Background Statement for SEMI Draft Document 5917

Line Item Revisions to SEMI S8-0915, SAFETY GUIDELINE FOR ERGONOMICS ENGINEERING OF SEMICONDUCTOR MANUFACTURING EQUIPMENT

Revisions on Multiple Topics

NOTICE: This background statement is not part of the balloted item. It is provided solely to assist the recipient in reaching an informed decision based on the rationale of the activity that preceded the creation of this Document.

NOTICE: Recipients of this Document are invited to submit, with their comments, notification of any relevant patented technology or copyrighted items of which they are aware and to provide supporting documentation. In this context, "patented technology" is defined as technology for which a patent has issued or has been applied for. In the latter case, only publicly available information on the contents of the patent application is to be provided.

Background Statement

This ballot consists of four (4) line items.

Line item 1 – Add a Definition for "hand-object coupling point" in the Terminology Section

Line item 2 – Add a reference to SEMATECH ISMI Manual Material Handling Application Guide

Line item 3 – Revisions and additions to hand/arm clearances

Part A: Add references to Related Documents section

Part B: Revisions to dimensions provided in Appendix 1, Section 7 and provisions for ungloved and gloved conditions

Part C: Add a New Related Information Section "Y" with additional hand/arm clearance design recommendations

Line item 4 – Add a new Related Information section to assist with determining what tasks are within the scope of an assessment to SEMI S8

Unless otherwise noted, all material to be added is <u>underlined</u>, and all material to be deleted is ~~struck through~~. Paragraphs throughout the document will be renumbered as necessary to accommodate any changes made as a result of this ballot.

As this is a technical ballot, all votes of Reject must be accompanied by reasons (negatives) and be sent to SEMI staff before the balloting deadline or they will be considered abstention votes. If you have any comments on the ballot (suggestions or questions that you do not believe are technical negatives) please clearly indicate them as COMMENTS to assist us with reducing the administrative overhead in handling them during the task force and committee meetings.

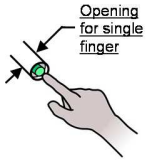
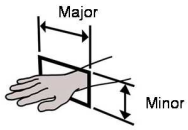
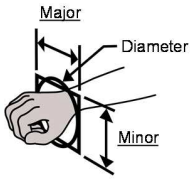
Additional Background Information for Line Item 3

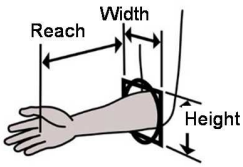
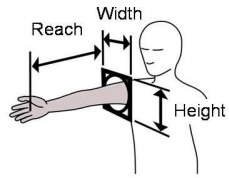
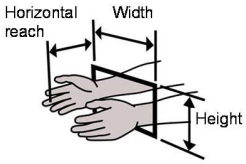
Line Item 3 makes adjustments to Section 7 of Appendix 1 of SEMI-S8 and provides design recommendations to fill in gaps. The proposed changes were developed during SEMI-S8 Task Force activities which have been ongoing since March of 2008. Calculations and rationale for the proposed changes are provided below.

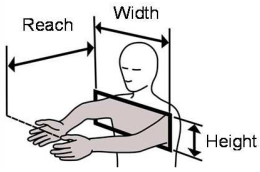
Hand/arm clearance dimensions in SEMI S8 Appendix 1, Section 7 have been part of SEMI-S8 since the S8-0999 version. Most of these dimensions were originally copied from Humanscale 7/8/9 (Diffrient, 1991). The majority of the data found in Humanscale were taken directly from or derived from US military research and design specifications. Rather than rely on Humanscale, which is a copyrighted document, it's best to use the original sources, which are not copyrighted. Most recent versions of the original sources that were used to create Humanscale are provided in the first table below. If a better source was found then the recommended dimensions were changed as needed. Full citations are provided in the References section of this background statement.

Some of the original sources for the dimensions use metric units while others use US customary units. Dimensions from the original sources in the original units were used for the provided recommendations with appropriate conversions made for the other measuring system (either metric or US customary).

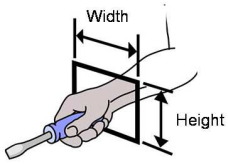
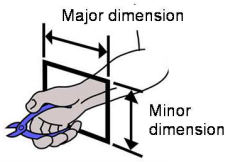
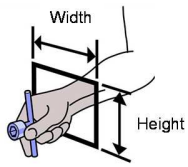
Sources for Dimension Provided in SEMI-S8 SESC Section 7

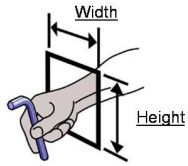
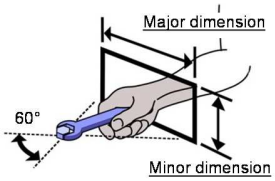
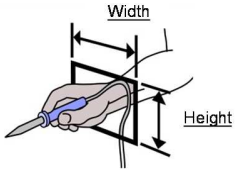
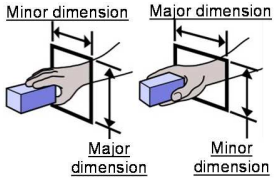
Section	*Criteria*	*Recommendation*	*Best Source*
7.3.1	Clearance provided for finger access, round (dia.) or square, one finger. 	Minimum diameter: Bare hand 32 mm (1.3 in.)	32 mm (1.25 in.) MIL-STD 1472F, 1999, p 136.
		Maximum depth: 59 mm (2.3 in.)	59 mm (2.3 in.) EN 547-2:2009, Section 4.10 using data from EN 547-3:2009.
~~7.3.1~~ 7.3.2	Clearance provided for 2, 3, or 4 finger twist of small knob. 	Minimum opening, object diameter plus: Bare hand: 58 mm (2.3 in.)	58 mm (2.3 in.) + object diameter plus for 2 or 4 Fingers, Diffrient [Humanscale] 7/8/9, 1991, chart 9a. (No alternative source found)
~~7.3.2~~ 7.3.3	Clearance provided for flat hand wrist access. 	Major dimension, minimum Bare hand 114 mm (4.5 in.)	114 mm (4.5 in.) Diffrient [Humanscale] 7/8/9, 1991, chart 9a.
		Minor dimension, minimum Bare hand 89 mm (3.5 in.) The hand can be held with the palm vertical or horizontal so “major” (parallel to a line through the large knuckles) and “minor” (perpendicular to a line through the large knuckles) dimensions are provided for the opening rather than “height” and “width” dimensions	89 mm (3.5 in.) Diffrient [Humanscale] 7/8/9, 1991, chart 9a.
~~7.3.3~~ 7.3.4	Clearance provided for fist to wrist access with thumb outside of fist. Opening may be circular or rectangular. 	Major dimension, minimum Bare hand 127 mm (5.0 in.)	125 mm (5.0 in.) bare hand. MIL-STD 1492F, 1999, p136.
		Minor dimension, minimum Bare hand 95 mm (3.7 in.)	95 mm (3.74 in.) bare hand (MIL-STD 1492F, 1999, p136.
		Diameter, minimum Bare hand 125 mm (5.0 in.) The hand can be held with the palm vertical or horizontal so “major” (parallel to a line through the large knuckles) and “minor” (perpendicular to a line through the large knuckles) dimensions are provided for the opening rather than “height” and “width” dimensions	125 mm (5.0 in.) dia. bare hand. MIL-STD 1492F, 1999, p 136.

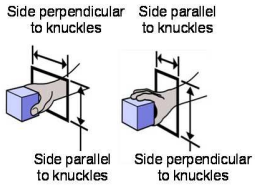
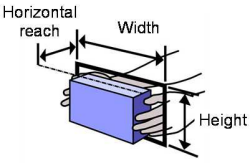
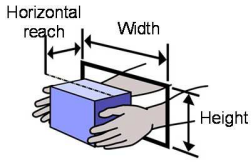
Section	*Criteria*	*Recommendation*	*Best Source*
~~7.3.7~~ 7.3.5	Clearance provided for one arm to elbow access. Opening may be circular or rectangular. 	Horizontal reach from opening to center of grasping area: 202 mm (8.0 in.)	202 mm (8.0 in) (Japanese Databook 2004-2006) 5th percentile female reach from elbow (284 mm) minus 50th percentile elbow circumference (257 mm) ÷ π.
		Minimum opening, rectangular dimensions: Width: 115 mm (4.5 in.)	115 mm (4.5 in.) MIL-STD 1492F, 1999, p 136.
		Height: 100 mm (4.0 in.)	102 mm (4.0 in.) MIL-STD 1492F, 1999, p 136.
		Minimum opening, circular dimension: 115 mm (4.5 in.) diameter	115 mm (4.5 in.) dia. MIL-STD 1492F, 1999, p 136.
7.3.6	Clearance provided for one arm to shoulder access. ~~(does not ensure visual access)~~ Opening may be circular or rectangular. 	Horizontal reach from opening to center of grasping area: 393 mm (15.5 in.)	392.5 mm (15.5 in) Japanese Databook 2004-2006. 5th percentile female grip reach from back (591.5 mm) minus 50th percentile thoracic depth (199 mm).
		~~Clearance, minimum 132 mm (5.2 in)~~ Minimum opening rectangular dimensions: 125 × 125 mm (5.0 × 5.0 in.) Minimum clearance, circular opening: 125 mm (5.0 in.) diameter	125 mm (5.0 in.) square or dia. MIL-STD 1492F, 1999, p 136.
~~7.3.5~~ 7.3.7	Clearance provided for two hands, hand to wrist access. 	Reach, maximum: 203 mm (8.0 in.)	202 mm (8.0 in) Japanese Databook 2004-2006. 5th percentile female reach from elbow (284 mm) minus 50th percentile elbow circumference (257 mm)/π. 203 mm (8.0 in.) (Diffrient [Humanscale] 7/8/9, 1991, chart 9a).
		Width, minimum: Bare hand: 191 mm (7.5 in)	191 mm (7.5 in.) (Diffrient [Humanscale] 7/8/9, 1991, chart 9a).
		Height, minimum: Bare hand: 114 mm (4.5 in.)	114 mm (4.5 in.) (Diffrient [Humanscale] 7/8/9, 1991, chart 9a).

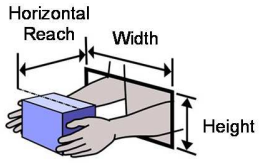
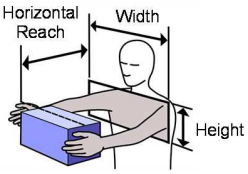
Section	*Criteria*	*Recommendation*	*Best Source*
~~7.3.4~~ 7.3.8	Clearance provided for two hands, arm to shoulders access.  	Reach maximum: ~~610 mm (24 in.)~~ [cannot find source] 393 mm (15.4 in)	393 mm (15.4 in) (Japanese Data Book 2004-2006) 5th percentile female grip reach from back (591.5 mm) minus 50th percentile thoracic depth (199 mm).
		Width: minimum: ~~500 mm (19.7 in.)~~ [Note: cannot find a source for this dimension] 495 mm (19.5 in)	495 mm (19.5 in) for a 95th%ile male. Kennedy, 1966, p 6.
		Height: minimum: 127 mm (5.0 in.)	127 mm (5.0 in.) (MIL-STD 1492F, 1999, p 136).

Dimension sources for the proposed Related Information section "Y" for additional hand/arm clearances are below. All of the provide dimensions are new to SEMI S8 so they have been underlined.

Number	*Criteria*	*Recommendation*	*References*
Y-1	Using common screwdriver with freedom to turn hand 180°.  	Width, minimum Bare hand 110 mm (4.3 in.)	110 mm (4.3 in.) MIL-HDBK-759C, 1995, p 195.
		Height, minimum Bare hand 120 mm (4.7 in.) Note: Greatest hand rotation strength is possible with the hand in a neutral position. An upright working posture is assumed.	120 mm (4.7 in.) MIL-HDBK-759C, 1995, p 195.
Y-2	Using pliers and wire cutting tools.  	Major dimension, minimum Bare hand 130 mm (5.2 in.)	Width = 130 mm (5.1 in.) MIL-HDBK-759C, 1995, p 195.
		Minor Dimension, minimum Bare hand 115 mm (4.5 in.) Note: Hand orientation depends on the orientation of the tool, which in turn depends on the orientation of the object to be cut or crimped, so "major" and "minor" dimensions are provided instead of "height" and "width."	Height = 115 mm (4.5 in.) MIL-HDBK-759C, 1995, p 195.
Y-3	"T" wrench use with freedom to turn hand 180°.  	Width, minimum Bare hand 135 mm (5.3 in.)	135 mm (5.3 in.) MIL-HDBK-759C, 1995, p. 195.
		Height, minimum Bare hand 155 mm (6.1 in.) Note: Greatest hand rotation strength is possible with the hand in a neutral position. An upright working posture is assumed.	155 mm (6.1 in.) MIL-HDBK-759C, 1995, p. 195.

Number	*Criteria*	*Recommendation*	*References*
Y-4	Allen wrench use with freedom to turn wrench 60°.  	Width, minimum Bare hand 120 mm (4.7 in.)	120 mm (4.7 in.) MIL-HDBK-759C, 1995, p 195.
		Height, minimum Bare hand 155 mm (6.1 in.) Note: Greatest hand rotation strength is possible with the hand in a neutral position. An upright working posture is assumed.	155 mm (6.1 in.) MIL-HDBK-759C, 1995, p 195.
Y-5	Using open end wrench with freedom to turn wrench through 60°.  	Major dimension, minimum Bare hand 270 mm (10.6 in.)	Width = 270 mm (10.6 in.) (60 degrees rotation) MIL-HDBK-759C, 1995, p 195.
		Minor dimension, minimum Bare hand 200 mm (7.9 in.) Note: Hand orientation depends on the orientation of the nut or bolt to be turned so “major” and “minor” dimensions of opening are provided instead of “height” and “width.”	Height = 200 mm (7.9 in.) (60 degrees rotation) MIL-HDBK-759C, 1995, p 195.
Y-6	Clearance for using test probe.  	Height and width, minimum Bare hand 90 mm (3.5 in.)	90 mm (3.5 in.) MIL-HDBK-759C, 1995, p 195.
Y-7	Clearance for grasping objects up to 50 mm with one hand.  	Minimum opening, major dimension Bare hand 120 mm (4.7 in.)	Height = 120 mm (4.7 in.) MIL-HDBK-759C, 1995, p 195.
		Minimum opening, minor dimension Bare hand 110 mm (4.3 in.) Objects can be grasped with the palm vertical or horizontal so “major” (parallel to a line through the large knuckles) and “minor” (perpendicular to a line through the large knuckles) dimensions are provided for the opening rather than “height” and “width” dimensions	Width = 110 mm (4.3 in.) MIL-HDBK-759C, 1995, p 196.

Number	*Criteria*	*Recommendation*	*References*
Y-8	Grasping objects wider than 50 mm with one hand.  	Dimension perpendicular to a line drawn through the knuckles of the fingers, minimum Bare hand Object width + 45 mm (1.8 in.)	Height = 45 mm (1.8 in.) + object width. MIL-HDBK-759C, 1995, p 196.
		Dimension parallel to a line drawn through the knuckles of the fingers, minimum Bare hand 125 mm (4.9 in.) Objects can be grasped with the palm vertical or horizontal so dimensions are based upon which side of the opening is parallel to a line drawn though the large knuckles of the hand.	Width = 125 mm (4.9 in.) MIL-HDBK-759C, 1995, p 196.
Y-9	Grasping large objects with two hands, with hands extended through openings up to but not including the large knuckles.  	Horizontal reach from opening to center of grasping area, maximum 61 mm (2.4 in.)	61 mm (2.4 in). 5th percentile female Middle finger length (68 mm) minus ½ of the fingertip width (13.5 mm). 68 - (13.5÷2) = 61.25 mm. Dimensions of the Hands, 2010.
		Opening width, minimum Bare hand Object width + 75 mm (3.0 in.)	Object width + 75 mm (3 in.). MIL-HDBK-759C, 1995, p. 196.
		Opening height, minimum Bare hand 125 mm (4.9 in.)	125 mm (5 in.) MIL-HDBK-759C, 1995, p 196.
Y-10	Clearance provided for grasping large objects with 2 hands extended through opening up to wrists (large knuckles pass through opening).  	Horizontal reach from the body side of opening to center of grasping area: 203 mm (8.0 in.) maximum	203 mm (8.0 in.) Diffrient [Humanscale] 7/8/9, 1991, chart 9a. (No alternative source found)
		Opening width, minimum Bare hand Object width + 115 mm (4.5 in.)	115 mm (4.5 in.) + box width (SAE-J925, 1993, p 6). 115 mm (4.5 in.) + box width (MIL-STD 1492F, 1999, p 136, fig 39). 115 mm (4.5 in.) + box width (Morgan, 1963, p 388, fig 9-35). 115 mm (4.5 in.) + box width (NASA/SP-2010-3407, 2010, p 659).
		Height of opening, minimum 125 mm (4.9 in.)	125 mm (4.9 in.) MIL-STD 1492D, 1992, figure 45, p 188.

Number	*Criteria*	*Recommendation*	*References*
Y-11	Clearance provided for grasping large objects with two hands with arms extended through opening up to elbows. 	Horizontal reach from body side of opening to center of grasping area: 202 mm (8.0 in.)	202 mm (8.0 in) 5th percentile female reach from elbow (284 mm) minus 50th percentile elbow circumference (257 mm)/π. Japanese Data Book 2004-2006, 2008.
		Width, minimum Obj. width + 152 mm (6.0 in.)	Object width + 152 mm (6 in.). MIL-HDBK-759C, 1995, p 196.
		Height, minimum 127 mm (5.0 in.)	127 mm (5.0 in.). MIL-HDBK-759C, 1995, p 196.
Y-12	Clearance provided for grasping items with two hands with arms extended though opening to shoulders. 	Horizontal reach from body side of opening to center of grasping area: 393 mm (15.5 in.)	392.5 mm (15.4 in) 5th percentile female grip reach from back (591.5 mm) minus 50th percentile thoracic depth (199 mm). Japanese Body Size Data Book 2004-2006, 2008.
		Width of opening, minimum: 483 mm (19 in.)	483 mm (19 in.) Clothed. Diffrient [Humanscale] 7/8/9, 1991, chart 9a.
		Height of opening, minimum 127 mm (5.0 in.)	127 mm (5.0 in.). MIL-HDBK-759C, 1995, p 196.

Hand/arm opening clearances were adjusted for glove conditions typically found in the semiconductor industry as follows:

Gloved Hand Measurements

Condition	Bare hand	Cleanroom (Nitrile) glove with knit Nylon liner	Chemical glove over cleanroom glove	Electrical insulating glove (leather glove over a rubber glove)	Thermal insulating glove
Image					
One side	0 mm (0 in.)	1.5 mm (0.06 in.)	3 mm (0.12 in.)	6.5 mm (0.25 in.)	6.5 mm (0.25 in.)
Two sides	0 mm (0 in.)	3 mm (0.12 in.)	6 mm (0.25 in.)	13 mm (0.5 in.)	13 mm (0.5 in.)
Source: Unpublished study conducted by Texas Instruments, 2011.					

Please forward a courtesy copy of any comments or negatives against the ballot to Paul Schwab at p-schwab@ti.com and Ron Macklin at ron.macklin@rmacklinandassociates.com.

