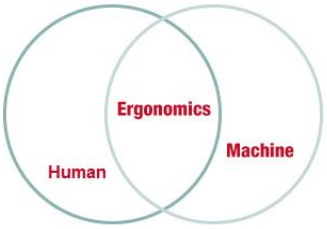
UNITED STATES ERGONOMICS

1.0 Overview

Our approach to ergonomics focuses on achieving measurable improvements in performance and comfort while reducing user fatigue and injury risk. United States Ergonomics has extensive experience testing human response to products and using that data to specify successful designs. United States Ergonomics is the only company in the United States offering Ergonomic Product Certification.



United States Ergonomics maintains a state-of-the-art ergonomics laboratory where product testing is performed. The capabilities of the lab include muscle effort monitoring (electromyography), dynamic postural analysis, contact pressure mapping, thermal analysis, human vibration analysis, Human Computer Aided Design and simulation, human motion analysis, physiologic testing, biomechanical modeling and more. Through these techniques it is possible to objectively quantify the effects of human performance and the effects of product design on the user.

US Ergonomics has extensive experience in the ergonomic testing & design of a broad range of consumer and professional products.

Products Tested:

Theme park character copstumes, exoskeletons, consumer appliances, surgical equipment, medical products, surgical gloves, exam gloves, industrial work gloves, golf gloves, chemical resitant gloves, pipets, powered and non-powered hand tools, bar code scanning equipment, office products, Point of Service devices (POS), sporting goods & equipment, protective gear, insoles, aircraft cockpit controls & layout, airline seating, office seating, truck seating, children's strollers, keyboards, industrial vehicles, lift trucks, automobile interiors, automotive seating, construction vehicles, mattresses, ejection seating, flight controls, professional footwear, control panels, joysticks, game controllers, appliances, cosmetic dispensers, medicinal packaging, aerospace tools, automotive assembly tools, toothbrushes, pens, pencils, hammers, grip surface materials, knives, computer mice, trackballs, 3-D CAD input devices, more…

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Product Design, Testing and Certification Services

1.1 Services

Product Design Services

- User Research & Concept Development
- Expert Review of Product Concept
- Development of ergonomic design specifications
- Ergonomic design support

Ergonomics Product Testing Services

- FDA 510K Human Factors Testing
- User Interface and Human Factors Testing
- Competitive product benchmarking
- Best-in-Class testing
- Concept validation testing
- Objective Correlation of Design to Comfort
- Patent claim validation & application support

Ergonomics Product Certification

- Based on Objective Test Results
- Support In Product Launch
- Hang Tags & Packaging Promotional Materials

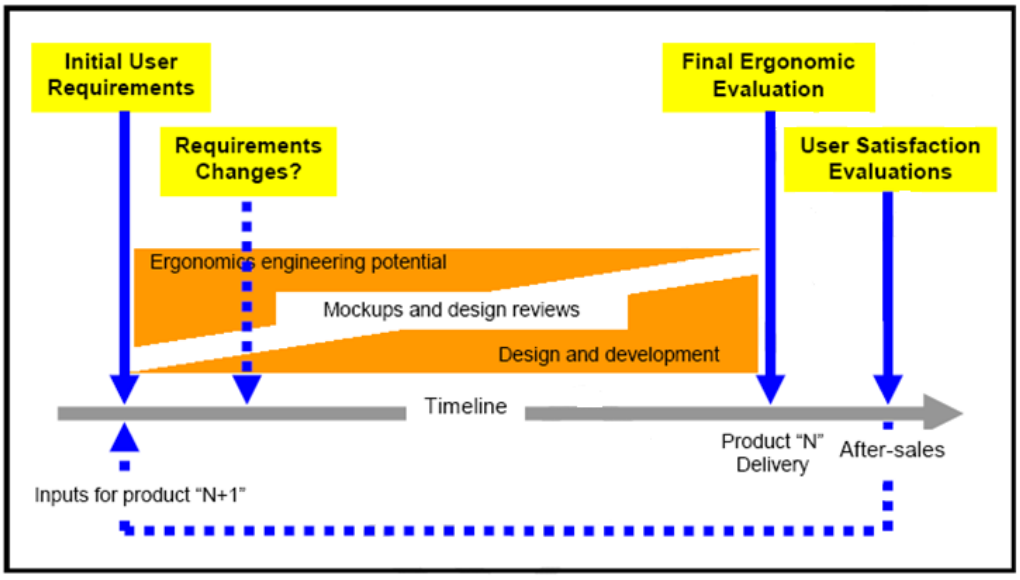
Marketing Support Services

- Validation of product claims
- Educational seminars for users
- Educational seminars for sales staff
- Conference presentations
- Peer review articles

