SEMI® S2-0310
Environmental, Health, and Safety Guideline for Semiconductor Manufacturing Equipment

Final Evaluation Report

Seren IPS

Models HR601 and HR1001 RF

RF Power Supplies

TUV Rheinland Evaluation Report File No. 31072336.002

Issue Date: 9 December 2010

TUV Rheinland of North America, Inc.
North American Headquarters
12 Commerce Road
Newtown, Connecticut 06470
Web: http://www.tuv.com
TUV Rheinland of North America, Inc.
San Diego Office
1819 Aston Avenue, Suite 103
Carlsbad, CA 92008
TEL (760) 929-1780  FAX (760) 929-1781
Web: http://www.tuv.com  E-mail: info-sdi@tuv.com

Applicant: Seren IPS Inc
Applicant Address: 1670 Gallagher Drive, Vineland, NJ 08360
Factory: 1670 Gallagher Drive, Vineland, NJ 08360
Type of Equipment: RF Power Supplies
Type or Model no.: HR601 and HR1001
Trademark:
Serial no.: HR601-0004 and HR1001-0001
Place of Evaluation: 12 Commerce Road, Newtown, CT
Date of Evaluation: October 5, 2010
Requirement: SEMI® S2-0310 Guideline

Evaluated by:
_________________________        Dec 9, 2010
signature        Date
Rich Trainor/ TÜV Rheinland of North America

Reviewed by:
_________________________       Dec 9, 2010
Signature        Date
Andras Szende/ TÜV Rheinland of North America
Table of Contents:

Attached Documents ................................................................................................................................. 4
Management Summary .............................................................................................................................. 5
Referenced Standards and Requirements .............................................................................................. 7
Risk Assessment Matrix .......................................................................................................................... 8
Equipment / System Description ............................................................................................................ 9
Facilities Connections ............................................................................................................................. 12
Detailed Summary of Assessment Findings .......................................................................................... 15
9 Documents Provided to User ............................................................................................................... 16
10 Hazard Warning Labels .................................................................................................................... 19
11 Safety Interlock Systems .................................................................................................................. 20
12 Emergency Shutdown ......................................................................................................................... 24
13 Electrical Design ............................................................................................................................... 27
14 Fire Protection .................................................................................................................................... 33
15 Heated Chemical Baths .................................................................................................................... 42
16 Ergonomics and Human Factors ..................................................................................................... 43
17 Hazardous Energy Isolation ............................................................................................................. 44
18 Mechanical Design ............................................................................................................................ 47
19 Seismic Protection ............................................................................................................................. 58
20 Automated Material Handlers .......................................................................................................... 60
21 Environmental Considerations ......................................................................................................... 62
22 Exhaust Ventilation ............................................................................................................................ 67
23 Chemicals .......................................................................................................................................... 70
24 Ionizing Radiation .............................................................................................................................. 74
25 Non-Ionizing Radiation and Fields .................................................................................................. 77
26 Lasers ................................................................................................................................................ 81
27 Sound Pressure Level ......................................................................................................................... 84
Appendix A - U.S. Installation Code Considerations ........................................................................... 86
Attached Documents:

Attachment 1: Electrical Design Test Report (13.4) IEC61010-1, File 31082335.001 Filed Separately
Attachment 2: Constructional Data Form (CDF) (13.4.3) IEC61010-1, File 31082335.001 Filed Separately
Attachment 3: Detailed Analysis and Test Worksheets (13.6, 18.6, 27.1 & SEMI S22) Refer to IEC 61010-1 report, File 31082335.001
Attachment 4: Safety Summary (Hazard and Risk Assessments) (13.7, 14.2, 18.3.1, 18.4.2, 20.4, 22.4.1, etc.)
Attachment 5: SEMI® S8 SESC Check-list and Supporting Documentation (16.2)
Attachment 6: Photographs, Technical Information and Miscellaneous Data (Refer to EC 61010-1 report, File 31082335.001) 6-1: System block diagram 6-2: Photographic documentation
Attachment 7: Applicant Seismic Data (19) Not applicable and not used
Attachment 8: SEMI® S14 Fire Protection Test Report (14.3) Not applicable and not used
Attachment 9: SEMI® S3 Safety Guideline For Process Liquid Heating Systems (15) Not applicable and not used
Attachment 10: Product/system documentation (9) Filed Separately 9-1: Key pages (general safety information and markings) 9-2: Task Listing (representing the User / Installation Manual set)
Management Summary:

Compliance Statement:

This equipment conforms with the applicable requirements of SEMI® S2-0310.

Scope of Evaluation:

The RF power supplies, Models HR601 and HR1001, serial numbers, HR601-0004 and HR1001-0001 were evaluated on October 5, 2010 at TUV Rheinland of NA, 12 Commerce Road, Newtown, CT 06470. The evaluation was performed with the assumption that the equipment is to be installed in the both the United States and Europe.

Summary of Assessment Results:

<table>
<thead>
<tr>
<th>Section</th>
<th>Title</th>
<th>Conforms to Stated Goal</th>
<th>Conforms to Performance Goal</th>
<th>Does Not Conform</th>
<th>Not Applicable</th>
<th>Information Needed</th>
</tr>
</thead>
<tbody>
<tr>
<td>9</td>
<td>Documents provided to user</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>Hazard warning labels</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>11</td>
<td>Safety interlock systems</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>12</td>
<td>Emergency shutdown</td>
<td></td>
<td></td>
<td>✓</td>
<td></td>
<td></td>
</tr>
<tr>
<td>13</td>
<td>Electrical design</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>14</td>
<td>Fire protection</td>
<td></td>
<td></td>
<td>✓</td>
<td></td>
<td></td>
</tr>
<tr>
<td>15</td>
<td>Heated chemical baths</td>
<td></td>
<td></td>
<td></td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>16</td>
<td>Ergonomics and human factors</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>17</td>
<td>Hazardous energy isolation</td>
<td>✓</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>18</td>
<td>Mechanical design</td>
<td></td>
<td></td>
<td></td>
<td>✓</td>
<td></td>
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<tr>
<td>19</td>
<td>Seismic protection</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>20</td>
<td>Automated material handlers</td>
<td></td>
<td></td>
<td></td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>21</td>
<td>Environmental considerations</td>
<td></td>
<td></td>
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<tr>
<td>22</td>
<td>Exhaust ventilation</td>
<td></td>
<td></td>
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<td>✓</td>
<td></td>
</tr>
<tr>
<td>23</td>
<td>Chemicals</td>
<td></td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>24</td>
<td>Ionizing radiation</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>25</td>
<td>Non-ionizing radiation and fields</td>
<td></td>
<td></td>
<td></td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>26</td>
<td>Lasers</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>27</td>
<td>Sound pressure level</td>
<td></td>
<td></td>
<td></td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>App. 6</td>
<td>Laser data sheet</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>App. A</td>
<td>U.S. installation code considerations</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Evaluator Qualifications:

TUV Rheinland provides manufacturers with reliable and comprehensive assessment and certification services to ensure that their products are safe for the industries, environments and people who depend on them. TUV Rheinland is a EU Notified Body, a Nationally Recognized Testing Laboratory (NRTL) in the United States, as well as an ISO 9000/ISO 14001 registrar. TUV Rheinland, based in Cologne, Germany, is a global player in product safety testing and certification. The company was founded in 1872 and employs at 490 locations over 13,300 people in 61 countries. TUV Rheinland is an active participant in the development of SEMI® guidelines, including SEMI® S2. Personnel involved in performing the SEMI S2 evaluations for TUV Rheinland meet the qualifications identified in SEMI S7.

Table of Verdict Abbreviations:

The equipment has been evaluated for conformance with each section of the SEMI® S2 Guideline. The evaluation results are indicated by one of the following verdict abbreviations in each subsection of the SEMI S2 Guideline text in this report. The full verdict text and the supporting rationale for the evaluation result are provided in the comment section of each subsection.

C (Conforms): The equipment conforms to the stated criteria of the section or to the performance goal as defined in SEMI® S2 section 8.3.4.3. Where it is determined that the equipment conforms to the 'performance goal' this will be stated inclusive of supporting rationale in accordance with Section 8.3.4.4.

X (Does Not Conform): The equipment conforms to neither the section nor to the intent of the section. Non-conformances are assigned a risk ranking based on categories identified in Table A1-3 of SEMI® S10-0307.

N (N/A): This section is not applicable to this equipment.

I (Information Needed): More information is needed to determine whether the equipment conforms to the section or to the intent of the section. (This verdict may only be used in Interim Reports)

Evaluation Report Notice:

This evaluation report is valid only for the model and serial number tested, and may be considered representative of those units, which are identical in construction to the system evaluated or differ in ways described in the “Scope” section of this report. This evaluation report is not a substitute for a certification and does not authorize the affixing of a TUV-Mark to the machine without a certificate from TUV Rheinland.

Any safety changes, revisions, or corrections should be submitted to the original testing body - “TUV Rheinland.”

According to the European safety laws, the machine manufacturer is ultimately responsible for the machine’s compliance, tests, documentation and declaration of conformity and for on-going conformity of any subsequent machines. To ensure effective protection of the user (operator), no contracts or agreements that reduce or limit the manufacturer’s liability are allowed between the equipment manufacturer and the buyer.

This evaluation report may not be duplicated in extracts without the permission of TUV Rheinland.
Referenced Standards and Requirements:

The following standards and requirements were used or referenced in the evaluation of the product(s):

- **SEMI® S2-0310** (this document)
- **SEMI® S8-0308** Safety Guidelines for Ergonomics Engineering of Semiconductor Manufacturing Equipment
- **SEMI® S8 (SESC)** Supplier Ergonomics Success Criteria
- **1997 UFC** Uniform Fire Code
- **SEMI® S1** Safety Guidelines for Visual Hazard Alerts
- **SEMI® S13** Safety Guidelines for Operation and Maintenance Manuals used with Semiconductor Manufacturing Equipment
- **SEMI® S14** Safety Guidelines for Fire Risk Assessment and Mitigation for Semiconductor Manufacturing Equipment
- **SEMI® S22** Safety Guideline for the Electrical Design of Semiconductor Manufacturing Equipment
- **IEC/EN/UL 61010-1** Safety requirements for electrical equipment for measurement, control and laboratory use
Risk Assessment Matrix:

The seriousness of each discrepancy is ranked accordance with the following matrix, which is derived from SEMI® S10-0307.

<table>
<thead>
<tr>
<th>RISK ASSESSMENT MATRIX</th>
<th>LIKELIHOOD</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>FREQUENT A</td>
</tr>
<tr>
<td>SEVERITY</td>
<td></td>
</tr>
<tr>
<td>CATASTROPHIC 1</td>
<td>VH</td>
</tr>
<tr>
<td>SEVERE 2</td>
<td>VH</td>
</tr>
<tr>
<td>MODERATE 3</td>
<td>H</td>
</tr>
<tr>
<td>MINOR 4</td>
<td>M</td>
</tr>
</tbody>
</table>

Discrepancies have been assessed using the following “Severity Grouping”:

1 – **Catastrophic** - Failure is capable of producing: One or more fatalities; System or facility loss; or Chemical release with acute, lasting environmental or public health impact.

2 – **Severe** - Failure is capable of producing: Disabling injury/illness; Major subsystem loss or facility damage; or Chemical release with temporary environmental or public health impact.

3 – **Moderate** - Failure is capable of producing: Injury requiring medical treatment or restricted work activity (OSHA recordable); Minor subsystem loss or facility damage; or Chemical release triggering external reporting requirements.

4 – **Minor** - Failure is capable of producing: Injury requiring first aid only; Non-serious equipment or facility damage; or Chemical release requiring routine cleanup without reporting.

Discrepancies have been assessed using the following “Likelihood Grouping”:

NOTE: Likelihood relates to the occurrence of a mishap, not to the exposure to a hazard.

A – **Frequent** - More than 1%.

B – **Likely** - More than 0.2%, but no more than 1%.

C – **Possible** - More than 0.04%, but no more than 0.2%.

D – **Rare** - More than 0.02%, but no more than 0.04%.

E – **Unlikely** - More than 0.002%, but no more than 0.02%.

E – **Not reasonable foreseeable** – Not more than 0.002%

Discrepancies are ranked according to the following “Risk Assessment Categories” which are determined from the above matrix.

VH – Very High; H – High; M – Medium; L – Low; VL – Very Low
Equipment / System Description:

Equipment / system overview:
RF Power Supplies are intended for use with radio frequency plasma processing systems and radio frequency processing applications. The HR-Series RF Power Supplies provide a level-controlled radio frequency power output. Available frequencies are 1.7-2.1MHz, 13.56MHz, 27.12MHz, and 40.68MHz at power levels up to 1000 Watts. The HR-Series RF Power Supplies feature a simplified front panel suitable for embedded use.

Equipment / system use or application:
for use with radio frequency plasma processing systems and radio frequency processing applications.

Principal safety aspects of the equipment / system design:
- Water cooled
- Power cord and plug
- Circuit breaker

Model variants and options:
HR601 and HR1001

Features that were not evaluated:
Optional touch panel

Additional information / remarks:
This product is a component of an overall product and is intended to be mounted in cabinet or rack that provides protection against access to connections. Front panel is intended to be user accessible.

Facilities Connections:
1. HR601 Electrical supply:
2. HR601 Water supply: 60 psi
3. HR1001 Electrical supply:
4. HR1001 Water supply: 60 psi
Detailed Summary of Assessment Findings:

Items that do not conform to the SEMI® Guideline(s):
(Items specified with risk rank, i.e. “RISK = (severity grouping number)(likelihood grouping letter) – (risk assessment category name)” in accordance with SEMI S10)

None.

Recommendations:
None.

Additional Information / Remarks:
None.

Product / System Photographs:
Point-by-Point Assessment Comments

8.3 Evaluation Report Contents: General

The evaluation report should include only the manuals (subsection 9.6) and the design-specific sections (Sections 10 through 27). The Appendices should be used in the evaluation, and referenced in the report, only as they pertain to the specific application.

9. Documents Provided to User

9.6 Manuals

9.6.1 a) The supplier should provide the user with manuals based on the originally intended use of the equipment. b) The manuals should describe the scope and normal use of the equipment, and provide information to enable safe facilitation, operation, maintenance, and service of the equipment.

a) C HR601 and HR1001 conform to the stated criteria because the manuals furnished with the equipment provide the necessary information.

Manual(s) supplied to user are [reviewed document reference]:

- HR SERIES RADIO FREQUENCY POWER SUPPLY OPERATOR’S MANUAL Revision: 0.04 Standard Configuration Document Number 6100240000

The equipment is not user serviceable; service literature is not provided to the user (customer) and therefore is not within the scope of this evaluation. Service is provided by Seren IPS

b) C HR601 and HR1001 conform to the stated criteria because manuals have been provided which contain facilitation, operation and maintenance information as necessary for safety. The equipment is not user serviceable.

9.6.2 The manuals should conform to SEMI S13.

NOTE 23: Fire suppression agents, and chemicals used to test fire detection or suppression systems, fall under the MSDS provisions of SEMI S13 when they are provided with the equipment.

NOTE 24: Hazardous energies within fire detection or suppression systems fall under the hazardous energy control provisions of SEMI S13 when fire detection or suppression systems are provided with the equipment.

HR601 and HR1001 conform to the stated criteria because the relevant manuals conform to SEMI S13 in intent, and as far as is applicable in relation to the safety of the design.

Note: The system does not feature fire detection or suppression systems.
9.6.3

In addition to the provisions of SEMI S13, the manuals should include:

a) Specific written instructions on routine Type 4 tasks, excluding troubleshooting (refer to Section 13.3);
b) Instructions for energy isolation ("lockout/tagout") (refer to Section 17.2);
c) Descriptions of the emergency off (EMO) and interlock functions;
d) A list of hazardous materials (e.g., lubricants, cleaners, coolants) required for maintenance, ancillary equipment or peripheral operations, including anticipated change-out frequency, quantity, and potential for contamination from the process;
e) A list of items that become solid waste as a result of the operation, maintenance, and servicing of the equipment, and that are constructed of or contain substances whose disposal might be regulated (e.g., beryllium-containing parts, vapor lamps, mercury switches, batteries, contaminated parts, maintenance wastes); and
f) Maintenance and troubleshooting procedures needed to maintain the effectiveness of safety design features or devices (i.e., engineering controls); and

9.6.4

Information should be provided regarding potential routes of unintended releases (see Section 21.2.4).

Section is not applicable to the HR601 and HR1001 because the equipment does not have unintentional releases.

9.6.5

Recommended decontamination and decommissioning procedures should be provided in accordance with SEMI S12, and should include the following information:

a) Identity of components and materials of construction, in sufficient detail to support recycling, refurbishment, and reuse decisions (see Section 8.5.3); and
b) Residual hazardous materials, or parts likely to become contaminated with hazardous materials, that may be in the equipment prior to decommissioning.

NOTE 25: It is recommended that the manual state that changes to the typical process chemistry or to the equipment could alter the anticipated environmental impact.

Section is not applicable to the HR601 and HR1001 because it and any of its internal parts are not exposed to hazardous materials in normal use. SEMI S12 is not relevant to the design.
9.6.6 Maintenance Procedures with Potential Environmental Impacts — The supplier’s recommended maintenance procedures should:

<p>| | | |</p>
<table>
<thead>
<tr>
<th></th>
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</tr>
</thead>
<tbody>
<tr>
<td>b</td>
<td>N Section is not applicable to the HR601 and HR1001 because it and any of its internal parts are not exposed to hazardous materials in normal use. SEMI S12 is not relevant to the design.</td>
<td></td>
</tr>
</tbody>
</table>

9.7 Fire Protection Documentation — The equipment supplier should provide:

<p>| | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>a</td>
<td>C HR601 and HR1001 conform to the stated criteria because information is provided in the form of the fire risk analysis/assessment that is an integral part of this report. Refer to Section 14.3 for additional details.</td>
<td></td>
</tr>
<tr>
<td>b</td>
<td>N Section is not applicable to the HR601 and HR1001 because it does not possess optional fire risk mitigation features. The design is conventional in that it does not exhibit extraordinary potential ignition sources nor employs excessively flammable media, thus does not exhibit fire risks to the extent to require controls or protective measures.</td>
<td></td>
</tr>
<tr>
<td>c</td>
<td>N Section is not applicable to the HR601 and HR1001 because it does not incorporate a fire detection system.</td>
<td></td>
</tr>
<tr>
<td>d</td>
<td>N Section is not applicable to the HR601 and HR1001 because it does not incorporate a fire suppression system.</td>
<td></td>
</tr>
<tr>
<td>e</td>
<td>N Section is not applicable to the HR601 and HR1001 because it does not incorporate any fire detection or suppression systems.</td>
<td></td>
</tr>
<tr>
<td>f</td>
<td>N Section is not applicable to the HR601 and HR1001 because it does not incorporate any fire detection or suppression systems.</td>
<td></td>
</tr>
</tbody>
</table>
### 10. Hazard Warning Labels

<table>
<thead>
<tr>
<th>10.1</th>
<th>Where it is impractical to eliminate hazards through design selection or to adequately reduce the associated risk with safety or warning devices, hazard-warning labels should be provided to identify and warn against hazards.</th>
</tr>
</thead>
<tbody>
<tr>
<td>C</td>
<td>HR601 and HR1001 conform to the stated criteria because hazard-warning labels are provided, where appropriate, on the equipment in accordance with the applicable sections of SEMI S2. Refer to Attachment 9 (product documentation/manuals) for details of the specific hazard warning and safety-critical markings used including their locations on the equipment.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>10.2</th>
<th>Labels should be durable and suitable for the environment of the intended use.</th>
</tr>
</thead>
<tbody>
<tr>
<td>C</td>
<td>HR601 and HR1001 conform to the stated criteria because the hazard warning labels used with the equipment are durable and suitable for environment they are exposed to.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>10.3</th>
<th>Labels should conform to SEMI S1. EXCEPTION: Some hazard label formats and content are dictated by law to SEMI S1. (e.g., laser labeling and chemical hazard communication labeling in certain countries of use) and may not conform to SEMI S1.</th>
</tr>
</thead>
<tbody>
<tr>
<td>C</td>
<td>HR601 and HR1001 conform to performance goal of the section because the relevant labels used on the equipment fundamentally conform to SEMI S1.</td>
</tr>
</tbody>
</table>
11. Safety Interlock Systems

### 11.1 Informative

This section covers safety interlocks and safety interlock systems.

**NOTE 27:** If a fire detection or suppression system is provided with the equipment, see Section 14 for additional information.

### 11.2 C

Where appropriate, equipment should use safety interlock systems that protect personnel, facilities, and the community from hazards inherent in the operation of the equipment.

**NOTE 28:** Safety critical parts whose primary function is to protect the equipment (e.g., circuit breakers, fuses) are typically not considered to be safety interlocks.

HR601 and HR1001 conform to performance goal because the interlock paddle switch is located on the rear panel where the RF output cable connector threads in. This switch is not intended to be accessible to the end user and is intended to provide protection to service personnel who may interact with the product with the cable removed. The switch is not intended to be a safety switch but is used as a precaution to remove the RF power if the cable is removed only.

### 11.3 C

Safety interlock systems should be designed such that, upon activation of the interlock, the equipment, or relevant parts of the equipment, is automatically brought to a safe condition.

**NOTE 29:** Timing is relevant to risk; a safe condition includes bringing the equipment to a safe state before the hazard can be accessed by personnel.

HR601 and HR1001 conform to performance goal because the interlock switch brings product into a safe condition

### 11.4 N

Upon activation, the safety interlock should alert the operator immediately.

**EXCEPTION:** Alerting the operator is not expected if a safety interlock triggers the EMO circuit (see Section 12) or otherwise removes power to the user interface.

**NOTE 30:** An explanation of the cause is preferred upon activation of a safety interlock.

Section is not applicable to the HR601 and HR1001 because it does not alert the operator. The interlock switch is for installation purposes only. Equipment that the power supply is connected to may have alerts

### 11.5 C

Safety interlock systems should be fault-tolerant and designed so that the functions or set points of the system components cannot be altered without disassembling, physically modifying, or damaging the device or component.

**EXCEPTION:** When safety interlock systems having adjustable set points or trip functions are used, access should be limited to maintenance or service personnel by requiring a deliberate action, such as using a tool or special keypad sequences, to access the adjustable devices or to adjust the devices.

**NOTE 31:** This section does not address the defeatability of safety interlocks. See Section 11.7 for additional information.

HR601 and HR1001 conform to performance goal because the interlock switch used is approved and reliable.
**11.6**

| N | a) Electromechanical devices and components are preferred. Solid-state devices and solid-state components may be used, provided that the safety interlock system, or relevant parts of the system, are evaluated for suitability for use in accordance with the appropriate standards.
|   | b) The evaluation for suitability should take into consideration abnormal conditions such as overvoltage, undervoltage, power supply interruption, transient overvoltage, ramp voltage, electromagnetic susceptibility, electrostatic discharge, thermal cycling, humidity, dust, vibration, and jarring.
|   | EXCEPTION: Where the severity of a reasonably foreseeable mishap is deemed to be Minor per SEMI S10, a software-based interlock may be considered suitable.
|   | NOTE 32: Where a safety interlock is provided to safeguard personnel from severe or catastrophic harm as categorized by SEMI S10, consideration of positive-opening type switches is recommended.
|   | NOTE 33: Evaluation for suitability for use may also include reliability, self-monitoring, and redundancy as addressed under standards such as NEMA ICS 1.1 and UL 991.
|   | NOTE 34: Solid-state devices include operational amplifiers, transistors, and integrated circuits.
|   | a) C HR601 and HR1001 conform to performance goal because the interlock switch uses an electromechanical switch
|   | b) C HR601 and HR1001 conform to performance goal because the interlock switch have been reviewed for abnormal conditions

**11.6.1**

| N | FECS [failsafe equipment control system] may be used in conjunction with electromechanical or solid state devices and components provided the programmable safety control system conforms to an appropriate standard for electronic safety systems. Components of the FECS should be tested and certified according to the requirements of the standard used. Examples of internationally recognized electronic safety systems standards include IEC 61508, ISO 13849-1 (EN 954-1), ANSI/ISA SP84.01, DIN/V/DVE-0801.
|   | Related Information 14 provides additional information on appropriate application of FECS design.
|   | NOTE 35: Paragraph 13.4.3 states additional assessment criteria for safety-related components and assemblies.
|   | NOTE 36: A FECS is a sub-system of a PES (Programmable Electronic System). IEC 61508 is the preferred standard for complex PES.
|   | NOTE 37: Related information 13 provides additional information on applications of FECS design.
|   | Section is not applicable to the HR601 and HR1001 because interlock switch system does not use FECS.