Respectfully,

Paul Schwab and Ron Macklin,
SEMI-S8 Task Force Co-Leaders

Review and Adjudication Information		
	Task Force Review	**Committee Adjudication**
Group:	Ergonomics Task Force	EHS NA TC Chapter
Date:	13 July, 2016	14 July, 2016
Time & Time Zone:	8:30 AM – 9:30 AM (U.S. Pacific Time)	9:00 AM to 5:00 PM (U.S. Pacific Time)
Location:	San Francisco Marriott Marquis Hotel 780 Mission Street	San Francisco Marriott Marquis Hotel 780 Mission Street
City, State/Country:	San Francisco, California 94103 USA	San Francisco, California 94103 USA
Leaders:	Paul Schwab (Texas Instruments, Inc.) Ron Macklin (R. Macklin & Associates)	Sean Larsen (Lam Research) Chris Evanston (Salus Engineering) Bert Planting (ASML)
Standards Staff:	Kevin Nguyen 408.943.7997 knguyen@semi.org	Kevin Nguyen 408.943.7997 knguyen@semi.org

Safety Checklist for SEMI Draft Document # 5917
Line Items Revisions to SEMI S8-0915, SAFETY GUIDELINE FOR ERGONOMICS ENGINEERING OF SEMICONDUCTOR MANUFACTURING EQUIPMENT

Developing/Revising Body

Name/Type:	Ergonomics Task Force
Technical Committee:	Environmental, Health, and Safety
Region:	North America

Leadership

Position	Last	First	Affiliation
Leader:	Schwab	Paul	Texas Instruments, Inc.
Leader:	Macklin	Ron	R. Macklin & Associates, LLC
Technical Editor	Sklar	Eric	Safety Guru, LLC

Documents, Conflicts, and Consideration

Safety related codes, standards, research studies, guidelines, and practices used in developing the safety guideline, and the manner in which each item was considered by the technical committee.

Reference	*Manner of Consideration*
Application Guide for Manual Material-Handling Requirements in SEMI-S8 ISMI, 2010, http://www.sematech.org/docubase/document/5029aeng.pdf.	Line Item 2, Related reference
Baker, P., J. M. McKendry, and G. Grant. Supplement III - Anthropometry of One-Handed Maintenance Actions. Port Washington, New York: U.S. Naval Training Device Center, 1960.	Line item 3, Hand/arm clearances.
Diffrient, Niels, Alvin R. Tilley, David Harman, and Henry Dreyfuss Associates. Humanscale 7/8/9 : A Portfolio of Information: Chart 9a Body Access. Cambridge, Mass: MIT Press, 1991.	Line item 3, Hand/arm clearances.
Dimensions of the Hands of the Japanese Data Collection 2010. Osaka, Japan: Research Institute of Human Engineering for Quality Life, 2010.	Line item 3, Hand/arm clearances.
EN 547-2:2009, Safety of machinery - Human body measurements - Part 2: Principles for determining the dimensions required for access openings, European Committee for Standardization, Vienna.	Line item 3, Hand/arm clearances. Finger clearance.
Japanese Body Size Data Book 2004-2006. Osaka, Japan: Research Institute of Human Engineering for Quality Life, 2008.	Line item 3, Hand/arm clearances.
Kennedy, K. W., and B. E. Filler. Aperture Sizes and Depths of Reach for One- and Two-Handed Tasks. AMRL-TR-66-27, 1966.	Line item 3, Hand/arm clearances.
MIL-HDBK-759C: Handbook for Human Engineering Design Guidelines. Washington, D.C: Department of Defense, 1995.	Line item 3, Hand/arm clearances.
MIL-STD-1472F: Human Engineering Design Criteria for Military Systems, Equipment and Facilities. Washington, D.C.: Dept. of Defense, 1999.	Line item 3, Hand/arm clearance.
Morgan, Clifford T., Jesse S. Cook III, Alphonse Chapanis, and Max W. Lund. Human Engineering Guide to Equipment Design. New York: McGraw-Hill, 1963.	Line item 3, Hand/arm clearances
NASA-STD-3000, Volume I, Man-Systems Integration Standards, Rev. B, NASA, Johnson Space Center, Houston, Texas1995.	Line item 3, Hand/arm clearances.
SEMI S2-0715 Environmental Health and Safety Guideline for Semiconductor Manufacturing Equipment.	All line items. Reviewed to avoid direct conflicts.

Reference	*Manner of Consideration*
SEMI S8-0715 Safety Guidelines for Ergonomics Engineering of Semiconductor Manufacturing Equipment.	All line items. Base document for changes.
Waters, Tomas R. Applications Manual for the Revised NIOSH Lifting Equation. Cincinnati OH: U.S. Department of Health and Human Services, 1994.	Line Item 1, Coupling points
Woodson, Wesley E. Human Factors Design Handbook: Information and Guidelines for the Design of Systems, Facilities, Equipment, and Products for Human Use. New York: McGraw-Hill, 1981.	Line item 3, Hand/arm clearances.
Note: Recommendations within this document were derived from or compared to the documents listed in this section. The Task Force selected criteria that meet the majority of the referenced documents, that are the most conservative, or that are most appropriate for the semiconductor industry and the regions where this equipment is used.	

Known inconsistencies between the safety guideline and any other safety related codes, standards, and practices cited in the safety guideline

# and Title Inconsistency with This Safety Guideline	*# and Title Inconsistency with This Safety Guideline*
None known	None known

Other conflicts with known codes, standards, and practices or with commonly accepted safety and health principles to the extent practical

# and Title	*Nature of Conflict with This Safety Guideline*
None known	None known

Participants and Contributors

Name, Last	*Name, First*	*Affiliation*
Austin	Lindy	Salus Engineering
Barsky	Joe	TUV Rheinland
Birrell	Ron	TUVSUD America
Breder	Paul	Estec Solutions
Brody	Steve	Product ESH Consulting
Crane	Lauren	KLA-Tencor
Crockett	Alan	
D'Agostino	Mark	Varian
Deboer	Dave	ASML
Ergete	Nigusu	Estec Solutions
Evanston	Chris	Salus Engineering
Faust	Bruce	TUV America
Fessler	Mark	TEL
Frankfurth	Mark	Cymer
Giles	Andrew	Estec Solutions
Green	Paul	Ultratech
Greenburg	Cliff	Nikon
Hamilton	Jeff	TEL
Harralson	Mark	Intel
Hayford	James	AMAT/Semitool
Hsu	Peter	Aixtron
Hughes	Stanley	Lam Research
Ibuka	Shigehito	Horiba
Illerhaus	Chris	CI Industrial Safety Consulting, LLC
Jones	Matt	Texas Instruments
Jumper	Steve	AMAT
Karl	Ed	Applied Materials
Kelly	Paul	Estec Solutions
Kiley	Andrew	Varian
Krauss	Mark	System Development-ESH
Krauss	Josh	EHS2
Kryska	Paul	Novellus
Kuwatani	Ken	TUV-SUD
Larsen	Sean	Lam Research
Layman	Curt	Seagate
Leboults	Kyle	Xactix
Macklin	Ron	Ron Macklin Associates
Marshall	Les	Global 450 Consortium
Mashiro	Supika	TEL
McDaid	Raymond	Global Foundries

Name, Last	*Name, First*	*Affiliation*
McGreevey	Mark	DNS Electronics
McNair	Andrea	TEL
Melville	Richard	Global Foundries
Mills	Ken	Estec Solutions
Nesbitt	Abraham	ESTEC
Nambu	Mitsuju	TEL
Nesbitt	Abraham	Intertek
Nguyen	Kevin	SEMI
Oswalt	James	Mattson
Petry	William	Global Foundries
Planting	Bert	ASML
Peel	George	Strongarm
Pochon	Stephan	TUV Rheinland of North America, Inc.
Rai	Sunny	Intertek
Raissi	Omid	TUV-SUD
Revilla	Fernando	TUV-SUD
Ritzen	Raymond	ASML
Roberge	Steven	Axcelis Technologies, Inc.
Sackllah	Michael	Intel
Sawyer	Debbie	Glacier Export Services, LLC
Schaab	John	Intel
Schwab	Paul	Texas Instruments, Inc.
Shristi	Kharel	KLA-Tencor
Sklar	Eric	Safety Guru
Sleiman	Samir	Brooks Automation
Stevens	David	Lam Research
Tan	Conrad	Lewis Bass
Vang	Tou	Lam Research
Visty	John	Salus Engineering
Werner	Stephen	Intel Corporation
Wong	Carl	AMAT
Yakimow	Byron	Cymer

The content requirements of this checklist are documented in § 15.2 of the *Regulations* Governing SEMI Standards Committees.

Semiconductor Equipment and Materials International
3081 Zanker Road
San Jose, CA 95134-2127
Phone: 408.943.6900, Fax: 408.943.7943

LETTER BALLOT

SEMI Draft Document 5917

Line Item Revisions to SEMI S8-0915, SAFETY GUIDELINE FOR ERGONOMICS ENGINEERING OF SEMICONDUCTOR MANUFACTURING EQUIPMENT

Revisions on Multiple Topics

NOTICE: Per ¶ 3.4.3.3.1 of the SEMI Standards *Procedure Manual*, the purpose, scope, limitations, and terminology sections of SEMI S8 are provided below.

1 Purpose

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

1.2 The purpose of these Safety 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: SEMI Standards and Safety Guidelines do not purport to address all safety issues associated with their use. It is the responsibility of the users of the Documents 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

This is a Draft Document of the SEMI International Standards program. No material on this page is to be construed as an official or adopted Standard or Safety Guideline. Permission is granted to reproduce and/or distribute this document, in whole or in part, only within the scope of SEMI International Standards committee (document development) activity. All other reproduction and/or distribution without the prior written consent of SEMI is prohibited.

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 Guideline 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 *United States Military Standard*[2]

MIL-STD-1472 — Department of Defense Design Criteria Standard – Human

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, ch. de la Voie-Creuse, CP 56, CH-1211 Geneva 20, Switzerland; Telephone: 41.22.749.01.11, Fax: 41.22.733.34.30, http://www.iso.org

[5] American National Standards Institute, 25 West 43rd Street, New York, NY 10036, USA; Telephone: 212.642.4900, Fax: 212.398.0023, http://www.ansi.org

This is a Draft Document of the SEMI International Standards program. No material on this page is to be construed as an official or adopted Standard or Safety Guideline. Permission is granted to reproduce and/or distribute this document, in whole or in part, only within the scope of SEMI International Standards committee (document development) activity. All other reproduction and/or distribution without the prior written consent of SEMI is prohibited.

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* — manual controls (actuators) that are intentionally provided to reduce risk to personnel, equipment, or the environment to Low or Very Low (see SEMI-S10) in response to a malfunction. Examples of critical controls include, but are not limited to: EMO actuators, emergency gas off actuators, and emergency stop actuators.

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 *ergonomic clearances* — the space that should remain clear around the equipment for ergonomics considerations related to tasks anticipated by the supplier. This can include pinch-point avoidance clearances, access space, component removal space, and room for doors to swing out.

NOTE 2: This definition is different from the concept of 'easement space' as provided in SEMI-E72, "*easement space* — the floor space that must remain clear to the rear and sides of the equipment (but not in front of the load face plane). This includes safety

This is a Draft Document of the SEMI International Standards program. No material on this page is to be construed as an official or adopted Standard or Safety Guideline. Permission is granted to reproduce and/or distribute this document, in whole or in part, only within the scope of SEMI International Standards committee (document development) activity. All other reproduction and/or distribution without the prior written consent of SEMI is prohibited.

aisles, ergonomic maintenance access space, component removal space, and room for doors to swing out." Ergonomic clearances includes all sides of the equipment, including the front of the load face plane.

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

5.2.15 *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°.

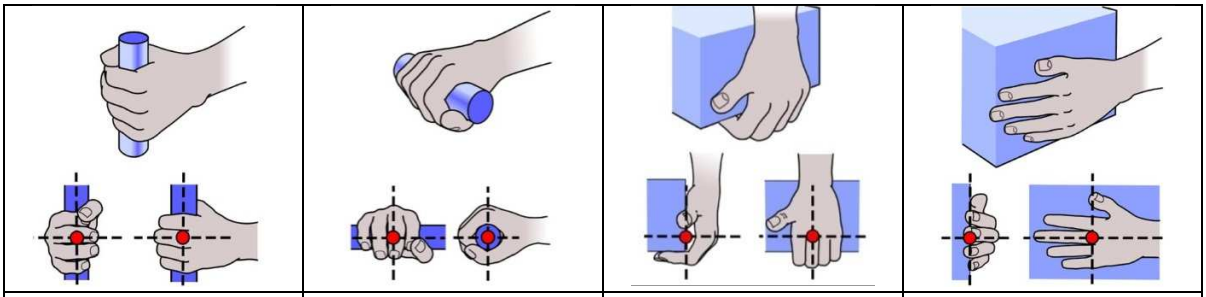
5.2.16 *force* — the mechanical effort to accomplish a specific movement or exertion. These include: static exertions, which produce no motion but have significant duration; dynamic exertions, which are motions including lifting, pushing, pulling; and contact stress, which is localized pressure exerted against the skin by an external force.

5.2.17 *frequency* — how often a task is performed over time.

5.2.18 *frequently used* — used in processing or job cycle at least once every hour. Multiple tool operation by a single operator should be considered.

Line Item 1 – Add a Definition for "hand-object coupling point" to the Terminology Section

5.2.19 *hand-object coupling point* — center of the interface between the hand and a handle or object. For the purposes of measuring, the intersection of a line through the center of the grip parallel to the axis of the large knuckles (metacarpophalangeal joints) and a perpendicular line that goes through the center of the large knuckle of the middle finger (metacarpophalangeal joint of the third finger). If object handling cannot be observed by the evaluator then the center of the handle/hand grip or the center of the anticipated hand grasp location may be used as the coupling point. Figure 1 provides visual depictions for common applications.



Vertical Handle	Horizontal Handle	Hook Grip	Side Grip
Red dot is the measuring location for the coupling point			

Figure 1: Hand-Object Coupling Point Examples

5.2.20 *human error* — errors which include: failure to perform a required function; performing a function that has an undesirable consequence; failure to recognize and correct a hazardous condition; or inadequate or incorrect response to a contingency.

5.2.21 *inadvertent actuation* — accidental or unintentional activation or deactivation of a control.

5.2.22 *infrequently used* — used in processing or job cycle less frequently than once every hour. Multiple tool operation by a single operator should be considered.

5.2.23 *installation* — the activities performed after the equipment is received at a user site through preparation for initial service, including transportation, lifting, uncrating, placement, leveling, and facilities fit up.

5.2.24 *lateral pinch* — grip in which the object is held between the thumb and the side of the index finger (often referred to as key grip).

5.2.25 *maintenance* — planned or unplanned activities intended to keep equipment in good working order.

This is a Draft Document of the SEMI International Standards program. No material on this page is to be construed as an official or adopted Standard or Safety Guideline. Permission is granted to reproduce and/or distribute this document, in whole or in part, only within the scope of SEMI International Standards committee (document development) activity. All other reproduction and/or distribution without the prior written consent of SEMI is prohibited.

5.2.26 *mock up* — a full size physical model of the equipment, generally made of relatively inexpensive materials, used for human factors evaluation.

5.2.27 *neutral posture* — the position of the human body in which the joints are least stressed. Generally, the body in its neutral position is standing erect with the eyes looking forward, and the arms hanging by the sides.

5.2.28 *non-neutral (awkward) postures* — the position of a joint(s) away from its neutral, or least stressed, posture.

5.2.29 *normal line of sight* — the line extending from the eyes, perpendicular to the intraocular line and 15° below the horizontal position of the eye.

5.2.30 *operation* — consists of functions by which the operator causes the equipment to perform its intended purpose; these may include loading product and setting or manipulating external controls.

5.2.31 *operator* — a user that interacts with the equipment only to the degree necessary for the equipment to perform its intended function.

5.2.32 *override* — to take precedence over the current control system state.

5.2.33 *palmar pinch* — grip where the fingers press against the palm of the hand, with the object held between the fingers and the palm. Thumb is not used (e.g., picking up a sheet of plywood).

5.2.34 *personal protective equipment (PPE)* — equipment and clothing worn to reduce potential for personal injury from hazards associated with the task to be performed (e.g., chemical gloves, respirators, safety glasses, etc.). In the context of this Document, cleanroom attire (e.g., gloves, smocks, booties, hoods) is not considered personal protective equipment.

5.2.35 *power grip* — a grip in which the fingers and thumb wrap entirely around the handle such that the thumb contacts or overlaps the index finger.

5.2.36 *postural stress* — stress occurring when a body position places undue load on the muscles, tendons, nerves, and blood vessels, or produces pressure on a joint.

5.2.37 *primary viewing area* — the 30° cone around the normal line of site (15° above, below, and to either side of the line of sight).

5.2.38 *problem tasks* — tasks which have been defined as presenting ergonomically incorrect conditions that are likely to cause biomechanical stresses or injury to personnel, misoperation, or damage to equipment or the product.

5.2.39 *risk factors* — those elements of the design which allow an increased potential for injury/illness to personnel, or for damage to equipment, environment, or product.

5.2.40 *semiconductor manufacturing equipment* — equipment used in the design, development, manufacture, assembly, measurement and test of semiconductors, and associated semiconductor support processes.

5.2.41 *service* — unplanned activities intended to return equipment, which has failed, to good working order.

5.2.42 *static posture* — a fixed position, with minimal movement of the particular body parts.

5.2.43 *stooping* — bending the head and shoulders, or the general body, forward and downward from an erect position.

5.2.44 *task* — a group of related job elements performed within the work cycle and directed toward a specific objective.

5.2.45 *task analysis* — an analytical process employed to determine the specific actions required of the user when operating, maintaining, or servicing equipment, or doing work on single or multiple tools. Within each task, steps are described in terms of the perception, decision-making, memory storage, posture, and biomechanical requirements, as well as the expected errors.

5.2.46 *tip pinch* — grip in which the object is held between the tips of the thumb and index finger.

5.2.47 *user* — person interacting with the equipment. Users may include operators, maintainers, service personnel, and others.

5.2.48 *user population* — a specific cross section of persons that may reasonably be expected to interact with the equipment to perform operation, maintenance, or service tasks.

This is a Draft Document of the SEMI International Standards program. No material on this page is to be construed as an official or adopted Standard or Safety Guideline. Permission is granted to reproduce and/or distribute this document, in whole or in part, only within the scope of SEMI International Standards committee (document development) activity. All other reproduction and/or distribution without the prior written consent of SEMI is prohibited.

5.2.49 *validation testing* — testing to confirm effectiveness of design. An item's "effectiveness" is viewed in terms of its functional design, specific to SEMI S8.

5.2.50 *WIP nest* — a storage structure for work in process (WIP).

5.2.51 *work environment* — the location where semiconductor devices and associated support processes are designed, developed, manufactured, assembled, measured, and tested.

5.2.52 *workplace layout* — the physical arrangement of equipment in the facility.

5.2.53 *workspace* — the available area where the user is expected to operate, maintain, and service the equipment.

5.2.54 *workstation* — the location where equipment controls and displays are found or the location of loading/unloading of material.

5.2.55 *work surface* — a (typically horizontal) surface provided for the location of input devices, handwriting, assembly work, etc. that is part of a seated or standing workstation.

6 General Guidelines

6.1 *Ergonomics-Related Safety Issues* — Ergonomics-related safety issues may exist whenever equipment design, installation, operation, service, or maintenance factors result in task demands that exceed the information processing or physical capabilities of properly trained users. For example, ergonomics-related safety issues may result from:

6.1.1 Static or awkward postures,

6.1.2 Repetitive motion,

6.1.3 Poor access, inadequate clearance, and excessive reach,

6.1.4 Lifting of heavy or bulky components,

6.1.5 Displays that are difficult to read or understand,

6.1.6 Controls that are confusing to operate or require too much force, and

6.1.7 Use of nonspecific warnings or faults to communicate machine problems.

6.2 Safety-related issues should be designed out or otherwise reduced to an acceptable level prior to production. Ergonomics-related safety issues are reduced by implementing sound ergonomics engineering principles in design, and structuring job requirements around human performance capabilities and limitations.

6.3 Equipment should be designed to reduce or eliminate the potential types of error caused by human-machine or human-task mismatch (e.g., inadvertent actuation, errors of omission or commission).

