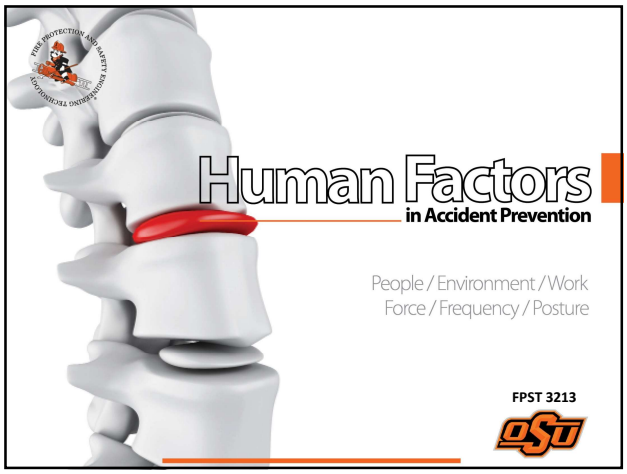
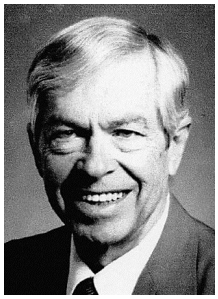


1

Snook Tables

2

Dr. Stover Snook



Dr. Snook earned a B.A. degree from Hartwick College, an M.A. from Fordham University, and a Ph.D. from Tufts University.

He is a Certified Professional Ergonomist (CPE), a Fellow of the Human Factors and Ergonomics Society, and a Fellow of the Ergonomics Society (UK).

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3

Career

- 1954 - Drafted into the Army in after graduating from college
- 1956 - Dunlap and Associates in Stamford, CT
  - Participated in the human factors design and evaluation of military missile systems, command and control systems, weather observing and forecasting systems, and aircraft cockpit design
- 1962 - joined the Liberty Mutual Research Center in Hopkinton, MA
  - Conducted occupational health research on low back pain, manual materials handling, cumulative trauma disorders, heat stress, fatigue, machine guarding, stairway design, and personal protective equipment.
- 1997 - retired as Assistant Vice President and Director of the Ergonomics Laboratories

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4

Career

- From 1974 to 2004, he was a Lecturer on Ergonomics at the Harvard School of Public Health, and a Visiting Scientist from 2004 to 2009.
- Pioneering Work:
  - The design of manual handling tasks (1991): revised tables of maximum acceptable weights and forces (2007)

    Stover H. Snook & Vincent M. Ciriello

    Ergonomics Journal

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Snook Tables

- The Liberty Mutual MMH Tables, commonly known as “Snook Tables”.
- Maximum acceptable weights and forces.

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6

Output

- "Is this weight or force too heavy or forceful for this task?"
- "How significant is the risk?"

7

- When a mixture of males and females are doing the task, the task should be designed so that it is acceptable to at least 75 per cent of the female population, which would make it acceptable to more than 90 percent of the male population.
- Any task that cannot be performed by at least 75 percent of the total population should be considered for MSD prevention controls and redesign.

8

Snook Tables

Above Shoulder
(above 54 in)

		Horizontal Distance (Front of Body to Hands) [in]								
		7			10			15		
		Distance of Lift [in]			Distance of Lift [in]			Distance of Lift [in]		
Frequency		10	20	30	10	20	30	10	20	30
1 / 8 h	1 / 8 h	35	31	29	29	26	24	26	24	22
1 / 30 min	2 / 1 h	31	26	24	24	22	20	22	20	18
1 / 5 min	12 / 1 h	26	24	22	22	20	18	20	20	18
1 / 2 min	30 / 1 h	26	24	22	22	20	18	20	20	18
1 / 1 min	1 / 1 min	26	24	20	20	20	18	20	18	15
1 / 14 s	4.3 / 1 min	20	20	18	18	18	13	18	18	13
1 / 9 s	6.7 / 1 min	18	18	15	15	15	13	15	15	13
1 / 5 s	12 / 1 min	18	18	13	13	13	11	13	13	11

Design goal = **18 pounds**

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9

- Select the tasks to be evaluated based on the most difficult and demanding lifting, lowering, carrying, pushing, or pulling tasks.
- When the task specific data does not match the values in the table, select the next highest table value that is closest to the actual task requirements.

