



The Human Interface with Computers



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“The advent of adjustable flat panel monitor desk stands represents the greatest improvement in the human/computer interface since video display technology was introduced over forty years ago.”



Historical Perspective on the Human / Computer Interface

- **The Early Years of Computing**
- **1960's-1970's**
 - VDT Displays Dominate
 - Large, integrated keyboards and monitors
 - Ergonomically very poor
- **Early '80's**
 - CRT Displays Dominate
 - Keyboard separated from terminal
 - First Intro of an Ergonomic Display product
 - Tilt and Swivel/Pan CRT mounting device.... Later transitioned to plastic bowl design
 - Most lifted monitor 75 to 100 mm (3 to 4") above the desktop



Historical Perspective on the Human / Computer Interface

- **Late 1980's and Early '90's: Era of Ergonomic Learning**
- **Computer operation was identified as the most stressful occupation in US industry by OSHA**
- **Involvement of Standards Organizations**
- **The science of “Ergonomics” brought into practice**
- **Identification of Musculoskeletal Stress Disorders (MSDs)**
 - **Work-related (Cum. Trauma Disorders/ Repetitive Strain Injuries)**
 - **Manifestations of MSDs: eye, neck and back strain, fatigue, headache, and wrist, hand, elbow and shoulder disorders**
 - **Carpal Tunnel Syndrome, Tenosynovitis, De Quervains's Disease, Trigger Finger, Tennis Elbow, Rotator Cuff, Tendonitis and Ganglion Cysts, etc.**
 - **Many of these diseases were clearly traced to improper video screen and keyboard placement.**

Historical Perspective on the Human / Computer Interface

- **Early-Mid 1990's: Networking Era**
- **Intro of “Point of Use”, in hospital rooms, dental offices, and industrial applications**
- **Ergonomic design of computer workstations began**
 - **First introduction of heavy duty computer arms, pivots and other mounting devices**
 - **Enabled manufacturers to place the computer screen and keyboard in the proper position for multi-shift, multi-operator work environments**



A heavy duty track-mounted arm providing lift, tilt and pan motion for a CRT monitor, keyboard and mouse. This design offered height adjustability to improve ergonomics for multiple users of a single computer. While popular in industrial and healthcare, these systems were typically too expensive for the home user.

Historical Perspective on the Human / Computer Interface

- **Late 1990's: Intro of the Flat Panel Monitor**
- **Smaller, lighter form factor accelerated "Point of Use" applications**
- **Introduction of the Video Electronics Standards Association (VESA) Flat Display Mounting Interface (FDMI™) Standard**
 - Center located mounting interface
 - Rapidly adopted as it facilitated POU applications
 - Facilitated easy fore and aft tilt
 - Allowed Portrait mode mounting
 - Paved path for adjustable height desk stands
- **New flat panel mounting products became available**
 - Lower cost, more compact



The VESA FDMI standard 4-hole mounting pattern has been widely adopted. This square hole pattern has enabled a wide variety of mounting options to be used on almost any flat panel monitor.