6.4 Engineering controls are the preferred means to reduce hazards. Where an engineering approach to ergonomic hazard control is not feasible, the user should implement administrative controls to mitigate hazards by reducing the duration, frequency, or severity of exposure.

6.5 Highest priority should be placed on issues which have the potential of resulting in injury to personnel. Secondary priority should be placed on issues which have the potential of resulting in significant damage to equipment.

6.6 Information exchange between equipment suppliers and users regarding human-machine interface issues is encouraged during the development stage, as part of beta site testing, after equipment is in full production, and throughout the life cycle of the equipment.

6.7 Ergonomics evaluation should be performed throughout the conception, design, build, and install phases to determine whether ergonomics guidelines have been met. The examination should yield a completed SESC document (see Appendix 1).

6.7.1 Equipment evaluation should identify risk factors associated with equipment design that affect operation, training, installation, maintenance, or service tasks.

This is a Draft Document of the SEMI International Standards program. No material on this page is to be construed as an official or adopted Standard or Safety Guideline. Permission is granted to reproduce and/or distribute this document, in whole or in part, only within the scope of SEMI International Standards committee (document development) activity. All other reproduction and/or distribution without the prior written consent of SEMI is prohibited.

6.7.2 Use of mock-ups and simulations are beneficial to identify and resolve ergonomic issues before the design is finalized. Testing should be performed with individuals who are representative of the user population under anticipated working conditions.

6.7.3 The evaluation should include consideration of multiple pieces of equipment under the control of one individual, resulting in an operation being repeated several times sequentially. The supplier should state the criteria for this scenario and include it in the report.

6.8 The overall objective is to provide for equipment effectiveness and for worker safety, convenience, and comfort when operating and maintaining the equipment.

6.9 Damage or undue deterioration of required garments or PPE should not occur as a result of equipment operation. Controls, such as knobs and switches, should be designed to be compatible with gloves worn by users for contamination control or personal protection. For example, cleanroom gloves typically reduce grip strength by 15%. Equipment displays should consider the potential for impaired vision and hearing that may occur with the use of cleanroom hoods, chemical goggles, or face shields.

6.10 Technical documentation (e.g., manuals) and on-equipment instructions (e.g., labels, indicators and screen menus) should be consistent in action, terminology, symbols, and format.

6.11 Equipment customized to meet specific customer requirements should not increase the level of ergonomic risk.

6.12 For recommendations on human interface design, see SEMI E95.

NOTE 3: SEMI E95 provides information on human computer interface. It is not the intent of SEMI S8 to incorporate the requirements of SEMI E95 by reference.

7 Documentation

7.1 The supplier should provide an evaluation of the equipment to SEMI S8 using Appendix 1, “Supplier Ergonomic Success Criteria” for measurable criteria. The evaluation should include a determination of the level of risk associated with non-conformance items. Evaluation of risk should be compatible with the SEMI S10 severity categories; catastrophic, severe, moderate, and minor.

7.1.1 For each item in Appendix 1 which does not meet the criteria, the evaluation report should include the measured actual dimensions, and state any supporting rationale for noncompliance. Supporting rationale may include test data or documented engineering judgment.

EXCEPTION: For § 1, the manual material handling analysis, the evaluation report should provide documented calculations regardless of the outcome of the analysis.

7.1.2 The evaluation report should also include the following information: manufacturer’s model number, serial number of unit evaluated, date the equipment was evaluated, a list of all tasks which were evaluated as part of the analysis and the name of the person performing the evaluation.

7.2 Supplier provided documentation should include administrative controls intended by the supplier to mitigate ergonomic risks.

7.3 Documents provided to the end user should illustrate all ergonomic clearances required by the supplier.

7.3.1 Space for ergonomic clearances should include room needed for of all of the following:

- operator tasks (e.g., loading and unloading of product or other materials, interfacing with the equipment, and seating),
- opening of access panels and covers (e.g., room for doors to swing out, up, or down), and
- maintenance access and postures intended for maintenance activity (e.g., component removal/insertion and specialty equipment such as ladders, steps, seating, diagnostic equipment, and lifting equipment).

This is a Draft Document of the SEMI International Standards program. No material on this page is to be construed as an official or adopted Standard or Safety Guideline. Permission is granted to reproduce and/or distribute this document, in whole or in part, only within the scope of SEMI International Standards committee (document development) activity. All other reproduction and/or distribution without the prior written consent of SEMI is prohibited.

7.3.2 The space for ergonomic clearances should also include consideration of space required for the servicing of components (particularly large components) that could reasonably be expected to fail during the expected lifetime of the equipment, including tools and specialty equipment that might be required for their repair, removal, or installation.

7.3.3 Documents provided to the equipment user should also describe the allowable range of vertical foot adjustment that will keep ergonomics-related measurements within supplier requirements (e.g., to keep heights of various items within the SESC acceptable limits).

7.4 The evaluation should specify an installation reference point for each independently adjustable section of the equipment for vertical measures. If there is a supplier recommended installation height, the reference for the evaluation should be the same. This installation height should be included in the supplier's installation documentation.

NOTE 4: Installation documentation may include installation manuals and other information provided by supplier addressing installation concerns.

8 Related Documents

8.3 CEN/CENELEC Standards

8.1 *SEMI Standards and Safety Guidelines*

SEMI S13 — Environmental, Health and Safety Guideline for Documents Provided to the Equipment User for Use with Manufacturing Equipment

8.2 *ANSI Standards*

ANSI Z535.4 — Product Safety Signs and Labels

ANSI/HFES 100 — Human Factors Engineering of Computer Workstations

8.3 *CEN/CENELEC Standards*[6]

EN 547-2: 2009, Safety of machinery - Human body measurements - Part 2: Principles for determining the dimensions required for access openings, European Committee for Standardization, Vienna.

EN 614-1 — Safety of Machinery – Ergonomic Design Principles, Part 1 – Terminology and General Principles

EN 894-1 — Safety/Ergonomics for Operator Interaction

EN 894-2:1997 — Safety of Machinery: Ergonomics Requirements for the Design of Displays and Control Actuators, Part 2: Displays

EN 50099-2 — Safety/Marking Principles

8.4 *ISO Standards*[4]

ISO 7250 — Basic Human Body Measurements for Technological Design

ISO 14738 — Safety of Machinery– Anthropometric Requirements for the Design of Workstations at Machinery

8.5 *JIS Standards*[7]

JIS Z 8513 — Ergonomics – Office Work with Visual Display Terminals (VDTs) – Visual Display Requirements

[6] European Committee for Standardization (CEN)/European Committee for Electrotechnical Standardization (CENELEC), Central Secretariat, rue de Stassart 35, B-1050 Brussels, Belgium; http://www.cenelec.com

[7] Japanese Standards Association, 4-1-24 Akasaka, Minato-ku, Tokyo 107-8440, Japan; Telephone: 81.3.3583.8005, Fax: 81.3.3586.2014, http://www.jsa.or.jp

This is a Draft Document of the SEMI International Standards program. No material on this page is to be construed as an official or adopted Standard or Safety Guideline. Permission is granted to reproduce and/or distribute this document, in whole or in part, only within the scope of SEMI International Standards committee (document development) activity. All other reproduction and/or distribution without the prior written consent of SEMI is prohibited.

LETTER BALLOT

8.6 *NIOSH Documents*[8]

NIOSH Publication No. 81-122 — Work Practices Guide for Manual Lifting, National Institute for Occupational Safety and Health, 1981.

Revised NIOSH Equation, *Ergonomics*, Vol. 36, No. 7, 1993.

8.7 *SAE Document*[9]

SAE J833 — Human Physical Dimensions

8.8 *SEMATECH Documents*[10]

Line Item 2 – Add a reference to SEMATECH ISMI Manual Material Handling Application Guide

Application Guide for Manual Material-Handling Requirements in SEMI-S8. ISMI 2010. Available from http://www.sematech.org/docubase/document/5029aeng.pdf.

Preventing User-Hostile Interfaces in IC-Fab Equipment — Ergonomic Approaches for Preventing Ten Frequent Interface Problems, Miller, Dwight P. and Whitehurst, Hugh, SEMATECH Technology Transfer #92091299NA-ENG, Nov. 1992.

SEMATECH SCC User interface Style Guide, 1.0. 92061179A-ENG, August 21, 1992.

[8] National Institute for Occupational Safety and Health, Technical Information Branch, 4676 Columbia Pkwy, Cincinnati, OH 45226, USA; http://www.niosh.com.my

[9] Society of Automotive Engineers, 400 Commonwealth Drive, Warrendale, PA 15096-0001, USA; Telephone: 724.776.4970, Fax: 724.776.0790, http://www.sae.org

[10] SEMATECH, 257 Fuller Road, Suite 2200, Albany, NY 12203, USA; Telephone: 518.649.1000, http://www.sematech.org

This is a Draft Document of the SEMI International Standards program. No material on this page is to be construed as an official or adopted Standard or Safety Guideline. Permission is granted to reproduce and/or distribute this document, in whole or in part, only within the scope of SEMI International Standards committee (document development) activity. All other reproduction and/or distribution without the prior written consent of SEMI is prohibited.

LETTER BALLOT

Line Item 3 – Revisions and Additions to Hand/Arm Clearances

Part A: Add references to Related Documents section

8.9 *Other Documents*

8.9.1 Bailey, Robert W. "Human Performance Engineering." Prentice Hall, 1989.

8.9.2 Eastman Kodak Company "Ergonomic Design for People at Work, Vols. 1 and 2." Van Nostrand-Reinhold, 1983.

8.9.3 Grandjean, E., Fitting the Task to the Man: A Textbook of Occupational Ergonomics (4th Ed.), Taylor & Francis, 1988.

8.9.4 Grether W.F. and Baker C.A., 1972, Visual Presentation of Information in Van Cott and Kincade "Human Engineering to Equipment Design." Washington DC, US Government Printing Office.

8.9.5 Konz, S. "Work Design: Industrial Ergonomics." (3rd Ed), Publishing Horizons, 1990.

8.9.6 Kroemer, K.H.E. "Engineering Anthropometry." Occupational Ergonomics Handbook, eds. W. Karwowski & W.S. Marras, CRC Press, Boca Raton, 1999.

8.9.7 MIL-HDBK-759: Handbook for Human Engineering Design Guidelines. Washington, D.C: Department of Defense.

8.9.8 MIL-STD-1472F: Human Engineering Design Criteria for Military Systems, Equipment and Facilities. Washington, D.C.: Dept. of Defense, 1999.

8.9.9 Pheasant, Stephen, Bodyspace "Anthropometry, Ergonomics and Design." Taylor & Francis, 1988.

8.9.10 Salvendy, Gavriel (ed.) "Handbook of Human Factors." Wiley, 1987.

8.9.11 Sanders, Mark S. and McCormick, Ernest "Human Factors in Engineering and Design." (7th Ed), McGraw-Hill Book Company, 1993.

8.9.12 Snook, Stover and V. Ciriello "The Design of Manual Handling Tasks — Revised Tables of Maximum Acceptable Weights and Forces." *Ergonomics*, Vol. 34, No. 9, 1991.

8.9.13 VanCott, Harold P. and Kinkade, Robert (eds.) "Human Engineering Guide to Equipment Design." U. S. Government Printing Office, 1972.

8.9.14 Human Hand Dimensions Data for Ergonomic Design 2010. Research Institute of Human Engineering for Quality Life. Osaka, Japan, 2010.

8.9.15 Garrett, J.W. The adult human hand: some anthropometric and biomechanical considerations. Human Factors 13 (1971): pp 117–131.

8.9.16 Hall, Charlotte. "External pressure at the hand during object handling and work with tools." International Journal of Industrial Ergonomics 20 (1997): pp. 191–206.

8.9.17 Gordon, Claire C. "1988 Anthropometric Survey of U.S. Army Personnel: Summary Statistics, Interim Report." U.S. Army Natick Research, Development and Engineering Center, 1989.

8.9.18 Harrison, Catherine R., and Robinette, Kathleen M. "CAESAR: Summary Statistics for the Adult Population (Ages 18-65) of the United States of America." Air Force Research Laboratory, Human Effectiveness Directorate, Crew System Interface Division, 2002.

8.9.19 Japanese Body Size Data 2004-2006. Research Institute of Human Engineering for Quality Life, Japan, 2008.

8.9.20 McDowell, M. A., *et al*. Anthropometric Reference Data for Children and Adults: United States, 2003–2006, National Health Statistics Reports, No. 10, October 22, 2008.

This is a Draft Document of the SEMI International Standards program. No material on this page is to be construed as an official or adopted Standard or Safety Guideline. Permission is granted to reproduce and/or distribute this document, in whole or in part, only within the scope of SEMI International Standards committee (document development) activity. All other reproduction and/or distribution without the prior written consent of SEMI is prohibited.

Semiconductor Equipment and Materials International
3081 Zanker Road
San Jose, CA 95134-2127
Phone: 408.943.6900, Fax: 408.943.7943

APPENDIX 1

SUPPLIER ERGONOMIC SUCCESS CRITERIA (SESC)

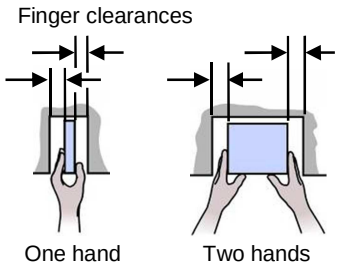
NOTICE: The material in this Appendix is an official part of SEMI S8 and was approved by full letter ballot procedures on November 21, 2006.

A1-1 Introduction

A1-1.1 Pictograms and text within the pictogram cells are provided for illustrative purposes only and are not normative. Also, the pictograms are not intended to depict every possible application of the guidelines.

Table A1-1 Supplier Ergonomic Success Criteria Checklist

Section 1: Manual Material Handling			
Section	*Indicator*	*Acceptance Criteria Metric Units (US Customary Units)*	*Actual/ Conforms?*
1.1	Potentially hazardous manual material handling tasks performed as part of operations, maintenance, or service are analyzed utilizing appropriate procedures. NOTE: Two hand lifting or lowering tasks should be analyzed: if the object being handled weighs more than 44.5 N (10 lbf); OR, if the object weighs more than 22.2 N (5 lbf) and the anticipated frequency is greater than 1 lift every 5 minutes. See Appendix 2 for further information.	Analysis and results documentation. Table A2-2, Appendix 2, or the equivalent, should be used to document two-hand lift/lower analysis.	Measure-ment _____ Conforms? Yes No N/A ☐ ☐ ☐

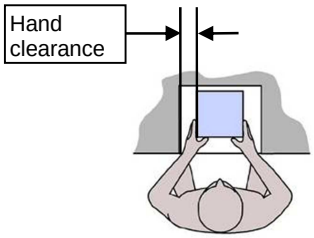
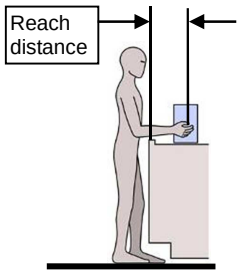
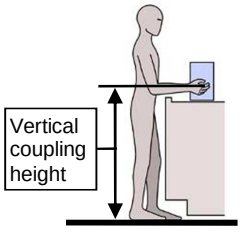
Section 2: Product Loading in a Standing Posture (Applicable to all media other than wafer cassettes including JEDEC trays, magazines and reticle cassettes.)				
Section	*Indicator*	*Acceptance Criteria Metric Units (US Customary Units)*	*Reference Pictogram*	*Actual/ Conforms?*
2.1	Clearance provided for finger thickness.	Minimum 38 mm (1.5 in.)		Measure-ment _____ Conforms? Yes No N/A ☐ ☐ ☐

This is a Draft Document of the SEMI International Standards program. No material on this page is to be construed as an official or adopted Standard or Safety Guideline. Permission is granted to reproduce and/or distribute this document, in whole or in part, only within the scope of SEMI International Standards committee (document development) activity. All other reproduction and/or distribution without the prior written consent of SEMI is prohibited.

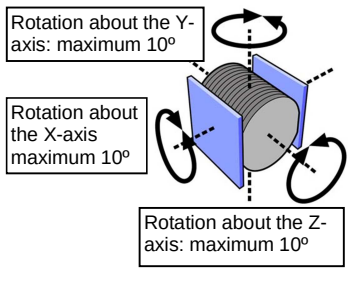
Semiconductor Equipment and Materials International
3081 Zanker Road
San Jose, CA 95134-2127
Phone: 408.943.6900, Fax: 408.943.7943

Section 2: Product Loading in a Standing Posture

(Applicable to all media other than wafer cassettes including JEDEC trays, magazines and reticle cassettes.)

Section	*Indicator*	*Acceptance Criteria Metric Units (US Customary Units)*	*Reference Pictogram*	*Actual/ Conforms?*
2.2	Clearance provided for hand thickness.	Minimum 76 mm (3 in.)		Measure-ment _____ Conforms? Yes No N/A ☐ ☐ ☐
2.3	Reach distance measured from the leading edge of the tool or obstruction to the hand/product coupling point(s).	Maximum 330 mm (13 in.)		Measure-ment _____ Conforms? Yes No N/A ☐ ☐ ☐
2.4	Vertical coupling point of hand to product in load position.	Maximum 1010 mm (40 in.) Minimum 890 mm (35 in.)		Measure-ment _____ Conforms? Yes No N/A ☐ ☐ ☐

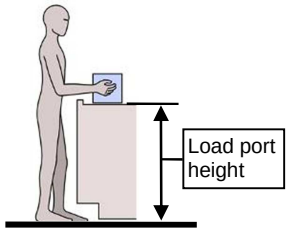
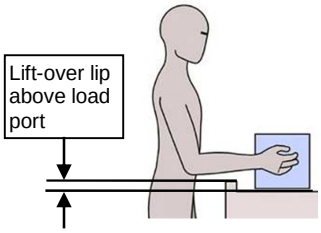
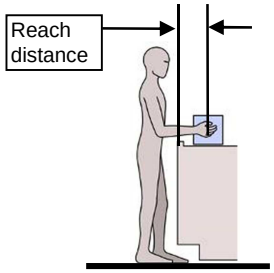
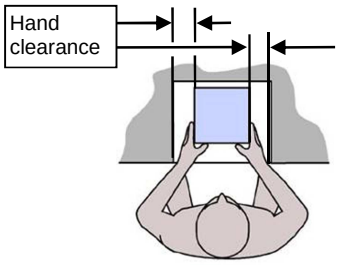
Section 3: Wafer Cassette Loading

Section	*Indicator*	*Acceptance Criteria Metric Units (US Customary Units)*	*Reference Pictogram*	*Actual/ Conforms?*
3.1	Wafer cassette loading should not require greater than 10° cassette rotation in any axis. NOTE: Unless otherwise specified, you should assume that 200 mm or smaller wafers are transported in the vertical orientation and that 300 mm wafers are transported in the horizontal orientation.	Less than 10° rotation in any axis.	**Wafer cassette shown in the manual carrying orientation** 	Measure-ment _____ Conforms? Yes No N/A ☐ ☐ ☐

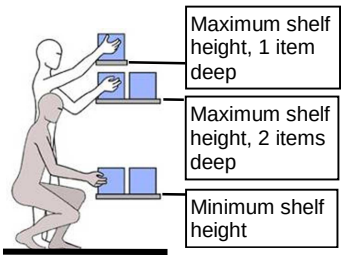
This is a Draft Document of the SEMI International Standards program. No material on this page is to be construed as an official or adopted Standard or Safety Guideline. Permission is granted to reproduce and/or distribute this document, in whole or in part, only within the scope of SEMI International Standards committee (document development) activity. All other reproduction and/or distribution without the prior written consent of SEMI is prohibited.

