Variable Name	*Class*	*Format*
CarrierLocationMatrix	SV	L,n 1. L,2 1. <$LocationID_1$> 2. <$CarrierID_1$> . . n. L,2 1. <$LocationID_n$> 2. <$CarrierID_n$>
LoadPortReservationState	DVVAL	51 (U1) Enumerated as: 0 = NOT RESERVEED 1 = RESERVED
$LoadPortReservationState_I$	SV	51 (U1) Enumerated as: 0 = NOT RESERVED 1 = RESERVED
LoadPortReservationStateList	SV	L,n 1.<$LoadPortReservationState_1$> . . n.<$LoadPortReservationState_N$>
LocationID	DVVAL	A[1-80] (Conforms to restrictions of ObjID as specified in SEMI E39.1, Section 6.)
$LocationID_i$	SV	A[1-80] (Conforms to restrictions of ObjID as specified in SEMI E39.1, Section 6.)
PartitionCapacity	DVVAL	51
$PartitionCapacity_i$	SV	51
PartitionID	DVVAL	A[1-80] (Conforms to restrictions of ObjID as specified in SEMI E39.1, Section 6.)
$PartitionID_i$	SV	A[1-80] (Conforms to restrictions of ObjID as specified in SEMI E39.1, Section 6.)
PartitionType	DVVAL	A[1-64]
$PartitionType_i$	SV	A[1-64]
PortAssociationState	DVVAL	51 (U1) Enumerated as: 0 = NOT ASSOCIATED 1 = ASSOCIATED
$PortAssociationState_i$	SV	51 (U1) Enumerated as: 0 = NOT ASSOCIATED 1 = ASSOCIATED
PortAssociationStateList	SV	L,n 1. <$PortAssociationState_1$> . . n. <$PortAssociationState_n$>
PortID	DVVAL	51
$PortID_i$	SV	51
PortStateInfo	DVVAL	L,2 1. <PortAssociationState> 2. <PortTransferState>

Variable Name	*Class*	*Format*
PortStateInfo$_i$	SV	L,2 1. <PortAssociationState$_i$> 2. <PortTransferState$_i$>
PortStateInfoList	SV	L,n 1. <PortStateInfo$_1$> . n. <PortStateInfo$_n$>
PortTransferState	DVVAL	51 (U1) Enumerated as: 0 = OUT OF SERVICE 1 = TRANSFER BLOCKED 2 = READY TO LOAD 3 = READY TO UNLOAD
PortTransferState$_i$	SV	51 (U1) Enumerated as: 0 = OUT OF SERVICE 1 = TRANSFER BLOCKED 2 = READY TO LOAD 3 = READY TO UNLOAD
PortTransferStateList	SV	L,n 1. <PortTransferState$_1$> . . n. <PortTransferState$_n$>
Reason	DVVAL	51 (U1) Enumerated as: 0 = VERIFICATION NEEDED 1 = VERIFICATION BY EQUIPMENT UNSUCCESSFUL 2 = READ FAIL 3 = IMPROPER SUBSTRATE POSITION
SlotMapStatus	DVVAL	51 (U1) Enumerated as: 0 = SLOT MAP NOT READ 1 = [SLOT] WAITING FOR HOST 2 = SLOT MAP VERIFICATION OK 3 = SLOT MAP VERIFICATION FAILED
SlotMap	DVVAL	L, n n= capacity (1...25) 1. Enumerated 2. Enumerated 3. . . n Each as 51 (U1) Enumerated as: 0 = UNDEFINED 1 = EMPTY 2 = NOT EMPTY 3 = CORRECTLY OCCUPIED 4 = DOUBLE SLOTTED 5 = CROSS SLOTTED
UnAllocatedPartitionCapacity	DVVAL	51
UnAllocatedPartitionCapacity$_i$	SV	51

7 SECS-II Attribute Definitions

7.1 *Carrier Object SECS-II Attributes Definitions*

7.1.1 The following are the SECS-II structure definitions for the E87 Carrier Object.

Table 5 Carrier Object Attribute Definitions

Attribute Name	*Attribute Data Form: SECS-II Structure*
"ObjType"	1. "Carrier"
"ObjID"	1. <CARRIERID> (Conforms to the restrictions of ObjID as specified in SEMI E39.1, Section 6.)
"Capacity"	51 (U1) Capacity Capacity Range: 1..25 Capacity Examples: 1, 13, 25
"CarrierAccessingStatus"	51 (U1) CarrierAccessingStatus CarrierAccessingStatus enumerated per Variable CarrierAccessingStatus
"CarrierIDStatus"	51 (U1) CarrierIDStatus CarrierIDStatus enumerated per Variable CarrierIDStatus
"ContentMap"	L, n n=Capacity 1. L,2 1. 20 (A) LotID 2. 20 (A) SubstID … n. L,2 1. 20 (A) LotID 2. 20 (A) SubstID SubstID conform to the restrictions of ObjID as specified in SEMI E39.1, Section 6.
"LocationID"	20 (A) LocationID LocationID conforms to the restrictions of ObjID as specified in SEMI E39.1, Section 6.
"SlotMap"	L, n n=Capacity 1. 51 (U1) enumerated … n. 51 (U1) enumerated enumerated per variable SlotMap
"SlotMapStatus"	51 (U1) SlotMapStatus SlotMapStatus enumerated per Variable SlotMapStatus.
"SubstrateCount"	51 (U1) SubstrateCount SubstrateCount Range: 0..25 SubstrateCount Examples: 1, 3, 21, 25
"Usage"	20 (A) Usage Usage is equipment defined, examples: "TEST", "DUMMY", "PRODUCT"

SEMI E88-1104[E]
SPECIFICATION FOR AMHS STORAGE SEM (STOCKER SEM)

This specification was technically approved by the Global Information & Control Committee and is the direct responsibility of the North American Information & Control Committee. Current edition approved by the North American Regional Standards Committee on July 11, 2004. Initially available at www.semi.org September 2004; to be published November 2004. Originally published September 1999; last published July 2004.

[E] This standard was editorially modified in September 2004 to correct a formatting error. Changes were made to Table 6.

1 Purpose

1.1 This standard establishes a Specific Equipment Model (SEM) for AMHS storage equipment (Stocker SEM). The model consists of equipment characteristics and behaviors that are to be implemented in addition to the SEMI E30 fundamental requirements and selected additional capabilities. The intent of this standard is to facilitate the integration of Stocker SEM equipment into an automated (e.g., semiconductor fabrication and flat panel display) factory. This document accomplishes this by defining an operational model for Stocker SEM equipment as viewed by a factory automation controller (Host). This definition provides a standard host interface and equipment operational behavior (e.g., control, state models, and data reports). Several topics require additional activity that are within the scope of this standard: queuing, parallel interface for carrier transfer (SEMI E23), stocker controller architecture, and scheduling and transport of the transfer unit.

2 Scope

2.1 The scope of this standard is limited to the usage and description of AMHS storage equipment (Stockers) as perceived by a SEMI Equipment Communications Standard 2 (SECS-II) host that complies with the GEM model (as specified in Section 13). It defines the view of the equipment through the SECS communication link. It does not define the internal operation of the equipment. It includes a specific transfer command state model and stocker controller state model as the basis for all equipment of this class.

2.2 This document assumes that the GEM fundamental requirements and selected additional capabilities (as specified in Section 13) have been implemented on the Stocker SEM equipment. It expands the GEM standard requirements and capabilities in the areas of state models (stocker controller, transfer command, carrier and stocker crane state models), collection events, alarm documentation, remote commands, data item variables, and material movement.

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

3 Limitations

3.1 *SEMI Standards Alignment*

3.1.1 The GEM (SEMI E30) model was used as the basis for Stocker SEM requirements definition in alignment with existing AMHS SEM Specifications.

3.2 *AMHS Storage Equipment Description*

3.2.1 This standard is targeted at the different types/configurations of 300 mm AMHS storage equipment. The term Stocker SEM equipment refers to all the types of AMHS storage equipment. The equipment types may have fundamental mechanical differences.

3.2.2 *Stocker (configuration)*

3.2.2.1 A Stocker is generally an AMHS automated storage and retrieval device used to provide temporary storage of carriers. The device is not required to provide temporary storage of carriers (for example, when used as a device to connect multiple IBSEM devices or as a floor to floor lifter). Additionally, any number of physical interfaces may exist to connect the stocker with external devices such as: Interbay and/or Intrabay Transport Systems, Process Equipment, other StockerSEM devices, Operator ports, etc.

4 Referenced Standards

4.1 *SEMI Standards*

SEMI E4 — SEMI Equipment Communications Standard 1 Message Transfer (SECS-I)

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

SEMI E23 — Specification for Cassette Transfer Parallel I/O Interface

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

SEMI E37 — High-Speed SECS Message Services (HSMS) Generic Services

SEMI E37.1 — High-Speed SECS Message Services Single Selected-Session Mode (HSMS-SS)

SEMI E84 — Specification for Enhanced Carrier Handoff Parallel I/O Interface

4.2 *Other References*

Harel, D., "Statecharts: A Visual Formalism for Complex Systems," Science of Computer Programming 8 (1987) 231-274.[1]

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

5 Terminology

5.1 *Abbreviations and Acronyms*

5.1.1 *AMHS* — Automated Material Handling System

5.1.2 *BP* — Buffer Port

5.1.3 *FOUP* — Front Opening Unified Pod

5.1.4 *GEM* — Generic Equipment Model

5.1.5 *IBSEM* — InterBay/IntraBay Specific Equipment Model

5.1.6 *ITS* — Interbay or Intrabay Transport System

5.1.7 *LP* — Loading Port

5.1.8 *OP* — Output Port

5.1.9 *PGV* — Person Guided Vehicle

5.1.10 *SC* — Stocker Controller

5.1.11 *TCP/IP* — Transmission Control Protocol/Internet Protocol

5.1.12 *TSC* — Transport System Controller

5.2 *Definitions*

5.2.1 *Automated Material Handling System* — an automated system to store and transport materials within the factory.

5.2.2 *automation* — the capability of managing material and data within the factory.

5.2.3 *bidirectional load port* — a load port used for loading and unloading carriers.

5.2.4 *buffer* — a set of one or more locations for holding carriers at the production equipment.

5.2.5 *buffer port* — special buffer port location on a stocker output shuttle. Contains carrier presence sensors so that the host can be notified when a carrier is situated at this position.

5.2.6 *carrier* — a container with one or more fixed positions for holding substrates. Examples of carriers include FOUPs and open cassettes.

5.2.7 *carrier ID* — a readable and unique identifier for the carrier.

5.2.8 *FOUP*—a closed carrier for holding wafers.

5.2.9 *host* — the factory computer system, or an intermediate system, that represents the factory and the user to the equipment. Refers system that controls or supervises the Stocker Controller (SC) throughout this document.

5.2.10 *independent port* — a load port on the stocker that is dedicated to input or output. It is considered that the carriers can only be transferred in one direction.

5.2.11 *interbay transport system* — a transport system used to move work-in-process between stockers in different parts of the factory.

5.2.12 *Intrabay Transport System* — a transport system dedicated to one or more bays in the factory and responsible for transferring carriers to and from production equipment. ITS consists of the physical units of the system (e.g., vehicles, nodes, docking stations), the low-level unit controllers, and a system-level controller. ITS excludes factory floor storage systems (stockers), but includes any short-term storage integral to the system, such as storage locations within an overhead track system that are accessible only to units of the particular ITS.

5.2.13 *load port* — the interface location on the equipment where carriers are transferred.

5.2.14 *loading port* — user or vehicle accessible port location on a stocker output shuttle. Contains carrier presence sensors so that the host can be notified when a carrier is situated at this position.

5.2.15 *output port* —port location on a stocker output shuttle, typically accessible by the stocker crane. Contains carrier presence sensors so that the host can be notified when a carrier is situated at this position.

5.2.16 *process equipment* — equipment used to make semiconductor devices. This excludes metrology and material handling equipment.

5.2.17 *production equipment* — equipment used to produce semiconductor devices, including wafer sorting, process, and metrology equipment and excluding material handling equipment.

1 Elsevier Science, P.O. Box 945, New York, NY 10159-0945, http://www.elsevier.nl/homepage/browse.htt

5.2.18 *Stocker Controller* — stocker Equipment Controller that communicates with the host and represents the system as the equipment.

5.2.19 *stocker crane* — stocker transfer agent specialized for the movement of carriers between shelves and input and output port locations.

5.2.20 *stocker equipment* — an individual stocker viewed as a single piece of equipment, with distributed components and distributed control, as illustrated in Figure 1. The stocker controller communicates with the host using HSMS and GEM and represents the system as an equipment. The factory may require more than one type of stocker.

5.2.20.1 Communications with transport system equipment may require a low-level handshake with a transport unit directly involved in the transfer of material (such as a vehicle or a docking station on an overhead track).

5.2.20.2 Communications between the various stocker units and controllers are proprietary to the supplier.

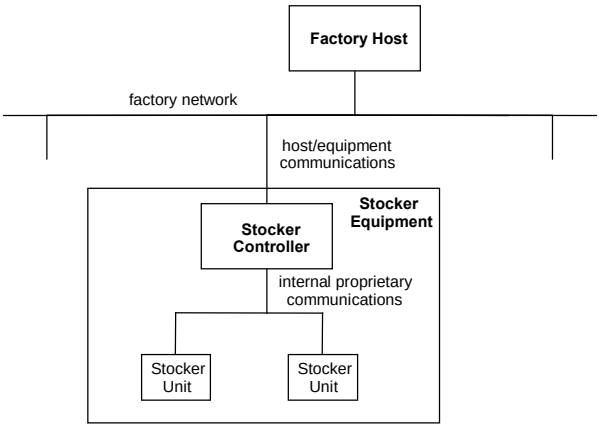

Figure 1
Example of Stocker Equipment

5.2.21 *stocker shelf* — locations within the stocker equipment to store carriers. These locations exclude load ports.

5.2.22 *stocker unit* — a physical component of the stocker system, such as a stocker crane, ID reader, wafer sensor, shuttle port, etc.

5.2.23 *swapping port* — a load port on the stocker capable of handling single load and unload of carriers or simultaneous replace of carriers.

5.2.24 *transfer agent* — a component of equipment specialized to the movement of transfer objects from place to place within a factory. May be of different types with widely-differing characteristics. Examples are fixed-arm robots, robot arms on fixed tracks, overhead gantries or even systems containing a heterogeneous collection of other transfer agents. Humans may also act as transfer agents.

5.2.25 *transfer completed port* — the destination port specified in a transfer command.

5.2.26 *transfer port* — point on the transport system at which a change of equipment ownership of the carrier occurs.

5.2.27 *transfer unit* — the element of movement (assemblage of carriers) of the ITS that consists of a maximum number of carriers allowed in a specific transfer command:

- AA is the maximum number of carriers allowed for acquire at the transfer source.
- BB is the maximum number of carriers allowed for deposit at the transfer destination.
- CC is the maximum number of carriers allowed for transfer in one transport vehicle.

5.2.27.1 The maximum size of the transfer unit is the minimum of AA, BB, and CC.

5.2.27.2 For purposes of the Stocker SEM, the transfer unit is limited to one carrier.

5.2.28 *transport system* — the component of AMHS that moves material from one part of the factory to another.

5.2.29 *transport unit* — a physical component of a transport system, such as a vehicle, node, or docking unit.