Development of a New Generation of Affordable Ergonomic Work Stations

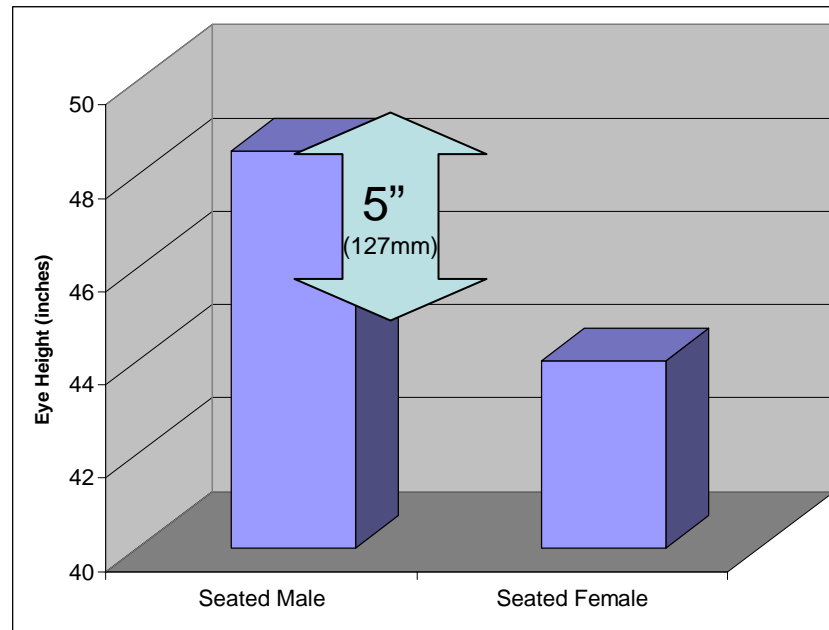


2001: Design of an Ergonomically Correct Desk Stand for Flat Panel Monitors

- **White paper published by Harry Sweere**
- **Became de facto standard for design of FPM desk stands**
- **Ergonomic Ground Rules for Optimal Monitor Positioning**
 - **Screen Height**
 - General: Center of Screen 15-20 degrees below eye height
 - Simple Rule: Top of screen at or slightly below eye height
 - **Screen Tilt**
 - General: tilted for consistent focal length, avoid glare
 - Simple Rule: Tilt until top and bottom are same distance from eye
 - **Screen Distance**
 - General: 18-28"- as far as possible within ability to read screen
 - Simple Rule: Position screen at arms length
 - **Keyboard**
 - General: 90-120 degree elbow angle
 - Simple Rule: forearms level, hands tilted slightly downward
 - Simple Rule: 20" (508mm) from top of monitor to centerline of keyboard

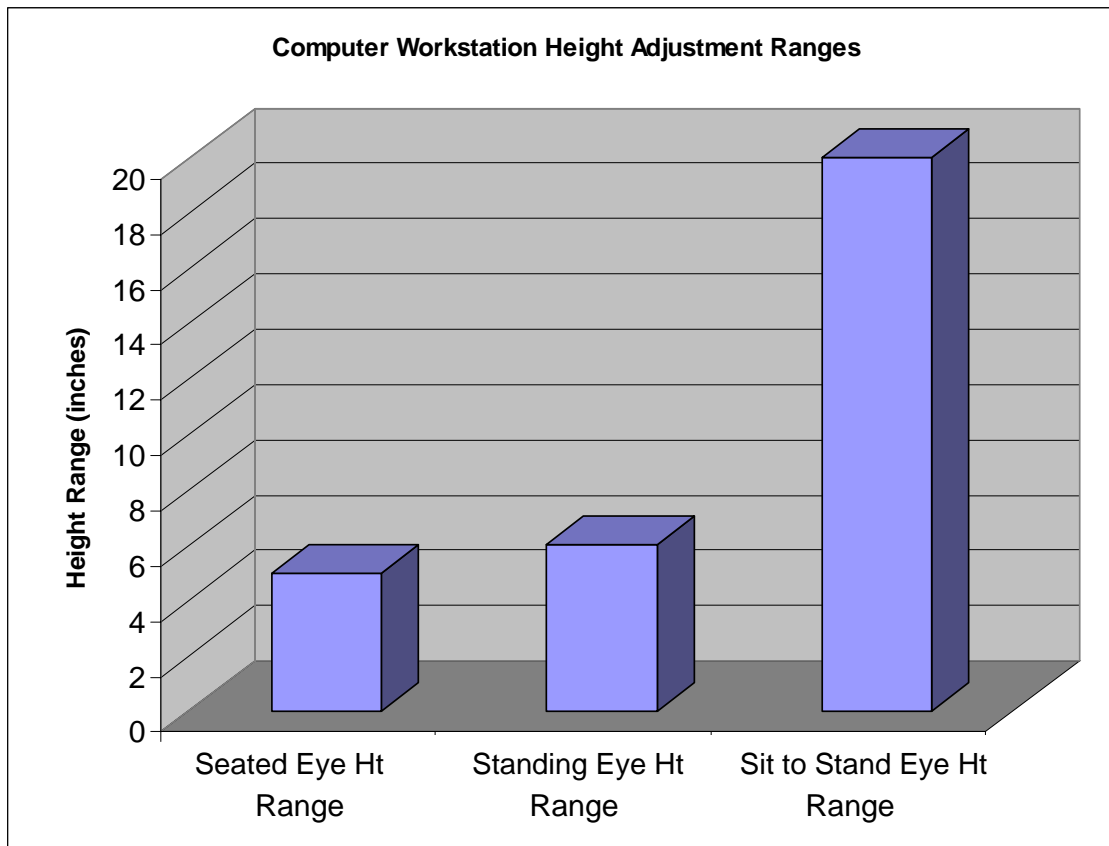
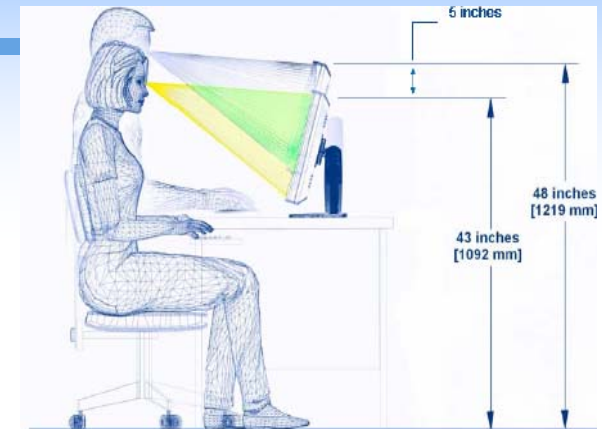
2001: Design of an Ergonomically Correct Desk Stand for Flat Panel Monitors