**11.7**

| N | The safety interlock system should be designed to minimize the need to override safety interlocks during maintenance activities.
|   | Section is not applicable to the HR601 and HR1001 because no such maintenance is required

**11.7.1**

| C | Safety interlocks that safeguard personnel during operator tasks should not be defeatable without the use of a tool.
|   | HR601 and HR1001 conform to performance goal because the interlock switch cannot be defeated because manual intervention is also required in addition to pressing the interlock switch to prevent accidental hazards.
<table>
<thead>
<tr>
<th>11.7.2</th>
<th>N</th>
<th>When maintenance access is necessary to areas protected by interlocks, defeatable safety interlocks may be used, provided that they require an intentional operation to bypass.</th>
</tr>
</thead>
</table>

Section is not applicable to the HR601 and HR1001 because no such maintenance is required

<table>
<thead>
<tr>
<th>11.7.2.1</th>
<th>N</th>
<th>Upon exiting or completing the maintenance mode, all safety interlocks should be automatically restored.</th>
</tr>
</thead>
</table>

Section is not applicable to the HR601 and HR1001 because no such maintenance is required

<table>
<thead>
<tr>
<th>11.7.2.2</th>
<th>N</th>
<th>If a safety interlock is defeated, the maintenance manual should identify administrative controls to safeguard personnel or to minimize the hazard.</th>
</tr>
</thead>
</table>

Section is not applicable to the HR601 and HR1001 because no such maintenance is required

<table>
<thead>
<tr>
<th>11.8</th>
<th>C</th>
<th>The restoration of a safety interlock should not initiate equipment operation or parts movement where this can give rise to a hazardous condition.</th>
</tr>
</thead>
</table>

HR601 and HR1001 conform to performance goal because restoring the interlock switch requires additional manual intervention to avoid a hazardous condition

<table>
<thead>
<tr>
<th>11.9</th>
<th>C</th>
<th>Switches and other control device contacts should be connected to the ungrounded side of the circuit so that a short circuit to ground does not result in the interlocks being satisfied.</th>
</tr>
</thead>
</table>

HR601 and HR1001 conform to performance goal because the interlock switch is connected to the ungrounded side of the circuit.

| 11.10  | N  | a) Where a hazard to personnel is controlled through the use of an enclosure, the enclosure should either:  
  • Require a tool to gain access and be labeled regarding the hazard against which it protects personnel; or  
  • Be interlocked.  
  b) In addition to enclosures, physical barriers at the point of hazard should be included where inadvertent contact is likely.  
  NOTE 38: Where the removal of a cover exposes a hazard, consider additional labels. See Section 10 for guidance. |
| --- | --- | --- |

a) Section is not applicable to the HR601 and HR1001 because the product has no accessible areas.  
b) Section is not applicable to the HR601 and HR1001 because no contact is likely as the product requires no maintenance and is swapped out for repair.
12. Emergency Shutdown

| 12.1  | a) The equipment should have an “emergency off” (EMO) circuit.  
   b) The EMO actuator (e.g., button), when activated, should place the equipment into a safe shutdown condition, without generating any additional hazard to personnel or the facility.  
   EXCEPTION 1: An EMO circuit is not needed for equipment rated 2.4 kVA or less, where the hazards are only electrical in nature, provided that the main disconnect meets the accessibility provisions of Section 12.5.2 and that the effect of disconnecting the main power supply is equivalent to activating an EMO circuit.  
   EXCEPTION 2: Assemblies that are not intended to be used as stand-alone equipment, but rather within an overall integrated system, and that receive their power from the user’s system, are not required to have an emergency off circuit. The assembly’s installation manual should provide clear instructions to the equipment installer to connect the assembly to the integrated system’s emergency off circuit.  
   NOTE 39: It is recommended that the emergency off function not reduce the effectiveness of safety devices or of devices with safety-related functions (e.g., magnetic chucks or braking devices) necessary to bring the equipment to a safe shutdown condition effectively.  
   NOTE 40: If a fire detection or suppression system is provided with the equipment, see Section 14 for additional information.  

| 12.1.1 | If the supplier provides an external EMO interface on the equipment, the supplier should include instructions for connecting to the interface.  

Section is not applicable to the HR601 and HR1001 because the product has no EMO shutdown and is a component of a larger system that may incorporate its own EMO shutdown

| 12.2  | Activation of the emergency off circuit should deenergize all hazardous voltage and all power greater than 240 volt-amps in the equipment beyond the main power enclosure.  
   EXCEPTION 1: A non-hazardous voltage EMO circuit (typically 24 volts) and its supply may remain energized.  
   EXCEPTION 2: Safety related devices (e.g., smoke detectors, gas/water leak detectors, pressure measurement devices, etc.) may remain energized from a non-hazardous power source.  
   EXCEPTION 3: A computer system performing data/alarm logging and error recovery functions may remain energized, provided that the energized breaker(s), receptacle(s), and each energized conductor termination are clearly labeled as remaining energized after EMO activation. Hazardous energized parts that remain energized after EMO activation should be insulated or guarded to prevent inadvertent contact by personnel.  
   EXCEPTION 4: Multiple units mounted separately with no shared hazards and without interconnecting circuits with hazardous voltages, energy levels or other hazardous conditions may have:  
   • Separate sources of power and separate supply circuit disconnect means if clearly identified, or  
   • Separate EMO circuits, if they are clearly identified.  

Section is not applicable to the HR601 and HR1001 because the product has no EMO shutdown and is a component of a larger system that may incorporate its own EMO shutdown.
12.2.1 N
The EMO circuit should not include features that are intended to allow it to be defeated or bypassed.

Section is not applicable to the HR601 and HR1001 because the product has no EMO shutdown and is a component of a larger system that may incorporate its own EMO shutdown

12.2.2 N
The EMO circuit should consist of electromechanical components.

EXCEPTION 1: Solid-state devices and components may be used, provided that the system or relevant parts of the system, are evaluated and found suitable for use. The components should be evaluated and found suitable considering abnormal conditions such as over voltage, under voltage, power supply interruption, transient over voltage, ramp voltage, electromagnetic susceptibility, electrostatic discharge, thermal cycling, humidity, dust, vibration, and jarring. The final removal of power should be accomplished by means of electromechanical components.

EXCEPTION 2: FECS [failsafe equipment control system] may be used provided the FECS conforms to an appropriate standard for electronic safety systems. Components of the FECS should be tested and certified according to the requirements of the standard used. IEC 61508 and ISO 13849-1 (EN 954-1) are examples of internationally recognized electronic safety systems standards. The final removal of power should be accomplished by means of electromechanical components.

NOTE 41: Paragraph 13.4.3 states additional assessment criteria for safety-related components and assemblies.
NOTE 42: A FECS is a sub-system of a PES (Programmable Electronic System). IEC 61508 is the preferred standard for complex PES.

Section is not applicable to the HR601 and HR1001 because the product has no EMO shutdown and is a component of a larger system that may incorporate its own EMO shutdown

12.2.3 N
All EMO circuits should be fault tolerant.

Section is not applicable to the HR601 and HR1001 because the product has no EMO shutdown and is a component of a larger system that may incorporate its own EMO shutdown

12.2.4 N
Resetting the EMO switch should not re-energize circuits, equipment, or subassemblies.

Section is not applicable to the HR601 and HR1001 because the product has no EMO shutdown and is a component of a larger system that may incorporate its own EMO shutdown

12.2.5 N
The EMO circuit should shut down the equipment by deenergizing rather than energizing control components.

Section is not applicable to the HR601 and HR1001 because the product has no EMO shutdown and is a component of a larger system that may incorporate its own EMO shutdown
12.2.6 N
The EMO circuit should require manual resetting so that power cannot be restored automatically.

Section is not applicable to the HR601 and HR1001 because the product has no EMO shutdown and is a component of a larger system that may incorporate its own EMO shutdown

12.3 N
a) The emergency off button should be red, mushroom shaped, and self latching.

b) A yellow background for the EMO should be provided.

a) Section is not applicable to the HR601 and HR1001 because the product has no EMO shutdown and is a component of a larger system that may incorporate its own EMO shutdown

b) Section is not applicable to the HR601 and HR1001 because the product has no EMO shutdown and is a component of a larger system that may incorporate its own EMO shutdown

12.4 N
All emergency off buttons should be clearly labeled as "EMO," "Emergency Off," or the equivalent and should be clearly legible from the viewing location. The label may appear on the button or on the yellow background.

Section is not applicable to the HR601 and HR1001 because the product has no EMO shutdown and is a component of a larger system that may incorporate its own EMO shutdown

12.5 N
Accessibility of EMO Actuators
Emergency off buttons should be readily accessible from operating and regularly scheduled maintenance locations and appropriately sized to enable activation by the heel of the palm.

Section is not applicable to the HR601 and HR1001 because the product has no EMO shutdown and is a component of a larger system that may incorporate its own EMO shutdown

12.5.1 N
Emergency off buttons should be located or guarded to minimize accidental activation.

Section is not applicable to the HR601 and HR1001 because the product has no EMO shutdown and is a component of a larger system that may incorporate its own EMO shutdown

12.5.2 N
No operation or regularly scheduled maintenance location should require more than 3 m (10 feet) travel to an EMO button.

Section is not applicable to the HR601 and HR1001 because the product has no EMO shutdown and is a component of a larger system that may incorporate its own EMO shutdown
12.5.3

| N | The person actuating or inspecting the EMO button should not be exposed to serious risks of tripping or falling or of coming in contact with energized electrical parts, moving machinery, surfaces or objects operating at high temperatures, or other hazardous equipment. |

Section is not applicable to the HR601 and HR1001 because the product has no EMO shutdown and is a component of a larger system that may incorporate its own EMO shutdown.

12.6

<table>
<thead>
<tr>
<th>N</th>
<th>EMO requirements and UPS units</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>See Section 13.5 for additional EMO guidelines when EMOs are used with UPSs.</td>
</tr>
</tbody>
</table>

Section is not applicable to the HR601 and HR1001 because the product has no EMO shutdown and is a component of a larger system that may incorporate its own EMO shutdown. No UPS is provided.
13. Electrical Design

13.1 General
This section covers electrical and electronic equipment that use hazardous voltages.

13.2 Types of Electrical Work
The following are the four types of electrical work defined by this guideline:

- **Type 1** – Equipment is fully deenergized.
- **Type 2** – Equipment is energized. Energized circuits are covered or insulated.

**NOTE 43:** Type 2 work includes tasks where the energized circuits are or can be measured by placing probes through suitable openings in the covers or insulators.

- **Type 3** – Equipment is energized. Energized circuits are exposed and inadvertent contact with uninsulated energized parts is possible. Potential exposures are no greater than 30 volts rms, 42.4 volts peak, 60 volts dc or 240 volt-amps in dry locations. Potential exposures to radio-frequency currents, whether induced or via contact, exceed the limits in Table A4-1 of Appendix 4.

- **Type 4** – Equipment is energized. Energized circuits are exposed and inadvertent contact with uninsulated energized parts is possible. Potential exposures are greater than 30 volts rms, 42.4 volts peak, 60 volts dc, or 240 volt-amps in dry locations. Potential exposures to radio-frequency currents, whether induced or via contact, exceed the limits in Table A5-1 of Appendix 5.

13.3 Energized Electrical Work

a) The supplier should design the equipment to minimize the need to calibrate, modify, repair, test, adjust, or maintain equipment while it is energized, and to minimize work that must be performed on components near exposed energized circuits.

b) The supplier should move as many tasks as practical from category Type 4 to Types 1, 2, or 3.

c) Routine Type 4 tasks, excluding troubleshooting, should have specific written instructions in the maintenance manuals.

d) General safety procedures (e.g., wearing appropriate Personal Protective Equipment and establishing barriers) for troubleshooting, including Type 4 work, should be provided.

- **a)** **C** HR601 and HR1001 conform to the stated criteria because it is designed in such a way to minimize exposure of maintenance/service personnel to exposed energized circuits.

- **b)** **C** HR601 and HR1001 conform to the stated criteria because Type 1 tasks apply throughout.

- **c)** **N** Section is not applicable to the HR601 and HR1001 because it does not entail the execution of routine Type 4 tasks.

- **d)** **N** Section is not applicable to the HR601 and HR1001 because it does not require servicing or entail the execution of routine Type 4 tasks.

13.4 Electrical Design

Equipment should conform to the appropriate international, regional, national or industry product safety requirements

HR601 and HR1001 conform to the stated criteria because they meet the relevant requirements of the product safety standard IEC 61010-1.

Refer to TÜV Rheinland test reports 31082335.001, issued as Attachment 1 of this Evaluation Report for further details.
13.4.1

Non-conductive or grounded conductive physical barriers should be provided:

- a) Where it is necessary to reach over, under, or around, or in close proximity to hazards.
- b) Where dropped objects could cause shorts or arcing.
- c) Where failure of liquid fittings from any part of the equipment would result in the introduction of liquid into electrical parts.
- d) Over the line side of the main disconnect.
- e) Where maintenance or service tasks on equipment in dry locations are likely to allow inadvertent contact with uninsulated energized parts containing either: potentials greater than 30 volts rms, 42.4 volts peak, or 60 volts dc; or power greater than 240 volt-amps.

NOTE 44: A dry location can be considered to be one that is not normally subject to dampness or wetness.

NOTE 45: Removable nonconductive and noncombustible covers are preferred.

<p>| | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>a)</td>
<td>C</td>
<td>HR601 and HR1001 conform to the stated criteria because it is provided with effective protective barriers as required however, it is a component of a larger system and needs to be reviewed in its end application to ensure compliance.</td>
</tr>
<tr>
<td>b)</td>
<td>N</td>
<td>Section is not applicable to the HR601 and HR1001 because it does not contain objects that can drop.</td>
</tr>
<tr>
<td>c)</td>
<td>N</td>
<td>Section is not applicable to the HR601 and HR1001 because it does not contain liquids.</td>
</tr>
<tr>
<td>d)</td>
<td>N</td>
<td>Section is not applicable to the HR601 and HR1001 because the main disconnect is the cord and plug.</td>
</tr>
<tr>
<td>e)</td>
<td>N</td>
<td>Section is not applicable to the HR601 and HR1001 because it is not intended to have maintenance or service tasks. The equipment is intended to be swapped in the field.</td>
</tr>
</tbody>
</table>

13.4.2

Where test probe openings are provided in barriers, the barriers should be located, and the probe openings should be sized, to prevent inadvertent contact with adjacent energized parts, including the energized parts of the test probes.

Section is not applicable to the HR601 and HR1001 because it does not use test probes

13.4.3

Where failure of components and assemblies could result in a risk of electric shock, fire, or personal injury, those components and assemblies should be certified by an accredited testing laboratory and used in accordance with the manufacturer's specifications, or otherwise evaluated to the applicable standard(s).

NOTE 46: With the exception of implementation of ground fault protection, shunt trip units that require power to trip (actuate) are not recommended to be used in a safety control circuit, because they are not fail-safe.

HR601 and HR1001 conform to the stated criteria because it meets the applicable requirements of the safety standard IEC 61010-1 and its regional/national deviations. Components have been verified on the basis of their specifications, approvals/certifications/listings or safety test reports as applicable, and by visual inspection as an integral part of the evaluation.

Refer to TUV Rheinland test reports 31082335.001, issued as Attachment 1 of this Evaluation Report for further details.
13.4.4 Electrical wiring for power circuits, control circuits, grounding (earthing) and grounded (neutral) conductors should be color coded according to appropriate standard(s) per Section 13.4, or labeled for easy identification at both ends of the wire. Where color is used for identification, it is acceptable to wrap conductor ends with appropriate colored tape or sleeving; the tape or sleeving should be reliably secured to the conductor.

EXCEPTION 1: Internal wiring on individual components, e.g., motors, transformers, meters, solenoid valves, power supplies.

EXCEPTION 2: Flexible cords.

EXCEPTION 3: Nonhazardous voltage multi-conductor cables (e.g., ribbon cables).

EXCEPTION 4: When proper color is not available for conductors designed for special application (e.g., high-temperature conductors used for furnaces and ovens).

HR601 and HR1001 conform to the stated criteria because the relevant conductors of the equipment are labeled or color-coded as appropriate. Green/yellow insulated conductors are used exclusively within protective earth/ground circuits.

13.4.5 Grounding (earthing) conductors and connectors should be sized to be compatible in current rating with their associated ungrounded conductors according to appropriate standard(s) per Section 13.4.

HR601 and HR1001 conform to the stated criteria because its earthing conductors and connectors are appropriately sized.

13.4.6 Electrical enclosures should be suitable for the environment in which they are intended to be used.

HR601 and HR1001 conform to the stated criteria because the equipment electrical enclosures are suitable for the environment of use. The equipment is not subjected to adverse environments.

13.4.7 Enclosure openings should safeguard against personnel access to uninsulated energized parts. (Refer to Appendix 1 for examples of openings for protection against access from operators).

Section is not applicable to the HR601 and HR1001 because it does not have any openings.

13.4.8 Top covers of electrical enclosures should be designed and constructed to prevent objects from falling into the enclosures. (Refer to Appendix 1 for examples of acceptable top enclosure openings.)

HR601 and HR1001 conform to the stated criteria because all horizontal and exposed enclosure surfaces are constructed without openings.
13.4.9  
| C | The short circuit current rating of the equipment or its industrial control panel, for each supply circuit from the facility to the equipment should be identified in the equipment installation instructions. |

HR601 and HR1001 conform to the stated criteria because the short circuit current rating of the equipment is stated in the relevant manual.

Note: The equipment short circuit rating is based upon the current interrupting capacity rating of the EMI filter.

13.4.10  
| C | The equipment should be provided with main overcurrent protection devices and main disconnect devices rated for at least 10,000 rms symmetrical amperes interrupting capacity (AIC).

NOTE 47: Some facilities may require higher AIC ratings due to electrical distribution system design.

EXCEPTION: Cord- and plug-connected single phase equipment, rated no greater than 240 volts line-to-line/150 volts line-to-ground and no greater than 2.4 kVA, may have overcurrent protection devices with interrupting capacity of at least 5,000 rms symmetrical amperes interrupting capacity (AIC).

HR601 and HR1001 conform to performance goal to the stated criteria because the manual requires that the main overcurrent protection be rated at 10kAIC.

13.4.11  
| C | Equipment should be designed to receive incoming electrical power from the facility to a single feed location that terminates at the main disconnect specified in 13.4.9.

This disconnect, when opened, should remove all incoming electrical power in the equipment from the load side of the disconnect.

The disconnect should also have the energy isolation ("lockout") capabilities specified in Section 17.

EXCEPTION 1: Equipment with more than one feed should be provided with provisions for energy isolation (lockout) for each feed and be marked with the following text or the equivalent at each disconnect: "WARNING: Risk of Electric Shock or Burn. Disconnect all [number of feed locations] sources of supply prior to servicing." It is preferred that all of the disconnects for the equipment be grouped in one location.

EXCEPTION 2: Multiple units mounted separately with no shared hazards and without interconnecting circuits with hazardous voltages, energy levels or other potentially hazardous conditions may have:
- Separate sources of power and separate supply circuit disconnect means, if they are clearly identified; or
- Separate EMO circuits, if they are clearly identified.

HR601 and HR1001 conform to the stated criteria because the equipment main power disconnect is the power cord and plug.

13.4.12  
| C | A permanent nameplate listing the manufacturer’s name, machine serial number, supply voltage, number of phases, frequency, short circuit current rating of the equipment or its industrial control panel, and full-load current should be provided, the nameplate(s) should state the above information for each circuit.

NOTE 48: Additional nameplate information may be required depending on the location of use.

HR601 and HR1001 conform to the stated criteria because it is furnished with a full nameplate, affixed on the top of the product.
### 13.5 Uninterruptable Power Supplies (UPSs)

This subsection applies to UPSs with outputs greater than: 30 volts rms, 42.4 volts peak; 60 volts dc; or 240 volt-amps.

<table>
<thead>
<tr>
<th>13.5.1</th>
<th>Whenever a UPS is provided with the equipment, its location and wiring should be clearly described within the installation and maintenance manual.</th>
</tr>
</thead>
</table>

Section is not applicable to the HR601 and HR1001 because it does contain a UPS and is not instructed to use a UPS

| 13.5.2 | Power from the UPS should be interrupted when any of the following events occur:  
- The emergency off actuator (button) is pushed; or  
- The main equipment disconnect is opened; or  
- The main circuit breaker is opened.  

EXCEPTION: Upon EMO activation, the UPS may supply power to the EMO circuit, safety related devices, and data/alarm logging computer systems as described in the exception clauses of Section 12.2. |
|---|---|

Section is not applicable to the HR601 and HR1001 because it does contain a UPS and is not instructed to use a UPS

<table>
<thead>
<tr>
<th>13.5.3</th>
<th>The UPS may be physically located within the footprint of the equipment provided that the UPS is within its own enclosure and is clearly identified.</th>
</tr>
</thead>
</table>

Section is not applicable to the HR601 and HR1001 because it does contain a UPS and is not instructed to use a UPS

<table>
<thead>
<tr>
<th>13.5.4</th>
<th>The UPS should be certified by an accredited testing laboratory and be suitable for its intended environment (e.g., damp location, exposure to corrosives).</th>
</tr>
</thead>
</table>

Section is not applicable to the HR601 and HR1001 because it does contain a UPS and is not instructed to use a UPS

<table>
<thead>
<tr>
<th>13.5.5</th>
<th>The UPS wiring should be identified as &quot;UPS Supply Output&quot; or equivalent at each termination point where the UPS wiring can be disconnected.</th>
</tr>
</thead>
</table>

Section is not applicable to the HR601 and HR1001 because it does contain a UPS and is not instructed to use a UPS
### 13.6 Electrical Safety Tests

| 13.6.1 C | Equipment connected to the facility branch circuit with a cord and plug should not exhibit surface leakage current greater than 3.5 milliampere (mA) as determined by testing completed in accordance with “Leakage Current Test for Plug-and-Cord Equipment” in SEMI S22, Testing section.  
EXCEPTION: Equipment with leakage current exceeding 3.5 mA is acceptable if documentation is provided to substantiate that the equipment is fully compliant with an applicable product safety standard that explicitly permits a higher leakage current.  
HR601 and HR1001 conform to the stated criteria because it was tested and the maximum leakage current did not exceed 3.5mA |

| 13.6.2 C | Equipment protective grounding circuits should have a measured resistance of one-tenth (0.1) ohm or less as determined by testing in accordance with “Earthing Continuity and Continuity of the Protective Bonding Circuit Test” in SEMI S22.  
HR601 and HR1001 conform to the stated criteria because it was tested and the resistances if its protective earth/ground bonding circuits were found to be less than or equal to the stipulated limit. |

| 13.7 N | Equipment with flammable liquids or gases  
Equipment in which flammable liquids or gases are used should be assessed to determine if additional precautions (e.g., purging) in the electrical design are necessary.  
NOTE 49: NFPA 497 and EN 1127-1 provide methods for making this assessment.  
Section is not applicable to the HR601 and HR1001 because it does not use flammable liquids or gases. |
### 14. Fire Protection

<table>
<thead>
<tr>
<th>14.1</th>
<th>Overview</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Informative</strong></td>
<td>This section applies to fire hazards that are internal to the equipment.</td>
</tr>
</tbody>
</table>

| 14.1.1 | This section provides minimum safety considerations for fire protection designs and controls on the equipment. |

| 14.1.2 | This section also provides minimum considerations for fire detection and suppression systems when provided with the equipment. |
| **Informative** | NOTE 50: Detailed guidance on fire risk assessment and mitigation for semiconductor manufacturing equipment is provided in SEMI S14. |

<table>
<thead>
<tr>
<th>14.2</th>
<th>Risk Assessment</th>
</tr>
</thead>
</table>

| 14.2.1 | A documented risk assessment should be performed or accepted by a party qualified to determine and evaluate fire hazards and the potential need for controls. The risk assessment should consider normal operations and reasonably foreseeable single-point failures within the equipment. It should not consider exposure to fire or external ignition sources not within the specified use environment. |
| **C** | NOTE 51: This risk assessment can be combined with the overall hazard analysis performed for this guideline, provided the risk assessor has the required professional expertise to perform risk assessments for fire hazards. SEMI S7 describes qualifications for such an assessor. |

HR601 and HR1001 conform to performance goal because a fire risk assessment has effectively been performed through consideration and application of the requirements for fire protection of the safety standard IEC 61010-1. The equipment in design is conventional in that it does not possess extraordinary or particular potential ignition sources and does not employ highly flammable materials or substances. The design does not exhibit excessive levels of fire risk to necessitate special or particular mitigation measures. Assessment reveals that the inherent design does not exhibit an unacceptable level of fire risk and that the containment of flame provisions, i.e. fire enclosures, as provided by the overall equipment enclosures is effectively a supplementary measure. Refer to TUV Rheinland test reports 31082335.001, issued as Attachment 1 of this Evaluation Report for further details. |

| 14.2.2 | If an accurate risk assessment depends on the user’s adherence to specified procedures or conditions of use, the supplier should describe such procedures or conditions and state their importance. |
| **N** | Section is not applicable to the HR601 and HR1001 because particular procedures or conditions of use for the mitigation of fire risk are not relevant. |
HR601 and HR1001 conform to performance goal because reference to SEMI S14 has been made during the course of this SEMI S2 evaluation. The compilation of a formal report to the SEMI S14 Guideline is deemed unnecessary because of the limited fire risks exhibited by the inherent design.

Section is not applicable to the HR601 and HR1001 because residual fire risks of significance have not been identified in the design. Refer to Risk Assessment Summary, Attachment 4 of this report for details of the inherent design in terms of fire.

Section is not applicable to the HR601 and HR1001 because the design does not necessitate the use of optional fire risk reduction features.

Section is not applicable to the HR601 and HR1001 because the design does not necessitate the use of optional fire risk reduction features.

Section is not applicable to the HR601 and HR1001 because there are no significant risks of smoke beyond that which would reasonably be expected in the event of (electrical) faults occurring within the equipment. In the event of faults or abnormal conditions the probability of contamination of the environment (clean room) is considered to be very small.
14.4 Fire Risk Reduction

14.4.1 Materials of Construction – Equipment should be constructed of noncombustible materials wherever reasonable. If process chemicals do not permit the use of noncombustible construction, then the equipment should be constructed of materials, suitable for the uses and compatible with the process chemicals used, that contribute least to the fire risk.

NOTE 52: Some regional codes (e.g., Uniform Fire Code) may require construction with noncombustible materials.

HR601 and HR1001 conform to the stated criteria because the materials used in its construction are non-combustible, or are types that possess an appropriately low flammability index in situations where fire risks dictate.

14.4.1.1 The flowchart in Appendix 5 may be used for the selection of materials of construction for equipment.

HR601 and HR1001 conform to the stated criteria because its constructional features and process chemicals results in the current design being acceptable based on the flowchart in Appendix 6.

14.4.1.2 Any portion of equipment that falls within the scope of SEMI F14 (Guide for the Design of Gas Source Equipment Enclosures) should be designed in accordance with that guide.

Section is not applicable to the HR601 and HR1001 because none of its portions fall within the scope of SEMI F14.

14.4.2 Elimination of Process Chemical Hazards – The option of substituting non-flammable process chemicals for flammable process chemicals should be considered.

Section is not applicable to the HR601 and HR1001 because it does not utilize process chemicals.

14.4.3 Engineering Controls

14.4.3.1 Fire risks resulting from process chemicals may be reduced using engineering controls (e.g., preventing improper chemical mixing, preventing temperatures from reaching the flash point).

Section is not applicable to the HR601 and HR1001 because it does not utilize process chemicals.

14.4.3.2 Fire risks resulting from materials of construction may be reduced using engineering controls (e.g., non-combustible materials).
C

barriers that separate combustible materials of construction from ignition sources, installing a fire suppression system that extinguishes ignited materials).

HR601 and HR1001 conform to the stated criteria because the significant materials used in the construction of the equipment are either non-combustible or fire retardant. Other materials are considered to be insignificant in terms of their quantities and their remote location from potential ignition sources.

14.4.3.3

Equipment power and chemical sources that present unacceptable fire risks should be interlocked with the fire detection and suppression systems to prevent start-up of the equipment or delivery of chemicals when the fire detection or suppression is inactive.