5.2.30 *zone* — a logical assignment referencing a set of one or more locations. A stocker can have several logical zone assignments. For example, a specific stocker may have 2 zones defined as LEFT_ZONE and RIGHT_ZONE. The assignment of zones is specific to the Stocker SEM equipment supplier and it may be desirable for the supplier to remain flexible in the assignment of zones so that it could be configured to meet the specific requirements of different users. A specific zone may only contain shelf locations or ports, but not both. A location may be in at most one zone.

6 Overview and Assumptions

NOTE 1: This section has been included as background information to help clarify requirements.

6.1 *Destination Control (to Shelf or to Output Port)*

6.1.1 The destination is controlled by Host when the carrier is input to the stocker (i.e., the carrier enters the stocker domain). The destination of the transfer command is required. It would be invalid for the Host to issue a transfer command to the SC without including a valid destination.

6.1.2 *Output to the Interbay Output Port*

6.1.2.1 The destination for a transfer command to move a carrier to an interbay output port must be a loading port. It is the responsibility of the Host to ensure that sufficient capacity exists in the destination stocker when delivering from a source stocker to a destination stocker (i.e., an interbay move). For example, it would be the responsibility of the Host to check the remaining capacity of the destination stocker prior to issuing the transfer command to send the carrier to the interbay output port of the source stocker.

6.1.3 *Output to the Intrabay Output Port*

6.1.3.1 The destination for a transfer command to move a carrier to an intrabay output port must be a loading port.

6.1.4 *Store to the Stocker Shelf*

6.1.4.1 The specific stocker shelf location is to be controlled by the Stocker Controller (SC). The Host does not specify a shelf ID in a transfer command. The Host sends the name of a zone as the destination in the transfer command

6.1.4.2 The carrier is stored to a stocker shelf temporarily when the Host requested output port destination is occupied. This is the responsibility of the Stocker Controller. The carrier count of the stocker is incremented due to this temporary storage (i.e., the current capacity decreases).

6.1.4.3 For multi-crane stockers, the carrier is temporarily stored to a stocker shelf when the source and destination is not accessible by the same stocker crane. This is the responsibility of the Stocker Controller. The carrier count of the zone containing the location where the carrier is temporarily stored is incremented due to this temporary storage (i.e. the current capacity decreases).

6.2 *Quantity Control in the Stocker (Capacity Planning)*

6.2.1 The number of carriers in the stocker is controlled by the Host. A list of carrier database entries in the specified stocker's SC database will be available to the Host upon request via a remote command.

6.3 *Number of Stocker Cranes*

6.3.1 No Limitation. May be zero for systems that do not include a crane. Host does not control the stocker crane directly.

6.4 *Port Type*

6.4.1 The independent input port and the independent output port are required for the Stocker SEM. The swapping type is considered as an independent port.

6.5 *Plural Sets of Input/Output Ports*

6.5.1 Plural sets of Input/Output ports connected to the interbay or intrabay transport system must be considered. (This would be considered a Multi-loop type interface connection to the stocker.) Examples of plural sets of interfaces are as follows:

- Main Loop/Sub Loop,
- Right-handed rotation/Left-handed rotation, and
- Double Track (i.e., Stacked Track).

6.6 *Carrier ID Reader*

- Manual Input Port: Carrier ID Reader is mandatory.
- Automated Input Port: Carrier ID Reader is a customer option.
- Carrier ID Reader at any output port: Carrier ID Reader is a customer option.

6.6.1 The intrabay automated input port is sometimes used as the manual Input Port. If one port is used for both an automated and a manual, the Carrier ID Reader is mandatory for this port. If there is a Carrier ID Reader, the scenario for a stocker transfer without a Carrier ID Reader is not applicable.

6.7 *Tag*

6.7.1 Same assumptions as Carrier ID Reader.

6.8 *Carrier Exchanger/Gas Purger*

6.8.1 Out of scope of Stocker SEM.

6.9 *Robot Arm in the Passive Type Stocker*

6.9.1 No assumption is made regarding the passive type stocker.

6.10 *Empty or Not Empty Carriers*

6.10.1 No assumption is made regarding empty and not empty carriers.

6.11 *Monitor/Dummy*

6.11.1 No assumption.

6.12 *Operation Mode*

6.12.1 No assumption.

6.13 *Transfer Completed Port*

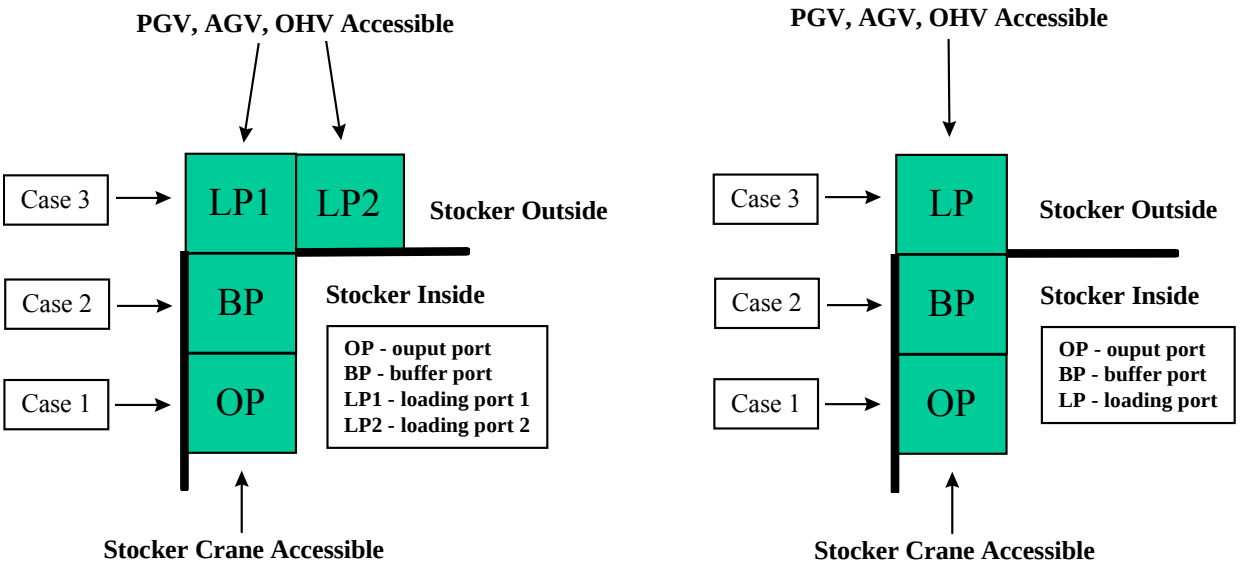

Figure 2
Output Shuttle Examples: L-Shaped Shuttle on Left, I-Shaped Shuttle on Right

6.13.1 The Transfer Completed Port is always the LoadingPort (LP) specified in the transfer command. If the end user desires that the Host issue a transfer to the TSC prior to the carrier arriving at the LP, the states defined in the Stocker Carrier State Model may be utilized.

7 Communication Requirements

7.1 It is required that any Stocker SEM compliant equipment follow the Communications State Model in SEMI E30. In addition, Stocker SEM compliant equipment shall support either SEMI E37 and SEMI E37.1 or SEMI E4.

8 State Models

8.1 *State Model Requirements*

8.1.1 The state models included in this standard are a requirement for Stocker SEM equipment. This standard requires implementation of all SEMI E30 state models (such as control, communication, on-line/off-line, etc. according to the GEM capabilities required per Section 13). A state model consists of a state model diagram, state definitions, and a state transition table. All state transitions in this standard, unless otherwise specified, shall correspond to collection events.

8.1.2 A state model is the host's view of the equipment, and does not necessarily describe the internal equipment operation. All Stocker SEM state model transitions shall be mapped into the appropriate internal equipment events that satisfy the requirements of those transitions. In certain implementations, the equipment may enter a state and have already satisfied all of the conditions required by the Stocker SEM state model for transition to another state. The equipment makes the required transition without any additional actions in this situation.

8.1.3 Some equipment may need to include additional substates other than those in this standard. Additional substates may be added, but shall not change the Stocker SEM defined state transitions. All expected transitions between Stocker SEM states shall occur.

8.2 *SC State Model*

8.2.1 *SC State Model Requirements*

8.2.1.1 The purpose of the SC state model is to provide information to the host regarding the overall status of the stocker system. The SC state model is valid when the SEMI E30 (GEM) state is ON-LINE. The SC state model is **not** valid when the SEMI E30 (GEM) state is OFF-LINE. Since a stocker may consist of many components (e.g.,

stocker crane, conveyor, ID reader, etc.), it may be possible to continue ON-LINE operation when the operation mode of some stocker components (as viewed by the SC) is a manual state. The details of what happens when individual components of the stocker enter a manual state are specific to the Stocker SEM equipment supplier. When the SEMI E30 Control state changes from OFF-LINE to ON-LINE, the SC State Model is started from the SC INIT state.

8.2.2 *SC State Model*

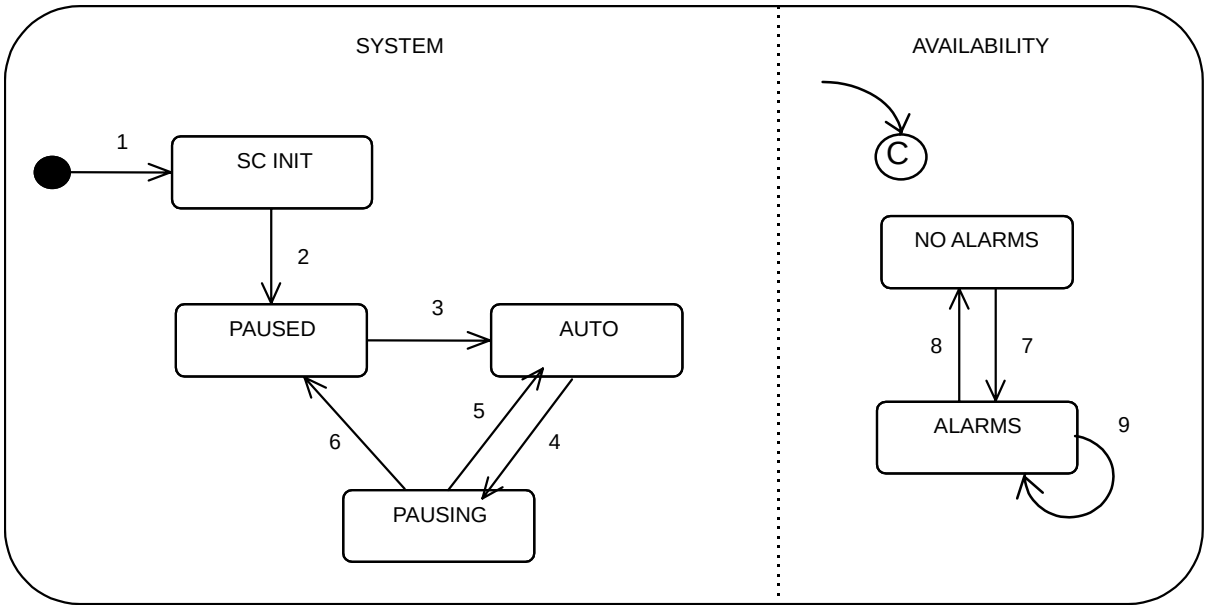

Figure 3
Generic Stocker SEM SC State Model Diagram

8.2.3 *SC State Definitions*

8.2.3.1 *SC INIT* — SC initialization of stocker components is occurring. This is a non-operational state. No commands from the host will be acknowledged, queued or processed. The system will not move out of this state if there are carriers moving on any of the stocker units controlled by the SC. Such devices must be manually or automatically recovered before transitioning to the next state.

8.2.3.2 *PAUSING* — A system PAUSE command has been received and is being processed. All carriers that are currently moving will continue until their physical movement stops (their transfer command may still be active). Carriers that are currently moving may continue to move but they must not begin another movement. TRANSFER commands are accepted and queued. All status requests will be processed. The RESUME, INSTALL, REMOVE, and LOCATE commands will also be processed.

8.2.3.3 *PAUSED* — No carriers are in the process of moving on any of the stocker units controlled by the SC. Carriers may be at any port position including the OP, BP, and LP positions. TRANSFER commands are accepted and queued. All status requests will be processed. The RESUME, INSTALL, REMOVE, and LOCATE commands will also be processed.

8.2.3.4 *AUTO* — Stocker is in the normal operational state. Commands are actively processed.

8.2.3.5 *NO ALARMS* — There are no alarms present in the system.

8.2.3.6 *ALARMS* — There are one or more alarms present in the system.

8.2.4 *SC State Transition Table*

Table 1 SC State Transition Table

Transition #	*Previous State*	*Trigger*	*New State*	*Actions*	*Comments*
1	none	SC Initiation.	SC INIT	S6F11 SCAutoInitiated	System runs through its startup sequence.
2	SC INIT	System started up successfully. All carrier movement stopped.	PAUSED	S6F11 SCPaused	System ready.
3	PAUSED	RESUME command.	AUTO	S6F11 SCAutoCompleted	System can now execute remote commands based upon other internal conditions (Alarm, GEM ONLINE, etc).
4	AUTO	PAUSE command.	PAUSING	S6F11 SCPauseInitiated	Carriers that are not moving remain there. Carriers that are moving must stop at the next logical stopping point.
5	PAUSING	RESUME command.	AUTO	S6F11 SCAutoCompleted	System can now execute remote commands based upon other internal conditions (Alarm, GEM ONLINE, etc).
6	PAUSING	All carrier movement has completed.	PAUSED	S6F11 SCPauseCompleted	System will accept and queue new commands but will not execute them. No new movement will occur. Outstanding Transfer Commands will remain NOT ACTIVE.
7	NO ALARMS	Alarm Set.	ALARMS	S6F11 AlarmSet	
8	ALARMS	All Alarms cleared.	NO ALARMS	S6F11 AlarmCleared	
9	ALARMS	Alarm Set.	ALARMS	S6F11 AlarmSet	Alarm occurs when there is already an outstanding alarm.

8.3 *TRANSFER Command State Model*

8.3.1 *TRANSFER Command State Model Requirements*

8.3.1.1 The TRANSFER command state model serves as the SEMI E30 Processing State Model. The purpose of the TRANSFER command state model is to provide information to the host regarding the control of the TRANSFER command. The TRANSFER command allows the host to manage carrier movement and scheduling. The control of each TRANSFER command must independently support the TRANSFER command state model.

8.3.2 *TRANSFER Command State Model Diagram*

8.3.2.1 The TRANSFER command state model is detailed for Stocker SEM equipment in Figure 4.

8.3.3 *TRANSFER Command State Definitions*

8.3.3.1 *QUEUED* — SC has acknowledged and queued the TRANSFER command. TRANSFER command has not been initiated.

8.3.3.2 *ACTIVE* — The carrier is involved in the physical aspect of the TRANSFER command. It is denoted by the time spanned by command initiation to command completion.

8.3.3.3 *TRANSFERRING (ACTIVE sub-state)* — The transfer command is actively being executed by the stocker.

8.3.3.4 *PAUSED (ACTIVE sub-state)* — The Transfer command is not actively being executed by the stocker. This may be due to an internal equipment error that does not immediately terminate the Transfer command unsuccessfully. This would allow the Host or Operator the opportunity to retry the transfer.

8.3.3.5 *CANCELING* — The TRANSFER command cancel procedure is being performed to terminate a transfer command which never entered the ACTIVE state (currently QUEUED). This state is entered via a CANCEL remote command.

