

SEMI E168.1-1114 (Reapproved 0923) SPECIFICATION FOR PRODUCT TIME MEASUREMENT IN GEM 300 PRODUCTION EQUIPMENT

This Standard was technically approved by the Metrics Global Technical Committee. This edition was approved for publication by the global Audits and Reviews Subcommittee on September 21, 2023. Available at www.semiviews.org and www.semi.org in September 2023; originally published January 2014; previously published November 2014.

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1 Purpose

1.1 SEMI E168 defines the concepts for creating an analysis-ready set of time elements. This Specification applies those concepts to production equipment typically found in 300 mm wafer fabs.

2 Scope

2.1 This Specification defines the details needed to apply the product time measurement (PTM) method to production equipment that implement the GEM 300 Standards for SECS-II communications (i.e., GEM 300 production equipment).

NOTICE: SEMI Standards and Safety Guidelines do not purport to address all safety issues associated with their use. It is the responsibility of the users of the Documents to establish appropriate safety and health practices, and determine the applicability of regulatory or other limitations prior to use.

3 Limitations

3.1 This Specification is limited to the time substrates spend at production equipment.

3.2 This Specification applies only to GEM 300 production equipment. The GEM 300 Standards used in this Specification to delineate time elements are SEMI E87, SEMI E90, SEMI E94, and SEMI E157. This includes, but is not limited to, most 300 mm production equipment.

3.3 A primary objective of this Specification is to support analysis of time periods that are routine. Most error situations and infrequently occurring scenarios in production equipment are not addressed. However, these are not specifically excluded from the scope and could be added at a later time. Many such scenarios are specific to a particular equipment make and model.

3.4 PTM, as applied to lot-level analysis, is limited to the case of one SEMI E94 control job per carrier.

3.5 Production equipment that use internal buffers to store carriers are included in the scope of this Specification, but are not fully supported in this version of the Standard. The same is true for production equipment that process substrates in batches.

4 Referenced Standards and Documents

4.1 SEMI Standards and Safety Guidelines

SEMI E5 — SEMI Equipment Communications Standard 2 Message Content (SECS-II)

SEMI E30 — Generic Model for Communications and Control of Manufacturing Equipment (GEM)

SEMI E40 — Standard for Processing Management

SEMI E87 — Specification for Carrier Management (CMS)

SEMI E90 — Specification for Substrate Tracking

SEMI E94 — Specification for Control Job Management

SEMI E148 — Specification for Time Synchronization and Definition of the TS-Clock Object

SEMI E157 — Specification for Module Process Tracking

SEMI E160 — Specification for Communication of Data Quality

SEMI E164 — Specification for EDA Common Metadata

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

5 Terminology

5.1 Note that terms from the Primary Standard also apply to this Specification.

5.2 Abbreviations and Acronyms

5.2.1 FOUP — front-opening unified pod

5.3 Definitions

5.3.1 *collection event* — an event that may be used to initiate the collection and reporting of data. A collection event may trigger an event report. A collection event also may start or stop one or more trace reports. [SEMI E53]

5.3.2 *control job* — defines a unit of work on equipment for one or more carriers. The work is described by a set of one or more process jobs to be applied to the material contained in the carriers. [SEMI E94]

5.3.3 *equipment recipe* — an executable specification of an activity or process on an equipment. The recipe is the user-managed, reusable portion of the set of instructions and settings that determine the processing environment seen by the material. Recipes may be subject to change between runs or processing cycles. An equipment recipe consists of one or more recipe components. [SEMI E157]

5.3.4 *front-opening unified pod (FOUP)* — a front-opening pod with an integrated (non-removable) cassette. [SEMI E98]

5.3.5 *GEM 300 Standards* — SEMI Equipment Communication Standards commonly implemented on production equipment in 300 mm wafer fabs. The most commonly used GEM 300 Standards include SEMI E30, SEMI E40, SEMI E87, SEMI E90, and SEMI E94.

5.3.5.1 *Discussion* — For the purposes of this Specification, SEMI E157 is included in this set.

5.3.6 *GEM 300 production equipment* — production equipment that implement GEM 300 Standards.

