



## **300 mm Operational Flowcharts and Scenarios, V. 10**

**International SEMATECH Manufacturing Initiative  
Technology Transfer #04014488A-TR**

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**Technology Transfer #04014488A-TR**  
**International SEMATECH Manufacturing Initiative**  
**April 30, 2004**

**Abstract:** This document contains a limited number of base operational flowcharts and scenarios for moving material and processing product within an end-user factory based on the communications interface requirements specified by the *I300I and J300 CIM Global Joint Guidance for 300 mm Semiconductor Factories – Release Five, April 2000*. International SEMATECH (ISMT) developed these flowcharts and scenarios under the direction of its member companies. The flowcharts include initialization, material movement, queue management, and product processing under a variety of operational criteria. Version 10 updates the flowcharts and scenarios to include changes to the SEMI standards up to the 0304 cycle and to be consistent with current member company implementation guidance.

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**Keywords:** Automated Materials Handling, Wafer Transport, Wafer Carriers, Standards, Factory Automation

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## **Acknowledgments**

We would like to acknowledge and thank the technical contributors listed below. Without their unflagging commitment and contributions, working diligently to achieve consensus on the common requirements and intended implementation strategies for the IC companies that they represent while respecting health business competition, this guidance would not exist. Most of these participants were members of the original International SEMATECH Equipment Integration and Automation Test User's Group (EIATUG) that established the first baseline flowcharts more than 4 years ago.

Their perseverance and ongoing contributions deserve our profound recognition and respect.  
Thank You!

Gino Crispieri (ISMI)  
Peter Cross (Intel)  
Karl Gartland (IBM)  
Blaine Crandall (TI)  
Les Marshall (AMD)  
Ralf Georgi (Infineon)  
Keith Peden (CCS Technologies)  
Charisse Rosier (ISMI)  
Lorn Christal (ISMI)

## Revision History

The following is the revision history (changes from R09 to R10) of this document and its flowcharts.

| Section          | Comments   |
|------------------|--|
| All pages        | Changed copyright statement to “(c) Copyright 1999-2003 International SEMATECH, Inc.”  |
| Cover sheet      | Changed “Version 09” to “Version 10.”  |
| Cover sheet      | Changed “December 2000” to “December 2003.”  |
| Cover sheet      | Changed “SEMI Standards Cycle Baseline: 1000” to “SEMI Standards Cycle 0703.”  |
| Cover sheet      | Removed the entire Modifications line. Only a single cycle is supported.   |
| Cover sheet      | Changed “Exception Handling” to “Limited Exception Handling.”  |
| Cover sheet      | Changed the abstract to reflect this as a basic view, rather than something every factory needs. Removed reference to CCS  |
| Cover sheet      | Replace with first abstract sentence with the following: “International SEMATECH (ISMT) developed these flowcharts and scenarios under the direction of its member companies.” |
| Cover sheet      | Removed CCS trademark data.  |
| Notices          | Changed copyright statement to “(c)1999-2003 International SEMATECH, Inc.”   |
| Revision History | Removed versions before R10 changes.   |
| 1                | Updated the Adobe version to 5.0.  |
| 1                | Removed CCS contact data.  |
| 1                | Replaced with first sentence with the following: “International SEMATECH (ISMT) developed these flowcharts and scenarios under the direction of its member companies.”         |
| 1.1              | Reflected the current version for each standard as of cycle 0703.  |
| 1.1              | Added the collaboration phase 1 document as a reference.   |
| 1.3              | Remove the whole section.  |
| 1.4              | Remove the whole section.  |
| 1.5              | Remove the whole section.  |
| 2.1              | Under Applicable Documents, changed “conforms to” to “is based on.”  |
| 2.1.1            | Added note to reflect context of alarms not necessarily requiring manual intervention.   |
| 2.1.3            | Removed the “Note: E30 equipment constants include:” box.  |
| 2.1.3            | Removed the “Note: E30 collection events include:” box.  |
| 2.1.4            | Reworded the first Note box to state collection events unique to E40.  |
| 2.1.4            | Removed the first paragraph in the second Note box, but left E40 transition and waiting for material events.   |
| 2.1.6            | In second Note box, highlighted that in E87 these are captured as alarms, but for IC maker event may be required.  |
| 2.1.6            | Added the word “E87” to the action boxes.  |
| 2.1.6            | Removed the “Note: E87 equipment constants include:” box.  |
| 2.1.7            | Added the word “E90” to the action boxes.  |
| 2.1.8            | Added the word “E94” to the action boxes.  |
| 3                | In second sentence, removed “both” and “or just individual wafers.”  |
| 3.1              | Under Applicable Documents, changed “conforms to” to “is based on.”  |
| 3.1.1            | In “CMHandler PORTACTION” box, added the following to the end of the box: “ServiceStatus=1” to indicate IN SERVICE.  |
| 3.1.1            | In the left column “Note: Port cannot be place in service because” box, added reasons.   |
| 3.1.1            | In “Note: A queued CarrierOut”, added item for internal buffer equipment only and changed empty to empty non-reserved port.  |
| 3.1.1            | The Yes from “Is CarrierOut Queued?” decision box now goes directly to the top of 3.3.4 (down its middle column).  |
| 3.1.2            | In “CMHandler PORTACTION” box, added the following to the end of the box: “ServiceStatus=0”  |



| Section | Comments   |
|---------|--|
| 3.1.2   | In the left column "Note: Port cannot be place out of service because" box, added reasons.   |
| 3.1.3   | Changed S3F23 to S3F27, S3F24 to S3F28, and updated their related parameters.  |
| 3.1.3   | Added decision block for reservation state.  |
| 3.1.3   | In last center block, changed "AMHS delivery" to "AHMS action."  |
| 3.1.4   | Changed S3F23 to S3F27, S3F24 to S3F28, and updated their related parameters.  |
| 3.1.4   | Added decision block for reservation state.  |
| 3.1.4   | In last center block, changed "AMHS delivery" to "AHMS action."  |
| 3.2     | Under Applicable Documents, changed "conforms to" to "is based on."  |
| 3.2.1.1 | Removed parameters in Bind box.  |
| 3.2.1.1 | In the "Note: A Bind service fails", added the last bullet for load port out of service and transfer blocked.  |
| 3.2.1.1 | Added note for asynchronous events.  |
| 3.2.1.2 | Removed parameters in CarrierNotification box.   |
| 3.2.1.2 | Added CAACK=6 to CM Handler box associated with the "Issue error" box.   |
| 3.2.1.3 | Change Note for Reservation State Model and services to indicate they are required for all equipment.  |
| 3.2.1.3 | Added load port out of service as a reason for ReserveAtPort.  |
| 3.2.1.4 | Removed parameters in CancelBind box.  |
| 3.2.1.4 | Changed third failure reason to "either loadport or carrier ID are not specified."   |
| 3.2.1.5 | Removed parameters in CancelCarrierNotification box.   |
| 3.2.1.5 | Changed first box to "CancelCarrierNotification Issued."   |
| 3.2.1.6 | Removed parameters in CancelReservationAtPort box.   |
| 3.2.2.1 | In initial decision box, removed LP association question.  |
| 3.2.2.1 | Moved decision for Manual before decision for Reservation.   |
| 3.2.2.1 | Exception handling now refers to end-user or supplier documentation.   |
| 3.2.2.1 | Reduced this section from 3 to 2 pages. Updated the labels starting on page 3.2-8.   |
| 3.2.2.1 | The "Begin/signal placing carrier on load port" box was moved.   |
| 3.2.2.1 | In a note, changed E81 to E87.   |
| 3.2.2.2 | Exception handling now refers to end-user or supplier documentation.   |
| 3.2.3.3 | Exception handling now refers to end-user or supplier documentation.   |
| 3.2.3.3 | Deleted CarrierOut from the title.   |
| 3.2.3.3 | Added a step that states, "Wait for carrier to arrive at destination."   |
| 3.2.3.2 | Exception handling now refers to end-user or supplier documentation.   |
| 3.2.3.2 | Changed carrier clamp scenario to Clamp Carrier (initiated the action), Is Carrier Clamped? (did the action succeed), No-Error (exception handling), Yes-Carrier Clamped-Send event (looks good, notify host).   |
| 3.2.3.2 | Exception handling now refers to end-user or supplier documentation.   |
| 3.2.3.2 | Changed carrier clamp scenario to Clamp Carrier (initiated the action), Is Carrier Clamped? (did the action succeed), No-Error (exception handling), Yes-Carrier Clamped-Send event (looks good, notify host).   |
| 3.2.3.2 | Removed a redundant NOT ASSOCIATED event and CancelBind service related to the load port being associated with another carrier.  |
| 3.2.3.2 | Exception handling now refers to end-user or supplier documentation.   |
| 3.2.3.7 | Exception handling now refers to end-user or supplier documentation.   |
| 3.2.3.7 | Changed carrier clamp scenario to Clamp Carrier (initiated the action), Is Carrier Clamped? (did the action succeed), No-Error (exception handling), Yes-Carrier Clamped-Send event (looks good, notify host).   |
| 3.2.3.7 | 1) Removed "C.2.5 is TBD." 2) Changed "Slot map read fail error." 3) Made last decision box a question.  |
| 3.2.3.7 | Deleted the note at the top of the page that read "For slot map read fail, host should only issue a CancelCarrier since the equipment cannot provide a map which is necessary for either host or equipment based slot map verification." There was an identical note at the bottom of the page and it was moved to the right side of the page. |
| 3.2.4.1 | Deleted the step at the bottom of the page that stated "Make wafer available for transfer from carrier."   |
| 3.2.4.1 | Changed the verbiage to read "UNOCCUPIED" from "NOT OCCUPIED."   |

| Section | Comments  |
|---------|---|
| 3.2.4.2 | Delete entire section and its contents. This is no longer supported in the document.  |
| 3.3.1   | Exception handling now refers to end-user or supplier documentation.  |
| 3.3.1   | Removed last note in this section that had discussed host operation.  |
| 3.3.2   | Modified boundary note to include all five cases.   |
| 3.3.2   | Added a YES option to the first decision block on the page. It was not present.   |
| 3.3.2   | Added a note which states: Operator removes the carrier before the equipment being ready as defined in the boundary conditions above.   |
| 3.3.2   | Reduced this section from 3 to 2 pages. Updated the labels starting on page 3.3-5.  |
| 3.3.2   | Deleted two steps, one a decision block for CarrierOut queued, and the other a step for Process Next CarrierOut to after TRANSFER BLOCKED and the triggering of the Presence/Placement sensors.   |
| 3.3.2   | Changed the Load port presence/placement sensors triggered step to be a decision block.   |
| 3.3.2   | Added a step and a note for Wait for operator End/signal.   |
| 3.3.3   | Modified one step to match the manual unload scenario 3.3.2. Note that the Carrier Placement logic was changed and that the Carrier Placement Error alarm was removed.  |
| 3.3.3   | Deleted the RESERVATION state model logic (3 blocks) and moved the "Leave LPTSM= TRANSFER BLOCKED, process next CarrierOut" state into the equipment column after CarrierOut queued decision block.   |
| 3.3.4   | Moved the TRANSFER BLOCKED step before the CarrierOut Ack to ensure the load port's availability. The TRANSFER BLOCKED step was after the CarrierOut Ack step and the concern was that the load port had to be blocked as soon as possible. Note that state transitions for Reservation and Associateion were also combined with Transfer Blocked in R10. |
| 3.3.4   | Modified the "Begin transfer from internal buffer" step to read "Queue the CarrierOut service."   |
| 3.3.4   | Add CarrierOut.rsp note.  |
| 3.3.4   | Added an alarm error message "Alarm (Carrier Presence Error) S5F1 [E87]" next to the Carrier Presence error step.   |
| 4.1     | Removed the first bullet in the second paragraph under Criteria is incorrect. E40 PRMtrlOrder and E94 ProcessOrderMgmt are independent of one another.  |
| 4.1.1.3 | Renamed the PRJOBQueued/Pooled State name to Queued/Pooled.   |
| 4.1.1.3 | Deleted the off-page reference for Processing Flowchart 4.2 at the bottom of the page.  |
| 4.1.1.4 | Renamed the PRJOBQueued/Pooled State name to Queued/Pooled.   |
| 4.1.1.4 | Async PRJobEvent (PJSM SCT-19) was changed to PJSM SCT-18 as 19 did not exist in the standard.  |
| 4.1.1.4 | Changed the TERMINAL block to refer back to 4.1.1.3, Wait for Host - Create next Process Job state block. Off page connector (2A/5).  |
| 4.1.2.3 | Deleted the off-page reference for Processing Flowchart 4.2 at the bottom of the page.  |
| 4.1.2.3 | Revised the last note on the page to read "Note: Once a Control Job is queued, it may be acted upon by CJAbort, CJStop or CJCancel or by the CJHOQ command."  |
| 4.1.2.5 | Async PRJobEvent (PJSM SCT-19) was changed to PJSM SCT-18 as 19 did not exist in the standard.  |
| 4.2.2   | Changed the last block to a decision block, with a NO return just before itself.  |
| 4.2.3   | Deleted the event associated with Async Event, ('JobWaitingforStart'), and S6F11 [E94].   |
| 4.2.3   | Deleted off-page connectors and associate arrows from ControlJobStart error to Selected State.  |
| 4.2.3   | Added a note, which states, "There is no E94-0703 CJSM transition in place to handle this. It should go to either the Selected or Paused state."  |
| 4.2.4   | Changed sync PRJobEvent , (PJSM SCT-3), S6F11[E40] from SCT-3 to SCT-2.   |
| 4.2.4   | Deleted the arrow from Issue Process Job Setup Error [E40] to PJSM State: SETTING UP [E40].   |
| 4.2.4   | Deleted the transitionAsync PRJobAlert (Setup) S6F11 [E40] to the PJ HANDLER state. These events are no longer used.  |
| 4.2.4   | Deleted the transition from Async PRJobEvent (WaitingForMaterial) If required by Process Job S6F11 [E40] to the MATERIAL HANDLER state. These events are no longer used.  |
| 4.2.5   | Deleted the transition Async PRJobAlert (WaitingForStart) S6F11 [E40] to PJ HANDLER. This event is no longer used.  |
| 4.2.5   | Changed state transition Async PRJobEvent (PJSM SCT-5) S6F11 [E40] from SCT-5 to SCT-3.   |
| 4.2.5   | Changed state transition Async PRJobEvent (PJSM SCT-5) S6F11 [E40] from SCT-6 to SCT-5.   |