2.0 Ergonomics Product Testing, Expert Review & Design

US Ergonomics specializes in the application of measurement-based technologies to assess the human response to product and/or workplace design. Test populations are selected to represent the appropriate user demographic. The results of these analyses are used to improve comfort and efficiency while reducing fatigue potential, injury risk and liabilities.

Products may be tested to assess both the cognitive and physical interface. User interface testing may include observational methods combined with structured survey based methods. To measure the physical interface between the user and product design several techniques may be applied, including muscle effort monitoring (electromyography), vibration analyses, thermal testing, contact pressure mapping, dynamic postural analyses (electrogoniometry), biomechanical modeling, physiologic testing, anthropometric analyses and subjective comfort testing.



Ergonomic Product Design Process
Source: International Ergonomic Association "Ergonomic Quality in Design Process"

3.0 Ergonomic Product Certification

The goal is to ensure that the product is not likely to increase the potential for user fatigue, discomfort, postural stress, misuse, error, and cumulative injury. The Ergonomic Product Certification process follows the procedures outlined by the International Ergonomic Association (IEA) to ensure the ergonomic quality of a product. The validation testing involves two main components as follows:

3.1 Controlled Laboratory Testing

The first is a controlled laboratory based test of the product with a sample of typically 18 individuals. The lab testing includes a combination of objective and subjective measurements to assess product use. Measurements may include muscle effort (using electromyography), dynamic posture (using electro-goniometry and/or video), contact pressure mapping, thermal testing, vibration testing, and structured survey based measurements. To perform effectively the product must perform in accordance with acceptable thresholds of effort, posture, temp, comfort, vibration, etc..

3.2 User Field Testing

The second part is field trial whereby we issue product to users in the workplace or home (consumer products). These individuals test and use the product in their daily activities for a minimum of a 1-month period. Numerically based rating surveys and a solicitation of user comments on product use and performance issues are issues daily. Data related to ease of use, effectiveness, fatigue, fit, comfort, performance, etc., are tracked and the users comments are compiled for evaluation. To pass the certification criteria the product must receive a majority of favorable ratings and perform at an acceptable level.

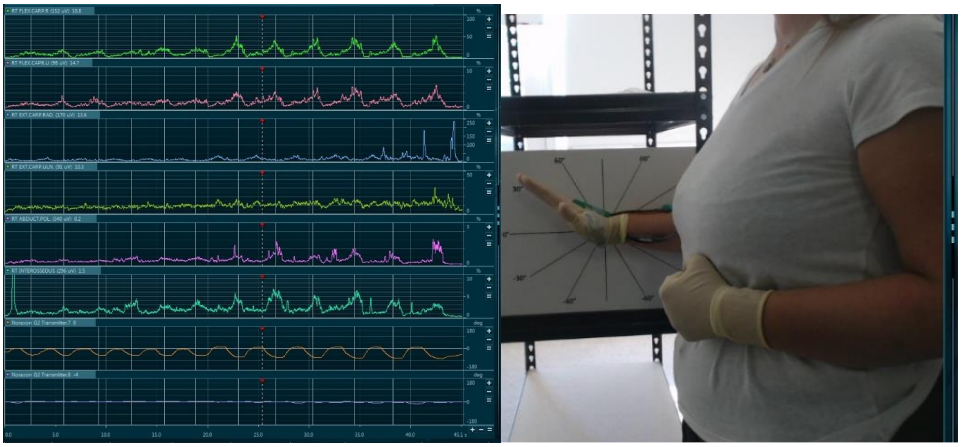
Assuming that the results from both of the test are positive, i.e., the product performs within established ergonomic guidelines and/or standards; the product is eligible for Ergonomic Certification.