- **Applied Anthropometric Data to FPM**
 - Adult Male and Female statistical distribution of body dimensions
- **Formed Basis for a 4.5” Lift Range of a height-adjustable desk stand to accommodate the average female to average male populations**
 - **Guideline increased 5” (127mm) range to accommodate taller European populations**



2001: The Design of an Ergonomically Correct Desk Stand for Flat Panel Monitors

- **Extended Ground Rules and Anthropometric Data to All Computing Conditions**



Neo-Flex LCD Stand

Ergonomic Computing Guidelines
Anthropometric Height Variation
Ergonomic User Adjustment Forces

Technical spec for an Ergonomically-Correct Desk Stand for the Average Range of Male and Female Operators

- **5" (127mm) vertical lift range**
 - Established as de facto standard
- **Weight adjustable for range of FPMs**
- **Rotation**
 - 35° (-5°/+30°) monitor pivot
 - 70° (35° L - 35° R) monitor pan
 - 90° monitor rotation for P/L applications
 - Adjustment moving forces: all, 3-4 lbs.
- **High Reliability**
- **Low Cost**



Introduction of Flat Panel Monitor Desk Stand



- **2001: Introduction of Affordable, Available Ergonomics**
- *“The advent of adjustable flat panel monitor desk stands represents the greatest improvement in the human/computer interface since video display technology was introduced over forty years ago.”*
 - *Harry Sweere, 2005*
- Now, for the first time in history, millions of computer users can adjust their computer display screen to exactly the right position to give them optimum viewing.
- Optimum viewing provides many benefits including better health, more productivity, fewer errors and generally happier workers.
- Some flat panel manufacturers are providing height-adjustable stands with their monitors
 - OEM Custom Products
- **Also available aftermarket**
 - Aftermarket Field-Adjustable Weight Capacity

The Three Support Surface Concept

The basis for an affordable, practical and effective ergonomic solution

outlined in "Office Ergonomics in the Era of Flat Panel Monitors" by Harry Sweere

Adjustable display support surface

Adjustable keyboard support surface

Fixed support surface used to do regular work and to support the two adjustable support surfaces

Ideally 20"

Workstations for Average Female to Average Male Computer Operators



Average Female



Average Male

- **This configuration will address the majority of all sitting office workers**

Lowering the Barrier to Entry for Ergonomics

- **Adjustable Work Surface Solution**

- Pin or Hook Adjustable Work Surface \$400
- Crank Adjustable Work Surface \$800
- Electrically Adjustable Work Surface \$1,200
- Descending Keyboard Tray \$175
- TOTAL COST **\$575-\$1,375**

- **3-Support Surface Workstation**

- Height Adjustable Desk Stand \$49
- Descending Keyboard Tray \$175
- TOTAL COST **\$224**

- **The 3-Support Surface concept enables use of the existing work surface.**
- **Two simple, low cost upgrades provide a full ergonomic solution for single or multiple-user work stations.**

A decorative graphic consisting of a vertical blue line and a horizontal blue line that intersect to form a crosshair. The lines have a slight gradient and are positioned on the left side of the slide, with the horizontal line extending across the width of the slide.

Constant Force™ Technology

Constant Force™ Technology

- **CF:** the foundation for a new wave of weight and height-adjustable ergonomic stands, arms and carts
- **CF™** uses a low-cost and reliable conventional spring mechanism that converts the spring's linear force curve into a flat, constant force, throughout the entire range of lifting or pivoting motion.
- This force conversion means that users exert very little effort to adjust their display
- These **low user forces** greatly improve ergonomics, plus make height adjustability available to a broader range of users such as children and disabled adults.



