2023 Wisconsin Safety Council Annual Conference
APRIL 18, 2023
81ST ANNUAL SAFETY CONFERENCE

Ergonomics - MMH & Cumulative Trauma Disorders

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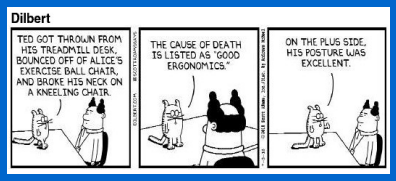
State of Wisconsin / DWD WC Division
https://dwd.wisconsin.gov/wc/safety/bio/dave-leix.htm

*The lighter side of Ergonomics – don't be a **'Ted'***



Sit / Stand Desks

Sit/Stand Desktop Riser - Small

Help relieve an aching back or boost employee productivity. Position desk risers to fit any height.

- Transitions easily from sitting to standing with side lever and gas lift assistance.
- Sits on desktop. Height adjusts 6-20".
- Desk riser lifts straight up and down.
- 5/8" thick scratch-resistant laminate.
- Easily install Monitor Mounts onto risers.

ULINE 1-800-295-5510

MODEL NO.	DESCRIPTION	RECOMMENDED USE	DIMENSIONS W x D	CAP. (LBS.)	WT. (LBS.)	PRICE EACH 1	PRICE EACH 2+
H-6306	Small	Portable Laptops	27 x 31"	35	43	$330	$320

The Napping Desk ….

Seinfeld - George Costanza

https://www.youtube.com/watch?v=W_qCFWi1KA&t=8s

Enter **The Sleeper Desk**, a multi-function, desk-meets-bed that would have been the answer to **George Costanza**'s dreams.

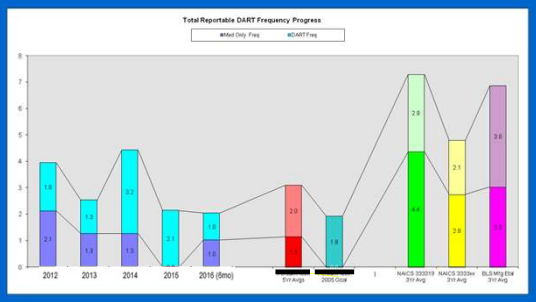
https://www.pedestrian.tv/news/some-genius-made-george-costanzas-sleeper-desk-a-reality/

Session Objectives

- Identify potential risk factors associated with MMH & CTD's
- Identify ergonomic principles which can be applied to reduce the risk of MMH & CTD's
- Provide reference materials to assist in implementing solutions
- Discuss Benchmarks & Loss Sources

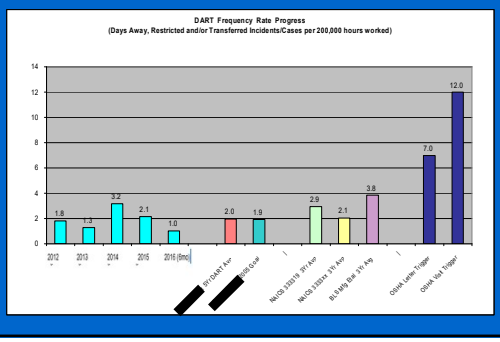
Benchmarking – How are we doing?

"ABC Co." OSHA Incidence Rates – 2012-2016 (6mos)



Benchmarking – How are we doing?

"ABC Co." OSHA DART Rates – 2012-2016 (6mos)

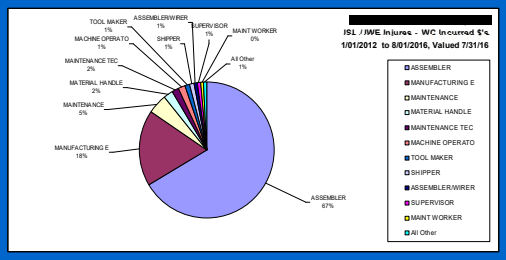


Workers' Compensation – Loss Sources

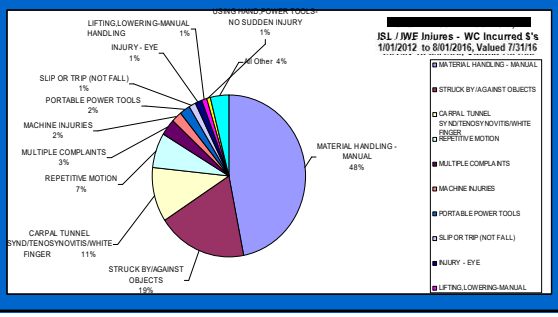
"ABC Co." – 2012-2016 (7mos)

Policy Effective Year	Count of Claim Number	Incurred Total Incl. Tot Expenses	Paid Total Incl. Total Expense
2012	18	$ 44,369.85	$ 30,557.39
2013	9	$ 102,274.14	$ 102,274.14
2014	14	$ 20,383.96	$ 20,383.96
2015	7	$ 8,171.09	$ 8,171.09
2016 (7mos)	5	$ 2,308.33	$ 2,308.33
	53	$ 177,507.37	$ 163,694.91

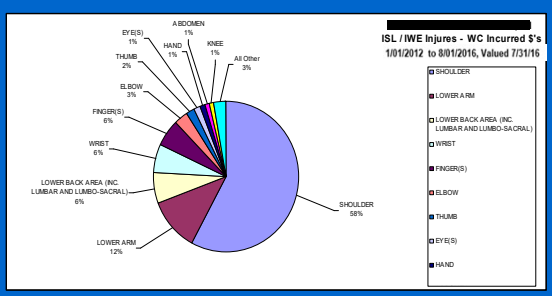
Workers' Compensation – Loss Sources
"ABC Co." – 2012-2016 (7mos)
Occupation – Incurred $ Losses



Workers' Compensation – Loss Sources
"ABC Co." – 2012-2016 (7mos)
Cause / Type – Incurred $ Losses



Workers' Compensation – Loss Sources
"ABC Co." – 2012-2016 (7mos)
Body Part – Incurred $ Losses



Workers' Compensation – Loss Sources
"ABC Co." – 2012-2016 (7mos)
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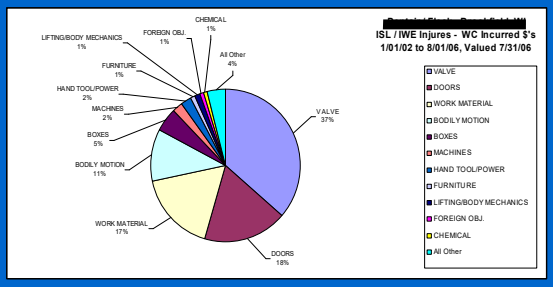


Ergonomics – What's in a name?

- Ergon – work (Greek)
- Nomus – natural law
  - Other names:

    Human Factors
    Human Engineering
    Biomechanics
    Work Physiology
    Engineering Psychology
    Engineering Anthropometry.

Goal of Ergonomics

- Obtain a good match between the Worker and the job
- Design jobs to fit the workers' capabilities
- Ergonomics benefits:
  - Increased Productivity
  - Decreased Injuries and Muscular Skeletal Disease

What are Cumulative Trauma Disorders?

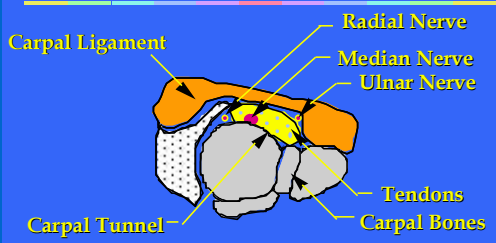
What are Cumulative Trauma Disorders?