| Section | Comments   |
|---------|--|
| 4.2.5   | Would like to change flow chart to look like 4.2.3., specifically with a decision block for ManualStartSuccessful.                                   |
| 4.2.5   | Removed PRJobAlerts.   |
| 4.2.7   | Added a note to SCT-13 that states, "Note: Not withstanding related E90 SCT-13 requirement, ISMT member companies require SCT-13 for all equipment." |
| 4.2.8   | Changed from SCT-7 to SCT-6, and SCT-8 to SCT-7.   |
| 4.2.8   | Changed from PROCESSING COMPLETE to PROCESS COMPLETE.  |
| 4.2.8   | Removed PRJobAlerts.   |
| 4.2.10  | Copied the entire page from the appendix A.2-4.2.10 here since it's more representative of the current flow.   |
| 4.2.10  | Changed from SCT-15 to SCT-16, and SCT-18 to SCT-17.   |
| 5       | Removed reference to SELETE since section 5.2 has been removed.  |
| 5.1     | Minor typo changes.  |
| 5.2     | Deleted Section 5.2.   |
| A       | Deleted section A.   |
| B       | Deleted section B.   |
| C       | Deleted section C.   |
| D       | Deleted section D.   |



## 1 INTRODUCTION

International SEMATECH (ISMT) developed the following flowcharts and scenarios under the direction of its member companies. Flowcharts cover initialization, material move in, material move out, queue management, and product processing under a variety of operational criteria within a 300 mm semiconductor factory.

The intent of these flowcharts is to cover the various operational criteria that would be considered by ISMT's member companies when developing their 300 mm factories. A factory may not use the entirety of each flowchart, but rather only those portions applicable to the factory's operation.

Conversely, an equipment supplier would consider only those flowcharts, or portions thereof, that are applicable to the supplier's equipment, but still within the criteria of multiple end-user factories.

The flowcharts are presented in a cross-functional format developed in Visio 2000.

### 1.1 Applicable Documents

The following documents are applicable to the flowcharts and scenarios in this document

#### SEMI Documents

- *E5-0703 SECS-II Message Content (SECS-II)*
- *E30-0703 Generic Equipment Model (GEM)*
- *E39-0703 Object Services Standard (OSS)*
- *E40-0703 Processing Management (PJM)*
- *E84-0303 Enhanced Carrier Handoff PI/O (EPIO)*
- *E87-0703 Carrier Management Standard (CMS)*
- *E90-0703 Substrate Management Standard (STS)*
- *E94-0702 Control Job Management (CJM)*

#### Industry Documents

- *I300I and J300 CIM GJG for 300 mm Semiconductor Factories, Release Five (GJG)*
- *ISMT Technology Transfer 00053953D-XFR – SELETE/ISMT CIM Base Functionality Requirements Collaboration Phase 1*

## 2 FLOWCHARTS – INITIALIZATION

The flowcharts in this section pertain to initialization situations.

### 2.1 Initialization – Clean Initialization

#### Purpose

This is a cross-functional operational flowchart that describes the equipment's communication interface behavior from the host's and the automated material handling system's (AMHS') point of view during a clean initialization.

#### Criteria

- A *clean initialization* is defined as an initialization following a power-down or software reboot that occurred when the equipment was idle and contained no material and no jobs.
- Equipment initialization is based on the requirements of each standard and of each specific equipment.

#### Applicable Documents

This operational flowchart is based on the following industry standards and specifications:

- SEMI E30 – *Generic Equipment Model*
- SEMI E40 – *Processing Management*
- SEMI E84 – *Enhanced Carrier Handoff*
- SEMI E87 – *Carrier Management*
- SEMI E90 – *Substrate Tracking*
- SEMI E94 – *Control Job Management*

#### Assumptions

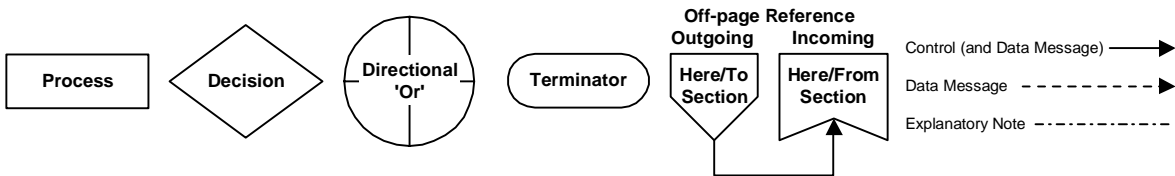
1. <none>

#### Flowchart Organization

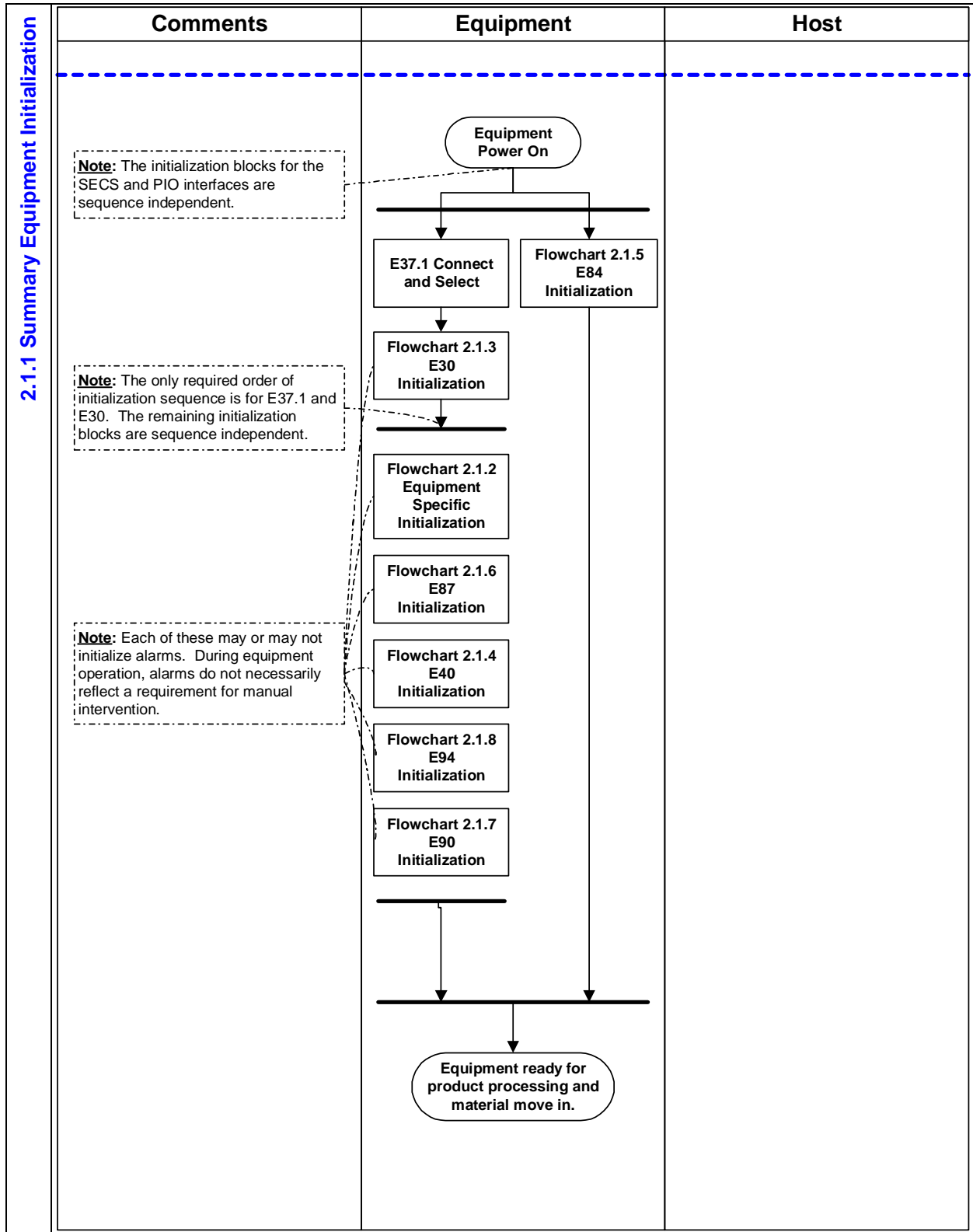
- 2.1.1 Summary Equipment Initialization
- 2.1.2 Equipment Specific Initialization
- 2.1.3 E30 Generic Equipment Model (GEM) Initialization
- 2.1.4 E40 Processing Management (PM) Initialization
- 2.1.5 E84 Enhanced Parallel (/O (EPIO) Initialization
- 2.1.6 E87 Carrier Management System (CMS) Initialization
- 2.1.7 E90 Substrate Tracking System (STS) Initialization
- 2.1.8 E94 Control Job Management (CJM) Initialization

**Legend**

|               |   |              |   |
|---------------|---|--------------|---|
| <i>AMSM</i>   | Access Mode State Model [E87]             | <i>LPTSM</i> | Load Port Transfer State Model [E87]    |
| <i>COSM</i>   | Carrier Object State Model [E87]          | <i>SCT-#</i> | State Change Transition - <transition#> |
| <i>LP</i>     | Load Port                                 | <i>SLSM</i>  | Substrate Location State Model [E90]    |
| <i>LPCASM</i> | Load Port/Carrier Asso. State Model [E87] | <i>SOSM</i>  | Substrate Object State Model [E90]      |
| <i>LPRSM</i>  | Load Port Reservation State Model [E87]   |              |   |

