

Minnesota Safety Conference May 10th, 2018



**Ergonomics:
Applications in the
Manufacturing
Environment**

Mark Anderson, PT, CPE
Ergonomist and Physical Therapist
ErgoSystems Consulting Group, Inc.
Minneapolis, MN

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Course Logistics

- ▶ **Handout**
 - www.ergosystemsconsulting.com
 - Resources Section
- ▶ **Course Schedule**
 - Starting/ending times
- ▶ **Rest rooms**
- ▶ **Fire exits**
- ▶ **Telephones**



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Lean Manufacturing and Ergonomics

- ▶ **Lean Manufacturing**
 - Optimize productivity and quality
 - Eliminate unnecessary and wasteful work practices
- ▶ **Ergonomics**
 - Optimize productivity and quality
 - Enhance overall performance of human beings



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Objectives: Ergonomics for Lean Manufacturing

- ▶ **Fitting ergonomics within Lean Manufacturing initiatives**
- ▶ **Keys to work station design**
- ▶ **Fundamentals of ergonomics principles**



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Ergonomics Example



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What Is Ergonomics?

- ▶ **Work Smarter – Not Harder**
- ▶ **Fit the Job to the Person – Not Force the Person to Fit the Job**



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Ergonomics and Gravity

- ▶ **Ergonomics is like throwing a ball into air**
- ▶ **What happens?**
 - **Correct! The ball comes back down**
- ▶ **Why?**
 - **Because GRAVITY works!**
- ▶ **What if we don't want the ball to come down?**
 - **Tell it . . . TO STAY!**



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Applied to work



What is the best option?

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So, in our workspace,
given a certain set of
circumstances we will
respond in a fairly
predictable way!



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If we want to
change the
response . . .
We need to
change the
circumstances!



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All about design

- ▶ **Poor design**
 - Poor response
- ▶ **Better design**
 - Better response



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Ergonomics . . .

Optimizing all aspects of job
performance – safety, quality and
productivity – through the
appropriate design and use of
workstations, work processes and
the overall organization of work.

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Optimal Relationship



Low Workstation Height

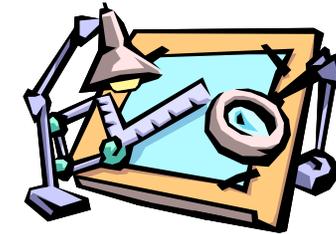


Correct Workstation Height

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Set of Principles

Develop a set of principles to guide the design process



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Ergonomics Principles

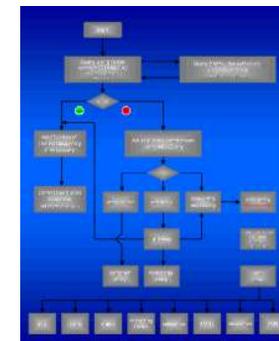
- Promote effective **work processes**
- Promote **neutral positions** with **support** for body/limbs
- Promote physical **movement**
- Control **material handling**
- Promote work in **reach zone**
- Provide correct **workstations, tools and equipment**
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Promote effective work processes

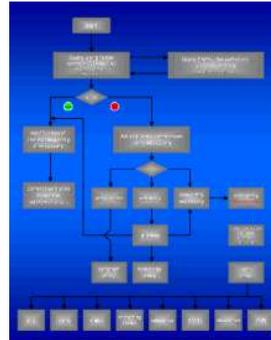
- ▶ **Lean**
- ▶ **Continuous Process Improvement**
- ▶ **Value Stream Mapping**
- ▶ **Kaizen Events**
- ▶ **Six Sigma**
- ▶ **5S +1**



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Promote effective work processes

- ▶ Take step back and really examine why something is done as it is
- ▶ If answer is... 'Because it has always been done that way!'
- ▶ Take fresh look
- ▶ Is there better way to get it done?



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Look at whole picture

- ▶ Goal is to:
 - Design work to take into account basic predictable human behavior
 - Provide an adequate level of job complexity and challenge
 - Involve worker in design process
 - Implement engineering, work practice and administrative control as appropriate



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Ergonomics Principles

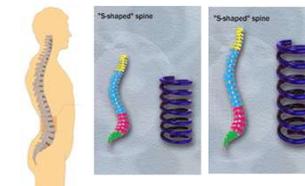
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Position in Neutral

- ▶ Spine neutral position
 - S-shape
- ▶ Spring like
- ▶ Arm/hand neutral position



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Provide support for body/limbs

- ▶ **Seated**
 - Compression of soft tissues
 - Decrease in blood flow and circulation
 - Proper seated support is critical
- ▶ **Limbs**
 - Proper support for limbs
 - Removes strain of weight bearing
 - Unloads neck, shoulders and back
- ▶ **Standing**
 - Unsupported standing for extended periods is not desired
 - Joint compression occurs decreasing joint space
 - Inadequate joint lubrication
 - Fluid tends to pool in lower extremities



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Out-of-Neutral Position

- ▶ **Wrists bent up, down or to side**



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Out-of-Neutral Position

- ▶ **Elbow flared out to sides**



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Out-of-Neutral Position

- ▶ **Hands and arms overhead**



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Out-of-Neutral Position

- ▶ Neck bent down or up or rotated



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Out-of-Neutral Position

- ▶ Back bent forward or backward or rotated



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Ergonomics Principles

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Dynamic Physical Movement

Stand at attention with 30 pounds of equipment

VS.