8.3.3.6 *ABORTING* — The TRANSFER command abort procedure is being performed to terminate a transfer command which has entered the ACTIVE state. This state can only be entered via an ABORT remote command. An unsuccessful transfer command completion will ultimately result from this state.

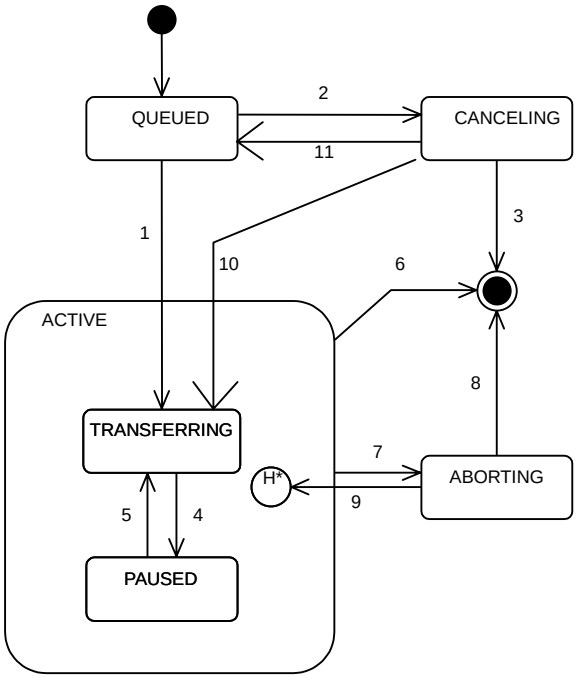

Figure 4
Generic Stocker SEM TRANSFER Command State Model Diagram

8.3.4 *TRANSFER Command State Transition Table*

Table 2 Transfer Command State Transition Table

Transition #	*Previous State*	*Trigger*	*New State*	*Actions*	*Comments*
1	QUEUED	The TRANSFER command has been initiated by the SC.	TRANSFER-RING	S6F11 TransferInitiated	
2	QUEUED	Host sends CANCEL command for a specified TRANSFER command to SC.	CANCELING	S6F11 TransferCancel-Initiated	TRANSFER command is to be removed from the TRANSFER command queue.
3	CANCELING	The cancel procedure for the TRANSFER command has completed by the stocker and the SC.	None	S6F11 TransferCancel-Completed	The carrier will still be situated at the transfer source location. The carrier may now be included in a future transfer.

Transition #	*Previous State*	*Trigger*	*New State*	*Actions*	*Comments*
4	TRANSFER-RING	The SC pauses execution of the TRANSFER command due to an anomaly condition.	PAUSED	S6F11 TransferPaused for a specific CommandID	It is an important distinction to make that the TRANSFER command is paused and not just the transfer agent. The Stocker Controller state will be ALARM.
5	PAUSED	The SC resumes execution of the TRANSFER command since the anomaly condition has been cleared.	TRANSFER-RING	S6F11 TransferResumed for a specific CommandID	If this was the only remaining stocker alarm, the Stocker Controller state will transition to NO ALARMS.
6	ACTIVE	The TRANSFER command has completed by the stocker and SC (either successfully or unsuccessfully).	None	S6F11 TransferCompleted sent to Host with appropriate ResultCode ResultCode = 0 if successful ResultCode is nonzero if unsuccessful	Carrier(s) could be located at any location or port located along the path of the transfer, if the TRANSFER command completed unsuccessfully. **Supplier Option** — The location of the carrier(s) associated with an unsuccessful transfer command must be a legal SourcePort for a new TRANSFER command.
7	ACTIVE	Host sends ABORT command for a specified TRANSFER command to SC.	ABORTING	S6F11 TransferAbort-Initiated	
8	ABORTING	The abort procedure for the TRANSFER command has completed by the stocker and SC.	None	S6F11 TransferAbort-Completed	Carrier could be located at any location or port located along the path of the ACTIVE transfer. **Supplier Option** — The location of the carrier associated with the aborted transfer command must be a legal SourcePort for issuing a new TRANSFER command.
9	ABORTING	TRANSFER command cannot be aborted.	ACTIVE	S6F11 TransferAbort-Failed	TRANSFER command could not be aborted due to the physical state of the equipment. Such conditions must be documented by the Stocker SEM equipment Supplier.
10	CANCELING	Transport system is unable to cancel the TRANSFER command because the transfer is now ACTIVE.	TRANSFER-RING	S6F11 TransferInitiated	
11	CANCELING	Transport system is unable to cancel the TRANSFER command and it is still queued.	QUEUED	S6F11 TransferCancel-Failed	

8.4 *Stocker Carrier State Model*

8.4.1 *Stocker Carrier State Model Requirements*

8.4.1.1 The purpose of the stocker carrier state model is to provide information to the host regarding carrier tracking (the Host will not control carriers) while the carrier is in the domain of the stocker. The carrier is in the domain of the stocker when it is in storage or transport internal to the stocker or on a stocker interface port (manual, interbay, or intrabay). The equipment shall track each carrier in compliance with the Stocker Carrier State Model.

8.4.2 *Stocker Carrier State Model*

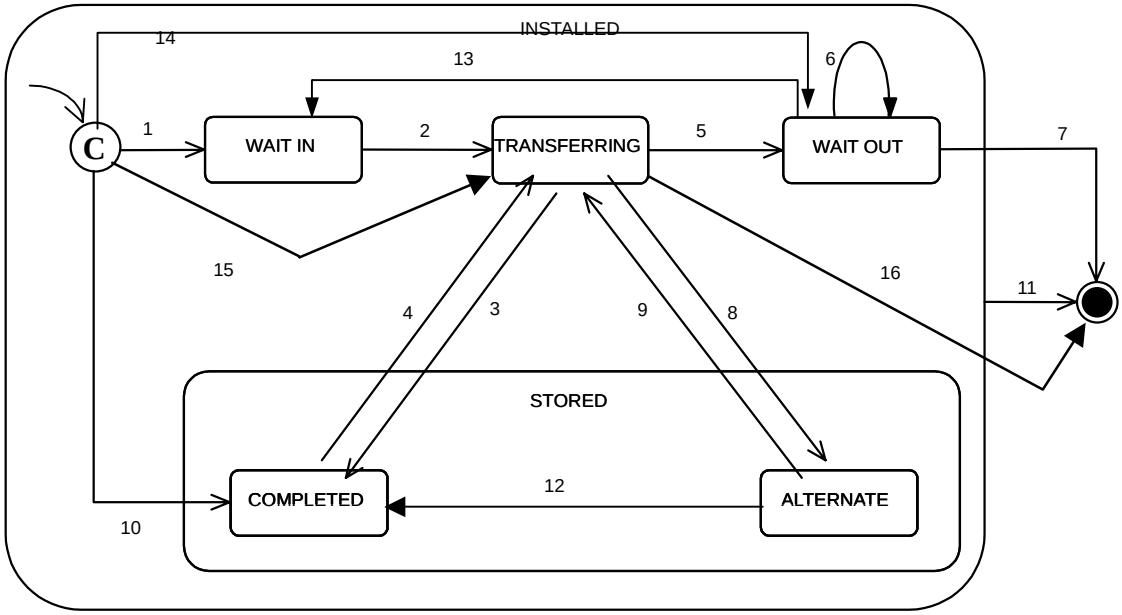

Figure 5
Generic Stocker SEM Carrier State Model Diagram

8.4.3 *Stocker Carrier State Definitions*

8.4.3.1 *INSTALLED* — Carrier in stocker database.

8.4.3.2 *WAIT IN (INSTALLED sub-state)* — Carrier at final internal port location of the stocker. Carrier is ready to be transferred to storage or output location and no further movement or action should be taken on this carrier prior to transfer.

8.4.3.3 *WAIT OUT (INSTALLED sub-state)* — Carrier is at an Output, Buffer, or Loading Port.

8.4.3.4 *TRANSFERRING (INSTALLED sub-state)* — Carrier 'moving' between locations in the stocker. The carrier may not be physically moving but may be on the crane (or other position) waiting for a new TRANSFER command as the result of an anomaly condition.

8.4.3.5 *STORED (INSTALLED sub-state)* — Carrier is sitting at a storage location.

8.4.3.6 *COMPLETED (STORED sub-state)* — The carrier is stored at a shelf location as a result of completing a transfer for which this shelf represents the destination of the transfer command.

8.4.3.7 *ALTERNATE (STORED sub-state)* — The carrier is temporarily stored at a shelf location. The transfer command completion is pending until the destination and the crane become available.

8.4.4 *Stocker Carrier State Transition Table*

Table 3 Stocker Carrier State Transition Table

Transition #	*Previous State*	*Trigger*	*New State*	*Action*	*Comments*
1	none	Carrier arrives at a WaitIn position of the stocker.	WAIT IN	S6F11 CarrierWaitIn	
2	WAIT IN	Stocker is executing a TRANSFER command for the carrier.	TRANSFERRING	S6F11 Carrier-Transferring	
3	TRANSFERRING	Completion of a TRANSFER command with a DEST of internal stocker storage.	COMPLETED	S6F11 CarrierStored	Carrier is at an internal storage destination.
4	COMPLETED	Stocker is executing a TRANSFER command for the carrier.	TRANSFERRING	S6F11 Carrier-Transferring	
5	TRANSFERRING	Carrier has arrived at the output port.	WAIT OUT	S6F11 CarrierWaitOut	
6	WAIT OUT	Carrier has advanced (automatically) on a port beyond the output port.	WAIT OUT	S6F11 CarrierWaitOut	
7	WAIT OUT	Carrier is removed from the stocker domain (removed from the output LP).	None	S6F11 CarrierRemoved	
8	TRANSFERRING	The destination of the move command is occupied.	ALTERNATE	S6F11 CarrierStoredAlt	SC is waiting for the Destination to become available.
9	ALTERNATE	The port becomes available and transfer command is first in queue.	TRANSFERRING	S6F11 CarrierResumed	Carrier continues with move to the Destination.
10	None	Carrier entry is created or modified in the SC database.	COMPLETED	S6F11 CarrierInstall-Completed	Could be due to an INSTALL remote command or initiated by the Stocker Controller.
11	INSTALLED	Carrier entry is removed from the SC database.	None	S6F11 CarrierRemove-Completed	Could be due to a REMOVE remote command.
12	ALTERNATE	Transfer command is Aborted.	COMPLETED	S6F11 CarrierStored	
13	WAIT OUT	Carrier on a bi-directional port is ready to be moved to a storage or output location.	WAIT IN	S6F11 CarrierWaitIn	Examples of a trigger could be the operator pressing a button or the host issuing a transfer command for the carrier.
14	None	The result of ID read at an output port that did not match the expected ID.	WAITOUT	S6F11 CarrierWaitOut	

Transition #	*Previous State*	*Trigger*	*New State*	*Action*	*Comments*
15	None	1. Carrier created directly on the crane (as the result of duplicate ID recovery). 2. Transfer Command received from host with the source being a port with no SC controlled sensors (e.g.directly connected process equipment).	TRANSFERRING	S6F11 Carrier-Transferring	It is also permissible to use state transitions #1 and #2 for the scenario in trigger #2 especially when the transfer command is queued. This transition may not be required in all configurations.
16	TRANSFERRING	Carrier has arrived at an Output port and is removed from the stocker domain.	None	S6F11 CarrierRemoved	This generally occurs when delivering directly to process equipment at a port with no sensors controlled by the SC.

8.5 *Stocker Crane State Model*

8.5.1 *Stocker Crane State Model Requirements*

8.5.1.1 The purpose of the stocker crane state model is to provide information to the host for use of stocker crane information and metric tracking (i.e., the Host will not control the stocker crane). If it is possible for the stocker to continue operation while the stocker crane is not operational then the Stocker Crane State Model will retain its current state and the SC State Model will be ALARM. When the stocker crane becomes operational again, the state of the Stocker Crane State Model will transition to the new state. Whether it is possible to continue operation while the stocker crane is not operational is specific to the stocker SEM equipment supplier. If a single stocker contains multiple stocker cranes, each stocker crane must comply with the stocker crane state model. Compliance with the stocker crane state model is only required for devices that contain a crane. The Host should not be dependent on any events from the stocker crane state model.

8.5.2 *Stocker Crane State Model*

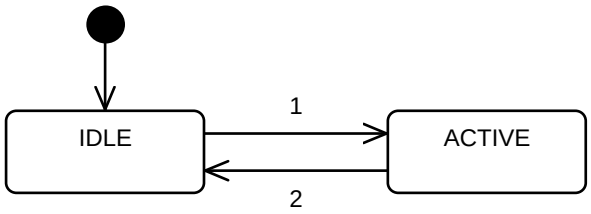

Figure 6
Generic Stocker SEM Stocker Crane State Model Diagram

8.5.3 *Stocker Crane State Definitions*

8.5.3.1 *IDLE* — The stocker crane is not performing Host or SC initiated work.

8.5.3.2 *ACTIVE* — The stocker crane is busy performing Host or SC initiated work.

8.5.4 *Stocker Crane State Transition Table*

Table 4 Stocker Crane State Transition Table

Transition #	*Previous State*	*Trigger*	*New State*	*Actions*	*Comments*
1	IDLE	Crane is requested to perform host or SC initiated work.	ACTIVE	S6F11 CraneActive	
2	ACTIVE	Crane completes host or SC initiated work.	IDLE	S6F11 CraneIdle	

8.6 *Port Transfer State Model*

8.6.1 *Port Transfer State Model Requirements*

8.6.1.1 The purpose of the port state model is to provided information to the host for the use in accessing ports. This may permit the host and stocker to utilize ports that are in service while avoiding the use of ports that are not in service.

8.6.2 *Port Transfer State Model*

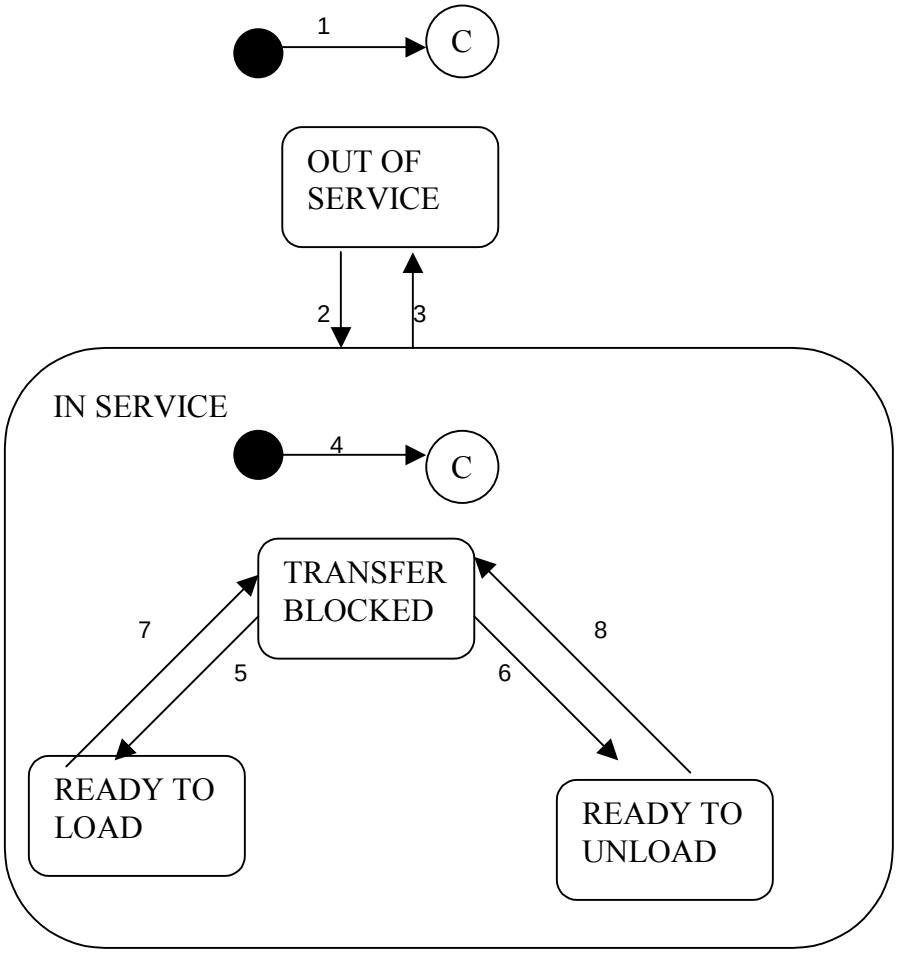

Figure 7
Port State Model Diagram
A-1.1.1.1

8.6.3 *Port Transfer State Definitions*

8.6.3.1 OUT OF SERVICE — Transfer to/from this port is disabled and the port should not be used in any Transfer command issued by the host. If the SC State is "Alarm" and the port cannot be accessed normally, the port transfer state shall be "Out Of Service". This includes situations where the "Alarm" may not be directly related to the port. For example, the alarm may be associated with the crane and since the crane cannot function, the port cannot be serviced normally. If any port on a multi-position conveyor with a single LP position is "Out Of Service", then all ports on the conveyor shall be "Out Of Service". If a command is issued by the host which uses this port, it will not be rejected simply because the port is in this state.

