OSC 10
Ohio Safety Congress & Expo

Common Tools for Assessing Ergonomics Risk Factors

Part One, Session #252

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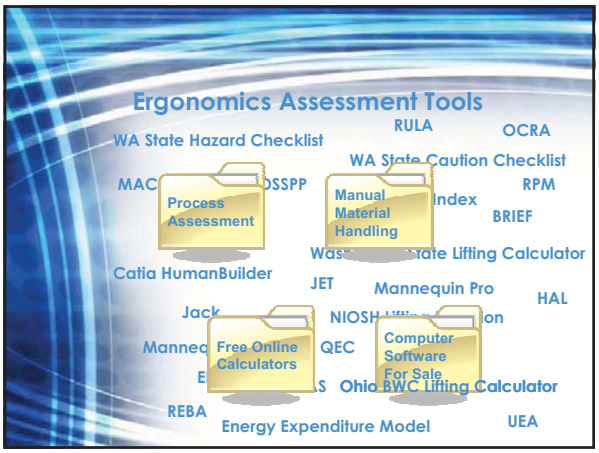
Comparing Ergonomics Guidelines and Assessment Tools

Ergonomics Assessment Tools

RULA
OCRA
WA State Hazard Checklist
WA State Caution Checklist
MAC
3DSSPP
RPM
Strain Index
MFA
BRIEF
ManTRA
Washington State Lifting Calculator
Catia HumanBuilder
JET
Mannequin Pro
HAL
Jack
NIOSH Lifting Equation
Mannequin Pro
QEC
EJA
EPF
WIN OWAS
Ohio BWC Lifting Calculator
REBA
Energy Expenditure Model
UEA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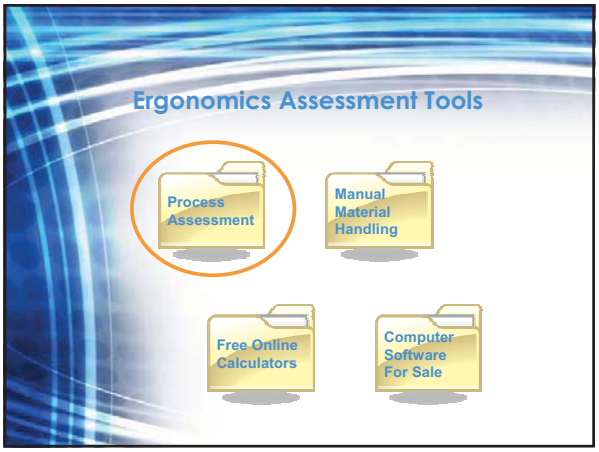
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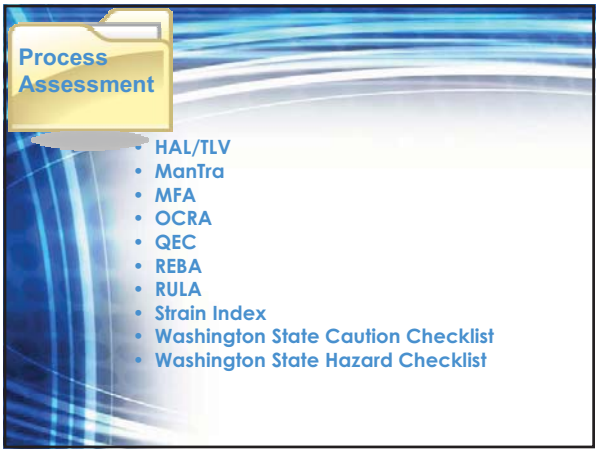
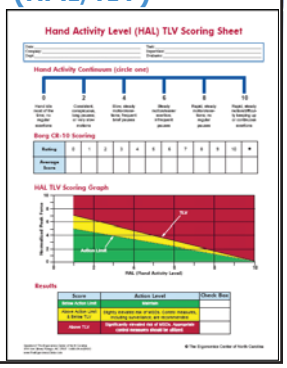

Process Assessment
• HAL/TLV
• ManTra
• MFA
• OCRA
• QEC
• REBA
• RULA
• Strain Index
• Washington State Caution Checklist
• Washington State Hazard Checklist