- Injuries to the tendons, tendon sheaths and related muscles and nerves
- Caused by repetition over time

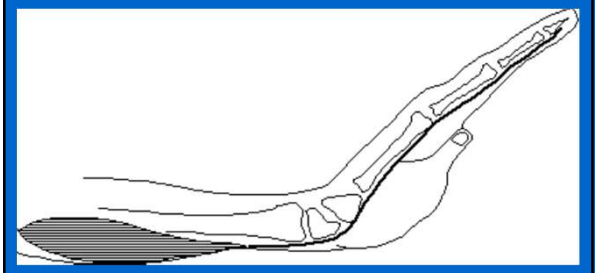
Most Common CTDs

- Carpal Tunnel Syndrome
- Tendonitis
- Tenosynovitis
- Epicondylitis (Tennis Elbow)
- DeQuervain's Disease
- Trigger Finger
- Vibration syndrome

Carpal Tunnel Syndrome



Median Nerve Position



Symptoms of CTDs

- Restricted joint movement
- Soft tissue swelling, pain, tenderness
- Tingling or numbness in fingertips
- Loss of sensation, and "nocturnal numbness"
- Feeling of "pins and needles"
- Dull aching pain that worsens when activity has stopped.

CTD Risk Factors

- Repetition
- Force
- Awkward Postures
- Contact Stress
- Vibration
- Cold Temperature

Personal Activities

- Knitting, needlepoint, sewing
- Tennis, racquetball, squash
- Golf, bowling, baseball
- Gardening
- Home maintenance
- Musical instruments
- Home computer use
- Adequate Sleep & Rest

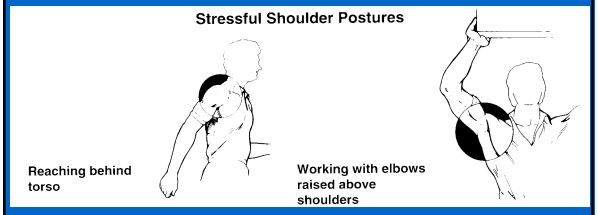
Comparative Odds Ratio Chart

(from Silverstein)

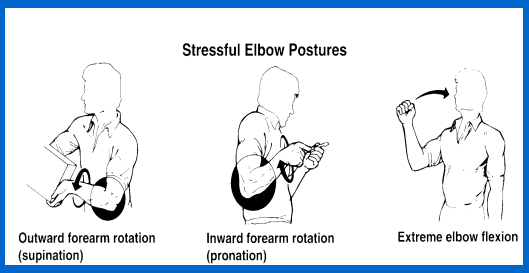
The odds of sustaining a CTD increase 30 times for tasks involving high force and repetition.

Exerted Force \ Repetition Frequency	Low	High
Low	1.0	3.6
High	4.9	30.3

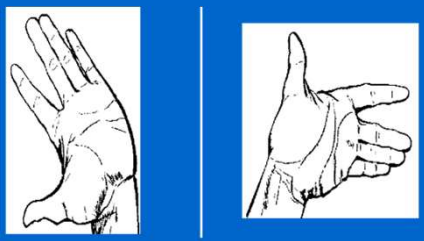
Stressful Shoulder Postures



Stressful Elbow Postures

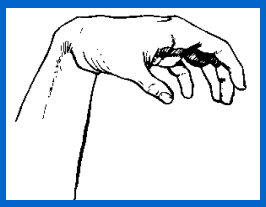


Stressful Wrist Postures

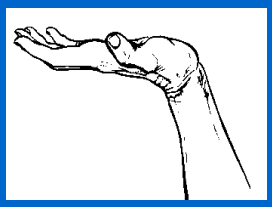


Radial Deviation **Ulnar Deviation**

Stressful Wrist Postures

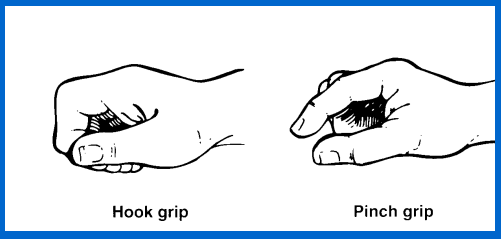


Flexion



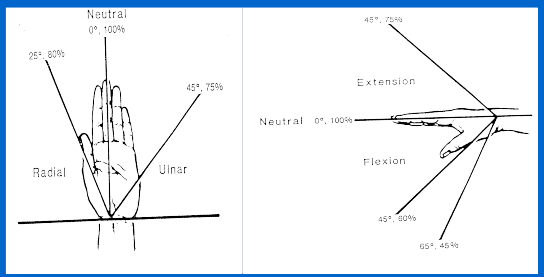
Extension

Stressful Hand Postures

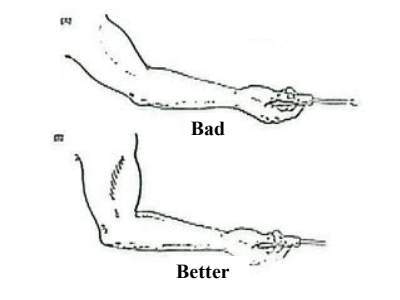


Avoid repetitive pinching in excess of 2 lbs.

Effect of wrist posture on grip strength



Avoid tasks with forearm rotation and extended reaching

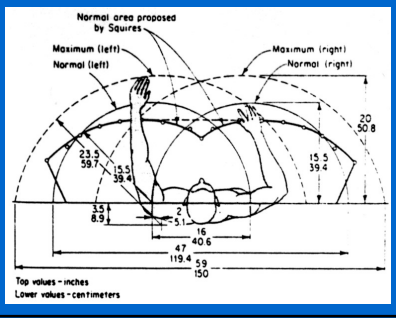


Anthropometrics

- What is it?
- The study of human body measurements, especially on a comparative basis
- Has it's roots dating to WWI – Petite vs XXL

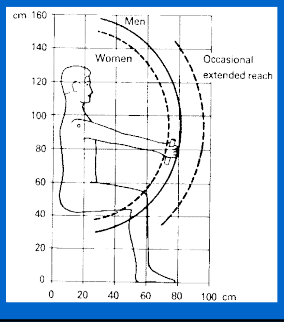
Minimize reaching

Keep repetitive reaching with 16 inches

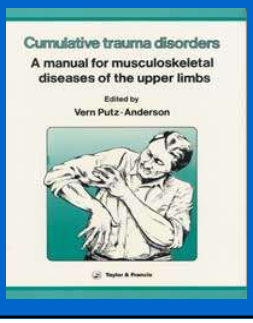


Minimize Reaching

Occasionally may reach beyond 16 inches



Ergo – CTD Guide – NIOSH/OSHA Edited & Uses It!!

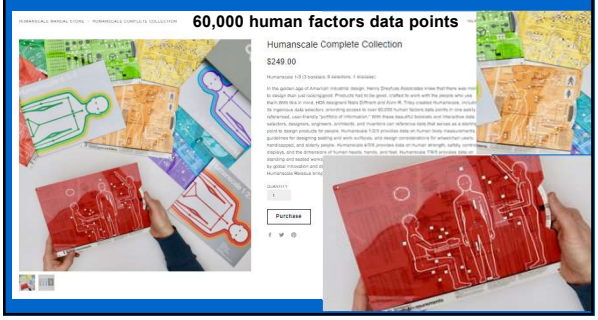


Humanscale - Henry Dreyfuss Associates

HDA designers Niels Diffrient and Alvin R. Tilley created Humanscale, including its ingenious data selectors, providing access to over **60,000 human factors data points** in one easily referenced, user-friendly "portfolio of information."

to purchase

https://humanscalemanual.com/store/complete-collection



Humanscale - Henry Dreyfuss Associates

HDA designers Niels Diffrient and Alvin R. Tilley created Humanscale.

Humanscale consists of pictorial selectors equipped with rotary dials. This portfolios contains selectors (two sides each) which present over 60,000 bits of information, basically encompassing anthropometry, guidelines for seating design, and requirements for the handicapped and elderly. Men, women, and children—large and small—are represented. Measurements are given in metric as well as English units.

Engineers, architects, industrial designers, planners, interior and furniture designers, and craftsmen will find that the selectors minimize their searching through numerous and conflicting sources and unreliable information.