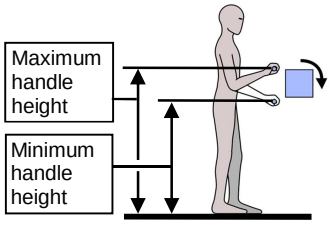
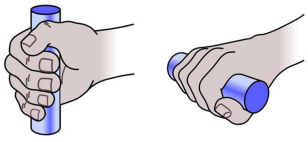
Semiconductor Equipment and Materials International
3081 Zanker Road
San Jose, CA 95134-2127
Phone: 408.943.6900, Fax: 408.943.7943

Section 3: Wafer Cassette Loading

Section	*Indicator*	*Acceptance Criteria Metric Units (US Customary Units)*	*Reference Pictogram*	*Actual/ Conforms?*
3.2	Load port height, vertical distance from standing surface (150–200 mm wafers).	Maximum 960 mm (38 in.) Minimum 890 mm (35 in.)		Measure-ment _____ Conforms? Yes No N/A ☐ ☐ ☐
3.3	Maximum lip height in front of cassette load port over which the cassette is lifted (150–200 mm wafer cassettes only). Measure lip height from the load surface.	Maximum 30 mm (1.2 in.)		Measure-ment _____ Conforms? Yes No N/A ☐ ☐ ☐
3.4	Reach distance from the leading edge of the tool or obstruction to the coupling point(s) on a rotation device or the product grasp point.	Maximum 330 mm (13 in.)		Measure-ment _____ Conforms? Yes No N/A ☐ ☐ ☐
3.5	Minimum hand clearance on either side of the cassette, measured from the side of the cassette to the nearest adjacent object.	Minimum 76 mm (3 in.)		Measure-ment _____ Conforms? Yes No N/A ☐ ☐ ☐

This is a Draft Document of the SEMI International Standards program. No material on this page is to be construed as an official or adopted Standard or Safety Guideline. Permission is granted to reproduce and/or distribute this document, in whole or in part, only within the scope of SEMI International Standards committee (document development) activity. All other reproduction and/or distribution without the prior written consent of SEMI is prohibited.

Section 4: Work in Process Storage (specific to wafer cassettes)				
Section	*Indicator*	*Acceptance Criteria Metric Units (US Customary Units)*	*Reference Pictogram*	*Actual/ Conforms?*
4.1	Integral wafer cassette/lot box storage shelf height (150 and 200 mm [6 and 8 in.] wafer cassette/lot boxes only).	Maximum (1 item deep) 1520 mm (60 in.) Maximum (2 items deep) 1220 mm (48 in.) Minimum 460 mm (18 in.)		Measure-ment _____ Conforms? Yes No N/A ☐ ☐ ☐

Section 5: Manual Wafer Cassette Rotation Device Design				
Section	*Indicator*	*Acceptance Criteria Metric Units (US Customary Units)*	*Reference Pictogram*	*Actual/ Conforms?*
5.1	Handle height, couple point for hand(s) from standing surface.	Maximum 1206 mm (47.5 in.) Minimum 838 mm (33 in.)		Measure-ment _____ Conforms? Yes No N/A ☐ ☐ ☐
5.2	Hand grip(s) shall allow for a full 'power grip' similar to grabbing a rung on a ladder or holding a pistol.	Allows for a full power grip in either pronated (palm facing down) or neutral (handshake position) posture.	Power grip examples  Neutral grip Pronated grip	Measure-ment _____ Conforms? Yes No N/A ☐ ☐ ☐
5.3	Single hand lift force	Maximum 37.8 N (8.5 lbf). This value includes a 15% capacity reduction due to cleanroom glove use. Wrist deviation reduces further strength capacity by 15%.	—	Measure-ment _____ Conforms? Yes No N/A ☐ ☐ ☐
5.4	Two hand lift force	Maximum 64.5 N (14.5 lbf). This value includes a 15% capacity reduction due to cleanroom glove use. Wrist deviation reduces further strength capacity by 15%.	—	Measure-ment _____ Conforms? Yes No N/A ☐ ☐ ☐

This is a Draft Document of the SEMI International Standards program. No material on this page is to be construed as an official or adopted Standard or Safety Guideline. Permission is granted to reproduce and/or distribute this document, in whole or in part, only within the scope of SEMI International Standards committee (document development) activity. All other reproduction and/or distribution without the prior written consent of SEMI is prohibited.

Semiconductor Equipment and Materials International
3081 Zanker Road
San Jose, CA 95134-2127
Phone: 408.943.6900, Fax: 408.943.7943

LETTER BALLOT

Section 6: Handle Design

Dimensions of handles and knobs to which one needs to apply less than:

- Linear force: 13 N (3 lbf)
- Torque: 0.43 N-m (3.8 lbf-in.)

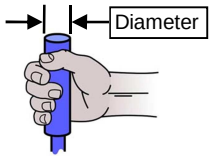
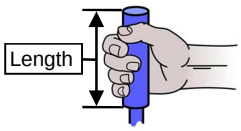
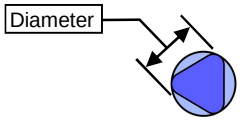
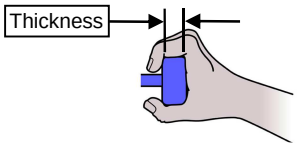
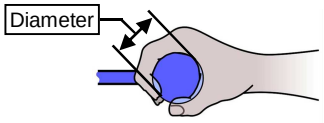
do not need to be assessed to the criteria in this section.

Sections 5.1 and 9 should be used to assess the location of all handles and knobs regardless of the force required.

Unless otherwise noted, the provided dimensions are acceptable for use with or without gloves.

If a handle is used for both machine operation and maintenance/service tasks then apply the operational criteria.

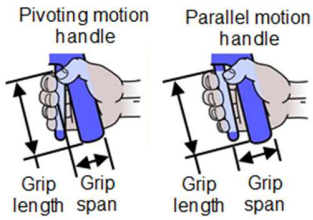
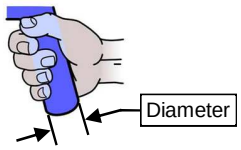
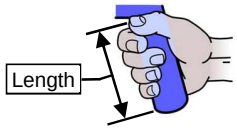
Forces provided in §§ 6.7.1, 6.8.1, and 6.9.1 are for hand-handle and hand-knob interface only and might exceed the maximum recommended forces for performing a task based on the appropriate analysis tool. See Appendix 2 for a list of lifting, strength, and material handling analysis tools.

Section	*Indicator*	*Acceptance Criteria Metric Units (US Customary Units)*	*Reference Pictogram*	*Actual/ Conforms?*
6.1	Handle surface finish	All edges radiused	—	Conforms? Yes No N/A ☐ ☐ ☐
6.2	*Cylindrical Handle*			—
6.2.1	Cylindrical handle diameter	Maximum 38 mm (1.5 in.) Minimum 25 mm (1 in.)		Measure-ment _____ Conforms? Yes No N/A ☐ ☐ ☐
6.2.2	Cylindrical handle length	Minimum 127 mm (5 in.)		Measure-ment _____ Conforms? Yes No N/A ☐ ☐ ☐
6.3	*Circular or Triangular Handle*			—
6.3.1	Circular or triangular handle diameter	Maximum 90 mm (3.5 in.) Minimum 50 mm (2 in.)		Measure-ment _____ Conforms? Yes No N/A ☐ ☐ ☐
6.3.2	Circular or triangular handle height (thickness)	Maximum 25 mm (1 in.) Minimum 19 mm (0.75 in.)		Measure-ment _____ Conforms? Yes No N/A ☐ ☐ ☐
6.4	*Ball Handle*			—
6.4.1	Ball handle diameter	Maximum 63 mm (2.5 in.) Minimum 38 mm (1.5 in.)		Measure-ment _____ Conforms? Yes No N/A ☐ ☐ ☐

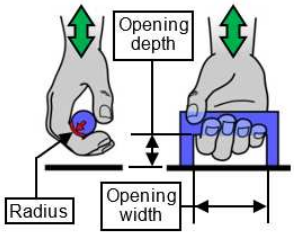
This is a Draft Document of the SEMI International Standards program. No material on this page is to be construed as an official or adopted Standard or Safety Guideline. Permission is granted to reproduce and/or distribute this document, in whole or in part, only within the scope of SEMI International Standards committee (document development) activity. All other reproduction and/or distribution without the prior written consent of SEMI is prohibited.

Semiconductor Equipment and Materials International
3081 Zanker Road
San Jose, CA 95134-2127
Phone: 408.943.6900, Fax: 408.943.7943

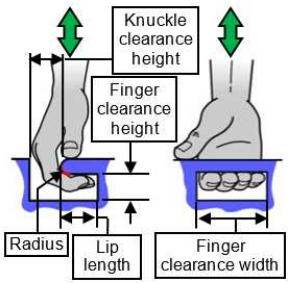
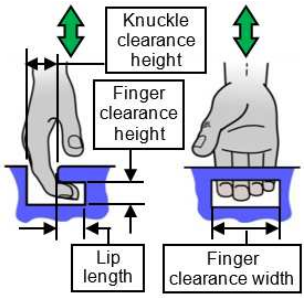
LETTER BALLOT

Section	*Indicator*	*Acceptance Criteria Metric Units (US Customary Units)*	*Reference Pictogram*	*Actual/ Conforms?*
6.5	*Squeeze Grip Handle*			—
6.5.1	Squeeze grip handle grip span Handle sections need not be cylindrical. Measurement taken at the maximum grip span of handle measured at the user's middle finger.	Maximum 89 mm (3.5 in.) open Minimum 38 mm (1.5 in.) closed		Measure-ment _____ Conforms? Yes No N/A ☐ ☐ ☐
6.5.2	Squeeze grip handle grip length.	Minimum 127 mm (5 in.)		Measure-ment _____ Conforms? Yes No N/A ☐ ☐ ☐
6.6	*Pistol Grip Handle*			—
6.6.1	Pistol grip handle diameter	Maximum 63 mm (2.5 in.) Minimum 38 mm (1.5 in.)		Measure-ment _____ Conforms? Yes No N/A ☐ ☐ ☐
6.6.2	Pistol grip handle length	Minimum 127 mm (5 in.)		Measure-ment _____ Conforms? Yes No N/A ☐ ☐ ☐

This is a Draft Document of the SEMI International Standards program. No material on this page is to be construed as an official or adopted Standard or Safety Guideline. Permission is granted to reproduce and/or distribute this document, in whole or in part, only within the scope of SEMI International Standards committee (document development) activity. All other reproduction and/or distribution without the prior written consent of SEMI is prohibited.

<table>
<tr><th>Section</th><th>Indicator</th><th>Acceptance Criteria
Metric Units
(US Customary Units)</th><th>Reference
Pictogram</th><th>Actual/
Conforms?</th></tr>
<tr><td>6.7</td><td colspan="3">Enclosed Handles
Guidelines for the design of optimum enclosed handles with a round section are provided in section 6.7.1. Use of cleanroom gloves with knit liners is assumed. Enclosed handles that do not meet the design criteria in section 6.7.1 should be assessed using the instructions and data provided in Appendix 3, Enclosed Handle Assessment Criteria.</td><td>—</td></tr>
<tr><td>6.7.1</td><td>Enclosed handle, full hand power grip (suitcase handle).</td><td>Opening width, minimum
122 mm (4.8 in.)
Opening depth, minimum
41 mm (1.6 in.)
Maximum push/pull force
<table>
<tr><td colspan="2">Operational tasks</td></tr>
<tr><td>Radius, min.</td><td>Force, max.</td></tr>
<tr><td>3.1 mm
(0.12 in.)</td><td>33 N
(7.4 lbf)</td></tr>
<tr><td>6.5 mm
(0.25 in.)</td><td>72 N
(16.1 lbf)</td></tr>
<tr><td>10 mm
(0.39 in.)</td><td>110 N
(24.8 lbf)</td></tr>
<tr><td colspan="2">Maintenance/service tasks</td></tr>
<tr><td>3.1 mm
(0.12 in.)</td><td>88 N
(19.8 lbf)</td></tr>
<tr><td>6.5 mm
(0.25 in.)</td><td>191 N
(42.9 lbf)</td></tr>
<tr><td>10 mm
(0.39 in.)</td><td>294 N
(66.1 lbf)</td></tr>
</table></td><td>
</td><td>Force
_____
Opening depth
_____
Opening width
_____
Radius
_____
Conforms?
Yes No N/A
☐ ☐ ☐</td></tr>
</table>

This is a Draft Document of the SEMI International Standards program. No material on this page is to be construed as an official or adopted Standard or Safety Guideline. Permission is granted to reproduce and/or distribute this document, in whole or in part, only within the scope of SEMI International Standards committee (document development) activity. All other reproduction and/or distribution without the prior written consent of SEMI is prohibited.

<table>
<tr><th>Section</th><th>Indicator</th><th>Acceptance Criteria
Metric Units
(US Customary Units)</th><th>Reference
Pictogram</th><th>Actual/
Conforms?</th></tr>
<tr><td>6.8</td><td colspan="3">Hook Grasp Handle
Hook grasp handles that do not meet the design criteria in section 6.8.1 should be assessed using the instructions and data provided in Appendix 3, Enclosed Handle Assessment Criteria.</td><td>—</td></tr>
<tr><td>6.8.1</td><td>Hook grasp handle (four fingers).</td><td>Finger clearance width, minimum
97 mm (3.8 in.)
Finger clearance height, minimum
28 mm (1.1 in.)
Knuckle clearance height, minimum
48 mm (1.9 in.)
Lip length, minimum
49 mm (1.9 in.)
Maximum push/pull force
<table>
<tr><th colspan="2">Operational tasks</th></tr>
<tr><th>Radius, min.</th><th>Force, max.</th></tr>
<tr><td>6.3 mm
(0.25 in.)</td><td>15 N
(3.5 lbf)</td></tr>
<tr><td>13 mm
(0.5 in.)</td><td>33 N
(7.5 lbf)</td></tr>
<tr><td>19 mm
(0.75 in.)</td><td>51 N
(11.5 lbf)</td></tr>
<tr><td colspan="2">Maintenance/service tasks</td></tr>
<tr><td>6.3 mm
(0.25 in.)</td><td>41 N
(9.3 lbf)</td></tr>
<tr><td>13 mm
(0.5 in.)</td><td>89 N
(20.1 lbf)</td></tr>
<tr><td>19 mm
(0.75 in.)</td><td>137 N
(30.9 lbf)</td></tr>
</table></td><td>
</td><td>Force
_____
Finger clearance height
_____
Finger clearance width
_____
Radius
_____
Lip
_____
Knuckle clearance height
_____
Conforms?
Yes No N/A
☐ ☐ ☐</td></tr>
<tr><td>6.9</td><td colspan="3">Finger Pull Handle
Finger pull handles that do not meet the design criteria in section 6.9.1 should be assessed using the instructions and data provided in Appendix 3, Enclosed Handle Assessment Criteria.</td><td>—</td></tr>
<tr><td>6.9.1</td><td>Finger pull handles (four fingers)</td><td>Finger clearance width, minimum
91 mm (3.6 in.)
Finger clearance height, minimum
22 mm (0.8 in.)
Knuckle clearance height, minimum
28 mm (1.1 in.)
Lip length, minimum
18 mm (0.7 in.)
Maximum push/pull force
<table>
<tr><th>Operational tasks</th></tr>
<tr><td>36 N (8.1 lbf) all radii</td></tr>
<tr><th>Maintenance/service tasks</th></tr>
<tr><td>97 N (21.7 lbf) all radii</td></tr>
</table></td><td>
</td><td>Force
_____
Finger clearance height
_____
Finger clearance width
_____
Lip
_____
Knuckle clearance height
_____
Conforms?
Yes No N/A
☐ ☐ ☐</td></tr>
</table>

This is a Draft Document of the SEMI International Standards program. No material on this page is to be construed as an official or adopted Standard or Safety Guideline. Permission is granted to reproduce and/or distribute this document, in whole or in part, only within the scope of SEMI International Standards committee (document development) activity. All other reproduction and/or distribution without the prior written consent of SEMI is prohibited.

Semiconductor Equipment and Materials International
3081 Zanker Road
San Jose, CA 95134-2127
Phone: 408.943.6900, Fax: 408.943.7943

Section 7: Clearance Criteria

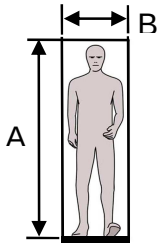
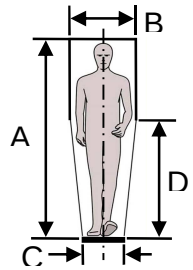
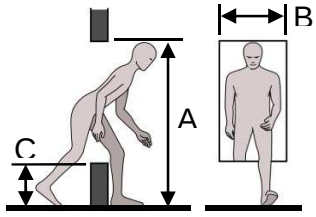
Equipment may extend into the recommended clearance envelopes provided that the assessor captures in the assessment report a rationale demonstrating that the impinging object(s) will not interfere with the task or tasks for which clearance is being evaluated. The rationale should give consideration to at least the following points:

- 95th percentile North American male body dimensions,
- Line-of-sight vision required throughout the task(s),
- Anticipated body motions (e.g., turning, reaching) during the task(s).

The following clearance criteria for design and assessment do not include consideration of the tools, materials, and devices identified by the supplier to be moved and used in the course of the task, and personal protective equipment recommended by the supplier to be worn by workers during the task(s). Additional clearance should be provided for these considerations.

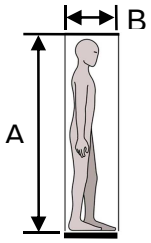
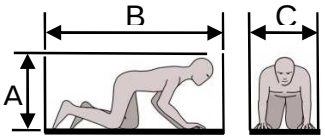
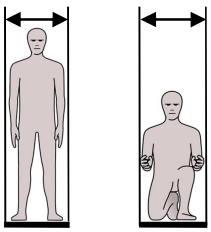
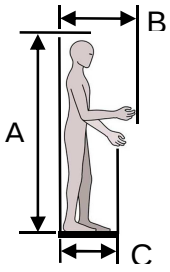
These criteria are limited to the equipment structure as provided, and installed per supplier instructions. If a horizontal dimension extends outside the envelope of the equipment, as provided, then the excursion should be included in the equipment ergonomics clearances (see for example SEMI S8, paragraph 7.3). Clearance around the equipment (ergonomic clearance), per the supplier's specifications, may be considered in determining conformance as applicable.

Clearances should be approached from a task analysis point of view. Clearances should be provided based on the nature of the tasks performed in the designated area.

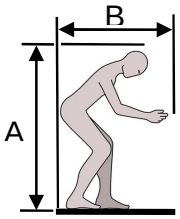
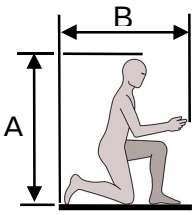
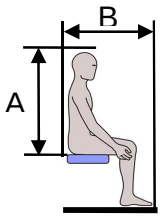
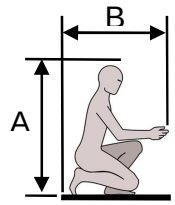
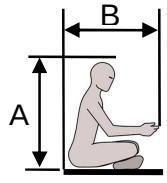
Section	*Indicator*	*Acceptance Criteria Metric Units (US Customary Units)*	*Reference Pictogram*	*Actual/ Conforms?*
7.1	Whole Body Clearance for Walking and Crawling (point-to-point access only and not work activities).			
7.1.1	Clearance for walking (operator tasks)	A. Vertical clearance, minimum. 1980 mm (78 in.) B. Passage width, minimum 610 mm (24 in.)		Measure-ments A. _____ B. _____ Conforms? Yes No N/A ☐ ☐ ☐
7.1.2	Clearance for walking (maintenance and service activity only)	A. Vertical clearance, minimum 1900 mm (74.8 in.) B. Upper body passage width, minimum 610 mm (24 in.) C. Walking surface width minimum 457 mm (18 in.) D. Elbow/hip clearance height, maximum height of sloped area 1002 mm (39.8 in.)		Measure-ments A. _____ B. _____ C. _____ D. _____ Conforms? Yes No N/A ☐ ☐ ☐
7.1.3	Clearance for walking through vertical hatchways (maintenance and service activity only)	A. Overhead clearance, minimum 1524 mm (60 in.) B. Upper body passage width, minimum 610 mm (24 in.) C. Height of threshold, maximum 406 mm (16 in.)		Measure-ments A. _____ B. _____ C. _____ Conforms? Yes No N/A ☐ ☐ ☐

This is a Draft Document of the SEMI International Standards program. No material on this page is to be construed as an official or adopted Standard or Safety Guideline. Permission is granted to reproduce and/or distribute this document, in whole or in part, only within the scope of SEMI International Standards committee (document development) activity. All other reproduction and/or distribution without the prior written consent of SEMI is prohibited.