Process Assessment

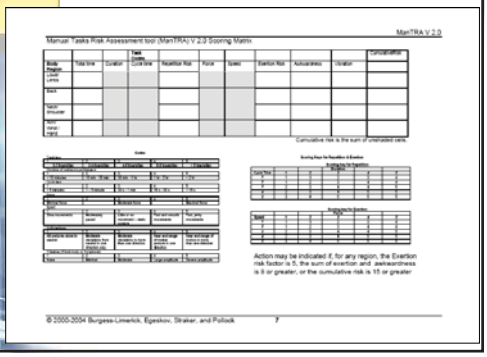
Hand Activity Level (HAL/TLV)

- ACGIH Threshold Limit Value and Action Limit for Hand Activity Level
- Length: 1-page
- Use for:
  - Detailed upper extremity analysis for mono-task processes
- Inputs:
  - Hand activity rating
  - Peak force rating
- Outputs
  - Score indicating action required



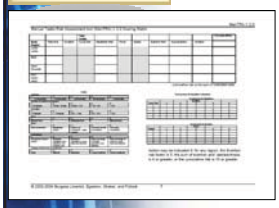
Process Assessment

ManTRA



Process Assessment

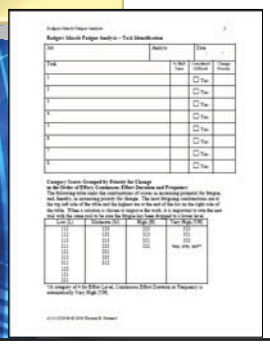
ManTRA

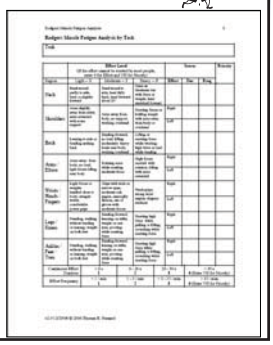


- Developed in Australia for health and safety inspectors
- Length: 1-page
- Use for:
  - Process level evaluation of entire body risk exposure for manual work
- Inputs:
  - 9 inputs from process and look-up tables
    - Total time, duration of continuous performance, cycle time, force, speed, awkwardness, vibration, repetition, and exertion
- Outputs:
  - Recommendations for countermeasure when:
    - Exertion > 5
    - Exertion + Awkwardness >=8
    - Cumulative Risk >=15

Process Assessment

Muscle Fatigue Assessment (MFA)

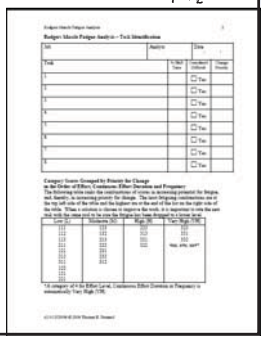




Process Assessment

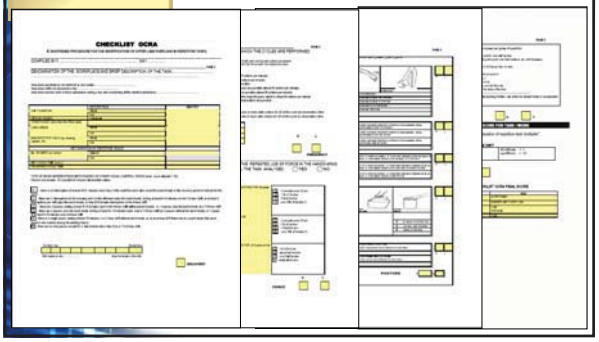
Muscle Fatigue Assessment (MFA)

- Developed by Rodgers to measure potential muscle fatigue
  - (theory: fatigue increases injury risk)
- Length: 1-page per task, plus summary sheet
- Use for:
  - Detailed analysis of processes performed for at least 1 hour or where awkward postures or frequent exertions are present
- Inputs:
  - Effort, duration, and frequency ratings by body part for each process task
- Outputs:
  - Ratings of fatigue potential by task (Low, Moderate, High, Very High)