Humanscale 1/2/3
1. Sizes of People
2. Seating Considerations,
3. Requirements for the Handicapped and Elderly

Humanscale 4/5/6
4. Human Strength and Safety
5. Controls and Displays
6. Designing for People

Humanscale 7/8/9
7. Standing and sitting at work
8. Space planning for the individual and the public
9. Access for maintenance, stairs, light, and color

to purchase
https://humanscalemanual.com/store/complete-collection

Control Strategies

- Engineering - the workplace, the tools and the product when possible
- Work Methods - How we get the task completed.
- Administrative - scheduling of work, rotation, training

Administrative Controls

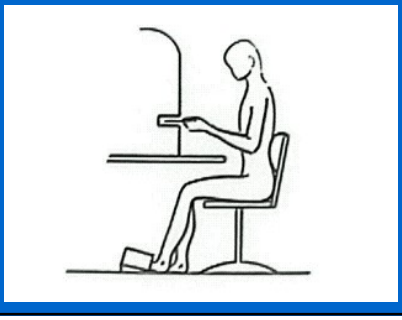
- Early Symptom Reporting
- Gradual break-in
- Rotation
- Job enlargement
- Breaks/interruptions
- Avoid incentive pay
- Avoid machine pacing
- Training in preferred work method- minimize forces and postures

Repetition - Engineering Controls

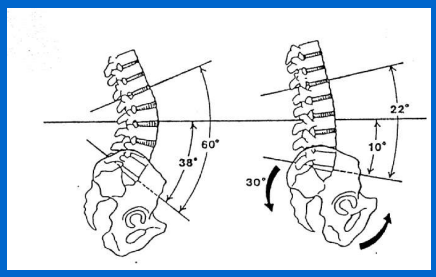
- Automation
- Combining operations
- Product design changes to reduce repetitions
- Alternative process

Sitting Workstations

Sitting - neutral posture

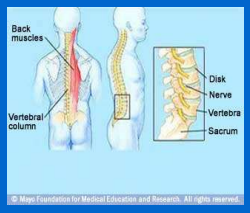


Sitting posture rotates pelvis backwards and flattens spine

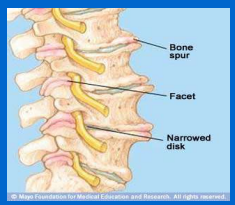


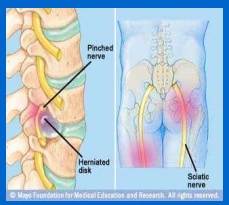
Standing Sitting

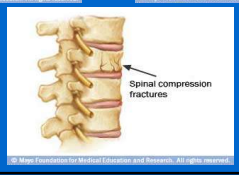
The Human Back
Muscles vs. Spine



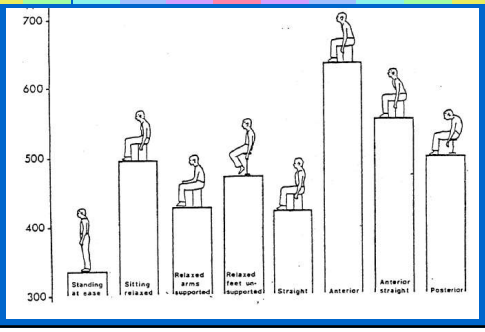
The Human Spine



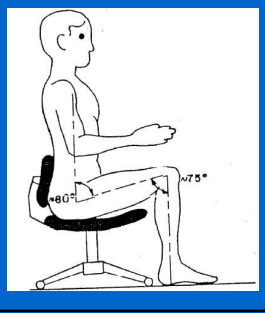




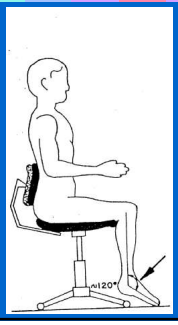
Effect of back posture on stress on lower back (in #'s PSI on L4-L5)

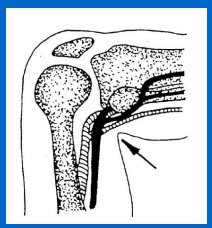


When chair is too low, the knee flexion angle becomes small and the weight is transferred to lower back



When chair is too high, it increases stress behind the knee, decreases blood circulation and increases pressure on the nerve.





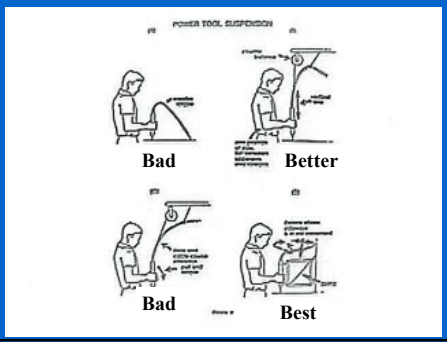
Forceful Exertion - Engineering Controls

- Use power tools instead of hand tools
- Use pneumatic tools with air disengagement clutch

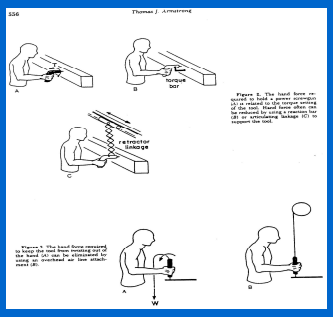
(torque reducer)

Forceful Exertion – Good Torque Arm and Handle Controls

Power Tool Suspension



Power Tool Suspension & Torque



Power Tool Suspension




Power Tool Suspension & Anti Torque Control

Forceful Exertion - Engineering Controls

- Provide good grips on tools (Increase coefficient of friction)
- Reduce friction when sliding an objective

Forceful Exertion - Engineering Controls

- Use power grip instead of pinch grip

In takes 4-5 times more force to pick up something using a pinch grip than a power grip.

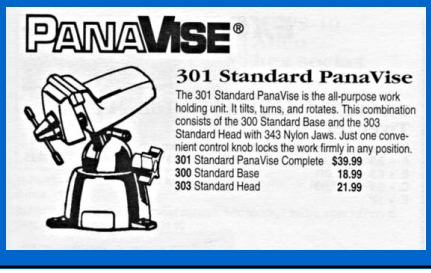
- Tool handle diameter for a power grip 1.0 - 1.75”

Grip Spans – Torque – Tactile vs. Slippery (oily) Parts

Grip Spans – Torque – Tactile vs. Slippery (wet) Parts

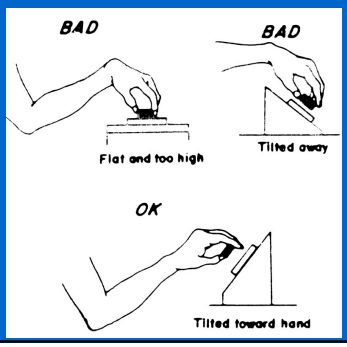
Forceful Exertion - Engineering Controls

- Use clamps & jigs for holding



Forceful Exertion - Engineering Controls – Good Fixture(s) Use

Work Surface Orientation



Forceful Exertion - Engineering Controls – Good Fixture Use

Forceful Exertion - Engineering Controls – Manual Fixture Bolt Up

Forceful Exertion - Engineering Controls – Good New Clamping Fixtures

Forceful Exertion - Engineering Controls

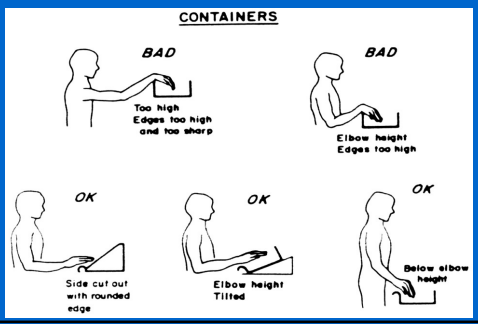
- Use ring flanges to reduce downward pressure

Forceful Exertion – Holding Tools

Forceful Exertion – Holding & Pushing Down on self tapping screws

Parts Container Placement:

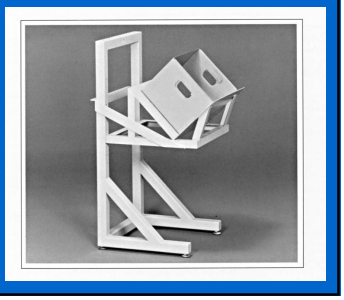
(Maintain neutral posture)



Parts Container Placement:

(Maintain neutral wrist/back postures)

Adjustable - Height Packing Stands



Parts Dispenser & Container Placements:

(Maintain neutral wrist/back postures)

Parts Container Access & Placement:

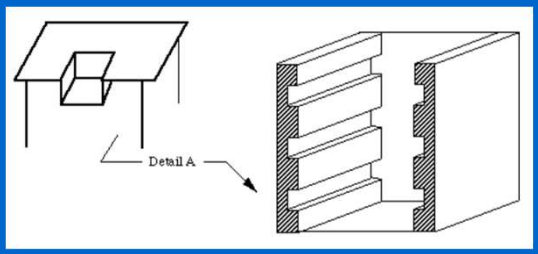
(Maintain neutral back posture)

Adjustable - Height Workstations

Adjustable - Height Workstations

Both adjustable for individual worker preferences

Multi - Level Worksurface



Adjustable - Height Workstations

Both adjustable for individual worker preferences

Adjustable - Height Workstations

Adjustable for individual worker preferences

Multi - Level Worksurface

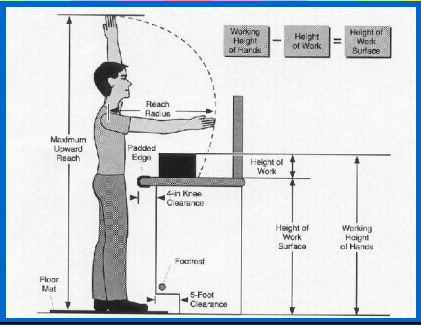
Standing Workstations

Standing Workstations - Engineering Controls

Standing workstations are preferred when the job regularly requires workers to:

- Lift objects weighing more than 10 lbs.
- Push downward
- Push or pull laterally
- Move between operations frequently
- When adequate knee space is not available

Working Height of hands - Ht of Work = Work Surface Height



Work Surface Heights for Multi-User Workstations

	Precision Work	Light Work	Heavy Work
Very Tall Adult	51 in	47 in	41 in
Average Adult	46 in	42 in	36 in
Very Short Adult	42 in	37 in	31 in

Work Surface Heights for Multi-User Workstations

Work Surface Heights

Variable Work (er) Surface Heights

Work Surface Heights – Power Tool Types & Orientation - Use Postures

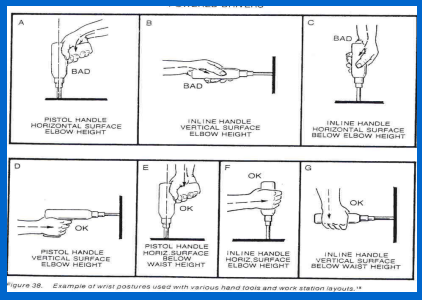


Figure 38. Example of wrist postures used with various hand tools and work station layouts.[4]

Work Surface Heights – Power Tool Types & Orientation - Use Postures

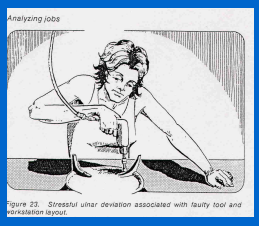


Figure 33. Stressful ulnar deviation associated with faulty tool and workstation layout.

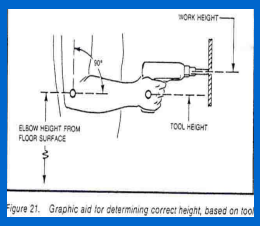


Figure 21. Graphic aid for determining correct height, based on tool

Work Surface Heights – Tool Use Postures

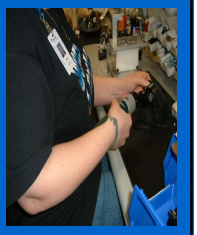

Work Surface Heights – Tool Use Postures


Work Surface Heights – Tool Use Postures


Work Surface Heights – Tool Use Postures


Work Surface Heights – Tool Use Postures





Work Surface Heights – Tool Use Postures


Work Surface Heights – Tool Use Postures


Work Surface Heights – Tool Use Postures

Standing Workstations - Engineering Controls

- Avoid foot controls for standing workers - Provide electric or pneumatic foot switches, designed for operation with either foot.
- Avoid elevated or mechanical foot actuated devices
- Provide a footrest up to 8 inches in height

Standing Workstations - Engineering Controls

- Avoid hard floors -
  Provide anti-fatigue matting for tasks with 2 or more hours of standing

Sitting Workstations

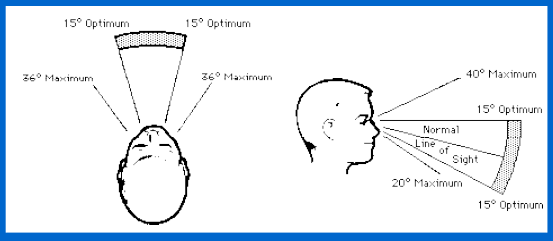
Sitting Workstations - Engineering Controls

Work Surface Height for Sitting Operators

- Writing or light assembly
  25.25 to 30.5 inches
- Coarse or medium work
  23.25 to 28.5 inches
  Adjust so hands are at elbow height

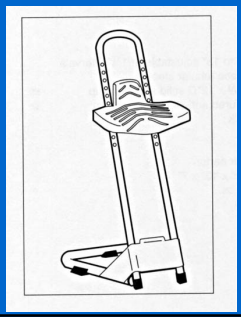
Sitting Workstations – Foot Rests

Avoid tilting the head more than 15 degrees forward

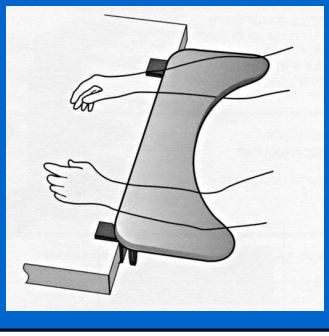


Characteristics of Ergonomic Chairs

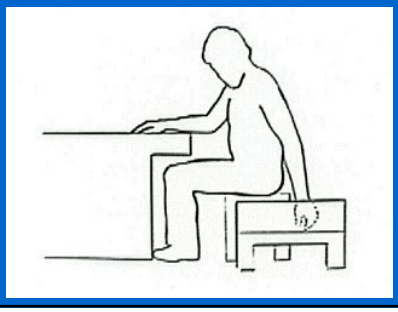
Sit/Stand Ergonomic Chairs



Arm rests to reduce static loading



Shoulder abduction:
Minimize reaching down and behind the body

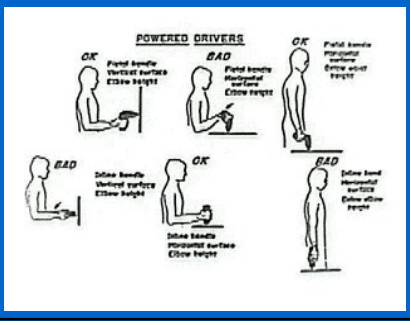


Hand Tools

Hand Tool Controls

- Provide a variety of hand tools
- Tool Handles should be textured, not smooth or highly polished
- Tools should fit hand comfortably
- Tools should allow for straight wrist
- Keep tools in good repair and cutting tools sharp

Proper match between work surface and power tool grip



Proper match between work surface and power tool grip

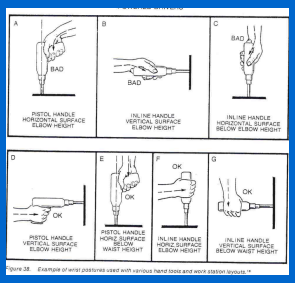
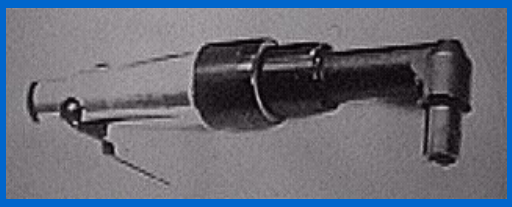
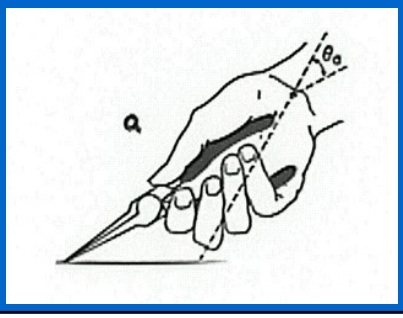