NOTE 53: Some jurisdictions require interlocking.

NOTE 54: Refer to Section 6.5 for criteria for acceptability.

Section is not applicable to the HR601 and HR1001 because it does not feature chemical or power sources that present fire risks that necessitate the use of particular controls. Fire detection or suppression systems are not relevant to the design.

14.4.3.4

Shutdown or failure of a fire detection or suppression system need not interrupt the processing of product within the equipment by immediately shutting down the equipment, but should prevent additional processing until the fire detection or suppression is restored. Software or hardware may be used for this function.

Section is not applicable to the HR601 and HR1001 because it does not feature fire detection or suppression systems.

14.4.3.5

Controlling smoke by exhausting it (using the supplier-specified equipment exhaust) from the cleanroom may be used to reduce fire risks from the generation of products of combustion. When used, this reduction method should be combined with detection or suppression when flames can be propagated.

NOTE 55: Controlling smoke may be sufficient when smoke is the only consequence (e.g., smoldering components that generate smoke).

NOTE 56: For controlling smoke to be effective, the smoke must be removed not only from the equipment, but also from the cleanroom. This is typically accomplished by using ducted exhaust.

NOTE 57: The use of exhaust to remove smoke may be subject to regulations such as building and fire codes.

NOTE 58: The use of exhaust to remove smoke may create hazards within the exhaust system. Therefore, a description of the expected discharge (i.e., anticipated air flow rate, temperature, and rate of smoke generation) into the exhaust system may be important information for installation of equipment.

Section is not applicable to the HR601 and HR1001 because, as considered, the design does not possess extraordinary risk of smoke generation, or combustion risk owing to emission of smoke. Smoke control measures are neither required nor implemented.

14.4.4

Fire Detection

The following criteria apply to any fire detection system determined to be appropriate for fire protection by the fire risk assessment:

NOTE 59: Heat detectors, smoke sensing devices, and other devices used solely for monitoring equipment status may not need to meet these requirements. Some local jurisdictions, however, may require that all smoke detectors be connected to building systems and be compliant with all applicable fire alarm codes.
Section is not applicable to the HR601 and HR1001 because it does not feature fire detection systems.

Note: The fire risks in the design are not of a magnitude to necessitate the use of fire detection provisions.

### 14.4.4.1

| N | The fire detection system, which includes detectors, alarms and their associated controls, should be certified by an accredited testing laboratory and suitable for the application and for the environment in which it is to be used.

**NOTE 60:** Such certifications typically require that the components of fire detection systems are readily identifiable and distinguishable from other components in the equipment.

Section is not applicable to the HR601 and HR1001 because fire detection systems are not relevant to the design.

### 14.4.4.2

| N | The fire detection, alarm and control system should be installed in accordance with the requirements of the certification in Section 14.4.4.1, and in accordance with requirements of the appropriate international or national codes or standards (e.g., NFPA 72).

Section is not applicable to the HR601 and HR1001 because fire detection systems are not relevant to the design.

### 14.4.4.3

| N | The fire detection system should be capable of interfacing with the facility’s alarm system.

It may be preferable for the equipment supplier to specify the location and performance of detectors, but not provide them, so that the user may better integrate the detection in the equipment with that in the facility. This alternative should be negotiated explicitly with the user.

Section is not applicable to the HR601 and HR1001 because fire detection systems are not relevant to the design.

### 14.4.4.4

| N | The fire detection system should activate alarms audibly and visually at the equipment.

Section is not applicable to the HR601 and HR1001 because fire detection systems are not relevant to the design.

### 14.4.4.5

| N | Manual activation capability for the fire detection system should be considered, for the purpose of providing notification to a constantly attended location.

Section is not applicable to the HR601 and HR1001 because fire detection systems are not relevant to the design.
**14.4.4.6**

Activation of trouble or supervisory conditions should result in all of the following:

- Notification of the operator;
- Allowing the completion of processing of substrates in the equipment;
- Prevention of processing of additional substrates until the trouble or supervisory condition is cleared; and
- Providing, through an external interface, a signal to the facility monitoring system or a constantly attended location.

**NOTE 61:** Some local jurisdictions require that such alarms signal the building/facility fire alarm systems.

Section is not applicable to the HR601 and HR1001 because fire detection systems are not relevant to the design.

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**14.4.4.7**

The fire detection system should be capable of operating at all times, including when the equipment is inoperable ((e.g., equipment controller problems) or in maintenance modes (e.g., some or all of the equipment’s hazardous energies are isolated (“locked out”). For the purpose of this section, “inoperable” includes the equipment states after an EMO is activated and after the equipment has had its hazardous energies isolated (i.e., has been “locked out”). Therefore, the detection system should not require hazardous voltages (e.g., line alternating current) to operate anything other than the equipment within the detection system’s control enclosure. Sensors and other devices outside the detection system’s control enclosure should not require hazardous voltage.

**EXCEPTION:** Operability is not required during maintenance of the fire detection system.

Section is not applicable to the HR601 and HR1001 because fire detection systems are not relevant to the design.

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**14.4.4.7.1**

Power at a hazardous voltage may be supplied to the detection system controller enclosure after the equipment EMO is activated or after the equipment has had its hazardous energies isolated only if the wiring providing the hazardous voltage is separated from other wiring and is suitably labeled.

Section is not applicable to the HR601 and HR1001 because fire detection systems are not relevant to the design.

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**14.4.4.7.2**

If the hazardous voltage supply to the detection system controller is not disconnected by the energy isolation method that removes the other hazardous voltages from the equipment, there must also be separate hazardous energy isolation capability for the hazardous voltage supplies to the detection system controller enclosure.

Section is not applicable to the HR601 and HR1001 because fire detection systems are not relevant to the design.

---

**14.4.4.8**

A back-up power supply, capable of sustaining the detection system for 24 hours, should be provided.

**NOTE 62:** Back-up power must be provided in accordance with local regulations. The requirements for back-up power vary among jurisdictions.

Section is not applicable to the HR601 and HR1001 because fire detection systems are not relevant to the design.
14.4.4.9

| N | The fire detection system should remain active following EMO activation. |

Section is not applicable to the HR601 and HR1001 because fire detection systems are not relevant to the design.

14.4.4.10

| N | There may be cases where the internal power supply for a detection system cannot supply power for the full length of extended maintenance procedures (i.e., procedures longer than the expected duration of the back-up power supply). In such cases, the supplier should provide written procedures for either removing the fire hazard or safely supplying power to the fire detection system. |

Section is not applicable to the HR601 and HR1001 because fire detection systems are not relevant to the design.

14.4.4.11

| N | Activation of the fire detection system should shut down the equipment within the shortest time period that allows for safe equipment shutdown. This includes shutdown of any fire-related hazard source that could create additional fire risks for the affected module or component.  
NOTE 63: See Sections 14.4.3.3 and 14.4.3.4 for related provisions.  
EXCEPTION 1: A non-recycling, deadman abort switch is acceptable on detection systems that are used for equipment shutdown, but not on those used for activation of a suppression system.  
EXCEPTION 2: Activation of the fire detection system should not remove power from fire and safety systems. |

Section is not applicable to the HR601 and HR1001 because fire detection systems are not relevant to the design.

14.4.4.12

| N | The equipment design and configuration should not prevent licensed parties from certifying the design and installation of fire detection systems.  
NOTE 64: This is not meant to suggest installation by licensed parties; however, some jurisdictions require fire detection and suppression system installers to be licensed as specified by the jurisdiction. |

Section is not applicable to the HR601 and HR1001 because fire detection systems are not relevant to the design.

14.4.5

| N | Fire Suppression  
The following criteria apply to any fire suppression system determined to be appropriate by the fire risk assessment.  
NOTE 65: As a fire detection system is generally required to provide the initiating sequence for the suppression system, it is the intention of this guideline that this be the same fire detection system described in 14.4.4. |

Section is not applicable to the HR601 and HR1001 because it does not feature fire suppression systems.  
Note: The fire risks in the design are not of a magnitude to necessitate the use of fire suppression provisions.
### 14.4.5.1

| N | The fire suppression system, which includes nozzles, actuators, and their associated controls, should be certified by an accredited testing laboratory and suitable for the application and for the environment in which it is to be used.  
NOTE 66: Such certifications typically require that the components of fire suppression systems are readily identifiable and distinguishable from other components in the equipment. This includes adequate labeling of piping. |

Section is not applicable to the HR601 and HR1001 because fire suppression systems are not relevant to the design.

### 14.4.5.2

| N |  
|  | • The fire suppression agent should be accepted for the application by an accredited testing laboratory.  
|  | • The suppression agent selection process should include an evaluation of the amount and storage location of the suppression agent and of potential damage to a cleanroom and the environment.  
|  | • The least damaging effective agent should be selected.  
|  | • If more than one agent is effective, the options should be specified to the user so that the user may specify which agent should be provided with the equipment.  
|  | • The supplier should also specify if the user may provide the agent. |

Section is not applicable to the HR601 and HR1001 because fire suppression systems are not relevant to the design.

### 14.4.5.3

| N | The fire suppression agent and delivery system should be designed and installed in accordance with the appropriate international or national standard (e.g., NFPA 12, NFPA 13, NFPA 2001).  
|  | It may be preferable for the equipment supplier to specify the location and performance of suppression system components, but not provide them, so that the user may better integrate the suppression in the equipment with that in the facility. This alternative should be negotiated explicitly with the user. |

Section is not applicable to the HR601 and HR1001 because fire suppression systems are not relevant to the design.

### 14.4.5.4

| N | The assessment of the equipment to SEMI S2 should include the risks associated with the suppression system.  
NOTE 67: This includes risks (e.g., chemical exposure, noise, and asphyxiation) introduced by the incorporation of the suppression systems. |

Section is not applicable to the HR601 and HR1001 because fire suppression systems are not relevant to the design.

### 14.4.5.5

| N | Activation of the fire suppression system should alarm audibly and visually at the equipment. This may be done by the same system that initiates activation. |

Section is not applicable to the HR601 and HR1001 because fire suppression systems are not relevant to the design.

### 14.4.5.6

| N | If the discharge is likely to present a risk to personnel, the alarm should provide adequate time to allow personnel to avoid the hazard of the agent discharge. |
Section is not applicable to the HR601 and HR1001 because fire suppression systems are not relevant to the design.

14.4.5.6.1

| N | If there is a confined space in the equipment, the asphyxiation hazard posed by the suppression system should be assessed. |

Section is not applicable to the HR601 and HR1001 because fire suppression systems are not relevant to the design.

14.4.5.7

| N | The fire suppression system should be capable of operating at all times, including when equipment is inoperable and during equipment maintenance. |
|   | NOTE 68: For the purpose of this section, "inoperable" includes the equipment state after the EMO is activated. |
|   | EXCEPTION: Most suppression systems contain sources of hazardous energy. These sources should be capable of being isolated (i.e., "locked out") to protect personnel. |

Section is not applicable to the HR601 and HR1001 because fire suppression systems are not relevant to the design.

14.4.5.8

| N | The fire suppression system should remain active following EMO activation. |

Section is not applicable to the HR601 and HR1001 because fire suppression systems are not relevant to the design.

14.4.5.9

| N | There may be cases where the internal power supply for a suppression system cannot supply power for the full length of extended maintenance procedures (i.e., procedures longer than the expected duration of the back-up power supply). In such cases, the supplier should provide written procedures for either removing the fire hazard or safely supplying power to the fire suppression system. |

Section is not applicable to the HR601 and HR1001 because fire suppression systems are not relevant to the design.

14.4.5.10

| N | Allowances can be made to provide for the deactivation of an automatic discharge of the suppression system when in the maintenance mode. Such deactivation switches should be supervised (i.e., if the suppression system is deactivated, there should be an indication to the user and the resumption of production in the equipment should be prevented.) |
|   | NOTE 69: Hazardous energies associated with the fire suppression system may be isolated (i.e., "locked out") using an energy isolation procedure (see Section 17) during equipment maintenance. |
|   | NOTE 70: The permissibility of deactivation of suppression systems varies among jurisdictions. |

Section is not applicable to the HR601 and HR1001 because fire suppression systems are not relevant to the design.
14.4.5.11
N
A back-up power supply, capable of sustaining the suppression system for 24 hours, should be included where the suppression system requires independent power from the detection system used to activate the suppression.

NOTE 71: The requirements for back-up power vary among jurisdictions.

Section is not applicable to the HR601 and HR1001 because fire suppression systems are not relevant to the design.

14.4.5.12
N
The fire suppression system should be capable of interfacing with the facility's alarm system. This may be done via the fire detection system.

Section is not applicable to the HR601 and HR1001 because fire suppression systems are not relevant to the design.

14.4.5.13
N
Activation of the fire suppression system should shut down the equipment within the shortest time period that allows for safe equipment shutdown.

NOTE 72: See Sections 14.4.3.3 and 14.4.3.4 for related provisions.

EXCEPTION: Activation of the fire suppression system should not remove power from fire and safety systems.

Section is not applicable to the HR601 and HR1001 because fire suppression systems are not relevant to the design.

14.4.5.14
N
The fire suppression system should be capable of manual activation, which should shut down the equipment and activate an alarm signal locally and at a constantly attended location.

Section is not applicable to the HR601 and HR1001 because fire suppression systems are not relevant to the design.

14.4.5.15
N
• The fire suppression system should be tested on a representative sample of the equipment.
• The test procedure should include a suppression agent discharge test, unless precluded for health or environmental reasons.
• This test may be performed at the equipment supplier's or other similar facility, but should be performed under conditions that adequately duplicate any factors (e.g., equipment exhaust) that may reduce the effectiveness of the suppression.
• This representative sample need not be fully operational, but should duplicate those factors (e.g., exhaust, air flow) that could negatively affect the performance of the system.

Section is not applicable to the HR601 and HR1001 because fire suppression systems are not relevant to the design.

14.4.5.16
N
Procedures for controlling access to the suppression agent source (e.g., protecting agent cylinders from disconnection by unauthorized personnel) should be provided.
Section is not applicable to the HR601 and HR1001 because fire suppression systems are not relevant to the design.

14.4.5.17 N
The equipment design and configuration should not prevent licensed parties from certifying the design and installation of fire suppression systems.

NOTE 73: This is not meant to suggest installation by licensed parties; however, some jurisdictions require fire detection and suppression system installers to be licensed as specified by the jurisdiction.

Section is not applicable to the HR601 and HR1001 because fire suppression systems are not relevant to the design.

14.4.5.18 N
Installation of Piping for Fire Suppression Agent — The fire suppression piping system should be:
- Made from corrosion-resistant components;
- Designed to minimize water accumulation around components and control other conditions that promote corrosion; and
- Designed so mechanical inspections are easily performed.

Section is not applicable to the HR601 and HR1001 because fire suppression systems are not relevant to the design.

14.4.5.19 N
Piping should be designed, installed, and tested to ensure that it is capable of containing the high pressures generated by the discharge of the suppression agent.

Section is not applicable to the HR601 and HR1001 because fire suppression systems are not relevant to the design.

14.4.5.20 N
The supplier should provide information necessary for proper field installation of piping.

Section is not applicable to the HR601 and HR1001 because fire suppression systems are not relevant to the design.

14.5 N
Warnings and Safe Work Practices for Fire Detection and Suppression Systems

Warnings and safe work practices related to fire detection and suppression features of the equipment (e.g., restrictions on using open flames within range of active fire detection systems, hazardous stored energy in pressurized suppression systems) should be part of the documentation provided by the supplier.

Section is not applicable to the HR601 and HR1001 because fire detection and suppression systems are not relevant to the design.
14.6 Maintenance and Testing of Fire Detection and Suppression Systems

The equipment supplier should provide detailed maintenance and testing procedures for the fire systems provided with each piece of equipment.

These procedures should include testing frequency, as well as details of special equipment required for testing.

Section is not applicable to the HR601 and HR1001 because fire detection and suppression systems are not relevant to the design.

14.6.1 Chemical generating test apparatus (e.g., canned smoke) should be avoided for cleanroom applications.

NOTE 74: Information about UV/IR generating sources used for testing fire detection systems may require consideration of Section 25 (Non-Ionizing Radiation).

Section is not applicable to the HR601 and HR1001 because fire detection systems are not relevant to the design.

14.6.2 The maintenance testing procedure should include testing of the facility interface and verifying that all the equipment fire detection and suppression systems are functional.

Section is not applicable to the HR601 and HR1001 because fire detection and suppression systems are not relevant to the design.

14.6.3 The detection and suppression systems should be designed so that preventative maintenance of components does not degrade their performance (e.g. by resulting in displacement or destruction of sensors).

Section is not applicable to the HR601 and HR1001 because fire detection and suppression systems are not relevant to the design.

14.6.4 Supplier should document the sound pressure level generated during suppression agent discharge, if the test is performed.

Section is not applicable to the HR601 and HR1001 because fire suppression systems are not relevant to the design.

14.6.5 Materials or procedures used for testing and maintenance of the fire detection and suppression system should not degrade the equipment’s ability to perform its intended function.

Section is not applicable to the HR601 and HR1001 because fire detection and suppression systems are not relevant to the design.
14.6.6

N

Suppliers should describe hazardous energies present in fire detection and suppression systems, and provide instructions for their proper isolation (see Section 17.2).

Section is not applicable to the HR601 and HR1001 because fire detection and suppression systems are not relevant to the design.

14.7

N

Environmental considerations

Suppliers should provide guidance to users regarding the impact on emissions of any fire suppression agents used in the equipment.

Section is not applicable to the HR601 and HR1001 because fire suppression systems are not relevant to the design.
### 15. Heated Chemical Baths

<table>
<thead>
<tr>
<th>15.1</th>
<th>Refer to SEMI S3 for the minimum safety design considerations for heated chemical baths. Each heated chemical bath should have the following:</th>
</tr>
</thead>
<tbody>
<tr>
<td>N</td>
<td>• Grounded or GFCI-protected heater;</td>
</tr>
<tr>
<td></td>
<td>• Power interrupt;</td>
</tr>
<tr>
<td></td>
<td>• Manual reset;</td>
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<tr>
<td></td>
<td>• Automatic temperature controller;</td>
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<tr>
<td></td>
<td>• Liquid level sensor;</td>
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<tr>
<td></td>
<td>• Fail-safe over-temperature protection;</td>
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<tr>
<td></td>
<td>• Proper construction materials;</td>
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<tr>
<td></td>
<td>• Exhaust failure interlock; and</td>
</tr>
<tr>
<td></td>
<td>• Overcurrent protection.</td>
</tr>
<tr>
<td>NOTE 75:</td>
<td>See Section 14 for fire protection risk assessment considerations for baths using combustible or flammable chemicals.</td>
</tr>
</tbody>
</table>

Section is not applicable to the HR601 and HR1001 because the product does not have heated chemical baths.
## 16. Ergonomics and Human Factors

### 16.1 General

Ergonomics and human factors design principles should be incorporated into the development of equipment to identify and eliminate or mitigate ergonomics- and human factors-related hazards.

HR601 and HR1001 conform to the section because through the application of the Supplier ergonomics Success Criteria the design has been adequately verified. Refer to the comments for sub-section 16.1.

The product is not intended to have any maintenance or service task during its intended lifetime (10 years). However, the fan has an intended life of 5 years. In this case, the power supply is either returned to the manufacture or the manufacture services the equipment in the field.

### 16.2 Provisions for Conformance

<table>
<thead>
<tr>
<th></th>
<th>Provisions for Conformance</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>a) Equipment should be assessed to the guidelines set forth in SEMI S8.</td>
</tr>
<tr>
<td>C</td>
<td>b) The Supplier Ergonomic Success Criteria (SESC; see SEMI S8), or the equivalent, should be used to document the assessment.</td>
</tr>
</tbody>
</table>

a) HR601 and HR1001 conforms to the section because its physical design and intended use in respect of relevant tasks has been assessed using the Supplier Ergonomics Success Criteria of the SEMI S8 Guideline. Refer to TUV Rheinland SEMI S8-0302 Evaluation Report, no. 31072336.004 as issued in conjunction with and forming Attachment 5 of this SEMI S2 Evaluation Report.
17. Hazardous Energy Isolation

17.1 General

17.1.1 C
Lockable energy isolation capabilities should be provided for tasks that may result in contact with hazardous energy sources.

HR601 and HR1001 conform to the stated criteria because the integral power cord and plug achieves disconnection of the electrical supply, which constitutes the sole source of hazard in respect of the replacement of the equipment.

Water supplied to the equipment for cooling have means for providing isolation and is provided by the end user.

17.1.2 N
Where service tasks may be safely performed on subassemblies, energy isolation devices (e.g. circuit breakers, disconnect switches, manual valves) may be provided for the subassemblies for use as an alternative to shutting down the entire equipment system. The isolation devices should isolate all hazardous energy to the subassemblies and be capable of being locked in the position in which the hazardous energy is isolated.

Section is not applicable to the HR601 and HR1001 because such tasks are not performed on sub-assemblies that feature hazardous energy hazards. Sub-isolation devices are not relevant to the design.

17.1.3 C
The person actuating or inspecting an energy isolating device should not be exposed to serious risks of tripping or falling or of coming in contact with energized electrical parts, moving machinery, surfaces or objects operating at high temperatures, or other hazardous equipment.

NOTE 76: Hazardous energies include electrical, stored electrical (e.g., capacitors, batteries), chemical, thermal/cryogenic, stored pressure (e.g., pressurized containers), suspended weight, stored mechanical (e.g., springs), generated pressure (e.g., hydraulics and pneumatics), and other sources that may lead to the risk of injury.

NOTE 77: In order to minimize down-time and provide ease of use, it is preferred to have energy isolation devices located in the areas where maintenance or service is performed.

NOTE 78: Energy isolation devices for incompatible hazardous energy sources (e.g., electrical and water, incompatible gases) are recommended to be separated.

NOTE 79: Isolation of hazardous energy may include: deenergizing of hazardous voltage; stopping flow of hazardous production material (HPM); containing HPM reservoirs; depressurizing or containing HPM and pneumatic lines; deenergizing or totally containing hazardous radiation; discharging of residual energy in capacitors; stopping of hazardous moving parts; and shutting off hazardous temperature sources.

NOTE 80: Energy isolation devices with integral locking capabilities are preferred, but may not be feasible or commercially available, in which case detachable lockout adapters may be used.

NOTE 81: See Section 14 for information on fire protection hazardous energies.

HR601 and HR1001 conform to the stated criteria because the integral power cord and plug achieves disconnection of the electrical supply, which constitutes the sole source of hazard in respect of the replacement of the equipment.

Water supplied to the equipment for cooling have means for providing isolation and is provided by the end user.
### 17.2 Installation and Maintenance Manuals

#### 17.2.1 C
Installation and maintenance manuals should identify the types of hazardous energies within the equipment.

HR601 and HR1001 conform to the stated criteria because the manual provides information relating to installation. No maintenance is performed.

#### 17.2.2 C
Installation and maintenance manuals should provide specific instructions for the equipment on how to:
- Shut down the equipment in an orderly manner;
- Locate and operate all the equipment’s energy isolating devices;
- Affix energy isolating ("lockout/tagout") devices;
- Relieve any stored energies;
- Verify that the equipment has actually been isolated and deenergized; and
- Properly release the equipment from its isolated state.

HR601 and HR1001 conform to the stated criteria because the integral power cord and plug achieves disconnection of the electrical supply, which constitutes the sole source of hazard in respect of the replacement of the equipment.

Water supplied to the equipment for cooling have means for providing isolation and is provided by the end user.

#### 17.2.3 N
Where the manufacturer provides written maintenance procedures for tasks within subassemblies, and intends that these tasks be performed without controlling hazardous energies at the entire equipment level, the installation and maintenance manuals should provide appropriate energy isolation procedures at the subassembly level.

Section is not applicable to the HR601 and HR1001 because it does not entail activities that present risk of contact to hazardous energized parts.

### 17.3 Electrical Energy Isolation

#### 17.3.1 C
The main energy isolation capabilities (equipment supply disconnect) should be in a location that is readily accessible and should be lockable only in the deenergized position.

NOTE 82: For equipment with multiple incoming supply sources, it is recommended that all of the energy isolation devices be located in one area.

HR601 and HR1001 conform to the stated criteria because the integral power cord and plug achieves disconnection of the electrical supply, which constitutes the sole source of hazard in respect of the replacement of the equipment.

### 17.4 Non-Electrical Energy Isolation
17.4.1 C

The equipment should include provisions and procedures so that hazardous energy sources, such as pressurized systems and stored energy, can be isolated or reduced to a zero energy state prior to maintenance or service work.

Water supplied to the equipment for cooling have means for providing isolation and is provided by the end user.

17.4.2 N

The hazardous energy isolation devices should be in a location that is readily accessible.

Section is not applicable to the HR601 and HR1001 because water isolation provisions are provided by the end user. This needs to be verified in the end installation.

17.4.3 N

The hazardous energy isolation devices should be capable of being locked in the position in which the hazardous energy is isolated.

Section is not applicable to the HR601 and HR1001 because water isolation provisions are provided by the end user. This needs to be verified in the end installation.
### 18. Mechanical Design

#### 18.1 Informative

This section covers hazards due to the mechanical aspects of the equipment.

NOTE 83: This is similar to the essential requirements of European Union directives. The supplier has the option of demonstrating compliance by choosing standards that are appropriate to the machine and application.

NOTE 84: Pressurized vessels must meet applicable codes and regulations.

#### 18.2 Machine Stability

Equipment, components and fittings should be designed and constructed so that they are stable under reasonably foreseeable shipping, installation, and operating conditions.

The need for special handling devices and anchors should be indicated in the instructions.

Unanchored equipment in its installed condition should not overbalance when tilted in any direction to an angle of 10 degrees from its normal position.

NOTE 85: See IEC 61010-1 for an example of stability tests.

HR601 and HR1001 conform to the stated criteria because it is designed and constructed to be sufficiently stable during all modes of handling during installation and removal and is provided with means for supporting it in its final location (i.e., rack). The design meets the essential mechanical requirements of the IEC 61010 standard and its national/regional derivatives, which has been considered as an integral part of the evaluation. Special handling devices and anchoring of the equipment is not required.

#### 18.3 Break-up during Operation

The various parts of the equipment and its linkages should be able to withstand the stresses to which they are subjected when used as designed.

Precautions should be taken to control risks from falling or flying objects.