10

Snook Tables

Floor to Knuckle
(below 29 in)

Frequency		Horizontal Distance (Front of Body to Hands) [in] 7 – Distance of Lift [in] 10	20	30	10 – Distance of Lift [in] 10	20	30	15 – Distance of Lift [in] 10	20	30
1 / 8 h	1 / 8 h	51	48	42	42	40	35	40	37	31
1 / 30 min	2 / 1 h	37	35	31	31	31	26	29	29	24
1 / 5 min	12 / 1 h	33	33	29	29	26	22	26	24	22
1 / 2 min	30 / 1 h	33	33	29	26	26	22	26	24	22
1 / 1 min	1 / 1 min	31	31	26	26	24	22	24	22	20
1 / 14 s	4.3 / 1 min	29	26	24	24	20	20	24	20	20
1 / 9 s	6.7 / 1 min	26	24	22	22	20	18	22	20	18
1 / 5 s	12 / 1 min	22	20	18	18	15	15	18	15	15

Design goal = **22 pounds**

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11

Carrying at about waist height
(elbows bent)

Frequency		Distance of Carry [ft] 7	14	27
1 / 8 h	1 / 8 h	46	46	42
1 / 30 min	2 / 1 h	35	35	31
1 / 5 min	12 / 1 h	35	35	31
1 / 2 min	30 / 1 h	33	33	31
1 / 1 min	1 / 1 min	33	33	31
1 / 20 s	3 / 1 min	31	26	26
1 / 10 s	6 / 1 min	29	24	OR

Design goal = **31 pounds**

12

Snook Tables

Middle Pull Point (hands about 36 in)

Frequency		Pull Distance [ft] 7 Initial	7 Sustained	24 Initial	24 Sustained	48 Initial	48 Sustained	97 Initial	97 Sustained	145 Initial	145 Sustained	194 Initial	194 Sustained
1 / 8 h	1 / 8 h	59	42	55	37	46	31	46	29	46	26	42	20
1 / 30 min	2 / 1 h	57	35	51	31	44	26	40	22	42	20	37	15
1 / 5 min	12 / 1 h	55	33	48	29	42	24	40	20	40	20	35	15
1 / 2 min	30 / 1 h	48	29	44	26	37	22	35	20	35	18	33	13
1 / 1 min	1 / 1 min	46	29	42	24	37	22	33	18	33	15	OR	OR
1 / 30 s	2 / 1 min	46	29	40	24	31	18	OR	OR	OR	OR	OR	OR
1 / 15 s	4 / 1 min	44	26	37	20	OR	OR	OR	OR	OR	OR	OR	OR
1 / 12 s	5 / 1 min	42	26	OR	OR	OR	OR	OR	OR	OR	OR	OR	OR
1 / 6 s	10 / 1 min	35	18	OR	OR	OR	OR	OR	OR	OR	OR	OR	OR

Design goal = **Initial 40 pounds, Sustained 20 pounds**

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Data Collection

Task variables needed to determine Snook Tables ***Design Goal***:

- Weight of Object
- Force Requirement
- Lift/Lower Distance
- Hand Distance (Horizontal Hand Position)
- Hand Height
- Push/Pull/Carry Distance
- Frequency
- Lifting/Lowering Zone

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Snook Tables Calculator

Snook Tables (Lift/Lower)

Lift Lower Point: Floor to Knuckle (below 29 in.)

Frequency: 1 action/5 minutes (12 actions/hour)

Horizontal Distance: 15 inches

Distance Of Lift: 20 inches

Actual Weight: 42

CALCULATE

RESULTS

Risk

Risk Index	1.75

Assessment Results

Design Goal	24.00 (lbs)

Task Variables

Lift/Lower Point	FloorToKnuckle
Frequency	1 action/5 minutes (12 actions/hour)
Horizontal Distance	15 inches
Distance of Lift	20 inches
Actual Weight	42

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ErgoPlus Industrial: https://industrial.ergo-plus.com/sign-up/create-account

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15

Lifting / Lowering – Variables

- Lift Lower Point (Vertical Location)
  - Above shoulder (above 54”)
  - Knuckle to shoulder (29 -54”)
  - Floor to knuckle (below 29”)
- Frequency
  - 1 action/8 hours
  - 1 action/30 minutes
  - 1 action/5 minutes
  - 1 action/2 minutes
  - 1 action/1 minute
  - 1 action/14 seconds
  - 1 action/9 seconds
  - 1 action/5 seconds
- Horizontal Distance
  - 7”
  - 10”
  - 15”
- Distance of Lift
  - 10”
  - 20”
  - 30”

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Lifting / Lowering – Example 1

Variables determined by the assessment:
- Lift Lower Point – Above Shoulder (above 54”)
- Frequency – 1 action every 5 minutes (12 actions per hour)
- Horizontal Distance – 10” (front of body to mid-line of hands)
- Distance of Lift – 30” (lifts from height at 28” to 60” = 32”)
- Weight of Object – 32 pounds

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Lifting / Lowering – Example 1

Snook Tables (Lift/Lower)

Lift Lower Point: Above Shoulder (above 54 in.)