Technology Comparison



Gas Springs ~ \$1.60
Not Weight-Adjustable
Loses Energy w/ Time

Constant Force Technology
Conventional Spring ~ \$.06 - \$.12
Reliable
Weight Adjustable



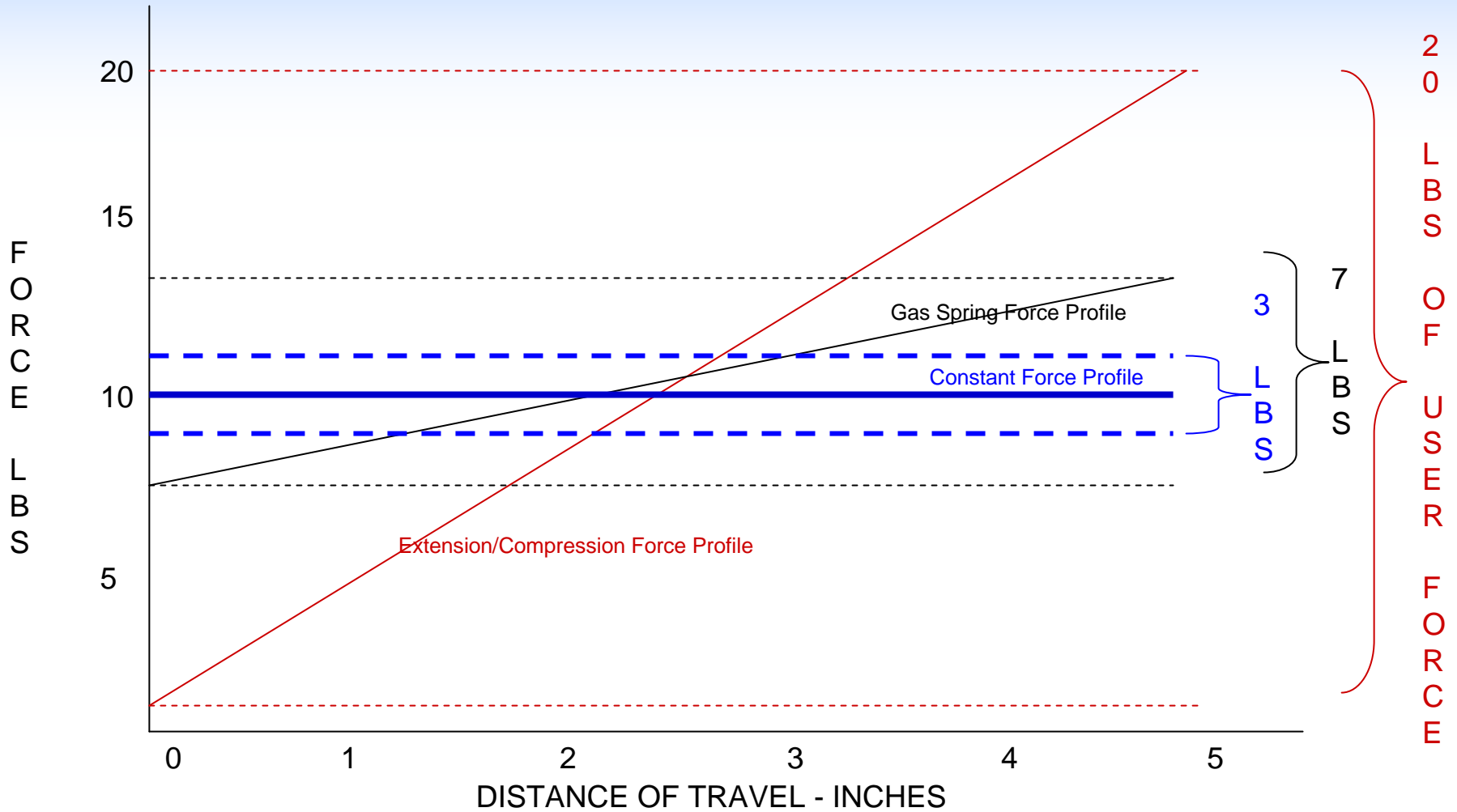
Coiled Flat Steel Springs ~ \$.50
Reliability Concerns
Not Weight-Adjustable



