SEMI S8-0308
SAFETY GUIDELINES FOR ERGONOMICS ENGINEERING OF SEMICONDUCTOR MANUFACTURING EQUIPMENT

This safety guideline was technically approved by the global Environmental, Health, and Safety Committee. This edition was approved for publication by the global Audits and Reviews Subcommittee on December 20, 2007. It was available at www.semi.org in February 2008 and on CD-ROM in March 2008. Originally published in 1995; previously published March 2007.

NOTICE: The official values in this guideline are expressed in The International System of Units (SI). Values that:

- are expressed in inch-pound (also known as "US Customary" or "English") units,
- are enclosed in parentheses, and
- directly follow values expressed in SI units

are not official, are provided for reference only, and might not be exact conversions of the SI values.

NOTICE: Paragraphs entitled "NOTE" are not an official part of this safety guideline and are not intended to modify or supersede the official safety guideline. These have been supplied by the committee to enhance the usage of the safety guideline.

1 Purpose

1.1 These guidelines provide ergonomics design principles and considerations for semiconductor manufacturing equipment.

1.2 The purpose of these guidelines is to promote compatibility between the user and the equipment in the manufacturing environment. The following general principles are integral to the ergonomics design and evaluation of equipment:

1.2.1 The equipment should be designed to optimize safety by distributing tasks. Tasks should be distributed among hardware, software, and users to make the best use of their respective capabilities and to minimize limitations and hazards. Appropriate distribution of tasks will also optimize performance.

1.2.2 Equipment should be designed to minimize potential for errors and mishaps, by conforming to users' expectations.

1.2.3 The equipment design should reduce fatigue and injury by fitting the equipment to the expected body size, strength, and range of motion characteristics of the user population. Such design will also facilitate task performance.

2 Scope

2.1 The guidelines address safety aspects of ergonomics engineering in the design of semiconductor manufacturing equipment. It should be noted that in order to ensure comprehensive coverage of potential safety hazards, some guidelines also address general design goals for effective human-machine performance. The guidelines apply to the design, operation, maintenance, and service of semiconductor manufacturing equipment, as well as, to a limited extent, equipment installation (see ¶ 7.3).

NOTICE: This safety guideline does not purport to address all of the safety issues associated with its use. It is the responsibility of the users of this safety guideline to establish appropriate safety and health practices and determine the applicability of regulatory or other limitations prior to use.

3 Limitations

3.1 International, national, and local standards, codes, and regulations must be consulted to ensure that equipment meets regulatory requirements**.**

3.2 Human factors data compiled in references and specifications are influenced by the population from which they were drawn and the reason they were collected. Human factors design criteria are sometimes based on studies using few subjects or are context-specific. Ergonomics experts should be consulted where data development or interpretation is required.

3.3 The equipment design should incorporate reasonable accommodations for users with special needs, such as left-handedness and color blindness. Where feasible the design should also accommodate users with hearing or vision impairments and/or physical disabilities. It should be understood that although designing for the target user population will accommodate some users with special needs, these guidelines cannot anticipate and fully accommodate all such users.

3.4 Existing models and subsystems that meet previous versions of SEMI S8 should continue to meet the guidelines of SEMI S8 in force at the time of design. Models with redesigns that significantly affect the ergonomic design of the equipment should include conformance to the latest version of SEMI S8 for the redesign.

NOTE 1: Conformance with this document is believed to be a suitable substitute for conformance with its predecessors.

3.5 Conformance with the guidelines in Appendix 1 (SESC) constitutes conformance with SEMI S8.

4 Referenced Standards and Documents

4.1 *SEMI Standards and Safety Guidelines*

SEMI E95 — Specification for Human Interface for Semiconductor Manufacturing Equipment

SEMI S1 — Safety Guideline for Equipment Safety Labels

SEMI S2 — Environmental, Health, and Safety Guidelines for Semiconductor Manufacturing Equipment

SEMI S10 — Safety Guideline for Risk Assessment and Risk Evaluation Process

4.2 *CEN/CENELEC Standards*[1]

4.2.1 European Norm (EN) standards are listed herein for application to semiconductor manufacturing equipment to be used in the European Union (EU). As EN standards are intended for use with a broad range of industrial and consumer products, conflicts with SEMI safety guidelines are likely. Additionally, provisional EN (prEN) standards are subject to revision prior to adoption.