Section is not applicable to the HR601 and HR1001 because its design does not possess elements that present potential break-up (emission of matter) hazards.

#### 18.3.1 N

The potential effects of fatigue, aging, corrosion and abrasion for the intended operating environment should be considered as part of the mechanical hazards risk assessment.

Section is not applicable to the HR601 and HR1001 because break-up hazard is not relevant to the design.

#### 18.3.2 N

Where a risk of rupture or disintegration remains despite the measures taken (e.g., a substrate chuck that loses its vacuum), the moving parts should be mounted and positioned in such a way that, in case of rupture, their fragments will be contained.

Section is not applicable to the HR601 and HR1001 because break-up hazard is not relevant to the design.

#### 18.3.3

Both rigid and flexible pipes carrying liquids or gases should be able to withstand the foreseen internal and external
stresses and should be firmly attached or protected against external stresses and strains. Based on the application, an appropriate factor of safety should be included.

Section is not applicable to the HR601 and HR1001 because break-up hazard is not relevant to the design.

18.4 Moving Parts

The moving parts of equipment should be designed, built and positioned to avoid hazards. Where hazards persist, equipment should be fitted with guards or protective devices that reduce the likelihood of contact that could lead to injury.

Section is not applicable to the HR601 and HR1001 because there are no moving parts

18.4.1 Where the machine is designed to perform operations under different conditions of use (e.g., different speeds or energy supplies), it should be designed and constructed in such a way that selection and adjustment of these conditions can be performed safely.

Section is not applicable to the HR601 and HR1001 because the equipment is not designed to operate under differing conditions in respect of hazards that may originate from moving parts of the end product.

18.4.2 Selection of Protection against Hazards Related to Moving Parts — Guards or protective devices used to protect against hazards related to moving parts should be selected on the basis of a risk assessment that includes the:
  - Hazards that are being guarded against;
  - Probability of occurrence and severity of injury of each hazard scenario; and
  - Frequency of removal of guards.

HR601 and HR1001 conform to the stated criteria because the factors outlined have been considered in respect of its safe mechanical design.

18.4.3 Guards and protection devices — Guards should:
  - Reduce the risk that personnel will contact the mechanical hazard to an acceptable level; and
  - Not give rise to additional risk.

HR601 and HR1001 conform to the stated criteria because the factors above have been considered in respect of the design of the implemented safeguards in the form of the equipment enclosures and covers
### 18.5 Lifting Equipment

Lifting equipment used for maintenance and service of SME should conform to each applicable criterion of Section 18.5 and its subordinate paragraphs.

**NOTE 84**: The purpose of this section is to encourage that the hazards and potential consequences related to lifting operations (e.g., falling loads, collisions, tripping) be given appropriate consideration during design and development of SME.

**EXCEPTION**: Lifting equipment that has documentation indicating conformance with an applicable standard, code, or regulation need conform to only Section 18.5.3, 18.5.4, and their subordinate paragraphs, in addition to the applicable standard, code, or regulation.

Section is not applicable to the HR601 and HR1001 because lifting equipment is neither supplied nor specified or recommended by the supplier for the equipment.

### 18.5.1 Lifting Equipment Design Criteria

#### 18.5.1.1 Mechanical Strength

- **N**

- **Mechanical Strength** – Lifting equipment should be designed such that it has a minimum factor of safety of 3, with the factor of safety determined as the ratio of yield strength to stress on each component, in the least favorable condition. For the purposes of Section 18.5, “least favorable condition” is the position and orientation of fixed or moveable elements that places the greatest stress on the components of the lifting equipment. It may be necessary to test more than one condition so that each element is tested in its “least favorable” condition. These elements include:
  - Fixed or removable booms
  - End effectors or grippers used in conjunction with fixed or removable booms, and
  - Fixtures designed to provide interconnection between the load and the lifting device, excluding slings

**NOTE 87**: A minimum safety factor of 3 appears in several standards (e.g., ASME B30.20 – Below-the-hook lifting device, sub-paragraph 20-1.2.2 General Construction)

**NOTE 88**: Other factors of safety are required by codes, laws, and regulations, as they pertain to other types of lifting equipment, these must be met as well (e.g., EN 1492 requires a safety factor (SF) of 7 for webbing slings, MIL-STD-1365 B requires a SF of 5 for hoist rings, and ASME B18.15M requires a SF of 5 for lifting eyes). Conformance with these criteria for things other than the lifting device is typically evaluated separately from lifting equipment used in support of SME.

Section is not applicable to the HR601 and HR1001 because lifting equipment per the intent of the section is not relevant to its design.

#### 18.5.1.2 Materials

- **N**

- **Materials** should be appropriate for their intended use. Materials should be chosen with particular consideration to the effects of corrosion, abrasion, impact and aging.

Section is not applicable to the HR601 and HR1001 because lifting equipment per the intent of the section is not relevant to its design.

#### 18.5.2 Design Verification

- **N**

- **Design Verification** – The conformance to these criteria should be demonstrated for the particular lifting equipment under consideration, or a representative sample thereof.

Section is not applicable to the HR601 and HR1001 because lifting equipment per the intent of the section is not relevant to its design.
18.5.2.1 Lifting equipment should undergo testing a verification that includes the following:

- Classical engineering calculations;
- Risk assessment, such as Failure Modes and Effects Analysis (FMEA); and
- Physical Testing, as described below for subsequently produced lifting equipment.

Section is not applicable to the HR601 and HR1001 because lifting equipment per the intent of the section is not relevant to its design.

18.5.2.2 A written report, including photographs or drawings of how the testing was conducted along with written test specifications and results of all tests should be prepared.

Section is not applicable to the HR601 and HR1001 because lifting equipment per the intent of the section is not relevant to its design.

18.5.2.3 Documentation – Documentation, including the elements in Sections 18.5.1 – 18.5.2.2, and Section 9.6.3 (user documentation) should be prepared and kept for a sufficient time period to support the equipment while in service and for a sufficient period of time (typically a minimum of 10 years) after the equipment is placed on the market. Conformance with this criterion may be demonstrated by making the documentation from the design verification available to the assessor and providing the assessor evidence that the equipment supplier has a program that will retain the records for an appropriate period.

NOTE 89: Several standards and Directives (e.g., ISO 2415 (forged shackles), and 98/37/EC (Machinery Directive)) require keeping records for 10 years or more beyond the time the last unit was produced, tested and shipped.

Section is not applicable to the HR601 and HR1001 because lifting equipment per the intent of the section is not relevant to its design.

18.5.3 Subsequently produced lifting equipment – Each individual piece of lifting equipment should have testing and record keeping specifications in accordance with the criteria for static and dynamic load testing. Test certificates should accompany each unit upon delivery. The supplier should retain a copy of test records for at least 10 years from the date of shipment.

EXCEPTION: Lifting accessories permanently affixed to and tested as part of a lifting fixture do not need individual testing.

Section is not applicable to the HR601 and HR1001 because lifting equipment per the intent of the section is not relevant to its design.

18.5.3.1 Static Load Testing

18.5.3.1.1 Static load testing should be conducted on each lifting device at 150% of the rated load and with the mechanical elements of the structure in their least favorable conditions (see Section 18.5.1.1 for guidance as to determining the “least favorable condition”).

NOTE 90: Static load test (proof load testing) of a new design is part of the process of validating the design’s maximum working load.

Section is not applicable to the HR601 and HR1001 because lifting equipment per the intent of the section is not relevant to its design.
18.5.3.1.2

The static test should be conducted for a minimum of 2 minutes beyond the time that the test load has stabilized (stopped moving).

Section is not applicable to the HR601 and HR1001 because lifting equipment per the intent of the section is not relevant to its design.

18.5.3.1.3

A static test should be considered acceptable if no permanent deformation or other physical damage is found once the test load has been removed and equipment examined. A static test resulting in damage or abnormality should be considered to be a failed test.

18.5.3.2 Dynamic Load Testing

18.5.3.2.1

Dynamic load testing should be performed on each lifting device, as this term is defined within this document.

NOTE 91: Dynamic load testing is conducted to confirm that the lifting equipment has been properly assembled, operated with account taken of the dynamic behavior of the lifting equipment and that all operational features, including mechanical stops, limit switches, brakes (if fitted) and all safety related features are fully adjusted and operational.

Section is not applicable to the HR601 and HR1001 because lifting equipment per the intent of the section is not relevant to its design.

18.5.3.2.2

Dynamic load testing should be performed on lifting fixtures or accessories, only if the number of load cycles to which they are foreseen to be subjected is sufficient to make such testing appropriate.

NOTE 92: The American Welding Society (AWS) Standard D14.1 table 3 considers cyclic loading of 20,000 cycles and below to be equivalent to static loading. Thus, there is no need to consider dynamic testing of welded metal lifting fixtures or lifting accessories if the foreseen number of cycles in the fixture’s or accessory’s life is less than 20,000.

Section is not applicable to the HR601 and HR1001 because lifting equipment per the intent of the section is not relevant to its design.

18.5.3.2.3

Dynamic load testing should be conducted:
- Using 110% of the working (rated) load;
- And with the mechanical elements of the structure in their least favorable conditions;
- For a minimum of two complete cycles at maximum operational speed of each axis of motion; and
- If the control circuit allows for a number of simultaneous movements (e.g., rotation and displacement of the load), by combining the movements concerned.

NOTE 93: For manual actuation of lifting equipment using a crank, it is recommended that the cranking speed be agreed upon by the supplier and evaluator based on the lifting device and the cranking mechanism. Manual cranks are not normally designed to a maximum cranking speed. The intent of this test is to verify that the cranking force is not sufficient to damage the lifting device when the device is exercised throughout its full operational range of motion. It is recommended that an agreed typical person be used to perform the cranking for this evaluation.

Section is not applicable to the HR601 and HR1001 because lifting equipment per the intent of the section is not relevant to its design.

18.5.3.2.4 Acceptance Criteria

18.5.3.2.4.1

There should be no noticeable signs of improper assembly.
Section is not applicable to the HR601 and HR1001 because lifting equipment per the intent of the section is not relevant to its design.

18.5.3.2.4.

There should be no noticeable signs of excessive wear.

Section is not applicable to the HR601 and HR1001 because lifting equipment per the intent of the section is not relevant to its design.

18.5.3.2.4.

There should be no noticeable signs of improper operation or incorrect adjustment of operational features, including mechanical stops, limit switches and brakes (if fitted).

Section is not applicable to the HR601 and HR1001 because lifting equipment per the intent of the section is not relevant to its design.

18.5.3.2.4.

There should be no noises that indicate a problem other than that a simple adjustment is required.

Section is not applicable to the HR601 and HR1001 because lifting equipment per the intent of the section is not relevant to its design.

18.5.3.2.4.

All safety features should be operational and perform their intended function.

Section is not applicable to the HR601 and HR1001 because lifting equipment per the intent of the section is not relevant to its design.

18.5.3.2.4.

There should be no permanent set (yielding) or any mechanical or structural member.

Section is not applicable to the HR601 and HR1001 because lifting equipment per the intent of the section is not relevant to its design.
18.5.4 Marking Criteria

18.5.4.1 Lifting equipment should be clearly marked in a lasting, and legible manner on a portion of the equipment that cannot be removed.

EXCEPTION: Lifting accessories permanently affixed to and tested as part of a lifting fixture do not need individual marking.

NOTE 94: Components of fixtures (e.g., individual components that make-up a larger lifting fixture) that could be used independently of their parent fixtures should be marked.

Section is not applicable to the HR601 and HR1001 because lifting equipment per the intent of the section is not relevant to its design.

18.5.4.1.1

a) There should not be conflicting marks on any piece of lifting equipment.
b) The working (rated) load should be visible and readable from the floor or working position.

a) Section is not applicable to the HR601 and HR1001 because lifting equipment per the intent of the section is not relevant to its design.
b) Section is not applicable to the HR601 and HR1001 because lifting equipment per the intent of the section is not relevant to its design.

18.5.4.1.2 The following minimum information should be included:

- Name and address of the manufacturer, or registered trade mark
- Working (rated) load
- Date of construction, and initial testing of that unit, and
- Serial number, if any.

NOTE 95: There are additional marking requirements, imposed by various standards and regulations, depending on equipment type (e.g., hoist, slings, and accessories). The supplier must ensure that such additional information be considered and provided as required. This includes and markings required by directives or regional requirements (e.g., the CE mark for the EU).

Section is not applicable to the HR601 and HR1001 because lifting equipment per the intent of the section is not relevant to its design.

18.5.5 Ergonomic Considerations

18.5.5.1 Lifting equipment is subject to the ergonomic design and assessment criteria, described elsewhere in this Safety Guideline, that that are applicable to the SME. Therefore, ergonomic factors should be considered in the design of lifting equipment.

Section is not applicable to the HR601 and HR1001 because lifting equipment per the intent of the section is not relevant to its design.

18.5.5.2

a) Handles and lifting points should be provided for use on lifting equipment that are to be positioned manually.
b) Handles or coupling points should be positioned such that their use does not promote awkward postures.
c) Postures and space requirements during movement of the lifting equipment should be evaluated as part of the overall ergonomic evaluation of the SME.
Section is not applicable to the HR601 and HR1001 because lifting equipment per the intent of the section is not relevant to its design.

18.5.5.3

It is recommended that handles or coupling points be provided or identified for manually driven axes in an effort to discourage the user from grabbing the load itself or the hoisting rope to maneuver the load in the horizontal plane. However, there are conditions where the controlling of a load in order to place the load into a specific location or orientation will require the user to grab the load itself and provide guidance. This is acceptable, but it is recommended that moving a load more than 5 cm [2 inches], be done using handles or specific coupling points identified on the lifting device for that purpose.

Section is not applicable to the HR601 and HR1001 because lifting equipment per the intent of the section is not relevant to its design.

18.6 Mechanisms Supporting and Moving Hinged Loads

18.6.1 Applicability of Section 18.6

18.6.1.1

Hinges and mechanisms that are constructed as part of the SME and are intended to support and lift nothing other than their associated hinged loads should conform to each applicable criterion of Section 18.6

EXCEPTION: Hinged loads having a total mass not more than 5 kg (11 lb).

Section is not applicable to the HR601 and HR1001 because lifting equipment per the intent of the section is not relevant to its design.

18.6.2 Informative

There are multiple ways by which the energy for movement of a hinged load can be provided:

18.6.2.1 Informative

Direct Human Power—Energy for lifting is supplied by a human and at a rate no greater than that at which it is provided by the human. This type includes simple machines (e.g., a handle mounted opposite a hinge) and complex machines (e.g., a winch driven by a human turning a crank handle which drives, through a series of gears, a drum which retracts a cable which, through a series of pulleys, lifts a load.

18.6.2.2 Informative

Stored Energy—At least some of the energy for lifting is supplied from a part of the mechanism in which it was stored, such as a spring (including a “gas spring”) or a counterweight.

18.6.2.3 Informative

External Power—Energy for lifting is supplied by an external source, such as an electric motor or pneumatic drive cylinder.

18.6.2.4 Combination of direct human power and stored energy.
18.6.2.5 Informative

Combination of external power and stored energy.

18.6.3 Design Criteria for Mechanisms Supporting and Moving Hinged Loads

18.6.3.1

Mechanical Strength—Mechanisms supporting hinged loads (including hinges) should be designed such that they have a minimum factor of safety of 3, where the factor of safety is the ratio of yield strength to stress on each component, in the least favorable condition. For the purposes of Section 18.6, “least favorable condition” is the position and orientation of fixed or moveable elements that places the greatest stress on the components of the support mechanism.

NOTE 96: Mechanisms supporting hinged loads include hinges; support hardware such as springs, gas-filled shocks, and spring dampeners; mounting hardware; and counterbalance mechanisms. This does not mean for example, a gas-filled shock must be “sized” to hold 3 times the mass of the hinged component if it is used only as an ergonomic assist.

NOTE 97: The “least favorable condition” may differ from component to component. Therefore, more than one position may need to be considered in designing and testing to meet this criterion.

NOTE 98: Failure to follow procedure controls (e.g., not venting chamber or removing hardware) may have a significant affect on these structures. It is recommended that such conditions be fully explored using analysis methods listed in Paragraph 18.6.4.2 or other similar methods designed to identify critical deficiencies within a design or process.

Section is not applicable to the HR601 and HR1001 because lifting equipment per the intent of the section is not relevant to its design.

18.6.3.2

Materials should be appropriate for their intended uses. Materials should be chosen with particular consideration to the effects of corrosion, abrasion, impact, and aging.

Section is not applicable to the HR601 and HR1001 because lifting equipment per the intent of the section is not relevant to its design.

18.6.4 Design Verification—The conformance to these criteria should be demonstrated for each mechanism supporting a hinged load, or a representative sample of each such design.

Section is not applicable to the HR601 and HR1001 because lifting equipment per the intent of the section is not relevant to its design.

18.6.4.1 Ergonomic Considerations—Means of moving hinged loads that use “direct human power” (with or without “stored energy”) should be assessed to the applicable sections of Appendix 1 (SESC) of SEMI S8.

Section is not applicable to the HR601 and HR1001 because lifting equipment per the intent of the section is not relevant to its design.
**18.6.4.2**

<table>
<thead>
<tr>
<th>N</th>
<th>Mechanisms supporting and moving hinged loads should undergo verification and testing that includes;</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>• Classical engineering calculations;</td>
</tr>
<tr>
<td></td>
<td>• Risk assessment, such as failure modes and effects analysis (FMEA), and</td>
</tr>
<tr>
<td></td>
<td>• Physical testing under static and dynamic load.</td>
</tr>
</tbody>
</table>

NOTE 99: "Classical engineering calculations" are calculations based on: dimensions and masses of the components of the mechanism, dimensions and mass of the load, and typical characteristics of the materials of which they are constructed.

NOTE 100: Several standards and directives (e.g., ISO 2415 (forged shackles) and 98/37/EC (Machinery Directive)) require keeping records for 10 years or more beyond the time the last unit was produced, tested, and shipped.

Section is not applicable to the HR601 and HR1001 because lifting equipment per the intent of the section is not relevant to its design.

### 18.6.4.3 Static Load Testing

#### 18.6.4.3.1

| N | Static load testing should be conducted on mechanisms supporting and moving hinged loads at 150% of the manufacturer’s intended configured load and with the mechanical elements of the structure in their least favorable conditions. This may be done prior to full integration, such as by using a test fixture, or after full integration. |

NOTE 101: The term “full integration” refers to the level of assembly where the moveable part of the hinge is attached to its static hinge portion as required to complete the SME assembly.

Section is not applicable to the HR601 and HR1001 because lifting equipment per the intent of the section is not relevant to its design.

#### 18.6.4.3.2

<table>
<thead>
<tr>
<th>Informative</th>
</tr>
</thead>
<tbody>
<tr>
<td>See Paragraph 18.6.3.1 for guidance as to determining the &quot;least favorable condition.”</td>
</tr>
</tbody>
</table>

#### 18.6.4.3.3

<table>
<thead>
<tr>
<th>N</th>
</tr>
</thead>
<tbody>
<tr>
<td>The static test should be conducted for a minimum of 2 minutes beyond the time that the test load has stabilized (stopped moving).</td>
</tr>
</tbody>
</table>

Section is not applicable to the HR601 and HR1001 because lifting equipment per the intent of the section is not relevant to its design.

#### 18.6.4.3.4

<table>
<thead>
<tr>
<th>N</th>
</tr>
</thead>
<tbody>
<tr>
<td>A static test should be considered acceptable if no permanent deformation or other physical damage is found once the test load has been removed and equipment examined. A static test resulting in damage or abnormality should be considered to be a failing test.</td>
</tr>
</tbody>
</table>

NOTE 102: Static load test (proof load testing) of a new design is part of the process of validating the design’s maximum working load.

Section is not applicable to the HR601 and HR1001 because lifting equipment per the intent of the section is not relevant to its design.

### 18.6.4.4 Dynamic Load Testing
18.6.4.4. 1
Dynamic load testing should be conducted on hinged loads at 100 percent of the manufacturer's intended configured load.  
NOTE 103: Dynamic load testing is conducted to confirm that equipment has been properly assembled and that all 
operational features, including mechanical stops, limit switches, brakes (if fitted) and all safety related features are fully 
adjusted and operational.

Section is not applicable to the HR601 and HR1001 because lifting equipment per the intent of the section is not relevant to its design.

18.6.4.4. 2
Dynamic load testing should be conducted for a minimum of five complete cycles at maximum operational speed of each 
axis of motion.  
NOTE 104: Dynamic testing of a hinged load at 100 percent of the manufacturer’s intended configured load is a different 
test that than specified in Section 18.5 for lifting equipment.  The latter has a more severe load condition than that stated 
for hinged loads and as such, may likely highlight areas of concern within two cycles of operation.  For testing of hinged 
loads, it was felt that additional operational cycles should be performed, allowing more opportunity for the mechanism to 
be exercised and areas of concern amply reviewed.

Section is not applicable to the HR601 and HR1001 because lifting equipment per the intent of the section is not relevant to its design.

18.6.4.4. 3
Dynamic testing using human power should be performed at speeds that do not put the human at unacceptable risk.

Section is not applicable to the HR601 and HR1001 because lifting equipment per the intent of the section is not relevant to its design.

18.6.4.4. Acceptance Criteria

18.6.4.4. 4.1
There should be no noticeable signs of improper assembly.

Section is not applicable to the HR601 and HR1001 because lifting equipment per the intent of the section is not relevant to its design.

18.6.4.4. 4.2
There should be no noticeable signs of excessive wear.

Section is not applicable to the HR601 and HR1001 because lifting equipment per the intent of the section is not relevant to its design.

18.6.4.4. 4.3
There should be no noticeable signs of improper operation or incorrect adjustment of operational features, including 
mechanical stops, limit switches, and brakes (if fitted).

Section is not applicable to the HR601 and HR1001 because lifting equipment per the intent of the section is not relevant to its design.
Section is not applicable to the HR601 and HR1001 because lifting equipment per the intent of the section is not relevant to its design.

18.6.4.4.

4.4

There should be no noises that indicate a problem other than that a simple adjustment is required.

Section is not applicable to the HR601 and HR1001 because lifting equipment per the intent of the section is not relevant to its design.

18.6.4.4.

4.5

All safety features should be operational and perform their intended function.

Section is not applicable to the HR601 and HR1001 because lifting equipment per the intent of the section is not relevant to its design.

18.6.4.4.

4.6

There should be no permanent set (yielding) of any mechanical or structural member.

Section is not applicable to the HR601 and HR1001 because lifting equipment per the intent of the section is not relevant to its design.

18.6.4.5

Documentation of Testing

18.6.4.5.

1

A written report should be prepared and should include:

- Written test specifications,
- Photographs or drawings of how the testing was conducted, and
- Results of all tests.

Section is not applicable to the HR601 and HR1001 because lifting equipment per the intent of the section is not relevant to its design.

18.6.4.5.

2

Documentation, including the elements in Sections 18.6.3 – 18.6.4.5.1, and Section 9.6.3 (user documentation), should be prepared and kept for sufficient time to support the equipment while in service and for sufficient time (typically a minimum of ten years) after the equipment is placed on the market. Conformance with this criterion may be demonstrated by making the documentation from design verification available to the assessor and providing the assessor evidence that the equipment supplier has a program that will retain the records for an appropriate period.

Section is not applicable to the HR601 and HR1001 because lifting equipment per the intent of the section is not relevant to its design.

18.6.5

Subsequently Produced Lifting Equipment—Each hinged load assembly supporting and moving a hinged load should be tested in accordance with Section 18.6.4.4 and have records kept in accordance with Section 18.6.4.5. Test certificates should accompany each unit upon delivery. The supplier should retain a copy of test records for at least 10 years from the date of shipment.

Section is not applicable to the HR601 and HR1001 because lifting equipment per the intent of the section is not relevant to its design.
18.7 | Extreme Temperatures
---
N
Surfaces that are accessible to personnel, and that are at high (per temperature limits in Table 1) or very cold temperatures (below -10° C [14° F]), should be fitted with guards or designed out.

Section is not applicable to the HR601 and HR1001 because there are no accessible surfaces of the product that have high temperatures.

18.7.1 | Where it is not feasible to protect or design out the exposures to extreme temperature, temperatures exceeding the limits are permitted, provided that either of the following conditions is met:
- Unintentional contact with such a surface is unlikely; or
- The part has a warning indicating that the surface is at a hazardous temperature.

Section is not applicable to the HR601 and HR1001 because there are no accessible surfaces of the product that have high temperatures.

### Table 1 Potentially Hazardous Surface Temperatures

<table>
<thead>
<tr>
<th>Accessible Parts</th>
<th>Maximum Surface Temperature, in °C</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Metal</td>
</tr>
<tr>
<td>Handles, knobs, grips, etc., held or touched for short periods (5 seconds or less) in normal use</td>
<td>60</td>
</tr>
<tr>
<td>Handles, knobs, grips, etc. held continuously in normal use</td>
<td>51</td>
</tr>
<tr>
<td>External surfaces of equipment, or parts inside the equipment, that may be touched</td>
<td>65</td>
</tr>
</tbody>
</table>
### 19. Seismic Protection

#### 19.1 General

<table>
<thead>
<tr>
<th>General</th>
<th>The equipment should be designed to control the risk of injury to personnel, adverse environmental impact, equipment and facility damage due to movement, overturning, or leakage of chemicals (including liquid splashing), during a seismic event. The design should also control equipment damage due to failure of fragile parts (e.g., quartzware, ceramics) during a seismic event.</th>
</tr>
</thead>
<tbody>
<tr>
<td>NOTE 105:</td>
<td>Users have facilities located in areas that are susceptible to seismic activity. The end user may require more stringent design criteria because of increased site vulnerability (e.g., local soil conditions and building design may produce significantly higher accelerations) and local regulatory requirements. Certified drawings and calculations may be required in some jurisdictions.</td>
</tr>
<tr>
<td>NOTE 106:</td>
<td>These criteria are intended to accomplish two things: (1) Allow equipment suppliers to design correctly the internal frame and components to withstand seismic forces; and (2) Allow equipment designers to provide end-users with the information needed to appropriately secure the equipment within their facility.</td>
</tr>
</tbody>
</table>

Section is not applicable to the HR601 and HR1001 because the equipment is a component of a larger system that is intended to be rack mounted. Seismic protection needs to be calculated and justified in the end application.