Frequency: 1 action/5 minutes (12 actions/hour)

Horizontal Distance: 10 inches

Distance Of Lift: 30 inches

Actual Weight: 32

CALCULATE

RESULTS

Risk

Risk Index	1.78

Assessment Results

Design Goal	18.00 (lbs)

Task Variables

Lift/Lower Point	AboveShoulder
Frequency	1 action/5 minutes (12 actions/hour)
Horizontal Distance	10 inches
Distance of Lift	30 inches
Actual Weight	32

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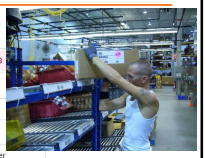

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Lifting / Lowering – Example 2

Variables determined by the assessment:
- Lift Lower Point - Knuckle to shoulder (29 -54")
- Frequency – 1 action every 5 minutes (12 actions per hour)
- Horizontal Distance – 15"
- Distance of Lift – 20" (lowers from height of 49.5" to 31" = 18.5")
- Weight of Object – 25 pounds

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Lifting / Lowering – Example 2

Snook Tables (Lift/Lower)

Lift Lower Point: Knuckle to Shoulder (between 29 and 54 in.)

Frequency: 1 action/5 minutes (12 actions/hour)

Horizontal Distance: 15 inches

Distance Of Lift: 20 inches

Actual Weight: 25

CALCULATE

RESULTS

Risk

Risk Index	0.96

Assessment Results

Design Goal	26.00 (lbs)

Task Variables

Lift/Lower Point	KnuckleToShoulder
Frequency	1 action/5 minutes (12 actions/hour)
Horizontal Distance	15 inches
Distance of Lift	20 inches
Actual Weight	25

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Lifting / Lowering – Example 3

Variables determined by the assessment:
- Lift Lower Point – Floor to Knuckle (below 29")
- Frequency – 1 action every 2 minutes (30 actions per hour)
- Horizontal Distance – 10" (front of body to mid-line of hands)
- Distance of Lift – 30" (lifts from height of 4" to 32" = 28")
- Actual Weight – 35 pounds

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21

Lifting / Lowering – Example 3

Snook Tables (Lift/Lower)

Lift Lower Point: Floor to Knuckle (below 29 in.)

Frequency: 1 action/2 minutes (30 actions/hour)

Horizontal Distance: 10 inches

Distance Of Lift: 30 inches

Actual Weight: 35

CALCULATE

RESULTS

Risk

Risk Index	1.59

Assessment Results

Design Goal	22.00 (lbs)

Task Variables

Lift/Lower Point	FloorToKnuckle
Frequency	1 action/2 minutes (30 actions/hour)
Horizontal Distance	10 inches
Distance of Lift	30 inches
Actual Weight	35

SAVE CANCEL

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22

Lifting / Lowering – Example 4

Variables determined by the assessment:

- Lift Lower Point –Knuckle to Shoulder (29 - 54")
- Frequency – 1 action every 30 minutes (2 actions per hour)
- Horizontal Distance – 7"
- Distance of Lift – 10"
- Weight of Object – 30 pounds

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23

Lifting / Lowering – Example 4

Snook Tables (Lift/Lower)

Lift Lower Point: Knuckle to Shoulder (between 29 and 54 in.)

Frequency: 1 action/30 minutes (2 actions/hour)

Horizontal Distance: 7 inches

Distance Of Lift: 10 inches

Actual Weight: 30

CALCULATE

RESULTS

Risk

Risk Index	0.86

Assessment Results

Design Goal	35.00 (lbs)

Task Variables

Lift/Lower Point	KnuckleToShoulder
Frequency	1 action/30 minutes (2 actions/hour)
Horizontal Distance	7 inches
Distance of Lift	10 inches
Actual Weight	30

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24

24

Carrying – Variables

Carrying is defined as manually grasping an object of definable size and mass with two hands and transporting the object horizontally from one place to another without mechanical assistance

- Frequency
  - 1 action/8 hours
  - 1 action/30 minutes
  - 1 action/5 minutes
  - 1 action/2 minutes
  - 1 action/1 minute
  - 1 action/20 seconds
  - 1 action/10 seconds

Select the most conservative value

- Carry Point (Vertical Location)
  - Waist height (elbows bent)
  - Below Waist Height (elbows straight)

Only two options

- Carry Distance
  - 7'
  - 14'
  - 27'

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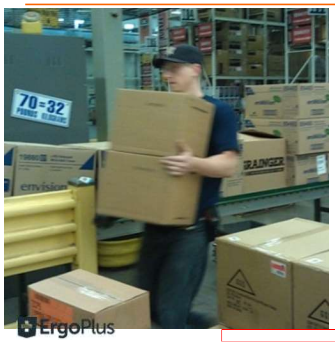
25