Two mile march with 30 pounds of equipment



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Physiology Principles

- ▶ **Movement/activity**
 - Promote dynamic not static muscle contractions
 - Build-in adequate physical recovery times
 - Incorporate movement into the work process
- ▶ **Position and support**
 - Design for neutral positions
 - Design for body/limb support at work stations

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Promote Physical Movement

- ▶ **Build in purposeful movement into the work process**
- ▶ **Dynamic vs. static muscle contraction**
- ▶ **Promote circulation**
- ▶ **30/30 Rule**



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Manual Material Handling

- ▶ **How much is too much?**
 - **10#, 50# 100#?**
 - **Difficult question to answer!**
 - **Factors/Variables to consider?**
 - **Brainstorm**
- ▶ **Factors:**
 - **Physiological**
 - **Biomechanical**
 - **Psychophysical**
 - **Epidemiological**

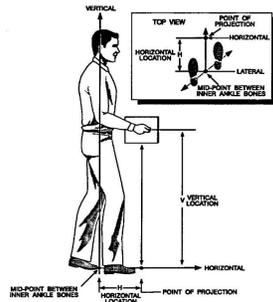


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Manual Material Handling

Variables:

- Load constant
- Frequency
- Horizontal distance
- Vertical distance
- Spine rotation
- Grip/coupling



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Manual Material Handling

Variables:

- Load constant
 - Frequency
 - Horizontal distance
 - Vertical distance
 - Spine rotation
 - Grip/coupling
- ▶ Oregon OSHA

http://www.orosha.org/interactive/liftin/g/lift_safety.html



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Manual Material Handling Guidelines

General Manual Material Handling Guidelines

- Load weight should be less than 51 pounds for a single person lift.
- Handle load within the maximum comfort zone.
- Handle load at a horizontal distance less than 12 inches from the body.
- Ideally, the frequency of lifting is once every five minutes or less, and a maximum frequency of 15 lifts per minute.
- Perform lifts without twisting.
- Provide a stable load to reduce balance shifting while lifting or carrying.
- Standing surfaces should be stable and high-friction.
- The load dimensions should allow a comfortable grasp, adequate handles are preferred.
- An optimal handle design has a 0.75 inch diameter, 4.5 inches or more in length, a 2 inch clearance, and has a cylindrical shape with a smooth, non-slip surface.
- An optimal handhold cutout should have a height of 3 inches or more, 4.5 inches in length, and have a semi-oval shape.
- Containers should be 16 inches or less in width and less than 12 inches in height for manual material handling purposes.

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Manual Material Handling

Illustration of recommended lifting zone



Criteria	Dimension	Description
A. Maximum Zone bottom	Min. 20"	Minimum height
B. Maximum Zone top	Max. 60"	Maximum height
C. Optimal Zone bottom	Min. 30"	Minimum height in optimal zone
D. Optimal Zone top	Max. 50"	Maximum height in optimal zone
E. Distance from body to hand placement	Max. 10"	Optimal distance in front of the body.

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Mechanical Material Handling

QUESTION:

What is the safest lift you can do?

ANSWER:

The one you don't!

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Mechanical Material Handling

Many types of carts, lifts, hoists, counter-balancers, etc. available.

Reduce or even eliminate manual material handling!



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Work in Reach Zone

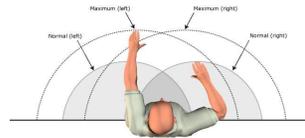
- ▶ **How much do you use your hands?**
- ▶ **Where do you use them?**
- ▶ **Comfort Reach Zone**
- ▶ **Functional Reach Zone**



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Work in Reach Zone

- ▶ **Stature and arm's length determine reach zones**
 - Comfort Reach
 - Functional Reach
- ▶ **Determine individual reach zone and set up workstation to promote reach in that zone**



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Provide Correct Workstation, Tools and Equipment



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Provide Correct Workstation, Tools and Equipment

- ▶ **How to assess if correct?**
 - Neutral position: Yes or No?
 - Reach zone: Yes or No?
 - Control force exerted/imposed: Yes or No?
 - Control repetition: Yes or No?

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Ergonomics Example



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Competency based training

▶ Results not achieved?

- Spend thousands of \$ on ergonomically designed tools, equipment and facility
- Workforce doesn't know how to make most of tool or equipment or furniture

▶ Acquire new skills

- Need to correctly practice new technique to acquire skill level to advance



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Control exposure to environment

- ▶ Light
- ▶ Noise
- ▶ Temperature
- ▶ Ventilation



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Health and Wellness!

- ▶ **Health and wellness**
 - Diet and nutrition
 - Body weight control
 - Stress management
 - Smoking cessation
 - Blood pressure control
 - Fluid intake - don't get dehydrated
 - Adequate rest/sleep
- ▶ **For example movement helps to control fatigue**



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Provide on-going feedback

- ▶ **100% Correct the First Time?**
 - Does any new process work 100% correctly out of gate?
 - Unintended consequences
 - Schedule formal follow-up sessions
 - Document outcome of follow-up
 - Alleviate issues identified in timely manner
- ▶ **Continuous Process Improvement and Ergonomics**
 - Continuous process improvement strategies have tremendous benefit
 - Waste is reduced
 - Productivity is enhanced
- ▶ **Applying ergonomics principles to overall continuous process improvement effort is integral to success of process!**



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Ergonomics Applications Collection



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Lean Manufacturing and Ergonomics

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**Lean manufacturing
and ergonomics
work well hand-in-
hand!**



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Thanks!

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