Semiconductor Equipment and Materials International
3081 Zanker Road
San Jose, CA 95134-2127
Phone: 408.943.6900, Fax: 408.943.7943

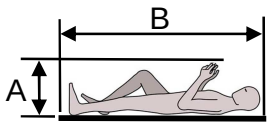
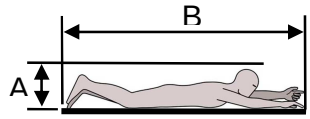
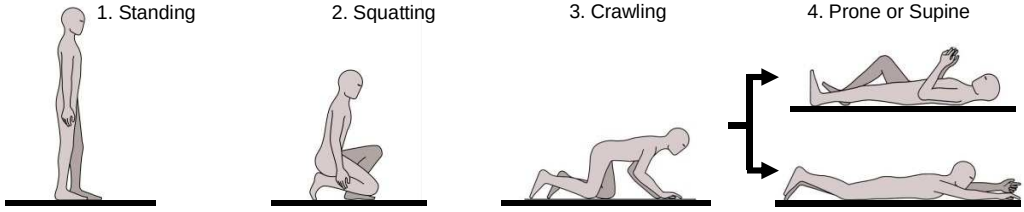
Section	*Indicator*	*Acceptance Criteria Metric Units (US Customary Units)*	*Reference Pictogram*	*Actual/ Conforms?*
7.1.4	Clearance for moving sideways (maintenance and service activity only)	A. Overhead clearance, minimum 1900 mm (74.8 in.) B. Forward horizontal clearance, minimum 477 mm (18.8 in.)		Measure-ments A. _____ B. _____ Conforms? Yes No N/A ☐ ☐ ☐
7.1.5	Kneeling crawl	A. Overhead clearance measured from floor, minimum 740 mm (29 in.) B. Forward horizontal clearance, minimum 1520 mm (60 in.) C. Elbow clearance, minimum 635 mm (25 in.)		Measure-ments A. _____ B. _____ C. _____ Conforms? Yes No N/A ☐ ☐ ☐
7.2	*Whole Body Clearance for Work Activities* These criteria apply to tasks that are anticipated by the supplier to involve manual and visual activity lasting longer than 5 minutes, or having multiple occurrences with a total duration of greater than 1 hour per 8-hour shift. Clearances should be provided based on the nature of the tasks performed in the designated area. When determining the working space required for a given task, first estimate where the hands, tools and equipment will be, the line-of-sight needed, and if the body will be supported (for example, sitting on a stool) for the envisioned task. Also consider space needed for movement such as squatting to lift an item or applying push/pull forces. Once this is done, estimate the posture(s) that will be associated with the task and use ¶¶ 7.2.1–7.2.9 to determine the various minimum clearance dimensions required for that posture. Clearances required for displays and controls in sections 8 and 9 should also be considered.			
7.2.1	Horizontal clearance for upper body (all postures)	Minimum 610 mm (24 in.)		Measure-ment _____ Conforms? Yes No N/A ☐ ☐ ☐
7.2.2	Standing	A. Overhead clearance, minimum 1980 mm (78 in.) B. Forward horizontal clearance[#1], minimum 690 mm (27 in.) C. Lower body clearance[#1], minimum 508 mm (20 in.)		Measure-ments A. _____ B. _____ C. _____ Conforms? Yes No N/A ☐ ☐ ☐

This is a Draft Document of the SEMI International Standards program. No material on this page is to be construed as an official or adopted Standard or Safety Guideline. Permission is granted to reproduce and/or distribute this document, in whole or in part, only within the scope of SEMI International Standards committee (document development) activity. All other reproduction and/or distribution without the prior written consent of SEMI is prohibited.

7.2.3	Stooping	A. Overhead clearance, minimum 1450 mm (57 in.) B. Forward horizontal clearance[#1], minimum 1020 mm (40 in.)		Measure-ments A. _____ B. _____ Conforms? Yes No N/A ☐ ☐ ☐
Section	*Indicator*	*Acceptance Criteria Metric Units (US Customary Units)*	*Reference Pictogram*	*Actual/ Conforms?*
7.2.4	Kneeling	A. Overhead clearance (from floor), minimum 1450 mm (57 in.) B. Forward horizontal clearance[#1], minimum 1220 mm (48 in.)		Measure-ments A. _____ B. _____ Conforms? Yes No N/A ☐ ☐ ☐
7.2.5	Sitting The given clearance dimensions do not provide room for movement of seating devices. Thickness of chair backrest is not included. Room for movement of the seating device is not included.	A. Overhead clearance measured from sitting surface, minimum 1010 mm (39.8 in.) B. Forward horizontal clearance (as measured from any obstruction, or front [user] side of backrest, if present)[#1] B1. Clearance for operation tasks (relaxed posture), minimum 1034 mm (40.7 in.) B2. Clearance for maintenance tasks (upright posture), minimum 867 mm (34.1 in.)		Measure-ments A. _____ B1. _____ B2. _____ Conforms? Yes No N/A ☐ ☐ ☐
7.2.6	Squatting	A. Overhead clearance, minimum 1220 mm (48 in.) B. Forward horizontal clearance[#1], minimum 790 mm (31 in.)		Measure-ments A. _____ B. _____ Conforms? Yes No N/A ☐ ☐ ☐
7.2.7	Sitting-on-floor	A. Overhead clearance, minimum 1000 mm (39 in.) B. Forward horizontal clearance[#1], minimum 690 mm (27 in.)		Measure-ments A. _____ B. _____ Conforms? Yes No N/A ☐ ☐ ☐

This is a Draft Document of the SEMI International Standards program. No material on this page is to be construed as an official or adopted Standard or Safety Guideline. Permission is granted to reproduce and/or distribute this document, in whole or in part, only within the scope of SEMI International Standards committee (document development) activity. All other reproduction and/or distribution without the prior written consent of SEMI is prohibited.

Semiconductor Equipment and Materials International
3081 Zanker Road
San Jose, CA 95134-2127
Phone: 408.943.6900, Fax: 408.943.7943

7.2.8	Supine (lying on back)	A. Vertical clearance (overhead), minimum 430 mm (17 in.) If the supplier specifies the use of a mechanic's-type creeper for a task, measure from the top surface of the creeper to the overhead obstruction. B. Length (forward), minimum 1980 mm (78 in.)		Measure-ments A. _____ B. _____ Conforms? Yes No N/A ☐ ☐ ☐
7.2.9	Prone (lying on stomach)	A. Vertical clearance (overhead), minimum 510 mm (20 in.) If the supplier specifies the use of a mechanic's-type creeper for a task, measure from the top surface of the creeper to the overhead obstruction. B. Length (forward), minimum 2440 mm (96 in.)		Measure-ments A. _____ B. _____ Conforms? Yes No N/A ☐ ☐ ☐
Section	*Indicator*	*Acceptance Criteria* *Metric Units (US Customary Units)*	*Reference Pictogram*	*Actual/ Conforms?*
7.2.10	To determine space needed to assume prone or supine positions from a standing posture, use the clearance recommendations for standing, squatting, and crawling sequentially. 			
7.3	*Hand/Arm Clearance* NOTE: Where appropriate to do so, dimensions have been adjusted for the use of cleanroom gloves			—

This is a Draft Document of the SEMI International Standards program. No material on this page is to be construed as an official or adopted Standard or Safety Guideline. Permission is granted to reproduce and/or distribute this document, in whole or in part, only within the scope of SEMI International Standards committee (document development) activity. All other reproduction and/or distribution without the prior written consent of SEMI is prohibited.

Semiconductor Equipment and Materials International
3081 Zanker Road
San Jose, CA 95134-2127
Phone: 408.943.6900, Fax: 408.943.7943

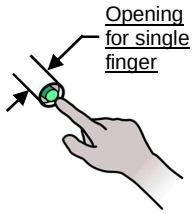
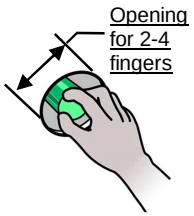
DRAFT
Document Number: 5917
Date: 5/18/2016

LETTER BALLOT

Line Item 3 – Revisions and Additions to Hand/Arm Clearances

Part B: Revisions to Dimensions Provided in Appendix 1, Section 7 and Provisions for Ungloved and Gloved Conditions

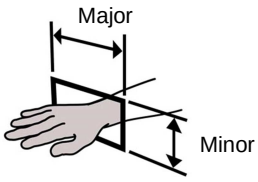
7.3	*Hand/Arm Clearance* ~~NOTE: Where appropriate to do so, dimensions have been adjusted for the use of cleanroom gloves~~ The recommended aperture sizes in this section do not ensure visual access. Larger openings should be used or viewports should be provided if visual access is desired. Access openings should have smooth edges. If hinged doors are used, they should not interfere with access. Clearances for clean room, chemical and thermal protective gloves have been provided where appropriate. • Cleanroom gloves with liners: add 3 mm (0.12 in.) • Chemical resistant gloves over cleanroom gloves and liners: add 6 mm (0.20 in.) • Thermal insulating gloves: add 13 mm (0.50 in.) Arm clearances include lightweight clothing with a cleanroom over-garment. Additional clearances should be added for heavier clothing or personal protective equipment where appropriate.

Section	*Indicator*	*Acceptance Criteria Metric Units (US Customary Units)*	*Reference Pictogram*	*Actual/ Conforms?*
7.3.1	Clearance provided for single finger access round (diameter) or square.	~~One finger access, minimum 32 mm (1.25 in.)~~ ~~2, 3, or 4 finger twist of small knob, minimum object diameter + 58 mm (2.3 in.)~~ Minimum diameter: Bare hand 32 mm (1.3 in.) Cleanroom glove 35 mm (1.4 in.) Chemical glove 38 mm (1.5 in.) Insulating glove 45 mm (1.8 in.)		Diameter _____ Depth _____ Conforms? Yes No N/A ☐ ☐ ☐
	Maximum depth of finger reach.	Maximum depth: 32 mm (1.3 in.)		
7.3.2	Clearance provided for 2, 3, or 4 finger twist of small, recessed knob.	Minimum opening, object diameter plus: Bare hand 58 mm (2.3 in.) Cleanroom glove 61 mm (2.4 in.) Chemical glove 64 mm (2.5 in.) Insulating glove 71 mm (2.8 in.)		Diameter _____ Conforms? Yes No N/A ☐ ☐ ☐

This is a Draft Document of the SEMI International Standards program. No material on this page is to be construed as an official or adopted Standard or Safety Guideline. Permission is granted to reproduce and/or distribute this document, in whole or in part, only within the scope of SEMI International Standards committee (document development) activity. All other reproduction and/or distribution without the prior written consent of SEMI is prohibited.

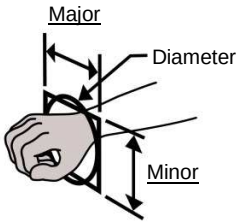
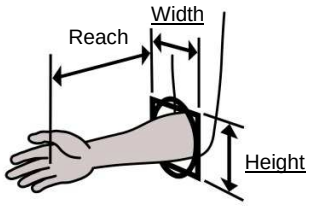
Semiconductor Equipment and Materials International
3081 Zanker Road
San Jose, CA 95134-2127
Phone: 408.943.6900, Fax: 408.943.7943

LETTER BALLOT

Section	*Indicator*	*Acceptance Criteria Metric Units (US Customary Units)*	*Reference Pictogram*	*Actual/ Conforms?*
~~7.3.2~~ 7.3.3	Clearance provided for flat hand wrist access.	~~Height (palm thickness), minimum 89 mm (3.5 in.)~~ ~~Width (palm width), minimum 114 mm (4.5 in.)~~ Major dimension, minimum Bare hand 114 mm (4.5 in.) Cleanroom glove 117 mm (4.6 in.) Chemical glove 119 mm (4.7 in.) Insulating glove 127 mm (5.0 in.) Minor dimension, minimum Bare hand 89 mm (3.5 in.) Cleanroom glove 92 mm (3.6 in.) Chemical glove 95 mm (3.7 in.) Insulating glove 102 mm (4.0 in.) The hand can be held with the palm vertical or horizontal so “major” (parallel to a line through the large knuckles) and “minor” (perpendicular to a line through the large knuckles) dimensions are provided for the opening rather than “height” and “width” dimensions		Major _____ Minor _____ Conforms? Yes No N/A ☐ ☐ ☐

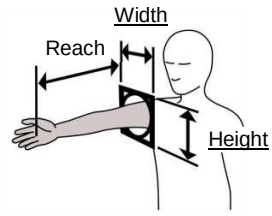
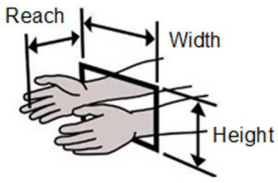
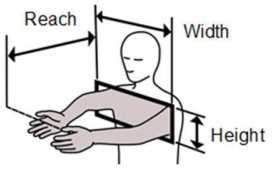
This is a Draft Document of the SEMI International Standards program. No material on this page is to be construed as an official or adopted Standard or Safety Guideline. Permission is granted to reproduce and/or distribute this document, in whole or in part, only within the scope of SEMI International Standards committee (document development) activity. All other reproduction and/or distribution without the prior written consent of SEMI is prohibited.

LETTER BALLOT

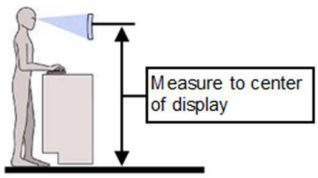
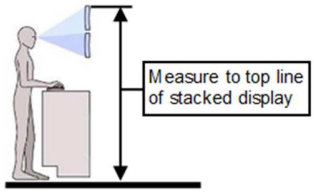
Section	*Indicator*	*Acceptance Criteria Metric Units (US Customary Units)*	*Reference Pictogram*	*Actual/ Conforms?*
~~7.3.3~~ 7.3.4	Clearance provided for fist to wrist access with thumb outside of fist.	~~Height (fist thickness), minimum 89 mm (3.5 in.)~~ ~~Width (fist width), minimum 127 mm (5 in.)~~ Rectangular opening: Major dimension, minimum Bare hand 127 mm (5.0 in.) Cleanroom glove 130 mm (5.1 in.) Chemical glove 133 mm (5.2 in.) Insulating glove 140 mm (5.5 in.) Minor dimension, minimum Bare hand 89 mm (3.5 in.) Cleanroom glove 92 mm (3.6 in.) Chemical glove 95 mm (3.7 in.) Insulating glove 102 mm (4.0 in.) The hand can be held with the palm vertical or horizontal so “major” (parallel to a line through the large knuckles) and “minor” (perpendicular to a line through the large knuckles) dimensions are provided for the opening rather than “height” and “width” dimensions Circular opening: Diameter, minimum Bare hand 127 mm (5.0 in.) Cleanroom glove 130 mm (5.1 in.) Chemical glove 133 mm (5.2 in.) Insulating glove 140 mm (5.5 in.)		Height _____ Width _____ Conforms? Yes No N/A ☐ ☐ ☐
~~7.3.7~~ 7.3.5	~~Clearance provided for one arm to elbow access, diameter, or square area (does not ensure visual access).~~ Clearance provided for one arm to elbow access.	~~Minimum 119 mm (4.7 in.)~~ Horizontal reach from opening to center of grasping area: 202 mm (8.0 in) Rectangular opening : Width, minimum 114 mm (4.5 in.) Height, minimum 102 mm (4.0 in.) Circular openings: Dia., minimum 114 mm (4.5 in.)		Height _____ Width _____ Width _____ Conforms? Yes No N/A ☐ ☐ ☐

This is a Draft Document of the SEMI International Standards program. No material on this page is to be construed as an official or adopted Standard or Safety Guideline. Permission is granted to reproduce and/or distribute this document, in whole or in part, only within the scope of SEMI International Standards committee (document development) activity. All other reproduction and/or distribution without the prior written consent of SEMI is prohibited.

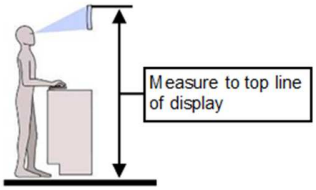
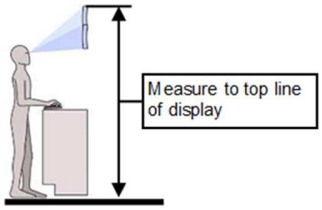
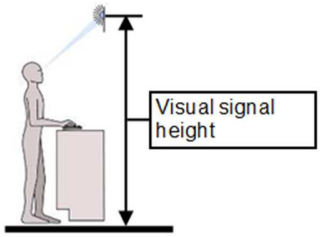
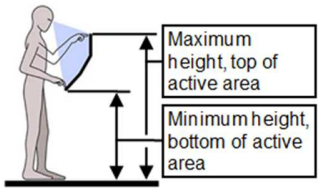
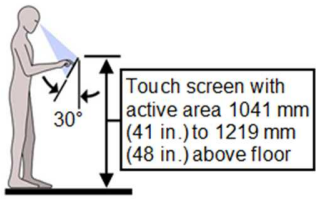
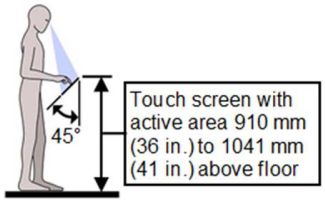
LETTER BALLOT

Section	*Indicator*	*Acceptance Criteria Metric Units (US Customary Units)*	*Reference Pictogram*	*Actual/ Conforms?*
7.3.6	Clearance provided for one arm to shoulder access ~~(does not ensure visual access)~~.	~~Minimum 132 mm (5.2 in.)~~ Horizontal reach from opening to center of grasping area: 393 mm (15.5 in) Rectangular opening: Width, minimum 127 mm (5.0 in.) Height, minimum 127 mm (5.0 in.) Circular opening: Dia., minimum 127 mm (5.0 in.)		Reach _____ Height _____ Width _____ Conforms? Yes No N/A ☐ ☐ ☐
~~7.3.5~~ 7.3.7	Clearance provided for two hands, hand to wrist access ~~(does not ensure visual access)~~.	Reach, maximum 203 mm (8 in.) Width, minimum 191 mm (7.5 in) Height, minimum 114 mm (4.5 in.)		Height _____ Width _____ Conforms? Yes No N/A ☐ ☐ ☐
~~7.3.4~~ 7.3.8	Clearance provided for two hands arm to shoulders access ~~(does not ensure visual access)~~.	~~Reach, maximum 610 mm (24 in.)~~ Reach, maximum 393 mm (15.4 in) Width, minimum 483 mm (19 in.) Height, minimum 114 mm (4.5 in.)		Height _____ Width _____ Conforms? Yes No N/A ☐ ☐ ☐

Section 8: Display Location

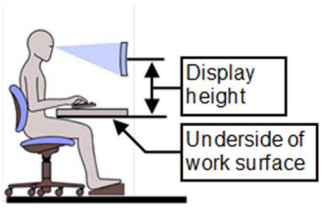
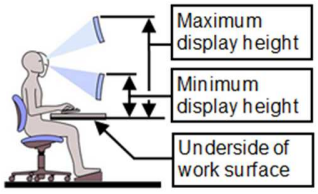
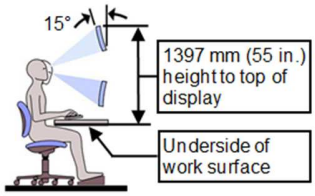
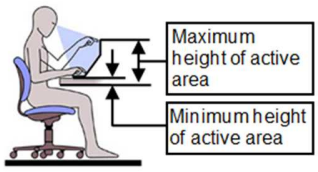
Section	*Indicator*	*Acceptance Criteria Metric Units (US Customary Units)*	*Reference Pictogram*	*Actual/ Conforms?*
8.1	Location for Operator Primary Interface, Standing Station			
8.1.1	Height of video display terminal (single monitor). Does not include touchscreens, measured from floor to center of screen.	Maximum 1470 mm (58 in.) Minimum 1320 mm (52 in.)		Measure-ment _____ Conforms? Yes No N/A ☐ ☐ ☐
8.1.2	Height of video display terminal (stacked monitors). Does not include touchscreens, measured from floor to top line of the top monitor. The primary monitor in a stacked configuration is the bottom monitor.	Maximum 1680 mm (66 in.)		Measure-ment _____ Conforms? Yes No N/A ☐ ☐ ☐

This is a Draft Document of the SEMI International Standards program. No material on this page is to be construed as an official or adopted Standard or Safety Guideline. Permission is granted to reproduce and/or distribute this document, in whole or in part, only within the scope of SEMI International Standards committee (document development) activity. All other reproduction and/or distribution without the prior written consent of SEMI is prohibited.