8.6.3.2 IN SERVICE — Transfer to/from this port is enabled.

8.6.3.3 The following are **optional** sub-states of the IN SERVICE state to provide information to the host for the use in accessing ports. The information is generally obtained by the SC via a low-level interface with the connected equipment (generally inline process tools). The connected equipment should generally, though not required, follow the Load Port Transfer State Model defined in SEMI E87. If these states are implemented, they are **not required** for every port.

8.6.3.3.1 *TRANSFER BLOCKED* — The state is neither READY TO LOAD nor READY TO UNLOAD.

8.6.3.3.2 *READY TO LOAD* — The port is able to accept (be loaded with) a carrier from the Stocker SEM equipment.

8.6.3.3.3 *READY TO UNLOAD* — The port is able to have a carrier removed (unloaded) by the Stocker SEM equipment.

8.6.3.4 *Port Transfer State Transition Table*

Table 5 Port Transfer State Transition Table

Transition #	*Previous State*	*Trigger*	*New State*	*Action*	*Comments*
1	None	System reset.	OUT OF SERVICE Or IN SERVICE	S6F11 PortOutOfService Or S6F11 PortInService	The new state is based on the current status of the port or the state prior to system reset.
2	OUT OF SERVICE	The equipment has determined that the port can be utilized for transfers.	IN SERVICE	S6F11 PortInService	
3	IN SERVICE	The equipment has determined that the port should not be used for transfers.	OUT OF SERVICE	S6F11 PortOutOfService	This could be the result of an alarm condition that affects only the port, the entire device, or a portion of the device which includes the port.
4	None	System Reset.	TRANSFER BLOCKED READY TO LOAD READY TO UNLOAD	S6F11 PortTransferBlocked S6F11 PortReadyToLoad S6F11 PortReadyToUnload	The new state is based on the current status of the port.
5	TRANSFER BLOCKED	Port ready for carrier delivery.	READY TO LOAD	S6F11 PortReadyToLoad	
6	TRANSFER BLOCKED	Port ready for carrier removal.	READY TO UNLOAD	S6F11 PortReadyToUnload	
7	READY TO LOAD	No carrier transfer allowed.	TRANSFER BLOCKED	S6F11 PortTransferBlocked	
8	READY TO UNLOAD	No carrier transfer allowed.	TRANSFER BLOCKED	S6F11 PortTransferBlocked	

9 Collection Event List

9.1 This section identifies data collection events and defines (Stream 6) reporting levels for variable data items. The host can use the report definition scenario defined in SEMI E30 to define reports at Stocker SEM defined levels. The intent of this section is to demonstrate that certain suggested data is available at specific events. The collection events are grouped according to whether or not they are associated with a state change (according to the state models defined within this document).

9.2 *Requirements*

9.2.1 This standard requires all collection events listed in the SEMI E30 standard (according to the GEM capabilities required per Section 14). There are cases where specific collection event names are designated for GEM defined collection events. Such collection event names are denoted by "Y" in the GEM column.

9.3 *State Transition Collection Event Table*

Table 6 State Transition Collection Event Table

Collection Event Name	*From State*	*To State*	*Required DVVALs*	*GEM*
SC STATE TRANSITION EVENTS				
AlarmCleared	ALARMS	NO ALARMS	CommandID ErrorID StockerUnitInfo ErrorNumber	Y
AlarmSet	NO ALARMS ALARMS	ALARMS ALARMS	CommandID ErrorID StockerUnitInfo RecoveryOptions ErrorNumber	Y
SCAutoCompleted	PAUSED PAUSING	AUTO AUTO	N/A	N
SCAutoInitiated	None	SC INIT	N/A	N
SCPauseCompleted	PAUSING	PAUSED	N/A	N
SCPaused	SC INIT	PAUSED	N/A	N
SCPauseInitiated	AUTO	PAUSING	N/A	N
TRANSFER COMMAND STATE TRANSITION EVENTS				
TransferAbortCompleted	ABORTING	None	CommandID CarrierID CarrierLoc CarrierZoneName	N
TransferAbortFailed	ABORTING	ACTIVE	CommandID CarrierID CarrierLoc CarrierZoneName	N
TransferAbortInitiated	ACTIVE	ABORTING	CommandID CarrierID CarrierLoc CarrierZoneName	N
TransferCancelCompleted	CANCELING	None	CommandID CarrierID CarrierLoc CarrierZoneName	N

Collection Event Name	*From State*	*To State*	*Required DVVALs*	*GEM*
TransferCancelFailed	CANCELING	QUEUED	CommandID CarrierID CarrierLoc CarrierZoneName	N
TransferCancelInitiated	QUEUED	CANCELING	CommandID CarrierID CarrierLoc CarrierZoneName	N
TransferCompleted	ACTIVE	None This event will occur when the carrier arrives at the transfer completed port. The TRANSFER command DEST is an LP if transferring to an output of the stocker.	CommandID CarrierID CarrierLoc ResultCode CarrierZoneName	N
TransferInitiated	QUEUED CANCELING	TRANSFERRING TRANSFERRING	CommandID CarrierID CarrierLoc CarrierZoneName Dest	N
TransferPaused	TRANSFERRING	PAUSED	CommandID CarrierID CarrierLoc CarrierZoneName	N
TransferResumed	PAUSED	TRANSFERRING	CommandID CarrierID CarrierLoc CarrierZoneName	N
STOCKER CARRIER STATE TRANSITION EVENTS				
CarrierInstallCompleted	None	COMPLETED	CarrierID CarrierLoc CarrierZoneName	N
CarrierRemoveCompleted	INSTALLED	None	CarrierID CarrierLoc CarrierZoneName	N
CarrierRemoved	WAIT OUT TRANSFERRING	None None	CarrierID HandoffType	N
CarrierResumed	ALTERNATE	TRANSFERRING	CommandID CarrierID CarrierLoc CarrierZoneName Dest StockerCraneID	N
CarrierStored	TRANSFERRING	COMPLETED	CarrierID CarrierLoc CarrierZoneName	N

Collection Event Name	*From State*	*To State*	*Required DVVALs*	*GEM*
CarrierStoredAlt	TRANSFERRING	ALTERNATE	CommandID CarrierID CarrierLoc CarrierZoneName Dest	N
CarrierTransferring	WAIT IN COMPLETED None	TRANSFERRING TRANSFERRING TRANSFERRING	CarrierID CarrierLoc CarrierZoneName StockerCraneID	N
CarrierWaitIn	None	WAIT IN	CarrierID CarrierLoc CarrierZoneName	N
CarrierWaitOut	TRANSFERRING WAIT OUT None	WAIT OUT WAIT OUT WAIT OUT	CarrierID CarrierLoc CarrierZoneName PortType	N
ZoneCapacityChange	Any State or None	Any State or None	ZoneData	N
STOCKER CRANE STATE TRANSITION EVENTS				
CraneActive	IDLE	ACTIVE	CommandID StockerCraneID	N
CraneIdle	ACTIVE	IDLE	CommandID StockerCraneID	N
PORT TRANSFER STATE TRANSITION EVENTS				
PortInService	None OUT OF SERVICE	IN SERVICE	PortID	
PortOutOfService	None IN SERVICE	OUT OF SERVICE	PortID	
PortTransferBlocked	Any	TRANSFER BLOCKED	PortID	
PortReadyToLoad	Any	READY TO LOAD	PortID	
PortReadyToUnload	Any	READY TO UNLOAD	PortID	

9.4 *Non-Transition Collection Event Table*

Table 7 Non-Transition Collection Event Table

Collection Event Name	*Event Description*	*Required DVVALs or Reports*
CarrierIDRead	A carrier identification has been performed by the stocker system. For reads that occur at an Input port, the event shall come prior to the CarrierWaitIn event. For reads that occur at CarrierWaitOut port locations, the CarrierIDRead event and the CarrierWaitOut events for that port shall be sent to the host in a consistent sequence (i.e. CarrierIDRead shall always precede the CarrierWaitOut, or alternatively, the CarrierWaitOut event shall always precede the CarrierIDRead event). There are not dependencies with this event at any other location.	CarrierID CarrierLoc IDReadStatus
CarrierInstallFailed	An INSTALL command has failed.	CarrierID FailureCode
CarrierLocateCompleted	A LOCATE remote command has completed.	CarrierLocations CommandID
CarrierRemoveFailed	A REMOVE command has failed.	CarrierID FailureCode

Collection Event Name	*Event Description*	*Required DVVALs or Reports*
IDReadError	All carriers related to an ID error situation have been dispositioned. This event occurs automatically when the stocker places the carrier that experienced the ID error to the pickup port (See Section 13.3.3).	CarrierID CarrierLoc IDReadStatus
OperatorInitiatedAction	The operator initiated an action from the Stocker Controller.	CommandID CommandType CarrierID Source Dest Priority

10 Variable Data Items

10.1 The purpose of this section is to define the list of variable data item requirements for Stocker SEM equipment. Values of these variables will be available to the host via collection event reports and host status queries.

10.2 *Requirements*

- All variable data items and data item restrictions defined in SEMI E30 are required on Stocker SEM equipment (according to the GEM capabilities required per Section 13).
- All variable data items in the Stocker SEM Variable Data Item Dictionary for specific equipment classifications are required for Stocker SEM equipment. The data item restrictions are also required.
- Some SVs in the Variable Data Item Dictionary are referenced by an "i" subscript (e.g., $CarrierID_i$). The "i" subscript denotes a specific instance of the SV. This is necessary since there is usually more than one instance of such an SV active in the system at the same time (e.g., if there are 20 carriers active at the same time then "i" could range from 1 to 20 for $CarrierID_i$). Variable Data Items containing the "i" subscript should not have Variable IDs assigned to them.
- All variable data items with a format of ASCII (A) shall be limited to printable characters in the decimal range of 32 to 126, with the exception of the following non-permitted characters: "*" (decimal 42), "\"(decimal 92).

10.2.1 Variable data items are documented in the Stocker SEM Variable Data Item Dictionary using the following format:

Variable Name	*Type*	*Description*	*Class*	*Format*	*Comments*

Where:

Variable Name: A unique name for the variable data item.

Type: CV – meaning common variables, variables that are general to all vehicles.

CSV – meaning configuration specific variables.

Description: If class is DVVAL, then the description shall contain a statement of when data is valid in terms of Stocker SEM events.

Class: The data type of the item.

Format: <SECS Message Language (SML) mnemonic>acceptable formats are SEMI E5 lists, ASCII, floating point, unsigned integer or signed integer. A description of "ANY", indicates that only the above formats are acceptable and is left to the supplier to decide.

Comments: Any additional information pertinent to the variable name.

10.3 *Variable Data Item Types*

10.3.1 *Equipment Constants (ECV)* — The value can be changed by the host using S2F15. The operator may have the ability to change some or all of the values. The value of an equipment constant may be queried at any time by the host using the S2F13/14 transaction or Stream 6 reports.

10.3.2 *Status Variables (SV)* — The values are valid at all times. A SV may not be changed by the host or operator, but may be changed by the equipment. A host or operator command may change an equipment status thus changing a SV. The value of status variables may be queried by the host at any time using the S1F3/4 or Stream 6 reports.

10.3.3 *Data Variables (DVVAL)* — These are variables which are valid upon the occurrence of a specific collection event, and may or may not be valid at other times depending upon the equipment. An attempt to read a variable data item when it's invalid will not result in an error, but the data reported may not have relevant meaning.

10.3.4 *Variable Data (V)* — This is a class of variable data which includes all the previously defined types of variables.

10.4 *Variable Data Item Dictionary*

Table 8 Variable Data Item Dictionary

Variable Name	*Type*	*Description*	*Class*	*Format*	*Comments*
ActiveCarriers	CV	List current status of all carrier information in the SC database.	SV	L,n 1. <CarrierInfo$_1$> . . n. <CarrierInfo$_n$>	
ActiveTransfers	CV	List current status of all ACTIVE TRANSFER commands.	SV	L,n 1. <TransferCommand$_1$> . . n. <TransferCommand$_n$>	
ActiveZones	CV	List current status associated with all zones being used by the SC.	SV	L,n 1. <ZoneData$_1$> . . n. <ZoneData$_n$>	
CarrierID	CV	Unique ID of the carrier.	DVVAL	A[1–64]	If an Id is created by the equipment (not obtained via an id reader, the host interface, or the user interface) it must be of the following format: UNKNOWNEqpNameSeq Where: UNKNOWN are the exact characters "UNKNOWN" EqpName is the value of the EqpName ECV (truncated if required) Seq is a unique sequence identifier determined by the vendor.
CarrierID$_i$	CV	Unique ID of the carrier.	SV	A[1–64]	See comment for CarrierID.
CarrierInfo	CV	All database information associated with a particular carrier.	DVVAL	L,2 1. <CarrierID> 2. <CarrierLoc>	

Variable Name	*Type*	*Description*	*Class*	*Format*	*Comments*
$CarrierInfo_i$	CV	All database information associated with a particular carrier.	SV	L,2 1. <$CarrierID_i$> 2. <$CarrierLoc_i$>	
CarrierLoc	CV	Unique location of the carrier within the stocker as reported by the SC.	DVVAL	A[1–64]	It is important to note that this is the unique location within the stocker (i.e., 2 carriers cannot be stored at the same CarrierLoc, but 2 carriers can be stored at the same ZoneName).
$CarrierLoc_i$	CV	Unique location of the carrier within the stocker as reported by the SC.	SV	A[1–64]	It is important to note that this is the unique location within the stocker (i.e., 2 carriers cannot be stored at the same CarrierLoc, but 2 carriers can be stored at the same ZoneName).
$CarrierLocationInfo_i$	CV	Carrier Location Information	DVVAL	L,3 1. <$CarrierID_i$> 2. <$CarrierLoc_i$> 3. <$CarrierZoneName_i$>	
CarrierLocations	CV	Carrier Location Information for the ‘LOCATE’ host command	DVVAL	L,n 1. <$CarrierLocationInfo_1$> . . n. < $CarrierLocationInfo_n$ >	‘n’ number of carriers
$CarrierState_i$	CV	The Carrier State	SV	U2	0 = None 1 = Wait In 2 = Transferring 3 = Completed 4 = Alternate 5 = Wait Out
CarrierZoneName	CV	The name of the zone associated with the carrier’s current location.	DVVAL	A[0–64]	A location may not be associated with a particular zone. This would be the case if ports are not assigned to a zone.
$CarrierZoneName_i$	CV	The name of the zone associated with the carrier’s current location.	SV	A[0–64]	A location may not be associated with a particular zone. This would be the case if ports are not assigned to a zone.
CommandName	CV	Name of Host issued remote command.	DVVAL	A[1–20]	
CommandID	CV	Remote Command ID	DVVAL	A[1–64]	Used to subsequently refer to a specified remote command (e.g., to cancel a remote command). If a command is generated by the Stocker Controller, the commandid must begin with the string ‘MANUAL’ followed by any arbitrary sequence identifier.
$CommandID_i$	CV	Remote Command ID	SV	A[1–64]	Used to subsequently refer to a specified remote command (e.g., to cancel a remote command).