5.3.7 *process module* — a component of the equipment capable of processing material (i.e., adding manufacturing value). A process module is directed in its processing by equipment recipes, which are under the control of the factory user. Process chamber is another term for process module. The SEMI E120 Module class describes the same concept. A process module can contain other process modules (submodules). [SEMI E157]

5.3.7.1 *Discussion* — In the context of this definition, ‘process’ does not refer specifically to physical changes of the substrates, but instead more generally to the execution of an equipment recipe as it applies to the process module. For example, the term process module applies equally to production equipment components where measurement or inspection occurs.

5.3.8 *process job* — a material processing job for a processing resource specifying and tracking the processing to be applied to the material. [SEMI E40]

5.3.9 *slot map* — the information that relates which slots in a carrier hold substrates, both correctly and incorrectly. [SEMI E87]

6 Conventions

6.1 Conventions from the Primary Standard also apply to this Specification.

7 Implementation Overview

7.1 This Subordinate Standard builds upon its Primary Standard. Refer to § 7 from SEMI E168 for an overview of its contents. To that basis is added the detail from the GEM 300 Standards.

7.2 Time Elements

7.2.1 One goal of PTM is uniformity of the data from one equipment or system to another and from one factory to another. This means that the messaging that contains the event reports used to delineate the time elements needs to be substantially similar in all cases. The most reliable way to achieve this is through the use of standard event reports.

7.2.2 Nearly all production equipment in 300 mm wafer fabs employ the same SECS-II-based Communication Standards. This set of GEM 300 Standards includes SEMI E30, SEMI E40, SEMI E87, SEMI E90, and SEMI E94. Some newer Standards such as SEMI E157 are sometimes included in this set. All of these are based on SEMI E5. It is from a subset of these Standards that the events used for PTM are taken.

7.2.3 The naming conventions for the GEM 300 Standards event identifiers (EventIDs) have been adopted from SEMI E164. The EventIDs for the GEM 300 Standards events used in this Specification have been reproduced in Appendix 2 to assist users of this Standard.

7.2.4 In this Specification, Level 3 and Level 4 time elements are defined for product time spent in production equipment. GEM 300 Standards events are specified as start and end events for the time elements.

7.2.5 Two separate cases are considered. The first is a lot-level view of product time, which excludes consideration of the individual substrates. This is most suitable for inclusion in a larger set of data for the purpose of tracking the movement of lots through the factory. The second case is a substrate-level viewpoint, which traces the time in the production equipment for each substrate individually. There is some overlap in the Time Element definitions for these two cases. The user may choose either case for an application of the PTM method, but they cannot be mixed.

7.3 Challenges of PTM for Production Equipment

7.3.1 *Standard Events/Data Identity* — Many of the events reported by the production equipment are mandated by widely used SEMI Communication Standards. However, these SECS-II events and variables do not fall under a standard naming convention. Mapping of production equipment's events to the SEMI Standard events is often difficult to achieve.

7.3.2 *Event Report Availability* — The degree of conformity to SEMI Communication Standards varies from one production equipment to another. In some cases, certain events that are deemed important to PTM are not available for reporting from the production equipment. In other cases, the needed event reports are available, but the user has not enabled their collection from the production equipment or the event reports do not contain sufficient context data. This may be due to a limitation of the production equipment (e.g., bandwidth) or a choice by the user to limit the data collected. If a needed event report is not available or contains insufficient context data, an alternative must be selected or an approach that excludes the event must be developed.

8 Prerequisites

8.1 The basic prerequisite for this Subordinate Standard is conformance to the Primary Standard.

[E168.01-RQ-00002-01] Production equipment shall conform to the requirements in SEMI E168. [/RQ]

8.2 For PTM, as it applies to GEM 300 production equipment, the additional prerequisites fall into three areas.

8.2.1 The first is support for the SEMI Communication Standards necessary to supply the event reports and associated data variables required to create the analysis-ready PTM data set.

8.2.2 The second is the availability of the specific, required data from that interface.

8.2.3 The third is a level of data quality adequate to ensure accurate and consistent results in any analysis of the PTM data set.

8.3 SEMI Communication Standards Support

8.3.1 The events used to mark the start and end of each time segment are taken from GEM 300 Standards. In order to support PTM from factory host to production equipment, the following prerequisites are necessary.

