ERGONOMICS CONSIDERATION IN DESIGN

NILESH PANCHOLI
B.E. (Mech.), M.E. (Mech.), Ph. D.
Email: *nhpancholi@gmail.com*
www.nileshpancholi.com

QUESTIONS

- Define ergonomics. Explain its applications in the product design.
- Discuss the role of ergonomics in engineering design. Give details of five examples where ergonomics considerations have improved or can improve product design and utility.
- Discuss some of the ergonomics factors that influence the design of work station for making sub assembly of three light components in large quantities.

ERGONOMICS

- INTRODUCTION TO ERGONOMICS
- THE SCIENCE OF **OPTIMISING** THE INTERACTIONS BETWEEN THE **PERSON (Man),** THE **JOB (Machine)** AND THE **ENVIRONMENT**.
- **OPTIMISING** , MAKE THE BEST OR MOST EFFECTIVE USE (L.*OPTIMISE BEST*)
- **JOB** , E.G.. ASSEMBLING MOBILE PHONES (CAN WE OPTIMISE?)
- **PERSON** E.G.. EMPLOYEE (CAN WE OPTIMISE?)
- **THE ENVIRONMENT** (CAN WE OPTIMISE?)

- ERGONOMICS AIMS TO CREATE A SAFE COMFORTABLE WORKPLACE
- SO WHY IS IT SO IMPORTANT ?

ERGONOMICS

- BENEFITS OF ERGONOMICS
- INCREASE IN PRODUCTIVITY
- INCREASE IN QUALITY
- INCREASE IN EMPLOYEE MORALE
- DECREASE IN ABSENTEEISM
- DECREASE IN (**RSI**) REPETITIVE STRESS INJURIES
- TASKS THAT CAUSE RSI's OFTEN HAVE:
- DECREASED PRODUCTION RATES AND POOR QUALITY
- HIGH ABSENTEEISM AND A HIGH TURN OVER OF STAFF
- HIGH MATERIAL WASTE
- FREQUENT REST BREAKS AND LOW MORALE
- THE ABOVE COST YOU MONEY !!

ERGONOMICS

- POOR ERGONOMIC COSTS YOU !
- A STUDY BY THE AMERICAN ACADEMY OF ORTHOPAEDIC SURGEONS SHOWS A COST OF $27 MILLION PER YEAR A COST WHICH ROSE SOME 500% IN THE EIGHT YEARS LEADING UP TO THE STUDY
- RSI'S ARE THE LEADING OCCUPATIONAL HAZARD
- 1974 HEALTH AND SAFETY ACT REQUIRES ALL EMPLOYERS TO TAKE ALL PRACTICAL STEPS TO PREVENT INJURY (STRESS & PHYSICAL)

- SO WHAT ARE RSI (REPETITIVE STRESS INJURIES)?

ERGONOMICS

- RSI (REPETITIVE STRESS INJURIES) ARE:
- **TENDINITIS**: THE SWELLING OF THE TENDONS WHICH ATTACH THE MUSCLE TO THE BONE
- **CARPAL TUNNEL SYNDROME (CTS):**THE TRAPPING OF THE NERVE AS IT PASSES THROUGH THE BASE OF THE WRIST.
- **GANGLIONIC CYSTS**:SMALL NODULES WHICH DEVELOP ON THE FINGERS OR WRIST.
- **TRIGGER FINGER**: A NODULE FORMS ON THE FINGER TENDON OR A GROVE DEVELOPS IN THE TENDON.
- **DEQUERVAINS DISEASE:** THE TENDONS IN THE BASE OF THE THUMB AND THE SIDE OF THE WRIST BECOME IRRITATED
- **BUT THE WAY THAT WE NORMALLY SEE THEM IS NECK OR BACK PAIN**