Variable Name	*Type*	*Description*	*Class*	*Format*	*Comments*
CommandInfo	CV	Command information associated with a particular transfer command.	DVVAL	L,2 1. <CommandID> 2. <Priority>	
$CommandInfo_i$	CV	Command information associated with a particular transfer command.	SV	L,2 1. $<CommandID_i>$ 2. $<Priority_i>$	
CommandType	CV	The type of Command being initiated	DVVAL	A[1–20]	Valid Values are 'TRANSFER' 'CANCEL' 'ABORT'
CurrentPortStates	CV	Current State of all the ports.	SV	L,n 1. $<PortInfo_1>$ . . n. $<PortInfo_n>$	
Dest	CV	Destination location identifier.	DVVAL	A[1–64]	Can either be a CarrierLoc or a ZoneName.
$Dest_i$	CV	Destination location identifier.	SV	A[1–64]	Can either be a CarrierLoc or a ZoneName.
EmptyCarrier	CV	Flag which denotes whether the carrier is empty or not empty.	DVVAL	U2	Empty = 0 Not Empty = 1
EnhancedCarriers	CV	List Current status of all carrier information in the SC database.	SV	L,n 1. $<EnhancedCarrierInfo_1>$ . . n. $<EnhancedCarrierInfo_n>$	This includes carriers that are on an Input conveyor prior to the 'WaitIn' (inner) position of the conveyor. These carriers are reported with a CarrierState of 0.
$EnhancedCarrierInfo_i$	CV	All database information associated with a particular carrier.	SV	L,5 1. $<CarrierID_i>$ 2. $<CarrierLoc_i>$ 3. $<CarrierZoneName_i>$ 4. $<InstallTime_i>$ 5. $<CarrierState_i>$	
EnhancedTransfers	CV	List current status of all transfer commands.	SV	L,n 1. $<EnhancedTransferCommand_1>$ . . n. $<EnhancedTransferCommand_n>$	
EnhancedTransfer-$Command_i$	CV	Information associated with a particular Transfer command.	SV	L,3 1. $<TransferState_i>$ 2. $<CommandInfo_i>$ 3. $<TransferInfo_i>$	
EnhancedActive-Zones	CV	List current status associated with all zoned being used by the SC.	SV	L,n 1. $<EnhancedZoneData_1>$. n. $<EnhancedZoneData_n>$	

Variable Name	*Type*	*Description*	*Class*	*Format*	*Comments*
EnhancedZoneData$_i$	CV	Information associated with a particular zone.	SV	L,4 1. <ZoneName$_i$> 2. <ZoneCapacity$_i$> 3. <ZoneSize$_i$> 4. <ZoneType$_i$>	
EqpName	CV	Unique ID of the SC	ECV	A[1–32]	
ErrorID	CV	The identification of the error.	DVVAL	A[1–64]	The following values are required: "DestOccupied" – Double Store "SourceEmpty" – Empty Retrieve Other values may be used as required.
ErrorNumber	CV	The unique id of an error.	DVVAL	U4	Used to subsequently refer to a specified stocker error (e.g. to RETRY a stocker operation). This value must be unique for all current outstanding errors.
FailureCode	CV	The failure reason used in the CarrierInstallFailed and CarrierRemoveFailed events.	DVVAL	U2	1 = Undefined Failure 2 = Location Occupied (Install) 3 = Carrier Doesn't Exist (Remove) 4–63 = Reserved
HandoffType	CV	Denotes the type of handoff that occurred at the equipment ownership transfer point (e.g., from loading port to vehicle).	DVVAL	U2	MANUAL = 1 means that no handoff handshake occurs (e.g., PGV handoff). AUTOMATED = 2 means that a handshake occurs (e.g., SEMI E84).
IDReadDuplicate-Option	CV	Indicates manner in which Duplicate ID reads must be processed.	ECV	U1	0 = Reject 1 = HostControlled See Carrier ID Error Scenarios (Table 14) for detailed information.
IDReadFailureOption	CV	Indicates manner in which IDRead Failures must be processed.	ECV	U1	0 = Reject 1 = HostControlled See Carrier ID Error Scenarios (Table 14) for detailed information.
IDReadMismatch-Option	CV	Indicated manner in which Mismatch ID reads must be processed.	ECV	U1	0 = Reject 1 = HostControlled See Carrier ID error Scenarios (Table 14) for detailed information.
IDReadStatus	CV	Result Code of an ID read event.	DVVAL	U2	Success = 0 Failure = 1 Duplicate = 2 Mismatch = 3
InstallTime$_i$	CV	Time the carrier was created in the SC database.	SV	TIME (A16)	yyyymmddhhmmsscc
PortID	CV	ID of the port.	DVVAL	A[1–64]	

Variable Name	*Type*	*Description*	*Class*	*Format*	*Comments*
$PortID_i$	CV	ID of the port.	SV	A[1–64]	
$PortInfo_i$	CV	Port information associated with a particular port.	SV	L,2 1. <$PortID_i$> 2. <$PortTransferState_i$>	
$PortTransferState_i$	CV	Port Transfer State.	SV	U2	1 – OutOfService 2 – InService 3 – TransferBlocked 4 – ReadyToLoad 5 – ReadyToUnload
PortType	CV	Definition of the type of port associated with the carrier's current location.	DVVAL	A[1–32]	"OP" = output port "BP" = buffer port "LP" = loading port
Priority	CV	Remote command priority.	DVVAL	U2	0 is not valid. 1 is the LOWEST priority, 99 is the highest priority.
$Priority_i$	CV	Remote command priority.	SV	U2	0 is not valid. 1 is the LOWEST priority, 99 is the highest priority.
RecoveryOptions (Supplier Option)	CV	List of options that the Host may use to try to recover a specific stocker error.	DVVAL	A[1–64] blank RETRY ABORT	This variable will enumerate the possible Host command responses to the error associated with the event. If blank, Host cannot do anything. If there are multiple otpions, they are comma seperated. For example: "RETRY, ABORT". Whitespace is ignored.
ResultCode	CV	Result Code of a stocker system command. Associated with the command completion event.	DVVAL	U2	Values of ResultCode will correspond to meaningful completion results (0 always signifies normal successful completion). The following Result Codes are required: 0 = Success 1 = Other Error 2 = Shelf Zone is FULL 3 = Duplicate ID 4 = Mismatch ID 5 = Failure to Read ID 6–63 = Reserved
SCState	CV	SC State (SYSTEM).	SV	U2	1 = SC Init 2 = Paused 3 = Auto 4 = Pausing
Source	CV	Source location unique identifier.	DVVAL	A[1–64]	
$Source_i$	CV	Source location unique identifier.	SV	A[1–64]	

Variable Name	*Type*	*Description*	*Class*	*Format*	*Comments*
SpecVersion	CV	Version of SEMI E88 to which the equipment is compliant.	SV	A[0–20]	Example values are: E88-0999, E88-0301. If the equipment is not compliant, a zero length value may be specified.
StockerCraneID	CV	The id of the stocker crane.	DVVAL	A[1–64]	Generally only used when there are multiple cranes in a stocker.
StockerUnitID	CV	Unique identification of a stocker unit (e.g., port, crane, transfer agent, etc.).	DVVAL	A[1–64]	When applicable, this value shall be the StockerCraneID, PortID, etc.
StockerUnitID$_i$	CV	Unique identification of a stocker unit (e.g., port, crane, transfer agent, etc.).	SV	A[1–64]	When applicable, this value shall be the StockerCraneID, PortID, etc.
StockerUnitInfo	CV	Information associated with a particular stocker unit.	DVVAL	L,2 1. <StockerUnitID> 2. <StockerUnitState>	
StockerUnitInfo$_i$	CV	Information associated with a particular stocker unit.	SV	L,2 1. <StockerUnitID$_i$> 2. <StockerUnitState$_i$>	
StockerUnitState	CV	The state of the stocker unit.	DVVAL	U2	The State of the component will be specific to the stocker configuration.
StockerUnitState$_i$	CV	The state of the stocker unit.	SV	U2	The State of the component will be specific to the stocker configuration.
TransferCommand	CV	Information associated with a particular TRANSFER command.	DVVAL	L,2 1. <CommandInfo> 2. <TransferInfo>	
TransferCommand$_i$	CV	Information associated with a particular TRANSFER command.	SV	L,n 1. <CommandInfo$_i$> 2. <TransferInfo$_i$>	
TransferInfo	CV	Carrier information associated with a particular transfer command.	DVVAL	L,3 1. <CarrierID> 2. <CarrierLoc> 3. <Dest>	
TransferInfo$_i$	CV	Carrier information associated with a particular transfer command.	SV	L,3 1. <CarrierID$_i$> 2. <CarrierLoc$_i$> 3. <Dest$_i$>	
TransferState	CV	State of Transfer Command.	SV	U2	1. Queued 2. Transferring 3. Paused 4. Canceling 5. Aborting
ZoneCapacity	CV	Available capacity (in carriers) of a particular zone.	DVVAL	U2	Example: If a stocker zone can store 100 carriers and 25 of the locations are currently occupied, then the ZoneCapacity is 75.

Variable Name	*Type*	*Description*	*Class*	*Format*	*Comments*
$ZoneCapacity_i$	CV	Available capacity (in carriers) of a particular zone.	SV	U2	Example: If a stocker zone can store 100 carriers and 25 of the locations are currently occupied, then the ZoneCapacity is 75.
ZoneData	CV	Information associated with a particular zone.	DVVAL	L,2 1. <ZoneName> 2. <ZoneCapacity>	
$ZoneData_i$	CV	Information associated with a particular zone.	SV	L,2 1. <$ZoneName_i$> 2. <$ZoneCapacity_i$>	
ZoneName	CV	Alphanumeric name of a particular zone.	DVVAL	A[1–64]	
$ZoneName_i$	CV	Alphanumeric name of a particular zone.	SV	A[1–64]	
$ZoneSize_i$	CV	Size (in carriers) of a particular zone.	SV	U2	The physical size of the zone.
$ZoneType_i$	CV	Type of the Zone.	SV	U2	1: Shelf 2: Port 3: Other

11 Alarm List

11.1 Since each model of Stocker SEM equipment differs in configuration, it is not practical to provide an exhaustive list of all possible alarms. Instead, the Stocker SEM is requiring the two tables provided as described in SEMI E30 (Section 8.4). Alarm List Table which is intended to provide for equipment configuration specific alarms and Alarm ID, Alarm Set/Cleared Event Table. Any alarm that is displayed locally at the equipment, if enabled, is required to be sent to the host. To be compliant, Tables 9 and 10 must be completed by the supplier, documenting all alarms.

11.2 *Alarm List Table*

11.2.1 The alarm list table contains examples of alarms that pertain to various configuration aspects of equipment. These examples are intended to illustrate that alarms pertain to situations in which there exists a potential for exceeding physical safety limits associated with people, equipment, and material being transported as per the SEMI E30 definition of an alarm. See SEMI E30 for further reference. The supplier is responsible for supplying documentation associated with these alarm definitions. Each alarm will have an associated alarm text (ALTX) and alarm identifier (ALID). Table 9 contains an example of alarm list information that is intended to be augmented when the Stocker SEM equipment supplier documents their interface. Examples highlighted by (*) are required by Stocker SEM.

Table 9 Alarm List Table

Equipment Cfg.	*Alarm Text*	*ALID*	*Danger*		*Affected*		
			Potential	*Imminent*	*Operator*	*Equipment*	*Material*
Stocker	stocker unit error*		X			X	X
	handoff error*		X		X	X	X
	database error*		X			X	

11.3 *Alarm ID, Alarm Set/Cleared Event Table*

11.3.1 The Alarm ID, Alarm Set/Cleared Event table documents the association of each ALID to a set and cleared event as required by SEMI E30. See SEMI E30 for further reference. The supplier is responsible for supplying documentation associated with these alarm definitions. Each alarm will have associated alarm set and cleared collection event identifiers ($CEID_{set}$ and $CEID_{clear}$).

Table 10 Alarm ID, Alarm Set/Cleared Event Table

Alarm ID (ALID)	*Alarm SET Event ($CEID_{set}$)*	*Alarm CLEARED Event ($CEID_{cleared}$)*

12 Remote Commands

12.1 The purpose of this section is to identify remote commands, command parameters, and valid commands versus states pertinent to the Stocker SEM.

12.2 *A. Requirements*

- The equipment shall support the SEMI E30 (according to the GEM capabilities required per Section 13) required remote commands.
- All the remote commands defined by Stocker SEM are required to be implemented as specified.
- The alphanumeric strings defined by Stocker SEM for RCMD and CPNAME are required.
- A completed table must be generated where an "X" is placed in the table for each state that a given command is valid.
- If additional remote commands are supported then a "remote commands versus valid states" matrix must be generated for these additional commands.
- For additional commands, a table must be generated similar to the remote command descriptions summary.

12.3 *Remote Commands Description*

12.3.1 *ABORT* — This command terminates the activity of a specific TRANSFER command based on CommandID while the command is in the ACTIVE state. This command might not be accepted due to mechanical issues if the stocker is in a specific condition (e.g., moving a carrier). The exact conditions surrounding when the ABORT command is not accepted by the SC must be documented by the Stocker SEM equipment supplier. If accepted, this command shall clear any error condition that was generated by the TRANSFER command being aborted. For example, if a 'DestOccupied' or 'SourceEmpty' error had occurred, the error shall be cleared.

12.3.2 *CANCEL* — This command terminates the activity of a specific TRANSFER command based on CommandID while the command is in the QUEUED state. This command must always be accepted by the SC when in the QUEUED state.

12.3.3 *INSTALL* — This is used to update the SC database by adding a specified CarrierID record to a specified CarrierLoc. If the CarrierID specified by the Host is already in the SC database then the additional fields will be updated based on the information contained in this command.

12.3.4 *LOCATE* — This command is used by the Host to query the SC for database carrier information.

12.3.5 *PAUSE* — This command puts the SC in the PAUSING state.

12.3.6 *REMOVE* — This is used to update the SC database by deleting a specified carrier. This command would be used for database recovery.

12.3.7 *RESUME* — This command puts the SC in the AUTO state.