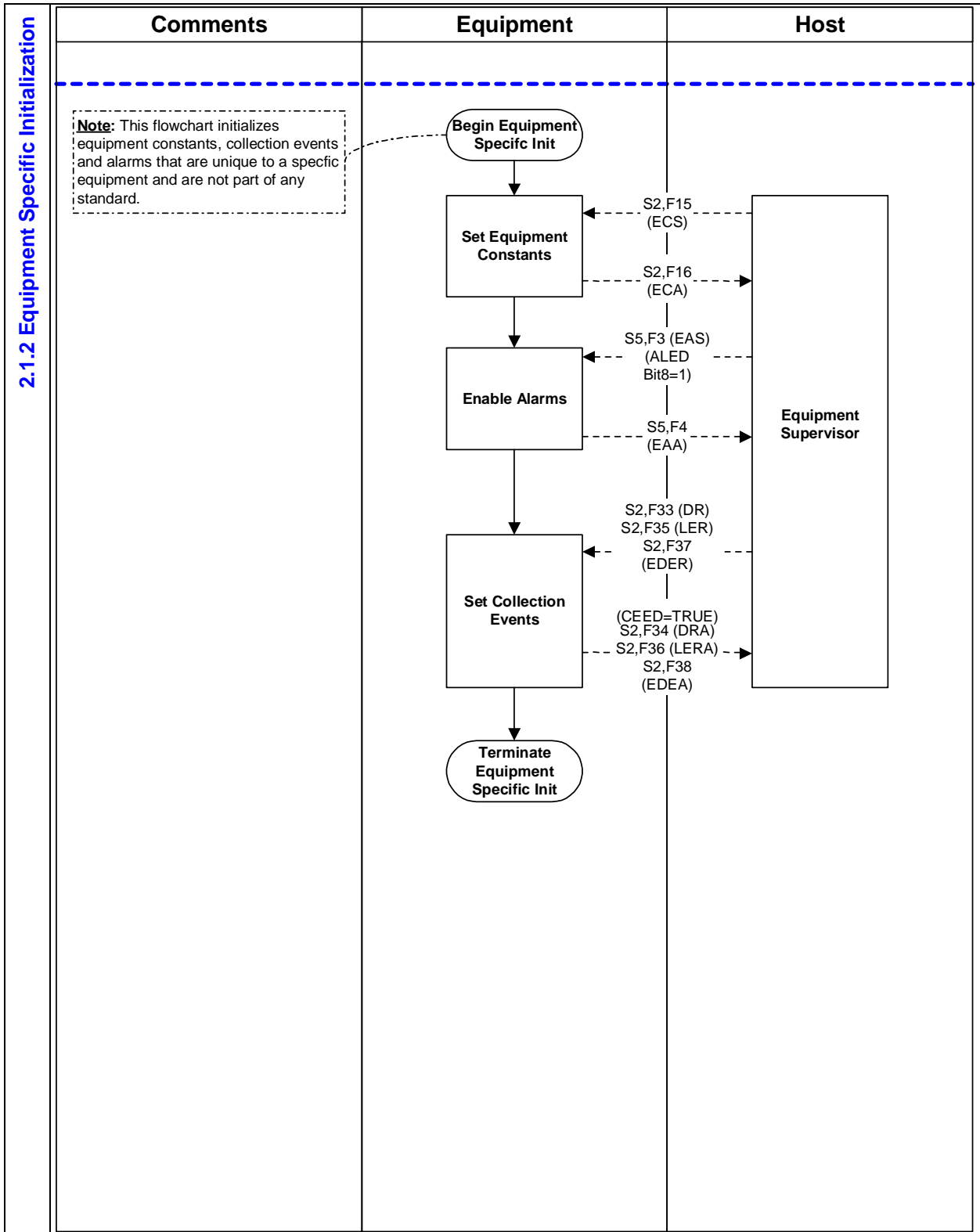


### 2.1.1 Summary Equipment Initialization

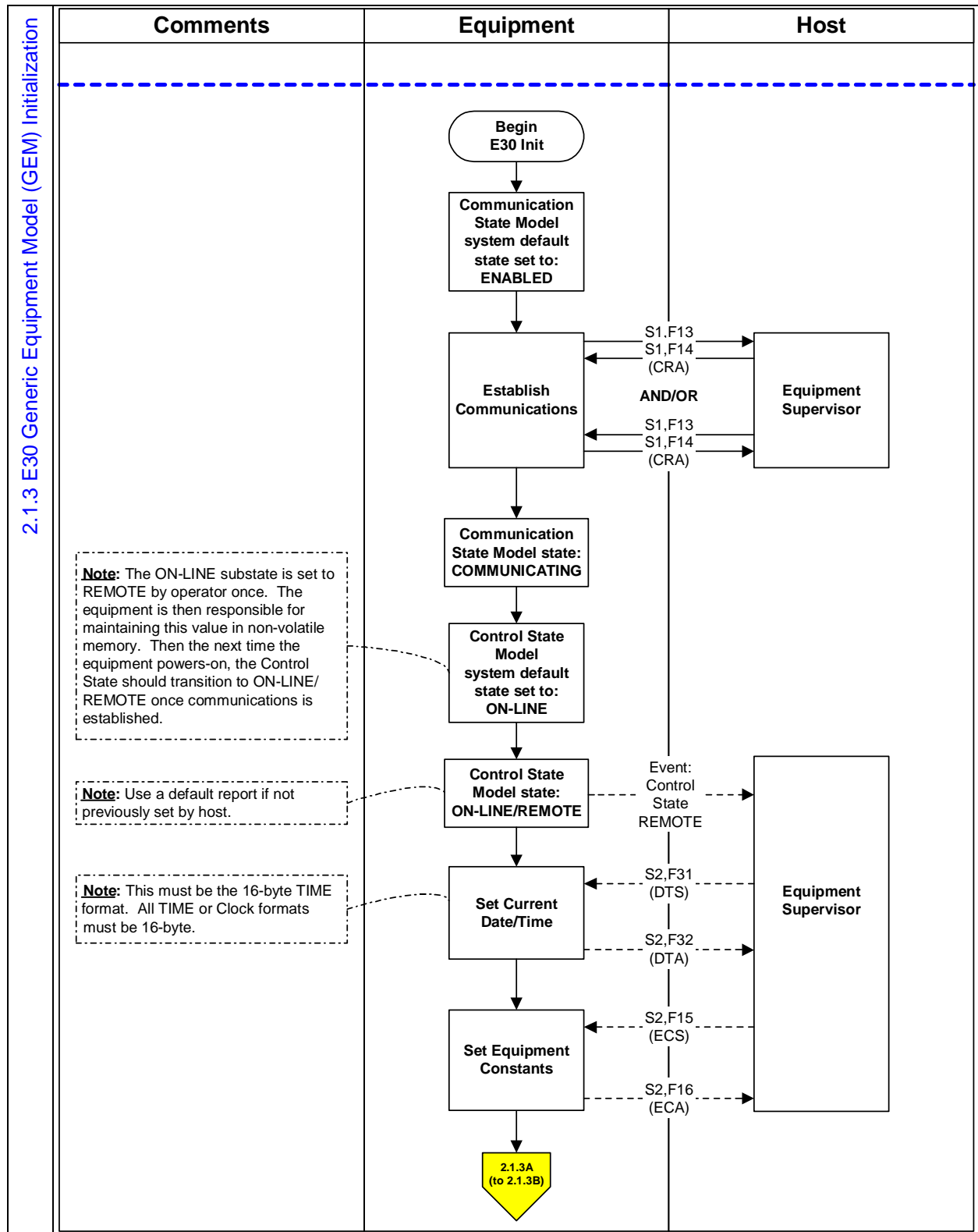




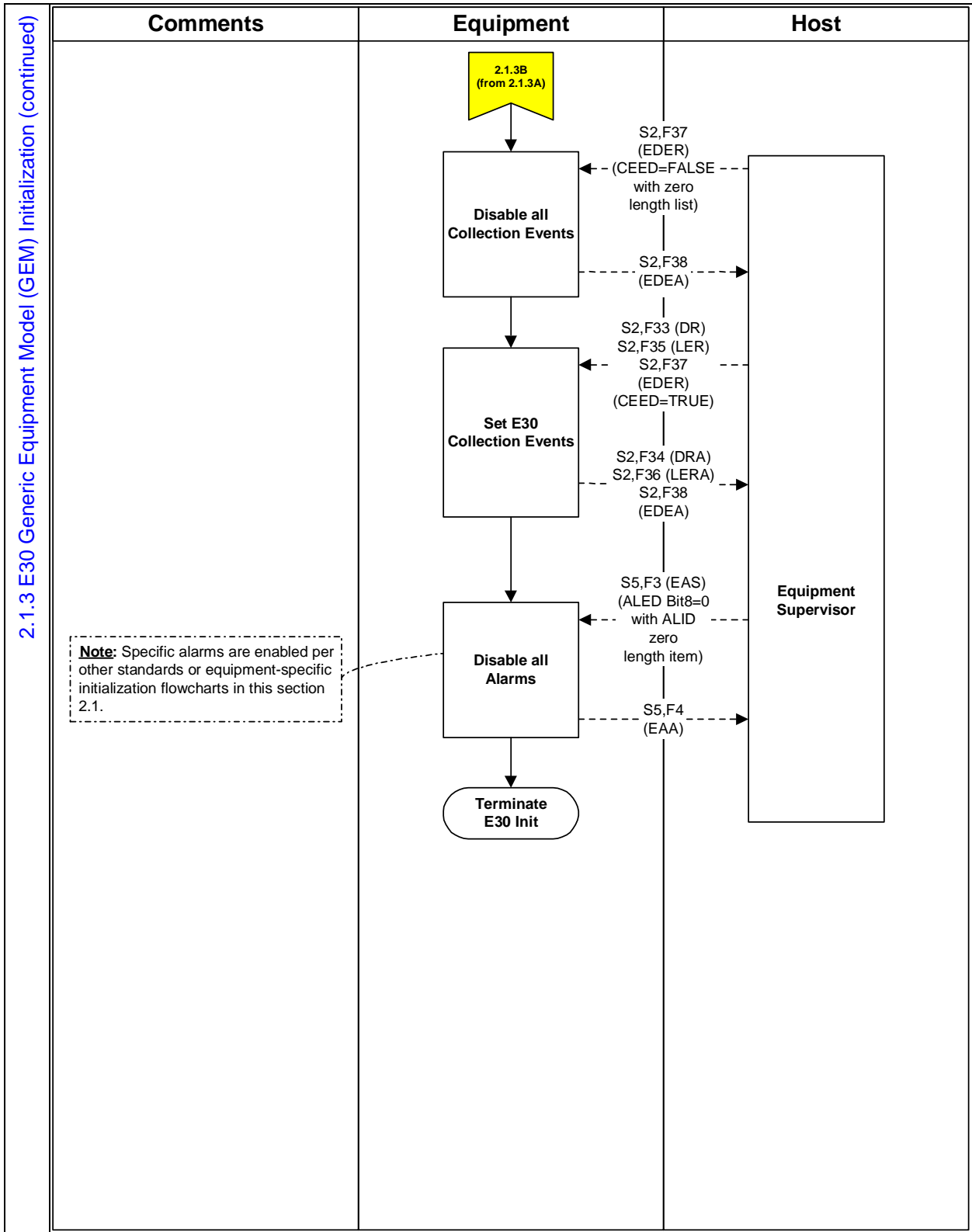
### 2.1.2 Equipment Specific Initialization