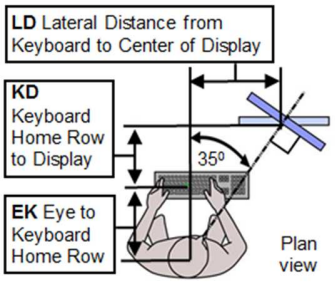
8.1.3	Height of infrequently used video display terminal (viewed briefly less often than once per hour) measured to top line of monitor.	Maximum 1680 mm (66 in.)		Measure-ment _____ Conforms? Yes No N/A ☐ ☐ ☐
Section	*Indicator*	*Acceptance Criteria* *Metric Units (US Customary Units)*	*Reference Pictogram*	*Actual/ Conforms?*
8.1.4	Height of very infrequently used video display terminal (viewed briefly less often than once per day) measured to top line of monitor.	Maximum 1880 mm (74 in.)		_____ Conforms? Yes No N/A ☐ ☐ ☐
8.1.5	Height of infrequently viewed visual signal measured to the top of the signal. This guideline does not apply to light towers.	Maximum 2130 mm (84 in.)		_____ Conforms? Yes No N/A ☐ ☐ ☐
8.1.6	Height of touch screen monitor. See § 9 for horizontal reach criteria.	Maximum 1470 mm (58 in.) measured from floor to uppermost active pad on screen. Minimum 910 mm (36 in.) measured from floor to lowest active pad on the screen.		_____ Conforms? Yes No N/A ☐ ☐ ☐
8.1.7	Tilt angle of touch screen monitor between 1041 mm (41 in.) and 1219 mm (48 in.) in height to top of screen.	Upward minimum 30°		_____ Conforms? Yes No N/A ☐ ☐ ☐
8.1.8	Tilt angle of touch screen monitor less than 1041 mm (41 in.) in height to top of screen.	Upward minimum 45°		_____ Conforms? Yes No N/A ☐ ☐ ☐
8.2	*Location for Operator Primary Interface, Seated Station* NOTE: A seated station is where a short cylinder office-style chair is used.			—

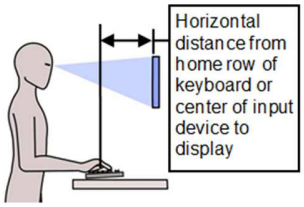
This is a Draft Document of the SEMI International Standards program. No material on this page is to be construed as an official or adopted Standard or Safety Guideline. Permission is granted to reproduce and/or distribute this document, in whole or in part, only within the scope of SEMI International Standards committee (document development) activity. All other reproduction and/or distribution without the prior written consent of SEMI is prohibited.

Semiconductor Equipment and Materials International
3081 Zanker Road
San Jose, CA 95134-2127
Phone: 408.943.6900, Fax: 408.943.7943

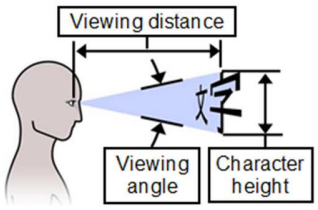
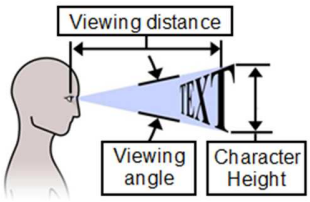
8.2.1	Height of video display terminal (single monitor). Does not include touchscreens, measured from the underside of the work surface to the centerline of monitor.	Maximum 517 mm (20.5 in.) Minimum 267 mm (10.5 in.)		_____ Conforms? Yes No N/A ☐ ☐ ☐
Section	*Indicator*	*Acceptance Criteria* *Metric Units (US Customary Units)*	*Reference* *Pictogram*	*Actual/* *Conforms?*
8.2.2	Height of video display terminal (stacked monitors), does not include touchscreens, measured from the underside of the work surface to the top line of top monitor. The primary monitor in a stacked configuration is the bottom monitor.	Maximum 727 mm (28.5 in.) Minimum 267 mm (10.5 in.)		_____ Conforms? Yes No N/A ☐ ☐ ☐
8.2.3	Tilt angle of video display terminal greater than 1397 mm (55 in.) from underside of work surface to top of display. Note: This line item becomes significant in the event that the maximum height criteria cannot be met.	Downward minimum 15°		_____ Conforms? Yes No N/A ☐ ☐ ☐
8.2.4	Height of touch screen monitor.	Maximum 397 mm (15.5 in.) measured from the underside of work surface to highest active pad on the screen. Minimum 77 mm (3.5 in.) measured from underside of work surface to lowest active pad on the screen. See § 9 for horizontal reach criteria.		_____ Conforms? Yes No N/A ☐ ☐ ☐

This is a Draft Document of the SEMI International Standards program. No material on this page is to be construed as an official or adopted Standard or Safety Guideline. Permission is granted to reproduce and/or distribute this document, in whole or in part, only within the scope of SEMI International Standards committee (document development) activity. All other reproduction and/or distribution without the prior written consent of SEMI is prohibited.

<table>
<tr><td>8.3</td><td colspan="3">Display Characteristics</td><td>—</td></tr>
<tr><td>8.3.1</td><td>Lateral distance from the centerline of the display to the center of the keyboard home row, which is typically the midpoint between the “G” and “H” keys on a keyboard with a standard “QWERTY” key layout.
When practical, off-center displays should be angled perpendicular to the user’s line of sight to minimize image distortion.</td><td>Calculate maximum lateral offset distance using the following formula: (KD+EK) × tan 35° = LD
KD = Forward distance from keyboard home row to display.
EK = 304 mm (12.0 in.) Constant forward distance from eye to keyboard home row.
LD = Maximum recommended lateral distance to center of display.</td><td>

Examples of maximum recommended offset dimensions using the provided formula.
<table>
<tr><th>Keyboard home row to display distance</th><th>Maximum offset</th></tr>
<tr><td>229 mm (9.0 in.)</td><td>373 mm (14.7 in.)</td></tr>
<tr><td>300 mm (11.8 in.)</td><td>423 mm (16.6 in.)</td></tr>
<tr><td>350 mm (13.8 in.)</td><td>458 mm (18.0 in.)</td></tr>
<tr><td>400 mm (15.7 in.)</td><td>493 mm (19.4 in.)</td></tr>
</table></td><td>Measure-ment
_____
Conforms?
Yes No N/A
☐ ☐ ☐</td></tr>
<tr><td>Section</td><td>Indicator</td><td>Acceptance Criteria
Metric Units (US Customary Units)</td><td>Reference
Pictogram</td><td>Actual/
Conforms?</td></tr>
<tr><td>8.3.2</td><td>Display distance. Measure horizontal distance from keyboard home row or center of input device in the home position to the display.
Applies to seated and standing workstations.
This recommendation does not apply to applications where input devices (keyboard, trackball, or mouse) are used more like machine controls (intermittent one finger entry on the keyboard, intermittent short term use of the mouse or trackball) than for standard typing (continuous use of keyboard for entry of long character strings, extended use of trackball or mouse in a graphical environment).</td><td>Minimum 229 mm (9.0 in.)</td><td>
</td><td>Measure-ment
_____
Conforms?
Yes No N/A
☐ ☐ ☐</td></tr>
</table>

This is a Draft Document of the SEMI International Standards program. No material on this page is to be construed as an official or adopted Standard or Safety Guideline. Permission is granted to reproduce and/or distribute this document, in whole or in part, only within the scope of SEMI International Standards committee (document development) activity. All other reproduction and/or distribution without the prior written consent of SEMI is prohibited.

8.3.3	Character height (specific to Chinese, Korean, and Japanese characters).	Minimum 25 minutes of arc (character height is greater than or equal to the viewing distance divided by 137.5). Minimum recommended viewing distance is 500 mm (19.7 in.).		Measure-ment _____ Conforms? Yes No N/A ☐ ☐ ☐
8.3.4	Character height (all characters other than Chinese, Korean, and Japanese).	Minimum 16 minutes of arc (character height is greater than or equal to the viewing distance divided by 215). Minimum recommended viewing distance is 500 mm (19.7 in.).		Measure-ment _____ Conforms? Yes No N/A ☐ ☐ ☐

Section 9: Hand Control Location

These criteria only apply to controls accessed for routine production operation and maintenance tasks from floor-standing postures and from chair-seated postures at a workstation or console.

EXCEPTION 1: These criteria do not apply to freestanding equipment or sub-systems with an installed height of less than 838 mm (33 in.) such as pumps, power supplies, chillers, and heat exchangers.

EXCEPTION 2: Infrequently used or critical controls may be located outside the recommended height ranges if their location makes them more readily accessible for other postures adopted during maintenance activities anticipated by the supplier. If this exception is used, the evaluator should note the activity and the means used to access the control recommended by the supplier (e.g., ladder or step platform).

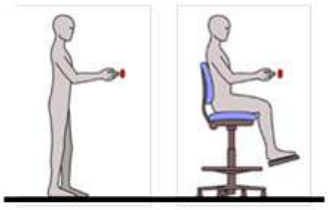
Controls that move as designed should be measured in the least favorable position.

Interpolate for intermediate values.

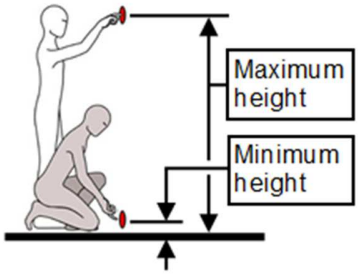
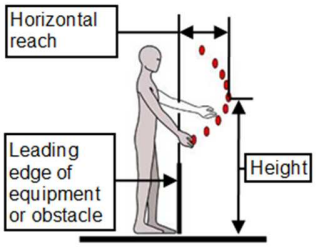
NOTE 1: See § 7 for other work postures.

NOTE 2: Devices outside the recommended ranges may have an operational means to meet the criteria (e.g., pull cord or extension rod).

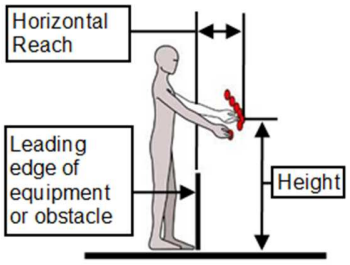
NOTE 3: Visual access is assumed for these reach criteria.

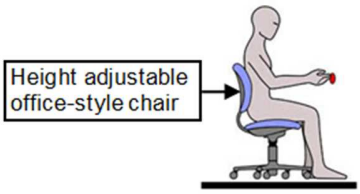
Section	*Indicator*	*Acceptance Criteria* *Metric Units (US Customary Units)*	*Actual/ Conforms*
9.1	Standing station NOTE: A standing station is one where the operator can assume a standing posture or a seated posture in a tall stool which places the operator at approximately the same stature.		—

This is a Draft Document of the SEMI International Standards program. No material on this page is to be construed as an official or adopted Standard or Safety Guideline. Permission is granted to reproduce and/or distribute this document, in whole or in part, only within the scope of SEMI International Standards committee (document development) activity. All other reproduction and/or distribution without the prior written consent of SEMI is prohibited.

9.1.1	Vertical location of very infrequently used controls (controls used less often than once every 24 hours) measured from the standing surface to the centerline of the control.	Maximum 1640 mm (64.5 in.) Minimum 0 mm (0 in.) 	_____ Conforms? Yes No N/A ☐ ☐ ☐
Section	*Indicator*	*Acceptance Criteria* *Metric Units (US Customary Units)*	*Actual/ Conforms*
9.1.2	Location of infrequently used and/or critical controls. Maximum reaches are indicated for various heights. Reaches are measured from the leading edge of the equipment or obstacle. Interpolate for intermediate values.	Controls should not be located above 1638 mm (64.5 in.) or below 838 mm (33 in.). Height / Horizontal reach 1638 mm (64.5 in.) / 254 mm (10 in.) 1524 mm (60 in.) / 368 mm (14.5 in.) 1422 mm (56 in.) / 432 mm (17 in.) 1321 mm (52 in.) / 470 mm (18.5 in.) 1219 mm (48 in.) / 483 mm (19 in.) 1118 mm (44 in.) / 470 mm (18.5 in.) 1016 mm (40 in.) / 394 mm (15.5 in.) 914 mm (36 in.) / 292 mm (11.5 in.) 838 mm (33 in.) / 178 mm (7 in.) 	_____ Conforms? Yes No N/A ☐ ☐ ☐

This is a Draft Document of the SEMI International Standards program. No material on this page is to be construed as an official or adopted Standard or Safety Guideline. Permission is granted to reproduce and/or distribute this document, in whole or in part, only within the scope of SEMI International Standards committee (document development) activity. All other reproduction and/or distribution without the prior written consent of SEMI is prohibited.

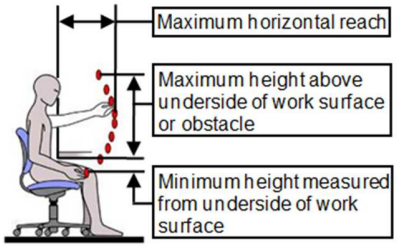
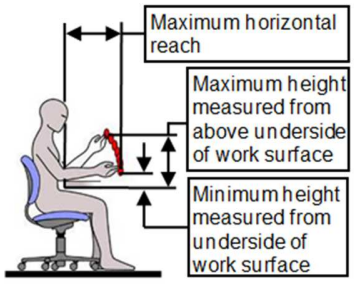
<table>
<tr>
<td>9.1.3</td>
<td>Location of frequently used controls. Maximum reaches are indicated for various heights. Reaches are measured from the leading edge of the equipment or obstacle. Interpolate for intermediate values.</td>
<td>Controls should not be located above 1270 mm (50 in.) or below 940 mm (37 in.).
<table>
<tr><th>Height</th><th>Horizontal reach</th></tr>
<tr><td>1270 mm (50 in.)</td><td>292 mm (11.5 in.)</td></tr>
<tr><td>1219 mm (48 in.)</td><td>330 mm (13 in.)</td></tr>
<tr><td>1168 mm (46 in.)</td><td>368 mm (14.5 in.)</td></tr>
<tr><td>1118 mm (44 in.)</td><td>394 mm (15.5 in.)</td></tr>
<tr><td>1067 mm (42 in.)</td><td>406 mm (16 in.)</td></tr>
<tr><td>1016 mm (40 in.)</td><td>394 mm (15.5 in.)</td></tr>
<tr><td>940 mm (37 in.)</td><td>318 mm (12.5 in.)</td></tr>
</table>


</td>
<td>_____
Conforms?
Yes No N/A
☐ ☐ ☐</td>
</tr>
<tr>
<td>9.2</td>
<td>Seated station
NOTE: A seated station is one where a short cylinder office-style chair is used.</td>
<td>
</td>
<td>_____
Conforms?
Yes No N/A
☐ ☐ ☐</td>
</tr>
</table>

This is a Draft Document of the SEMI International Standards program. No material on this page is to be construed as an official or adopted Standard or Safety Guideline. Permission is granted to reproduce and/or distribute this document, in whole or in part, only within the scope of SEMI International Standards committee (document development) activity. All other reproduction and/or distribution without the prior written consent of SEMI is prohibited.

Semiconductor Equipment and Materials International
3081 Zanker Road
San Jose, CA 95134-2127
Phone: 408.943.6900, Fax: 408.943.7943

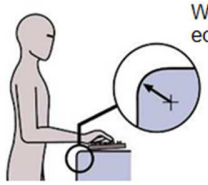
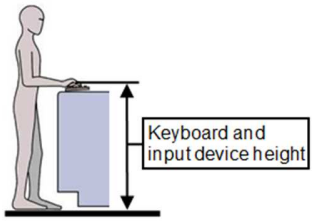
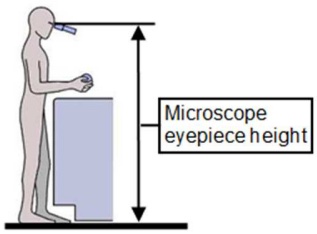
LETTER BALLOT

<table>
<tr><th>Section</th><th>Indicator</th><th>Acceptance Criteria
Metric Units (US Customary Units)</th><th>Actual/
Conforms</th></tr>
<tr><td>9.2.1</td><td>Location of infrequently used and/or critical controls. Maximum reaches are indicated for various heights. Reaches are measured from the leading edge of the work surface or obstacle. Heights are measured from the underside[#1] of the work surface. Interpolate for intermediate values.</td><td>Controls should not be located greater than 724 mm (28.5 in.) above or 140 mm (5.5 in.) below the underside of the work surface.
<table>
<tr><th>Height</th><th>Horizontal reach</th></tr>
<tr><td>724 mm (28.5 in.)</td><td>356 mm (14 in.)</td></tr>
<tr><td>597 mm (23.5 in.)</td><td>432 mm (17 in.)</td></tr>
<tr><td>495 mm (19.5 in.)</td><td>470 mm (18.5 in.)</td></tr>
<tr><td>394 mm (15.5 in.)</td><td>483 mm (19 in.)</td></tr>
<tr><td>292 mm (11.5 in.)</td><td>483 mm (19 in.)</td></tr>
<tr><td>191 mm (7.5 in.)</td><td>470 mm (18.5 in.)</td></tr>
<tr><td>89 mm (3.5 in.)</td><td>445 mm (17.5 in.)</td></tr>
<tr><td>−13 mm (−0.5 in.)</td><td>381 mm (15 in.)</td></tr>
<tr><td>−140 mm (−5.5 in.)</td><td>254 mm (10 in.)</td></tr>
</table>

</td><td>Measure-ment
_____
Conforms?
Yes No N/A
☐ ☐ ☐</td></tr>
<tr><td>9.2.2</td><td>Location of frequently used controls. Maximum reaches are indicated for various heights. Reaches are measured from the leading edge of the work surface or obstacle. Heights are measured from the underside[#1] of the work surface. Interpolate for intermediate values.</td><td>Controls should not be located greater than 394 mm (15.5 in.) above or less than 89 mm (3.5 in.) above the underside of the work surface.
<table>
<tr><th>Height</th><th>Horizontal reach</th></tr>
<tr><td>394 mm (15.5 in.)</td><td>330 mm (13 in.)</td></tr>
<tr><td>343 mm (13.5 in.)</td><td>368 mm (14.5 in.)</td></tr>
<tr><td>292 mm (11.5 in.)</td><td>394 mm (15.5 in.)</td></tr>
<tr><td>241 mm (9.5 in.)</td><td>406 mm (16 in.)</td></tr>
<tr><td>191 mm (7.5 in.)</td><td>419 mm (16.5 in.)</td></tr>
<tr><td>140 mm (5.5 in.)</td><td>419 mm (16.5 in.)</td></tr>
<tr><td>89 mm (3.5 in.)</td><td>419 mm (16.5 in.)</td></tr>
</table>

</td><td>Measure-ment
_____
Conforms?
Yes No N/A
☐ ☐ ☐</td></tr>
</table>

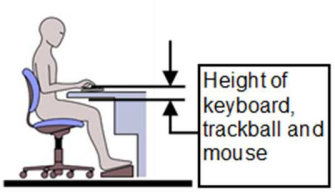
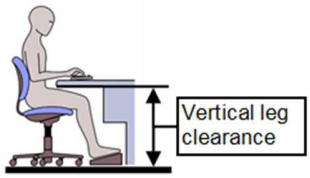
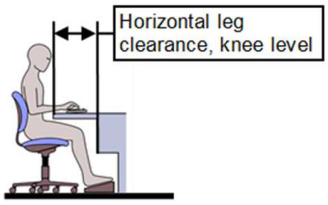
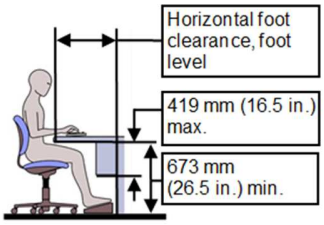
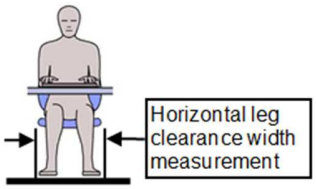
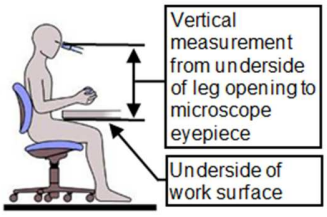
This is a Draft Document of the SEMI International Standards program. No material on this page is to be construed as an official or adopted Standard or Safety Guideline. Permission is granted to reproduce and/or distribute this document, in whole or in part, only within the scope of SEMI International Standards committee (document development) activity. All other reproduction and/or distribution without the prior written consent of SEMI is prohibited.