[E168.01-RQ-00003-00] Production equipment shall support the SEMI Standards listed as required in Table 1, including support for the collection events used in this Specification and all required data variables. The versions of these Standards shall be recent enough to include all collection events used by this Specification from each Standard. [/RQ]

[E168.01-RQ-00004-00] The equipment communication interface shall be capable of sufficient bandwidth to report all collection events and data needed by this Specification in addition to any other SECS-II communications required by the factory host. [/RQ]

[E168.01-RQ-00005-00] The user shall configure the SECS-II communications to collect all the collection events and supporting data variables required by this Specification. [/RQ]

[E168.01-RQ-00006-00] SECS-II communication logs for the selected production equipment shall be provided for processing by the PTM method. [/RQ]

Table 1 Support for SEMI Standards

<i>RequirementID</i>	<i>SEMI Standard</i>
Lot and Substrate-Level Analysis	
E168.01-RQ-00007-00	SEMI E40, Standard for Processing Management
E168.01-RQ-00008-00	SEMI E87, Specification for Carrier Management (CMS)
E168.01-RQ-00009-00	SEMI E94, Specification for Control Job Management
Substrate-Level Analysis Only	
E168.01-RQ-00010-00	SEMI E90, Specification for Substrate Tracking
	SEMI E157, Specification for Module Process Tracking is not required. However, support for SEMI E157 or equivalent events is accommodated in Table 9 to provide additional detail in tracking product time spent in process modules.

8.3.2 No events from SEMI E40 are used in the time element definitions for this Specification. SEMI E40 is included in Table 1 because the process job identifier provides useful context information and because SEMI E94 requires the implementation of SEMI E40.

8.3.3 In the case where SEMI E157 is not supported, many production equipment have equivalent events that may be substituted for the two needed from the Module Process state model. Specifically, these events denote the beginning and end of equipment recipe execution within a process module. These are used to differentiate between arrival and departure of the substrate from the process module.

8.3.4 Events from other Standards also may be used in some cases. Refer to § 9.5.10 for a discussion and examples of user extensions.

8.4 Data Quality

8.4.1 Important aspects of data quality are discussed in § 8.4 of SEMI E168.

8.4.2 In addition, SEMI E160 provides a means to communicate the level of quality required or delivered for selected production equipment data. The use of SEMI E160 would help to ensure an adequate level of data quality for the data (i.e., events and data variables) to be used in PTM.

8.4.3 A key part of data quality is synchronization of the production equipment clock(s) with the factory information and control system (FICS) time. Production equipment should synchronize all on-board clocks with a factory-selected time server on a regular basis.

8.4.3.1 SEMI E148 provides one means of achieving time synchronization. Conformance to SEMI E148 would help to ensure proper production equipment clock time synchronization.

9 Requirements

9.1 The following is the top-level parent requirement of all others in this Specification.

[E168.01-RQ-00001-01] Conformance to this Specification requires conformance to all other identified requirements in this Specification as stated conditions apply. [/RQ]

9.2 This Specification applies the PTM method defined in SEMI E168 specifically to GEM 300 production equipment.

[E168.01-RQ-00011-01] The requirements in this Specification apply only to communications exchanged between host and GEM 300 production equipment. [/RQ]

9.3 This Specification's requirements consist of two parts: data set construction and time element definition. In this Specification, these topics are revisited with a focus on GEM 300 production equipment.

9.4 Product Time Data Set Construction

9.4.1 Product Time Inputs

[E168.01-RQ-00012-01] To support PTM in GEM 300 production equipment, the data specified in Table 2 shall be provided. [/RQ]

Table 2 Data Required for PTM in GEM 300 Production Equipment

<i>RequirementID</i>	<i>Required Data</i>	<i>Description</i>
E168.01-RQ-00013-01	Communication Log	A record of the messages exchanged between host and production equipment during the time period specified for analysis. This record can be a message log recorded by the host or a log recorded by the production equipment. Necessary context data shall be included in the event reports (refer to § 9.5.4). This Specification does not specify the format for this log.
E168.01-RQ-00014-01	Event-Source Documentation - Collection Events	A list of collection event identifiers (CEIDs) for the collection events supported by the production equipment with names and descriptions of those events sufficient to document the meaning of the event and allow the user to associate the corresponding standard event (if any).
E168.01-RQ-00015-01	Event-Source Documentation - Data Variables	A list of variable identifiers (VIDs) of the variables supported by the production equipment with names and descriptions of those variables sufficient to document the meaning of each and allow the user to associate the corresponding standard variable (if any).
E168.01-RQ-00016-01	Event Configuration	A list of report identifiers (RPTIDs) of the event reports linked to each collection event, along with definitions for the event reports, including the VIDs of the variables to be included with each report.
		Note that the production equipment user may reconfigure the event reports for a SECS-II interface at any time. This listing needs to pertain to the particular communication log under investigation.