ERGONOMICS

- **MUSCLE STRAINS AND SPRAINS**
- MUSCLES EXERT FORCES TO CREATE MOVEMENT AND TO HOLD THE BODY IN VARIOUS POSTURES. MUSCLES WHICH ARE STRESSES CAN LEAD TO MUSCLE STRAINS AND SPRAINS WHICH LEAD TO CHRONIC PAIN AND TISSUE DEGENERATION. THE MOST COMMON IS LOWER BACK PAIN.
- **CAUSES OF MUSCLES STRAINS AND SPRAINS**
- HIGHLY REPETITIVE EXERTIONS
- EXERTIONS IN AWKWARD POSTURES
- EXERTIONS WITH EXTERNAL LOADS

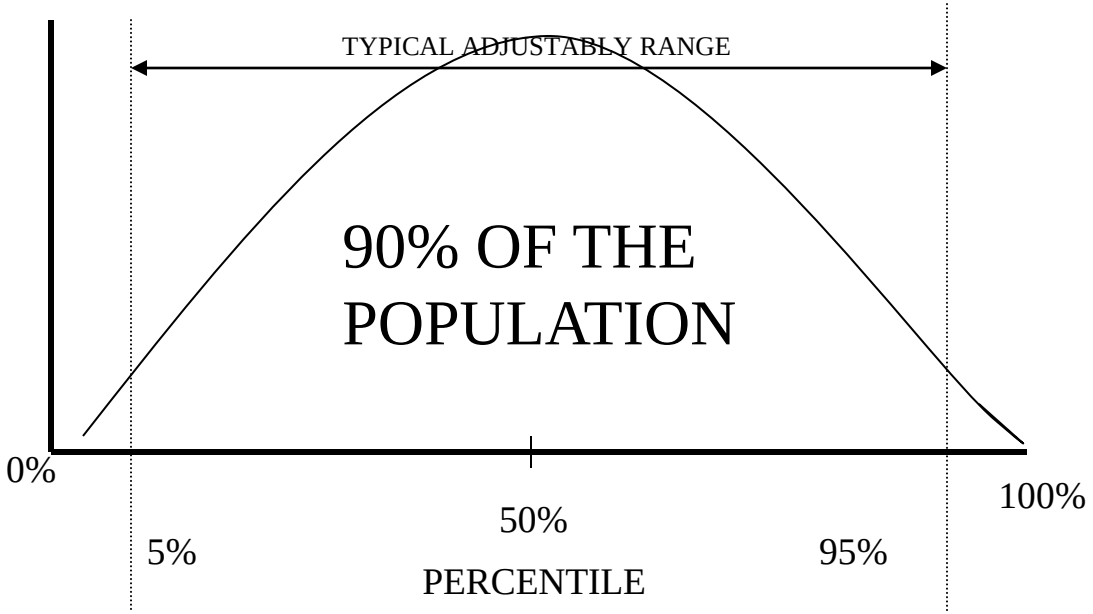
- **SO WHAT CAN BE DONE TO HELP PREVENT RSI'S ?**

ERGONOMICS

- **HOW TO REDUCE RSI'S**
- 1 USE ANTHROPOMETRIC DATA
- 2 REDUCE THE NUMBER OF REPETITIONS
- 3 REDUCE THE FORCE REQUIRED
- 4 ELIMINATE AWKWARD POSTURES

ERGONOMICS

- **1 USE ANTHROPOMETRIC DATA**
- ANTHROPOMETRIC DATA IS THE DATA COLLECTED FROM A CROSS SECTION OF THE POPULATION TO LOOK AT THE STANDARD DISTRIBUTION OF SHAPE AND SIZE.
- (Anthropometrics is the comparative study of human body measurements and properties.)



ERGONOMICS

- **2 REDUCE THE NUMBER OF REPETITIONS**
- DECREASE PRODUCTION RATES
- LIMIT OVERTIME
- CHANGE METHOD
- PROVIDE MECHANICAL ASSISTS
- AUTOMATE WHENEVER POSSIBLE
- CHANGE PRODUCT DESIGN
- ROTATE EMPLOYEES
- PERFORM RELIEF EXERCISES AND TAKE MANY BREAKS
- INCREASE THE NUMBER OF EMPLOYEES TO EACH TASK
- EXPAND THE NUMBER OF TASKS