12.3.8 *RETRY (Supplier Option)* — This command may be used by the Host when an error is encountered by the stocker. The Host would use this command to allow the stocker to retry the movement which generated the error condition. This command shall clear the error condition that is being addressed by the command.

12.3.9 *TRANSFER* — This is a SECS-II Enhanced Remote Command instead of a SECS-II Host Command Send (S2,F49 instead of S2,F41). See the examples in Section 15.1 for details.

12.3.10 This command is used to perform the entire transfer command for the carrier to be transferred between stocker locations. The execution of this command will include allocation of resources, acquiring the carrier, moving the carrier to the destination, queuing the carrier at an alternate destination (if needed), depositing the carrier, and returning the resources for other use. The number of carriers in the TRANSFER command is always equal to one (i.e., the size of the transfer unit is always equal to one carrier).

12.3.11 *INFOUPDATE* — This is used to associate information with a carrier while in the SC database. This command is an optional feature and is not required for compliance. If this command is not supported, then a HCACK of '1' (Command does not exist) shall be returned. If the carrier does not exist in the SC database, then a HCACK of '3' (At least one parameter is invalid) shall be returned.

12.3.12 *Remote Commands and Associated Host Command Parameters*

12.3.12.1 This table describes the allowable command parameters (CPNAME) for each remote command (RCMD). Equipment shall support all parameters. The column marked Req/Opt, specifies which parameters are required to be sent by the host and which parameters may be optionally sent by the host.

Table 11 Allowable Command Parameters

Remote Command	*Parameters*		
	Cpname	*Req/Opt*	*Comment*
ABORT	"COMMANDID"	R	Must specify the commandID that was used for the TRANSFER command that is being ABORT'ed.
CANCEL	"COMMANDID"	R	Must specify the commandID that was used for the TRANSFER command that is being CANCEL'ed.
INSTALL	"CARRIERID" "CARRIERLOC"	R R	
LOCATE	"CARRIERID" or "ZONENAME" or "CARRIERLOC"	O	SC will check its database and return the carrier information to the Host with a single 'CarrierLocateCompleted' event for all relevant carriers. If the Host issues the LOCATE command with CARRIERID then SC returns information associated with the carrier specified by the Host. If the Host issues the LOCATE command with ZONENAME or CARRIERLOC, all carrier information in the specified area (ZONENAME or CARRIERLOC) will be returned. If the Host issues the LOCATE command without a Cpname, all carrier information in the SC database will be returned.
	"COMMANDID"	O	Unique Command Identifier for the LOCATE command. It does not have a relationship to the CommandId of a TRANSFER command.
PAUSE	None	N/A	Once received by the SC, the SC will queue any TRANSFER commands until the SC receives and successfully executes the RESUME command. Once in the AUTO state the SC will process the TRANSFER commands in its queue.
REMOVE	"CARRIERID"	R	
RESUME	None	N/A	Returns the PAUSEd SC to the AUTO state.
RETRY Supplier Option	"ERRORNUMBER"	R	Since more than one error can occur for the same TRANSFER command, an ERRORNUMBER must be used to identify the ERRORNUMBER to which to apply the RETRY.
TRANSFER	"COMMANDINFO" "TRANSFERINFO"	R R	
INFOUPDATE	"CARRIERID" *"hostDefined"*	R O	The "HostDefined" cpnames are used to indicate the name of the data that is to be associated with a carrier. See Section 13 for example scenarios. The data associated with a carrier is for display purposes only and information such as the carrier's current location and state cannot be changed with this command.

12.3.13 *Host Command Parameters Name and Values*

Table 12 Host Command Parameters CPNAMES

Cpname	*Parameter Value*		
	Description	*Range*	*Format*
CARRIERID	Unique ID of the carrier.		A[1–64]
CARRIERLOC	Unique carrier location within the stocker.		A[1–64]
COMMANDID	Unique command identifier created by the Host.		A[1–64]

Cpname	*Parameter Value*		
	Description	*Range*	*Format*
COMMANDINFO	L,2 COMMANDID PRIORITY		L,2
DEST	Destination location identifier.	Must be a valid ZoneName. Must be a loading port for a move to an output shuttle (DEST = LP).	A[1–64]
ERRORNUMBER	Unique error identifier created by the stocker.		A[1–64]
PRIORITY	Remote command priority.	0 is not valid. 1 is the LOWEST priority, 99 is the highest priority.	U2
SOURCE	Unique source location identifier.	Stocker Robot/Crane is a valid SOURCE (Supplier Option).	A[1–64]
TRANSFERINFO	L,3 CARRIERID SOURCE DEST	SOURCE may intentionally be left blank by the Host. If this is true, the stocker must determine the carrier's current location by checking its database for the specified CARRIERID.	L,3

12.3.14 *Remote Commands versus SC, Transfer Command and Stocker Carrier States*

12.3.14.1 The following table indicates SC, TRANSFER Command and Stocker Carrier States where the remote commands are allowed. This is indicated with a "X" mark. Remote commands act independently of other state models (e.g., Stocker Crane States are independent from the Stocker SEM remote commands). "NA" (Not Applicable) means that States and Remote Commands have no direct relationship.

Table 13 Remote Commands versus SC and TRANSFER Command States

	COMMAND									
	TRANSFER	*RETRY*	*RESUME*	*REMOVE*	*PAUSE*	*LOCATE*	*INSTALL*	*CANCEL*	*ABORT*	*INFOUPDATE*
SC STATE										
AUTO	X	X		X	X	X	X	X	X	X
ALARMS	X	X	X	X	X	X	X	X	X	X
SC INIT										
NO ALARMS	X		X	X	X	X	X	X	X	X
PAUSED	X	X	X	X		X	X	X	X	X
PAUSING	X	X	X	X		X	X	X	X	X
TRANSFER COMMAND STATE										
ACTIVE (PAUSED)	NA	X	NA		NA	X			X	NA
ACTIVE (QUEUED AT ALT.)	NA		NA		NA	X			X	NA
ACTIVE (TRANSFERRING)	NA		NA		NA	X			X	NA
ABORTING	NA		NA		NA	X				NA
CANCELING	NA		NA		NA	X				NA

QUEUED	NA		NA		NA	X		X		NA
STOCKER CARRIER STATE										
STORED (ALTERNATE)		NA	NA		NA	X		NA	X	X
STORED (COMPLETED)	X	NA	NA	X	NA	X	X	NA		X
TRANSFERRING	X	NA	NA		NA	X		NA	NA	X
WAIT IN	X	NA	NA	X	NA	X	X	NA	NA	X
WAIT OUT		NA	NA	X	NA	X	X	NA	NA	X

12.4 *Remote Command Relies*

12.4.1 For a TRANSFER remote command the HCACK in the reply message must return an error 6 (No such Object Exists) if the SOURCE is not specified and the CARRIERID is not in the SC database. If the SOURCE is invalid (i.e. not a valid CarrierLoc), then the HCACK in the reply message must return an error of 3 (Invalid Parameter).

12.4.2 For a LOCATE remote command the HCACK in the reply message must return an error 6 (No such Object Exists) if value specified for the CARRIERID, ZONENAME, or CARRIERLOC does not exist in the SC database.

13 Scenarios

13.1 The scenarios that follow represent Application Notes. In the scenarios, all unique Remote CommandIDs must initially be created and sent by the Host. Subsequent event reports sent from the equipment referring to the status of a particular remote command must return the applicable CommandID. All collection events identified in Table 6 are assumed to be enabled (per the SEMI E30 definition/scenario) throughout the following scenarios. Variable data specified in the Host commands has been chosen arbitrarily for the purpose of demonstrating message structure/content. The Collection Event Report definitions contained in the scenarios are examples that could be defined by the host.

Normal Operation

13.1.1 *Carrier Transfer from an Input to a Storage Location (No ID Reader at Input Port)*

13.1.1.1 The carrier is transferred from a stocker input port to a storage location. The SC inserts the carrier into the database based on the CarrierID sent by the Host in the TRANSFER command. This is the scenario when the stocker does not have a carrier ID reader at the input port. A good example of this would be for a interbay transport input port.

STEP	COMMENTS	HOST	SC	COMMENTS
1.	Carrier 123456 enters the domain of the stocker			
2.	Since there is no ID reader, the SC can choose any arbitrary CarrierID to internally track the carrier; However, the SC must send the empty string as the CarrierID to the Host so that the Host can distinguish this condition. It is the Host responsibility to recognize that the empty string "" for the CarrierID denotes that a carrier ID reader does not exist at this input port.		←S6,F11	Event Report Send (ERS) CarrierWaitIn · CarrierID = "" /* Empty String */ · CarrierLoc · CarrierZoneName
3.	Event Report Acknowledge (ERA)	S6,F12→		
4.			←S6,F11	Event Report Send (ERS) ZoneCapacityChange
5.	Event Report Acknowledge (ERA)	S6,F12→		
6.	Enhanced Remote Command (ERC) **TRANSFER** · COMMANDID · PRIORITY · TRANSFERINFO 1. CARRIERID = "123456" 2. SOURCE = blank 3. DEST = "STORAGE"	S2,F49→		In this scenario SOURCE is the name of an input port position and DEST is the ZoneName STORAGE which is a SC selected shelf. Both CARRIERID and SOURCE must be included to do an automatic install of the carrier into the SC database.
7.			←S2,F50	Enhanced Remote Command Acknowledge (ERCA)
8.			←S6,F11	Event Report Send (ERS) TransferInitiated · CommandID = · CarrierID = "123456" · CarrierLoc = · CarrierZoneName = · Dest = "STORAGE"
9.	Event Report Acknowledge (ERA)	S6,F12→		
10.			←S6,F11	Event Report Send (ERS) CarrierTransferring · CarrierID = "123456" · CarrierLoc · CarrierZoneName
11.	Event Report Acknowledge (ERA)	S6,F12→		
12.			←S6,F11	Event Report Send (ERS) ZoneCapacityChange
13.	Event Report Acknowledge (ERA)	S6,F12→		
14.			←S6,F11	Event Report Send (ERS) CraneActive
15.	Event Report Acknowledge (ERA)	S6,F12→		

STEP	COMMENTS	HOST	SC	COMMENTS
16.			←S6,F11	Event Report Send (ERS) TransferCompleted · CommandID · CarrierID = "123456" · CarrierLoc = "112" · ResultCode = 0 · CarrierZoneName = "STORAGE"
17.	Event Report Acknowledge (ERA)	S6,F12→		
18.			←S6,F11	Event Report Send (ERS) CarrierStored · CarrierID = "123456" · CarrierLoc = "112" · CarrierZoneName = "STORAGE"
19.	Event Report Acknowledge (ERA)	S6,F12→		
20.			←S6,F11	Event Report Send (ERS) CraneIdle
21.	Event Report Acknowledge (ERA)	S6,F12→		

13.1.2 *Carrier Transfer from an Input to a Storage Location (ID Reader at Input Port)*

13.1.2.1 The carrier is transferred from a stocker input port to a storage location. The carrier is automatically inserted into the SC database by the SC based on the carrier ID read which occurs on the stocker input port.

STEP	COMMENTS	HOST	SC	COMMENTS
1.	Carrier 123456 enters the domain of the stocker			
2.			←S6,F11	Event Report Send (ERS) CarrierIDRead · CarrierID = "123456" · CarrierLoc = SOURCE · IDReadStatus = 0
3.	Event Report Acknowledge (ERA)	S6,F12→		
4.			←S6,F11	Event Report Send (ERS) CarrierWaitIn · CarrierID = "123456" · CarrierLoc = SOURCE
5.	Event Report Acknowledge (ERA)	S6,F12→		
6.			←S6,F11	Event Report Send (ERS) ZoneCapacityChange
7.	Event Report Acknowledge (ERA)	S6,F12→		
8.	Enhanced Remote Command (ERC) TRANSFER · COMMANDID · PRIORITY · TRANSFERINFO 1. CARRIERID = "123456" 2. SOURCE 3. DEST = "STORAGE"	S2,F49→		In this scenario SOURCE is the name of a input port position and DEST is the ZoneName STORAGE which is a SC selected shelf. SOURCE is optional since the SC knows where the CARRIERID is located.
9.			←S2,F50	Enhanced Remote Command Acknowledge (ERCA)
10.			←S6,F11	Event Report Send (ERS) TransferInitiated · CommandID · CarrierID = "123456" · CarrierLoc · CarrierZoneName · Dest = "STORAGE"
11.	Event Report Acknowledge (ERA)	S6,F12→		

STEP	COMMENTS	HOST	SC	COMMENTS
12.			←S6,F11	Event Report Send (ERS) CarrierTransferring · CarrierID = "123456" · CarrierLoc · CarrierZoneName
13.	Event Report Acknowledge (ERA)	S6,F12→		
			←S6,F11	Event Report Send (ERS) ZoneCapacityChange
	Event Report Acknowledge (ERA)	S6,F12→		
14.			←S6,F11	Event Report Send (ERS) CraneActive
15.	Event Report Acknowledge (ERA)	S6,F12→		
16.			←S6,F11	Event Report Send (ERS) TransferCompleted · CommandID · CarrierID = "123456" · CarrierLoc · ResultCode = "0" · CarrierZoneName
17.	Event Report Acknowledge (ERA)	S6,F12→		
18.			←S6,F11	Event Report Send (ERS) CarrierStored · CarrierID · CarrierLoc = "112" · CarrierZoneName
19.	Event Report Acknowledge (ERA)	S6,F12→		
			←S6,F11	Event Report Send (ERS) ZoneCapacityChange
	Event Report Acknowledge (ERA)	S6,F12→		
20.			←S6,F11	Event Report Send (ERS) CraneIdle
21.	Event Report Acknowledge (ERA)	S6,F12→		

13.1.3 *Carrier Transfer to an Automated Stocker Output Port*

13.1.3.1 The carrier is transferred from a stocker location (storage location or input port) to an output port where it is then automatically transferred (Carrier Handoff) to an automated vehicle such as an OHV or AGV.

STEP	COMMENTS	HOST	SC	COMMENTS
1.	Enhanced Remote Command (ERC) TRANSFER · COMMANDID · PRIORITY · TRANSFERINFO 1. CARRIERID 2. SOURCE 3. DEST = "LP1"	S2,F49→		In this scenario SOURCE is the name of a CarrierLoc or ZoneName and DEST is the name of a loading port. Either CARRIERID or SOURCE is optional.
2.			←S2,F50	Enhanced Remote Command Acknowledge (ERCA)
3.			←S6,F11	Event Report Send (ERS) TransferInitiated · CommandID · CarrierID · CarrierLoc · CarrierZoneName · Dest = "LP1"
4.	Event Report Acknowledge (ERA)	S6,F12→		
5.			←S6,F11	Event Report Send (ERS) CarrierTransferring · CarrierID · CarrierLoc · CarrierZoneName

STEP	COMMENTS	HOST	SC	COMMENTS
6.	Event Report Acknowledge (ERA)	S6,F12→		
			←S6,F11	Event Report Send (ERS) ZoneCapacityChange
	Event Report Acknowledge (ERA)	S6,F12→		
7.			←S6,F11	Event Report Send (ERS) CraneActive
8.	Event Report Acknowledge (ERA)	S6,F12→		
9.			←S6,F11	Event Report Send (ERS) CraneIdle
10.	Event Report Acknowledge (ERA)	S6,F12→		
11.			←S6,F11	Event Report Send (ERS) TransferCompleted · CommandID · CarrierID · CarrierLoc · ResultCode = "0" · CarrierZoneName
12.	Event Report Acknowledge (ERA)	S6,F12→		
13.			←S6,F11	Event Report Send (ERS) CarrierWaitOut · CarrierID · CarrierLoc = "LP1" · CarrierZoneName · PortType = "LP"
14.	Event Report Acknowledge (ERA)	S6,F12→		
			←S6,F11	Event Report Send (ERS) ZoneCapacityChange
	Event Report Acknowledge (ERA)	S6,F12→		
15.	Carrier leaves the domain of the stocker as it is acquired by the transport vehicle.			
16.			←S6,F11	Event Report Send (ERS) CarrierRemoved · CarrierID · HandoffType = AUTOMATED
17.	Event Report Acknowledge (ERA)	S6,F12→		
18.			←S6,F11	Event Report Send (ERS) ZoneCapacityChange
19.	Event Report Acknowledge (ERA)	S6,F12→		

13.1.4 *Carrier Transfer to a Stocker Output Port Requiring Intermediate Storage*

13.1.4.1 The carrier is requested by the Host to be transferred from a stocker input port (with an ID reader) to a manual output port but requires intermediate storage due to the destination output port being fully occupied with carriers.