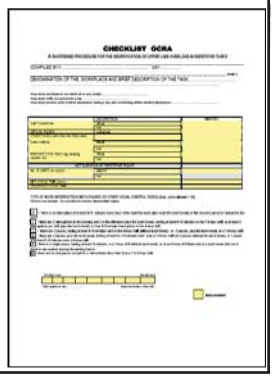
Process Assessment

OCRA



Process Assessment

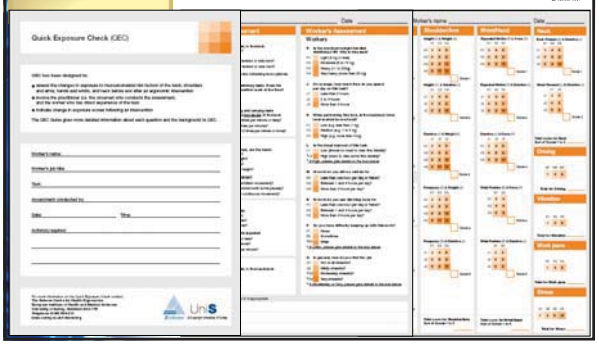
OCRA



- Developed in Italy and used in the European Union (translated to English)
- Length: 4-pages long
- Use for:
  - Identifying upper extremity risk in repetitive tasks
- Inputs:
  - Multiple ratings of ergonomics risk factors
- Outputs:
  - OCRA Checklist Score and OCRA Index provide a color rating =risk rating (Green= Borderline/Very Low, Yellow=Acceptable, Low Red=Low, Average Red=Average, Very Red/Violet=High)

Process Assessment

Quick Exposure Check (QEC)



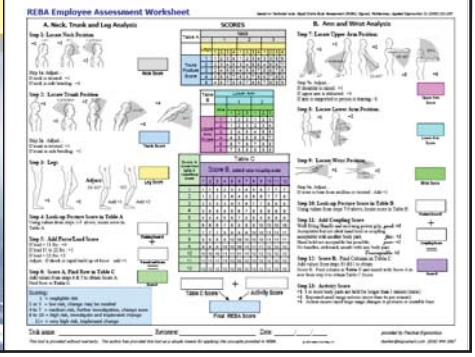
Process Assessment

Quick Exposure Check (QEC)

- Developed in United Kingdom for the Health and Safety Executive
- Length: 3-pages
  - (1st page is cover sheet, 2nd page assessment, 3rd page scores)
- Use for:
  - Assessment of musculoskeletal risk factor exposure for back, shoulders, arms, hands, wrists, and neck
- Inputs:
  - Associate feedback
  - Risk factor and exposure ratings and scores from interaction tables
- Outputs:
  - Multiple scores that can be used for prioritization, countermeasure development, etc.

Process Assessment

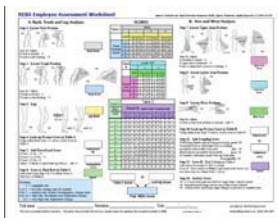
Rapid Entire Body Assessment (REBA)



Process Assessment

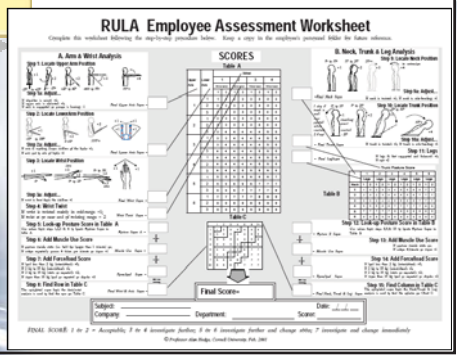
Rapid Entire Body Assessment (REBA)

- Developed by Hignett & McAtamney at the University of Nottingham (UK)
- Length: 1-page checklist and 1-page job aid with "look up" tables
- Use for:
  - **Quick process assessment of ergonomics risk to entire body**
- Inputs:
  - **Observed ratings for posture and force**
  - **Scores from form's lookup tables**
- Outputs:
  - **REBA score with Risk Level table**
    - **1=Negligible**
    - **2-3=Low**
    - **4-7=Medium**
    - **8-10=High**
    - **11-15=Very High**



Process Assessment

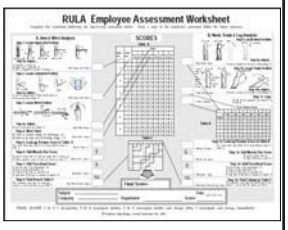
Rapid Upper Limb Assessment (RULA)



Process Assessment

Rapid Upper Limb Assessment (RULA)

- Developed by McAtamney & Corlett at the University of Nottingham (UK)
- Length: 1-page
- Use for:
  - **Quick process assessment of ergonomics risk to upper extremities**
- Inputs:
  - **Observed ratings for posture and force**
  - **Scores from form's lookup tables**
- Outputs:
  - **RULA score with guidance on further actions necessary**
    - **1 or 2=Acceptable**
    - **3 or 4=Investigate further**
    - **5 or 6=Investigate further & change SOON**
    - **7=Investigate further & change IMMEDIATELY**



