso twisting and sideways bending    | Torso bent sideways  | Postural constraints                   | Severely restricted posture  |
| Grip on the load                       | No handles or handholds but can be held underneath, or has strap or loop handles | Floor surface                          | Mostly dry and clean (damp or some debris), OR reasonably firm OR minor damage |
| Environmental factors                  | Extremes of temperature  | Obstacles on route                     | Carry the load up or down a steep slope  |

- (a) Evaluate and justify when should be used the Manual Handling Chart (MAC) method in advanced ERA. (4 marks)
- (b) Based on **Figure APPENDIX A.1** and **Table Q1.1**, evaluate and analyze the minimum and maximum of the Load Weight / Frequency for Manual Handling Chart (MAC) method. (6 marks)
- (c) Based on **Figure APPENDIX A.2**, develop and create the formula with calculate the total final score, risk level and action level of the risks posed by lifting activities. Use appropriate sketch to support your explanations. (6 marks)
- (d) Based on result **Q1(c)**, develop and recommend the **FOUR (4)** suggestions to improve manual schoolchildren lifting and carrying around large and heavy school backpacks. (4 marks)

**Q2**

The most common complaints bringing children to a physiotherapist are back and neck pain. Some causes of back pain in children include poor posture, inappropriate forms of exercise and carrying heavy schoolbags. Poor posture (sitting) is usually habitual and makes the spine vulnerable to injury and pain as shown in **Figure APPENDIX B.1**. This injury and pain is caused by excessive stress from prolonged poor posture and can arise from many tissues around the spine. These tissues include muscles, ligaments, discs and the joints of the spine. In order to assess the static and sustained work posture, the Rapid Upper Limb Assessment (RULA) method was developed to rapidly evaluate the exposure of individual workers to ergonomic risk factors associated with upper extremity Musculoskeletal Disorders (MSDs) as shown in **Figure APPENDIX B.2**. **Table Q2.1** shows the data collection for each items of the lifting task.

**Table Q2.1:** Critical measurements of the prolonged poor posture (sitting)

| <b>Item</b>  |
|--|
| Upper arm position in 92.5 degrees with shouders is raised and abducted but arm is supported by desk     |
| Lower arm position 110 degrees with arm is working across midline and out to side of body                |
| Wrist position in 17 degrees with wrist is bent from midline and wrist is twisted in mid-range           |
| Posture mainly static more than 4 times per minutes with load while writing using pensile less than 200g |
| Neck position in 38 degrees with neck is twisted and side bending  |
| Back position in 42 degrees with back is twisted and side bending  |
| Leg position as shown in <b>Figure Q2a</b>   |



- (a) Evaluate and justify when should be used the Rapid Upper Limb Assessment (RULA) method in order to assess the static and sustained work posture. (4 marks)
- (b) Based on **Figure APPENDIX B.1** and **Table Q2.1**, evaluate and analyze score of the Part A (Arm and Wrist) and Part B (Neck, Trunk and Leg) for Rapid Upper Limb Assessment (RULA) method using **Figure APPENDIX B.2** (6 marks)
- (c) Develop and create the formula with calculate the total final score, risk level and action level of the prolonged poor posture (sitting). Use appropriate sketch to support your explanations. (6 marks)
- (d) Based on result **Q2(e)**, develop and recommend the **FOUR (4)** suggestions to improve prolonged poor posture (sitting) among schoolchildren. (4 marks)

**Q3**

An ergonomic assessment, also called an ergonomic risk assessment (ERA), is an objective measure of the risk factors in your work environment that may lead to musculoskeletal disorders or injuries among your workforce. In Malaysia, an ergonomics assessor known as an Ergonomic Trained Person (ETP) that recognized by Department of Occupational Safety & Health (DOSH).

- (a) Describe and explain **FOUR (4)** duties and responsibilities of an Ergonomics Trained Person (ETP). (4 marks)
- (b) There are two approaches for initiating an Ergonomic Risk Assessment (ERA) including proactive and reactive approach. Create and develop a framework for ERA by providing detail explanations how they can be achieved. (6 marks)
- (c) All ERA activities, information and outcomes should be finalized and documented in the form of a report. Construct and determine the content of Initial ERA and Advanced ERA report. (6 marks)
- (d) Create and differentiate between Initial ERA and Advanced ERA in term of an Ergonomic Trained Person (ETP). (4 marks)