9.4.1.1 For SECS-II communication, the information needed to document the event configuration is specified in the S2F33/F34 and S2F35/36 message transactions. However, these messages need be sent only once and may not be available in each communication log.

9.4.1.2 Communication Log

9.4.1.2.1 SECS-II messages are structured as a set of nested lists. Each data item in the message is either a data value or a list designator with the length of the list included. Each item in a list also may be a data value or a list (nested list).

9.4.1.2.2 The communication log format for SECS-II is not specified. However, the content is addressed in the following two requirements.

[E168.01-RQ-00017-01] Communication logs shall contain all SECS-II messages exchanged over the time period specified for analysis. [/RQ]

[E168.01-RQ-00018-00] Communication logs shall include the following for each SECS-II message: a) the stream and function indicator (e.g., S6F11), b) a timestamp associated with the event, and c) all data items from the original message, including the format and value of each variable data item. [/RQ]

9.4.1.3 Event-Source Documentation

9.4.1.3.1 In GEM 300 production equipment, all event data is collected using collection events that trigger event reports. These are typically reported by the production equipment using the S6F11 message.

[E168.01-RQ-00019-01] The documentation for each collection event shall include the CEID, the supplier name for the event, and a description of when and why the event occurs. In the case where the event is required by one of the GEM 300 Standards, the standard name for that event as specified in SEMI E164 also shall be included. [/RQ]

9.4.1.3.2 Refer to Appendix 2, ¶ A2-1.1 for a list of the standard events used in this Specification and the corresponding EventIDs from SEMI E164.

[E168.01-RQ-00020-01] The documentation for each data variable shall include the VID, the supplier name for the variable, and a description of the content of the variable. In the case where the variable is required by one of the GEM 300 Standards, the standard name for that variable also shall be included. [/RQ]

9.4.1.4 *Event Configuration*

9.4.1.4.1 SECS-II provides the production equipment user with the capability to configure SECS-II event data collection. This is done in three stages.

9.4.1.4.1.1 The first stage is the definition of event reports. Each event report is assigned an RPTID and a list of VIDs. The S2F33 message is used to request the definition of event reports.

9.4.1.4.2 The second stage of SECS-II event configuration is the linking of event reports to specific events. The S2F35 message is used to provide a list of CEIDs and the RPTIDs attached to each.

9.4.1.4.3 The third stage of SECS-II event configuration is the enabling of each event to be reported. This is requested by the host using the S2F37 message.

[E168.01-RQ-00021-01] The user shall provide a list of CEIDs representing all collection events enabled for the production equipment, including the RPTIDs attached to each, as input to the PTM method. [/RQ]

9.4.2 *Product Time Data Transformations*

9.4.2.1 This section builds upon the data transformation steps defined in SEMI E168. It adds GEM 300 Standard specific information and requirements.

9.4.2.2 *Step 1* — Communication Log Normalization – no additional comment

9.4.2.3 *Step 2* — Message Filtering

[E168.01-RQ-00022-01] For GEM 300 production equipment, the message filtering step shall retain the following messages when they appear in the communication log:

- S6F11 – Event Report Send
- S3F17 – Carrier Action Request (CARRIERACTION = Bind or ProceedWithCarrier per SEMI E87)
- S2F33 – Define Report
- S2F35 – Link Event Report
- S14F9 – Create Object Request (Create control job object)
- S16F3 – Process Job Create Request (and alternatives S16F11, S16F15)

[/RQ]

9.4.2.4 *Step 3* — Data Code Translation

9.4.2.4.1 The event-source documentation (§ 9.4.1.3) and event configuration (§ 9.4.1.4) serve as the inputs to the data code translation.

9.4.2.5 *Step 4* — Context Data Population

9.4.2.5.1 Selected messages provide links between certain key context data items.

- The S14F9 message specifies the control job, as well as the identifiers for the carrier, control job, and process job. This links these identifiers to one another.
- The S16F15 message specifies the process job, as well as the identifiers for the carrier, process job, and substrate. These identifiers are linked by this message.

- The S3F17 contains the identifiers of the carrier and the load port, and typically also contains the content map with lot and substrate identifiers, linking those variables.