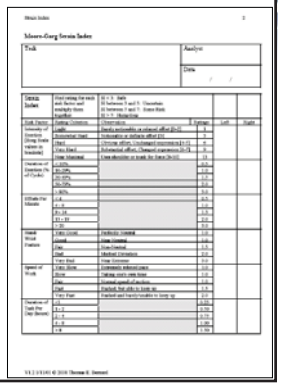
Process Assessment

Strain Index

Process Assessment

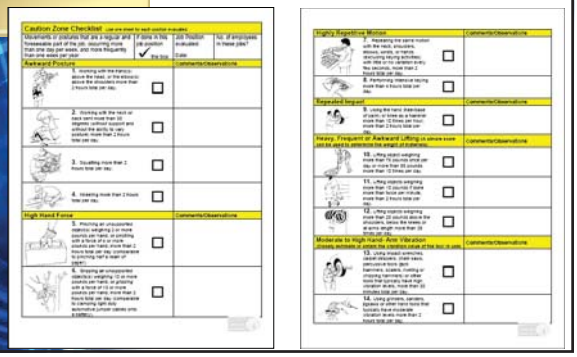
Strain Index

- **Developed by Moore and Garg**
- **Length: 1-page**
- **Use for:**
  - **Assessment of risk to hand & wrists**
- **Inputs:**
  - **6 inputs**
    - **Intensity of exertion, duration of exertion, efforts per minute, hand/wrist posture, speed of work, duration of task per day**
- **Outputs:**
  - **Strain Index score**
    - **<3 is "Safe"**
    - **Between 3 and 5 is "Uncertain"**
    - **Between 5 and 7 is "Some Risk"**
    - **>7 is "Hazardous"**



Process Assessment

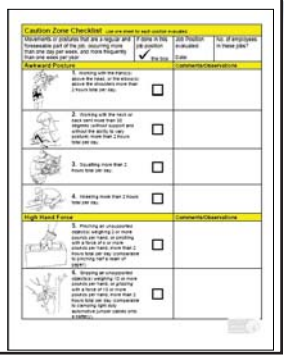
Washington State Caution Checklist



Process Assessment

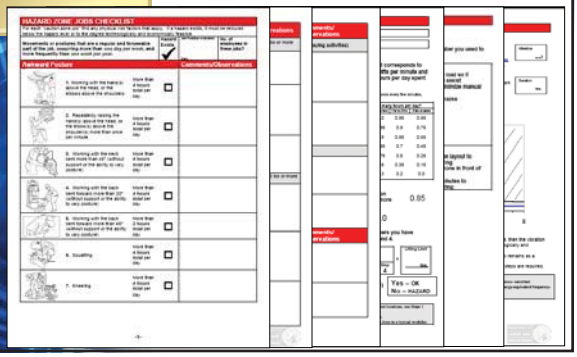
Washington State Caution Checklist

- Developed by Washington State Department of Labor and Industries
- Length: 2-pages
- Use for:
  - **Detailed process analysis when movements or postures are regular and foreseeable part of the job (occurring more than one day per week, and more frequently than one week per year)**
- Inputs:
  - **14 ergo risk factor inputs per process**
- Outputs:
  - **List of physical risk factors that may need additional investigation**
  - **Count of check boxes could be used for prioritization of ergo activities**



Process Assessment

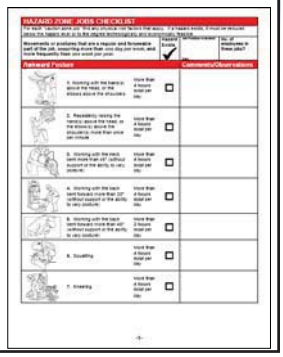
Washington State Hazard Checklist



Process Assessment

Washington State Hazard Checklist

- Developed by Washington State Department of Labor and Industries
- Length: 6-pages
- Use for:
  - **Detailed process analysis when movements or postures are regular and foreseeable part of the job (occurring more than one day per week, and more frequently than one week per year)**
  - **Issues identified on Washington State's Caution Checklist**
- Inputs:
  - **Multiple inputs for many ergonomics risk factors (posture, vibration, etc.)**
- Outputs:
  - **List of physical risk factors to resolve**


HAZARD ZONE JOBS CHECKLIST

Hazard Factor			Comments/Observations
1. Working with the hands above the head, or the elbows above the shoulder	More than 4 hours total per day	☐	
2. Repeatedly raising the hand(s) above the head, or the elbow(s) above the shoulder(s) more than once per minute	More than 4 hours total per day	☐	
3. Working with the neck bent more than 45° (without support of the arm), to very intensive	More than 4 hours total per day	☐	
4. Working with the back bent forward more than 30° (without support of the arm), to very intensive	More than 4 hours total per day	☐	
5. Working with the back bent forward more than 45° (without support of the arm), to very intensive	More than 2 hours total per day	☐	
6. Squatting	More than 4 hours total per day	☐	
7. Kneeling	More than 4 hours total per day	☐	