- END OF QUESTION -

APPENDIX A



Load weight/frequency graph for lifting operations

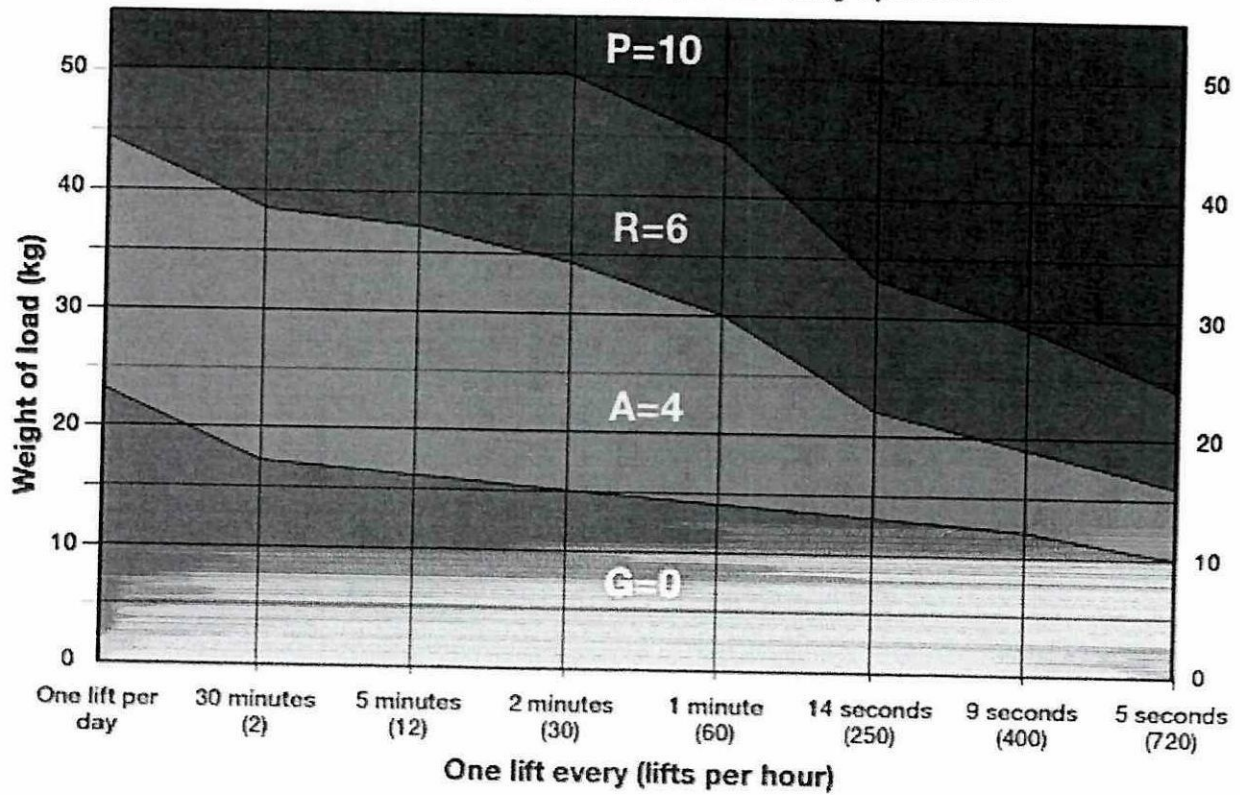


Figure APPENDIX A.1

TERBUKA



APPENDIX A

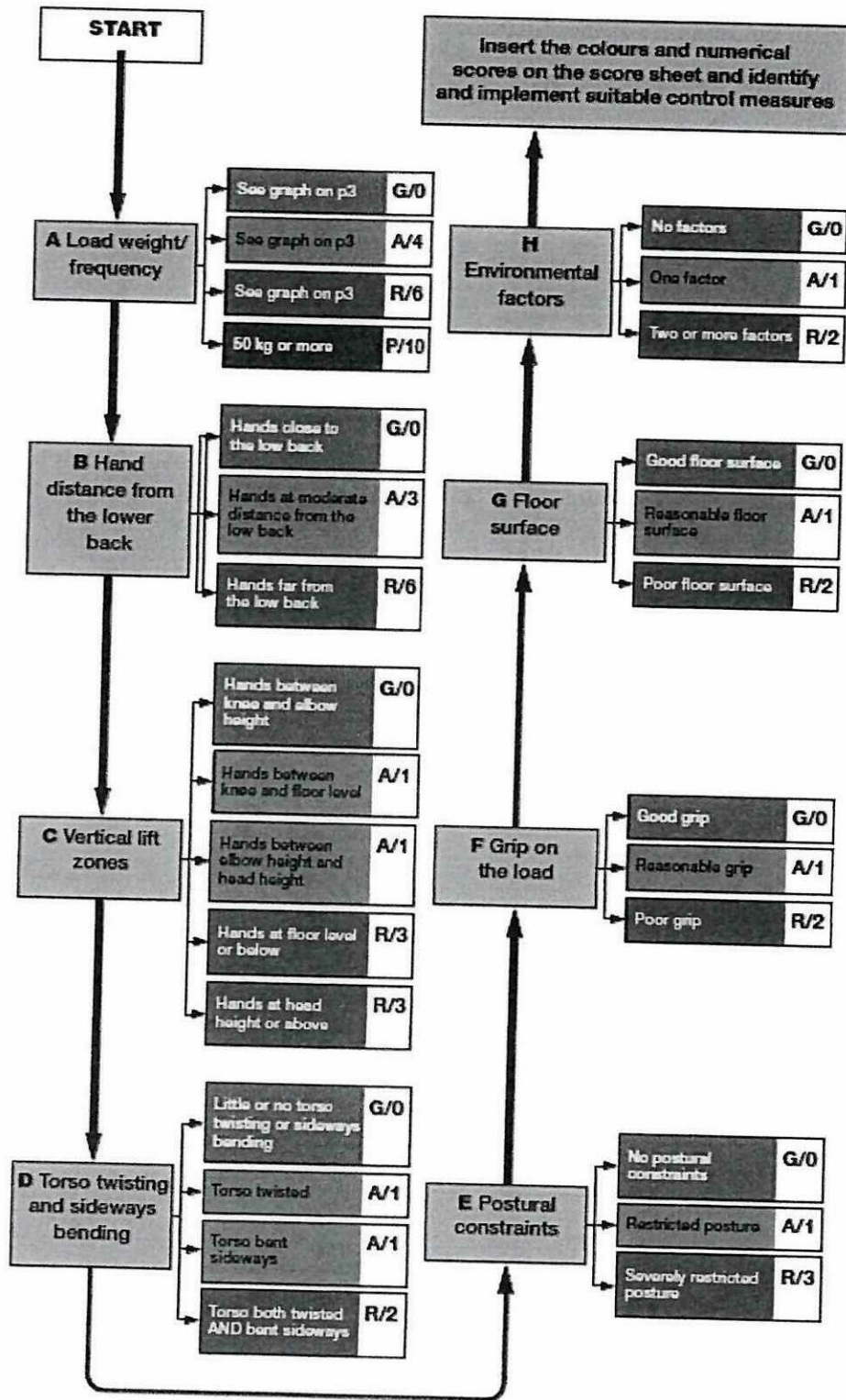


Figure APPENDIX A.2