Carrying – Example 1



Variables determined by the assessment:
- Carry Point – Waist Height
- Frequency – 1 carry/2 minutes (30 carries per hour)
- Carry Distance – 27' (front of body to mid-line of hands)
- Actual Weight – 52 pounds

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Carrying – Example 1

Snook Tables (Carry)

Carry Point: Waist Height

Frequency: 1 carry/2 minutes (30 carries/hour)

Carry Distance: 27

Actual Weight: 52

CALCULATE

RESULTS

Risk

Risk Index	1.68

Assessment Results

Design Goal	31.00 (lbs)

Task Variables

Carry Point	WaistHeight
Frequency	1 carry/2 minutes (30 carries/hour)
Distance	27
Actual Weight	52

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27

Carrying – Example 2

Variables determined by the assessment:
- Carry Point – Waist Height
- Frequency – 1 carry every minute
- Carry Distance – 27'
- Actual Weight – 40 pounds

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Carrying – Example 2

Snook Tables (Carry)

Carry Point: Waist Height
Frequency: 1 carry/minute
Carry Distance: 27
Actual Weight: 40
CALCULATE

RESULTS

Risk

Risk Index	1.29

Assessment Results

Design Goal	31.00 (lbs)

Task Variables

Carry Point	WaistHeight
Frequency	1 carry/minute
Distance	27
Actual Weight	40

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Push / Pull – Variables

- Push/Pull Point (Vertical Location)
  - High (hands about 55")
  - Middle (hands about 36")
  - Low (hands about 24")
- Frequency
  - 1 action/8 hours
  - 1 action/30 minutes
  - 1 action/5 minutes
  - 1 action/2 minutes
  - 1 action/1 minute
  - 1 action/30 seconds
  - 1 action/15 seconds
  - 1 action/12 seconds
  - 1 action/6 seconds
- Push/Pull Distance
  - 7'
  - 24'
  - 48'
  - 97'
  - 145'
  - 194'
- Force Measurement
  - Initial Force
  - Sustained Force

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Push / Pull – Measurement

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31

Push / Pull – Measurement

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Push / Pull – Meter

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33

Push / Pull – Example 1

Variables determined by the assessment:
- Pull Point – Middle
- Frequency – 1 pull per 5 minutes
- Pull Distance – 97'
- Initial Force = 53 lbs.
- Sustained Force = 25 lbs.

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34

Push / Pull – Example 1

Snook Tables (Pull)

Pull Point: Middle (Hands about 36")

Frequency: 1 action/5 minutes (12 actions/hour)

Pull Distance: 97

Initial Force: 53

Sustained Force: 25

CALCULATE

RESULTS

Risk

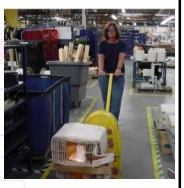
Risk Index	1.32	1.25

Assessment Results	Initial	Sustained
Design Goal	40.00 (lbs)	20.00 (lbs)

Task Variables

Pull Point	Middle (Hands about 36")
Frequency	1 action/5 minutes (12 actions/hour)
Pull Distance	97
Initial Force	53
Sustained Force	25

SAVE CANCEL



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35

Push / Pull – Example 2

Variables determined by the assessment:
- Pull Point – Low
- Frequency – 1 pull per 2 minutes
- Pull Distance – 24'
- Initial Force = 75 lbs.
- Sustained Force = 34 lbs.

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Push / Pull – Example 2

Snook Tables (Pull)

Pull Point: Low (Hands about 24")
Frequency: 1 action/2 minutes (30 actions/hour)
Pull Distance: 24
Initial Force: 75
Sustained Force: 34

CALCULATE

RESULTS

Risk

Risk Index	1.63	1.42

Assessment Results	Initial	Sustained
Design Goal	46.00 (lbs)	24.00 (lbs)

Task Variables

Pull Point	Low (Hands about 24")
Frequency	1 action/2 minutes (30 actions/hour)
Pull Distance	24
Initial Force	75
Sustained Force	34

SAVE CANCEL

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Push / Pull – Example 3

Variables determined by the assessment:
- Pull Point – Middle
- Frequency – 1 pull per 30 minutes
- Pull Distance –145'
- Initial Force = 35 lbs.
- Sustained Force = 14 lbs.