STEP	COMMENTS	HOST	SC	COMMENTS
1.	Carrier 123456 is sitting at the stocker crane accessible input port position.			
2.	Enhanced Remote Command (ERC) TRANSFER · COMMANDID · PRIORITY · TRANSFERINFO 1. CARRIERID 2. SOURCE 3. DEST = "LP"	S2,F49→		In this scenario SOURCE is the name of an input port position and DEST is the name of a loading port. Either CARRIERID or SOURCE is optional.
3.			←S2,F50	Enhanced Remote Command Acknowledge (ERCA)

STEP	COMMENTS	HOST	SC	COMMENTS
4.			←S6,F11	Event Report Send (ERS) TransferInitiated · CommandID · CarrierID · CarrierLoc · CarrierZoneName · Dest = "LP"
5.	Event Report Acknowledge (ERA)	S6,F12→		
6.			←S6,F11	Event Report Send (ERS) CarrierTransferring · CarrierID · CarrierLoc · CarrierZoneName
7.	Event Report Acknowledge (ERA)	S6,F12→		
			←S6,F11	Event Report Send (ERS) ZoneCapacityChange
	Event Report Acknowledge (ERA)	S6,F12→		
8.			←S6,F11	Event Report Send (ERS) CraneActive
9.	Event Report Acknowledge (ERA)	S6,F12→		
10.			←S6,F11	Event Report Send (ERS) CraneIdle
11.	Event Report Acknowledge (ERA)	S6,F12→		
12.			←S6,F11	Event Report Send (ERS) CarrierStoredAlt · CommandID · CarrierID · CarrierLoc = "132" · Dest = "LP" · CarrierZoneName
13.	Event Report Acknowledge (ERA)	S6,F12→		
			←S6,F11	Event Report Send (ERS) ZoneCapacityChange
	Event Report Acknowledge (ERA)	S6,F12→		
14.			←S6,F11	Event Report Send (ERS) CarrierResumed · CommandID · CarrierID · CarrierLoc = "132" · Dest = "LP" · CarrierZoneName
15.	Event Report Acknowledge (ERA)	S6,F12→		
			←S6,F11	Event Report Send (ERS) ZoneCapacityChange
	Event Report Acknowledge (ERA)	S6,F12→		
16.			←S6,F11	Event Report Send (ERS) CraneActive
17.	Event Report Acknowledge (ERA)	S6,F12→		
18.			←S6,F11	Event Report Send (ERS) CraneIdle
19.	Event Report Acknowledge (ERA)	S6,F12→		
20.			←S6,F11	Event Report Send (ERS) TransferCompleted · CommandID · CarrierID · CarrierLoc · ResultCode = "0" · CarrierZoneName
21.	Event Report Acknowledge (ERA)	S6,F12→		

STEP	COMMENTS	HOST	SC	COMMENTS
22.			←S6,F11	Event Report Send (ERS) CarrierWaitOut · CarrierID · CarrierLoc = "LP" · CarrierZoneName · PortType = "LP"
23.	Event Report Acknowledge (ERA)	S6,F12→		
			←S6,F11	Event Report Send (ERS) ZoneCapacityChange
	Event Report Acknowledge (ERA)	S6,F12→		
24.	Carrier leaves the domain of the stocker as it is acquired manually by a PGV.			
25.			←S6,F11	Event Report Send (ERS) CarrierRemoved · CarrierID · HandoffType = MANUAL
26.	Event Report Acknowledge (ERA)	S6,F12→		
27.			←S6,F11	Event Report Send (ERS) ZoneCapacityChange
28.	Event Report Acknowledge (ERA)	S6,F12→		

13.1.5 *Carrier Transfer to an Automated Stocker Output with Multiple Loading Ports*

13.1.5.1 Three carriers are requested to the stocker output. The output shuttle consists of multiple carrier positions including the stocker crane set down port (OP – location 03) and two AGV accessible port locations (LPs – locations 05 and 06). The port shuttle also has a BP (location 04) that is the location reached by a carrier before reaching the LP positions. The Host sends the three Transfer commands to the stocker and they are queued. The first two Transfer commands send carriers to LP locations 05 and 06 respectively. These carriers are to be loaded by the same AGV. The third carrier is also requested to LP 05. Each carrier is transferred to the OP where it then automatically travels forward on the shuttle toward the BP and LPs (see figure in Section 6.16). The first two carriers arrive at the LPs. The vehicle removes the two carriers from the LPs. The third carrier then shuttles forward to the LP location 05.

STEP	COMMENTS	HOST	SC	COMMENTS
1.	Enhanced Remote Command (ERC) TRANSFER · COMMANDID = "060658" · PRIORITY = "20" · TRANSFERINFO 1. CARRIERID = "11111" 2. SOURCE 3. DEST = "06"	S2,F49→		In this scenario SOURCE is the name of a CarrierLoc or ZoneName and DEST is the name of a "loading port." Either CARRIERID or SOURCE may be empty.
2.			←S2,F50	Enhanced Remote Command Acknowledge (ERCA)
3.			←S6,F11	Event Report Send (ERS) TransferInitiated · CommandID = "060658" · CarrierID = "11111" · CarrierLoc · CarrierZoneName · Dest = "06"
4.	Event Report Acknowledge (ERA)	S6,F12→		
5.			←S6,F11	Event Report Send (ERS) CarrierTransferring · CarrierID = "11111" · CarrierLoc · CarrierZoneName
6.	Event Report Acknowledge (ERA)	S6,F12→		

STEP	COMMENTS	HOST	SC	COMMENTS
			←S6,F11	Event Report Send (ERS) ZoneCapacityChange
	Event Report Acknowledge (ERA)	S6,F12→		
7.			←S6,F11	Event Report Send (ERS) CraneActive
8.	Event Report Acknowledge (ERA)	S6,F12→		
9.	The Host issues the other two commands for carriers "22222" and "33333." These commands are queued by the stocker because it is active performing the command for carrier "11111."			
10.	Enhanced Remote Command (ERC) TRANSFER · COMMANDID = "101883" · PRIORITY = "21" · TRANSFERINFO 1. CARRIERID = "22222" 2. SOURCE 3. DEST = "05"	S2,F49→		In this scenario SOURCE is the name of a CarrierLoc or ZoneName and DEST is the name of an "loading port." Either CARRIERID or SOURCE may be empty.
11.			←S2,F50	Enhanced Remote Command Acknowledge (ERCA)
12.	Enhanced Remote Command (ERC) TRANSFER · COMMANDID = "012155" · PRIORITY = "30" · TRANSFERINFO 1. CARRIERID = "33333" 2. SOURCE 3. DEST = "05"	S2,F49→		In this scenario SOURCE is the name of a CarrierLoc or ZoneName and DEST is the name of an output port. Either CARRIERID or SOURCE may be empty.
13.			←S2,F50	Enhanced Remote Command Acknowledge (ERCA)
16.	The first carrier is set down by the stocker on the output port.			
17.			←S6,F11	Event Report Send (ERS) CraneIdle
18.	Event Report Acknowledge (ERA)	S6,F12→		
19.			←S6,F11	Event Report Send (ERS) CarrierWaitOut · CarrierID = "11111" · CarrierLoc = "03" · CarrierZoneName · PortType = "OP"
20.	Event Report Acknowledge (ERA)	S6,F12→		
21.	Now that carrier "11111" has left the "stocker set down" position of the output port, the stocker initiates the next highest priority queued command.			
22.			←S6,F11	Event Report Send (ERS) TransferInitiated · CommandID = "012155" · CarrierID = "33333" · CarrierLoc · CarrierZoneName · Dest = "05"
23.	Event Report Acknowledge (ERA)	S6,F12→		

STEP	COMMENTS	HOST	SC	COMMENTS
24.			←S6,F11	Event Report Send (ERS) CarrierTransferring · CarrierID = "33333" · CarrierLoc · CarrierZoneName
25.	Event Report Acknowledge (ERA)	S6,F12→		
			←S6,F11	Event Report Send (ERS) ZoneCapacityChange
	Event Report Acknowledge (ERA)	S6,F12→		
26.			←S6,F11	Event Report Send (ERS) CraneActive
27.	Event Report Acknowledge (ERA)	S6,F12→		
28.	Carrier "11111" arrives at the buffer port.			
29.			←S6,F11	Event Report Send (ERS) CarrierWaitOut · CarrierID = "11111" · CarrierLoc = "04" · PortType = "BP" · CarrierZoneName
30.	Event Report Acknowledge (ERA)	S6,F12→		
			←S6,F11	Event Report Send (ERS) ZoneCapacityChange
	Event Report Acknowledge (ERA)	S6,F12→		
31.	Carrier "11111" arrives at the first vehicle loading port.			
32.			←S6,F11	Event Report Send (ERS) CarrierWaitOut · CarrierID = "11111" · CarrierLoc = "05" · PortType = "LP" · CarrierZoneName
33.	Event Report Acknowledge (ERA)	S6,F12→		
34.	Carrier "11111" can cycle forward one more port so it does.			
35.	Carrier "11111" arrives at the vehicle loading "end" port ("06").			
36.			←S6,F11	Event Report Send (ERS) TransferCompleted · CommandID = "060658" · ResultCode = 0 · CarrierID = "11111" · CarrierLoc = "06" · CarrierZoneName
37.	Event Report Acknowledge (ERA)	S6,F12→		
38.			←S6,F11	Event Report Send (ERS) CarrierWaitOut · CarrierID = "11111" · CarrierLoc = "06" · PortType = "LP" · CarrierZoneName
39.	Event Report Acknowledge (ERA)	S6,F12→		
40.	The stocker sets down carrier "33333" on the output port.			
41.			←S6,F11	Event Report Send (ERS) CraneIdle
42.	Event Report Acknowledge (ERA)	S6,F12→		

STEP	COMMENTS	HOST	SC	COMMENTS
43.			←S6,F11	Event Report Send (ERS) CarrierWaitOut · CarrierID = "33333" · CarrierLoc = "03" · CarrierZoneName · PortType = "OP"
44.	Event Report Acknowledge (ERA)	S6,F12→		
45.	Now the stocker can initiate the next transfer command.			
46.			←S6,F11	Event Report Send (ERS) TransferInitiated · CommandID = "101883" · CarrierID = "22222" · CarrierLoc · CarrierZoneName · Dest "05"
47.	Event Report Acknowledge (ERA)	S6,F12→		
48.			←S6,F11	Event Report Send (ERS) CarrierTransferring · CarrierID = "22222" · CarrierLoc · CarrierZoneName
49.	Event Report Acknowledge (ERA)	S6,F12→		
			←S6,F11	Event Report Send (ERS) ZoneCapacityChange
	Event Report Acknowledge (ERA)	S6,F12→		
50.			←S6,F11	Event Report Send (ERS) CraneActive
51.	Event Report Acknowledge (ERA)	S6,F12→		
52.	Carrier "33333" arrives at the buffer port.			
53.			←S6,F11	Event Report Send (ERS) CarrierWaitOut · CarrierID = "33333" · CarrierLoc = "04" · PortType = "BP" · CarrierZoneName
54.	Event Report Acknowledge (ERA)	S6,F12→		
			←S6,F11	Event Report Send (ERS) ZoneCapacityChange
	Event Report Acknowledge (ERA)	S6,F12→		
55.	At this point, the CarrierWaitOut at BP event could be optionally used as an advanced notification to the Host to go ahead and request a vehicle to come and pick up carriers "11111" and "33333".			
56.	Carrier "33333" arrives at the first vehicle loading port (its destination).			
57.			←S6,F11	Event Report Send (ERS) TransferCompleted · CommandID = "012155" · ResultCode = 0 · CarrierID = "33333" · CarrierLoc = "05" · CarrierZoneName
58.	Event Report Acknowledge (ERA)	S6,F12→		

STEP	COMMENTS	HOST	SC	COMMENTS
59.			←S6,F11	Event Report Send (ERS) CarrierWaitOut · CarrierID = "33333" · CarrierLoc = "05" · PortType = "LP" · CarrierZoneName
60.	Event Report Acknowledge (ERA)	S6,F12→		
61.	Now carriers "11111" and "33333" are on the two vehicle loading port locations of the output port.			
62.			←S6,F11	Event Report Send (ERS) CraneIdle
63.	Event Report Acknowledge (ERA)	S6,F12→		
64.			←S6,F11	Event Report Send (ERS) CarrierWaitOut · CarrierID = "22222" · CarrierLoc = "03" · CarrierZoneName · PortType = "OP"
65.	Event Report Acknowledge (ERA)	S6,F12→		
66.	Carrier "22222" arrives at the buffer port.			
67.			←S6,F11	Event Report Send (ERS) CarrierWaitOut · CarrierID = "22222" · CarrierLoc = "04" · PortType = "BP" · CarrierZoneName
68.	Event Report Acknowledge (ERA)	S6,F12→		
			←S6,F11	Event Report Send (ERS) ZoneCapacityChange
	Event Report Acknowledge (ERA)	S6,F12→		
69.	The vehicle arrives and removes the two carriers from the output port. The carriers leave the domain of the stocker.			
70.			←S6,F11	Event Report Send (ERS) CarrierRemoved · CarrierID = "33333" · HandoffType = AUTOMATED
71.			←S6,F11	Event Report Send (ERS) CarrierRemoved · CarrierID = "11111" · HandoffType = AUTOMATED
72.	Event Report Acknowledge (ERA)	S6,F12→		
			←S6,F11	Event Report Send (ERS) ZoneCapacityChange
	Event Report Acknowledge (ERA)	S6,F12→		
73.	Event Report Acknowledge (ERA)	S6,F12→		
			←S6,F11	Event Report Send (ERS) ZoneCapacityChange
	Event Report Acknowledge (ERA)	S6,F12→		
74.	The third carrier is now able to "cycle forward" on the output port to a vehicle loading port.			

STEP	COMMENTS	HOST	SC	COMMENTS
75.			←S6,F11	Event Report Send (ERS) TransferCompleted · CommandID = "101883" · ResultCode = 0 · CarrierID = "22222" · CarrierLoc = "05" · CarrierZoneName
76.	Event Report Acknowledge (ERA)	S6,F12→		
77.			←S6,F11	Event Report Send (ERS) CarrierWaitOut · CarrierID = "22222" · CarrierLoc = "05" · PortType = "LP" · CarrierZoneName
78.	Event Report Acknowledge (ERA)	S6,F12→		
79.	No carrier is occupying the "06" port location, however because the requested destination for "22222" was "05" the carrier does not cycle forward on the output conveyor. The carrier waits at location "05" for its vehicle.			