#### 19.1.1 Design Loads

<table>
<thead>
<tr>
<th>Design Loads</th>
<th>The equipment, subassemblies, and all devices used for anchoring the equipment should be designed as follows:</th>
</tr>
</thead>
<tbody>
<tr>
<td>NOTE 107:</td>
<td>It is recommended that the hazard analysis described in Section 6.8 be used to evaluate both the risk of part failure and the effectiveness of control measures.</td>
</tr>
</tbody>
</table>

Section is not applicable to the HR601 and HR1001 because it does not possess parts that are likely to sustain damage in a seismic event to result in the emergence of hazardous situations.

| These parts should be accessible for evaluation of damage. |
| --- | --- |
| NOTE 108: | SEMI S8 contains guidelines for maintainability and serviceability; these may be used to determine accessibility. |

Section is not applicable to the HR601 and HR1001 because such parts are not relevant to the design.

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Seren IPS Inc  
Eue, HR601 and HR1001  
Report/file no.: 31072336.002  
Page: 62 of 93  
QF1307S20310RT Rev. 0
19.2.1 N
For equipment containing hazardous production materials (HPMs), the equipment should be designed to withstand a horizontal loading of 94% of the weight of the equipment, acting at the equipment’s center of mass.

Section is not applicable to the HR601 and HR1001 because the equipment is a component of a larger system that is intended to be rack mounted. Seismic protection needs to be calculated and justified in the end application.

19.2.2 N
For equipment not containing hazardous production materials (HPMs), the equipment should be designed to withstand a horizontal loading of 63% of the weight of the equipment, acting at the equipment’s center of mass.

NOTE 109: Subassemblies may include transformers, vessels, power supplies, vacuum pumps, monitors, fire suppression components, or other items of substantial mass that are attached to the equipment.

Section is not applicable to the HR601 and HR1001 because it does not use hazardous material.

19.2.3 N
Horizontal loads should be calculated independently on each of the X- and Y-axes, or on the axis that produces the largest loads on the anchorage points.

Section is not applicable to the HR601 and HR1001 because the equipment is a component of a larger system that is intended to be rack mounted. Seismic protection needs to be calculated and justified in the end application.

19.2.4 N
When calculating for overturning, a maximum value of 85% of the weight of the equipment should be used to resist the overturning moment.

NOTE 110: Because equipment may be placed into service anywhere in the world, it is recommended that the seismic protection design of the equipment be based upon requirements that allow the equipment, as designed, to be installed in most sites worldwide. The above loads are based on 1997 Uniform Building Code (UBC) requirements for rigid equipment in Seismic Zone 4, and are assumed to satisfy most design situations worldwide.

NOTE 111: If the equipment or internal component is flexible as defined by the UBC, is located above the midheight of the building, or is within 5 km of a major active fault, the horizontal design loadings in Sections 19.2.1 and 19.2.2 may not be conservative. Likewise, there are several conditions for which the horizontal design loadings are overly conservative (e.g., rigid equipment with rigid internal components located at grade, or sites with favorable soils conditions). For these conditions, designing based on the more detailed approach in the UBC may result in a more economical design. It is recommended that the user engage a professional mechanical, civil, or structural engineer to make these determinations.

Section is not applicable to the HR601 and HR1001 because the equipment is a component of a larger system that is intended to be rack mounted. Seismic protection needs to be calculated and justified in the end application.
19.3 Provision of data

The supplier should provide the following data and procedures to the user. This information should be included in the installation instructions as part of the documentation covered in Section 9.

- A drawing of the equipment, its support equipment, its connections (e.g., ventilation, water, vacuum, gases) and the anchorage locations identified in Section 19.4.
- The type of feet used and their location on a base frame plan drawing.
- The weight distribution on each foot.
- Physical dimensions, including width, length, and height of each structurally independent module.
- Weight and location of the center of mass for each structurally independent module.
- Acceptable locations on the equipment frame for anchorage.

NOTE 112: A “structurally independent module” reacts to seismic loads by transferring substantially all of the loads to its own anchorages, as opposed to transferring the loads to adjacent modules.

Section is not applicable to the HR601 and HR1001 because the equipment is a component of a larger system that is intended to be rack mounted. Seismic protection needs to be calculated and justified in the end application.

19.4 Tie-ins, attachments, or seismic anchorage points

The locations of the tie-ins, attachments, or seismic anchorage points should be clearly identified.

NOTE 113: It is not the intent of SEMI S2 that the supplier provide the seismic attachment point hardware. Such hardware may be provided as agreed upon between supplier and user.

NOTE 114: It is the responsibility of the user to verify that the vibration isolation, leveling, seismic reinforcing, and load distribution is adequate.

Section is not applicable to the HR601 and HR1001 because the equipment is a component of a larger system that is intended to be rack mounted. Seismic protection needs to be calculated and justified in the end application.
## 20. Automated Material Handlers

### 20.1 Informative
This section covers automated material handlers, which include:
- Substrate handlers;
- Industrial robots and industrial robot systems; and
- Unmanned transport vehicles (UTVs).

**NOTE 115:** Substrate handlers typically handle a single substrate at a time, and are distinguished from industrial robots by their small load capacity.

### 20.2 General
The means of incorporating personnel safeguarding into automated material handlers should be based on a hazard analysis. The hazard analysis should include consideration of the size, capacity, speed, and spatial operating range of the handler.

Section is not applicable to the HR601 and HR1001 because the equipment has no automated material handlers.

### 20.2.1 Subsystem Stops
- **If a separate stop button is used for the automated material handler, it should be differentiated from the EMO button.**

Section is not applicable to the HR601 and HR1001 because the equipment has no automated material handlers.

### 20.3 Substrate Handlers
See Section 20.2, General.

Section is not applicable to the HR601 and HR1001 because the equipment has no automated material handlers.

### 20.4 Industrial Robots and Industrial Robot Systems
Industrial robots and industrial robot systems should meet the requirements of appropriate national or international standards, e.g., ANSI/RIA R15.06, ISO 10218, EN 775. If there are deviations from these standards because of semiconductor applications of the robot, these deviations may be found acceptable based on risk assessments.

**TÜV RHEINLAND NOTE:** EN 775 is no longer valid and replaced by EN ISO 10218-1.

Section is not applicable to the HR601 and HR1001 because the equipment has no robots.
20.5 UTVs

NOTE 116: There are two basic types of UTVs:
(1) the floor-traveling (including both rail-guided and rail-independent) UTV, that automatically travels on the floor to a specified destination where it is unloaded or loaded; and
(2) the space-traveling UTV, which automatically travels without resting on the floor (e.g., in the space below the ceiling) to a specified destination where it is loaded or unloaded. UTVs do not include rail-guided mechanisms that are attached to equipment (such as in wet benches).

20.5.1 Collision Avoidance — UTVs generally travel in wide areas and are used in a system rather than stand alone operation. UTVs should be equipped with a non-contact approach sensing device so that they do not inadvertently contact people or other objects.

Section is not applicable to the HR601 and HR1001 because UTVs are not employed in or with the equipment.

20.5.2 UTVs: Loading and Unloading Equipment

20.5.2.1 UTVs should be interlocked with equipment such as semiconductor process equipment, automated load ports, stockers, ground-based conveyors, and automated warehouses as needed to ensure that the load remains secure and that the UTV and transfer components are not in conflict with one another.

Section is not applicable to the HR601 and HR1001 because UTVs are not relevant to the design.

20.5.2.2 If loading results in an unsafe condition, the equipment should detect and indicate the condition, and movement of all loading equipment should stop immediately. The system should not reset or restart automatically.

Section is not applicable to the HR601 and HR1001 because UTVs are not relevant to the design.
## 21. Environmental Considerations

### 21.1 Informative

This section covers environmental impacts throughout the life of the equipment.

**NOTE 117:** It is recommended that environmental impacts be balanced against other factors, including safety and health, legal, and regulatory requirements.

**NOTE 118:** It is recommended that the manufacturer maintain awareness of relevant environmental regulations, either internally or through the user.

**NOTE 1119:** The user is responsible for providing the manufacturer with information regarding any environmental restrictions that are specific to a given site and that may impact equipment design (e.g., cumulative emissions limits, permit requirements, site-specific programs).

**NOTE 1120:** See Section 14 for fire suppression emission issues.

**NOTE 1121:** References to “process” in this section are meant to refer to the baseline process.

### 21.2 Design

#### 21.2.1 Informative

The following design guidelines apply to all phases of equipment life, from concept to decommissioning to disposal.

**NOTE 122:** The documentation described in Sections 8.5.3 and 9.4 provide information that can be used for evaluating conformance to this section.

#### 21.2.2 Resource Conservation

**C** The manufacturer should consider resource conservation (i.e., reduction, reuse, recycling) during equipment design, for example:

- Water reuse or water recycling within the equipment;
- Reduced chemical consumption, energy use, and water use (e.g., reducing resource use when no process is occurring);
- Reduced use of resources during maintenance procedures (e.g., parts cleaning procedures could include minimum rinse rates and rinse times);
- Recycling or reusing chemicals in the equipment, rather than consuming only new materials;
- Reducing volume of packaging, increasing recycled content of packaging, and/or designing reusable packaging.

HR601 and HR1001 conform to the stated criteria because the materials used in its construction meet, as far as reasonably practicable, the considerations of this section for resource conservation.

Note: The design does not employ process chemicals, produce effluents or require consumables other than small quantities of lubricant and replacement lamps.

### 21.2.3 Chemical Selection

**N** a) Chemical selection for process, maintenance, and utility uses (e.g., gases, etchants, strippers, cleaners, lubricants, and coolants) should take into account effectiveness, environmental impacts, volume, toxicity, by-products, decommissioning, disposal, and recyclability; use of the least hazardous chemical is preferred.

b) To the extent practicable, the utilities, maintenance, and process should be designed so that the equipment operates without the use of:

- Ozone depleting substances (ODSs) as identified by the Montreal Protocol, such as chlorofluorocarbons (CFCs), methylchloroform, hydrochlorofluorocarbons (HCFCs), and carbon tetrachloride, or
- Perfluorocompounds (PFCs), including CF4, C2F6, NF3, C3F8, and SF6, and CHF3 due to their global warming potential.
Section is not applicable to the HR601 and HR1001 because it does not utilize toxic chemistries or substances capable of having a known deleterious effect upon the environment.

Section is not applicable to the HR601 and HR1001 because it does not utilize toxic chemistries or substances capable of having a known deleterious effect upon the environment.

### 21.2.4 Prevention and Control of Unintended Releases

#### 21.2.4.1 Equipment design, including feed, storage, and waste collection systems, should prevent potential unintended releases. At a minimum:

Section is not applicable to the HR601 and HR1001 because substances capable of adversely affecting the environment are not relevant to the design.

#### 21.2.4.2 Secondary containment for liquids should be capable of holding at least 110% (see first row of Table A2-1 of Appendix 2) of the volume of the single largest container, or the largest expected volume for any single point failure.

**NOTE 123:** In some circumstances secondary containment may be specified by the equipment supplier, but provided by the user.

Section is not applicable to the HR601 and HR1001 because substances capable of adversely affecting the environment are not relevant to the design.

#### 21.2.4.3 Chemical storage containers and secondary containment should be designed for accessibility and easy removal of collected material.

Section is not applicable to the HR601 and HR1001 because substances capable of adversely affecting the environment are not relevant to the design.

#### 21.2.4.4 Secondary containment should have alarms and gas detection or liquid sensing, as appropriate, or have recommended sensing points identified in the equipment installation instructions.

Section is not applicable to the HR601 and HR1001 because substances capable of adversely affecting the environment are not relevant to the design.

#### 21.2.4.5 Equipment design should allow personnel to determine all in-equipment container levels conveniently without having to open the containers, where ignorance of the level could result in an inadvertent release.

Section is not applicable to the HR601 and HR1001 because substances capable of adversely affecting the environment are not relevant to the design.
<table>
<thead>
<tr>
<th>Section</th>
<th>Status</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>21.2.4.6</td>
<td>N</td>
<td>Overfill level detectors and alarms should be provided for in-equipment containers.&lt;br&gt;Section is not applicable to the HR601 and HR1001 because substances capable of adversely affecting the environment are not relevant to the design.</td>
</tr>
<tr>
<td>21.2.4.7</td>
<td>N</td>
<td>Secondary containment and other control systems should be designed to ensure that chemicals cannot be combined, where the combination could result in an inadvertent release.&lt;br&gt;Section is not applicable to the HR601 and HR1001 because substances capable of adversely affecting the environment are not relevant to the design.</td>
</tr>
<tr>
<td>21.2.4.8</td>
<td>N</td>
<td>a) Equipment components should be compatible with chemicals used in the manufacturing process.&lt;br&gt;b) Chemical systems should be designed for the specified operating conditions, and have sufficient mechanical strength and corrosion resistance for the intended use.&lt;br&gt;a) Section is not applicable to the HR601 and HR1001 because substances capable of adversely affecting the environment are not relevant to the design.&lt;br&gt;b) Section is not applicable to the HR601 and HR1001 because substances capable of adversely affecting the environment are not relevant to the design.</td>
</tr>
<tr>
<td>21.2.4.9</td>
<td>N</td>
<td>Equipment should be able to accept a signal from a monitoring device and stop the supply of chemical, at the first non-manual valve within the affected system.&lt;br&gt;Section is not applicable to the HR601 and HR1001 because substances capable of adversely affecting the environment are not relevant to the design.</td>
</tr>
<tr>
<td>21.2.4.10</td>
<td>N</td>
<td>Chemical distribution systems should be capable of automatic shutoff and remote shutdown.&lt;br&gt;Section is not applicable to the HR601 and HR1001 because substances capable of adversely affecting the environment are not relevant to the design.</td>
</tr>
</tbody>
</table>

**21.2.5 Informative**<br>**Effluents, Wastes, and Emissions**<br>NOTE 124: It is recommended that the manufacturer document its efforts to minimize the equipment’s generation of hazardous wastes, solid wastes, wastewater, and air emissions.<br>NOTE 125: It is recommended that SEMI F5 be used for guidance in gaseous effluent handling.
21.2.5.1 Equipment design that allows connection to a central waste collection system is preferred, except where collection at the equipment may facilitate recycling or reuse opportunities or otherwise reduce environmental impacts.

NOTE 126: It is recommended that individual drains and exhausts be kept separate (e.g., separate outlets for acid drain, solvent drain, deionized (DI) water drain; acid exhaust, solvent exhaust).

Section is not applicable to the HR601 and HR1001 because substances capable of adversely affecting the environment are not relevant to the design.

21.2.5.1.1 Point-of-use collection containers should be designed for accessibility as well as the possible reuse and recycling of the collected materials.

Section is not applicable to the HR601 and HR1001 because substances capable of adversely affecting the environment are not relevant to the design.

21.2.5.2 Equipment should use partitions, double-contained lines, or other similar design features to prevent the mixing of incompatible waste streams.

Section is not applicable to the HR601 and HR1001 because substances capable of adversely affecting the environment are not relevant to the design.

21.2.5.3 The manufacturer should evaluate the feasibility of including integrated controls for effluent and emission treatment.

Section is not applicable to the HR601 and HR1001 because substances capable of adversely affecting the environment are not relevant to the design.

21.2.5.4 Dilution in excess of process or safety requirements should not be used to reduce contaminant discharge concentrations.

Section is not applicable to the HR601 and HR1001 because substances capable of adversely affecting the environment are not relevant to the design.

21.2.5.5 Segregation of effluents, wastes, and emissions should be provided in the following cases:

- Where chemically incompatible;
- Where segregation facilitates recycling or reuse; or
- Where separate abatement or treatment methods are required.

NOTE 127: It is recommended that the equipment design documentation show evidence of consideration of by-products generated during equipment operation, clean-up, maintenance, and repair. By-products can include deposits in drains or ducts, and replaceable parts (e.g., batteries, vapor lamps, contaminated parts).
Section is not applicable to the HR601 and HR1001 because substances capable of adversely affecting the environment are not relevant to the design.

21.2.6 Decommissioning and Disposal

21.2.6.1 C Equipment design should address (see Section 8.5.3 for documentation provisions) construction material and component reuse, refurbishment, and recycling.

HR601 and HR1001 conform to the stated criteria because it was designed, as far as reasonably practicable, with considerations given over to component reuse, refurbishment and recycling.
Note: The majority of the raw materials used in the construction of the equipment are readily reusable or recyclable.

21.2.6.2 N The equipment should be designed to facilitate equipment decontamination and disposal, e.g., by use of removable liners or replaceable modules. This includes minimizing the number of parts that become contaminated with hazardous materials.
NOTE 128: It is recommended that SEMI S12 "Guidelines for Equipment Decontamination" be used for guidance during equipment decontamination.

N Section is not applicable to the HR601 and HR1001 because it does not utilize toxic chemistries or substances capable of adversely affecting the environment to necessitate decontamination provisions.
## 22. Exhaust Ventilation

<table>
<thead>
<tr>
<th>22.1</th>
<th>General</th>
<th>Equipment exhaust ventilation should be designed to prevent potentially hazardous chemical exposures to employees as follows:</th>
</tr>
</thead>
<tbody>
<tr>
<td>N</td>
<td></td>
<td>Section is not applicable to the HR601 and HR1001 because it does not feature exhaust ventilation. The design does not utilize toxic chemistries or hazardous substances to necessitate exhaust provisions for control of potential airborne chemical exposures.</td>
</tr>
</tbody>
</table>

| 22.1.1 | N | As primary control when normal operations present potentially hazardous chemical exposures to employees by diffusive emissions that cannot be otherwise prevented or controlled (e.g., wet decks, spin coaters). NOTE 129: In the context of this section, "primary control" means that it is the control of first choice (e.g., rather than personal protective equipment). |
|        | | Section is not applicable to the HR601 and HR1001 because exhaust ventilation is not relevant to the design. |

| 22.1.2 | N | As supplemental control when intermittent activities (e.g., chamber cleaning, implant source housing cleaning) present potentially hazardous chemical exposures to employees which cannot reasonably be controlled by other means. Supplemental exhaust hoods or enclosures may be integrated into the equipment design, or supplied completely by the equipment user. |
|        | | Section is not applicable to the HR601 and HR1001 because exhaust ventilation is not relevant to the design. |

| 22.1.2.1 | N | When a procedure (e.g., cleaning) specified by the supplier requires exhaust ventilation, the supplier should include the minimum criteria for exhaust during the procedure. |
|          | | Section is not applicable to the HR601 and HR1001 because exhaust ventilation is not relevant to the design. |

| 22.1.3 | N | As secondary control when a single-point failure presents the potential for employee exposures to hazardous materials. and this exposure cannot be controlled by other means (e.g., use of all welded fittings). EXCEPTION: Secondary exhaust control enclosures for non-welded connections (e.g., valve manifold boxes that enclose piping jungles) are not included in this guideline for those hazardous gases that are transported below atmospheric pressure (e.g., via vacuum piping systems) if it can be demonstrated that equivalent leak protection is provided. Equivalent protection may include such things as equipping the vacuum delivery system with a fail-safe (e.g., to close) valve automatically activated by a loss of vacuum pressure. Loss of vacuum pressure should also activate a visual and audible alarm provided in visual or audible range of the operator. |
|        | | Section is not applicable to the HR601 and HR1001 because exhaust ventilation is not relevant to the design. |
### Exhaust ventilation design

<table>
<thead>
<tr>
<th></th>
<th>Exhaust ventilation design</th>
</tr>
</thead>
<tbody>
<tr>
<td>N</td>
<td>a) Equipment exhaust ventilation should be designed and a ventilation assessment conducted in accordance with both Section 23.5 and SEMI S6, to control, efficiently and safely, for potential worst-case, realistic employee exposures to chemicals during normal operation, maintenance, or failure of other equipment components (hardware or software).</td>
</tr>
<tr>
<td></td>
<td>b) All design criteria and test protocols should be based on recognized methods. See also Section 23.3.</td>
</tr>
</tbody>
</table>

**a)** Section is not applicable to the HR601 and HR1001 because exhaust ventilation is not relevant to the design.

**b)** Section is not applicable to the HR601 and HR1001 because exhaust ventilation is not relevant to the design.

### Exhaust documentation

<table>
<thead>
<tr>
<th></th>
<th>Exhaust documentation</th>
</tr>
</thead>
<tbody>
<tr>
<td>N</td>
<td>Documentation should be developed showing the equipment exhaust parameters and relevant test methods, and should include:</td>
</tr>
<tr>
<td></td>
<td>▪ Duct velocity (where needed to transport solid particles);</td>
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<tr>
<td></td>
<td>▪ Volumetric flow rate Q;</td>
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<tr>
<td></td>
<td>▪ Capture velocity (where airborne contaminants are generated outside an enclosure);</td>
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<tr>
<td></td>
<td>▪ Face velocity (where applicable);</td>
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<tr>
<td></td>
<td>▪ Hood static pressure SPh;</td>
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<tr>
<td></td>
<td>▪ Duct diameter at the point of connection to facilities; and</td>
</tr>
<tr>
<td></td>
<td>▪ Location(s) on the duct or hood where all ventilation measurements were taken.</td>
</tr>
</tbody>
</table>

Section is not applicable to the HR601 and HR1001 because exhaust ventilation is not relevant to the design.

### Exhaust flow interlocks

<table>
<thead>
<tr>
<th></th>
<th>Exhaust flow interlocks</th>
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</thead>
<tbody>
<tr>
<td>N</td>
<td>Exhaust flow interlocks should be provided by the manufacturer on all equipment that uses hazardous production materials (HPMs) where loss of exhaust may create a hazard. Flow (e.g., pitot probe) or static pressure (e.g., manometer) switches are the preferred sensing methods.</td>
</tr>
<tr>
<td></td>
<td>NOTE 130: Sail switches (switches that are connected to a lever that relies upon air velocity to activate) are generally not recommended.</td>
</tr>
<tr>
<td></td>
<td>NOTE 131: It is recommended that the pressure or flow measuring point be located upstream of the first damper.</td>
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<tr>
<td></td>
<td>NOTE 132: Section 11 contains provisions for safety interlocks.</td>
</tr>
</tbody>
</table>

Section is not applicable to the HR601 and HR1001 because exhaust ventilation is not relevant to the design.
22.4.1

a) When the exhaust falls outside the prescribed limits (i.e., below the minimum or above the maximum specified by the equipment supplier), an alarm should be provided within audible or visible range of the operator, and the process equipment should be placed in a safe stand-by mode. A time delay for the equipment to go into standby mode may be allowable, based on an appropriate risk assessment.

b) The system should be capable of interfacing with the facility alarm system.

NOTE 133: If exhaust is being monitored by only a flow sensing device, abnormally high flow may well indicate an unacceptable condition. For example, if a door to an enclosure is open, the flow will be abnormally high, but the differential pressure will be abnormally low and the flow pattern will be substantially changed. If such conditions present an unacceptable risk, the equipment supplier needs to specify an upper setpoint for a flow monitor. However, if excess flow conditions are acceptable, the upper limit can be infinite, thereby making it impossible for the flow to exceed the upper setpoint and obviating the need for an alarm.

NOTE 134: It is recommended that non-HPM chemical process exhaust be equipped with audible and visible indicators only.

a) N Section is not applicable to the HR601 and HR1001 because exhaust ventilation is not relevant to the design.

b) N Section is not applicable to the HR601 and HR1001 because exhaust ventilation is not relevant to the design.

22.4.2

N Exhaust flow interlocks and alarms should require manual resetting.

Section is not applicable to the HR601 and HR1001 because exhaust ventilation is not relevant to the design.

22.4.3

N Exhaust flow interlocks should be fault-tolerant.

Section is not applicable to the HR601 and HR1001 because exhaust ventilation is not relevant to the design.

22.5

Equipment and equipment components

N Equipment and equipment components should be designed using good ventilation principles and practices to ensure chemical capture and to optimize exhaust efficiency.

NOTE 135: It is recommended that exhaust optimization be achieved with total equipment static pressure requirements of -10 to -375 Pa (-1 to –38mm H2O or -0.05 to -0.15 inches H2O). See also Section 6.6 of SEMI S6-0707.

NOTE 136: Related Information 16 contains recommendations on design.

Section is not applicable to the HR601 and HR1001 because exhaust ventilation is not relevant to the design.
### 23. Chemicals

#### 23.1 General

| N | a) The manufacturer should generate a chemical inventory identifying the chemicals anticipated to be used or generated in the equipment. At a minimum, this should include chemicals in the recipe used for equipment qualification or "baseline" recipe, as well as intended reaction products and anticipated by-products.  
|   | b) Chemicals on this list that can be classified as hazardous production materials (HPMs), or odorous (odor threshold <1 ppm) or irritant chemicals (according to their material safety data sheets), should also be identified.  

| N | a) Section is not applicable to the HR601 and HR1001 because it does not utilize controlled or harmful substances that fall within the scope of this Section 23.  
|   | b) Section is not applicable to the HR601 and HR1001 because it does not utilize chemicals that are classified as hazardous production materials.  

#### 23.2 Hazard analysis

| N | A hazard analysis (see Section 6.8) should be used as an initial determination of chemical risk as well as to validate that the risk has been controlled to an appropriate level.  

| N | Section is not applicable to the HR601 and HR1001 because hazardous production materials or harmful substances are not relevant to the design.  

| N | The hazard analysis, at a minimum, should address the following conditions:  
|   | • Potential mixing of incompatible chemicals;  
|   | • Potential chemical emissions during routine operation;  
|   | • Potential chemical emissions during maintenance activities; and  
|   | • Potential key failure points and trouble spots (e.g., fittings, pumps).  

| N | Section is not applicable to the HR601 and HR1001 because hazardous production materials or harmful substances are not relevant to the design.  

| N | All routes of exposure (e.g. respiratory, dermal) should be considered in exposure assessment.  

| N | Section is not applicable to the HR601 and HR1001 because hazardous production materials or harmful substances are not relevant to the design.  

#### 23.3 Order of preference

| N | The order of preference for controls in reducing chemical-related risks is as follows:  

| N | Substitution or elimination (see also Section 21.2.2);  

Section is not applicable to the HR601 and HR1001 because hazardous production materials or harmful substances are not relevant to the design.