Certifications available for global markets

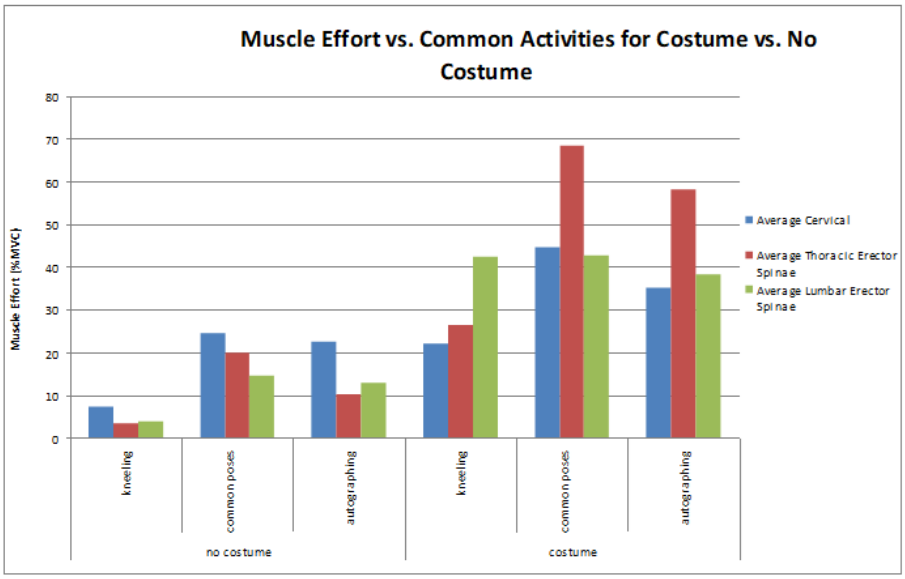
4.0 Testing Methods

A summary description of the methodologies US-Ergo may apply to the design and testing of product includes the following:

Electromyography – Measurements of muscle effort during product be monitored using electromyography (EMG). Applicable to the superficial muscle groups this technique can be used to measure effort and predict fatigue potential. It is often used to compare products or work techniques. Thresholds of exertion may be used to determine if a design is acceptable. As a guideline, average muscle exertion over 20% of an individual's maximum strength will increase the potential for fatigue.

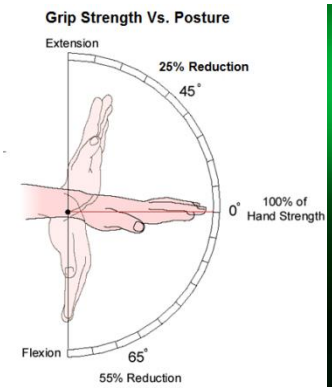


Sample muscle effort measurement



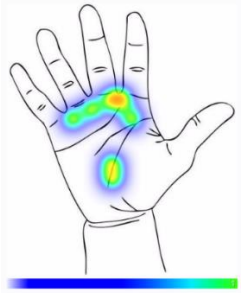
Sample EMG from Character Costume Test

Dynamic Postural Analysis: Postural technique is directly related to joint stress and exertion levels. The postures associated with work or product use will directly impact productivity and ergonomic risk. Methods to measure postural technique include electrogoniometry and video based analysis. Three-dimensional kinematic analyses of body movement are used to assess effort and performance levels.

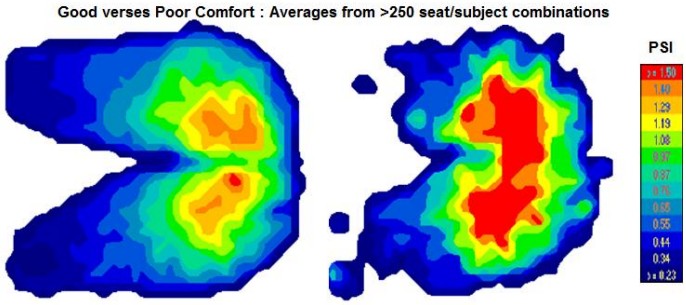


Contact Pressure – is measured using flexible force sensors and using self-mapped pressure point ID. Sensors may be placed at key contact areas this technique can record the level of pressure between the user/work interface. Typically applied to measure hand contact on tools or body support on seats, and foot pressure distribution.