9.4.2.5.2 Using these messages, it is possible to create a map of load port to carrier to lot to control job to process job to substrate so that within the timeframe of carrier arrival to carrier departure, any of the identifiers can be translated into any of the others.

9.4.2.5.2.1 Since there are multiple substrates, we can link one substrate to any of the other context data (i.e., it is a many-to-one relationship). However, linking in the other direction is a one-to-many relationship and therefore points to all substrates in the lot (e.g., a carrier links to all the substrates delivered in the carrier).

9.4.2.6 Step 5 — Time Segment Construction

[E168.01-RQ-00023-00] Time segment construction shall be done using the Level 4 time elements specified in § 9.5.3. [RQ]

9.4.3 Data Set Output Format

9.4.3.1 SEMI E168 specifies the PTMData output file format. This Subordinate Specification adds detail to some PTMData fields defined in its Primary Specification (refer to Table 3) and adds new fields specific to GEM 300 production equipment (refer to Table 4). Unaffected fields are not included. The field order, as specified in SEMI E168, is not affected. The new fields are specified in the order that they are to appear, following the existing fields.

Table 3 Additional Definition for PTMData Fields from SEMI E168

<i>RequirementID</i>	<i>Field</i>	<i>Description</i>	<i>Format</i>
E168.01-RQ-00024-01	SystemType	Model of the production equipment.	Text (no change)
E168.01-RQ-00025-01	SystemID	Production equipment identifier.	Text (no change)
E168.01-RQ-00026-00	StartEventID	EventID that started the time element, using SEMI E164 naming convention.	Text (no change)
E168.01-RQ-00027-00	EndEventID	EventID that ended the time element, using SEMI E164 naming convention.	Text (no change)
E168.01-RQ-00028-00	TimeElementLabel	Using Level 4 time elements specified in Tables 6 and 7.	Text (no change)
E168.01-RQ-00029-00	TimeElementName	Using Level 4 time elements specified in Tables 6 and 7.	Text (no change)
E168.01-RQ-00030-01	CarrierLocationID	The production equipment identifier used as a portion of the CarrierLocationID shall be set as part of the user configuration. The location identifier portion of the CarrierLocationID shall be the same as the SEMI E87 LocationID.	Text (no change)

9.4.3.2 Where the description field in Table 3 includes the text ‘for appropriate time elements,’ the requirement applies only for time elements where such a value exists.

Table 4 Added PTMData Fields to Support GEM 300 Production Equipment

<i>RequirementID</i>	<i>Field</i>	<i>Description</i>	<i>Format</i>
E168.01-RQ-00031-00	CtrlJobID	Identifier of the SEMI E94 control job (for appropriate time elements).	Text
E168.01-RQ-00032-00	PRJobID	Identifier of the SEMI E40 process job (for appropriate time elements).	Text

<i>RequirementID</i>	<i>Field</i>	<i>Description</i>	<i>Format</i>
E168.01-RQ-00033-01	RecipeID	Identifier of the equipment recipe or process program associated with the current processing of the product unit (for appropriate time elements).	Text

9.5 Time Elements

9.5.1 SEMI E168 does not define the Level 3 or Level 4 time elements in detail because they are specific to the type of event-source. Those time elements are defined in Table 5 and Table 6 for GEM 300 production equipment.

9.5.2 Level 3 — Resources

9.5.2.1 In Level 3, wait time and active time elements are further subdivided into elements related to specific factory resources. This Subordinate Standard is focused on the time the product unit spends at production equipment. However, there are some time elements needed during this time period that are more closely associated with the FICS and with the AMHS.

[E168.01-RQ-00034-01] The Level 3 time elements that are subcategories of Wait Time are:

- Wait for FICS
- Wait for Production Equipment
- Wait for AMHS

[/RQ]

[E168.01-RQ-00035-00] The Level 3 time elements that are subcategories of Active Time are:

- Active Time for Production Equipment
- Active Time for Carrier Handoff

[/RQ]

9.5.2.2 Table 5 shows the Level 3 time elements with their associated parent categories. Note that the ‘Active Time for Carrier Handoff’ time element is a cooperative effort between the AMHS and the production equipment factory resources.