Ergonomics Assessment Tools

- Process Assessment
- Manual Material Handling
- Free Online Calculators
- Computer Software For Sale

Manual Material Handling

- Liberty Mutual Manual Material Handling Tables
- MAC (Manual Handling Assessment Tables)
- NIOSH Lifting Equation
- Ohio BWC Lifting Guidelines
- Washington State Lifting Calculator

Manual Material Handling

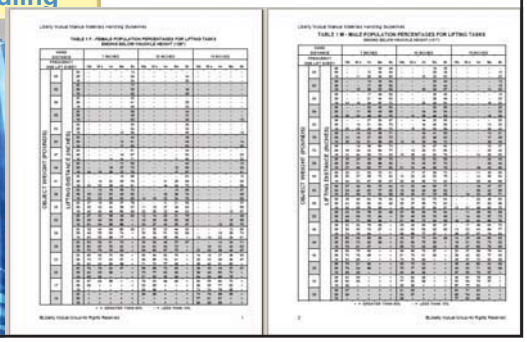
Liberty Mutual Manual Material Handling Tables

- Developed by Stover Snook
- Length: Many tables
- Use for:
  - Evaluation of most manual material handling tasks
- Inputs:
  - Multiple inputs for gender, activity, work heights, etc.
- Outputs:
  - Percentile of population protected

http://libertymmhtables.libertymutual.com/CM_LMTablesWeb/pdf/LibertyMutualTables.pdf

Manual Material Handling

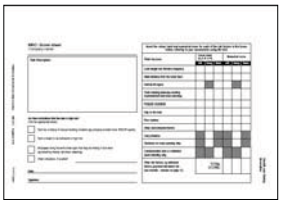
Liberty Mutual Manual Material Handling Tables



Manual Material Handling

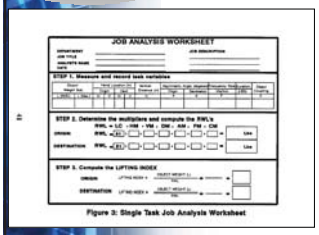
MAC (Manual Handling Assessment Tables)

- Developed in the UK for the Health and Safety Executive
- Length: 1-page
- Use for:
  - Analysis of manual material handling tasks including lifting, carrying, and team lifts
- Inputs:
  - Color ratings for several different aspects of the lifting or carrying tasks
- Outputs:
  - Color risk rating (Green, Amber, Red, or Violet color rating)



Manual Material Handling

NIOSH Lifting Equation

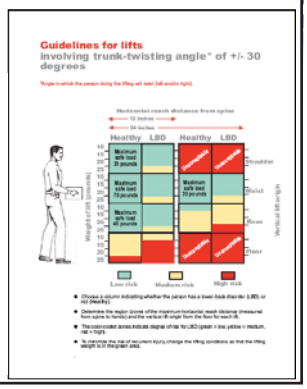


- Developed by National Institute of Occupational Safety and Health
- Length: 1-page
- Use for:
  - Evaluation of manual lifting tasks
  - Many assumptions about lifting conditions
- Inputs:
  - Object weight, H, V, D, A, F, Lifting duration, and Coupling
- Outputs:
  - Recommended Weight Limit (RWL)
  - Lifting Index (LI)

Manual Material Handling

Ohio BWC Lifting Guidelines

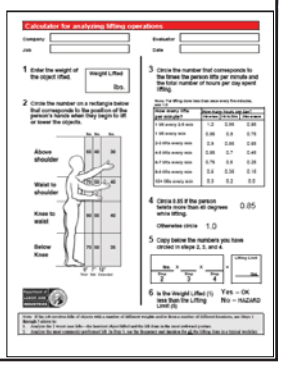
- Developed by the Ohio Bureau of Workers' Compensation
- Length: 3 look-up tables
- Use for:
  - Analysis of lifting task
  - Includes values for associates who have a low back disorder
- Inputs:
  - Health of associate, weight of lift, horizontal reach distance from spine
- Outputs:
  - Risk rating (Low, Medium, High)