Flat Panel Monitor Application



Force-Displacement Profiles



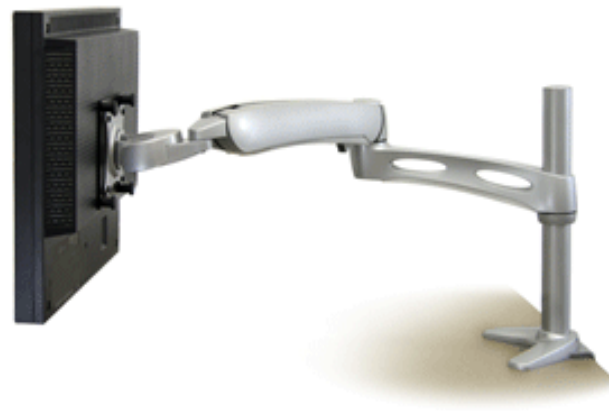
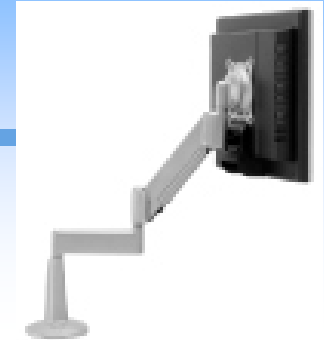
Josie and our Height-Adjustable Stand



- **Low user forces means even a small child can easily raise or lower the monitor**
- **This will significantly increase the percentage of users who willingly adjust their workstation and the frequency with which adjustments are made**

Monitor Arm Products

- **Desk-Mounted Arm Solutions**
- **Technical Specs**
 - Designed for the seated computer operator
 - 13" vertical lift, for 5% female to 95% male operators
 - Weight capacity: 5-20 lbs.
 - CF Arm and CF pivot are user-adjustable
 - Four-bar linkage so monitor is always held vertical
 - Moving forces: 5-6 pounds



We're in an Exciting Era for Ergonomics

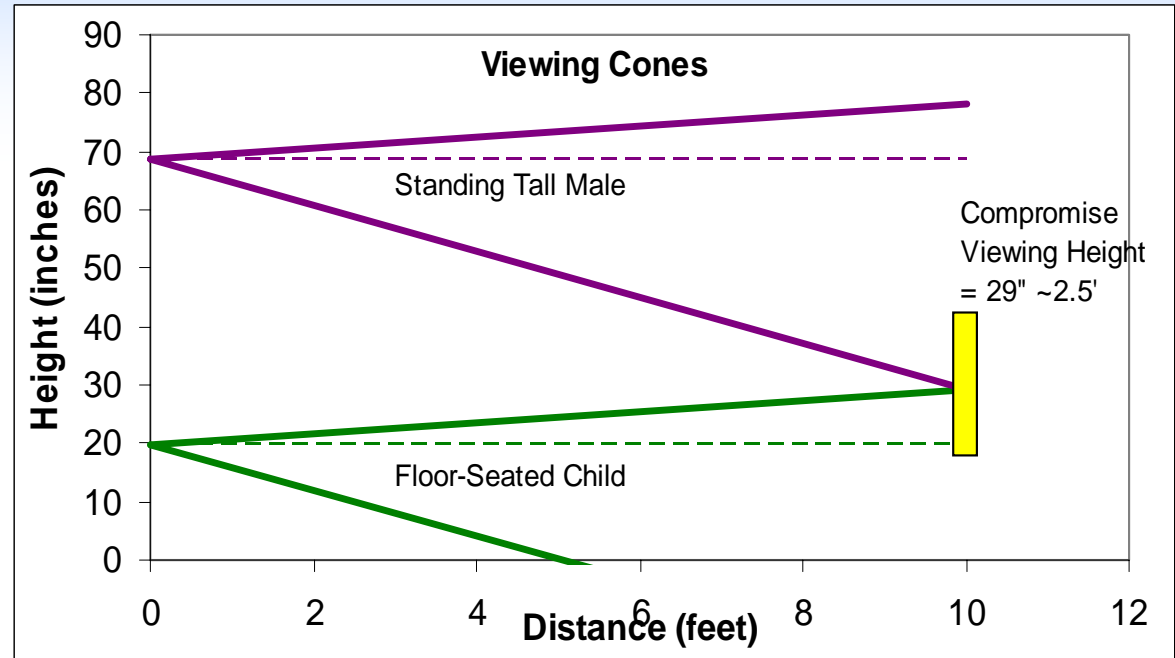
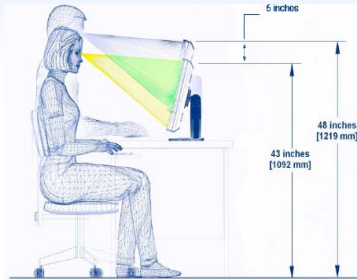
- **The Science of Ergonomics has been embraced by the business world**
- **Medical knowledge of ergonomic injuries is sound and making continued progress**
- **Flat Panel Monitors are now widely available**
- **New flat panel mounting solutions are becoming more readily available**
- **Height-adjustable desk stands enable a dramatic price reduction lowering the barrier to entry**
 - **The basis for the 3-Point Support Surface approach**
 - **This will bring ergonomic solutions into the home, small offices, and cost-sensitive businesses**
- **Constant Force Technology simplifying the adjustment process**