Table 5 Level 3 Time Elements

<i>Level 1</i>	<i>Level 2</i>	<i>Level 3</i>
Product Time	Wait Time	Wait for FICS
		Wait for Production Equipment
		Wait for AMHS
	Active Time	Active Time for Production Equipment
		Active Time for Carrier Handoff

9.5.3 Level 4 — Detailed Time Elements

9.5.3.1 Level 4 time elements provide the finest level of detail defined in this Specification. These are shown in Table 6 (wait time elements) and Table 7 (active time elements).

9.5.3.2 There are two sets of Level 4 time elements. One set is for analysis at the lot-level (i.e., lot-focused) and the other set is for the substrate-level (i.e., substrate-focused). These are shown in two columns in each of the tables. Only one set at a time is to be used.

Table 6 Level 4 Wait Time Elements

<i>Level 3</i>	<i>RequirementID</i>	<i>Level 4 Production Unit (Lot) Level</i>	<i>Level 4 Production Unit (Substrate) Level</i>
Wait for FICS	E168.01-RQ-00036-00	Wait for Command to Production Equipment	Wait for Command to Production Equipment
	E168.01-RQ-00037-00	Wait for Job Definition on Production Equipment	Wait for Job Definition on Production Equipment
Wait for Production Equipment	E168.01-RQ-00038-00	Wait for Prior Lot to Clear at Production Equipment	Wait for Prior Lot to Clear at Production Equipment
	E168.01-RQ-00039-00		Wait for Prior Substrates to Clear at Production Equipment
	E168.01-RQ-00040-00		Wait for Last Substrate to Complete at Production Equipment
	E168.01-RQ-00041-00	Wait for Lot-Based Setup at Production Equipment	Wait for Lot-Based Setup at Production Equipment
	E168.01-RQ-00042-00		Wait for Substrate-Based Setup at Production Equipment
	E168.01-RQ-00043-00		Wait for Lot-Based Post-Processing at Production Equipment
	E168.01-RQ-00044-00		Substrate Post-Process Waiting in Process Module
Wait for AMHS	E168.01-RQ-00045-00	Wait for AMHS Preparation	Wait for AMHS Preparation

Table 7 Level 4 Active Time Elements

<i>Level 3</i>	<i>RequirementID</i>	<i>Level 4 Production Unit (Lot) Level</i>	<i>Level 4 Production Unit (Substrate) Level</i>
Active Time for Production Equipment	E168.01-RQ-00046-00	Active Process Execution on Lot by Production Equipment	
	E168.01-RQ-00047-00		Active Process Execution on Substrate by Production Equipment
	E168.01-RQ-00048-00	Active Time for Carrier Transport within Production Equipment	
	E168.01-RQ-00049-00		Active Time for Substrate Transport within Production Equipment
	E168.01-RQ-00050-01	Active Time for Lot Preprocessing at Production Equipment	Active Time for Lot Preprocessing at Production Equipment
	E168.01-RQ-00051-01		Active Time for Substrate Preprocessing at Production Equipment
	E168.01-RQ-00052-00	Active Time for Lot Post-Processing at Production Equipment	Active Time for Lot Post-Processing at Production Equipment
Active Time for Carrier Handoff	E168.01-RQ-00053-00	Active Time for Carrier Arrival	Active Time for Carrier Arrival
	E168.01-RQ-00054-00	Active Time for Carrier Departure	Active Time for Carrier Departure

9.5.4 Context Information

9.5.4.1 Events specified in the GEM 300 Standards are used to mark the beginning and end of each time segment. However, the production equipment collection event identifier (CEID) is not sufficient for the assignment of time elements. Context information needs to be included with events to identify the product unit, to clarify the event (e.g., material location), and to determine when the event occurred.

9.5.4.2 Material Location

9.5.4.2.1 The material location can be used to determine which time element should begin with a particular event. For example, refer to RQ-00076 and others in Table 9. The PTM method classifies the material locations into material location types to facilitate their use for this purpose.

