



**GOErgo**<sup>™</sup> presents  
The Global Organization of Ergonomics

*The 20th Annual*

**appliedergonomics**

CONFERENCE 2017

*Practitioners talking with practitioners*

## **Measuring 101 – How to Make the Most of Your Ergonomics Assessments Using Low-Tech Measurement Tools**

**Gary Allread, The Ohio State University**

**Rick Barker, Inteva Products**

# Workshop Description

---

1. There is often confusion about what ergonomists and safety professionals should have in their “ergonomics toolbox” and also how to best use these tools
2. This workshop will:
  - Guide attendees through the decision-making process of choosing the types of measurement devices needed to provide accurate results
  - Combine this discussion with a review of the level of measurement accuracy needed by several common ergonomics assessment tools
3. These concepts will be applied to a series of hands-on activities
4. Attendees also will be briefed on some of the more quantitative ergonomics measurement tools available and the appropriate situations for their use

# Workshop Presenters

---

- Gary Allread
  - Program Director for SRI•Ergonomics at The Ohio State University
  
- Rick Barker
  - Corporate Ergonomist for Inteva Products



1.

## **Physical Work Exposures Linked to Injury Risk**

# Known Physical Workplace Exposures Linked to Injury Risk

---

- Force
  - The level of muscular effort required to perform a task
- Posture
  - The body position assumed during a task
- Repetition
  - The number of (similar) exertions required during a task
- Static work postures
- Lack of micro-rest breaks
- Vibration (tools, surfaces)
- Mechanical contact
  - Soft tissue compression
  - High impact force
- Environmental conditions

# Basic Measurement Principles

---

- Force and moment arm/lever
- Posture
- Repetition
- Whole-Body exertion

2.

## **Useful Measurement Equipment for Conducting Ergonomics Evaluations**

# Suggested Equipment for Your Ergonomics Toolkit

---

- Primary
  - Heavy-duty scale
  - Heavy-duty tape measure
  - Digital video camera

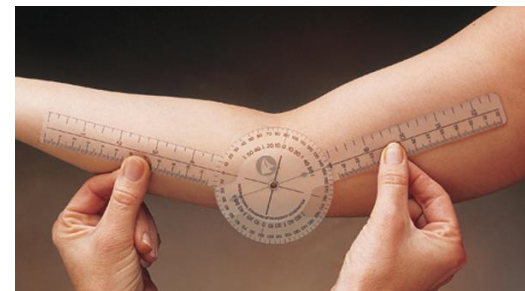




# Suggested Equipment for Your Ergonomics Toolkit

---

- Secondary (industry/work-specific)
  - Push-pull gauge
  - Stopwatch
  - Heartrate monitor
  - Hand grip dynamometer
  - Goniometer



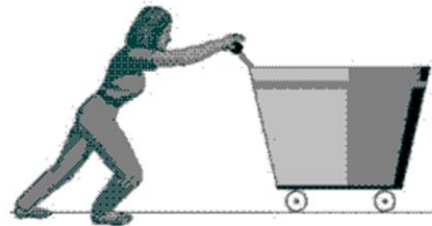
3.

## **Equipment Needed for Commonly Used Ergonomics Assessment Tools**

# Common Ergonomics Assessment Tools

---

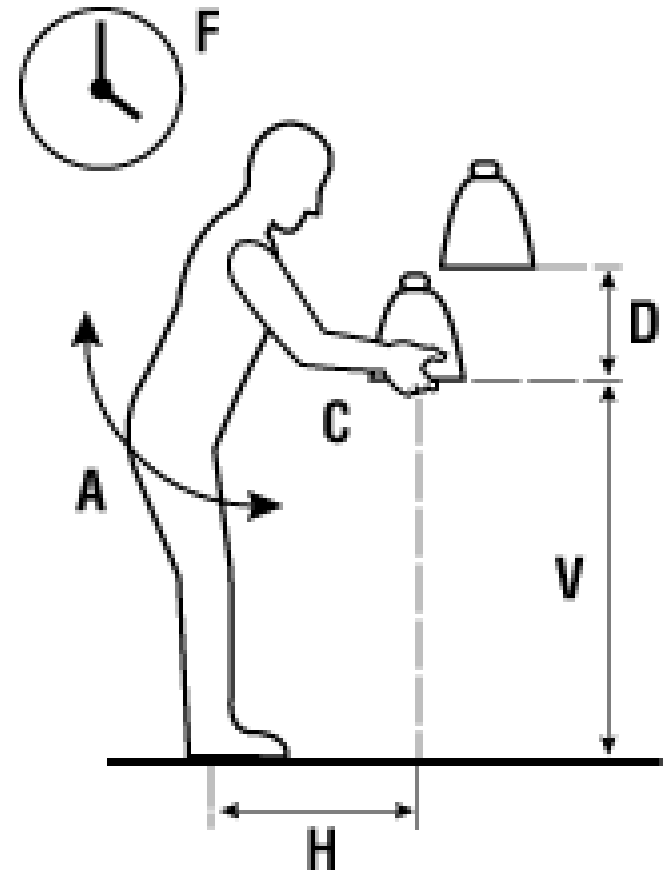
- Ergonomics workplace checklists
- NIOSH *Lifting Guide*
- Rapid Upper Limb Assessment (RULA)
- Strain Index
- Liberty Mutual / psychophysical tables
- Hand Activity Level
- ACGIH for Lifting