13.1.6 *Database Operations (Install, Remove, Locate, and Update a Carrier Record)*

STEP	COMMENTS	HOST	SC	COMMENTS
1.	The host desires to insert a SC database entry for carrier 123456 at stocker storage location 123			
2.	Host Command Send (HCS) INSTALL · CARRIERID = "123456" · CARRIERLOC = "123"	S2,F41→		
3.			←S2,F42	Host Command Acknowledge (HCA)
4.			←S6,F11	Event Report Send (ERS) CarrierInstallCompleted · CarrierID = "123456" · CarrierLoc = "123" · CarrierZoneName
5.	Event Report Acknowledge (ERA)	S6,F12→		
6.			←S6,F11	Event Report Send (ERS) ZoneCapacityChange
7.	Event Report Acknowledge (ERA)	S6,F12→		

STEP	COMMENTS	HOST	SC	COMMENTS
1.	The host desires to remove the SC database entry for carrier 123456 from the SC database.			
2.	Host Command Send (HCS) REMOVE · CARRIERID = "123456"	S2,F41→		
3.			←S2,F42	Host Command Acknowledge (HCA)
4.			←S6,F11	Event Report Send (ERS) CarrierRemoveCompleted · CarrierID · CarrierLoc · CarrierZoneName
5.	Event Report Acknowledge (ERA)	S6,F12→		

6.			←S6,F11	Event Report Send (ERS) ZoneCapacityChange
7.	Event Report Acknowledge (ERA)	S6,F12→		

STEP	COMMENTS	HOST	SC	COMMENTS
1.	The host desires to perform a database lookup(locate) for carrier 123456.			
2.	Host Command Send (HCS) LOCATE · CARRIERID = "123456"	S2,F41→		
3.			←S2,F42	Host Command Acknowledge (HCA)
4.			←S6,F11	Event Report Send (ERS) CarrierLocateCompleted · CarrierID = "123456" · CarrierLoc = "123" · CarrierZoneName = "Zone1"
5.	Event Report Acknowledge (ERA)	S6,F12→		

STEP	COMMENTS	HOST	SC	COMMENTS
1.	The host desires to update the SC database location of carrier 123456(currently thought to be at stocker storage location 123).			
2.	Host Command Send (HCS) INSTALL · CARRIERID = "123456" · CARRIERLOC = "456"	S2,F41→		
3.			←S2,F42	Host Command Acknowledge (HCA)
4.			←S6,F11	Event Report Send (ERS) CarrierInstallCompleted · CarrierID = "123456" · CarrierLoc = "456" · CarrierZoneName The existing database entry for carrier 123456 is updated with the new CarrierLoc information.
5.	Event Report Acknowledge (ERA)	S6,F12→		

STEP	COMMENTS	HOST	SC	COMMENTS
1.	The host desires to update the SC database with information associated with carrier 123.			
2.	Host Command Send (HCS) INFOUPDATE · CARRIERID = "123" · LOTID = "LOT456" · Operation = "OP480"	S2,F41→		The Lot and Operation information associated with the carrier are sent to the SC.
3.			←S2,F42	Host Command Acknowledge (HCA)

STEP	COMMENTS	HOST	SC	COMMENTS
1.	The host desires to remove the LotId associated with carrier 123 from the SC database.			
2.	Host Command Send (HCS) INFOUPDATE · CARRIERID = "123" · LOTID = ""	S2,F41→		The Lot and Operation information associated with the carrier are sent to the SC.
3.			←S2,F42	Host Command Acknowledge (HCA)

13.2 *Anomaly Operation*

13.2.1 *Source Location Empty during Transfer – Empty Retrieve*

13.2.1.1 The Host issues a TRANSFER command to the SC to transfer a carrier from an input port to a storage location. When the stocker attempts to pick up the carrier at the input port, it finds that the source location is empty.

STEP	COMMENTS	HOST	SC	COMMENTS
1.	Carrier 123456 is sitting at the stocker crane accessible input port position.			
2.	Enhanced Remote Command (ERC) **TRANSFER** · COMMANDID · PRIORITY · TRANSFERINFO 1. CARRIERID = "123456" 2. SOURCE 3. DEST = "STORAGE"	S2,F49→		In this scenario SOURCE is the name of a input port position and DEST is the ZoneName STORAGE which is a SC selected shelf. SOURCE is optional since the SC knows where the CARRIERID is located.
3.			←S2,F50	Enhanced Remote Command Acknowledge (ERCA)
4.			←S6,F11	Event Report Send (ERS) TransferInitiated · CommandID · CarrierID = "123456" · CarrierLoc · CarrierZoneName · Dest = "STORAGE"
5.	Event Report Acknowledge (ERA)	S6,F12→		
6.			←S6,F11	Event Report Send (ERS) CarrierTransferring
7.	Event Report Acknowledge (ERA)	S6,F12→		
			←S6,F11	Event Report Send (ERS) ZoneCapacityChange
	Event Report Acknowledge (ERA)	S6,F12→		
8.			←S6,F11	Event Report Send (ERS) CraneActive
9.	Event Report Acknowledge (ERA)	S6,F12→		
10.				The stocker attempts to pick the carrier but finds the position to be empty.
11.			←S5,F1	Alarm Report Send (ARS) · ALCD(Alarm Set) · ALID · ALTX
12.	Alarm Report Acknowledge (ARA) · ACKC5	S5,F2→		
13.			←S6,F11	Event Report Send (ERS) AlarmSetEvent · CommandID · ErrorID = SourceEmpty · StockerDeviceInfo · RecoveryOptions =RETRY, ABORT
14.	Event Report Acknowledge (ERA)	S6,F12→		
15.	The Host may choose to disposition the error as follows: 1. Retry the TRANSFER · The stocker attempts to pick the carrier from the input port again			

13.2.1.2 The Host issues a TRANSFER command to the SC to transfer a carrier from a shelf to an output port. When the stocker attempts to pick up the carrier at the shelf, it finds that the source location is empty.

STEP	COMMENTS	HOST	SC	COMMENTS
1.	Carrier 123456 is logically sitting at a shelf location.			
2.	Enhanced Remote Command (ERC) **TRANSFER** · COMMANDID · PRIORITY · TRANSFERINFO 1. CARRIERID = "123456" 2. SOURCE 3. DEST = "LP1"	S2,F49→		.
3.			←S2,F50	Enhanced Remote Command Acknowledge (ERCA)
4.			←S6,F11	Event Report Send (ERS) TransferInitiated
5.	Event Report Acknowledge (ERA)	S6,F12→		
6.			←S6,F11	Event Report Send (ERS) CarrierTransferring
7.	Event Report Acknowledge (ERA)	S6,F12→		
8.			←S6,F11	Event Report Send (ERS) CraneActive
9.	Event Report Acknowledge (ERA)	S6,F12→		
10.				The stocker attempts to pick the carrier but finds the position to be empty.
11.			←S5,F1	Alarm Report Send (ARS) · ALCD(Alarm Set) · ALID · ALTX
12.	Alarm Report Acknowledge (ARA) · ACKC5	S5,F2→		
13.			←S6,F11	Event Report Send (ERS) AlarmSetEvent · CommandID · ErrorID = SourceEmpty · StockerDeviceInfo · RecoveryOptions =RETRY, ABORT
14.	Event Report Acknowledge (ERA)	S6,F12→		
15.	The Host may choose to disposition the error as follows: 1. Retry the TRANSFER · The stocker attempts to pick the carrier from the shelf again			
16.	The Host may choose to disposition the error as follows: 1. Abort the TRANSFER			The carrier is deleted from the SC database and a CarrierRemoveCompleted event is generated as well as a TransferAbortCompleted event and a ZoneCapacityChange event.

13.2.2 *Dest Location Full during Transfer – Double Store*

13.2.2.1 The Host issues a TRANSFER command to the SC to transfer a carrier from an input port to a storage location. When the stocker attempts to place the carrier to the storage location, it finds that the location is occupied.

STEP	COMMENTS	HOST	SC	COMMENTS
1.	Carrier 123456 is sitting at the stocker crane accessible input port position.			
2.	Enhanced Remote Command (ERC) TRANSFER · COMMANDID · PRIORITY · TRANSFERINFO 1. CARRIERID = "123456" 2. SOURCE 3. DEST = "STORAGE"	S2,F49→		In this scenario SOURCE is the name of a input port position and DEST is the ZoneName STORAGE which is a SC selected shelf. SOURCE is optional since the SC knows where the CARRIERID is located.
3.			←S2,F50	Enhanced Remote Command Acknowledge (ERCA)
4.			←S6,F11	Event Report Send (ERS) TransferInitiated · CommandID · CarrierID = "123456" · CarrierLoc · CarrierZoneName · Dest = "STORAGE"
5.	Event Report Acknowledge (ERA)	S6,F12→		
6.			←S6,F11	Event Report Send (ERS) CarrierTransferring · CarrierID = "123456" · CarrierLoc · CarrierZoneName
7.	Event Report Acknowledge (ERA)	S6,F12→		
			←S6,F11	Event Report Send (ERS) ZoneCapacityChange
	Event Report Acknowledge (ERA)	S6,F12→		
8.			←S6,F11	Event Report Send (ERS) CraneActive
9.	Event Report Acknowledge (ERA)	S6,F12→		
10.				The stocker attempts to place the carrier to the storage location but finds the location to be full.
11.			←S5,F1	Alarm Report Send (ARS) · ALCD(Alarm Set) · ALID · ALTX
12.	Alarm Report Acknowledge (ARA) · ACKC5	S5,F2→		
13.			←S6,F11	Event Report Send (ERS) AlarmSetEvent · CommandID · ErrorID = DestOccupied · StockerDeviceInfo · RecoveryOptions = RETRY, ABORT /* Supplier Option */
14.	Event Report Acknowledge (ERA)	S6,F12→		
15.	Supplier Option The Host may choose to disposition the error as follows: 1. Retry the TRANSFER · The stocker attempts to place the carrier to the dest location again			This is a Supplier Option to implement this Host initiated recovery method.

STEP	COMMENTS	HOST	SC	COMMENTS
16.	If the ABORT command is issued by the Host, an unkown carrier is created in the SC database at the physical location responsible for the error. This generates a CarrierInstalledCompleted event for the newly created carrier. The newly created carrier is NOT automatically sent to the LP of the manual output port. The host can issue a new TRANSFER command for the carrier currently on the crane as well as the recently created unkown carrier.			
17.	If the operator indicates, via the stocker console (supplier option), that the SC should select another shelf location, an unknown carrier is created in the SC database at the physical location responsible for the error. This generates a CarrierInstalledCompleted event for the newly created carrier. The newly created carrier is NOT automatically sent to the LP of the manual output port. The host can issue a new Transfer command for the recently created unknown carrier. The original transfer command for the carrier on the crane completes with success at the other shelf location.			

13.2.3 *Carrier ID Errors*

13.2.3.1 A carrier ID error occurred. See table below for possible Carrier ID errors and resolutions.

Table 14 Carrier ID Error Scenarios at Stocker Ports

ID Error	*Error Description*	*Input Port Action*	*Intrabay Output Port Action**
Failure	ID read fails Examples of reasons for failure are: · Bad bar code reader · Bad bar code label · Obstruction of bar code read · Other	If IDReadFailureOption is 'Reject' Option 1. 1. CarrierIDRead event sent. 2. Carrier automatically sent to LP of manual output port. 3. IDReadError event sent when carrier arrives at LP of manual output port. Option 2 - manual input port only. 1. CarrierIDRead event sent. 2. Stocker automatically sends carrier back to operator accessible location of input port(if necessary). 3. IDReadError event sent Person picks up carrier from input port with the PGV. If IDReadFailureOption is 'HostControlled'. 1. CarrierIDread event sent. 2. CarrierWaitIn event sent with unkown carrier ID. 3. Host issues Transfer Command.	Either of the following scenarios are acceptable based upon the supplier's option when moving carrier 456. Option 1: 1. CarrierIDRead event sent. 2. Carrier continues as if there was no reader and all events (CarrierWaitOut, TransferComplete, etc) will be sent with the ID (456) of the carrier as if there was no reader at the port. 3. IDReadError event sent when carrier arrives at LP of this output port. Option 2: 1. CarrierWaitOut event for 456. 2. CarrierIDRead event for Unknown carrier. 3. TransferComplete for 456 with ID failure error. 4. SC automatically deletes carrier 456 from database and sends CarrierRemoveCompleted event. 5. SC automatically creates Unknown carrier at the port and sends event according to Carrier State Model. 6. Carrier continues to or remains at LP of this output port with CarrierWaitOut for created Unknown carrier at each position. 7. IDReadError event sent when carrier arrives at LP of this output port.

ID Error	*Error Description*	*Input Port Action*	*Intrabay Output Port Action**
Duplicate	The carrier ID read results in an ID that matches another entry already in the SC database at a different physical location. Example at Input – Carrier 123 read at ID reader, but there is already a database entry for a carrier with CarrierID 123. Example at Output – Carrier 456 requested to ID reader but CarrierIDRead result is 123, but there is already a database entry for a carrier with CarrierID 123. DuplicateIDs are a subset of unkownIDs with the following format: UNKNOWNDUP-oldid-Seq. Where Seq is a unique sequence identifier.	1. CarrierIDRead event sent for 123. 2. If existing carrier 123 has a TransferCommand, send TransferCompleted with 'Duplicate ID' ResultCode. 3. SC automatically Deletes carrier 123 from SC database and sends CarrierRemovedCompleted. 4. SC automatically creates a DuplicateID carrier at previous location and sends event according to Carrier State Model. 5. CarrierWaitIn event for 123 at the port. If IDReadDuplicateOption is 'Reject' EITHER Option 1: 6a. Carrier 123 automatically sent to LP of manual output port. 7a. IDReadError event sent for 123 when carrier arrives at LP of manual output port. 8a. Host or manual maintenance required to disposition the carrier that SC thought was 123 that is now a Duplicate. OR Option 2 – manual input port only: 6b. Stocker automatically sends carrier back to operator accessible location of input port(if necessary). 7b. IDReadError event sent. 8b. Person picks up carrier from input port with the PGV. 9b. Host or manual maintenance required to disposition the carrier that SC thought was 123 that is now a Duplicate. If IDReadDuplicateOption is 'HostControlled': 6c. Host responsible for sending appropriate Transfer Commands for both carriers.	If IfReadDuplicateOption is 'Reject' or 'HostControlled' and carrier's previous location is a shelf. 1. CarrierWaitOut event for 456. 2. CarrierIDRead 123 event sent. 3. If carrier ID has a TransferCommand, send TransferCompleted with 'Duplicate ID' ResultCode. 4. SC automatically deletes carrier 123 from SC database and sends CarrierRemoveCompleted event. 5. SC automaically creates a DuplicateID carrier at previous location and sends event according to Carrier State Model. 6. SC automatically deletes carrier 456 from SC database and sends CarrierRemoveCompleted event. 7. TransferCompleted for 456 with duplicate ID ResultCode. 8. SC automatically creates an carrier123 at the port location and sends CarrierWaitOut event. 9. Carrier continues to LP of this output port. (CarrierWaitOut for 123 at each position.) 10. IDReadError event sent when carrier arrives at the LP of this output port. 11. Host or manual maintenance required to disposition the carrier that SC thought was 123 (now a duplicate). Note: The TransferCompleted events may come anywhere from step 3 to step 8.