### 23.3.2

| N | Engineering controls (e.g., enclosure, ventilation, interlocks); |
| N | Section is not applicable to the HR601 and HR1001 because hazardous production materials or harmful substances are not relevant to the design. |

### 23.3.3

| N | Administrative controls (e.g., written warnings, standard operating procedures); |
| N | Section is not applicable to the HR601 and HR1001 because hazardous production materials or harmful substances are not relevant to the design. |

### 23.3.4

| N | Personal protective equipment. |
| N | Section is not applicable to the HR601 and HR1001 because hazardous production materials or harmful substances are not relevant to the design. |

### 23.4

| N | Design of engineering controls |
| N | The design of engineering controls (e.g., enclosure, ventilation, interlocks) should include consideration of (see also Appendix 2): |
| N | - Pressure requirements; |
| N | - Materials incompatibility; |
| N | - Equipment maintainability; |
| N | - Chemical containment; and |
| N | - Provisions for exhaust ventilation (see Section 22). |

| N | Section is not applicable to the HR601 and HR1001 because hazardous production materials or harmful substances are not relevant to the design. |

### 23.5

| N | Assessments, measurements and reports |
| N | a) During equipment development, the supplier should conduct an assessment that documents conformance to the following airborne chemical control criteria. |
| N | b) All measurements should be taken using recognized methods with documented sensitivities and accuracy. |
| N | c) A report documenting the survey methods, equipment operating parameters, instrumentation used, calibration data, results, and discussion should be available. |

| N | Section is not applicable to the HR601 and HR1001 because hazardous production materials or harmful substances are not relevant to the design. |
Section is not applicable to the HR601 and HR1001 because hazardous production materials or harmful substances are not relevant to the design.

23.5.1

There should be no chemical emissions to the workplace environment during normal equipment operation. Conformance to this subsection can be shown by demonstrating ambient air concentrations to be less than 1% of the Occupational Exposure Limit (OEL) in the worst-case personnel breathing zone. Where a recognized method does not provide sufficient sensitivity to measure 1% OEL, then the lower detection limit of the method may be used to satisfy this criterion.

Section is not applicable to the HR601 and HR1001 because hazardous production materials or harmful substances are not relevant to the design.

23.5.2

Chemical emissions during maintenance activities should be minimized. Conformance to this subsection can be shown by demonstrating ambient air concentrations to be less than 25% of the OEL, in the anticipated worst-case personnel breathing zone, during maintenance activities.

Section is not applicable to the HR601 and HR1001 because hazardous production materials or harmful substances are not relevant to the design.

23.5.3

Chemical emissions during equipment failures should be minimized. Conformance to this subsection can be shown by demonstrating ambient air concentrations to be less than 25% of the OEL, in the anticipated worst-case personnel breathing zone, during a realistic worst-case system failure.

NOTE 137: The use of direct reading instrumentation under simulated operating, maintenance, or failure conditions is the preferred measurement method. Where used, it is recommended that the sample location(s) be representative of the worst-case, realistic exposure location(s). It is recommended that the peak concentration be directly compared to the OEL to demonstrate conformance to Sections 23.5.1 – 23.5.3.

NOTE 138: It is recommended that integrated sampling methods be used when direct-reading instrumentation does not have adequate sensitivity, or when direct-reading technology is not available for the chemicals of interest. Where integrated sampling is used, it is recommended that the sample duration and locations(s) be representative of the worst-case, realistic, anticipated exposure time and locations. The resulting average concentration is directly compared to the OEL to demonstrate conformance to subsections 23.5.1 – 23.5.3.

NOTE 139: Tracer gas testing (see Appendix 2 of SEMI S6 for an acceptable method) may be used when direct-reading instrumentation does not have adequate sensitivity, or when direct-reading technology is not available for the chemicals of interest. Tracer gas testing should be used where testing conditions may be hazardous (e.g., system failure simulation with potential release of hazardous gas to atmosphere). It is recommended that tracer gas testing be used only when an accurate rate of chemical emission can be determined. Where used, it is recommended that the sample location(s) be representative of the worst-case, realistic exposure location(s).

Section is not applicable to the HR601 and HR1001 because hazardous production materials or harmful substances are not relevant to the design.

23.5.4

Chemical emissions outside the enclosure during a realistic worst-case system failure should be less than the lower of the following two values: 25% of the lower explosive limit (LEL), or 25% of the OEL.

Section is not applicable to the HR601 and HR1001 because hazardous production materials or harmful substances are not relevant to the design.
### 23.6 Hazardous gases

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<tbody>
<tr>
<td><strong>N</strong></td>
<td><strong>N</strong></td>
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</tbody>
</table>

| a) | Section is not applicable to the HR601 and HR1001 because hazardous production materials or harmful substances are not relevant to the design. |
| b) | Section is not applicable to the HR601 and HR1001 because hazardous production materials or harmful substances are not relevant to the design. |

- Equipment that uses hazardous gases may require continuous detection and, if so, should have sample points mounted in the equipment, or have recommended sampling points identified in the equipment installation instructions.
- Where the gas supply is part of or controlled by the equipment, the equipment should be able to accept a signal from an external monitoring device and shut down the supply of the gas.

### 23.7 Hazard warning labels

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<tbody>
<tr>
<td><strong>N</strong></td>
<td><strong>N</strong></td>
</tr>
</tbody>
</table>

- Appropriate hazard warning labels should be placed at all chemical enclosure access openings.

- Section is not applicable to the HR601 and HR1001 because hazardous production materials or harmful substances are not relevant to the design.
### 24. Ionizing Radiation

#### 24.1 General
- **Informative**
  - This section covers equipment that produces ionizing radiation (e.g., x-rays, gamma rays) or uses radioactive sources.

#### 24.2 Accessible emissions of radiation
- **N**
  - Accessible emissions of ionizing radiation should be designed as low as reasonably achievable. This criteria can be met by demonstrating conformance to the provisions in subsections 24.2.1 and 24.2.2 and Appendix 2.

  Section is not applicable to the HR601 and HR1001 because it does not produce or utilize ionizing radiation nor employ radioactive materials.

#### 24.2.1 Accessible levels of ionizing radiation during normal operations
- **N**
  - Accessible levels of ionizing radiation during normal operations should be less than 2 microsieverts (0.2 millirem) per hour above background. See also Table A2-1 of Appendix 2.

  Section is not applicable to the HR601 and HR1001 because ionizing radiation and radioactive sources are not relevant to the design.

#### 24.2.2 Accessible levels of ionizing radiation during maintenance and service procedures
- **N**
  - Accessible levels of ionizing radiation during maintenance and service procedures should be less than 10 microsieverts (1 millirem) per hour above background. See also Table A2-1 of Appendix 2.

  Section is not applicable to the HR601 and HR1001 because ionizing radiation and radioactive sources are not relevant to the design.

#### 24.2.3 a) Access to radioactive contamination or internal exposure
- **N**
  - Access to radioactive contamination or internal exposure (e.g., inhalation, ingestion) to radioactive materials should be minimized.

  - **b)** The hazards and controls for the prevention of personnel contamination and internal exposures should be detailed in the operation and maintenance manuals.

  **NOTE 140:** The use of radioactive material is strictly regulated around the world. Import, export, and transportation of radioactive materials is also highly regulated. Licenses may be required to possess, use, and distribute radioactive materials.

  **NOTE 141:** Many regions require both user and import licenses, and the timely acquisition of these licenses depends on the information provided by the equipment supplier.

  **NOTE 142:** Radiation producing machines are also regulated around the world. Regulations and licensing requirements may cover activities such as importing, exporting, installing, servicing and using radiation producing equipment.

  a) **N** Section is not applicable to the HR601 and HR1001 because ionizing radiation and radioactive sources are not relevant to the design.

  b) **N** Section is not applicable to the HR601 and HR1001 because ionizing radiation and radioactive sources are not relevant to the design.
24.2.4 N The manufacturer should supply, in the user documentation, a contact phone number and address for the manufacturer’s radiation safety support personnel.

Section is not applicable to the HR601 and HR1001 because ionizing radiation and radioactive sources are not relevant to the design.

24.3 N Equipment design

Equipment should be designed to minimize access or exposure to ionizing radiation during normal operation, maintenance, and service. Potential exposures should be controlled in the following order of preference:

Section is not applicable to the HR601 and HR1001 because ionizing radiation and radioactive sources are not relevant to the design.

24.3.1 N Engineering Controls

Engineering controls (e.g. shielding, interlocks) should be the primary mechanism to minimize emission of ionizing radiation or access to ionizing radiation.

Section is not applicable to the HR601 and HR1001 because ionizing radiation and radioactive sources are not relevant to the design.

24.3.1.1 N Radiation shielding for the equipment facilities connections (e.g., gas and exhaust lines) should be designed such that removal and replacement of the shielding during installation is minimized.

Section is not applicable to the HR601 and HR1001 because ionizing radiation and radioactive sources are not relevant to the design.

24.3.2 N Non-defeatable safety interlocks should be provided on barriers preventing maintenance access to radiation fields in excess of 10 microsieverts (mSv) or 1 millirem per hour.

Section is not applicable to the HR601 and HR1001 because ionizing radiation and radioactive sources are not relevant to the design.

24.3.3 N Administrative Controls

When administrative controls (e.g., distance, time, standard operating procedures, labeling) are to be used, the equipment supplier should provide detailed documentation explaining the use of the administrative controls.

Section is not applicable to the HR601 and HR1001 because ionizing radiation and radioactive sources are not relevant to the design.
24.4 Equipment utilizing or producing ionizing radiation

Equipment utilizing or producing ionizing radiation should be labeled appropriately.
NOTE 143: Label contents are typically controlled by regulation in the country in which the equipment is to be used.

Section is not applicable to the HR601 and HR1001 because ionizing radiation and radioactive sources are not relevant to the design.

24.5 Assessment

The manufacturer should conduct an assessment to document conformance to the criteria specified in 24.2.1 through 24.2.2 during normal equipment operation, maintenance, and service.

Section is not applicable to the HR601 and HR1001 because ionizing radiation and radioactive sources are not relevant to the design.

24.5.1 A radiation survey should be used to confirm design compliance and serve as a baseline survey (see also Table A3-1 of Appendix 3).

Section is not applicable to the HR601 and HR1001 because ionizing radiation and radioactive sources are not relevant to the design.

24.5.2

a) Measurements should be taken using recognized methods with documented sensitivities and accuracy.
b) A report documenting the survey methods, equipment operating parameters, instrumentation used, calibration data, source locations, results, and discussion should be made available.

a) Section is not applicable to the HR601 and HR1001 because ionizing radiation and radioactive sources are not relevant to the design.
b) Section is not applicable to the HR601 and HR1001 because ionizing radiation and radioactive sources are not relevant to the design.

24.5.3 If supplemental administrative controls are recommended based on survey results or calculations, a discussion should be provided in the operations and maintenance manuals describing the source locations, radiation levels, and recommended control measures.

NOTE 144: Ionizing radiation sources must be registered or licensed according to the regulations of the country of destination. These radiation sources must conform to the regulations of central or local government agencies, whichever is stricter.

NOTE 145: It is recommended that equipment containing radioactive materials should demonstrate conformance to licensing with local regulatory agencies prior to shipment.

NOTE 146: Equipment that uses particle acceleration in its process has the potential for generating ionizing radiation as a result of nuclear interactions between the accelerated particles and various materials. These materials can include materials of construction of the equipment, accumulated residual process materials in the equipment, and the target materials.

Section is not applicable to the HR601 and HR1001 because ionizing radiation and radioactive sources are not relevant to the design.
25. Non-Ionizing Radiation and Fields

### 25.1 Informative

This section covers equipment that produces non-ionizing radiation, except laser sources, in the following categories:
- Static electric and magnetic (0 Hz)
- Sub-radio frequency electric and magnetic fields (< 3 kHz)
- Radio frequency (3 kHz - 300 GHz)
- Infrared radiation (700 nm - 1 mm)
- Visible Light (400 nm - 700 nm)
- Ultraviolet Light (180 - 400 nm)

### 25.2 Potentially hazardous radiation emissions accessible to persons

Potentially hazardous non-ionizing radiation emissions that are accessible to any personnel should be limited to the lowest practical level. This criterion can be met by demonstrating conformance to the following provisions:

**EXCEPTION:** Emissions of non-ionizing radiation exceeding the cardiac pacemaker limits in Appendix 3 but less than the levels in 25.2.1 and 25.2.2 should be identified with appropriate labeling. See also Section 25.5.1.

Section is not applicable to the HR601 and HR1001 because potentially hazardous non-ionizing radiation sources or fields are not accessible to personnel.

#### 25.2.1

Accessible levels of non-ionizing radiation during normal operations are less than the Operator-Accessible Limit (see Appendix 3);

Section is not applicable to the HR601 and HR1001 because potentially hazardous non-ionizing radiation and fields are not relevant to the design.

#### 25.2.2

Accessible levels of non-ionizing radiation during maintenance and service procedures are less than the Maintenance- and Service-Accessible Limit (see Appendix 3).

Section is not applicable to the HR601 and HR1001 because potentially hazardous non-ionizing radiation and fields are not relevant to the design.

### 25.3 Radiation sources

Sources of potentially hazardous non-ionizing radiation should be identified in the operation and maintenance manuals, and appropriate parameters listed. Parameters include frequency, wavelength, power levels, continuous wave or pulsed (see also Appendix 3). If pulsed, parameters also include the pulse repetition rate, pulse duration, and description of the pulse waveform.

**EXCEPTION:** Visible sources which are intended to be viewed or which provide illumination (e.g., display panels, visible alarm indicators), and are not lasers, do not need to be identified.

**NOTE 147:** It is recommended that UV/IR generators that are part of fire protection test apparatus, and are provided with the equipment, be considered as possible sources of potentially hazardous non-ionizing radiation.

Section is not applicable to the HR601 and HR1001 because potentially hazardous non-ionizing radiation and fields are not relevant to the design.
### 25.4 Equipment design

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>25.4</td>
<td>Equipment should be designed to minimize access or exposure to non-ionizing radiation during normal operation, maintenance, and service. Potential exposures should be controlled in the following order of preference:</td>
</tr>
</tbody>
</table>

Section is not applicable to the HR601 and HR1001 because potentially hazardous non-ionizing radiation and fields are not relevant to the design.

#### 25.4.1 Engineering controls (e.g., enclosure, shielding, guarding, grounding, interlocks);

Section is not applicable to the HR601 and HR1001 because potentially hazardous non-ionizing radiation and fields are not relevant to the design.

#### 25.4.2 Administrative controls (e.g., written warnings, standard operating procedures, labeling);

Section is not applicable to the HR601 and HR1001 because potentially hazardous non-ionizing radiation and fields are not relevant to the design.

#### 25.4.3 Personal protective equipment.

Section is not applicable to the HR601 and HR1001 because potentially hazardous non-ionizing radiation and fields are not relevant to the design.

### 25.5 Equipment labeling

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
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</tr>
</thead>
<tbody>
<tr>
<td>25.5</td>
<td>Equipment utilizing or producing potentially hazardous non-ionizing radiation should be labeled.</td>
</tr>
</tbody>
</table>

Section is not applicable to the HR601 and HR1001 because potentially hazardous non-ionizing radiation and fields are not relevant to the design.

#### 25.5.1 a) Hazard warning labels should be provided by the manufacturer when emission levels are measured that may impact cardiac pacemakers or magnetizable prostheses.

b) These warning labels should be located where the emissions exceed the pacemaker limit. (See Appendix 3 for pacemaker labeling levels and references.)

a) Section is not applicable to the HR601 and HR1001 because potentially hazardous non-ionizing radiation and fields are not relevant to the design.
Section is not applicable to the HR601 and HR1001 because potentially hazardous non-ionizing radiation and fields are not relevant to the design.

### 25.6 Assessments, measurements and reports

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
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</tr>
</thead>
<tbody>
<tr>
<td>a)</td>
<td>The manufacturer should conduct an assessment to document conformance to the criteria specified in 25.2.1 and 25.2.2. Engineering calculations may be used as part of this assessment.</td>
</tr>
<tr>
<td>b)</td>
<td>All measurements should be taken using recognized methods with documented sensitivities and accuracy.</td>
</tr>
<tr>
<td>c)</td>
<td>A report documenting the survey methods, equipment operating parameters, instrumentation used, calibration data, source location(s), and discussion should be provided (see Appendix 3).</td>
</tr>
</tbody>
</table>

Section is not applicable to the HR601 and HR1001 because potentially hazardous non-ionizing radiation and fields are not relevant to the design.

### 25.6.1 If supplemental administrative controls are recommended based on survey results or calculations, a discussion should be provided in the operations and maintenance manuals describing the source location(s), radiation levels, and recommended control measures.

Section is not applicable to the HR601 and HR1001 because potentially hazardous non-ionizing radiation and fields are not relevant to the design.

### 25.6.2 Administrative control procedures recommended for operation, maintenance, or service activities should be documented in the operations and maintenance manuals.

Section is not applicable to the HR601 and HR1001 because potentially hazardous non-ionizing radiation and fields are not relevant to the design.
# 26. Lasers

## 26.1 General

| N | a) Equipment containing lasers should be properly identified with a laser product classification. This classification should be based on the laser radiation level accessible during operation, per the applicable standard or regulation. |
| N | b) The laser product classification, applicable standard, and the certification file number (where appropriate) should be documented on a Laser Data Sheet (format in Part 1 of Appendix 5) that is provided to the user. |

Section is not applicable to the HR601 and HR1001 because the product does not use a laser

### 26.1.1 As an alternative to completing a Laser Data Sheet, the equipment manufacturer may provide the information that is specified on the Laser Data Sheet in another format. The information should be organized so the user can easily read and understand it.

Section is not applicable to the HR601 and HR1001 because the product does not use a laser

### 26.1.2 Equipment should not exceed the laser product classification of Class 2; however, individual lasers may exceed this classification prior to integration into the final equipment assembly.

Section is not applicable to the HR601 and HR1001 because the product does not use a laser

### 26.1.3 Equipment and lasers should be labeled according to the appropriate standards (e.g., IEC 60825-1, 21CFR 1040.10). NOTE 148: A Class 1 product label is required in some jurisdictions, but is not currently required in the United States. NOTE 149: The laser product classification for some equipment will be Class 1 or 2, even though an embedded laser is of a higher hazard classification.

Section is not applicable to the HR601 and HR1001 because the product does not use a laser

### 26.1.4 Equipment suppliers should provide maintenance or service task information in the documents provided to users for equipment that requires access to laser radiation in excess of the maximum permitted exposure (MPE) [AEL of Class 1].

Section is not applicable to the HR601 and HR1001 because the product does not use a laser
26.1.4.1

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</table>
| N | The information for these tasks should be documented on a Laser Data Sheet (see Appendix 5) in the documents provided to users and should include the accessible laser and beam parameters (see A5-2), laser control measures (see A5-3), and personal protective equipment (see A5-4) for each laser or task requiring this access.

EXCEPTION 1: In the case of proprietary beam parameters, an acceptable alternative is to provide the nominal ocular hazard distance (NOHD) results (according to IEC 60825-1 or its equivalent) for each task requiring access above the MPE.

EXCEPTION 2: If a laser system is a stand-alone product delivered as a component or spare for laser equipment, the laser system supplier’s responsibility for Laser Data Sheet information is limited to that which applies specifically to the stand-alone laser product and not the integrated laser equipment.

Section is not applicable to the HR601 and HR1001 because the product does not use a laser

26.1.5

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</table>
| N | The physical location of the embedded laser sources and access points within the laser product should be identified in the documents provided to users.

Section is not applicable to the HR601 and HR1001 because the product does not use a laser

26.2

**Equipment design**

<p>| | |</p>
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</table>
| N | Equipment, including beam diagnostic or alignment tools, should be designed to prevent injury from all lasers during normal operation, and should minimize risk of injury during maintenance or service.

Potential exposures should be controlled in the following order of preference [following sub-sections]:

Section is not applicable to the HR601 and HR1001 because the product does not use a laser

26.2.1

<p>| | |</p>
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</thead>
</table>
| N | Engineering controls (e.g., enclosures, shielding, filters, use of fiber optics to transmit energy, interlocks).

Section is not applicable to the HR601 and HR1001 because the product does not use a laser

26.2.2

<p>| | |</p>
<table>
<thead>
<tr>
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</thead>
</table>
| N | Temporary enclosures or control measures for maintenance, service, and non-routine tasks.

Section is not applicable to the HR601 and HR1001 because the product does not use a laser

26.2.3

<p>| | |</p>
<table>
<thead>
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<th></th>
</tr>
</thead>
</table>
| N | Administrative controls (e.g., written warnings, standard operating procedures, labeling).

Section is not applicable to the HR601 and HR1001 because the product does not use a laser
26.2.4 Personal protective equipment.

NOTE 150: Temporary enclosures and personal protective equipment are considered to be administrative controls, because they require human action to implement.

NOTE 151: Certain classes of laser products are regulated around the world. Regulations and licensing requirements may cover activities such as importing, exporting, distributing, demonstrating, installing, servicing, and using these laser products.

Section is not applicable to the HR601 and HR1001 because the product does not use a laser.

26.3 Operation and Maintenance Manuals

The equipment supplier should provide the following in the operation and maintenance manuals:
- A description of laser-related hazards present during operation, maintenance, or service, and methods to minimize the hazard;
- Justification for any procedures that require a laser controlled area and the dimensions of this hazard zone;
- Administrative controls used in maintenance and service activities; and
- A description of necessary personal protective equipment.

Section is not applicable to the HR601 and HR1001 because the product does not use a laser.

26.4 Information for evaluator

The following detailed information should be available for the evaluator:
- Justification for when engineering controls are not feasible to limit exposure during operation or maintenance tasks, and how administrative controls provide equivalent protection (see Section 26.2); and
- Documentation showing compliance with an appropriate international laser product safety or industry standard, or the national standard for country of use.

Section is not applicable to the HR601 and HR1001 because the product does not use a laser.
### 27. Sound Pressure Level

#### 27.1 General

| N | Equipment should be designed to control exposures to sound pressure levels equal to or greater than 80 dBA continuous or intermittent sound pressure level, and 120 dB instantaneous (impulse) sound pressure level. NOTE 152: It is recommended that efforts be made to decrease sound pressure levels as they approach 80 dBA (i.e., 77 to 80 dBA), due to the additive sound pressure level effects of multiple pieces of equipment in the same vicinity. |

Section is not applicable to the HR601 and HR1001 because it does not possess elements that are capable generating hazardous sound pressure levels to necessitate engineering or other noise mitigation controls.

Note: A reference sound level survey per Section 27.3 has been conducted and has noise levels to be less than 80 dBA at any standard measurement location. Refer to Attachment 3 for detailed measurement data.

#### 27.2 Safety controls

The order of preference for controlling exposures is as follows:

| N | Engineering controls (e.g., source sound pressure level reduction, absorption, enclosures, barriers, acoustic dampening) – At a minimum, the design of the engineering controls should consider the sound pressure levels and type, the frequency, and the appropriate control technologies. |

Section is not applicable to the HR601 and HR1001 because hazardous sound pressure is not relevant to the design.

| N | Administrative controls – Acceptable administrative controls should be limited to supplemental hazard warning labels and operating procedures. NOTE 153: Noise labeling is typically implemented as signs located in the users facility. |

Section is not applicable to the HR601 and HR1001 because hazardous sound pressure is not relevant to the design.

#### 27.3 Surveys

| N | Sound level surveys should be conducted by the manufacturer during equipment development for equipment that may emit hazardous sound pressure levels. |

Section is not applicable to the HR601 and HR1001 because hazardous sound pressure is not relevant to the design.

27.3.1 The survey should be conducted in accordance with a recognized standard. In addition, the following test criteria should be applied:

Section is not applicable to the HR601 and HR1001 because hazardous sound pressure is not relevant to the design.
27.3.1.1
N
The equipment mode of operation during the sound pressure level tests should simulate as closely as possible the actual modes and operating positions that may be experienced by the equipment user.

Section is not applicable to the HR601 and HR1001 because hazardous sound pressure is not relevant to the design.

27.3.1.2
N
Measurements should be taken in locations that best simulate actual positions of operators relative to the equipment. As a general guideline, the microphone should be traversed 1 meter from the equipment, 1.2 meters above the ground to simulate seated operators, 1.5 meters above the ground to simulate standing operators, and 3.5 meters (or as far as possible) away from the nearest walls or sound-reflecting objects. Measurements are taken 360 degrees around the equipment wherever possible.

NOTE 154: Background level may be subtracted using an accepted method. If the sound pressure level difference is less than 3 dBA, the contribution of the source from the background cannot be adequately distinguished and the survey results would not be valid for values over 80 dBA.

Section is not applicable to the HR601 and HR1001 because hazardous sound pressure is not relevant to the design.

Table 2 Sound Pressure Level Test Criteria

<table>
<thead>
<tr>
<th>Difference between sound pressure level measured with noise source operating and background sound pressure level (dBA)</th>
<th>Correction to be subtracted from the sound pressure level measured with the noise source operating to obtain the sound pressure level due to noise source alone (dBA)</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>4</td>
<td>2.5</td>
</tr>
<tr>
<td>5</td>
<td>1.7</td>
</tr>
<tr>
<td>6</td>
<td>1.3</td>
</tr>
<tr>
<td>7</td>
<td>1</td>
</tr>
<tr>
<td>8</td>
<td>0.8</td>
</tr>
<tr>
<td>9</td>
<td>0.6</td>
</tr>
<tr>
<td>10</td>
<td>0.4</td>
</tr>
</tbody>
</table>

27.3.2
N
If the measured sound pressure level is less than 70 dBA, the manufacturer should provide to the evaluator test data documenting sound pressure levels, survey equipment, equipment calibration, test conditions and results.

Section is not applicable to the HR601 and HR1001 because hazardous sound pressure is not relevant to the design.

27.3.3
N
If the measured sound pressure level is greater than 70 dBA, the test data should include all of the information in 27.3.2, and should also include the expected duration of personnel exposure.
Section is not applicable to the HR601 and HR1001 because sound pressure controls are not relevant to the design.

### 27.3.4

| N | If measured sound pressure level is greater than 75 dBA, information should be provided in the equipment maintenance manual describing the sound pressure level(s) and location(s). |

Section is not applicable to the HR601 and HR1001 because sound pressure controls are not relevant to the design.
APPENDIX 6 – Laser Data Sheet

A6-1 Equipment Information (all Laser Product Classes)

<table>
<thead>
<tr>
<th>Laser equipment manufacturer:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Equipment model no.:</td>
</tr>
<tr>
<td>Date Laser Data Sheet completed:</td>
</tr>
<tr>
<td>Laser Product Classification (e.g., 1, 1M, 2, 2M, 3A, 3R, 3B, 4)</td>
</tr>
<tr>
<td>Classification Standard(s) (e.g., IEC, FDA/CDRH, JIS):</td>
</tr>
<tr>
<td>Certification File Identification Number (e.g., CDRH accession number, or if CDRH accession number has been applied for, but not yet received, a statement of 'pending' along with the submittal date may be used instead. If self declaring under IEC 60825-1 or if certification is not required (e.g., if class 1 laser product is incorporated without changes, then 'N/A' may be used):</td>
</tr>
</tbody>
</table>

A6-2 Laser Information (greater than Class 2 and embedded Class 3R (3A), 3B and 4)

Is access to laser radiation above the maximum permissible exposure (MPE) level [beyond the AEL of Class 2] required during maintenance or service tasks?