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Push / Pull – Example 3

Snook Tables (Pull)

Pull Point: Middle (Hands about 36")
Frequency: 1 action/30 minutes (2 actions/hour)
Pull Distance: 145
Initial Force: 35
Sustained Force: 14

CALCULATE

RESULTS

Risk

Risk Index	0.83	0.70

Assessment Results	Initial	Sustained
Design Goal	42.00 (lbs)	20.00 (lbs)

Task Variables

Pull Point	Middle (Hands about 36")
Frequency	1 action/30 minutes (2 actions/hour)
Pull Distance	145
Initial Force	35
Sustained Force	14

SAVE CANCEL

Variables determined by the assessment:
- Pull Point – Middle
- Frequency – 1 pull per 30 minutes
- Pull Distance –145'
- Initial Force = 35 lbs.
- Sustained Force = 14 lbs.

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Liberty Mutual Tables

Liberty Manual Research laboratory 25-year study

- Tests at least 80 hours for each subject
- All factors being under control (weight, distance…)

https://libertymmhtables.libertymutual.com/?action=initTaskSelection

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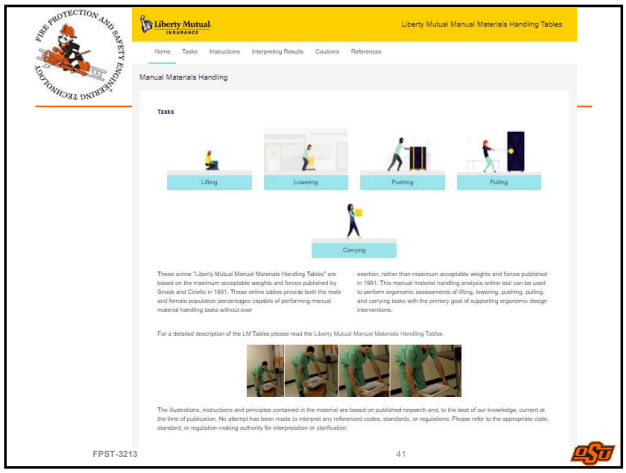
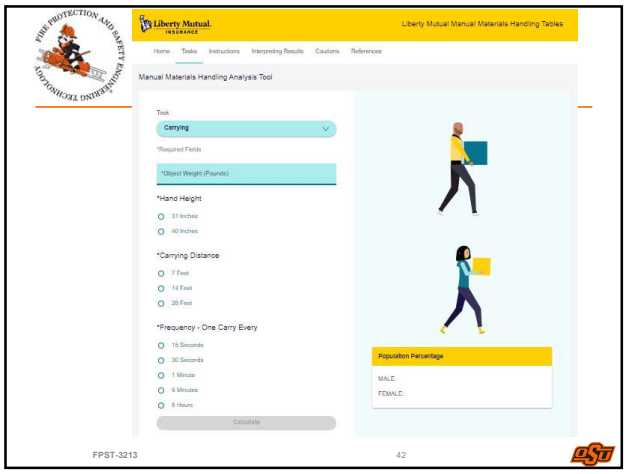
40



41



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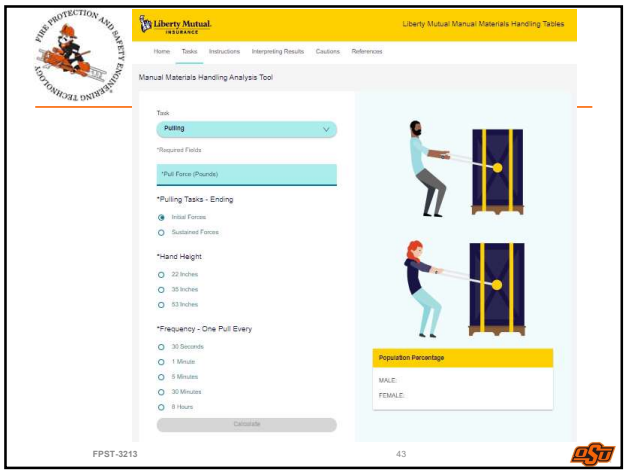

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REBA and RULA

44

REBA

- Rapid Entire Body Assessment (REBA)
- Systematic process to evaluate <u>whole body</u> postural MSD risks associated with certain job tasks
- Developed by Dr. Sue Hignett and Dr. Lynn McAtamney
  - Ergonomists from University of Nottingham in England.

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REBA Objectives

- Simple postural analysis
- Divide the body into segments
- Provide a scoring system for muscle activity
- Consider coupling as an important variable

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REBA

- Considers critical tasks of a job
- Single page worksheet
  - Body postures
  - Forceful exertions
  - Type of movement or action
  - Repetition
  - Coupling