Semiconductor Equipment and Materials International
3081 Zanker Road
San Jose, CA 95134-2127
Phone: 408.943.6900, Fax: 408.943.7943

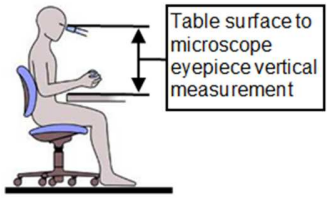
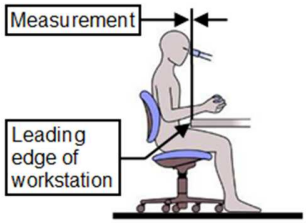
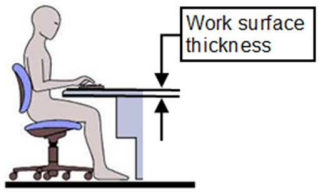
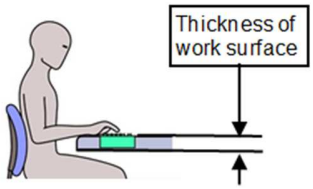
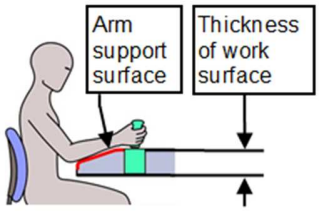
LETTER BALLOT

Section 10: Workstation Design				
Section	*Indicator*	*Acceptance Criteria Metric Units (US Customary Units)*	*Reference Pictogram*	*Actual/ Conforms?*
10.1	*Standing Station* NOTE: A standing station is one where the operator can assume a standing posture or a seated posture in a tall stool which places the operator at approximately the same stature.			—
10.1.1	Work surface edge radius where the operator can assume a static posture in contact with the edge.	Minimum 6.4 mm (0.25 in.) radius		Measure-ment _____ Conforms? Yes No N/A ☐ ☐ ☐
10.1.2	Height of keyboard, trackball, or mouse (to home row, top of ball/mouse).	Maximum 1020 mm (40 in.) Minimum 970 mm (38 in.)		Measure-ment _____ Conforms? Yes No N/A ☐ ☐ ☐
	NOTE: In applications where input devices (keyboard, trackball, or mouse) are used more like machine controls (intermittent one finger entry on the keyboard, intermittent short term use of the mouse or trackball) than for standard typing (continuous use of keyboard for entry of long character strings, extended use of trackball or mouse in graphical environment), it is appropriate to use the height and reach locations described in § 9, Hand Control Location (standing station).			
10.1.3	Height of microscope eyepieces. Should be adjustable through at least this range.	Range includes 1270 mm (50 in.) to 1730 mm (68 in.)		Measure-ment _____ Conforms? Yes No N/A ☐ ☐ ☐
10.2	*Seated Station* NOTE: A seated station is one where a height-adjustable, office-style chair is used.			—
10.2.1	Height of keyboard, trackball, or mouse. (measured to home row and top of ball/mouse from the underside of the work surface).	Maximum 87 mm (3.5 in.) Minimum 37 mm (1.5 in.)		Measure-ment _____ Conforms? Yes No N/A

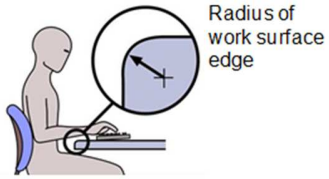
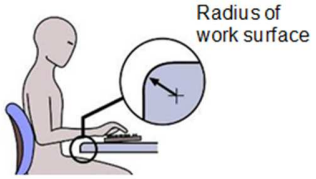
This is a Draft Document of the SEMI International Standards program. No material on this page is to be construed as an official or adopted Standard or Safety Guideline. Permission is granted to reproduce and/or distribute this document, in whole or in part, only within the scope of SEMI International Standards committee (document development) activity. All other reproduction and/or distribution without the prior written consent of SEMI is prohibited.

	NOTE: In applications where input devices (keyboard, trackball, or mouse) are used more like machine controls (intermittent one finger entry on the keyboard, intermittent short term use of the mouse or trackball) than for standard typing (continuous use of keyboard for entry of long character strings, extended use of trackball or mouse in graphical environment), it is appropriate to use the height and reach locations described in § 9 of this table, Hand Control Location (seated station).			☐ ☐ ☐
Section	*Indicator*	*Acceptance Criteria Metric Units (US Customary Units)*	*Reference Pictogram*	*Actual/ Conforms?*
10.2.2	Vertical leg clearance.	Minimum 673 mm (26.5 in.)		Measure-ment _____ Conforms? Yes No N/A ☐ ☐ ☐
10.2.3	Horizontal leg clearance, depth at knee level.	Minimum 508 mm (20 in.)		Measure-ment _____ Conforms? Yes No N/A ☐ ☐ ☐
10.2.4	Horizontal leg clearance, depth at foot level.	Minimum 660 mm (26 in.) depth clearance at a minimum vertical range of 419 mm (16.5 in.) to 673 mm (26.5 in.) below the underside of the work surface.		_____ Conforms? Yes No N/A ☐ ☐ ☐
10.2.5	Horizontal leg clearance, width.	Minimum 610 mm (24 in.)		Measure-ment _____ Conforms? Yes No N/A ☐ ☐ ☐
10.2.6	Equipment integrated microscope: Height of microscope eyepiece measured from underside of work surface to center of eyepiece. Must be adjustable with the entire range.	Range includes 495 mm (19.5 in.) to 658 mm (25.9 in.).		Measure-ment _____ Conforms? Yes No N/A ☐ ☐ ☐
	NOTE: The intent of the change of reference from the floor to the underside of the work surface is to allow for higher work surfaces in situations where there is a specific advantage, and to ensure in those cases that the other design features are located appropriately for the higher work surface.			

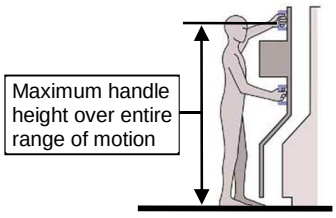
This is a Draft Document of the SEMI International Standards program. No material on this page is to be construed as an official or adopted Standard or Safety Guideline. Permission is granted to reproduce and/or distribute this document, in whole or in part, only within the scope of SEMI International Standards committee (document development) activity. All other reproduction and/or distribution without the prior written consent of SEMI is prohibited.

	Stand-alone (table top) microscopes: Height of microscope eyepiece measured from the top of the work surface to center of eyepiece. Must be adjustable with the entire range.	Range includes 445 mm (17.5 in.) to 607 mm (23.9 in.).		Measure-ment _____ Conforms? Yes No N/A ☐ ☐ ☐
Section	*Indicator*	*Acceptance Criteria* *Metric Units (US Customary Units)*	*Reference Pictogram*	*Actual/ Conforms?*
10.2.7	Microscope eyepiece location in relation to leading edge of workstation.	Eye pieces are flush with or protrude horizontally beyond the leading edge of the workstation toward the user (applicable at all eyepiece height adjustment settings).		Measure-ment _____ Conforms? Yes No N/A ☐ ☐ ☐
10.2.8	Thickness of work surface. Only needs to be applied to depth of work surface in section 10.2.3 of this table.	Maximum 51 mm (2 in.)		Measure-ment _____ Conforms? Yes No N/A ☐ ☐ ☐
10.2.9	Thickness of work surface used for an enclosed keyboard. Only needs to be applied to depth of work surface in section 10.2.3 of this table.	Maximum 75 mm (3 in.)		Measure-ment _____ Conforms? Yes No N/A ☐ ☐ ☐
10.2.10	Maximum work surface thickness for non-keyboard applications. Only needs to be applied to depth of work surface in section 10.2.3 of this table.	Maximum 145 mm (5.7 in.)		Measure-ment _____ Conforms? Yes No N/A ☐ ☐ ☐
10.2.11	For work surfaces thicknesses greater than 75 mm (3 in.), arm support surface should be present in front of primary controls used by each hand.	Arm support surface should be present in front of primary controls.		_____ Conforms? Yes No N/A ☐ ☐ ☐

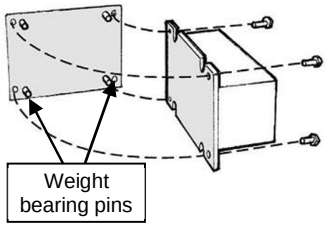
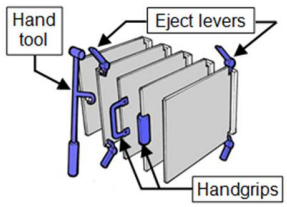
This is a Draft Document of the SEMI International Standards program. No material on this page is to be construed as an official or adopted Standard or Safety Guideline. Permission is granted to reproduce and/or distribute this document, in whole or in part, only within the scope of SEMI International Standards committee (document development) activity. All other reproduction and/or distribution without the prior written consent of SEMI is prohibited.

10.2.12	Work surface edge radius where the operator can assume a static posture in contact with the edge.	Work surfaces less than or equal to 51 mm (2.0 in.) thick, minimum 6 mm (0.25 in.) radius. Work surfaces greater than 51 mm (2.0 in.) thick, minimum 13 mm (0.5 in.) radius.		Measure-ment _____ Conforms? Yes No N/A ☐ ☐ ☐
10.2.13	Work surface edge radius where the operator can assume a static posture in contact with the edge.	Minimum 6 mm (0.25 in.) radius		Measure-ment _____ Conforms? Yes No N/A ☐ ☐ ☐

Section 11: Equipment Maintainability and Serviceability

Section	*Indicator*	*Acceptance Criteria Metric Units (US Customary Units)*	*Reference Pictogram*	*Actual/ Conforms?*
11.1	Minimum lighting level in maintenance areas is required where the worker has to read information, use a hand tool, or make a connection. This provision can be met by providing integral lighting or portable lighting that does not have to be hand held. Lighting should be properly rated for the environment of intended use.	Minimum 300 lux (30 fc)	—	Conforms? Yes No N/A ☐ ☐ ☐
11.2	Covers or doors must, unless fully removable, be self-supporting, in the open position, and not require manual support during maintenance. Exceptions may be allowed for self-closing doors for fire safety or compliance reasons.	Supports present	—	Conforms? Yes No N/A ☐ ☐ ☐
11.3	Height of access cover handle over the entire range of motion required for maintenance. This requirement can be met by the use of a ladder or step platform; however, its use should be noted in the assessment report.	Maximum 1700 mm (67 in.).		Measure-ment _____ Conforms? Yes No N/A ☐ ☐ ☐
11.4	Serviceable components are replaceable as modular packages, and are configured to facilitate removal and replacement.	Serviceable components configured as described.	—	Conforms? Yes No N/A ☐ ☐ ☐

This is a Draft Document of the SEMI International Standards program. No material on this page is to be construed as an official or adopted Standard or Safety Guideline. Permission is granted to reproduce and/or distribute this document, in whole or in part, only within the scope of SEMI International Standards committee (document development) activity. All other reproduction and/or distribution without the prior written consent of SEMI is prohibited.

11.5	Serviceable components should not be stacked directly on one another (i.e., a lower layer should not support an upper layer).	Serviceable components independently accessible.	—	Conforms? Yes No N/A ☐ ☐ ☐
Section	*Indicator*	*Acceptance Criteria Metric Units (US Customary Units)*	*Reference Pictogram*	*Actual/ Conforms?*
11.6	Weight bearing aids to support items that can fall if not supported by at least one hand while being attached should be provided for items which are specified for installation as part of a maintenance or service task. Alignment aids provided to facilitate positioning when precise alignment is needed to insert fasteners for items which are specified for installation as part of a maintenance or service task. Note: aids include, but are not limited to pins, hooks, bayonet mounts, and keyholes.	Weight bearing/alignment aids present.	An example of weight bearing aids	Conforms? Yes No N/A ☐ ☐ ☐
11.7	Cables, connectors, plugs, and receptacles should be labeled, keyed, color coded, or otherwise configured to make connection easier and prevent cross connection. This feature is assessed only if a SEMI S2 assessment is not being conducted.	Identification present, keyed where needed.	—	Conforms? Yes No N/A ☐ ☐ ☐
11.8	Circuit boards mounted in a card cage configuration should have gripping or ejecting aids for mounting and removal.	Finger access, gripping, or ejecting aids available.	Several examples of circuit board removal devices	Conforms? Yes No N/A ☐ ☐ ☐

#1 Distance measured away from the equipment or obstruction for body clearance in the given posture.

This is a Draft Document of the SEMI International Standards program. No material on this page is to be construed as an official or adopted Standard or Safety Guideline. Permission is granted to reproduce and/or distribute this document, in whole or in part, only within the scope of SEMI International Standards committee (document development) activity. All other reproduction and/or distribution without the prior written consent of SEMI is prohibited.

Semiconductor Equipment and Materials International
3081 Zanker Road
San Jose, CA 95134-2127
Phone: 408.943.6900, Fax: 408.943.7943

LETTER BALLOT

[Appendices 2 and 3 have been omitted from the ballot in the interest of brevity. If you need a copy of these sections in order to vote, please contact SEMI Staff.]

APPENDIX 2

LIFTING, STRENGTH, AND MATERIALS HANDLING

APPENDIX 3

ENCLOSED HANDLE ASSESSMENT CRITERIA

[Related Information sections 1 through 6 have been omitted from the ballot in the interest of brevity. If you need a copy of these sections in order to vote, please contact SEMI Staff.]

RELATED INFORMATION 1

ANTHROPOMETRIC RESOURCE DATA

RELATED INFORMATION 2

WORKSTATION DESIGN

RELATED INFORMATION 3

DESIGN FOR MAINTAINABILITY AND SERVICEABILITY

RELATED INFORMATION 4

HAZARD ALERTS, LABELS, AND ALARMS

RELATED INFORMATION 5

CONTROLS AND DISPLAYS

RELATED INFORMATION 6

USER COMPUTER INTERFACE

This is a Draft Document of the SEMI International Standards program. No material on this page is to be construed as an official or adopted Standard or Safety Guideline. Permission is granted to reproduce and/or distribute this document, in whole or in part, only within the scope of SEMI International Standards committee (document development) activity. All other reproduction and/or distribution without the prior written consent of SEMI is prohibited.

Semiconductor Equipment and Materials International
3081 Zanker Road
San Jose, CA 95134-2127
Phone: 408.943.6900, Fax: 408.943.7943

LETTER BALLOT

Line Item 3 – Revisions and Additions to Hand/Arm Clearances

Part C: Add a New Related Information Section "Y" with additional hand/arm clearance design recommendations

RELATED INFORMATION Y
ADDITIONAL HAND/ARM CLEARANCE RECOMMENDATIONS

NOTICE: This Related Information is not an official part of SEMI doc. 5917 and was derived from the work of the EHS Global Technical Committee. This Related Information was approved for publication by full letter ballot procedures on [A&R approval date].

RY-1 Hand and Arm Clearance Recommendations are Provided for Gloved and Ungloved Conditions

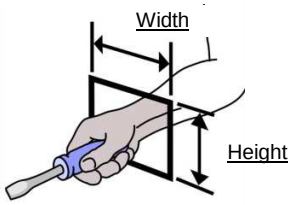
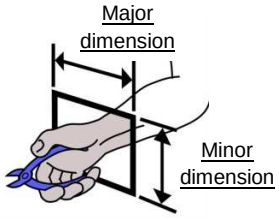
RY-1.1 The recommended apertures sizes in this section do not ensure visual access. Larger openings should be used or viewports should be provided if visual access is desired.

RY-1.2 Access openings should have smooth edges. If hinged doors are used, they should not interfere with access.

Clearances for cleanroom, chemical and thermal protective gloves have been provided where appropriate.

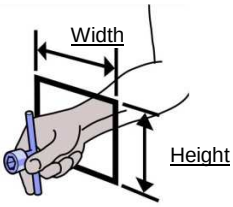
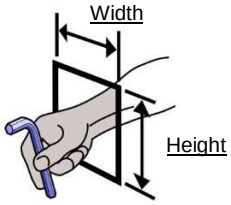
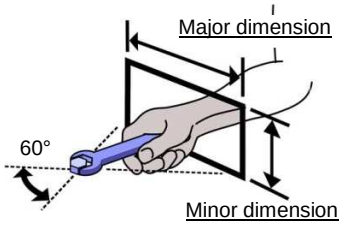
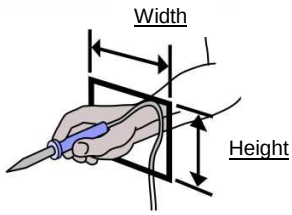
- Cleanroom gloves with liners: add 3 mm (0.12 in.)
- Chemical resistant gloves over cleanroom gloves and liners: add 6 mm (0.20 in.)
- Thermal insulating gloves: add 13 mm (0.50 in.)

RY-1.3 Arm clearances include lightweight clothing with a cleanroom over-garment. Additional clearances should be added for heavier clothing where appropriate.

Number	*Indicator*	*Recommended Dimensions*	*Reference Pictogram*
Y-1	Using common screwdriver with freedom to turn hand 180°.	Width, minimum Bare hand 110 mm (4.3 in.) Cleanroom glove 113 mm (4.4 in.) Chemical glove 116 mm (4.6 in.) Insulating glove 123 mm (4.8 in.) Height, minimum Bare hand 120 mm (4.7 in.) Cleanroom glove 123 mm (4.8 in.) Chemical glove 126 mm (5.0 in.) Insulating glove 133 mm (5.2 in.)	
Y-2	Using pliers and wire cutting tools.	Major dimension, minimum Bare hand 130 mm (5.1 in.) Cleanroom glove 133 mm (5.2 in.) Chemical glove 136 mm (5.4 in.) Insulating glove 143 mm (5.6 in.) Minor Dimension, minimum Bare hand 115 mm (4.5 in.) Cleanroom glove 118 mm (4.6 in.) Chemical glove 121 mm (4.8 in.) Insulating glove 128 mm (5.0 in.)	