NO > The information in Parts A6-2 (remaining), A6-3 and A6-4 need not be provided.

YES > Complete the information in Parts A6-2, A6-3 and A6-4 for each task and the laser that requires access.

Multiple lasers contained within the equipment > Provide the following information for each task/laser combination that meets the above criteria [greater than Class 2 and embedded Class 3R (3A), 3B & 4].

Laser Parameters (for each laser):

Laser manufacturer:

A6-2.1 Laser medium type (HeNe, Nd:YAG, Argon, KrF, Diode, etc.)

A6-2.2 Wavelength(s) (nm)

A6-2.3 Laser hazard classification (individual laser) NOTE 1566 If a laser is used in both continuous wave and pulsed modes, complete both A7-2.4 and A7-2.5.

A6-2.4 Continuous Wave (CW) lasers

A. Power in Watts

B. Irradiance in Watts/square centimeter (W/cm² at aperture)
A6-2.5 Pulsed laser characteristics
   A. Pulse Duration in Seconds (s)
   B. Energy per Pulse in Joules (J)
   C. Pulse Repetition Frequency in Hertz (Hz)
   D. Average Power in Watts (W)
   E. Radiant Exposure Joules/square centimeter (J/cm²)
   F. Q-Switch controlled pulses (Yes/No)

A6-2.6 Beam parameters at maintenance and service access points
EXCEPTION: In the case of proprietary information, an acceptable alternative to providing the Beam Parameters is to provide NOHD results for each access point according to IEC 60825 or equivalent.
   A. Beam shape—Circular (C), Rectangular (R), Elliptical (E)
   B. Beam size (mm)—Major axis (R/E) or diameter (C)
   Minor axis (R/E)
   C. Beam divergence in milliradians (mr)
   Major axis (R/E or diameter (C)
   Minor axis (R/E)
   D. Focal length in millimeters (mm) (of the emitting lens)
   Major axis (R/E or diameter (C)
   Minor axis (R/E)
   E. Is there a collecting optics hazard? (Yes/No)

A6-3 Laser Control Measures

A6-3.1 Specify maintenance/service tasks requiring access to laser radiation in excess of the MPE and recommended laser control measures. NOTE 2: Suppliers may alternatively provide a reference to laser control measures information that is located in a document available to users.
   A. Task 1
   B. Task 2
   C. Etc.

A6-3.2 Of the tasks in A6-3.1, which tasks need a Laser Controlled Area (for class 3b or 4 lasers)?

A6-3.3 If a nominal ocular hazard distance (NOHD) is used as a control measure, then provide the NOHD calculations and assumptions. See IEC 60825-1 for NOHD calculations. EXCEPTION: If specific information required by A6-2.6 is proprietary, suppliers may provide the NOHD results and an explanation of the assumptions made.

A6-3.4 Include a beam path diagram identifying the accessible points. NOTE 158: A description of the access points from the exterior of the tool can be considered equivalent to a diagram.

A6-4 Personal Protective Equipment

Laser Parameters (for each laser)
   A. Optical Density (OD) of PPE required during maintenance
   B. OD of PPE required during service activities
   C. Other types of PPE (e.g., skin protection) if needed

NOTE 159: Suppliers may alternatively provide a reference to PPE information located in a document available to users.
### APPENDIX A – U.S. Installation Code Considerations

The following items, marked "Considered," were taken into account during the evaluation:

<table>
<thead>
<tr>
<th>Section</th>
<th>Description</th>
<th>Considered</th>
<th>Not Considered</th>
</tr>
</thead>
<tbody>
<tr>
<td>A1</td>
<td>The machine nameplate meets the requirements of NFPA 79:2007, clause 16.4</td>
<td>☒ Considered</td>
<td>☐ Not Considered</td>
</tr>
<tr>
<td>A2</td>
<td>The intended installation of the equipment meets the requirements of Article 400-7 of the NEC, which allows stationary equipment to be connected by flexible cords and cables to facilitate their frequent interchange, and for other applications. Article 400-8 of the NEC prohibits flexible cords and cables to be used as a substitute for the fixed wiring of a structure, where they are run through holes in walls, ceiling, floors, etc.</td>
<td>☐ Considered</td>
<td>☒ Not Considered</td>
</tr>
<tr>
<td>A3</td>
<td>The intended installation of the equipment meets the requirements of Article 300-4 of the NEC, which addresses wiring passing through and around framing members in building structures.</td>
<td>☐ Considered</td>
<td>☒ Not Considered</td>
</tr>
<tr>
<td>A4</td>
<td>The intended installation of the equipment and its wiring entrances, meet the requirements of NFPA 79, clause 16.</td>
<td>☒ Considered</td>
<td>☐ Not Considered</td>
</tr>
<tr>
<td>A5</td>
<td>The definition of, and the size of, overcurrent protection of supply conductors to electrical machinery meets the requirements of Article 670 of the NEC. If overcurrent protection is provided on the equipment, the machine is marked with the following or equivalent: “Overcurrent protection provided at machine terminals”; otherwise, proper sizing information is provided (NFPA 79:2007, clause 16.4.5).</td>
<td>☒ Considered</td>
<td>☐ Not Considered</td>
</tr>
</tbody>
</table>

**Comments, Sections A1 to A5:** None

End of Evaluation Report
Attachment 4
Hazard Analysis Table
### Hazard Analysis Table

**Hazard Identification and Result**

<table>
<thead>
<tr>
<th></th>
<th>Hazard Identification and Result</th>
<th>DPH</th>
<th>LO</th>
<th>PA</th>
<th>Risk</th>
<th>PR</th>
<th>Hazard Avoidance (comments)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>S2, Section 11.10 – What if the operator attempted to open an electrical enclosure?</td>
<td>2 (S1)</td>
<td>D (F1)</td>
<td>1 (P2)</td>
<td>I</td>
<td>1</td>
<td>A tool is required to assess the electrical enclosure.</td>
</tr>
<tr>
<td>4</td>
<td>S2, Section 14.2.1 – What if there was an ignition inside of the equipment during normal operation?</td>
<td>2 (S1)</td>
<td>D (F1)</td>
<td>1 (P2)</td>
<td>I</td>
<td>1</td>
<td>The equipment is housed in a metal enclosure</td>
</tr>
<tr>
<td>5</td>
<td>S2, Section 18.3.1 – What if parts and components are affected by fatigue, aging, corrosion and abrasion?</td>
<td>2 (S1)</td>
<td>E (F1)</td>
<td>2 (P2)</td>
<td>I</td>
<td>1</td>
<td>Equipment is enclosed by metal. Circuit protection is provided to minimize hazards</td>
</tr>
<tr>
<td>12</td>
<td>What if the facility electrical power is loss?</td>
<td>1 (S1)</td>
<td>E (F1)</td>
<td>2 (P2)</td>
<td>I</td>
<td>1</td>
<td>Product stops with no potential hazards. Manual restart is required when power is restored</td>
</tr>
</tbody>
</table>

**Date:** December 3, 2010  
**Name of assessing engineer:** Rich Trainor  
**Signature:**

**PA - Possibility of Avoidance**  
(P1=1-Possible; P2=2-almost Impossible)

**DPH - Degree of Possible Harm:**  
S1 = 1-Minor, 2-Moderate (reversible); S2=3-Severe (irreversible), 4-Catastrophic/death

**LO - Likelihood of Occurrence/Frequency of Exposure:**  
F1 = E- unlikely (seldom), D- rare, C- possible (often); F2 = B- likely (frequently), A-frequent (permanent)

**Risk (categories):**  
Very Low, Low, Significant, High, Very High, Extreme (or list as I-V as per EN954)
### Hazard Identification and Result

<table>
<thead>
<tr>
<th>Hazard Identification and Result</th>
<th>DPH</th>
<th>LO</th>
<th>PA</th>
<th>Risk</th>
<th>PR</th>
<th>Hazard Avoidance (comments)</th>
</tr>
</thead>
<tbody>
<tr>
<td>13 What if the facility water is lost?</td>
<td>2 (S1)</td>
<td>E (F1)</td>
<td>2 (P2)</td>
<td>I</td>
<td>1</td>
<td>Process stops. Manual restart required.</td>
</tr>
<tr>
<td>16 What if the input Water is overpressure?</td>
<td>2 (S1)</td>
<td>D (F1)</td>
<td>1 (P2)</td>
<td>I</td>
<td>1</td>
<td>Internal parts are pressure rated to prevent rupture</td>
</tr>
<tr>
<td>17 What if the process water pressure is out of tolerance?</td>
<td>2 (S1)</td>
<td>C (F1)</td>
<td>2 (P2)</td>
<td>I</td>
<td>1</td>
<td>No hazard. Alerts the operator (alarm).</td>
</tr>
<tr>
<td>18 What if the temperature is above the tolerance?</td>
<td>2 (S1)</td>
<td>D (F1)</td>
<td>2 (P2)</td>
<td>I</td>
<td>1</td>
<td>No hazard</td>
</tr>
<tr>
<td>19 What if a water leak occurs?</td>
<td>2 (S1)</td>
<td>D (F1)</td>
<td>2 (P2)</td>
<td>I</td>
<td>1</td>
<td>Internal parts are pressure rated to prevent rupture. External water leak will not create a hazard</td>
</tr>
</tbody>
</table>

**Date:** December 3, 2010  
**Name of assessing engineer:** Rich Trainor  
**Signature:**

**PA - Possibility of Avoidance**  
P1 = 1-Possible; P2 = 2-almost Impossible  
**DPH - Degree of Possible Harm:**  
S1 = 1-Minor, 2-Moderate (reversible); S2=3-Severe (irreversible), 4-Catastrophic/death  
**LO - Likelihood of Occurrence/Frequency of Exposure:**  
F1 = E- unlikely (seldom), D- rare, C- possible (often); F2 = B- likely (frequently), A-frequent (permanent)  
**Risk (categories):**  
Very Low, Low, Significant, High, Very High, Extreme (or list as I-V as per EN954)
Flow-chart for determination of risk and related categories

**Hazard Estimation:**

<table>
<thead>
<tr>
<th>PA</th>
<th>DPH</th>
<th>LO</th>
<th>Risk (categories)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Possibility of Avoidance</td>
<td>Degree of Possible Harm</td>
<td>Likelihood of Occurrence/Frequency of Exposure</td>
<td>Very Low, Low, Significant, High, Very High, Extreme</td>
</tr>
</tbody>
</table>

**Categories of Performance Ranking (PR):**

B - Use of good engineering principles.
1 - Use of well-tried components & principles.
2 - Periodic checking (functional testing).
3 - Single fault “fail-safe” requirements.
4 - Single fault “fail-safe” requirements with accumulation of faults not leading to an unsafe state (i.e. not causing a failure).

N = Normal reference point.
(N) = Acceptable reference point.
- = Unacceptable reference point.
SEMI® S8-0308
Safety Guidelines for Ergonomics Engineering of Semiconductor Manufacturing Equipment

Final Evaluation Report

Seren IPS Inc

Models HR601 and HR1001 RF

RF Power Supplies

TUV Rheinland Evaluation Report File No. 31072336.004

Issue Date: December 3, 2010

TUV Rheinland of North America, Inc.
North American Headquarters
12 Commerce Road
Newtown, Connecticut 06470
Web: http://www.tuv.com
Applicant: Seren IPS Inc

Applicant Address: 1670 Gallagher Drive, Vineland, NJ 08360

Type of Equipment: RF Power Supplies

Type or Model No.: HR601 and HR1001

Trademark: 

Serial No.: HR601-0004 and HR1001-0001

Place of Evaluation: 12 Commerce Road, Newtown, CT

Date of Evaluation: October 5, 2010

Requirement: SEMI® S8-0308 Guideline

Evaluated by:

_________________________      Dec 3, 2010
signature
Rich Trainor/ TÜV Rheinland of North America

Reviewed by:

_________________________      Dec 3, 2010
Signature  date
Andras Szende/ TÜV Rheinland of North America
Table of Contents:

Management Summary: 4
Compliance Statement: 4
Scope of Evaluation: 4
Summary of Assessment Results: 4
Evaluator Qualifications: 5
Table of Verdict Abbreviations: 5
Evaluation Report Notice: 5
Risk Assessment Matrix: 6
Equipment / System Description: 7
Test Setup: 8
Evaluated tasks: 8
Reference Equipment documentation and assisting personal: 8
Detailed Summary of Assessment Findings: 9

Attached Documents:

Attachment A: SESC Checklist
Attachment B: Task List
Attachment C: Photo Documentation
Management Summary:

Compliance Statement:

This equipment does not conform with the applicable requirements of SEMI® S2-0308.

Scope of Evaluation:

The RF power supplies, Models HR601 and HR1001, serial numbers, HR601-0004 and HR1001-0001 were evaluated on October 5, 2010 at TUV Rheinland of NA, 12 Commerce Road, Newtown, CT. The evaluation was performed with the assumption that the equipment is to be installed in both the United States and Europe.

Summary of Assessment Results:

<table>
<thead>
<tr>
<th>Section</th>
<th>Title</th>
<th>Conforms</th>
<th>Does Not Conform</th>
<th>Not Applicable</th>
<th>Information Needed</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Manual Material Handling</td>
<td></td>
<td></td>
<td></td>
<td>✓</td>
</tr>
<tr>
<td>2</td>
<td>Product loading in a standing posture</td>
<td></td>
<td></td>
<td></td>
<td>✓</td>
</tr>
<tr>
<td>3</td>
<td>Wafer cassette loading</td>
<td></td>
<td></td>
<td></td>
<td>✓</td>
</tr>
<tr>
<td>4</td>
<td>Work in process storage</td>
<td></td>
<td></td>
<td></td>
<td>✓</td>
</tr>
<tr>
<td>5</td>
<td>Manual wafer cassette rotation device design</td>
<td></td>
<td></td>
<td></td>
<td>✓</td>
</tr>
<tr>
<td>6</td>
<td>Handle design</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>Maintainability and Serviceability</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>Display location</td>
<td></td>
<td></td>
<td></td>
<td>✓</td>
</tr>
<tr>
<td>9</td>
<td>Hand Control Location</td>
<td></td>
<td></td>
<td></td>
<td>✓</td>
</tr>
<tr>
<td>10</td>
<td>Workstation Design</td>
<td></td>
<td></td>
<td></td>
<td>✓</td>
</tr>
</tbody>
</table>
Evaluator Qualifications:

TUV Rheinland provides manufacturers with reliable and comprehensive assessment and certification services to ensure that their products are safe for the industries, environments and people who depend on them. TUV Rheinland is a EU Notified Body, a Nationally Recognized Testing Laboratory (NRTL) in the United States, as well as an ISO 9000/ISO 14001 registrar. TUV Rheinland, based in Cologne, Germany, is a global player in product safety testing and certification. The company was founded in 1872 and employs at 360 locations over 12,500 people in 62 countries. TUV Rheinland is an active participant in the development of SEMI® guidelines, including SEMI® S2.

Personnel involved in performing the SEMI S2 evaluations for TUV Rheinland meet the qualifications identified in SEMI S7.

Table of Verdict Abbreviations:

The equipment has been evaluated for conformance with each section of the SEMI® S2 Guideline. The evaluation results are indicated by one of the following verdict abbreviations in each subsection of the SEMI S2 Guideline text in this report. The full verdict text and the supporting rationale for the evaluation result are provided in the comment section of each subsection.

C (Conforms): The equipment conforms to the section or to the intent of the section as allowed for in SEMI® S2 paragraph 8.3.1.1. Where it is determined that the equipment conforms to the intent of the section will be stated with supporting rationale. (The results of a risk assessment indicating no significant risk may be used in determining that the equipment conforms to the intent of the section.)

X (Does Not Conform): The equipment conforms to neither the section nor to the intent of the section. Non-conformances are assigned a risk ranking based on categories identified in Table 1 of SEMI® S10-1103.

N (N/A): This section is not applicable to this equipment.

I (Information Needed): More information is needed to determine whether the equipment conforms to the section or to the intent of the section. (This verdict may only be used in Interim Reports)

Evaluation Report Notice:

This evaluation report is valid only for the model and serial number tested, and may be considered representative of those units, which are identical in construction to the system evaluated or differ in ways described in the “Scope” section of this report. This evaluation report is not a substitute for a certification and does not authorize the affixing of a TUV-Mark to the machine without a certificate from TUV Rheinland.

Any safety changes, revisions, or corrections should be submitted to the original testing body - “TUV Rheinland.”

According to the European safety laws, the machine manufacturer is ultimately responsible for the machine’s compliance, tests, documentation and declaration of conformity and for on-going conformity of any subsequent machines. To ensure effective protection of the user (operator), no contracts or agreements that reduce or limit the manufacturer’s liability are allowed between the equipment manufacturer and the buyer.
Risk Assessment Matrix:

The seriousness of each discrepancy is ranked accordance with the following matrix, which is derived from SEMI® S10-1103.

<table>
<thead>
<tr>
<th>RISK ASSESSMENT MATRIX</th>
<th>LIKELIHOOD</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>FREQUENT A</td>
</tr>
<tr>
<td>CATASTROPHIC</td>
<td>VH</td>
</tr>
<tr>
<td>1</td>
<td></td>
</tr>
<tr>
<td>SEVERE</td>
<td>VH</td>
</tr>
<tr>
<td>2</td>
<td></td>
</tr>
<tr>
<td>MODERATE</td>
<td>H</td>
</tr>
<tr>
<td>3</td>
<td></td>
</tr>
<tr>
<td>MINOR</td>
<td>M</td>
</tr>
<tr>
<td>4</td>
<td></td>
</tr>
</tbody>
</table>

Discrepancies have been assessed using the following “Severity Grouping”:

1 – **Catastrophic** - Failure is capable of producing: One or more fatalities; System or facility loss; or Chemical release with acute, lasting environmental or public health impact.

2 – **Severe** - Failure is capable of producing: Disabling injury/illness; Major subsystem loss or facility damage; or Chemical release with temporary environmental or public health impact.

3 – **Moderate** - Failure is capable of producing: Injury requiring medical treatment or restricted work activity (OSHA recordable); Minor subsystem loss or facility damage; or Chemical release triggering external reporting requirements.

4 – **Minor** - Failure is capable of producing: Injury requiring first aid only; Non-serious equipment or facility damage; or Chemical release requiring routine cleanup without monitoring.

Discrepancies have been assessed using the following “Likelihood Grouping”:

NOTE: Likelihood relates to the occurrence of a mishap, not to the exposure to a hazard.

A – **Frequent** - More than 1%.

B – **Likely** - More than 0.2%, but no more than 1%.

C – **Possible** - More than 0.04%, but no more than 0.2%.

D – **Rare** - More than 0.02%, but no more than 0.04%.

E – **Unlikely** - Not more than 0.02%.

Discrepancies are ranked according to the following “Risk Assessment Categories” which are determined from the above matrix.

**VH** – Very High

**H** – High

**M** – Medium

**L** – Low

**VL** – Very Low
Equipment / System Description:

Equipment / system overview:
RF Power Supplies are intended for use with radio frequency plasma processing systems and radio frequency processing applications. The HR-Series RF Power Supplies provide a level-controlled radio frequency power output. Available frequencies are 1.7-2.1MHz, 13.56MHz, 27.12MHz, and 40.68MHz at power levels up to 1000 Watts. The HR-Series RF Power Supplies feature a simplified front panel suitable for embedded use.

Equipment / system use or application:
for use with radio frequency plasma processing systems and radio frequency processing applications.

Model variants and options:
HR601 and HR1001

Features that were not evaluated:
Optional touch panel

Additional information / remarks:
None
Test Setup:

**Installation environment:**
The products were evaluated in a test lab environment. Protective clothing (Jumpsuit, gloves, booties, and hairnet) were not worn during the review but were considered. The product was on a flat surface 30” (762mm) from the floor. A simulated rack was provided with an opening 12” (305mm) from the floor for mounting.

**Mounting height:**
A simulated rack was provided with an opening 12” (305mm) from the floor for mounting.

**Clearance:**
The product was situated in the test lab with unlimited clearance.

**Other ergonomic relevant setup parameter:**
The rack product was standing on casters. The products were connected to AC power with a hard wired power cord and plug. The product had no obstructions on any sides. The covers were in place. There was no accessibility to hazardous voltages or moving parts. The products use no chemicals or liquids. The products use water to cool the internal PCB.

Evaluated tasks:

**Operational tasks:**
The products have no operational tasks.

**Maintenance / Service tasks:**
The product has no maintenance tasks other than general cleaning (if required) and service operations evaluated were limited to those reasonably expected to be performed by the manufacturers personnel during service, based upon information provided by the applicant. For a detailed list of evaluated service tasks please reference appendix C.

**Multiple tool operation:**
The product is not a tool and has only one operation.

Reference Equipment documentation and assisting personal:

**Assisting personnel:**
Ed Dunn, Engineer and Project Manager

**Reference documentation:**
Operating Manual, Document Number 6100240000, Rev 0.04
Detailed Summary of Assessment Findings:

Items that do not conform to the SEMI® Guideline(s):
(all items specified with risk rank, i.e. “RISK = (severity grouping number)(likelihood grouping letter) – (risk assessment category name)” in accordance with SEMI S10)

Product has no deviations

End of Evaluation Report
Attachment A
SESC Checklist
APPENDIX A, Supplier Ergonomic Success Criteria Checklist (SESC-Checklist)

<table>
<thead>
<tr>
<th>Section</th>
<th>Indicator</th>
<th>Acceptance Criteria</th>
<th>Actual</th>
<th>Conform</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Manual Material Handling</td>
<td>Analysis and results documentation. Table A2-2, Appendix 2, or the equivalent, should be used to document 2-hand lift/lower analysis.</td>
<td>The following MMH task has been analyzed: 1) Installing and removing power supply: L1=0.51</td>
<td>C</td>
</tr>
</tbody>
</table>
| 1.1     | Potentially Hazardous manual material handling tasks performed as part of operations, maintenance, or service tasks 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 one lift every 5 minutes.  
  See Appendix 2 for further information. | | | |
### 2 Product loading in a standing posture
(Applicable to all media other than wafer cassettes including: JEDEC trays, magazines, and reticle cassettes.)