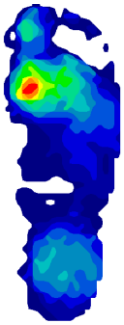
Areas of Pressure Product A



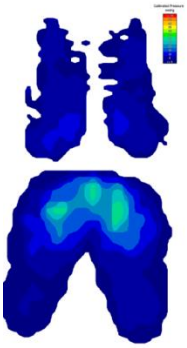
Areas of Pressure Product B



Sample Used in the Development of Seating Comfort Models

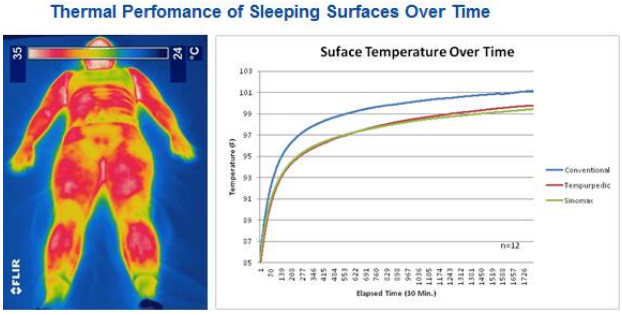


Dynamic foot pressure mapping



Analysis of seat support

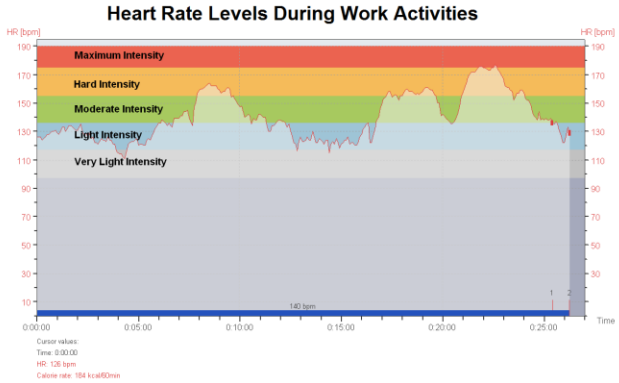
Thermal Conductivity – Skin sensitivity to moderately warm or cold temperatures can affect comfort, usability and injury potential. To quantify the thermal characteristics of materials that come in contact with the skin, surface temperature may be measured. Common applications include seating, hand tools, mattresses and other product that a user may come in contact with. The thermal performance may allow product comparisons or be assessed relative to desirable thermal limits.



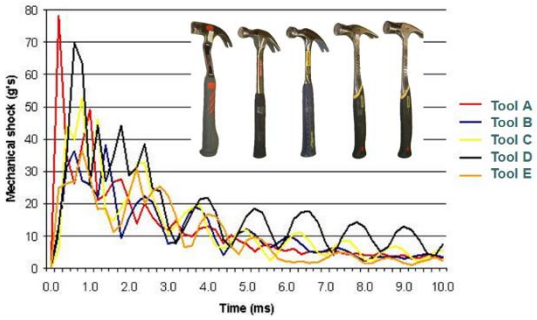
Thermal imaging

Thermal Sensors

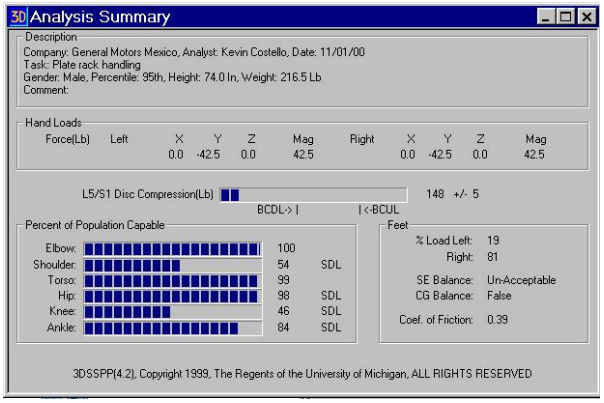
Heart Rate– is measured to compare work demands, assess whole body fatigue potential and to determine appropriate work/rest schedules. The cardiovascular requirements of work should also be considered in the development of pre-employment screening programs.