Manual Material Handling

Washington State Lifting Calculator

- Developed by Washington State Department of Labor and Industries
- Length: 1-page
- Use for:
  - Analysis of lifting tasks
- Inputs:
  - Object weight, position of hands at beginning of lift, frequency, hours per day, twisting
- Outputs:
  - Lifting Limit
  - Rating: OK or Hazard



Ergonomics Assessment Tools

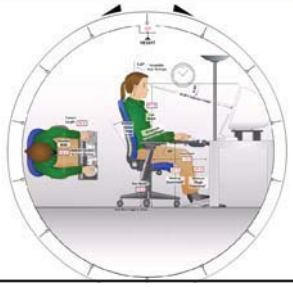
- Process Assessment
- Manual Material Handling
- Free Online Calculators
- Computer Software For Sale

Free Online Calculators

- Auburn Engineers, Inc. Work Height Calculators
  - http://www.ergopage.com/?q=node/27
- NIOSH Lifting Equation
  - Single-task
    - http://www.ccohs.ca/oshanswers/ergonomics/niosh/calculating_rwl.html
  - Multi-task
    - http://www.engin.umich.edu/dept/ioe/C4E/downloads/nioshwpg.zip
- Ohio BWC Lifting Guidelines
  - http://www.ohiobwc.com/employer/programs/safety/liftguide/liftguide.asp
- Online RULA Calculator
  - http://www.rula.co.uk/
- OSHA Injury Cost Calculator
  - http://www.osha.gov/SLTC/etools/safetyhealth/mod1_estimating_costs.html
- WIN OWAS
  - http://turva1.me.tut.fi/owas/

Free Online Calculators

Auburn Engineers, Inc. Work Height Calculators
http://www.ergopage.com/?q=node/27



Free Online Calculators

- NIOSH Lifting Equation
  - Single-task
    - http://www.ccohs.ca/oshanswers/ergonomics/niosh/calculating_rwl.html
  - Multi-task
    - http://www.engin.umich.edu/dept/ioe/C4E/downloads/nioshwpg.zip

NIOSH LIFTING GUIDELINE: JOB ANALYSIS WORKSHEET

DEPARTMENT
JOB TITLE
ANALYST
DATE

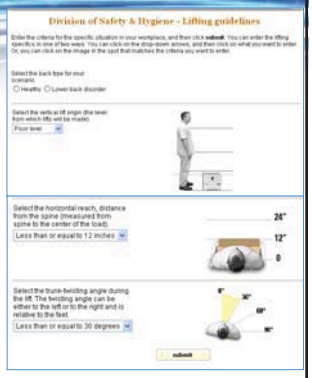
JOB DESCRIPTION

Task No.	RWL	LI	Object Wt. (lbs) C (avg)	C (max)	Hand Location (in.) Origin H	Origin V	Destin H	Destin V	Asymmetry (degrees) Orig.	Dest.	Period (hours) P	Freq (/min) F	Handle C	CM	HM	VM	DM	AM	FM
5	12.5	1.3	12	12	16	58	28	30	0	0	1	2.4	FAIR	1.00	0.38	0.72	0.85	1.00	0.91
6	23.8	0.5	12	12	12	4	16	20	0	0	1	2.4	FAIR	0.95	0.63	0.91	0.93	1.00	0.91
4	21.2	0.6	12	12	16	52	16	20	0	0	1	2.4	FAIR	1.00	0.63	0.84	0.88	1.00	0.91
8	21.2	0.6	12	12	16	52	16	20	0	0	1	2.4	FAIR	1.00	0.63	0.84	0.88	1.00	0.91
10	21.2	0.6	12	12	16	52	16	20	0	0	1	2.4	FAIR	1.00	0.63	0.84	0.88	1.00	0.91
3	23.8	0.5	12	12	16	36	16	20	0	0	1	2.4	FAIR	1.00	0.63	0.96	0.93	1.00	0.91
9	23.8	0.5	12	12	16	36	16	20	0	0	1	2.4	FAIR	1.00	0.63	0.96	0.93	1.00	0.91
1	25.5	0.5	12	12	16	20	20	20	0	0	8	0.1	FAIR	0.95	0.56	0.93	1.00	1.00	1.00
2	25.5	0.5	12	12	16	20	16	20	0	0	1	2.4	FAIR	0.95	0.63	0.93	1.00	1.00	0.91
7	25.5	0.5	12	12	16	20	16	20	0	0	1	2.4	FAIR	0.95	0.63	0.93	1.00	1.00	0.91