# Common Ergonomics Assessment Tools

---

- Example:
  - NIOSH *Lifting Guide*



# Common Ergonomics Assessment Tools

- Example:
  - Rapid Upper Limb Assessment (RULA)

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

**A. Arm and Wrist Analysis**

**Step 1: Locate Upper Arm Position:**

+1   +2   +2   +2   +3   +4

**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:**

+1   +2   +3   +4

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

**Step 3: Locate Wrist Position:**

+1   +2   +3   +4

**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 >10 minutes):  
 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.

**SCORES**

**Table A: Wrist Posture Score**

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

**Table B: Trunk Posture Score**

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

**Table C: Neck, trunk and leg score**

Wrist and Arm Score	Neck, trunk and leg score						
	1	2	3	4	5	6	7+
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	5	5	6	6	7	7
7	5	5	6	6	7	7	7
8+	5	5	6	7	7	7	7

**Scoring: (final score from Table C)**  
 1 or 2 = acceptable posture  
 3 or 4 = further investigation, change may be needed  
 5 or 6 = further investigation, change soon  
 7 = investigate and implement change

**B. Neck, Trunk and Leg Analysis**

**Step 9: Locate Neck Position:**

+1   +2   +3   +4

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

**Step 10: Locate Trunk Position:**

+1   +2   +3   +4

**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

**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 >10 minutes),  
 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

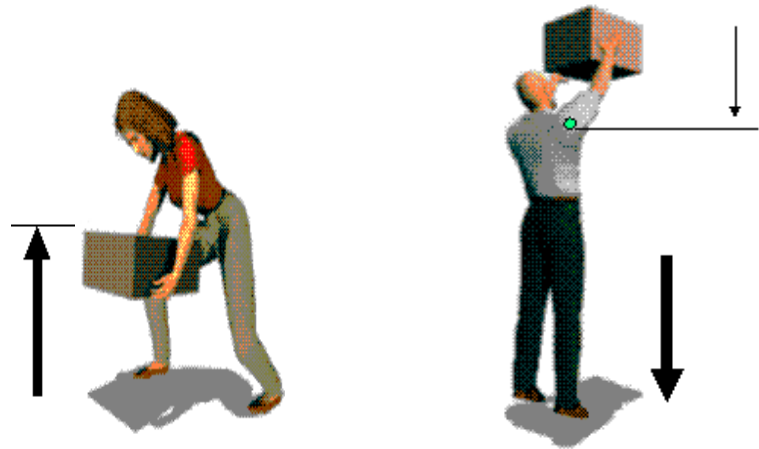
**Step 15: Find Column in Table C**  
 Add values from steps 12-14 to obtain Neck, Trunk and Leg Score. Find Column in Table C.

**Task name:** \_\_\_\_\_ **Reviewer:** \_\_\_\_\_ **Date:** \_\_\_\_\_ / \_\_\_\_\_ / \_\_\_\_\_

This tool is provided without warranty. The author has provided this tool as a simple means for applying the concepts provided in RULA. © 2004 Nease Consulting, Inc. provided by Practical Ergonomics rbarber@ergosmart.com (816) 444-1667

# Common Ergonomics Assessment Tools

- Example:
  - Liberty Mutual / psychophysical tables



4.

## **Measurement Accuracy Needed for Common Ergonomics Assessment Tools**

# What Level of Measurement Accuracy is Needed?

---

- How more- or less-quantification impacts the various, common ergo assessment methods
- How this impacts assessment results
- Various workshops will be conducted to demonstrate these concepts



5.

## **Trade-Offs Between Low-Tech and High-Tech Measurement Tools**

# Situations Where a More Advanced Tool is Needed

---

- Workplace examples:
  - In product or task development
  - Where a solution may be less obvious
  - Where the work task is more complicated
  - For work conditions that are more problematic, possibly high-injury, or not easy to solve

# Examples of Higher-Tech Ergonomics Assessment Tools

---

- Electromyography (EMG)
- Optical tracking systems
- Vibration measurements
- Force transducers
- 3D Static Strength Prediction Program
- Industrial Lumbar Motion Monitor

6.

## **Resources to Find Measurement Tools**

# Ergonomics Measurement Resources

---

- Tools that are in the public domain
- Fee-based, commercially available tools