ERGONOMICS

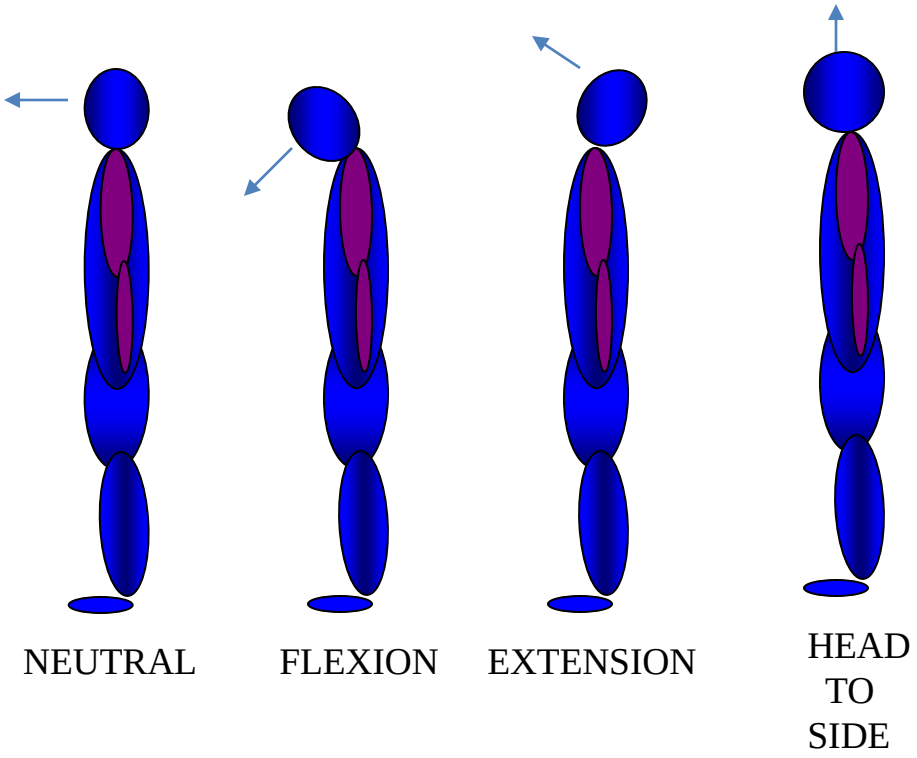
- **3 REDUCE THE FORCE REQUIRED**
- USE POWER TOOL AND ASSISTS WHEREVER POSSIBLE
- USE ALL OF THE HAND TO GRIP INSTEAD OF JUST THE FINGERS
- SPREAD THE FORCE OVER AS WIDE AN AREA AS POSSIBLE
- PROVIDE ADEQUATE GRIPPING SURFACES
- USE JIGS AND PRODUCTION AIDS (ERGONOMICS)

ERGONOMICS

- **4 ELIMINATE AWKWARD POSTURES**
- i) THE HEAD AND NECK
- ii) THE TORSO AND BACK
- iii) THE ELBOW AND SHOULDER
- iv) THE HAND AND WRIST