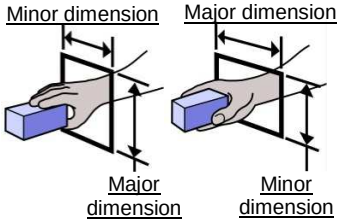
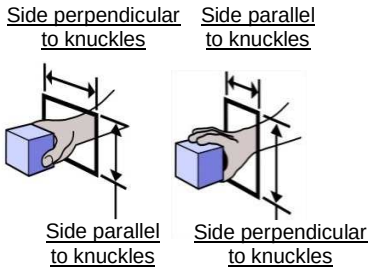
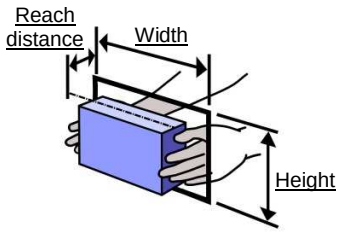
This is a Draft Document of the SEMI International Standards program. No material on this page is to be construed as an official or adopted Standard or Safety Guideline. Permission is granted to reproduce and/or distribute this document, in whole or in part, only within the scope of SEMI International Standards committee (document development) activity. All other reproduction and/or distribution without the prior written consent of SEMI is prohibited.

LETTER BALLOT

Y-3	"T" wrench use with freedom to turn hand 180°.	Width, minimum Bare hand 135 mm (5.3 in.) Cleanroom glove 138 mm (5.4 in.) Chemical glove 141 mm (5.6 in.) Insulating glove 148 mm (5.8 in.) Height, minimum Bare hand 155 mm (6.1 in.) Cleanroom glove 158 mm (6.2 in.) Chemical glove 161 mm (6.3 in.) Insulating glove 168 mm (6.6 in.)	
Y-4	Allen wrench use with freedom to turn wrench 60°.	Width, minimum Bare hand 120 mm (4.7 in.) Cleanroom glove 123 mm (4.8 in.) Chemical glove 126 mm (5.0 in.) Insulating glove 133 mm (5.2 in.) Height , minimum Bare hand 155 mm (6.1 in.) Cleanroom glove 158 mm (6.2 in.) Chemical glove 161 mm (6.3 in.) Insulating glove 168 mm (6.6 in.)	
Y-5	Using open end wrench with freedom to turn wrench through 60°.	Major dimension, minimum Bare hand 270 mm (10.6 in.) Cleanroom glove 273 mm (10.7 in.) Chemical glove 276 mm (10.8 in.) Insulating glove 283 mm (11.1 in.) Minor dimension, minimum Bare hand 200 mm (7.9 in.) Cleanroom glove 203 mm (8.0 in.) Chemical glove 206 mm (8.1 in.) Insulating glove 213 mm (8.4 in.)	
Y-6	Using test probe.	Width and height, minimum Bare hand 90 mm (3.5 in.) Cleanroom glove 93 mm (3.6 in.) Chemical glove 95 mm (3.7 in.) Insulating glove 103 mm (4.1 in.)	

This is a Draft Document of the SEMI International Standards program. No material on this page is to be construed as an official or adopted Standard or Safety Guideline. Permission is granted to reproduce and/or distribute this document, in whole or in part, only within the scope of SEMI International Standards committee (document development) activity. All other reproduction and/or distribution without the prior written consent of SEMI is prohibited.

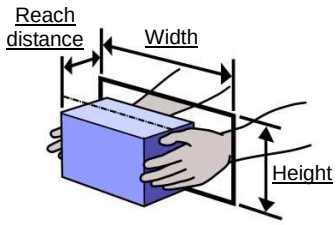
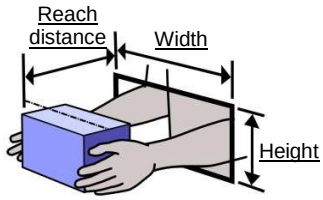
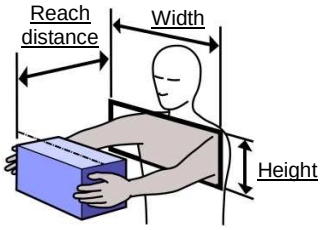
LETTER BALLOT

Y-7	Grasping small objects up to 50 mm wide with one hand.	Major dimension, minimum Bare hand 120 mm (4.7 in.) Cleanroom glove 123 mm (4.8 in.) Chemical glove 126 mm (5.0 in.) Insulating glove 133 mm (5.2 in.) Minor dimension, minimum Bare hand 110 mm (4.3 in.) Cleanroom glove 113 mm (4.4 in.) Chemical glove 116 mm (4.6 in.) Insulating glove 123 mm (4.8 in.)	
Y-8	Grasping objects wider than 50 mm with one hand.	Dimension of opening perpendicular to a line drawn through the large knuckles, minimum Bare hand Object width + 45 mm (1.8 in.) Cleanroom glove Object width + 48 mm (1.9 in.) Chemical glove Object width + 51 mm (2.0 in.) Insulating glove Object width + 58 mm (2.3 in.) Dimension of opening parallel to a line drawn through the large knuckles, minimum Bare hand 125 mm (4.9 in.) Cleanroom glove 128 mm (5.0 in.) Chemical glove 131 mm (5.2 in.) Insulating glove 138 mm (5.4 in.)	
Y-9	Clearance provided for grasping large objects 2 hands extended through opening up to fingers.	Horizontal reach from body side of opening to center of grasping area, maximum 61 mm (2.4 in.) Opening width, minimum Bare hand Object width + 75 mm (3.0 in.) Cleanroom glove Object width + 78 mm (3.1 in.) Chemical glove Object width + 81 mm (3.2 in.) Insulating glove Object width + 88 mm (3.5 in.) Opening height, minimum Bare hand 125 mm (4.9 in.) Cleanroom glove 128 mm (5.0 in.) Chemical glove 131 mm (5.2 in.) Insulating glove 138 mm (5.4 in.)	

This is a Draft Document of the SEMI International Standards program. No material on this page is to be construed as an official or adopted Standard or Safety Guideline. Permission is granted to reproduce and/or distribute this document, in whole or in part, only within the scope of SEMI International Standards committee (document development) activity. All other reproduction and/or distribution without the prior written consent of SEMI is prohibited.

Semiconductor Equipment and Materials International
3081 Zanker Road
San Jose, CA 95134-2127
Phone: 408.943.6900, Fax: 408.943.7943

LETTER BALLOT

Y-10	Clearance provided for grasping large objects with 2 hands extended through opening up to wrists.	Horizontal reach from the body side of opening to center of grasping area: 203 mm (8.0 in.) maximum Width, minimum Bare hand: Obj. width + 150 mm (5.9 in.) Cleanroom glove: Obj. width + 153 mm (6.0 in.) Chemical glove: Obj. width + 156 mm (6.1 in.) Insulating glove Obj. width + 163 mm (6.4 in.) Height, minimum Bare hand 125 mm (4.9 in.) Cleanroom glove 128 mm (5.0 in.) Chemical glove 131 mm (5.2 in.) Insulating glove 138 mm (5.4 in.)	
Y-11	Clearance provided for grasping large objects with two hands with arms extended through opening up to elbows.	Horizontal reach from body side of opening to center of grasping area: 202 mm (8.0 in) Width, minimum Obj. width + 150 mm (5.9 in.) Height, minimum 127 mm (5.0 in.)	
Y-12	Clearance provided for grasping items with two hands with arms extended though opening to shoulders.	Horizontal reach from body side of opening to center of grasping area: 393 mm (15.5 in.) Width, minimum 483 mm (19 in.) Height, minimum 127 mm (5.0 in.)	

This is a Draft Document of the SEMI International Standards program. No material on this page is to be construed as an official or adopted Standard or Safety Guideline. Permission is granted to reproduce and/or distribute this document, in whole or in part, only within the scope of SEMI International Standards committee (document development) activity. All other reproduction and/or distribution without the prior written consent of SEMI is prohibited.

Semiconductor Equipment and Materials International
3081 Zanker Road
San Jose, CA 95134-2127
Phone: 408.943.6900, Fax: 408.943.7943

LETTER BALLOT

Line Item 4 – Add a New Related Information Section for to Assist with Determining What Tasks are within the Scope of an Assessment to SEMI S8

RELATED INFORMATION Z

PLANNING A SEMI S8 EVALUATION

NOTICE: This Related Information is not an official part of SEMI doc. 5917 and was derived from the work of the EHS Global Technical Committee. This Related Information was approved for publication by full letter ballot procedures on [A&R approval date].

RZ-1 Overview and Planning Stage

RZ-1.1 When preparing for an evaluation to SEMI S8, it's helpful to identify and group operational, service, and maintenance tasks associated with a given piece of equipment in order to go through the operational lifecycle of the equipment and to capture what will be needed to complete an evaluation adequately.

RZ-1.2 It is important to understand how people work on equipment within the production environment and what tasks are performed during the operation, maintenance, and service of SME.

RZ-1.2.1 For the purposes of an evaluation to SEMI S8, each task should be considered to be in one of three categories:

- Operation tasks (e.g., loading and unloading the items to be processed, replenishing consumable supplies)
- Maintenance tasks (e.g., monthly or quarterly chamber cleaning)
- Service tasks (e.g., replacement of a failed heating element)

RZ-1.3 When categorizing tasks, it is important to keep in mind that the task categories may not be well-aligned with the job titles of the people performing the tasks. For example, periodic checking and correction of temperature uniformity may be categorized as a "maintenance task", but performed in some users' facilities by "operators." Furthermore, personnel performing maintenance often perform operation tasks, and personnel performing service often perform both maintenance and operation tasks.

NOTE: Tasks associated with, modifications or upgrades, or decommissioning (including decontamination) and removal at the end of service life are not intended to be part of the SEMI S8 evaluation. (See §2.1 of the main body.)

RZ-1.5 The intent of a SEMI S8 evaluation is to assess those tasks required or anticipated for the use of the equipment and evaluating how the equipment has met the design goals in the purpose statement (§1.2 of the main body). It is not necessary to consider every possible service task. For example, it is not necessary to expect that major structural elements, such as frame members, will fail and need to be replaced.

RZ-2 Terminology

RZ-2.1 *component* — assembly, subassembly, or piece part.

RZ-2.2 *maintenance* — activities, such as replenishing consumables, replacing filtration devices, adjusting flow levels, removing debris, performing alignment functions, by which a person causes the equipment to continue working properly. Maintenance does not include activities conforming to the definition of "service."

RZ-2.3 *operation* — activities, such as loading product and setting or manipulating external controls, by which a person causes the equipment to perform its intended function. Operation does not include activities conforming to the definition of "maintenance" or "service."

RZ-2.4 *spareable component* — a component that has been determined as needing to be available to maintain or restore proper operation of the equipment. This includes consumables and components for which, based on experience, failure, or wear-out is expected within five (5) years.

RZ-2.5 *SME* — see 5.2.39 semiconductor manufacturing equipment in §5 of the main body.

RZ-2.6 *service* — activities, such as replacing a power supply, vacuum pump, motion control device, wafer handling robot, by which a person causes the equipment to be returned to proper operation after a failure.

This is a Draft Document of the SEMI International Standards program. No material on this page is to be construed as an official or adopted Standard or Safety Guideline. Permission is granted to reproduce and/or distribute this document, in whole or in part, only within the scope of SEMI International Standards committee (document development) activity. All other reproduction and/or distribution without the prior written consent of SEMI is prohibited.

RZ-2.7 *task* — a series of related actions (for example, load/unload, adjust, align, remove/install, repair, replace) with a definite beginning and end.

RZ-3 Tasks to be considered

RZ-3.1 For each task that has been identified, one needs to also consider what's required to be able to perform the given task (e.g., equipment needed, people needed, sequence of operation needed).

RZ-3.2 Figure RZ-1 is a flowchart to help guide the equipment manufacturer, engineer, or evaluator through the process of determining all the steps involved in a task that could fall within the scope of a SEMI S8 evaluation.

RZ-3.3 For each identified task in the Table RZ-1 below, use the flowchart in Figure RZ-1 to determine whether the task fits within a SEMI-S8 evaluation and what sections of SEMI S8 are needed to perform an ergonomics related evaluation adequately.

RZ-3.4 Some tasks will require the use of Appendix 2 to evaluate their risk adequately. Table A2-1 in Appendix 2 provides guidance on appropriate methods of evaluation. In some cases, external guidance and assessment tools (e.g., analysis involving psychophysical data, biomechanical modeling) may be needed depending on the task being evaluated.

Table RZ-1 Examples of Tasks to be Considered in a SEMI S8 Evaluation

Category	Task
Operation	Loading / unloading product (FOUPs, FOSBs, SMIF pods, open cassettes, saw frame carriers, lead frame magazines, JEDEC trays, device trays, device tubes, etc.)
	Loading /unloading photo reticles and masks
	Loading process chemicals / materials (photoresist, epoxy, wire [for wire bond], manually poured chemicals, mold compound, targets, etc.)
	Consumable change-out (e.g. CMP polish pads, wafer tape)
	Gas cylinder replacement
Maintenance	Chamber opening for cleaning access
	Implanter source removal for cleaning
	Chamber opening for cleaning access
	Diffusion furnace tube removal for cleaning
	Gate valve removal/replacement for cleaning
	Robot maintenance and calibration
	Removal/Replacement of HEPA filters
	Clean and lubricate mechanical elements
Service	Removal/replacement of power supplies and generators
	Removal/Replacement of Diffusion furnace heater elements
	Removal/replacement of process level vacuum pumps
	Removal/Replacement of failed vacuum pump
	Removal Replacement of robot
	Removal Replacement of failed chamber lid lift or components thereof
	Removal/Replacement of fans within a fan/filter unit
	Clearing jams (wafers or devices)

This is a Draft Document of the SEMI International Standards program. No material on this page is to be construed as an official or adopted Standard or Safety Guideline. Permission is granted to reproduce and/or distribute this document, in whole or in part, only within the scope of SEMI International Standards committee (document development) activity. All other reproduction and/or distribution without the prior written consent of SEMI is prohibited.

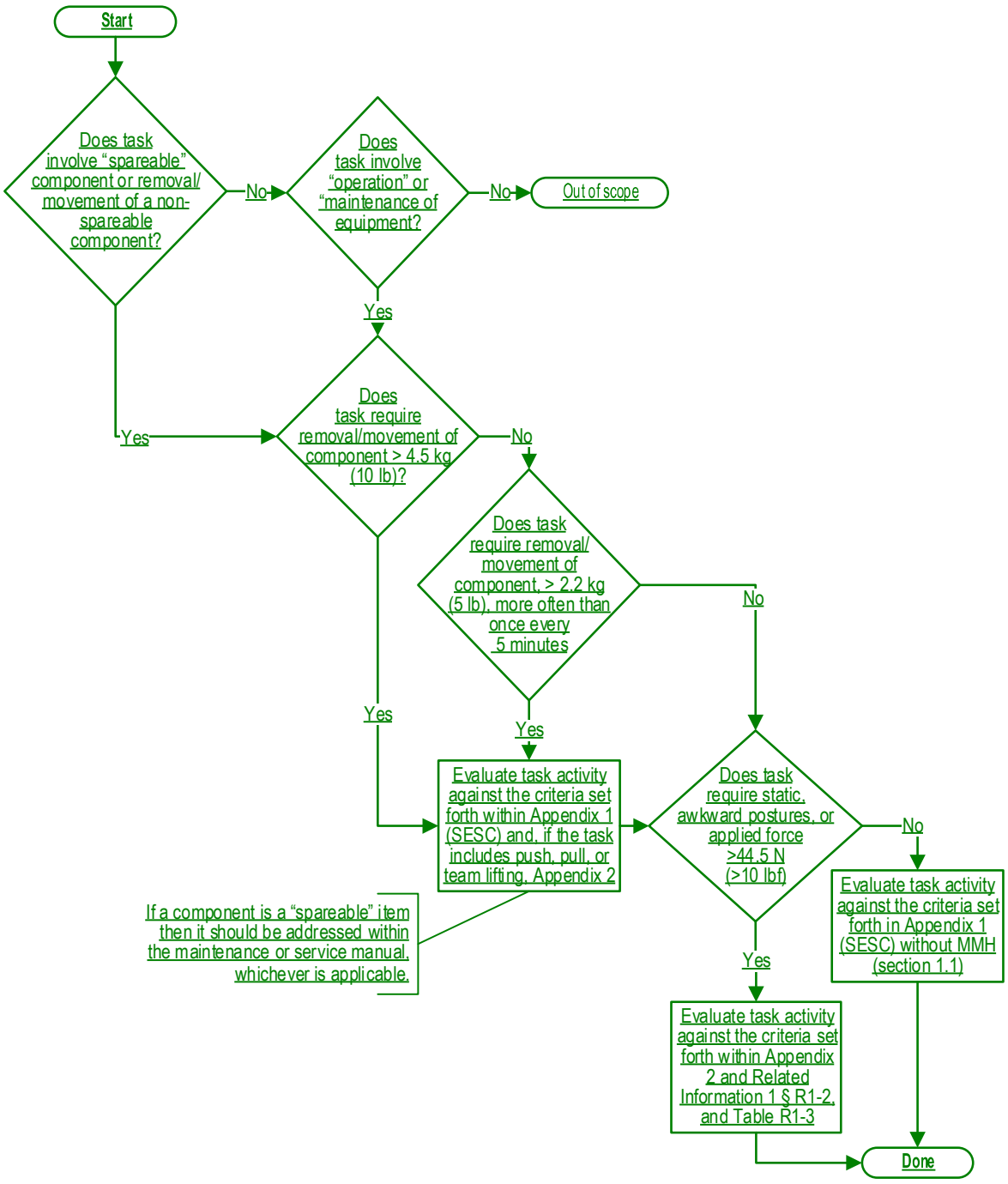


Figure RZ-1 SEMI S8 Evaluation Scope Flowchart

This is a Draft Document of the SEMI International Standards program. No material on this page is to be construed as an official or adopted Standard or Safety Guideline. Permission is granted to reproduce and/or distribute this document, in whole or in part, only within the scope of SEMI International Standards committee (document development) activity. All other reproduction and/or distribution without the prior written consent of SEMI is prohibited.

Semiconductor Equipment and Materials International
3081 Zanker Road
San Jose, CA 95134-2127
Phone: 408.943.6900, Fax: 408.943.7943

LETTER BALLOT

NOTICE: SEMI makes no warranties or representations as to the suitability of the Standards and Safety Guidelines set forth herein for any particular application. The determination of the suitability of the Standard or Safety Guideline is solely the responsibility of the user. Users are cautioned to refer to manufacturer's instructions, product labels, product data sheets, and other relevant literature, respecting any materials or equipment mentioned herein. Standards and Safety Guidelines are subject to change without notice.

By publication of this Standard or Safety Guideline, SEMI takes no position respecting the validity of any patent rights or copyrights asserted in connection with any items mentioned in this Standard or Safety Guideline. Users of this Standard or Safety Guideline are expressly advised that determination of any such patent rights or copyrights and the risk of infringement of such rights are entirely their own responsibility.

This is a Draft Document of the SEMI International Standards program. No material on this page is to be construed as an official or adopted Standard or Safety Guideline. Permission is granted to reproduce and/or distribute this document, in whole or in part, only within the scope of SEMI International Standards committee (document development) activity. All other reproduction and/or distribution without the prior written consent of SEMI is prohibited.