Task No.	RWL Origin	RWL Dest.	LI Origin	LI Dest.	HM	VM	DM	FM	AM	CM	TASK	CM	HM	VM	DM	AM	FM
5	15.8	12.5	0.76	0.96	0.56	0.72	0.85	0.91	1.00	1.00	Acceptable	0.95	0.38	0.93	0.85	1.00	0.91
6	27.6	25.5	0.44	0.50	0.63	0.91	0.93	0.91	1.00	0.95	Acceptable	0.95	0.63	0.93	0.93	1.00	0.91
4	21.2	22.3	0.57	0.54	0.63	0.84	0.88	0.91	1.00	1.00	Acceptable	0.95	0.63	0.93	0.88	1.00	0.91
8	21.2	22.3	0.57	0.54	0.63	0.84	0.88	0.91	1.00	1.00	Acceptable	0.95	0.63	0.93	0.88	1.00	0.91
10	21.2	22.3	0.57	0.54	0.63	0.84	0.88	0.91	1.00	1.00	Acceptable	0.95	0.63	0.93	0.88	1.00	0.91
3	25.8	25.8	0.46	0.50	0.63	0.96	0.93	0.91	1.00	1.00	Acceptable	0.95	0.63	0.93	0.93	1.00	0.91
9	25.8	25.8	0.46	0.50	0.63	0.96	0.93	0.91	1.00	1.00	Acceptable	0.95	0.63	0.93	0.93	1.00	0.91
1	24.9	25.5	0.48	0.51	0.56	0.93	1.00	1.00	1.00	0.95	Acceptable	0.95	0.56	0.93	1.00	1.00	1.00
2	25.5	25.5	0.47	0.47	0.63	0.93	1.00	0.91	1.00	0.95	Acceptable	0.95	0.63	0.93	1.00	1.00	0.91
7	25.5	25.5	0.47	0.47	0.63	0.93	1.00	0.91	1.00	0.95	Acceptable	0.95	0.63	0.93	1.00	1.00	0.91

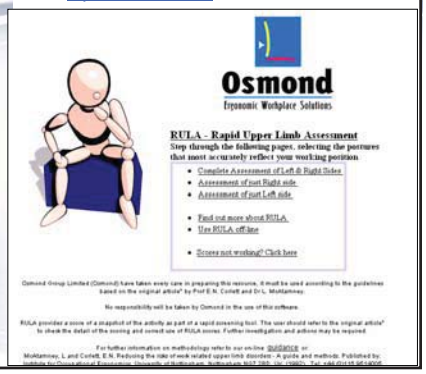
Free Online Calculators

- Ohio BWC Lifting Guidelines
  - http://www.ohiobwc.com/employer/programs/safety/liftguide/liftguide.asp



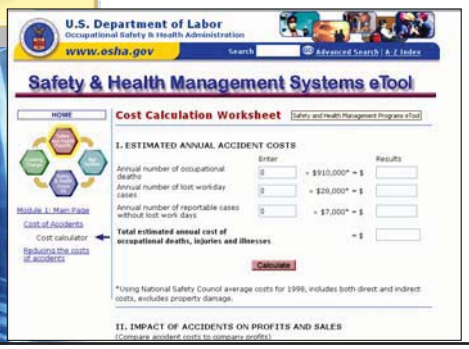
Free Online Calculators

- Online RULA Calculator
  - http://www.rula.co.uk/



Free Online Calculators

- OSHA Injury Cost Calculator
  - http://www.osha.gov/SLTC/etools/safetyhealth/mod1_estimating_costs.html



Ergonomics Assessment Tools

- Process Assessment
- Manual Material Handling
- Free Online Calculators
- Computer Software For Sale

Computer Software For Sale

Ergonomics Human Simulation Software

- Delmia Human Modeling
  - http://plmus.3ds.com/V5/humanmodeling.cfm
- IPME
  - www.maad.com/index.pl/ipme
- Jack
  - http://www.plm.automation.siemens.com/en_us/products/tecnomatix/assembly_planning/jack/index.shtml
- NexGen Ergonomics
  - AnyBody Modeling System
    - http://www.nexgenergo.com/ergonomics/anybody.html
  - HumanCad
    - http://www.nexgenergo.com/ergonomics/humancad.html
  - ManneQuin
    - http://www.nexgenergo.com/ergonomics/mannequin.html
- Ramsis
  - http://www.ramsis.de/
- SAFEWORK
  - http://www.safework.com/
- SANTOS (University of Iowa)
  - http://www.digital-humans.org/santos/