EN 894-2 — Safety/Ergonomics for Displays

EN 894-3 — Safety/Ergonomics for Control Actuators

EN 60204-1 — Safety of Machinery – Electrical Equipment of Machines, Part 1 – Specification for General Requirements

4.3 *Military Standard* [2]

MIL-STD-1472 — Human Engineering Design Criteria for Military Systems, Equipment, and Facilities

4.4 *NFPA Standard*[3]

NFPA 79 — Electrical Standard for Industrial Machinery

4.5 *ISO Standard*[4]

ISO 9241 — Ergonomic Requirements for Office Work with Visual Display Terminals

4.6 *Other Standards and Documents*

Humanscale, The MIT Press, Massachusetts Institute of Technology, Cambridge, MA 02142, 1974

ANSI/IES RP7[5] — Practice for industrial lighting

1 European committee for standardization (CEN)/European Committee for Electrotechnical Standardization (CENELEC), Central Secretariat: rue de Stassart 35, B-1050 Brussels, Belgium. http://www.cenelac.org

2 United States Military Standards, Available through the Naval Publications and Forms Center, 5801 Tabor Avenue, Philadelphia, PA 19120-5099, USA. Telephone: 215.697.3321

3 National Fire Protection Association, 1 Batterymarch Park, Quincy, MA 02269, USA. http://www.nfpa.org

4 International Organization for Standardization, ISO Central Secretariat, 1, rue de Varembé, Case postale 56, CH-1211 Geneva 20, Switzerland. Telephone: 41.22.749.01.11; Fax: 41.22.733.34.30; http://www.iso.ch

Waters, Thomas, *et.al.*, *Application Manual for the Revised NIOSH Lifting Equation*, U.S. Department of Health and Human Services (NIOSH), Cincinnati, OH, 1994.

A. Mital, A.S. Nicholson, M.M. Ayoub: *A Guide to Manual Materials Handling*, Taylor and Francis, London, 1993.

NOTICE: Unless otherwise indicated, all documents cited shall be the latest published versions.

5 Terminology

5.1 *Abbreviations and Acronyms*

5.1.1 *MAWL* — Maximum Acceptable Weight of Lift

5.1.2 *MMH* — Manual Material Handling

5.1.3 *SESC* — Supplier Ergonomics Success Criteria (see Appendix 1)

5.2 *Definitions*

5.2.1 *administrative controls* — administrative controls modify the way in which a job is performed without involving equipment design. They are non-engineering controls which include: job rotation, job enlargement, work-rest scheduling, micro-breaks, and stretching exercises. Engineering controls are preferred over administrative controls.

5.2.2 *anthropometric considerations* — design considerations based upon anthropometric (e.g., size and strength) limitations of user personnel.

5.2.3 *anthropometry* — description of the physical measurement of humans (e.g., size and strength).

5.2.4 *cognitive* — relating to human information processing, perception, and attention.

5.2.5 *critical controls and displays* — controls and displays which prevent the equipment from entering, or indicate that equipment is entering an unsafe condition in which hazards to personnel or damage to equipment may occur. Emergency Off (EMO) switches, interlock defeat indicators, and malfunction alarms are examples of critical controls and displays.

5.2.6 *cumulative trauma disorder* — a disorder which results from the accumulation of stresses (e.g., forces, repetitive movements, etc.) to a body part over a period of time.

5.2.7 *duration* — the length of time of a cycle or the entire task, which represents the time of exposure to single or multiple risk factors.

5.2.8 *emergency off (EMO)* — a control circuit which, when activated, places the equipment into a safe shutdown condition.

5.2.9 *engineering control* — a method to eliminate or mitigate a hazard through equipment design.

5.2.10 *ergonomic-related hazard* — an equipment or workplace condition that creates stress to the user that contributes to the risk of developing either an acute injury or a cumulative trauma disorder.

5.2.11 *ergonomic issues* — those issues dealing with the user's physical and cognitive needs, capabilities, and human performance limitations in relation to the design of machines, tasks, and other features of the human's working environment.

5.2.12 *ergonomics* — the study of human mental and physical capability in relation to the working environment and the equipment operated by the worker.

5.2.13 *excessive reach* — a reach which may result in biomechanical or other stress to the user.

5.2.14 *extended reach* — a reach which requires either stretching, stooping, crouching, bending forward at the waist greater than 20°, or shoulder flexion or abduction greater than 45°.

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5 American National Standards Institute, Headquarters: 1819 L Street, NW, Washington, DC 20036, USA. Telephone: 202.293.8020; Fax: 202.293.9287. New York Office: 11 West 42nd Street, New York, NY 10036, USA. Telephone: 212.642.4900; Fax: 212.398.0023; http://www.ansi.org