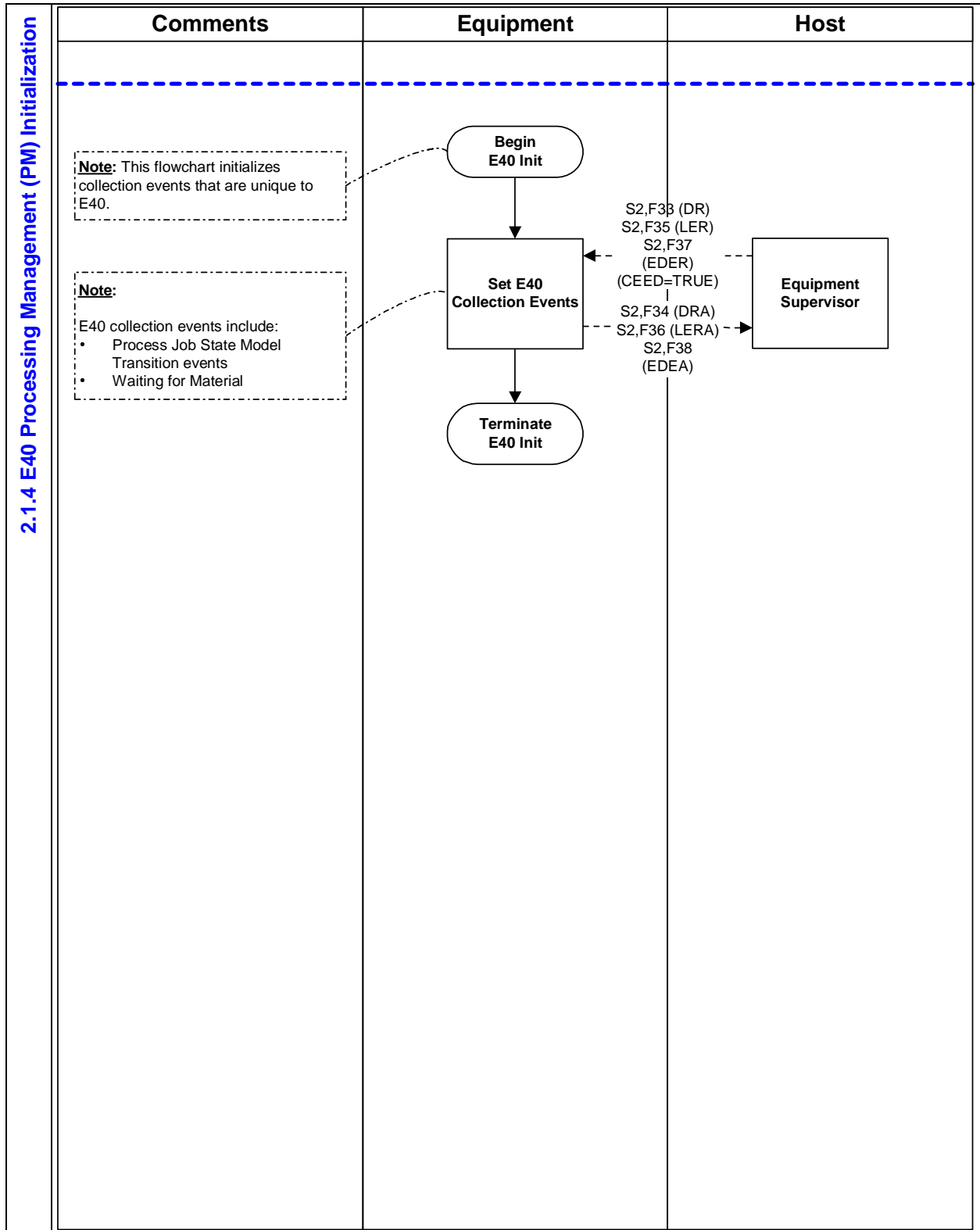
### 2.1.3 E30 Generic Equipment Model (GEM) Initialization



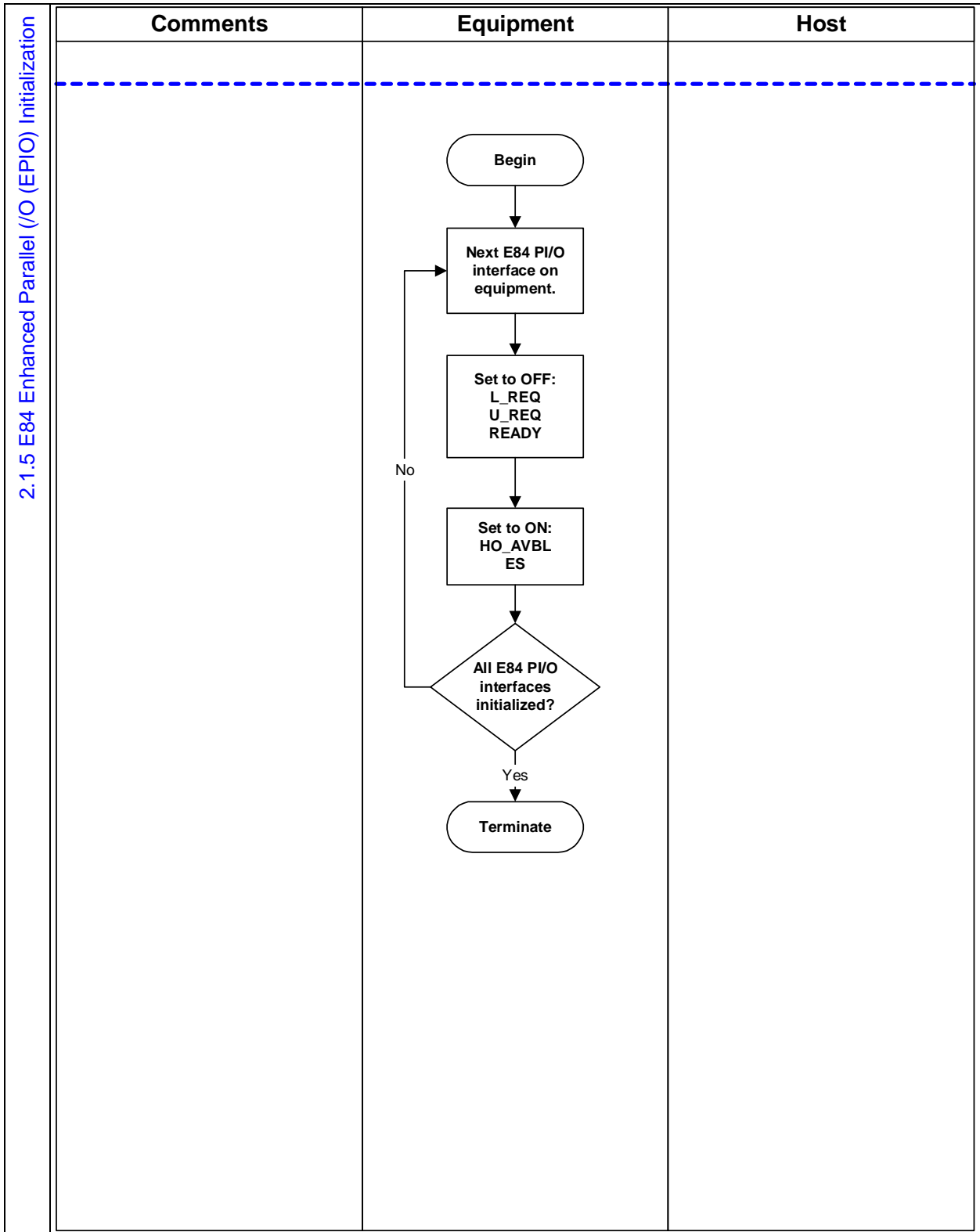
2.1.3 E30 Generic Equipment Model (GEM) Initialization (continued)



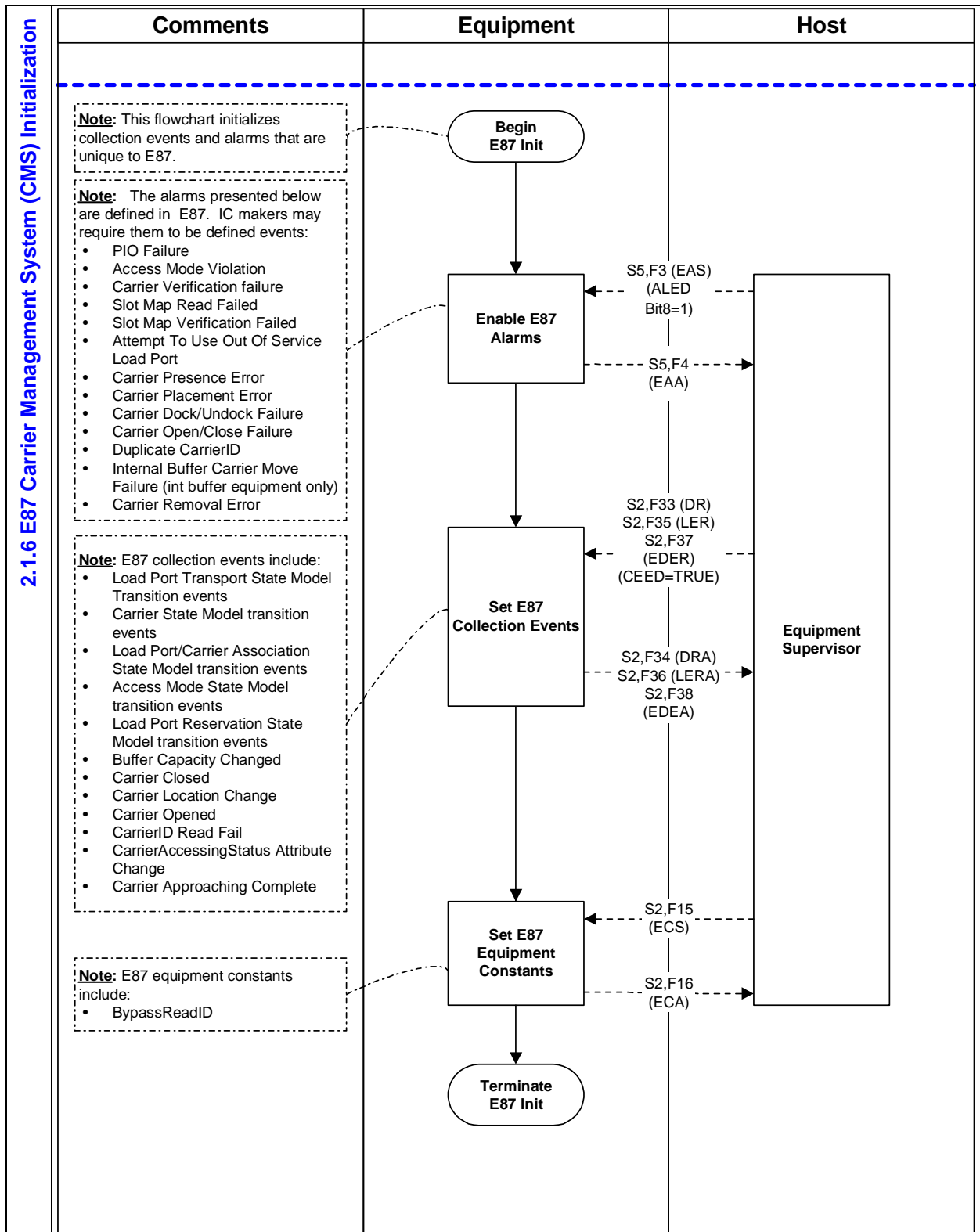
### 2.1.4 E40 Processing Management (PM) Initialization



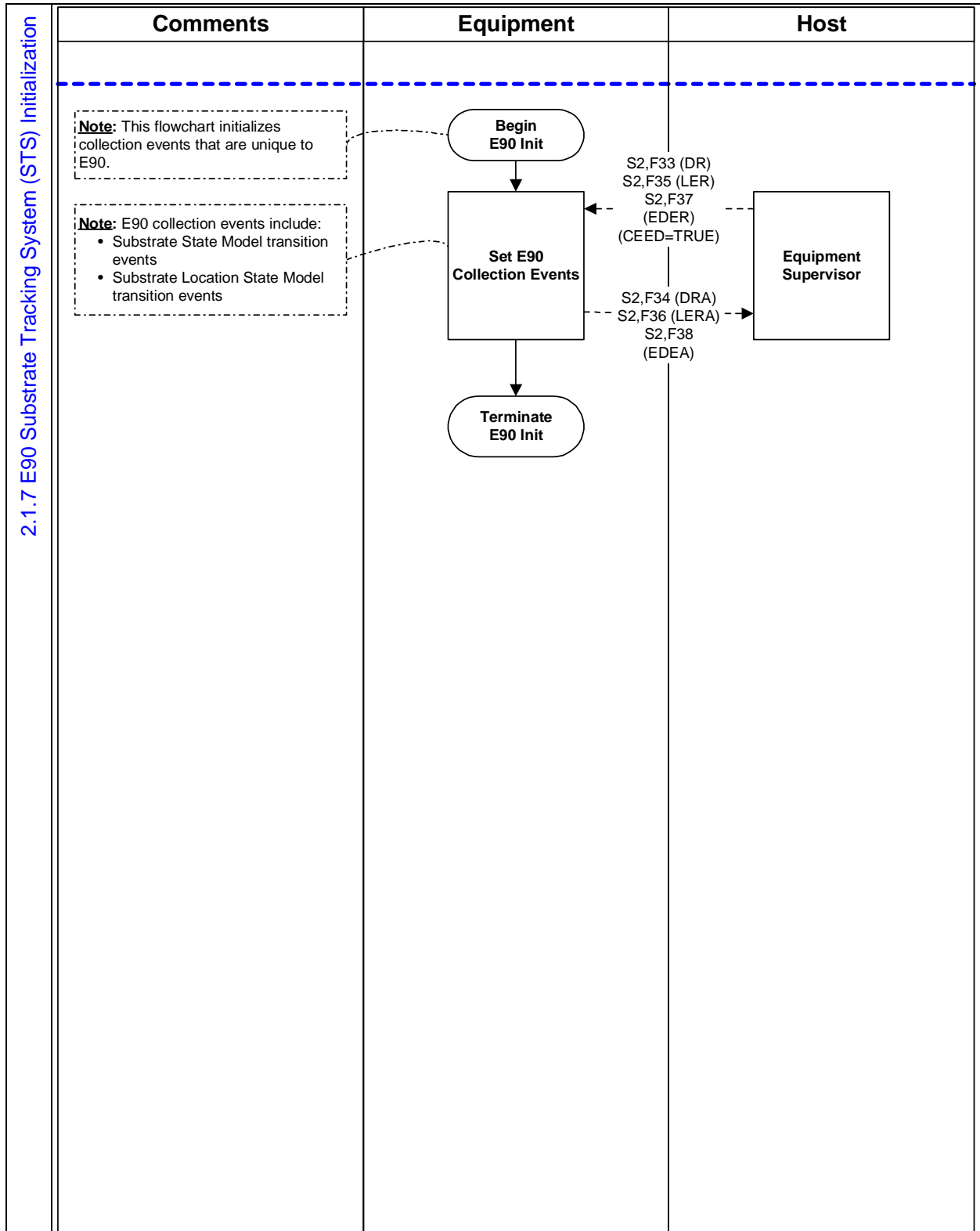
**2.1.5 E84 Enhanced Parallel (/O (EPIO) Initialization**