Figure 38. Example of wrist postures used with various hand tools and work station layouts.[4]

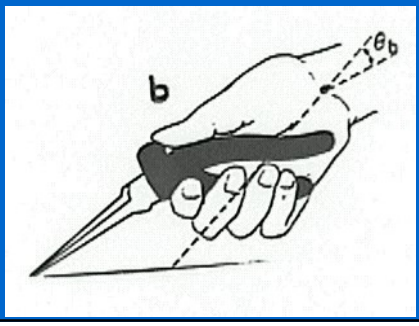
Angle nut runner enables straight wrist operation



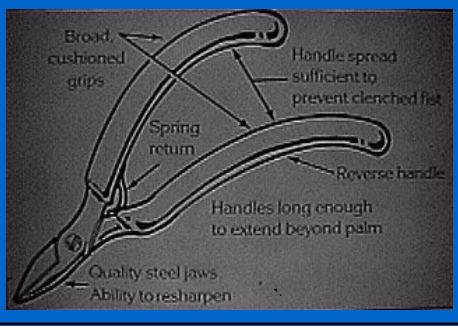
Awkward wrist postures using standard pliers



Design tool for straight wrist operation

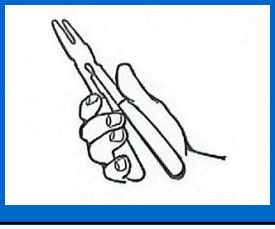


Spring Action Return Handle



Extend handle to accommodate:

- Finger span >3.75 “
- Hand grip > 4.5 “



Handle & Trigger Pressure Points

Figure 20. Example of how a hand tool can compress finger tendons (a). A sharp-edged tool (b) is more likely to produce injury than a rounded tool (c).

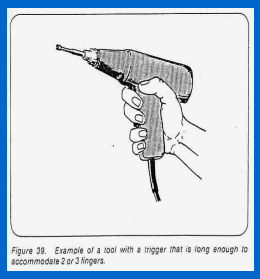
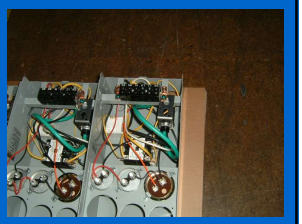


Figure 39. Example of a tool with a trigger that is long enough to accommodate 2 or 3 fingers.

Design tools & fixtures for straight wrist operation



Good Multiple Finger – Spade Grip Triggers

Single Finger Activation - Stressor

Vibration - Engineering Controls

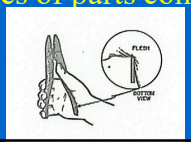
- Uncouple the operator
- Maintain light grip
- Use vibration absorbing materials
- Isolation mounts for handles
- Tool and equipment maintenance

Left Handed Workers

- **Approximately 10% of population (923 million people)**
- **Design for both right and left handed workers**
- **If not possible, two designs should be available**

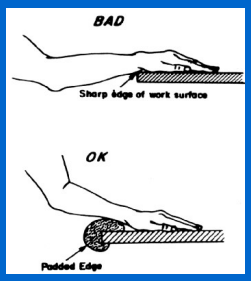
Mechanical Stress - Engineering Controls

- Tool Handle size
- Tool handle shape
- Avoid form - fitting handles
- Round edges of parts containers



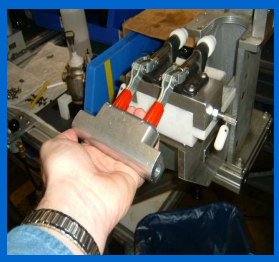
Mechanical Stress - Engineering Controls

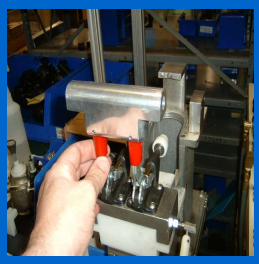
- Round edges of table tops



Mechanical Stress – Round & Pad Edges – Don't use Hand as Hammer

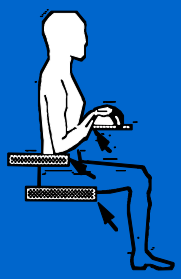
Mechanical Hand Stress – Good, Broad Pressure Points – Leverages





Mechanical Stress - Engineering Controls

- Pad edges of support surfaces

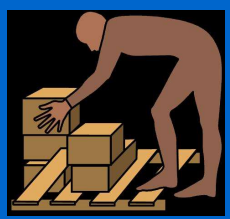


Mechanical Stress - Engineering Controls??

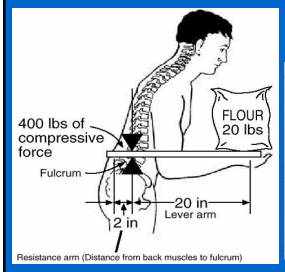
Mechanical Stress & Pressure - Engineering Controls??

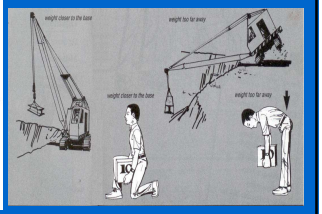
MMH - Manual Materials Handling

MMH – Palletizing



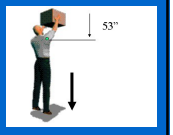
Spine – Fulcrum Forces

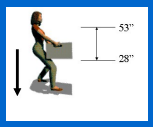


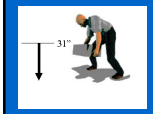


Liberty Mutual MMH – Task Evaluations

LibertyMutualTables.pdf

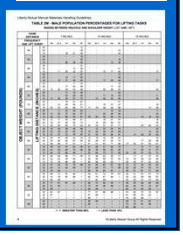






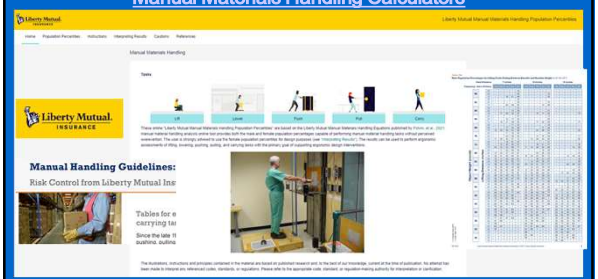
Task Evaluations on line at:
www.libertymutual.com

Manual Materials Handling | Liberty Mutual
Manual Materials Handling Tables



Liberty Mutual Manual Materials Handling (MMH) – Task Evaluations

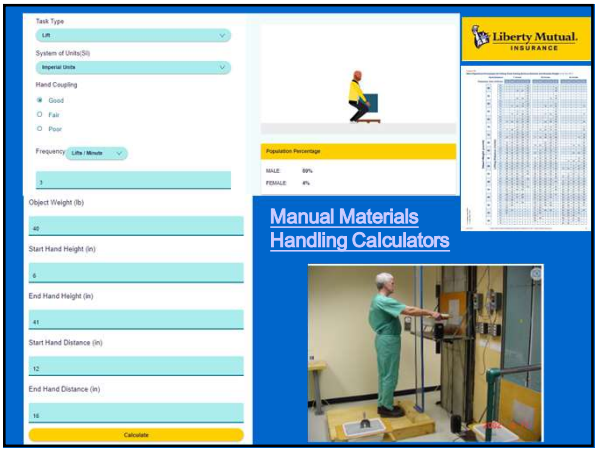
Manual Materials Handling Calculators

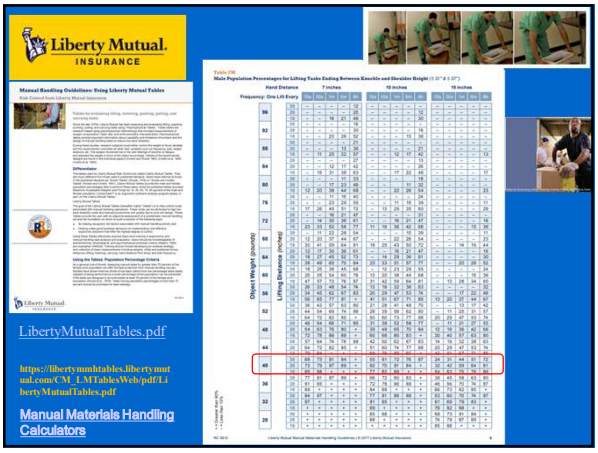


https://libertymmhtables.libertymutual.com/

Liberty Mutual Manual Materials Handling (MMH) – Task Evaluations

[Manual Materials Handling Calculators]