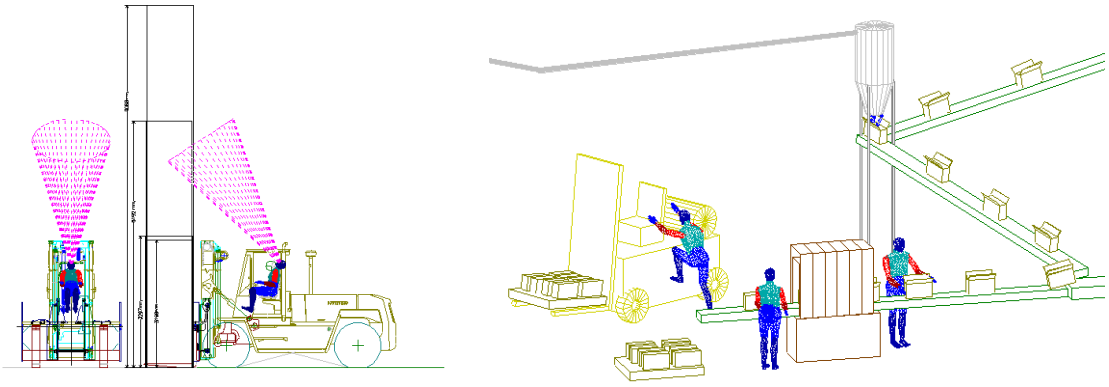
Vibration – Whole body & Hand/arm vibration are measured in accordance with published standards (ISO, ANSI, EU). Based on the vibration magnitude and frequency, safe exposure limits may be determined. Hand/arm vibration tests are typically conducted on powered hand tools (assembly tools, grinders, jack hammers, etc.). Whole body vibration tests are typically performed on ride on vehicles (lift trucks, loaders, etc.) or vibrating floor areas.



Biomechanical Modeling- is applied to simulate the effects of a work method and job design on the human. Calculations of joint forces and torques as well as spinal disc pressures may be compared to population limitations to establish safe limits. Modeling also allows design concepts to be evaluated in a virtual state.



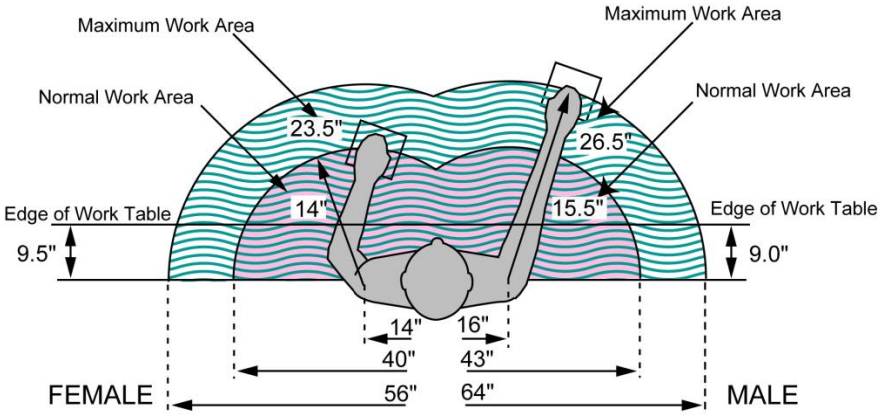
Human CAD Analysis – 3-dimensional evaluation of equipment or processes may be completed using Computer Aided Design tools. A computer generated humanoid may be selected from various percentile groups and/or global populations to simulate activities. The technique allows an objective design comparison related to joint forces and torques, sizing, reach and vision ranges and more.



Simulation

User Survey Methods – We may apply a variety of subjective survey methodologies to assess the ease of product use, cognitive workflow, error analysis and perceptions of work demands. These techniques are helpful in determining psychophysical work requirements and developing thresholds based on the perceived exertion. A combination of NASA-TLX, Borg, and Likert scales may be applied.

Anthropometric Analyses – The variation in human body size & shape, range of joint motion and strength must be considered in product design. Anthropometric data may be obtained from various global populations. It is applied to ensure that the job design meets the requirements of its intended user's physical capabilities.



Human Productivity Testing - Doing more work with less effort is the definition of ergonomic productivity. Measurable gains in work efficiency are achievable through better technique, better products or better job design. Human efficiency can be dramatically improved while simultaneously reducing ergonomic risks and enhancing employee/user comfort.