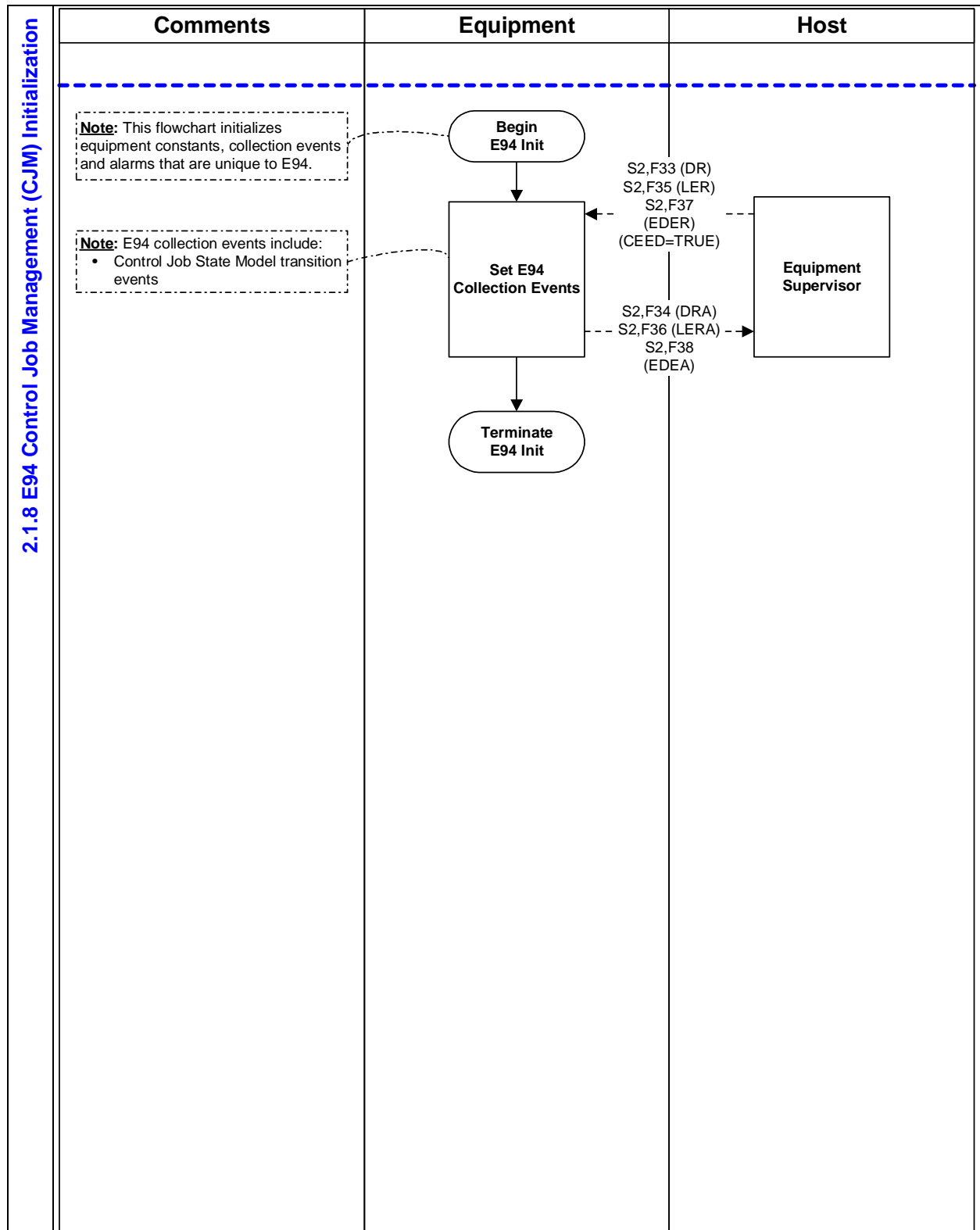
### 2.1.6 E87 Carrier Management System (CMS) Initialization



### 2.1.7 E90 Substrate Tracking System (STS) Initialization



### 2.1.8 E94 Control Job Management (CJM) Initialization





### 3 FLOWCHARTS – MATERIAL MOVEMENT

These flowcharts pertain to the movement of material to and from the equipment. This includes carriers with wafers.

#### 3.1 Material Movement – Support Services

##### Purpose

This cross-functional operational flowchart describes the equipment’s communication interface behavior from the host’s and operator’s point of view for support services such as changing the load port access mode and placing the load port in and out of service.

##### Applicable Documents

This operational scenario is based on the following industry standards and specifications:

- SEMI E39 – *Object Services*
- SEMI E84 – *Enhanced Carrier Handoff PI/O*
- SEMI E87 – *Carrier Management*

##### Assumptions

1. <none>

##### Flowchart Organization

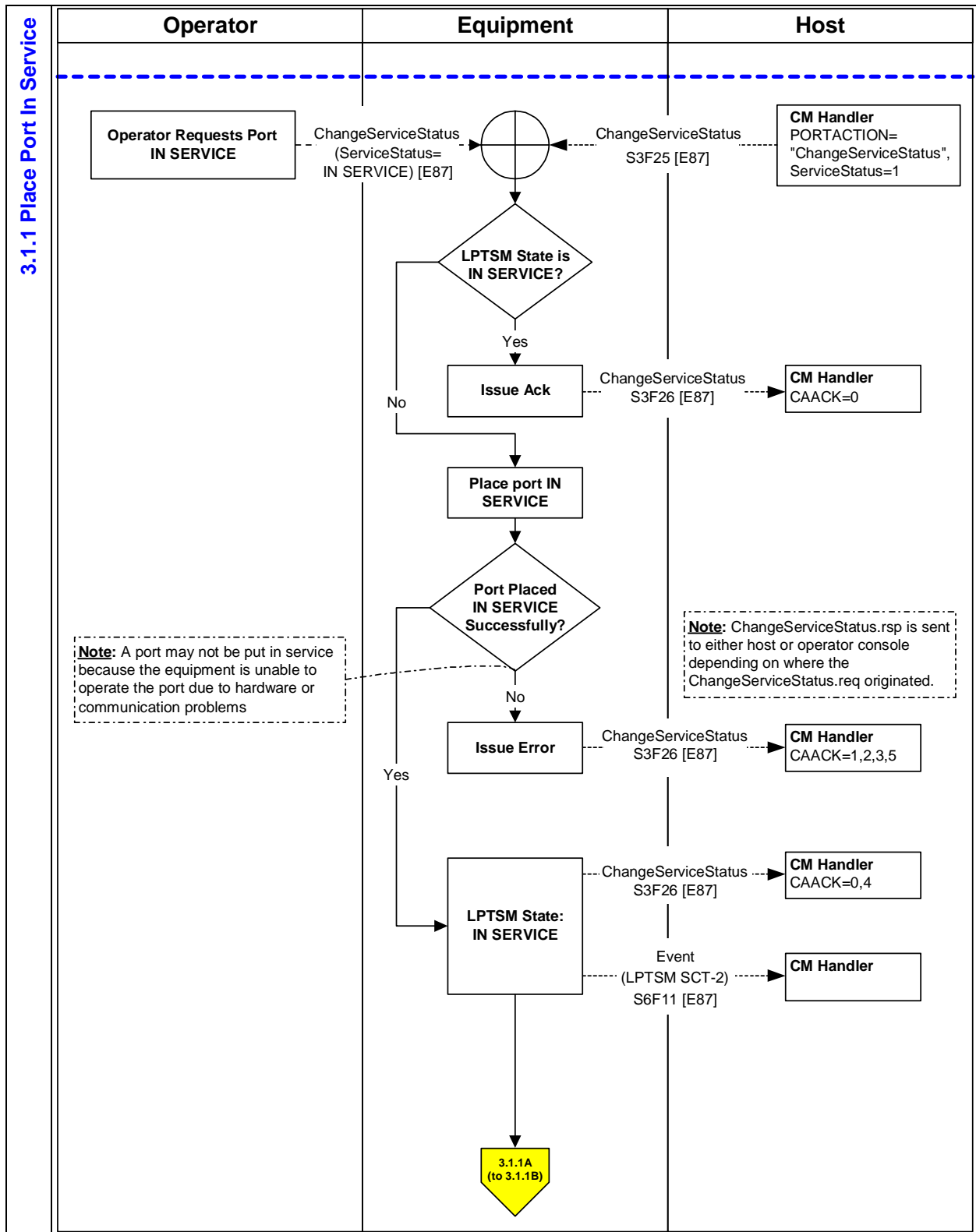
- 3.1.1 Place Port In Service
- 3.1.2 Place Port Out of Service
- 3.1.3 Access Mode Change – AUTO
- 3.1.4 Access Mode Change – MANUAL