[E168.01-RQ-00055-01] Material locations within the production equipment shall be categorized using the following material location types:

- Carrier – a separate substrate location within a carrier
- Transport – a location that moves within the production equipment
- ProcessModule – a fixed location where the intended function of the production equipment is executed
- Buffer – a fixed, passive location where a substrate may be placed to await further transport
- ActiveNonprocess – a fixed location where a nonprocess activity occurs

[/RQ]

9.5.4.2.2 Some events referenced in Table 9 are qualified with these material location types.

Table 8 Additional Information on Material Location Types

<i>Location Type</i>	<i>Description</i>
Carrier	In a 300 mm wafer fab, this is a wafer slot in a front-opening unified pod (FOUP).
Transport	A transport location is typically the end effector on a robot arm.
ProcessModule	This includes locations in process modules for physical processing, measurement, or inspection.
Buffer	This may be an intermediate point of handoff between two transfer robots or a temporary storage location for the substrate to await the availability of resources.
ActiveNonprocess	An example is a prealigner, where the orientation of the wafer is adjusted.

9.5.4.3 Job Identification

9.5.4.3.1 The SEMI E94 and SEMI E40 job specifications are needed for linking the jobs to the product units. The control job request includes the carrier identifier (CarrierID) and the process job identifier(s) (PRJobIDs). The process job request includes the identifiers of the carrier and the slots used in the processing. Other messages (typically the S3F17 or collection events) link the lot identifier (LotID) to the CarrierID. This is sufficient to link the LotID to the jobs.

9.5.4.3.2 Using this information, any control job and process job events that are used can be linked to the product unit given only the job identifier in the event report.

9.5.5 Level 4 — Time Element Definitions

9.5.5.1 Table 9 defines each of the Level 4 time elements listed in Tables 6 and 7. Each nonheader row contains the definition of a single time element.

9.5.5.2 Except where noted, the definitions in Table 9 cover both the lot-focused and substrate-focused time elements.

9.5.5.3 The time elements in Table 9 are not listed in chronological order. The order of the time elements is dependent, to some degree, on factors such as factory implementation choices, production equipment design, and factory situation.

NOTE 1: Refer to Related Information 1 for example sequences of messages and time elements.

[E168.01-RQ-00056-01] For GEM 300 production equipment, the PTM method shall use the time elements as defined in Table 9, using either the set designated for Substrates or the set for Lots, but not both at the same time. [/RQ]

9.5.5.4 Table 9 contains three columns.

9.5.5.4.1 The first is the RequirementID.

9.5.5.4.2 The second column lists the name of each time element. Below the name, in parentheses, is the 'Label.' The label is a shortened name intended for visualizations or tables where space may be limited.

9.5.5.4.3 The third column contains the definition of each time element. This includes:

- Text to describe the time element such as the reason for waiting (if wait time) or the particular activity (if active time).
- The EventID of each event that will start this time element.
- The EventID of each event that will end this time element.

9.5.5.4.4 Each EventID mentioned in the bullets above is followed by text explaining the significance of the event.

9.5.5.5 For some time elements, multiple pairs of start and end events are specified. This is a recognition that the same category of time may occur at different points in the message sequence.

9.5.5.6 In a few cases, two consecutive time segments may be assigned the same time element. This presents the user the opportunity, during analysis, to differentiate the two occurrences of that time element or combine them.

9.5.5.7 Where more than one pair of start and end events are listed, a numbered list is used to differentiate the pairs. The title of each numbered item refers to the circumstances in which that set of start and end events occur.

9.5.5.8 Level 2 and Level 3 time elements are provided as divider rows above their Level 4 time elements listed in Table 9.

Table 9 Level 4 Time Element Definitions

<i>RequirementID</i>	<i>Level 4 Time Element Name (Label)</i>	<i>Time Element Definition</i>
E168.01-RQ-00057-00	<i>Wait Time Elements (Level 2)</i>	
E168.01-RQ-00058-01	<i>Wait for FICS (Level 3)</i>	
E168.01-RQ-00059-01	Wait for Command to Production Equipment (WaitForCmd)	The product unit is waiting for the production equipment to accept a command from the FICS leading toward active time for the product unit. 1) Waiting for host to confirm the identification of the carrier (ProceedWithCarrier approach). <i>Start:</i> Carrier:3:NoState-WaitingForHost <i>CarrierID of newly arrived carrier is read and reported to the host.</i> <i>End:</i> Carrier:8:WaitingForHost-IDVerificationOk <i>Carrier has been identified by the production equipment and confirmed by the host.</i> 2) Waiting for host to send a command to start a previously queued control job. <i>Start:</i> ControlJob:6:Selected-WaitingForStart <i>Production equipment has selected the control job for execution and is waiting for a start command from the host.</i> <i>End:</i> ControlJob:7:WaitingForStart-Executing <i>The start command has been received and execution begins.</i>