MMH – Liberty Task Evaluations

Component	Hand Height at Start (in)	Distance Moved	Hand Distance (in)	Force1 /Weight (initial) (pounds)	Force2 (sustained)(pounds)	Frequency	Twisting Angle	Reaching	Bending	Male %	Female %	Energy Expenditure (Kcal/min)	Max Male Dur.	Max Fem Dur.
Lift	18	36 in.	15	43	0	1. hr.	160	Considerable	Considerable	46	<10	2.15	8.0	8.0
Carry	31	20 ft.	0	43	0	1. hr.	0		None	>90	50	2.15	8.0	8.0

	Twist Angle	Reaching	Bending	Energy Expenditure (Kcal/min.)	Male %	Female %	Max Male Dur.	Max Fem Dur.
EVALUATION FORENTIRE TASK	160	Considerable	Considerable	2.16	46	<10	8.	8.

MMH - Manual Materials Handling Convert Verticle to Lateral

Manual Lifting & Palletizing – Limit to Pallets to Below Heart Height

MMH – Liberty Task Evaluation
MMH – Palletizing 2510's

Component	Hand Height at Start (in)	Distance Moved	Hand Distance (in)	Force1/ Weight (initial)(pounds)	Force2 (sustained)(pounds)	Frequency	Twisting Angle	Reaching	Bending	Male %	Female %	Energy Expenditure (Kcal/min)	Max Male Dur.	Max Fem Dur.
Lower	16	10 in.	10	20	0	20. min.	15	Moderate	Considerable	>90	>90	2.15	8.0	8.0
Lift	16	6 in.	10	20	0	20. min.	10	Moderate	Considerable	>90	>90	2.15	8.0	8.0
Lift	16	22 in.	10	20	0	20. min.	10	Moderate	Considerable	>90	86	2.15	8.0	8.0
Lift	16	38 in.	10	20	0	20. min.	10	Moderate	Considerable	>90	54	2.16	8.0	8.0
Lift	16	54 in.	10	20	0	20. min.	10	Moderate	Considerable	>90	22	2.16	8.0	8.0

	Twist Angle	Reaching	Bending	Energy Expenditure (Kcal/min.)	Male %	Female %	Max Male Dur.	Max Fem Dur.
EVALUATION FOR ENTIRE TASK	15	Moderate	Considerable	2.15	>90	22	8.0	8.0

Liberty Mutual - Residual Risk Reduction (R3) Worksheet
"Current Methods"

Hazard	Existing Controls	Frequency	Likelihood	Severity	Risk
Palletizing outbound units/boxes - tier 1 onto outbound pallet	Box weights under 20#'s; Safety Lifting Training; Controlled "lower" guide to pallet	5	3	3	45
Palletizing outbound units/boxes - tiers 2 & 3 onto outbound pallet	Box weights under 20#'s; Safety Lifting Training; Controlled "handling in mid range" onto pallet (MMH between knuckle height to heart heights)	5	2	3	30
Palletizing outbound units/boxes - tiers 4 & 5 onto outbound pallet	Box weights under 20#'s; Lifting / "handling in mid range" onto pallet (MMH between knuckle height to heart heights)	5	4	4	80
					0
				Risk Index:	155

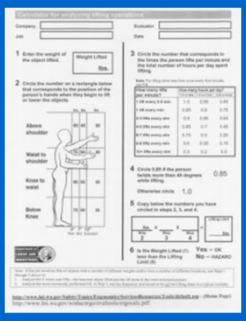
Liberty Mutual - Residual Risk Reduction (R3) Worksheet
"Proposed Revised Methods"

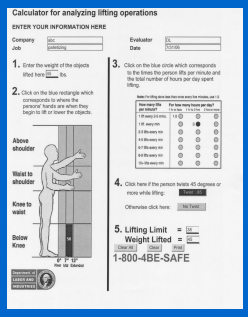
Hazard	Proposed - New Controls	Frequency	Likelihood	Severity	Risk
Palletizing outbound units/boxes - tier 1 onto outbound pallet	Box weights under 20#'s; Safety Lifting Training; Controlled "lower" guide to pallet	5	3	3	45
Palletizing outbound units/boxes - tiers 2 & 3 onto outbound pallet	Box weights under 20#'s; Safety Lifting Training; Controlled "handling in mid range" onto pallet (MMH between knuckle height to heart heights)	5	2	3	30
Prohibiting the Palletizing of outbound units/boxes - tiers 4 & 5 onto outbound pallet	No manual lifting or handling of boxes over 3rd tier (above heart height) allowed	0	0	0	0
					0
				Risk Index:	75

R3 = 52%

MMH – NIOSH Lifting Equation
State of WA –

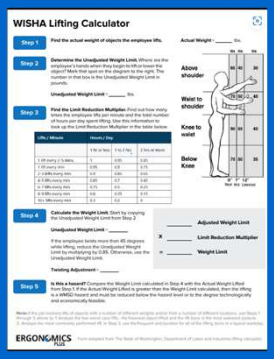
https://lni.wa.gov/safety-health/safety-topics/search-by-topic?query=sprainsStrains





https://lni.wa.gov/safety-health/safety-topics/search-by-topic?query=sprainsStrains

MMH – NIOSH Lifting Equation _ State of WA –



A Step-by-Step Guide to the WISHA Lifting Calculator (ergo-plus.com)

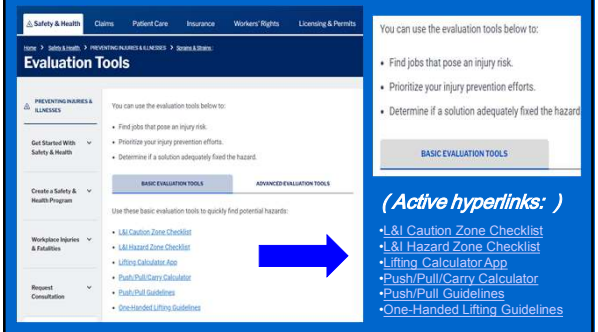
Measure & Enter Task Variables
Task variables needed to calculate the Weight Limit and Lifting Index when using the WISHA Lifting Calculator:

1) Weight
2) Vertical Hand Position
3) Horizontal Hand Position
4) Frequency
5) Duration
6) Twisting

wisha-lifting-calculator-1.png (489×637) (ergo-plus.com)

Evaluation Tools (wa.gov)

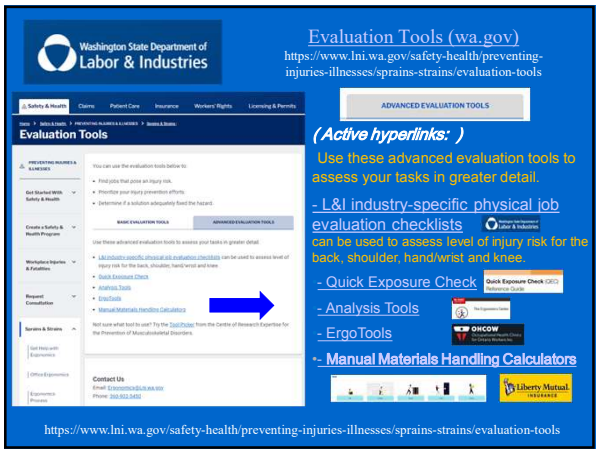
https://www.lni.wa.gov/safety-health/preventing-injuries-illnesses/sprains-strains/evaluation-tools



(Active hyperlinks:)

