

Cardinal Safety Conference Wednesday March 14th, 2018

Ergonomics: Applications in the Manufacturing Environment

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Course Logistics

- ▶ Manual/handouts
- ▶ Course Schedule
 - Starting/ending times
- ▶ Rest rooms
- ▶ Fire exits
- ▶ Telephones
- ▶ Group Introductions



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



Objectives: Ergonomics for Lean Manufacturing

- ▶ Fitting ergonomics within Lean Manufacturing initiatives
- ▶ Keys to work station design
- ▶ Understanding and keys to avoiding MSD's (musculoskeletal disorders)
- ▶ Fundamentals of mechanical handling



Ergonomics Example



What Is Ergonomics?

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



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!



Applied to work



What is the best option?



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



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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MSDs

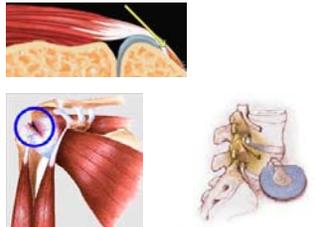
Some people do develop **Musculo-Skeletal Disorders**



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What are MSD's?

- ▶ Tennis elbow
- ▶ Rotator cuff tendonitis
- ▶ Bulging lumbar disc



ErgoSystems

What causes MSD's?

- ▶ **Single episode**
 - Can you hurt your self doing one thing one time?
 - **Yes!**
- ▶ **Cumulative**
 - How about 10 times, or a 100 times, or 1000 times?
 - **Yes!**



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Which one is a bigger problem?

- ▶ **100 people go see doctor with MSD**
- ▶ **How many?**
 - Single episode
 - Cumulative
- ▶ **Focus on both and really focus on the Cumulative factors**



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The Body

- ▶ Magnificent feat of engineering
- ▶ Strong yet supple
- ▶ Capable of phenomenally precise movement
- ▶ Able to heal itself



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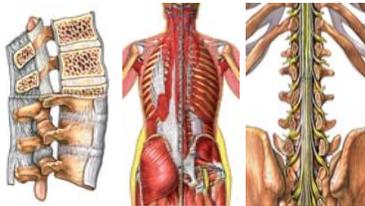
Background on Body

- › Skeleton/Bone
- › Joints
- › Ligaments
- › Tendons
- › Muscles
- › Nerves
- › Blood supply



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Components of Spine



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Spinal Discs

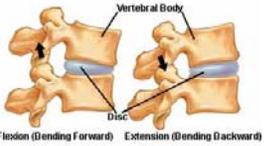
- › Disc wall
- › Disc core



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Spinal Discs

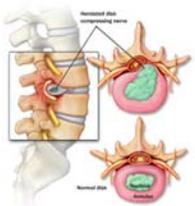
- › Disc function
- › Shock absorber
- › Spacer



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Types of spine problems

- › Disc problems
- › Joint pain
- › Nerve compression
- › Soft tissue pain



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Spine Protection

- › Control compression and shear stress into structures of the spine!



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Arms and Hands, Legs and Feet

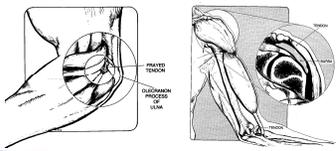
- › Function of extremities
- › Make up of extremities



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Types of extremity problems

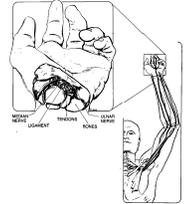
- › Soft tissue inflammation
 - Tendonitis
 - Bursitis



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Types of extremity problems

- › Nerve compression
 - Carpal Tunnel Syndrome
 - Thoracic Outlet Syndrome



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Lower extremities

- ▶ **Problems**
 - Tendonitis
 - Instability
 - Arthritis
 - Spurs
 - Bunion



MSD Medical Management

- ▶ If experience MSD what should be done?
 - Early reporting
 - Prompt evaluation and treatment
 - First aid
 - Health care professional
 - If needed, restrict physical activity
 - If off work, promote early return to work
 - If needed, provide restricted activity with return to work
 - Evaluate true cause and rectify situation as feasible

Set of Principles

Develop a set of principles to guide the design process



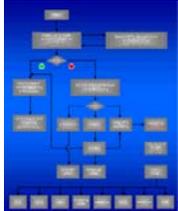
Ergonomics Principles

- 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
- Provide competency based training
- Control exposure to work environment
- Promote health and wellness
- Provide on-going feedback



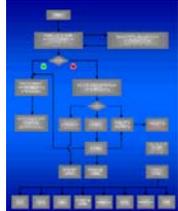
Promote effective work processes

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



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?



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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Position in Neutral

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



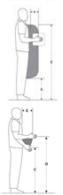
Manual Material Handling Guidelines

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.

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.

Mechanical Material Handling

QUESTION:
What is the safest lift you can do?



ANSWER:
The one you don't!

Mechanical Material Handling

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

Reduce or even eliminate manual material handling!



Ergonomics Principles

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- **Promote work in reach zone**
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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**



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



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?



Out-of-Neutral Position

- ▶ Wrists bent up, down or to side



Out-of-Neutral Position

- ▶ Elbow flared out to sides



Out-of-Neutral Position

- ▶ Hands and arms overhead



Out-of-Neutral Position

- ▶ Neck bent down or up or rotated



Out-of-Neutral Position

- ▶ Back bent forward or backward or rotated



Force - Back

- ▶ Major cause of work-related musculoskeletal disorders



Force - Back

- ▶ Lifting, lowering, pushing and pulling objects and materials



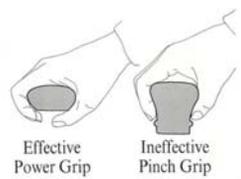
Force - Back

- ▶ Identify how and when force exerted
 - Determine if excessive
 - Out-of-neutral positions



Force - Hand

- ▶ **Power grip**
 - Strongest grip
- ▶ **Pinch grip**
 - 15 or 20% of power grip



Effective Power Grip Ineffective Pinch Grip

Force - Hand

- ▶ **Gloves**
 - Reduce grip force by 20%
 - Adequate fit
 - Adequate friction



Repetition

- ▶ Limited time in out-of-neutral position with excessive force
- ▶ Higher repetition levels magnify negative impact
- ▶ Machine pacing



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



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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Cardinal Case Studies

Ergonomics Applications Collection



Ergonomics Applications
 ErgoSystems
 1997 to 2017

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

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



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