Computer Software For Sale

- Auburn Engineers, Inc.
  - E-Tools
  - Ergo Job Analyzer (EJA)
  - http://www.ergopage.com/etools
- ErgoWeb
  - Job Evaluator Toolbox (JET)
  - http://www.ergoweb.com/ergobuyer/index.cfm?fuseaction=category.display&category_ID=5
- HumanTech, Inc.
  - Risk Prioritization Method (RPM)
  - BRIEF
  - http://www.humantech.com/products/software/
- NexGen Ergonomics
  - Ergo Intelligence Upper Extremity Assessment (UEA)
  - http://www.nexgenergo.com/ergonomics/ergointeluea.html
- Sandalwood
  - Risk Priority Management (RPM)
  - ErgoTool
  - http://www.sandalwood.com/products.html

Computer Software

- University of Michigan 3D Static Strength Postural Prediction Model
  - http://www.engin.umich.edu/dept/ioe/3DSSPP/
- University of Michigan Energy Expenditure Prediction Program
  - http://www.engin.umich.edu/dept/ioe/ENGEXP/
- Ergo Imager
  - http://www.nexgenergo.com/ergonomics/ergoimager.html
- ErgoMaster
  - http://www.nexgenergo.com/ergonomics/ergomast.html

AGENDA

- Comparing ergonomics assessment tools
- Which tool is right for my situation?
- How can I use these tools to create ergonomics guidelines?
- Where can I find additional information?

For Process Assessments

	Body Parts Assessed	Number of Pages	Level of Detail
Hand Activity Level (HAL)	Upper Extremity	1-page	Entire Job Process
Manual Tasks Risk Assessment Tool (ManTRA)	Entire Body	1-page	Entire Job Process
Muscle Fatigue Assessment (MFA)	Entire Body	Multiple (1-page per step)	Individual Job Steps
OCRA	Upper Extremity	4-pages	Entire Job Process
Quick Exposure Check (QEC)	Entire Body	1-page + Cover sheet + Score sheet	Entire Job Process
Rapid Entire Body Assessment (REBA)	Entire Body	1-page checklist, 1-page job aid	Entire Job Process
Rapid Upper Limb Assessment (RULA)	Upper Extremity	1-page	Entire Job Process
Strain Index (JSI)	Upper Extremity	1-page	Entire Job Process
Washington State Department of Labor and Industries Caution Zone Checklist	Entire Body	2-pages	Entire Job Process
Washington State Department of Labor and Industries Hazard Zone Jobs Checklist	Entire Body	6-pages	Entire Job Process

For Material Handling Tasks

	Tasks	Notes
Liberty Mutual Manual Material Handling Tables	Lifting, Lowering, Pushing, Pulling, etc.	Considers gender
MAC	Lifting, Carrying, Team Lifts	Considers team lifts
NIOSH Lifting Equation	Lifting	Multi-lift task analysis is complex
Ohio BWC Lifting Tables	Lifting	Considers those with low back disorder
Washington State Lifting Calculator	Lifting	Based on NIOSH

AGENDA

- Comparing ergonomics assessment tools
- Which tool is right for my situation?
- How can I use these tools to create ergonomics guidelines?
- Where can I find additional information?

Creating Guidelines

Choose Your Assessment Tool

Select Your Targets

Issue Your Guidelines

Creating Guidelines

- Keep 'em simple
- Check your results frequently and revise as needed
- Know your users, and keep in touch with them!
- Focus on continuous improvement!

AGENDA

- Comparing ergonomics assessment tools
- Which tool is right for my situation?
- How can I use these tools to create ergonomics guidelines?
- Where can I find additional information?

Ergonomics Assessment Tool Listings in the Public Domain

- **University of South Florida—Dr. Thomas Bernard**
  - http://personal.health.usf.edu/tbernard/ergotools/index.html
- **Cornell University--Workplace Ergonomics Tools**
  - http://ergo.human.cornell.edu/cutools.html
- **Health and Safety Executive—United Kingdom**
  - http://www.hse.gov.uk/msd/risk.htm#risk
- **Ryerson University--Inventory of Ergonomics Tools, Dr. Patrick Neumann**
  - http://www.ryerson.ca/hfe/documents/ryerson_tool_inventory.pdf
- **Occupational Health & Safety Agency for Healthcare in British Columbia**
  - http://www.ohsah.bc.ca/462/2044/
- **MIRTH EU Project**
  - http://www.ergonomics.ie/mirth.html

Questions ?