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APPENDIX B

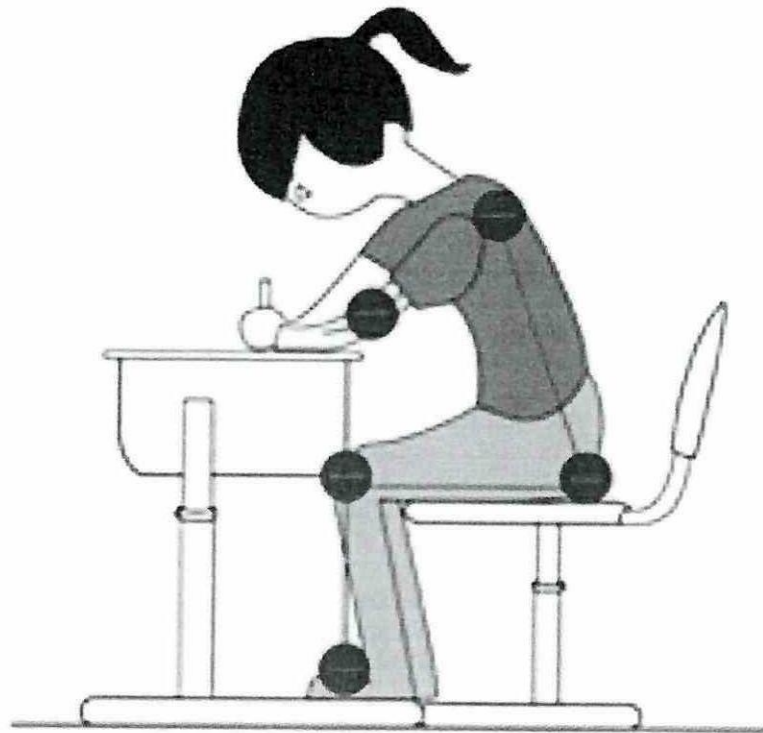


Figure APPENDIX B.1

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APPENDIX B

RULA Employee Assessment Worksheet

A. Arm and Wrist Analysis

Step 1: Locate Upper Arm Position:



Step 1a: Adjust...  
If shoulder is raised: +1  
If upper arm is abducted: +1  
If arm is supported or person is leaning: -1

Step 2: Locate Lower Arm Position:



Step 2a: Adjust...  
If either arm is working across midline or out to side of body: Add +1

Step 3: Locate Wrist Position:



Step 3a: Adjust...  
If wrist is bent from midline: Add +1

Step 4: Wrist Twist:

If wrist is twisted in mid-range: +1  
If wrist is at or near end of range: +2

Step 5: Look-up Posture Score in Table A:

Using values from steps 1-4 above, locate score in Table A

Step 6: Add Muscle Use Score

If posture mainly static (i.e. held > 1 minute), Or if action repeated occurs 4X per minute: +1

Step 7: Add Force/Load Score

If load < 4.4 lbs. (intermittent): +0  
If load 4.4 to 22 lbs. (intermittent): +1  
If load 4.4 to 22 lbs. (static or repeated): +2  
If more than 22 lbs. or repeated or shocks: +3

Step 8: Find Row in Table C

Add values from steps 5-7 to obtain Wrist and Arm Score. Find row in Table C.

Task Name:

Date:

B. Neck, Trunk and Leg Analysis

Step 9: Locate Neck Position:



Step 9a: Adjust...  
If neck is twisted: +1  
If neck is side bending: +1

Step 10: Locate Trunk Position:



Step 10a: Adjust...  
If trunk is twisted: +1  
If trunk is side bending: +1

Step 11: Legs:

If legs and feet are supported: +1  
If not: +2

| Table B: Trunk Posture Score |      |
|------------------------------|------|
| Posture Score                | Legs |
| 1                            | 1    |
| 2                            | 2    |
| 3                            | 3    |
| 4                            | 4    |
| 5                            | 5    |
| 6                            | 6    |
| 7                            | 7    |
| 8                            | 8    |
| 9                            | 9    |

Step 12: Look-up Posture Score in Table B:

Using values from steps 9-11 above, locate score in Table B

Step 13: Add Muscle Use Score

If posture mainly static (i.e. held > 1 minute), Or if action repeated occurs 4X per minute: +1

Step 14: Add Force/Load Score

If load < 4.4 lbs. (intermittent): +0  
If load 4.4 to 22 lbs. (intermittent): +1  
If load 4.4 to 22 lbs. (static or repeated): +2  
If more than 22 lbs. or repeated or shocks: +3

Step 15: Find Column in Table C

Add values from steps 12-14 to obtain Neck, Trunk and Leg Score. Find column in Table C.

| Table A   |           | Wrist Score |             |
|-----------|-----------|-------------|-------------|
| Upper Arm | Lower Arm | Wrist Twist | Wrist Twist |
| 1         | 1         | 1           | 1           |
| 1         | 2         | 2           | 2           |
| 1         | 3         | 3           | 3           |
| 1         | 4         | 4           | 4           |
| 2         | 1         | 1           | 1           |
| 2         | 2         | 2           | 2           |
| 2         | 3         | 3           | 3           |
| 2         | 4         | 4           | 4           |
| 3         | 1         | 1           | 1           |
| 3         | 2         | 2           | 2           |
| 3         | 3         | 3           | 3           |
| 3         | 4         | 4           | 4           |
| 4         | 1         | 1           | 1           |
| 4         | 2         | 2           | 2           |
| 4         | 3         | 3           | 3           |
| 4         | 4         | 4           | 4           |
| 5         | 1         | 1           | 1           |
| 5         | 2         | 2           | 2           |
| 5         | 3         | 3           | 3           |
| 5         | 4         | 4           | 4           |
| 6         | 1         | 1           | 1           |
| 6         | 2         | 2           | 2           |
| 6         | 3         | 3           | 3           |
| 6         | 4         | 4           | 4           |

Neck, Trunk, Leg Score

| Table C           |                        |
|-------------------|------------------------|
| Wrist / Arm Score | Neck, Trunk, Leg Score |
| 1                 | 1                      |
| 2                 | 2                      |
| 3                 | 3                      |
| 4                 | 4                      |
| 5                 | 5                      |
| 6                 | 6                      |
| 7                 | 7                      |
| 8                 | 8                      |
| 9                 | 9                      |
| 10                | 10                     |

Scoring (final score from Table C)

1-2 = acceptable posture  
3-4 = further investigation, change may be needed  
5-6 = further investigation, change soon  
7 = investigate and implement change

RULA Score

based on RULA, a survey method for the investigation of work-related upper limb disorders. McAtamney & Corlett. Applied Ergonomics 1993, 24(2), 91-99