Future Challenges



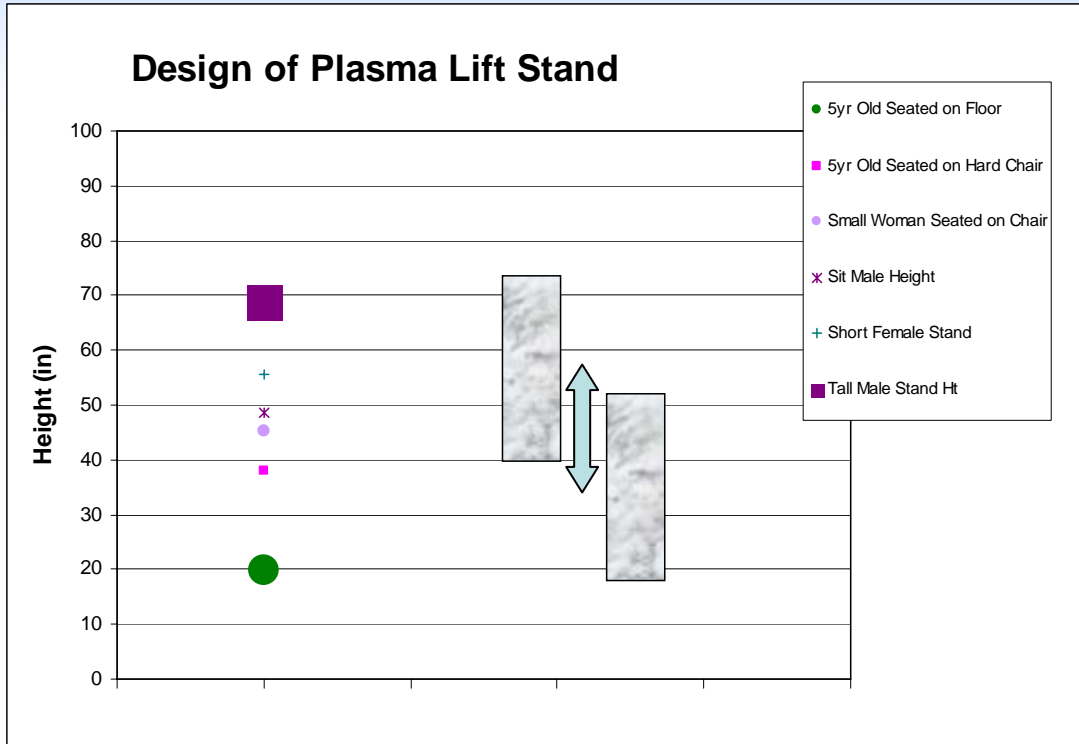
- **Ergonomic Science**
 - **Aging Workforce, Bifocal Viewing**
 - Monitor Arms will become an important solution
 - **Home Ergonomics**
 - Children and Adults sharing workstations
 - Television viewing ergonomics
- **Ergonomic Products**
 - **Height/Angle Adjustable Large Display solutions for home use**
 - **Low Cost Sit/Stand Workstations**
 - **Low User Force Adjustment Solutions**

Large TV Home Viewing Challenges (50" TV Example)



- **Implies the Optimal position for adapting to all viewing considerations in the home is TV 10' from viewer, center of the monitor 29" high**
 - **BUT.....**
 - **Top of monitor is out of viewing cone for child**
 - **Bottom is out of viewing cone for standing male**
 - **Bottom of monitor ~18" or lower..... no space for electronics**

A Practical Solution



- ***Provide Height-Adjustability to enable optimal positioning for the specific audience***
- ***Provide tilt and lift to make easy adjustments***
- ***Make lower end of range as low as practical... allowing for shelves***



THANK YOU!!



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