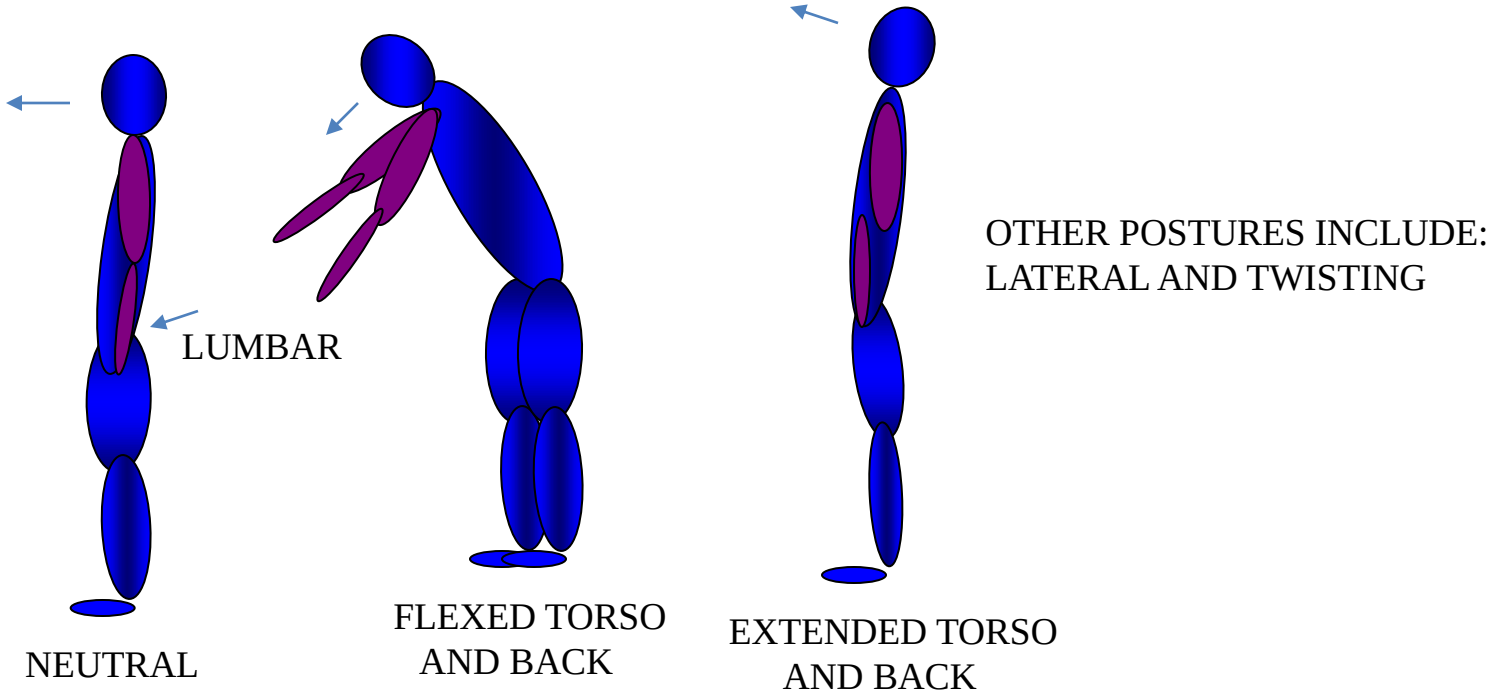
ERGONOMICS

- THE HEAD AND NECK



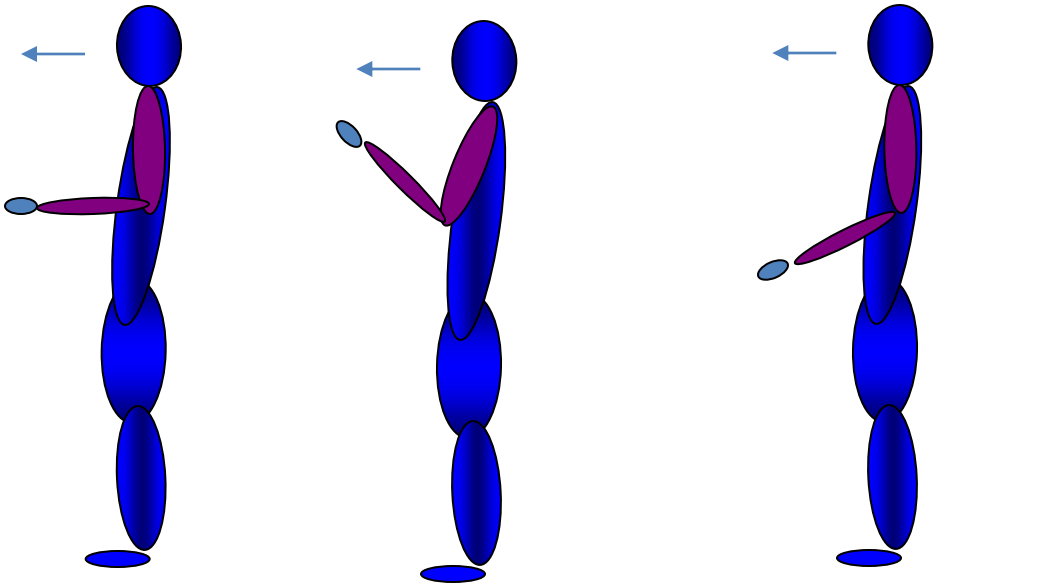
ERGONOMICS

- THE TORSO AND BACK



ERGONOMICS

- THE ELBOW AND SHOULDER



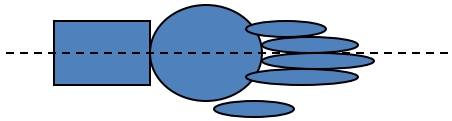
NEUTRAL
90-110’