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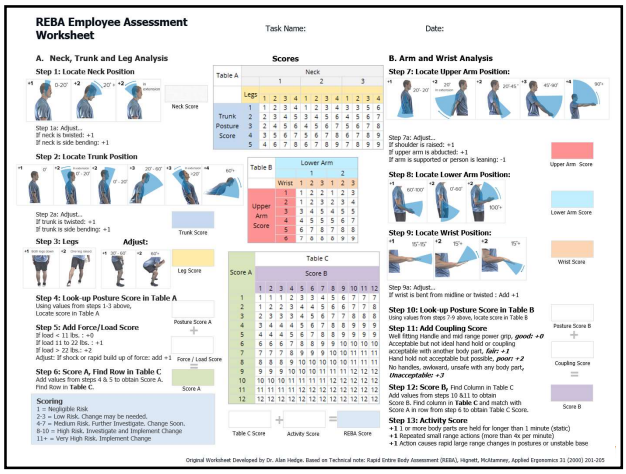

48

REBA Output

Level of MSD risk for the work task being evaluated:

Score	Level of MSD Risk
1	negligible risk, no action required
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

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REBA Limitations

- One posture at a single point in time
- Evaluator must decide what the worst part of the task is

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Assessment Preparation

Tools needed:

- Clip board and pen
- REBA worksheet or data collection worksheet
- Camera (video & picture)
- Goniometer
- Weight Measurement Gauge - if weight is not known and scale is not available
- REBA Excel calculator
- Personal Protective Equipment (PPE).

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Task Selection

Selection of the posture to be evaluated should be based on:

- The most difficult postures and demanding work tasks (based on worker interview and initial observation).
- The posture sustained for the longest period of time.
- The posture where the highest force loads occur.

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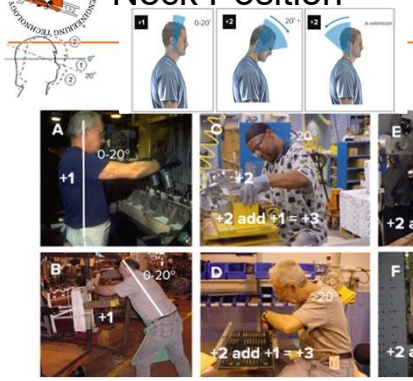
Determine & Record Task Variables

FPST-3213 53 Source: Ergo-Plus.com

53

Neck Position



FPST-3213 54 Source: Ergo-Plus.com

54

Trunk Position
A
+1
B
+2 add +1 = +3
C
+2
0-20°
D
20-60°
+3
E
>60°
+4
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55
Source: Ergo-Plus.com

55

Leg Position
Leg position adjustment:
Add +1 - if knees 30-60° flexed
Add +2 - if knees > 60° flexed
A
+1
B
+1
+2
D
+2
E
+1 add +1 = +2
30-60°
F
+2 add +2= +4
>60°
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56
Source: Ergo-Plus.com

56

Load / Force Score
A
< 11 lbs. = +0
B
< 11 lbs. = +0
If load < 11lbs. = +O
If load 11 to 22 lbs. = +1
If l o a d > 2 2 lbs.= + 2
C
11 – 22 lbs. = +1
D
> 22 lbs. = +2
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57
Source: Ergo-Plus.com

57

Load / Force Score

If shock, rapid build up, or sudden exertion is required by the job task being evaluated:
Add +1

FPST-3213 58 Source: Ergo-Plus.com

58

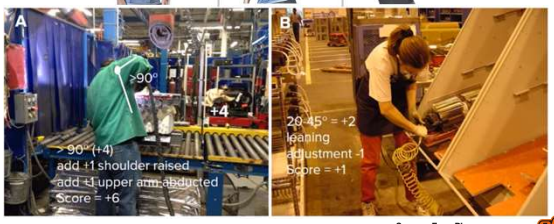
Load / Force Score

Upper Arm adjustment:
If shoulders is raised: +1
If upper arm is abducted: +1
If arm is supported or person is leaning: -1

FPST-3213 59 Source: Ergo-Plus.com

59

Upper Arm Position

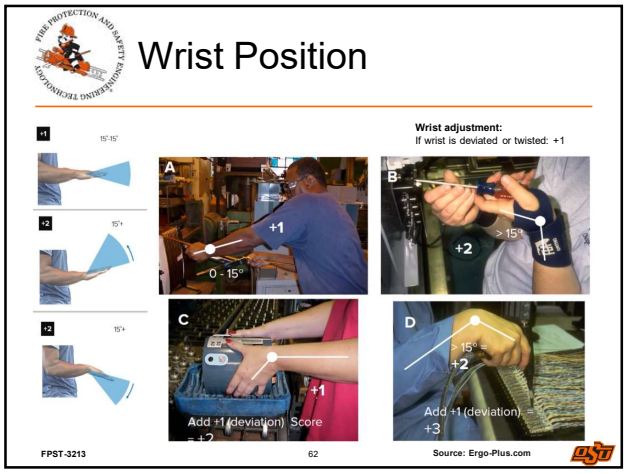


FPST-3213 60 Source: Ergo-Plus.com

60

Lower Arm Position
+1
60°-100°
+2
0°-60°
+2
100°+
A
+1
60 - 100°
B
>100°
+2
C
+2
0 - 60°
FPST-3213
61
Source: Ergo-Plus.com