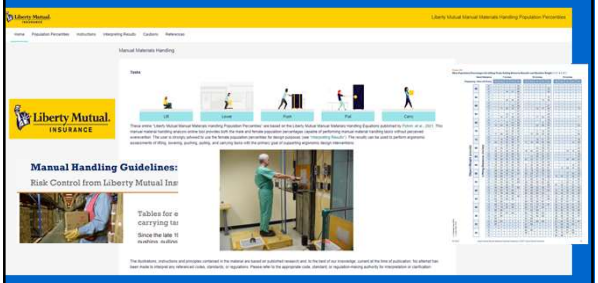
- L&I Caution Zone Checklist
- L&I Hazard Zone Checklist
- Lifting Calculator App
- Push/Pull/Carry Calculator
- Push/Pull Guidelines
- One-Handed Lifting Guidelines

https://www.lni.wa.gov/safety-health/preventing-injuries-illnesses/sprains-strains/evaluation-tools



Liberty Mutual Manual Materials Handling (MMH) – Task Evaluations

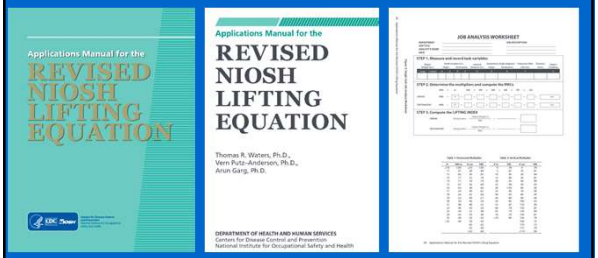
Manual Materials Handling Calculators



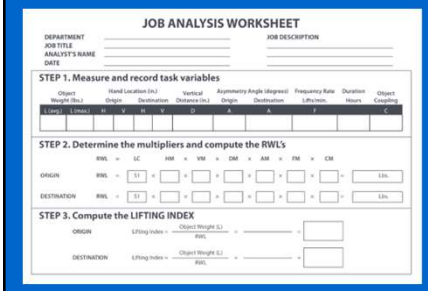
https://libertymmhtables.libertymutual.com/

NIOSH Lifting Equation

https://www.cdc.gov/niosh/docs/94-110/default.html



NIOSH Lifting Equation
https://www.cdc.gov/niosh/docs/94-110/default.html



JOB ANALYSIS WORKSHEET

DEPARTMENT
JOB TITLE
ANALYST'S NAME
DATE

JOB DESCRIPTION

STEP 1. Measure and record task variables

Object Weight (lbs.)		Hand Location (in.)				Vertical Distance (in.)	Asymmetry Angle (degrees)		Frequency Rate Lifts/min.	Duration Hours	Object Coupling
L (wt.)	L (meas.)	H	V	H	V	D	A	A	F		C

STEP 2. Determine the multipliers and compute the RWL's

	RWL	=	LC	×	HM	×	VM	×	DM	×	AM	×	FM	×	CM	
ORIGIN	RWL	=	51	×		×		×		×		×		×		= Lbs.
DESTINATION	RWL	=	51	×		×		×		×		×		×		= Lbs.

STEP 3. Compute the LIFTING INDEX

ORIGIN: Lifting Index = Object Weight (L) / RWL = ____ = ____

DESTINATION: Lifting Index = Object Weight (L) / RWL = ____ = ____

Task Measurement Variables

1) Weight
2) Origin Hand Loc
3) Destination Hand Loc
4) Vertical Distance
5) Asymmetry Angle (degree
6) Frequency
7) Duration
8) Coupling

NIOSH Lifting Equation
https://www.cdc.gov/niosh/docs/94-110/default.html

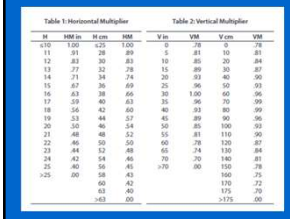


Table 1: Horizontal Multiplier

H	HM in	H cm	HM
≤10	1.00	≤25	1.00
11	.91	28	.89
12	.83	30	.83
13	.77	32	.78
14	.71	34	.74
15	.67	36	.69
16	.63	38	.66
17	.59	40	.63
18	.56	42	.60
19	.53	44	.57
20	.50	46	.54
21	.48	48	.52
22	.46	50	.50
23	.44	52	.48
24	.42	54	.46
25	.40	56	.45
>25	.00	58	.43
		60	.42
		63	.40
		>63	.00

Table 2: Vertical Multiplier

V in	VM	V cm	VM
0	.78	0	.78
5	.81	10	.81
10	.85	20	.84
15	.89	30	.87
20	.93	40	.90
25	.96	50	.93
30	1.00	60	.96
35	.96	70	.99
40	.93	80	.99
45	.89	90	.96
50	.85	100	.93
55	.81	110	.90
60	.78	120	.87
65	.74	130	.84
70	.70	140	.81
>70	.00	150	.78
		160	.75
		170	.72
		175	.70
		>175	.00

Table 7: Coupling Multiplier

Coupling Type	CM V<30 in	CM V≥30 in
Good	1.00	1.00
Fair	.95	1.00
Poor	.90	.90

A series of general design/redesign suggestions for each job-related risk factor are provided in Table 8. These suggestions can be used to develop a practical ergonomic design/redesign strategy.

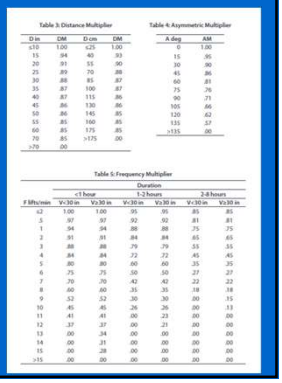


Table 3: Distance Multiplier

D in	DM	D cm	DM
≤10	1.00	≤25	1.00
15	.94	40	.93
20	.91	55	.90
25	.89	70	.88
30	.88	85	.87
35	.87	100	.87
40	.87	115	.86
45	.86	130	.86
50	.86	145	.85
55	.85	160	.85
60	.85	175	.85
70	.85	>175	.00
>70	.00		

Table 4: Asymmetric Multiplier

A deg	AM
0	1.00
15	.95
30	.90
45	.86
60	.81
75	.76
90	.71
105	.66
120	.62
135	.57
>135	.00

Table 5: Frequency Multiplier

F lifts/min	Duration <1 hour V<30 in	Duration <1 hour V≥30 in	Duration 1-2 hours V<30 in	Duration 1-2 hours V≥30 in	Duration 2-8 hours V<30 in	Duration 2-8 hours V≥30 in
≤2	1.00	1.00	.95	.95	.85	.85
.5	.97	.97	.92	.92	.81	.81
1	.94	.94	.88	.88	.75	.75
2	.91	.91	.84	.84	.65	.65
3	.88	.88	.79	.79	.55	.55
4	.84	.84	.72	.72	.45	.45
5	.80	.80	.60	.60	.35	.35
6	.75	.75	.50	.50	.27	.27
7	.70	.70	.42	.42	.22	.22
8	.60	.60	.35	.35	.18	.18
9	.52	.52	.30	.30	.00	.15
10	.45	.45	.26	.26	.00	.13
11	.41	.41	.00	.23	.00	.00
12	.37	.37	.00	.21	.00	.00
13	.00	.34	.00	.00	.00	.00
14	.00	.31	.00	.00	.00	.00
15	.00	.28	.00	.00	.00	.00
>15	.00	.00	.00	.00	.00	.00

NIOSH Lifting Equation
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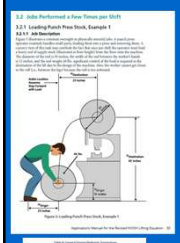
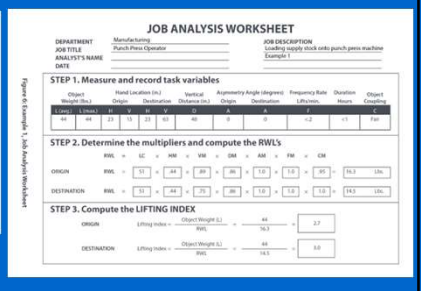




JOB ANALYSIS WORKSHEET

DEPARTMENT: Manufacturing
JOB TITLE: Punch Press Operator
ANALYST'S NAME
DATE

JOB DESCRIPTION: Loading supply stock onto punch press machine
Example 1

STEP 1. Measure and record task variables

Object Weight (lbs.)		Hand Location (in.)				Vertical Distance (in.)	Asymmetry Angle (degrees)		Frequency Rate Lifts/min.	Duration Hours	Object Coupling
L (wt.)	L (meas.)	H	V	H	V	D	A	A	F		C
44	44	23	15	23	63	40	0	0	<.2	<1	Fair

STEP 2. Determine the multipliers and compute the RWL's

	RWL	=	LC	×	HM	×	VM	×	DM	×	AM	×	FM	×	CM	
ORIGIN	RWL	=	51	×	.44	×	.89	×	.86	×	1.0	×	1.0	×	.95	= 16.3 Lbs.
DESTINATION	RWL	=	51	×	.44	×	.75	×	.86	×	1.0	×	1.0	×	1.0	= 14.5 Lbs.