ELBOW FLEXION
<90’

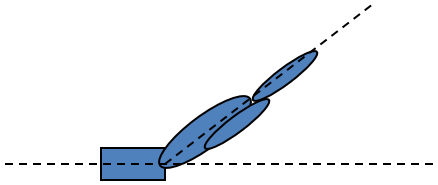
ELBOW EXTENSION
>110’

ERGONOMICS

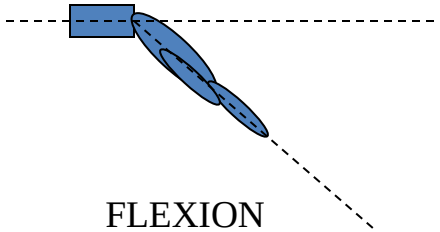
- THE HAND AND WRIST



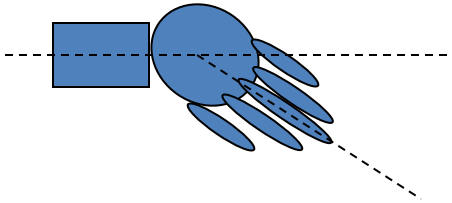
NEUTRAL



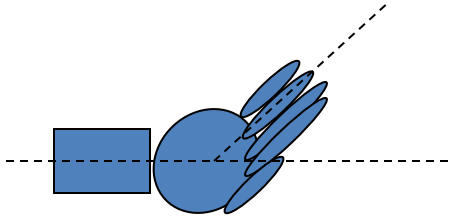
EXTENSION



FLEXION



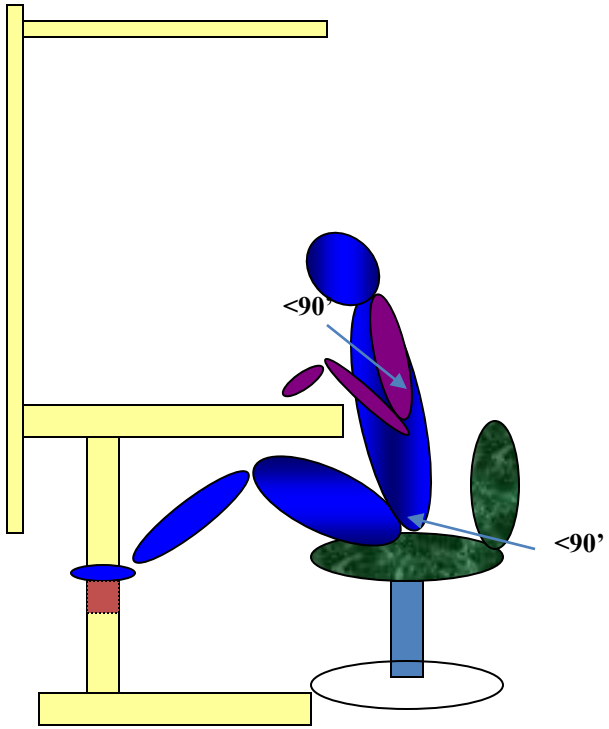
RADIAL
DEVIATION



ULNAR
DEVIATION

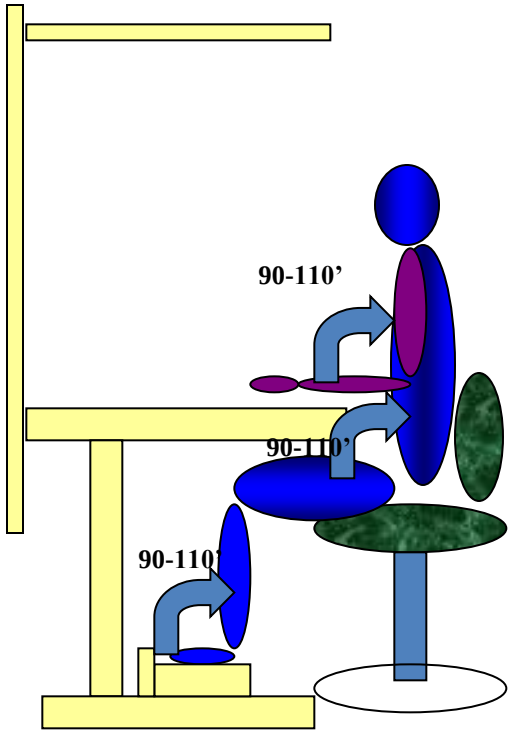
ERGONOMICS

- AN ERGONOMIC WORKSTATION INCORRECTLY SET-UP



ERGONOMICS

- AN ERGONOMIC WORKSTATION CORRECTLY SET-UP