##### Legend

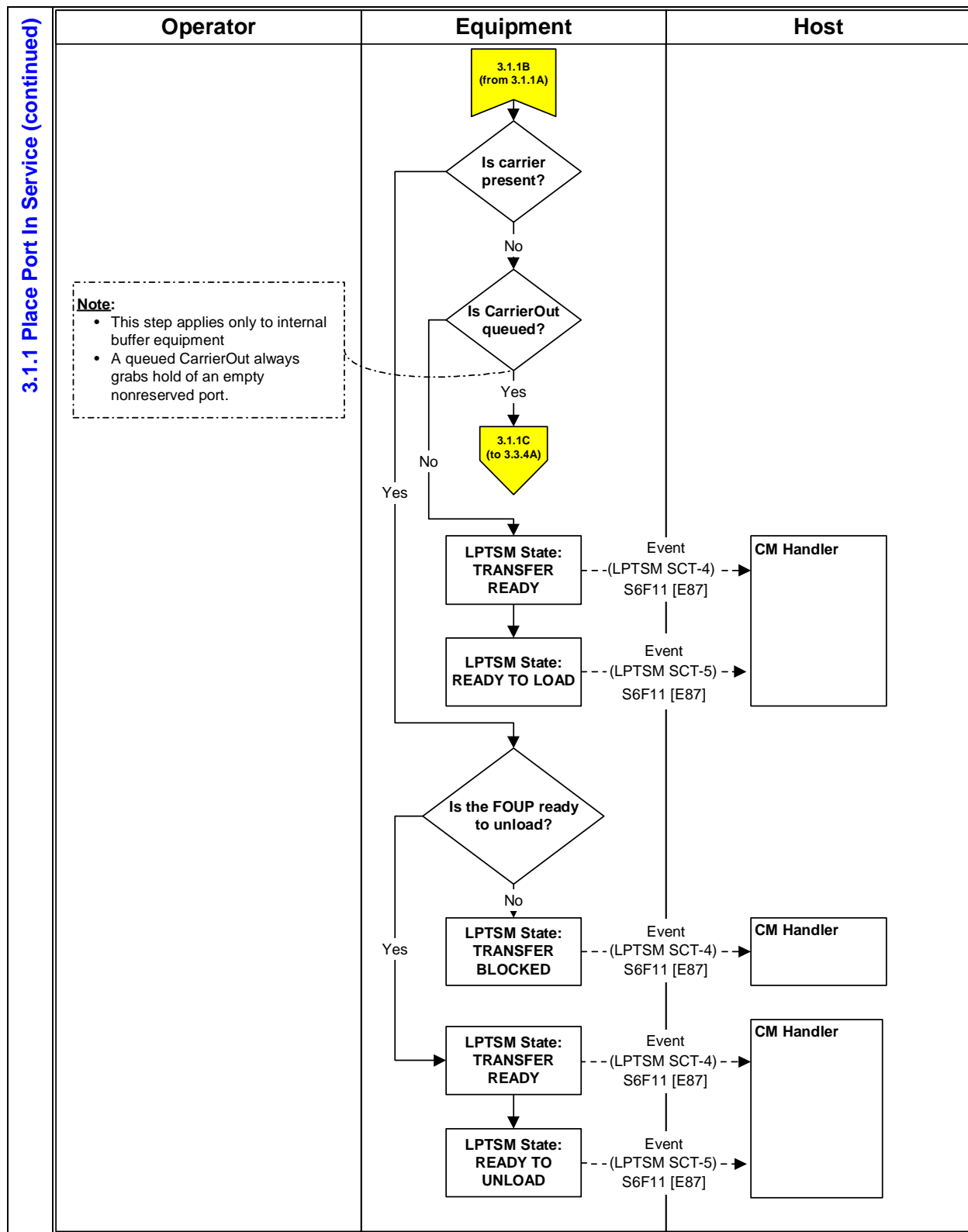
|               |   |              |   |
|---------------|---|--------------|---|
| <b>AMSM</b>   | Access Mode State Model [E87]             | <b>LPTSM</b> | Load Port Transfer State Model [E87]    |
| <b>COSM</b>   | Carrier Object State Model [E87]          | <b>SCT-#</b> | State Change Transition - <transition#> |
| <b>LP</b>     | Load Port                                 | <b>SLSM</b>  | Substrate Location State Model [E90]    |
| <b>LPCASM</b> | Load Port/Carrier Asso. State Model [E87] | <b>SOSM</b>  | Substrate Object State Model [E90]      |
| <b>LPRSM</b>  | Load Port Reservation State Model [E87]   |              |   |



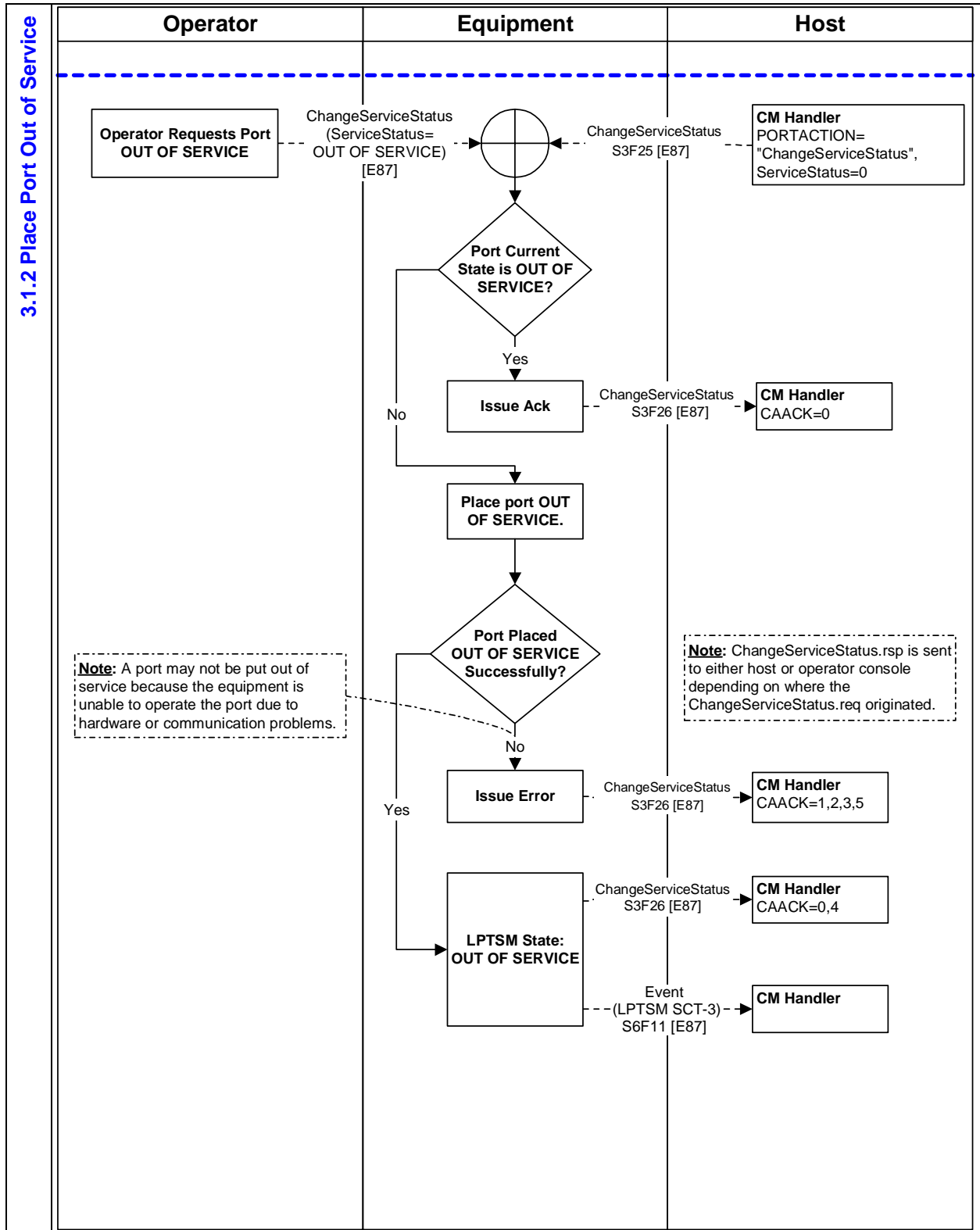
### 3.1.1 Place Port In Service



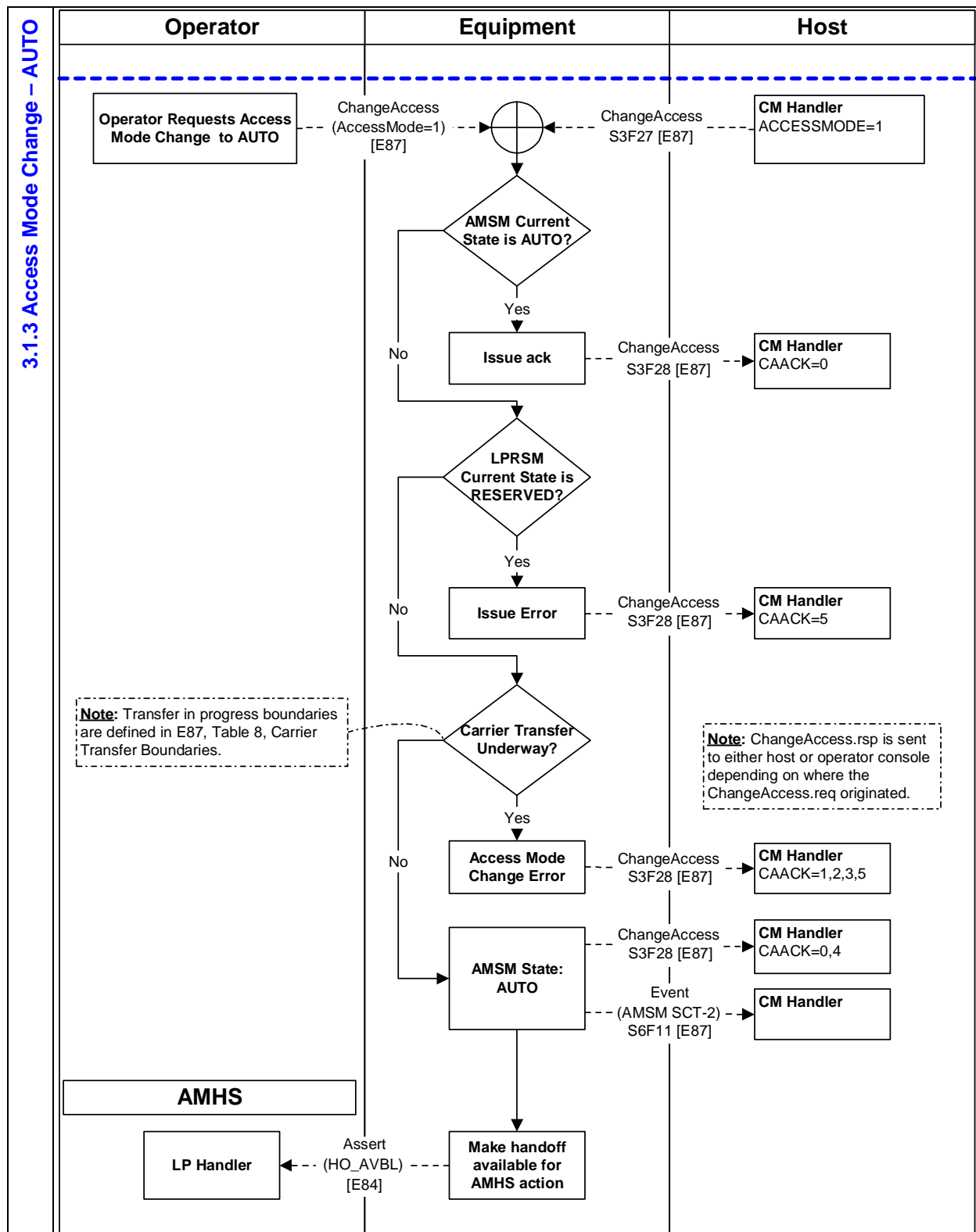
### 3.1.1 Place Port In Service (continued)