<table>
<thead>
<tr>
<th></th>
<th>Description</th>
<th>Minimum</th>
<th>Maximum</th>
<th>Requirement</th>
<th>Result</th>
</tr>
</thead>
<tbody>
<tr>
<td>2.1</td>
<td>Clearance provided for finger thickness.</td>
<td>minimum 38 mm (1.5 in)</td>
<td>No product loading required</td>
<td>N</td>
<td></td>
</tr>
<tr>
<td>2.2</td>
<td>Clearance provided for hand thickness.</td>
<td>minimum 76 mm (3.0 in)</td>
<td>No product loading required</td>
<td>N</td>
<td></td>
</tr>
<tr>
<td>2.3</td>
<td>Reach distance measured from the leading edge of the tool or obstruction to the hand/product coupling point(s).</td>
<td>maximum 330 mm (13 in)</td>
<td>No product loading required</td>
<td>N</td>
<td></td>
</tr>
<tr>
<td>2.4</td>
<td>Vertical coupling point of hand to product in load position</td>
<td>maximum 1010 mm (40 in)</td>
<td>No product loading required</td>
<td>N</td>
<td></td>
</tr>
</tbody>
</table>

### 3 Wafer cassette loading

<table>
<thead>
<tr>
<th></th>
<th>Description</th>
<th>Minimum</th>
<th>Maximum</th>
<th>Requirement</th>
<th>Result</th>
</tr>
</thead>
<tbody>
<tr>
<td>3.1</td>
<td>Wafer cassette loading should not require greater than 10 degrees cassette rotation in any axis. Note: Unless otherwise specified you should assume that 200mm or smaller wafers are transported in vertical orientation and that 300mm wafer are transported in horizontal orientation.</td>
<td>less than 10 degrees rotation in any axis.</td>
<td>No wafer cassettes</td>
<td>N</td>
<td></td>
</tr>
<tr>
<td>3.2</td>
<td>Load port height, vertical distance from standing surface. (150 - 200mm wafers)</td>
<td>maximum 960 mm (38 in)</td>
<td>No wafer cassettes</td>
<td>N</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>minimum 890 mm (35 in)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3.3</td>
<td>Maximum lip height in front of cassette load port over which cassette must be lifted (150 - 200mm wafer cassettes only). Measure lip height from the load surface</td>
<td>maximum 30 mm (1.2 in)</td>
<td>No wafer cassettes</td>
<td>N</td>
<td></td>
</tr>
<tr>
<td>3.4</td>
<td>Reach distance from the leading edge of the tool or obstruction to the coupling point(s) on rotation device or the product grasp point.</td>
<td>maximum 330 mm (13 in)</td>
<td>No wafer cassettes</td>
<td>N</td>
<td></td>
</tr>
</tbody>
</table>
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 (3.0 in) | No wafer cassettes | N

4 Work in process storage (specific to wafer cassettes)

4.1 Integral wafer cassette/lot box storage shelf height (150 and 200mm wafer cassette/lot boxes only) | (1 box deep) maximum 1520 mm (60 in) (2 boxes deep) maximum 1220 mm (48 in) minimum 460 mm (18 in) | No work in process storage | N

5 Manual wafer cassette rotation device design

5.1 Handle height, couple point for hand(s) from standing surface. | maximum 1206 mm (47.5 in) minimum 838 mm (33 in) | No wafer cassettes | N

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. | No wafer cassettes | N

5.3 Single hand lift force | Maximum 37.8 N (8.5 lb) This value includes a 15% capacity reduction due to clean room glove use. Wrist deviation reduces further strength capacity by 15% | No wafer cassettes | N
### 6.1 Handle surface finish
- All edges radiused
- No handles

### 6.2 Cylindrical handle
- No cylindrical handles

#### 6.2.1 Cylindrical handle diameter (D)
- Maximum 38 mm (1.5 in)
- Minimum 25 mm (1.0 in)
- No cylindrical handles

#### 6.2.2 Cylindrical handle length (L)
- Minimum 127 mm (5.0 in)
- No cylindrical handles

### 6.3 Circular or triangular handle
- No cylindrical handles

#### 6.3.1 Circular or triangular handle diameter (D)
- Maximum 90 mm (3.5 in)
- Minimum 50 mm (2.0 in)
- No cylindrical handles

#### 6.3.2 Circular or triangular handle height (thickness) (H)
- Maximum 25 mm (1.0 in)
- Minimum 19 mm (.75 in)
- No cylindrical handles

### 6.4 Ball handle
- No ball handle

#### 6.4.1 Ball handle diameter
- Maximum 63 mm (2.5 in)
- No ball handle

### 6.5 Pliers handle
- No pliers handle

#### 6.5.1 Pliers handle grip span (S)
- Maximum 89 mm (3.5 in) open
- No pliers handle

#### 6.5.2 Pliers handle length (L)
- Minimum 127 mm (5.0 in)
- No pliers handle

---

5.4 Two hand lift force
- Maximum 64.5 N (14.5 lb)
- This value includes a 15% capacity reduction due to clean room glove use.
- Wrist deviation reduces further strength capacity by 15%
- No wafer cassettes

---
### 6.6 Pistol grip handle

<table>
<thead>
<tr>
<th>Subsection</th>
<th>Description</th>
<th>Minimum (in)</th>
<th>Maximum (in)</th>
<th>Test Result</th>
</tr>
</thead>
<tbody>
<tr>
<td>6.6.1</td>
<td>Pistol grip handle diameter (D)</td>
<td>38</td>
<td>63</td>
<td>No pistol grip handle</td>
</tr>
<tr>
<td>6.6.2</td>
<td>Pistol grip handle length (L)</td>
<td>127</td>
<td></td>
<td>No pistol grip handle</td>
</tr>
</tbody>
</table>

### 6.7 Enclosed handles

<table>
<thead>
<tr>
<th>Subsection</th>
<th>Description</th>
<th>Minimum (in)</th>
<th>Maximum (in)</th>
<th>Test Result</th>
</tr>
</thead>
<tbody>
<tr>
<td>6.7.1</td>
<td>Enclosed handle, full hand power grip (Suitcase handle)</td>
<td>45</td>
<td>25</td>
<td>No full power grip handle</td>
</tr>
<tr>
<td>6.7.1.1</td>
<td>Diameter (d), requiring no greater than 71 N (16 lbf) force</td>
<td>6.3</td>
<td>19</td>
<td>No full power grip handle</td>
</tr>
<tr>
<td>6.7.1.2</td>
<td>Diameter (d), requiring no greater than 89 N (20 lbf) force</td>
<td>13</td>
<td></td>
<td>No full power grip handle</td>
</tr>
<tr>
<td>6.7.1.3</td>
<td>Diameter (d), requiring no greater than 180 N (40 lbf) force</td>
<td>19</td>
<td></td>
<td>No full power grip handle</td>
</tr>
<tr>
<td>6.7.2</td>
<td>Enclosed handle, three fingers</td>
<td>38</td>
<td>90</td>
<td>No three finger handles</td>
</tr>
<tr>
<td>6.7.3</td>
<td>Enclosed handle, two fingers</td>
<td>38</td>
<td>60</td>
<td>No two finger handles</td>
</tr>
<tr>
<td>6.7.4</td>
<td>Enclosed handle, one finger</td>
<td>Width (W)</td>
<td>minimum 38 mm (1.5 in)</td>
<td>Depth (D)</td>
</tr>
<tr>
<td>-------</td>
<td>-----------------------------</td>
<td>-----------</td>
<td>-----------------------</td>
<td>-----------</td>
</tr>
<tr>
<td>6.8</td>
<td>Hook grasp handle</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6.8.1</td>
<td>Hook grasp handle (four fingers)</td>
<td>Opening length (L)</td>
<td>minimum 90 mm (3.5 in)</td>
<td>Opening width (W)</td>
</tr>
<tr>
<td>6.8.2</td>
<td>Hook grasp handle pull force (four fingers)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6.9</td>
<td>Finger pull handle</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6.9.1</td>
<td>Finger pull handles (four fingers)</td>
<td>Opening length (L)</td>
<td>minimum 90 mm (3.5 in)</td>
<td>Opening width (W)</td>
</tr>
<tr>
<td>6.9.2</td>
<td>Finger pull handles pull force (four fingers)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>Maintainability and Serviceability</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>---</td>
<td>---</td>
<td>---</td>
<td></td>
<td></td>
</tr>
<tr>
<td>7.1</td>
<td>Minimum lighting level in routine maintenance areas is required where the operator has to read information, use a hand tool, or make a connection. This provision can be met by providing integral lighting or portable lighting which can be temporarily attached such that it does not have to be hand held.</td>
<td>minimum 300 lux (30 fc)</td>
<td>Equipment has no routine maintenance and no area where the operator has to read information</td>
<td></td>
</tr>
</tbody>
</table>
| 7.2 | Full Body Clearance  
Note: Clearances should be approached from a task analysis point of view. Clearances should be provided based on the nature of the task in the designated area | | |
| 7.2.1 | Any posture: upper body clearance (shoulder width) | minimum 610 mm (24 in) | Upper body clearance is anticipated to be greater than 610mm when installed in a rack. This needs to be verified in the end installation |
| 7.2.2 | Standing:  
overhead clearance, measured from the floor forward horizontal clearance  
(see Note 3) | minimum 1980 mm (78 in)  
minimum 690 mm (27 in) | No such posture |
| 7.2.3 | Sitting-on-Floor:  
overhead clearance, measured from the floor forward horizontal clearance (see Note 3)  
working height | minimum 1000 mm (39 in)  
minimum 690 mm (27 in)  
minimum 280 mm (11 in) | |
| 7.2.4 | Squatting:  
overhead clearance, measured from the floor forward horizontal clearance (see Note 3)  
working height | minimum 1220 mm (48 in)  
minimum 790 mm (31 in)  
minimum 460 mm (18.1 in) | Overhead clearance is anticipated to be greater than minimum allowed when installed in a rack, to allow access to install or remove. This needs to be verified in the end installation |
| 7.2.5 | Kneeling:  
overhead clearance, measured from the floor forward horizontal clearance (see Note 3)  
working height | minimum 1450 mm (57 in)  
minimum 1220 mm (48 in)  
minimum 640 mm (25.2 in) | No such posture |
<table>
<thead>
<tr>
<th>Section</th>
<th>Description</th>
<th>Minimum Clearances</th>
<th>Result</th>
</tr>
</thead>
<tbody>
<tr>
<td>7.2.6</td>
<td>Kneeling Crawl: overhead clearance, measured from the floor forward horizontal clearance (see Note 3)</td>
<td>minimum 740 mm (29 in) minimum 1520 mm (60 in)</td>
<td>No such posture</td>
</tr>
<tr>
<td>7.2.7</td>
<td>Stooping: overhead clearance, measured from the floor forward horizontal clearance (see Note 3)</td>
<td>minimum 1450 mm (57 in) minimum 1020 mm (40 in) minimum 640 mm (25.2 in)</td>
<td>No such posture</td>
</tr>
<tr>
<td>7.2.8</td>
<td>Supine (lying on back): height</td>
<td>minimum 430 mm (17 in) minimum 1980 mm (78 in)</td>
<td>No such posture</td>
</tr>
<tr>
<td>7.2.9</td>
<td>Prone or crawl space: height</td>
<td>minimum 510 mm (20 in) minimum 2440 mm (96 in)</td>
<td>No such posture</td>
</tr>
<tr>
<td>7.3</td>
<td>Hand/Arm Clearance (where appropriate to do so, dimensions have been adjusted for the use of cleanroom gloves)</td>
<td>Sufficient clearance</td>
<td></td>
</tr>
<tr>
<td>7.3.1</td>
<td>Clearance provided for finger access, round (dia) or square: one finger 2, 3, or 4 finger twist of small knob</td>
<td>minimum 32 mm (1.25 in) minimum object diameter + 58 mm (2.3 in)</td>
<td>No such clearance required</td>
</tr>
<tr>
<td>7.3.2</td>
<td>Clearance provided for flat hand to wrist access: height, palm thickness width, palm width</td>
<td>minimum 89 mm (3.5 in) minimum 114 mm (4.5 in)</td>
<td>Sufficient clearance is anticipated to be greater than minimum allowed when pushing the equipment out to allow grasping from the front when installed in a rack, to allow for remove. This needs to be verified in the end installation</td>
</tr>
<tr>
<td>7.3.3</td>
<td>Clearance provided for fist to wrist access: height, palm thickness width, palm width</td>
<td>minimum height 89 mm (3.5 in) minimum width 127 mm (5.0 in)</td>
<td>No such clearance required</td>
</tr>
<tr>
<td>Section</td>
<td>Description</td>
<td>Compliance</td>
<td></td>
</tr>
<tr>
<td>---------</td>
<td>-------------</td>
<td>------------</td>
<td></td>
</tr>
<tr>
<td>7.3.4</td>
<td>Clearance provided for two hands arm to shoulders access (does not ensure visual access): reach width height</td>
<td>maximum 610 mm (24.0 in) minimum 483 mm (19 in) minimum 114 mm (4.5 in)</td>
<td>No such clearance required N</td>
</tr>
<tr>
<td>7.3.5</td>
<td>Clearance provided for two hands, hand to wrist access (does not ensure visual access): reach width height</td>
<td>maximum 203 mm (8.0 in) minimum 191 mm (7.5 in) minimum 114 mm (4.5 in)</td>
<td>No such clearance required N</td>
</tr>
<tr>
<td>7.3.6</td>
<td>Clearance provided for one arm to shoulder access, diameter or square area (does not ensure visual access)</td>
<td>minimum 132 mm (5.2 in)</td>
<td>No such clearance required N</td>
</tr>
<tr>
<td>7.3.7</td>
<td>Clearance provided for one arm to elbow access, diameter or square area (does not ensure visual access)</td>
<td>minimum 119 mm (4.7 in)</td>
<td>No such clearance required N</td>
</tr>
<tr>
<td>7.4</td>
<td>Maintenance and Service Access</td>
<td>Supports present Equipment t is designed to installed in a rack and is provided with covers and brackets to allow for easy removal P</td>
<td></td>
</tr>
<tr>
<td>7.4.1</td>
<td>Enclosures or covers 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.</td>
<td>Equipment can be grasped to remove from rack when pushed out slightly from the rear of the rack P</td>
<td></td>
</tr>
<tr>
<td>7.4.2</td>
<td>Access covers should be equipped with full-handed grasp areas or other means for opening them.</td>
<td>Handles present, refer to section 6 for design criteria</td>
<td></td>
</tr>
<tr>
<td>7.4.3</td>
<td>Height of access cover handle over the entire range of motion required for routine operation or maintenance. There can be no greater than a 254 mm (10 in) deep obstruction in front of the handle.</td>
<td>maximum 1700 mm (67 in)</td>
<td>No cover handle N</td>
</tr>
<tr>
<td>7.5</td>
<td>Replaceable Components</td>
<td>No replicable components N</td>
<td></td>
</tr>
<tr>
<td>7.5.1</td>
<td>Serviceable components are replaceable as modular packages, and are configured for rapid removal and replacement</td>
<td>Serviceable components configured as described Equipment is intended to be replaced in the field and returned to the manufacture for repairs N</td>
<td></td>
</tr>
<tr>
<td>7.5.2</td>
<td>Serviceable components should not be stacked directly on one another (i.e., a lower layer should not support an upper layer).</td>
<td>Serviceable components independently accessible No stacked components N</td>
<td></td>
</tr>
</tbody>
</table>
### 7.5.3 Heavy components

Heavy components (objects which have a lifting index of 0.5 or greater, see SESC section 1.0) or bulky components (greater than 36 in. in length) requiring frequent removal/installation should include guide/locating aids to assist in positioning.

<table>
<thead>
<tr>
<th>Guide/locating pins present</th>
<th>No such guide/locating pin deemed necessary</th>
<th>N</th>
</tr>
</thead>
</table>

### 7.5.4 Cables, connectors, plugs, and receptacles

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 an S2 assessment is not being conducted.

<table>
<thead>
<tr>
<th>Identification present, keyed where needed</th>
<th>All cables and connectors are properly labeled</th>
<th>P</th>
</tr>
</thead>
</table>

### 7.5.5 Circuit boards

Circuit boards mounted in a card cage configuration should have gripping or ejecting aids for mounting and removal.

<table>
<thead>
<tr>
<th>Finger access, gripping or ejecting aids available</th>
<th>No such circuit boards</th>
<th>N</th>
</tr>
</thead>
</table>

### 8 Display location

<table>
<thead>
<tr>
<th>Display location</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>8.1 Location for operator primary interface, standing station (See Note 1)</td>
<td>No displays</td>
<td>N</td>
</tr>
<tr>
<td>8.1.1 Height of video display terminal (single monitor). Does not include touch screens, measured from floor to center of screen.</td>
<td>maximum 1470 mm (58 in) minimum 1320 mm (52 in)</td>
<td>No displays</td>
</tr>
<tr>
<td>8.1.2 Height of video display terminal (stacked monitors). Does not include touch screens, measured from floor to top line of the top monitor.</td>
<td>maximum 1680 mm (66 in) The primary monitor in a stacked configuration is the bottom monitor</td>
<td>No displays</td>
</tr>
<tr>
<td>8.1.3 Height of infrequently used video display terminal (viewed briefly less often than once per hour) measured to top line of monitor</td>
<td>maximum 1680 mm (66 in)</td>
<td>No displays</td>
</tr>
<tr>
<td>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</td>
<td>maximum 1880 mm (74 in)</td>
<td>No displays</td>
</tr>
<tr>
<td>8.1.5 Height of infrequently viewed visual signal measured to the top of the signal. This guideline does not apply to light towers.</td>
<td>maximum 2130 mm (84 in)</td>
<td>No displays</td>
</tr>
</tbody>
</table>
| 8.1.6 | Height of touch screen monitor. | 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  
See section 9 for horizontal reach criteria. | No touch screen monitor | N |
| 8.1.7 | Tilt angle of touch screen monitor between 41 and 48 in. in height to top of screen | Upward minimum 30 degrees | No tilt angle touch screen | N |
| 8.1.8 | Tilt angle of touch screen monitor less than 41 in. in height to top of screen | Upward minimum 45 degrees | No tilt angle touch screen | N |
| 8.2 | Location for operator primary interface, seated station (See Note 2) | No seated station | No seated station | N |
| 8.2.1 | Height of video display terminal (single monitor), does not include touch screens, measured from the underside (see Note 4) of the work surface to centerline of monitor. | maximum 517 mm (20.5 in)  
minimum 267 mm (10.5 in) | No seated station | N |
| 8.2.2 | Height of video display terminal (stacked monitors), does not include touch screens, measured from the underside (see Note 4) of the work surface to the top line of top monitor. | maximum 727 mm (28.5 in)  
minimum 267 mm (10.5 in)  
The primary monitor in a stacked configuration is the bottom monitor | No seated station | N |
<p>| 8.2.3 | Tilt angle of video display terminal greater than 727 mm (28.5 in) in height to top of screen measured from the underside of the work surface. This criterion applies only if the maximum height criterion (8.2.2) is not met. | Downward minimum 15 degrees | No seated station | N |</p>
<table>
<thead>
<tr>
<th>Section</th>
<th>Description</th>
<th>Measurement Criteria</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>8.2.4</td>
<td>Height of touch screen monitor.</td>
<td>Maximum 397 mm (15.5 in) measured from the underside (see Note 4) of the work surface to highest active pad on the screen. Minimum 77 mm (3.5 in) measured from the underside (see Note 4) of the work surface to lowest active pad on the screen. See section 9 for horizontal reach criteria.</td>
<td>No seated station</td>
</tr>
<tr>
<td>8.3</td>
<td>Display characteristics</td>
<td></td>
<td>No such characters</td>
</tr>
<tr>
<td>8.3.1</td>
<td>Lateral distance from the centerline of the display to the centerline of the input device(s). See MIL-STD-1472 for a depiction of this.</td>
<td>Maximum 320 mm (12.6 in)</td>
<td>No such characters</td>
</tr>
<tr>
<td>8.3.2</td>
<td>Character height (Specific to Chinese, Korean, and Japanese characters)</td>
<td>Character height is greater than or equal to the viewing distance divided by 143. Recommended viewing distance is between 457 mm (18 in) and 762 mm (30 in)</td>
<td>No such characters</td>
</tr>
<tr>
<td>8.3.3</td>
<td>Character height (All characters other than Chinese, Korean, and Japanese)</td>
<td>Character height is greater than or equal to the viewing distance divided by 215. Recommended viewing distance is between 457 mm (18 in) and 762 mm (30 in)</td>
<td>No such characters</td>
</tr>
</tbody>
</table>
## Hand Control Location

(These criteria only apply to controls, tools, and materials accessed for routine production operation and maintenance)

<p>| | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>9</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>Hand Control Location</strong></td>
<td></td>
</tr>
<tr>
<td>9.1</td>
<td>Standing station (See Note 1)</td>
<td>No standing station</td>
</tr>
<tr>
<td>9.1.1</td>
<td>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.</td>
<td>maximum 1640 mm (64.5 in) minimum 0 mm (0 in)</td>
</tr>
<tr>
<td>9.1.2</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 equipment or obstacle. Controls should not be located above 1638mm (64.5 in) or below 838mm (33 in). Interpolate for intermediate values.</td>
<td>No such hand controls</td>
</tr>
</tbody>
</table>

- Height of 1638 mm (64.5 in)
- Height of 1524 mm (60 in)
- Height of 1422 mm (56 in)
- Height of 1321 mm (52 in)
- Height of 1219 mm (48 in)
- Height of 1118 mm (44 in)
- Height of 1016 mm (40 in)
- Height of 914 mm (36 in)
- Height of 838 mm (33 in)

- Reach 254 mm (10.0 in)
- Reach 368 mm (14.5 in)
- Reach 432 mm (17.0 in)
- Reach 470 mm (18.5 in)
- Reach 483 mm (19.0 in)
- Reach 470 mm (18.5 in)
- Reach 394 mm (15.5 in)
- Reach 292 mm (11.5 in)
- Reach 178 mm (7.0 in)
9.1.3 Location of frequently used controls. Maximum reaches are indicated for various heights. Reaches are measured from the leading edge of the equipment or obstacle. Controls should not be located above 1270mm (50 in) or below 940mm (37 in). Interpolate for intermediate values.

<table>
<thead>
<tr>
<th>Height</th>
<th>Reach</th>
<th>Height</th>
<th>Reach</th>
<th>Height</th>
<th>Reach</th>
<th>Height</th>
<th>Reach</th>
</tr>
</thead>
<tbody>
<tr>
<td>1270 mm (50 in)</td>
<td>292 mm (11.5 in)</td>
<td>1219 mm (48 in)</td>
<td>330 mm (13.0 in)</td>
<td>1168 mm (46 in)</td>
<td>368 mm (14.5 in)</td>
<td>1118 mm (44 in)</td>
<td>394 mm (15.5 in)</td>
</tr>
<tr>
<td>1067 mm (42 in)</td>
<td>406 mm (16.0 in)</td>
<td>1016 mm (40 in)</td>
<td>434 mm (17.0 in)</td>
<td>940 mm (37 in)</td>
<td>394 mm (15.5 in)</td>
<td>318 mm (12.5 in)</td>
<td></td>
</tr>
</tbody>
</table>

No such hand controls

9.2 Seated station (See Note 2)

<table>
<thead>
<tr>
<th>Height</th>
<th>Reach</th>
<th>Height</th>
<th>Reach</th>
<th>Height</th>
<th>Reach</th>
<th>Height</th>
<th>Reach</th>
</tr>
</thead>
<tbody>
<tr>
<td>1397 mm (55 in)</td>
<td>356 mm (14.5 in)</td>
<td>1270 mm (50 in)</td>
<td>432 mm (17.0 in)</td>
<td>1168 mm (46 in)</td>
<td>470 mm (18.5 in)</td>
<td>1067 mm (42 in)</td>
<td>483 mm (19.0 in)</td>
</tr>
<tr>
<td>965 mm (38 in)</td>
<td>483 mm (19.0 in)</td>
<td>864 mm (34 in)</td>
<td>470 mm (18.5 in)</td>
<td>762 mm (30 in)</td>
<td>445 mm (17.5 in)</td>
<td>660 mm (26 in)</td>
<td>470 mm (18.5 in)</td>
</tr>
<tr>
<td>533 mm (21 in)</td>
<td>381 mm (15.0 in)</td>
<td>445 mm (17.5 in)</td>
<td>305 mm (12.0 in)</td>
<td>318 mm (12.5 in)</td>
<td>254 mm (10.0 in)</td>
<td>No seated station</td>
<td>N</td>
</tr>
</tbody>
</table>

No seated station
9.2.2 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. Controls should not be located above 1067mm (42 in) or below 762mm (30 in). Interpolate for intermediate values.

<table>
<thead>
<tr>
<th>Height (mm)</th>
<th>Reach (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1067 (42 in)</td>
<td>reach 330 (13.0 in)</td>
</tr>
<tr>
<td>1016 (40 in)</td>
<td>reach 368 (14.5 in)</td>
</tr>
<tr>
<td>965 (38 in)</td>
<td>reach 394 (15.5 in)</td>
</tr>
<tr>
<td>914 (36 in)</td>
<td>reach 406 (16.0 in)</td>
</tr>
<tr>
<td>864 (34 in)</td>
<td>reach 419 (16.5 in)</td>
</tr>
<tr>
<td>813 (32 in)</td>
<td>reach 419 (16.5 in)</td>
</tr>
<tr>
<td>762 (30 in)</td>
<td>reach 419 (16.5 in)</td>
</tr>
</tbody>
</table>

No seated station

10 Workstation Design

<table>
<thead>
<tr>
<th>Workstation Design</th>
<th>Minimum Radius</th>
<th>No workstation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Standing station</td>
<td>6.4 mm (.25 in)</td>
<td>N</td>
</tr>
<tr>
<td>Height of keyboard, trackball, or mouse.</td>
<td>1020 (40 in)</td>
<td>No workstation</td>
</tr>
<tr>
<td>Height of microscope eyepieces. Must be adjustable.</td>
<td>Range includes 1270mm (50in.) to 1730mm (68in.)</td>
<td>No workstation</td>
</tr>
</tbody>
</table>

No seated station

10.2 Seated station (See Note 2) No workstation
| 10.2.1 | Height of keyboard, trackball, or mouse. (to home row, top of ball/mouse). | maximum 87 mm (3.5 in) | No workstation | N |
|        | Note: In applications where input devices (keyboard, trackball, 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 Section 9 Hand control location (Seated station). | | | |
| 10.2.2 | Vertical leg clearance. | minimum 673 mm (26.5 in) | No workstation | N |
| 10.2.3 | Horizontal leg clearance, depth at knee level. | minimum 508 mm (20 in) | No workstation | N |
| 10.2.4 | Horizontal leg clearance, depth at foot level. | minimum 660 mm (26 in) depth X 254 mm (10 in) vertical foot clearance | No workstation | N |
| 10.2.5 | Horizontal leg clearance, width. | minimum 610 mm (24 in) | No workstation | N |
| 10.2.6 | Equipment integrated microscope: | Range includes 495mm (19.5in.) to 658mm (25.9in.) | No microscope | N |
|        | Height of microscope eyepiece measured from the underside (see Note 4) of the work surface to center of eyepiece. Must be adjustable with the entire range. | | | |
|        | Stand-alone (table top) microscopes: | Range includes 445mm (17.5in.) to 607mm (23.9in.) | | |
|        | Height of microscope eyepiece measured from the top of the work surface to center of eyepiece. Must be adjustable with the entire range. | | | |
| 10.2.7 | Microscope eyepiece location in relation to the leading edge of workstation. | Eye pieces are flush with or protrude beyond the leading edge of the work station toward the used (applicable at all eyepiece height adjustment settings). | No microscope | N |
| 10.2.8 | Thickness of work surface. | maximum 51 mm (2.0 in) | No such work surface | N |
| 10.2.9 | Work surface edge radius where the operator can assume a static posture in contact with the edge. | minimum 6 mm (.25 in) radius | No such work surface | N |
Note 1: 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.

Note 2: A seated station is one where a short cylinder office style chair is used.

Note 3: Distance measured away from the equipment or obstruction for body clearance in the given posture.

Note 4: 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.
Attachment B
Task List
## Tasks

### Operation Tasks

<table>
<thead>
<tr>
<th>No.</th>
<th>Task Name</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>No operation tasks</td>
<td>Frequency: N/A</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Mounting Height (from floor): N/A</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Description: N/A</td>
</tr>
</tbody>
</table>

### Maintenance Tasks

<table>
<thead>
<tr>
<th>No.</th>
<th>Task Name</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>No maintenance tasks</td>
<td>Frequency: N/A</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Mounting Height (from floor): N/A</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Description: N/A</td>
</tr>
</tbody>
</table>

### Service Tasks

<table>
<thead>
<tr>
<th>No.</th>
<th>Task Name</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Reset circuit breaker</td>
<td>Frequency: Less than once per year</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Mounting Height (from floor): Various, dependent of final installation location</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Description: Reset circuit breaker in front panel if tripped</td>
</tr>
<tr>
<td>2</td>
<td>Plug / unplug power cord</td>
<td>Frequency: Less than once per year</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Mounting Height (from floor): Various, dependent of final installation location</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Description: Remove plug when removing power supply (or inserting plug when installing power supply)</td>
</tr>
<tr>
<td>3</td>
<td>Install / Remove power supply</td>
<td>Frequency: Less than once in 5 years</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Mounting Height (from floor): Various, dependent of final installation location</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Description: Remove plug when removing power supply or (inserting plug when installing power supply), removing screws from front brackets, slide out power supply and remove</td>
</tr>
<tr>
<td>4</td>
<td>Replace Fan</td>
<td>Frequency: Less than once in 5 years</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Mounting Height (from floor): Various, dependent of final installation location</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Description: Remove plug when removing power supply or (or inserting plug when installing power supply), removing screws from front brackets, slide out power supply and remove. Remove top cover, disconnect fan and remove fan. Replace fan and reinstall</td>
</tr>
</tbody>
</table>
Attachment C
Photo Documentation
Photo Documentation