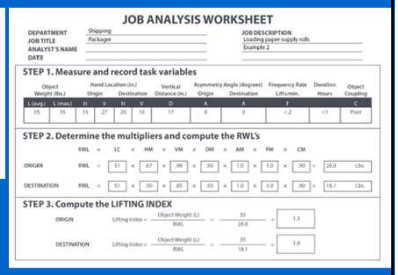
STEP 3. Compute the LIFTING INDEX

ORIGIN: Lifting Index = Object Weight (L) / RWL = 44 / 16.3 = 2.7

DESTINATION: Lifting Index = Object Weight (L) / RWL = 44 / 14.5 = 3.0

Figure 6. Example 1, Job Analysis Worksheet

NIOSH Lifting Equation
https://www.cdc.gov/niosh/docs/94-110/default.html



JOB ANALYSIS WORKSHEET

DEPARTMENT: Shipping
JOB TITLE: Packager
ANALYST'S NAME:
DATE:
JOB DESCRIPTION: Loading paper supply rolls, Example 2

STEP 1. Measure and record task variables

Object Weight (lbs.)		Hand Location (in.)				Vertical Distance (in.)	Asymmetry Angle (degrees)		Frequency Rate	Duration	Object Coupling
		Origin		Destination			Origin	Destination	Lifts/min.	Hours	
L (lbs.)	L (max.)	H		H	V	D	A	A	F		C
15	35	15	27	20	10	17	0	0	<.2	<1	Poor

STEP 2. Determine the multipliers and compute the RWL's

	RWL	=	LC	×	HM	×	VM	×	DM	×	AM	×	FM	×	CM		
ORIGIN	RWL	=	51	×	.67	×	.96	×	.93	×	1.0	×	1.0	×	.90	=	28.0 LBs.
DESTINATION	RWL	=	51	×	.50	×	.85	×	.93	×	1.0	×	1.0	×	.90	=	18.1 LBs.

STEP 3. Compute the LIFTING INDEX

ORIGIN	Lifting Index =	Object Weight (L) / RWL	= 35 / 28.0	=	1.3
DESTINATION	Lifting Index =	Object Weight (L) / RWL	= 35 / 18.1	=	1.9

NIOSH Lifting Equation
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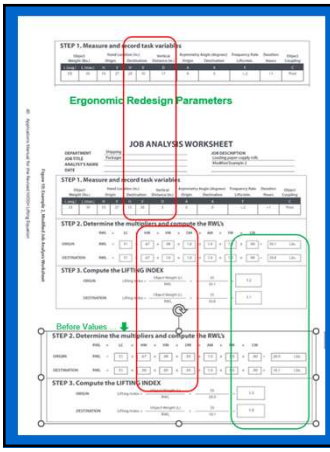

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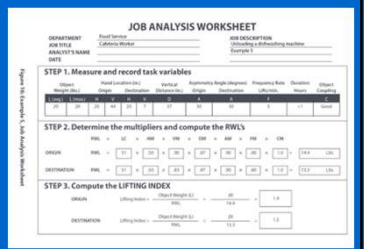


JOB ANALYSIS WORKSHEET

DEPARTMENT: Food Service
JOB TITLE: Cafeteria Worker
ANALYST'S NAME:
DATE:
JOB DESCRIPTION: Unloading a dishwashing machine, Example 5

STEP 1. Measure and record task variables

Object Weight (lbs.)		Hand Location (in.)				Vertical Distance (in.)	Asymmetry Angle (degrees)		Frequency Rate	Duration	Object Coupling
		Origin		Destination			Origin	Destination	Lifts/min.	Hours	
L (lbs.)	L (max.)	H		H	V	D	A	A	F		C
27	30	20	30	20	7	37	30	30	1	<1	Good

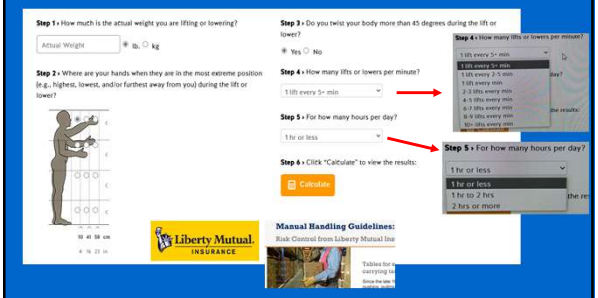
STEP 2. Determine the multipliers and compute the RWL's

	RWL	=	LC	×	HM	×	VM	×	DM	×	AM	×	FM	×	CM		
ORIGIN	RWL	=	51	×	.50	×	.96	×	.87	×	.90	×	.80	×	1.0	=	14.4 LBs.
DESTINATION	RWL	=	51	×	.50	×	.85	×	.87	×	.90	×	.80	×	1.0	=	13.3 LBs.

STEP 3. Compute the LIFTING INDEX

ORIGIN	Lifting Index =	Object Weight (L) / RWL	= 20 / 14.4	=	1.4
DESTINATION	Lifting Index =	Object Weight (L) / RWL	= 20 / 13.3	=	1.5

WorkSafe BC - Lift/Lower Calculator (worksafebcmedia.com)



WorkSafeBC Lift/Lower Calculator (worksafebcmedia.com)

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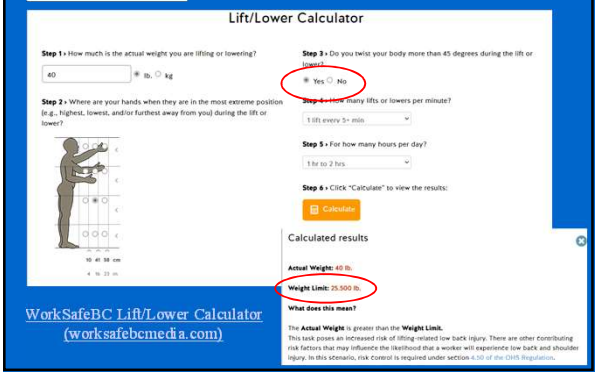

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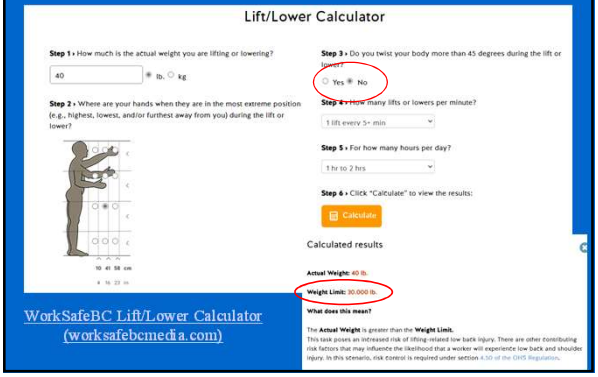

WorkSafeBC Lift/Lower Calculator (worksafebcmedia.com)

Manual Lifting & Palletizing – Team Lifts Where Necessary

Manual Lifting – Raise Parts to Avoid Below Knuckle Heights

Manual Lifting – Avoid Below Knuckle Height Lifts

Tilt workstation towards worker to reduce reaching and bending motions

Manual vs. Mechanical Lifting – Avoid Excessive Weights & Adverse Postures

Use a fixture or jig to reposition work surface to minimize body posture deviations

Partners
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CORPORATE SAFETY AWARDS

"Safety, A Way Of Life - Everyone goes home safe, whole and healthy, every day"

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Ergonomics - MMH & Cumulative Trauma Disorders

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Notes