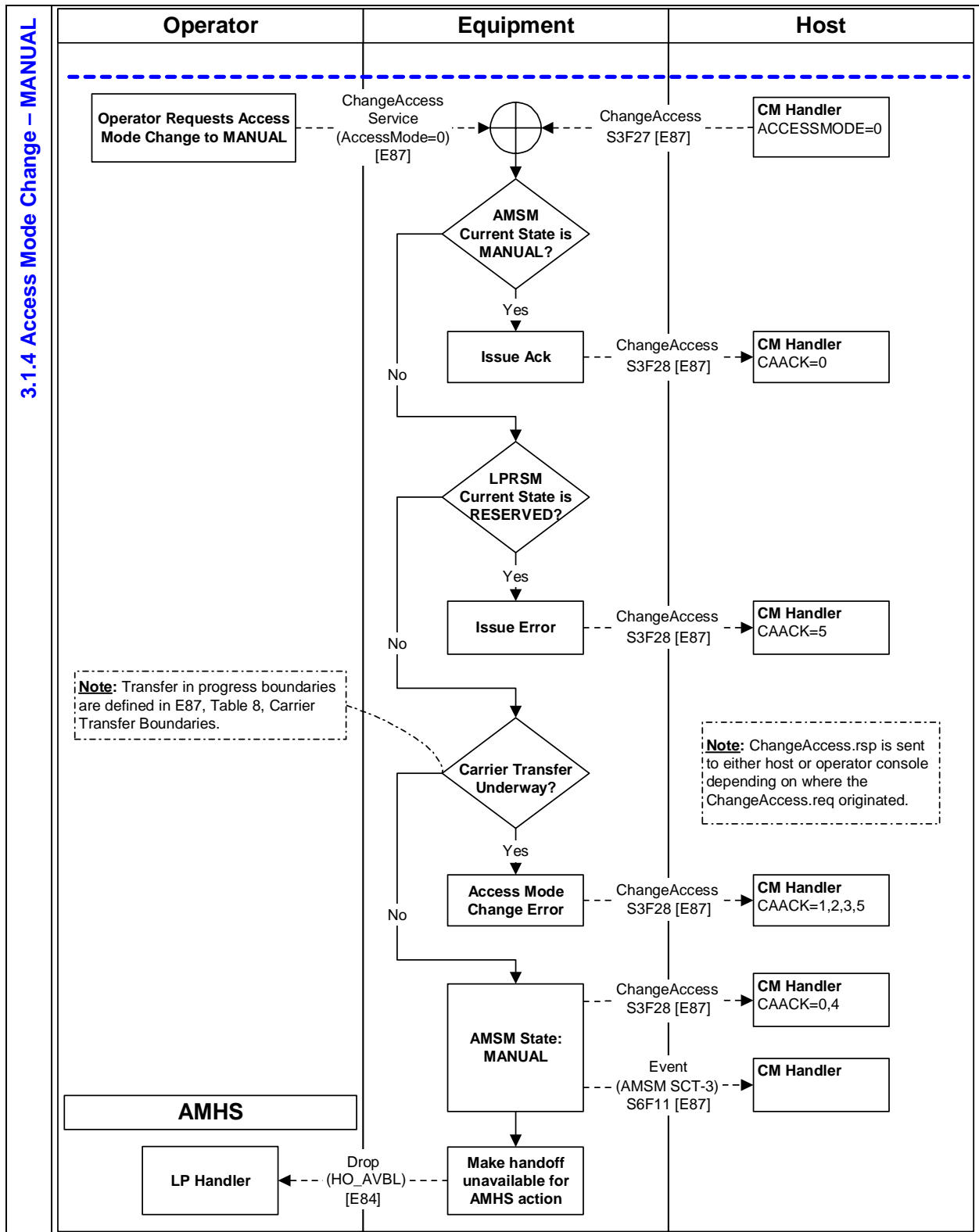
### 3.1.2 Place Port Out of Service



### 3.1.3 Access Mode Change – AUTO



### 3.1.4 Access Mode Change – MANUAL



## 3.2 Material Movement – Move In

### Purpose

This cross-functional operational flowchart describes the equipment's communication interface behavior from the host's and AMHS' point of view and within the following criteria during carrier move in:

- Delivery method (*automatic/manual*)
- Verification method (*host/equipment/none*)
- Buffer type (*fixed/internal*)

### Applicable Documents

This operational flowchart is based on the following industry standards and specifications:

- SEMI E39 – *Object Services*
- SEMI E84 – *Enhanced Carrier Handoff PI/O*
- SEMI E87 – *Carrier Management*
- SEMI E90 – *Substrate Management*

### Assumptions

1. <none>

### Flowchart Organization

#### 3.2.1 Material Movement – Move In – Assignment

- 3.2.1.1 Bind
- 3.2.1.2 Carrier Notification
- 3.2.1.3 Reserve At Port
- 3.2.1.4 Cancel Bind
- 3.2.1.5 Cancel Carrier Notification
- 3.2.1.6 Cancel Reservation At Port

#### 3.2.2 Material Movement – Move In – Carrier Placement

- 3.2.2.1 Manual Load – Single Handoff
- 3.2.2.2 Automated Load – Single Handoff
- 3.2.2.3 Internal Buffer – CarrierIn Load After CarrierOut

#### 3.2.3 Material Movement – Move In – Verification

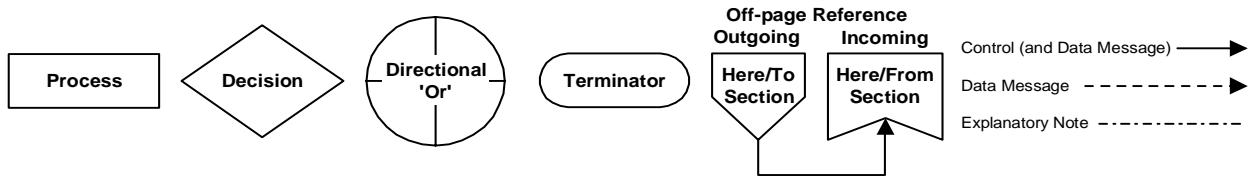
- 3.2.3.1 Carrier ID Verification – Summary
- 3.2.3.2 Carrier ID Verification – Detailed
- 3.2.3.3 Equipment Based ID Verification
- 3.2.3.4 Host-Based ID Verification
- 3.2.3.5 Carrier ID Read Failed
- 3.2.3.6 Carrier ID Reader Unavailable
- 3.2.3.7 Slot Map Verification

3.2.4 Material Movement – Move In – Substrates

3.2.4.1 Carrier Delivered Substrates

**Legend**

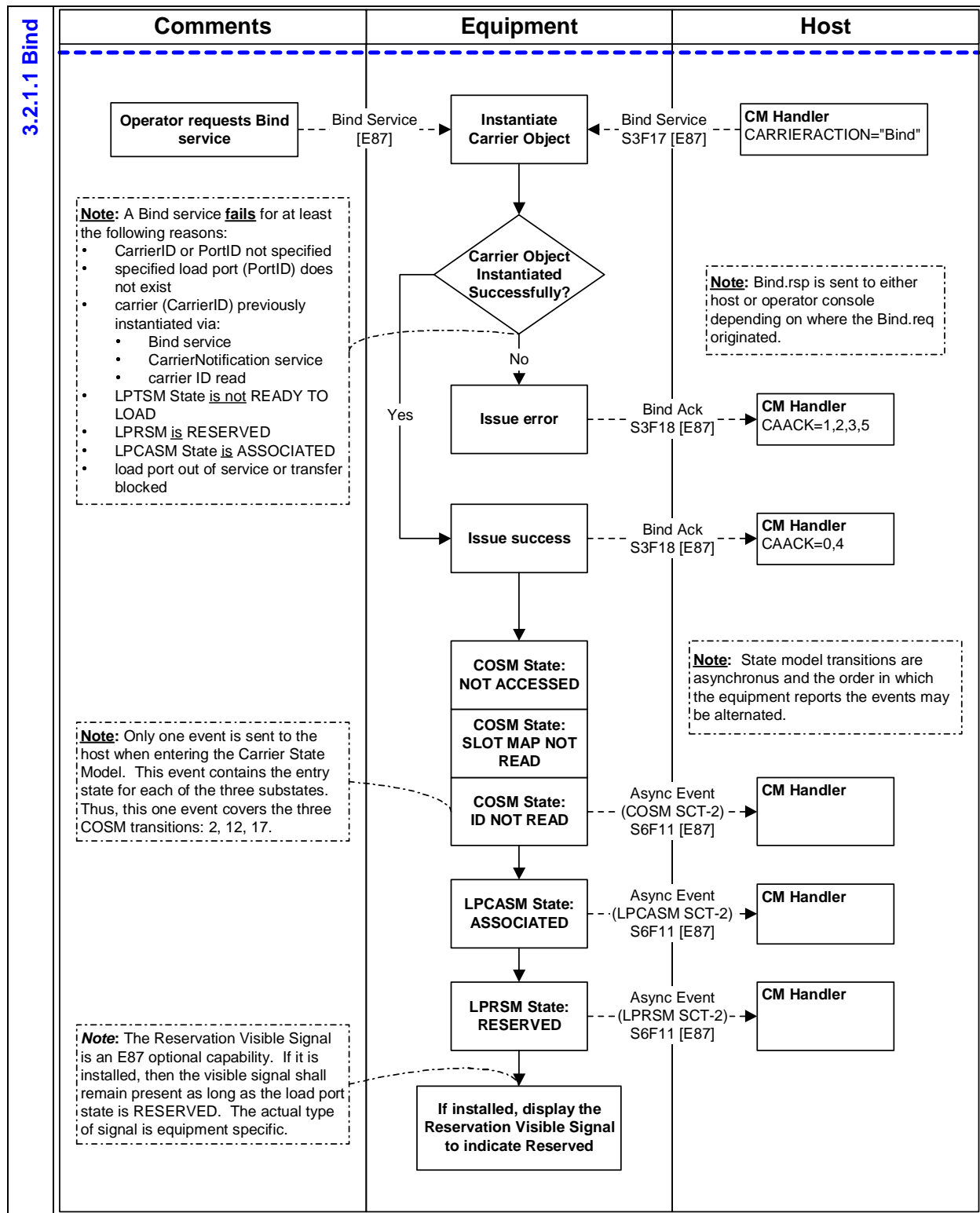
|               |  |              |  |
|---------------|--|--------------|--|
| <b>AMSM</b>   | <b>Access Mode State Model [E87]</b>             | <b>LPTSM</b> | <b>Load Port Transfer State Model [E87]</b>          |
| <b>COSM</b>   | <b>Carrier Object State Model [E87]</b>          | <b>SCT-#</b> | <b>State Change Transition - &lt;transition#&gt;</b> |
| <b>LP</b>     | <b>Load Port</b>                                 | <b>SLSM</b>  | <b>Substrate Location State Model [E90]</b>          |
| <b>LPCASM</b> | <b>Load Port/Carrier Asso. State Model [E87]</b> | <b>SOSM</b>  | <b>Substrate Object State Model [E90]</b>            |
| <b>LPRSM</b>  | <b>Load Port Reservation State Model [E87]</b>   |              |  |





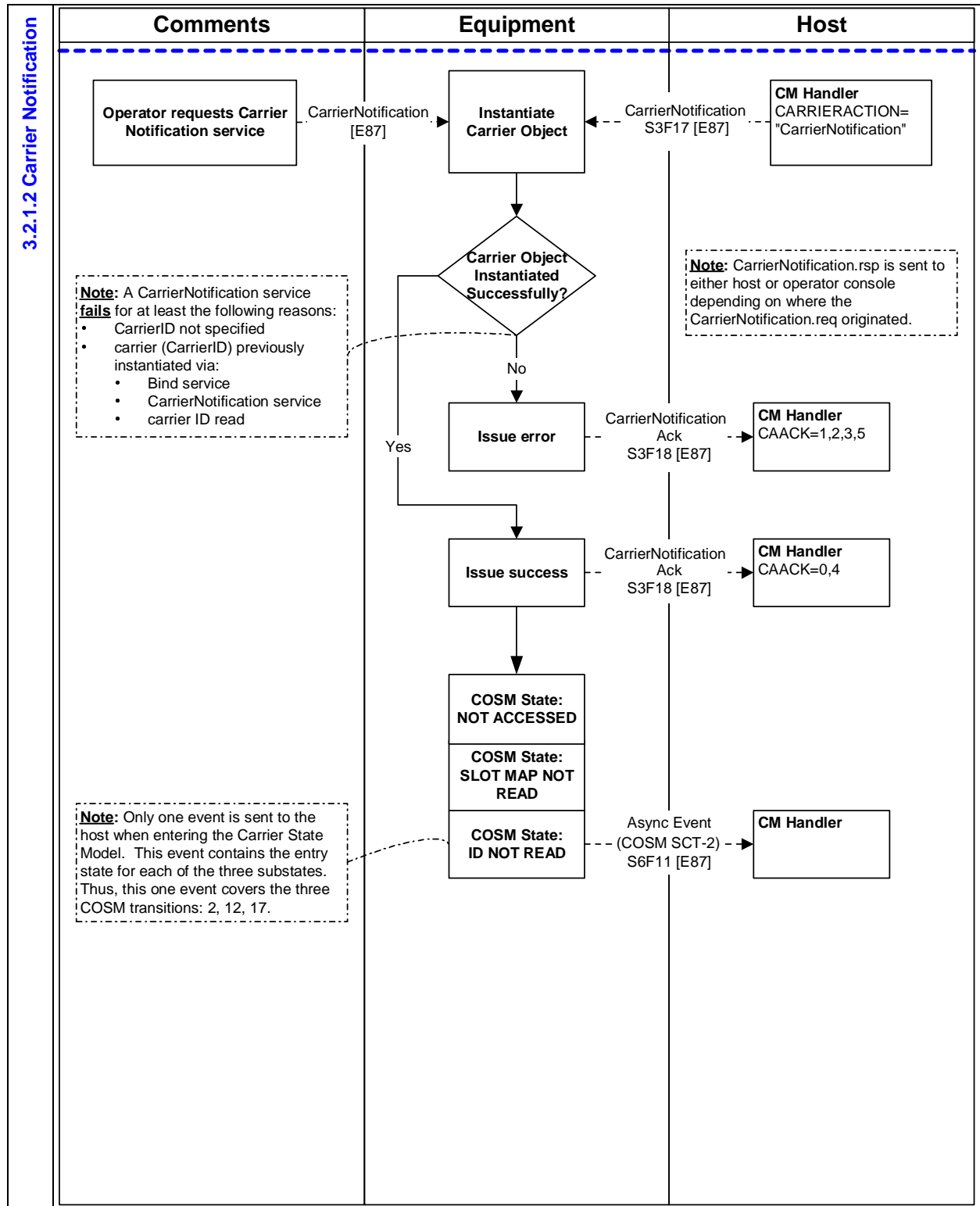
### 3.2.1 Material Movement – Move In – Assignment