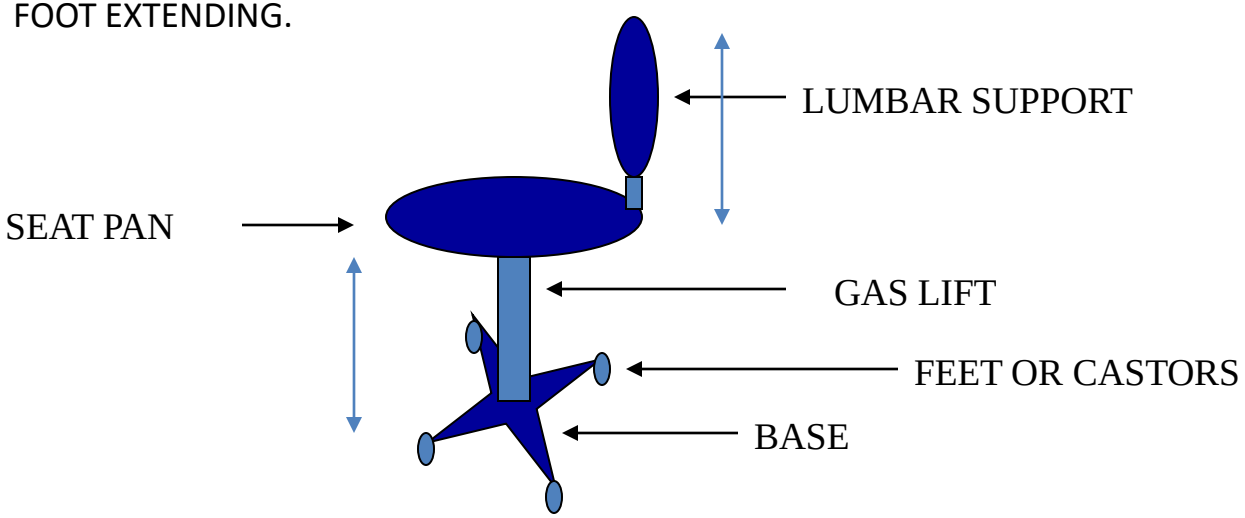
ERGONOMICS

- WORK SURFACE HEIGHT
- THE WORK POSITION SHOULD BE FULLY ADJUSTABLE SO THAT EACH EMPLOYEE CAN ADJUST THE WORK AREA TO FIT THEIR ANTHROPOMETRIC REQUIREMENTS.
- DIFFERENT TASKS NEED DIFFERENT WORK HEIGHTS
- FOR PRECISION WORK THE WORK PIECE SHOULD BE AT ELBOW HEIGHT OR 2” ABOVE
- FOR LIGHT ASSEMBLY WORK THE WORK PIECE SHOULD BE 2-4” BELOW THE ELBOW HEIGHT
- FOR HEAVY WORK THE WORK PIECE SHOULD BE 4-8” BELOW THE ELBOW
- ALSO THE NEED OF A CHAIR SHOULD BE TAKEN INTO CONSIDERATION