61


Wrist Position
+1
15°-15°
+2
15°+
+2
15°+
Wrist adjustment:
If wrist is deviated or twisted: +1
A
+1
0 - 15°
B
> 15°
+2
C
+1
Add +1 (deviation) Score = +2
D
> 15° =
+2
Add +1 (deviation) =
+3
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Source: Ergo-Plus.com

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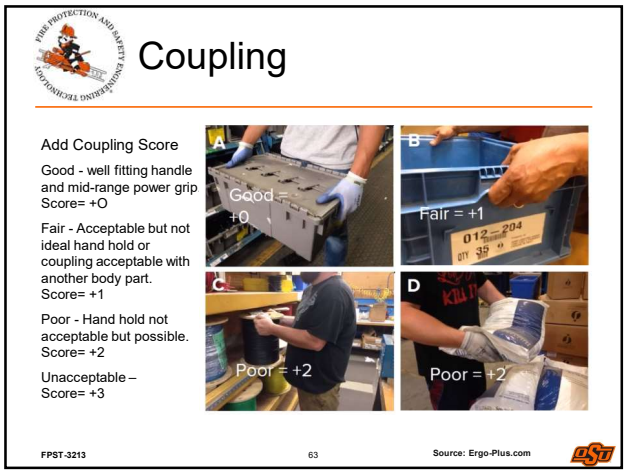
Coupling
Add Coupling Score
Good - well fitting handle and mid-range power grip
Score= +O
Fair - Acceptable but not ideal hand hold or coupling acceptable with another body part.
Score= +1
Poor - Hand hold not acceptable but possible.
Score= +2
Unacceptable –
Score= +3
A
Good = +0
B
Fair = +1
C
Poor = +2
D
Poor = +2
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Source: Ergo-Plus.com

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Activity Score

+1 - One or more body parts are held for longer than 1 minute (static)

+1 - Repeated small range actions (more than 4x per minute)

+1 - Action causes rapid large range changes in postures or unstable base

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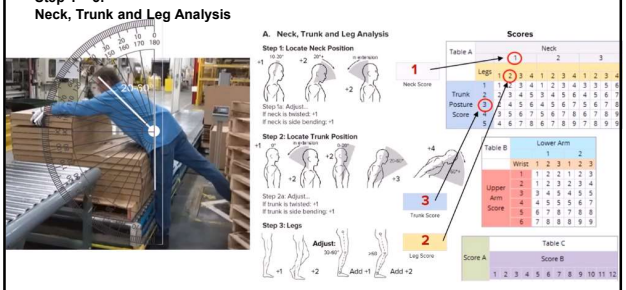
Example

Step 1 – 3:
Neck, Trunk and Leg Analysis



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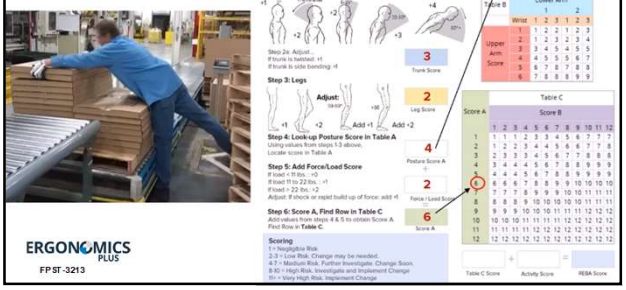
Example

