



ISMI Manual Material Handling Risk Characterization Guideline

**International SEMATECH Manufacturing Initiative
Technology Transfer #08064933A-ENG**

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June 10, 2008

Abstract: Risk levels in SEMI S10, *Safety Guideline for Risk Assessment*, are determined based on the likelihood and severity of injury resulting from non-conforming design. SEMI S10 provides a high level description of various risk assessment techniques but does not provide adequate information to relate SEMI S8, *Safety Guidelines for Ergonomics Engineering of Semiconductor Manufacturing Equipment*, ergonomics risk assessment results to the likelihood or severity categories.

Keywords: Ergonomics, Risk Assessment

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1.0 SCOPE

- 1.1 This guideline is intended to be used to characterize risk and end user expectations for the control of manual material handling activities assessed as part of a SEMI S8 assessment.

2.0 ABSTRACT

- 2.1 In determining conformance with SEMI S8, it has become common practice for assessors to determine that equipment conforms if none of the non-conforming design features are determined to present very high, high, or medium risk
- 2.2 Risk levels in SEMI S10 are determined based on the likelihood and severity of injury resulting from non-conforming design. SEMI S10 provides a high level description of various risk assessment techniques but does not provide adequate information to relate ergonomics risk assessment results to the likelihood or severity categories. This lack of direction has led to significant variability in risk characterization and, therefore, the determination of equipment conformance.
- 2.3 One of the purposes of SEMI S8 is to clarify expectations between equipment suppliers and end users. Without standardized, consistent risk characterization methods this value is lost. Providing an objective model to equipment assessors will provide consistency and clarify expectations.

3.0 KEYWORDS

- 3.1 Risk assessment, ergonomics

4.0 PURPOSE

- 4.1 The purpose of this document is to provide a model to distinguish non-conforming manual material handling (MMH) tasks that present an acceptable level of risk to end users from non-conforming MMH tasks that present an unacceptable level of risk to end users.

5.0 LIMITATIONS

- 5.1 This document addresses only the gap between determination of assessment tool results and conclusions about the acceptability of the task. For more information on assessment tool selection and usage, see the latest version of SEMI S8.

6.0 TERMINOLOGY

- 6.1 Administrative controls – A method to modify the way in which a job is performed without involving equipment design. They are non-engineering controls that include job rotation, job enlargement, work-rest scheduling, micro-breaks, and stretching exercises. Engineering controls are preferred over administrative controls.
- 6.2 Biomechanical modeling – A computer model used to calculate static strength requirements and spinal compression forces resulting from manual material handling.
- 6.3 Components – An individual passive or active part used in a higher level mechanical or electrical assembly.
- 6.4 Controls – Methods of eliminating or lessening the risk associated with work tasks. Controls can be either administrative or engineering.
- 6.5 Disc compression – Compression force on the vertebrae of the low back resulting from manual material handling.
- 6.6 Engineering control – A method to eliminate or mitigate a hazard through equipment design.
- 6.7 Lifting index – The ratio of actual weight (or force required) to recommended maximum weight (or force) resulting from an assessment using either the NIOSH model or psychophysical data.
- 6.8 Maintenance – Planned or unplanned activities intended to keep equipment in good working order.
- 6.9 Manual material handling – Any lifting, pushing, pulling, or carrying activity.
- 6.10 Psychophysical data – Data collected by having subjects select their maximum acceptable weight of handling under experimental conditions. Psychophysical evaluations compare these data to actual values intrinsic to a task.
- 6.11 Service – Unplanned activities intended to return equipment that has failed to good working order.

7.0 REFERENCED STANDARDS

- 7.1 SEMI S2 – *Environmental, Health and Safety Guideline for Semiconductor Manufacturing Equipment*
- 7.2 SEMI S8 – *Safety Guidelines for Ergonomics Engineering of Semiconductor Manufacturing Equipment*
- 7.3 SEMI S10 – *Safety Guideline for Risk Assessment*

8.0 GENERAL GUIDELINES

- 8.1 Table 1 identifies whether or not engineering controls or administrative controls are required based on the anticipated task frequency and assessment tool result.
- 8.2 Assessment results include lifting index (as a result of either 1991 NIOSH or psychophysical assessment), disc compression (from biomechanical modeling), and female strength capability (from biomechanical modeling).
- 8.3 Maintenance task frequencies are annual or more frequent, quarterly or more frequent, monthly or more frequent, and weekly or more frequent. Service tasks are categorized as either service of parts expected to fail or service of parts not expected to fail. Task frequencies are on a per-tool basis.
- 8.4 If an administrative control, or specific method, is required to change an unacceptable activity (controls required zone) into an acceptable activity (controls not required zone), that specific control or method must be documented in the assessment report and the supplier manuals.

Table 1 Risk Characterization Model

Biomechanical Strength Capability (see note 1)	> 59–75%	> 47–59%	> 20–47%	≤ 20%
Biomechanical Disc Compression (see note 2)	> 770–871 lbs	> 871–938 lbs	> 938–1105 lbs	> 1105 lbs
	> 3.43–3.87 kN	> 3.87–4.17 kN	> 4.17–4.92 kN	> 4.92 kN
Lifting Index (see note 3)	> 1.0–1.3	> 1.3–1.5	> 1.5–2.0	> 2.0
Task Frequency				
Weekly or more frequent	Control is required	Control is required	Control is required	Control is required
Monthly or more frequent	Control is not required	Control is required	Control is required	Control is required
Quarterly or more frequent	Control is not required	Control is required	Control is required	Control is required
Annually or more frequent	Control is not required	Control is not required	Control is required	Control is required
Service of part expected to fail (see Section 8.5)	Control is not required	Control is not required	Control is not required	Control is required
Service of part not expected to fail	Control is not required	Control is not required	Control is not required	Control is not required

Note 1: Percent of females capable of performing the task when 5th percentile anthropometry is modeled.

Note 2: Low back disc compression force when 95th percentile male and 5th percentile female anthropometry are modeled.

Note 3: Ratio of actual weight (or force required) to recommended maximum weight (or force) using either the NIOSH model or psychophysical data.

- 8.5 Serviceable items that should be considered “expected to fail” include, but are not limited to, pumps, robots, valves, electric motors, fan filter units, power supplies, lamps, hydraulic or pneumatic cylinders, transformers, and controllers.
- 8.6 Assessors should consider the complete task including all components that must be removed to get to the failed component to determine activity acceptability.

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