ERGONOMICS

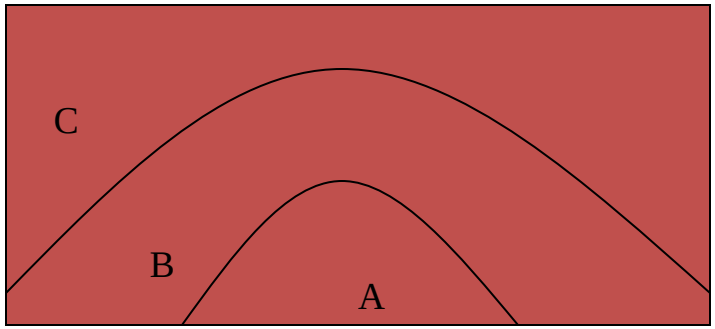
- **THE NEED OF A CHAIR**
- IF THE TASK AT HAND REQUIRES NO LARGE FORCES THEN A CHAIR SHOULD BE USED
- FOOT RESTS ARE REQUIRED TO GIVE THE JOINTS IN THE LEG THE CORRECT POSTURE

- **THE CORRECT USE OF THE CHAIR**
- CHAIRS SHOULD BE ADJUSTED AT THE BEGINNING OF EACH SHIFT
- ALLOW 7-10” CLEARANCE BETWEEN SEAT PAN AND THE BOTTOM OF THE BENCH
- FEET SHOULD NOT REST ON THE BENCH FRAME CROSS MEMBER THIS GIVE NO SUPPORT TO STOP THE FOOT EXTENDING.



ERGONOMICS

- **A GOOD WORK AREA ORGANIZATION**
- MINIMIZE REACHING UPWARDS, TO THE SIDE AND BEHIND
- ALL TOOLS AND PARTS TO BE PLACED BETWEEN SHOULDER AND ELBOW HEIGHT AND WITH THE FLEXABILITY TO BE MOVED INTO ANYBODY'S REACH
- ORGANIZE AREA TO ELIMINATE TWISTING
- A GOOD PLACEMENT OF TOOLS AND PARTS IS SHOWN BELOW



A - DIRECT WORK AREA 6"-14"
B - OFTEN ACCESSED ITEMS 14"-16"
C - REARELY ACCESSED ITEMS 16"-22"

ERGONOMICS

- NOISE
- NOISE IS DISTRACTING
- INTERFERE WITH COMMUNICATION
- AFFECTS THE ABILITY TO CONCENTRATE
- EXCESSIVE NOISE CAN RESULT IN HEARING LOSS

- HEARING CAN BE AFFECTED BY A NOISE LEVEL OF 85dBA OVER AN 8 HOUR EXPOSURE, THIS USUALLY AFFECTS THE ABILITY TO HEAR HIGH FREQUENCY SOUNDS

ERGONOMICS

- NOISE EXPOSURE CAN BE REDUCED BY
- SUBSTITUTE WITH A QUIETER PROCESS OR EQUIPMENT
- SEPARATE EMPLOYEES FROM NOISY EQUIPMENT
- CHANGE THE DIRECTION OF THE NOISE
- ABSORB THE NOISE WITH SOUND DAMPENERS

ERGONOMICS

- LIGHTING
- DIFFERENT TASKS REQUIRE DIFFERENT LIGHTING LEVELS (lux) DEPENDING ON THE DEGREEE OF VISION REQUIRED
- VISUAL TASKS THAT REQUIRE INSPECTION OF A VERY SMALL SIZE MIN 1000lux
- VISUAL TASKS THAT REQUIRE SMALL SIZE ASSEMBLY 500-1000lux
- VISUAL TASKS THAT REQUIRE ROUGH BENCH WORK / ASSEMBLY 200-500lux
- GLARE
- POSITION LIGHTS OUT OF 'LINE OF SIGHT' FOR THE OPERATOR
- USE INDIRECT LIGHTING
- USE LIGHT SHIELDS OR HOODS
- AVOID SHINY SURFACES
- GLARE CAN ALSO BE REDUCED BY MOVING THE WORK PIECE.