Step 4 – 6:
Calculate the score for Group A



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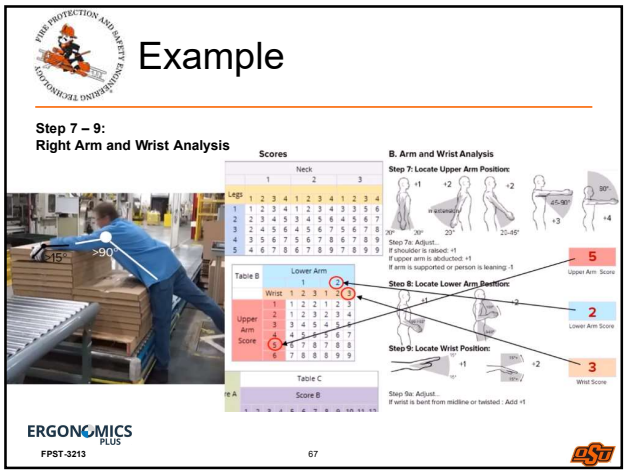
Example
Step 7 – 9:
Right Arm and Wrist Analysis
Scores
B. Arm and Wrist Analysis
Step 7: Locate Upper Arm Position:
Step 8: Locate Lower Arm Position:
Step 9: Locate Wrist Position:
5
Upper Arm Score
2
Lower Arm Score
3
Wrist Score
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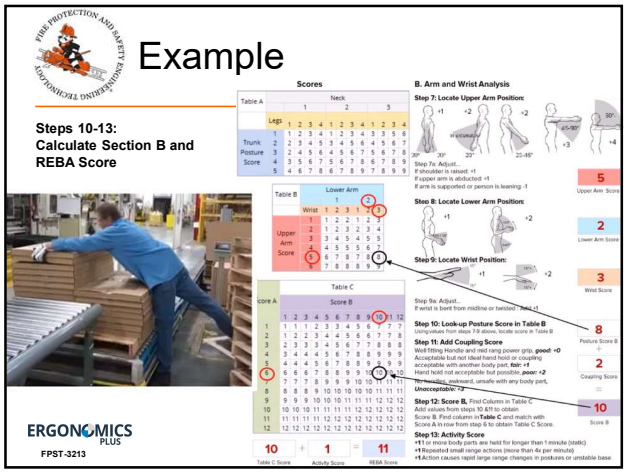
Example
Steps 10-13:
Calculate Section B and REBA Score
Scores
B. Arm and Wrist Analysis
Step 7: Locate Upper Arm Position:
Step 8: Locate Lower Arm Position:
Step 9: Locate Wrist Position:
Step 10: Look-up Posture Score in Table B
Step 11: Add Coupling Score
Step 12: Score B.
Step 13: Activity Score
10
1
11
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Example
RESULTS
= REBA Score
11
Score
Level of MSD Risk
1
negligible risk, no action required
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
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RULA

- Rapid Upper Limb Assessment
  - 1993 – UK
- Considers biomechanical and postural load requirements of job tasks/demands on the neck, trunk and upper extremities

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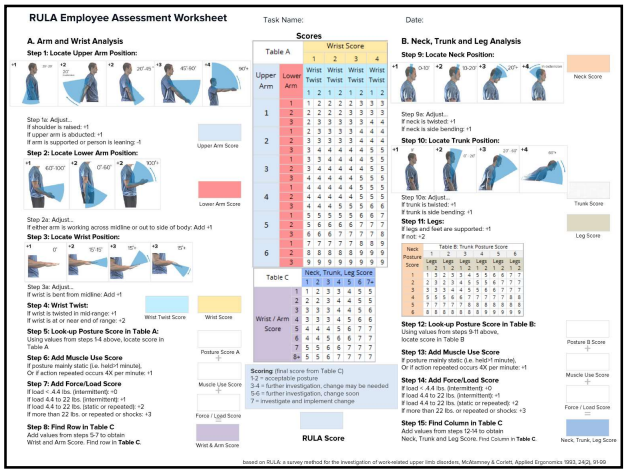

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RULA Output

Level of MSD risk for the work task being evaluated:

Score	Level of MSD Risk
1-2	negligible risk, no action required
3-4	low risk, change may be needed
5-6	medium risk, further investigation, change soon
6+	very high risk, implement change now

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Which Assessment do I use?

- Qualitative
  - RULA
  - REBA
  - Snook
- Quantitative
  - NIOSH
  - WISHA

- "How significant is the risk?"
- "Is this weight or force too heavy or forceful for this task?"

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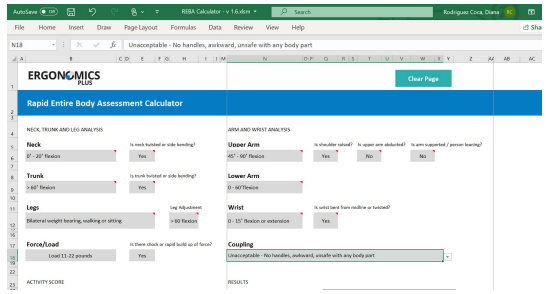

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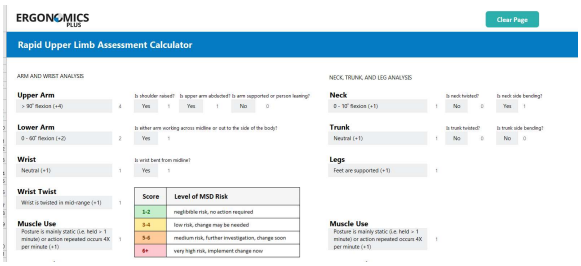

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Example 1

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Example 2

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Conclusion

- Material handling tasks should be designed to minimize the weight, range of motion and frequency of the activity, and using the equation allows you to get closer to optimal from the beginning

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