#### 3.2.1.1 Bind



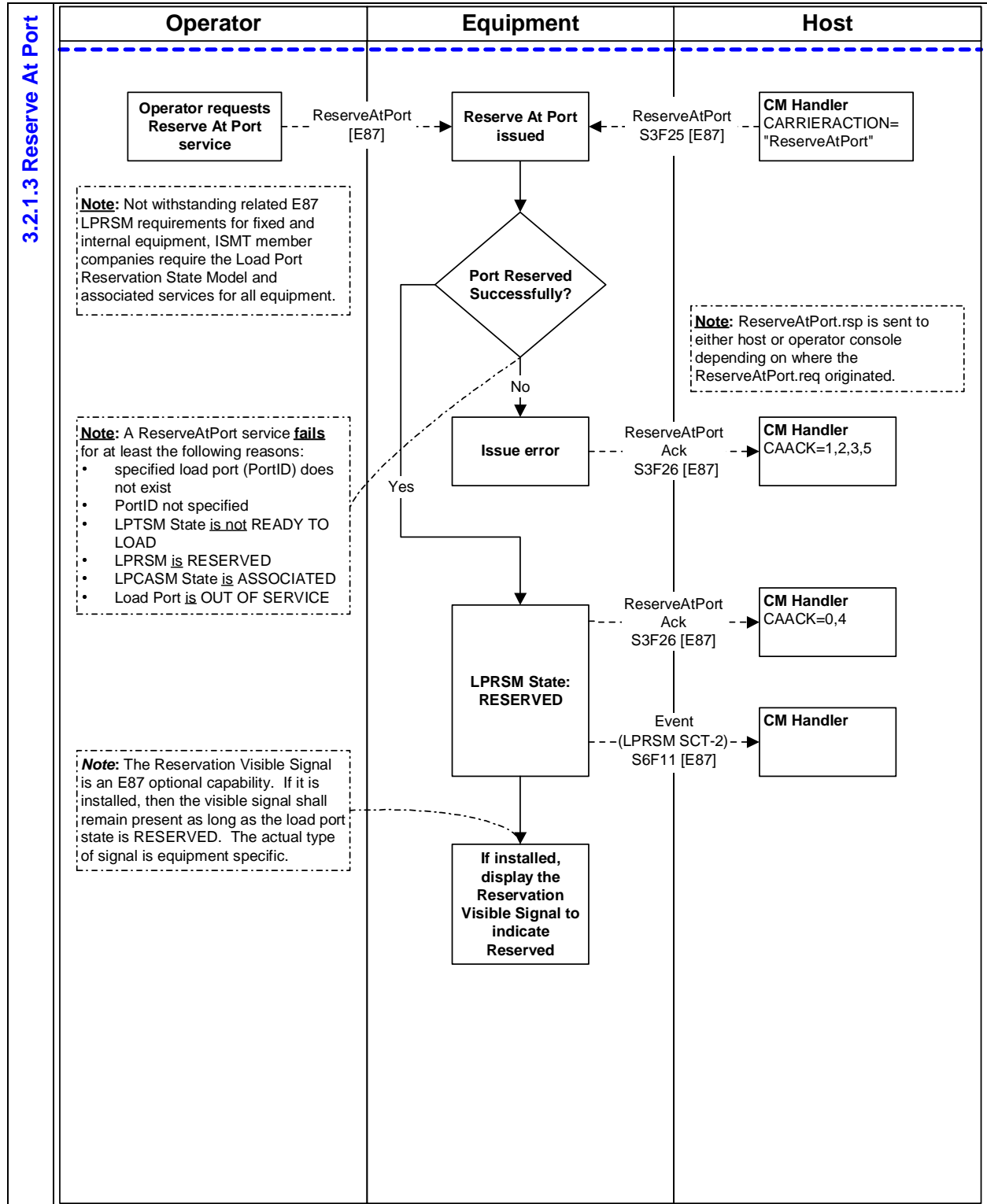
### 3.2.1 Material Movement – Move In – Assignment

#### 3.2.1.2 Carrier Notification



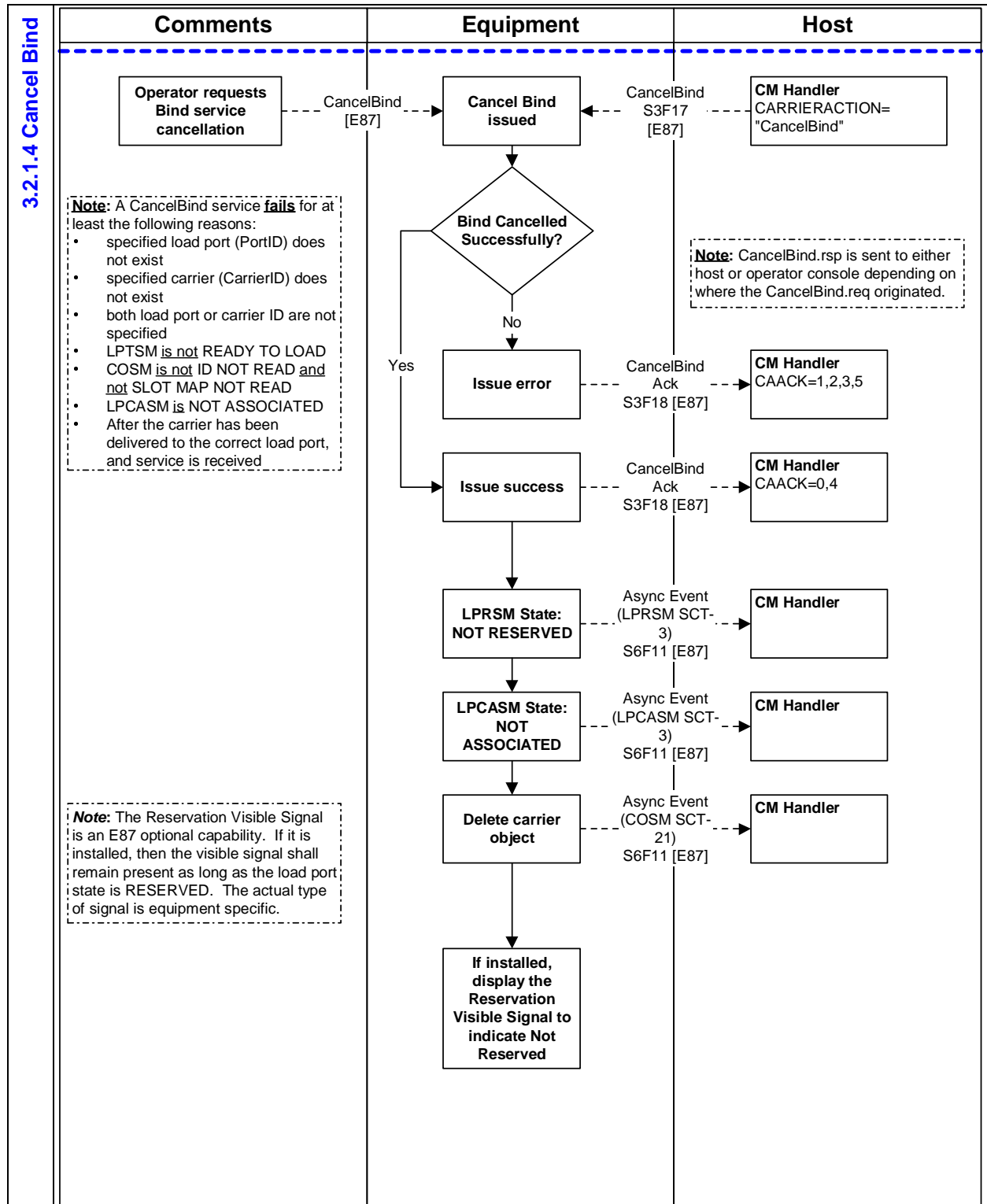
### 3.2.1 Material Movement – Move In – Assignment

#### 3.2.1.3 Reserve At Port



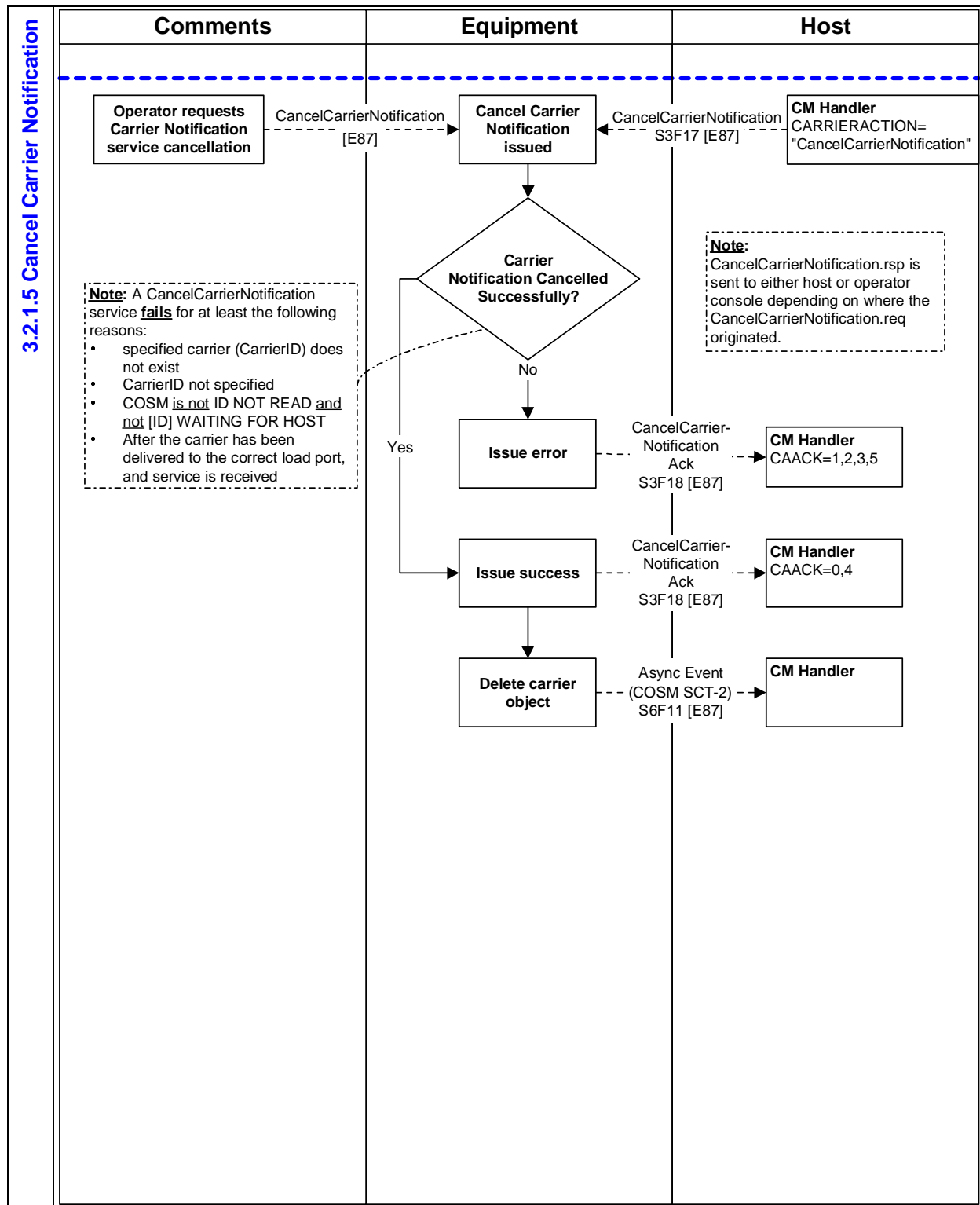
### 3.2.1 Material Movement – Move In – Assignment

#### 3.2.1.4 Cancel Bind



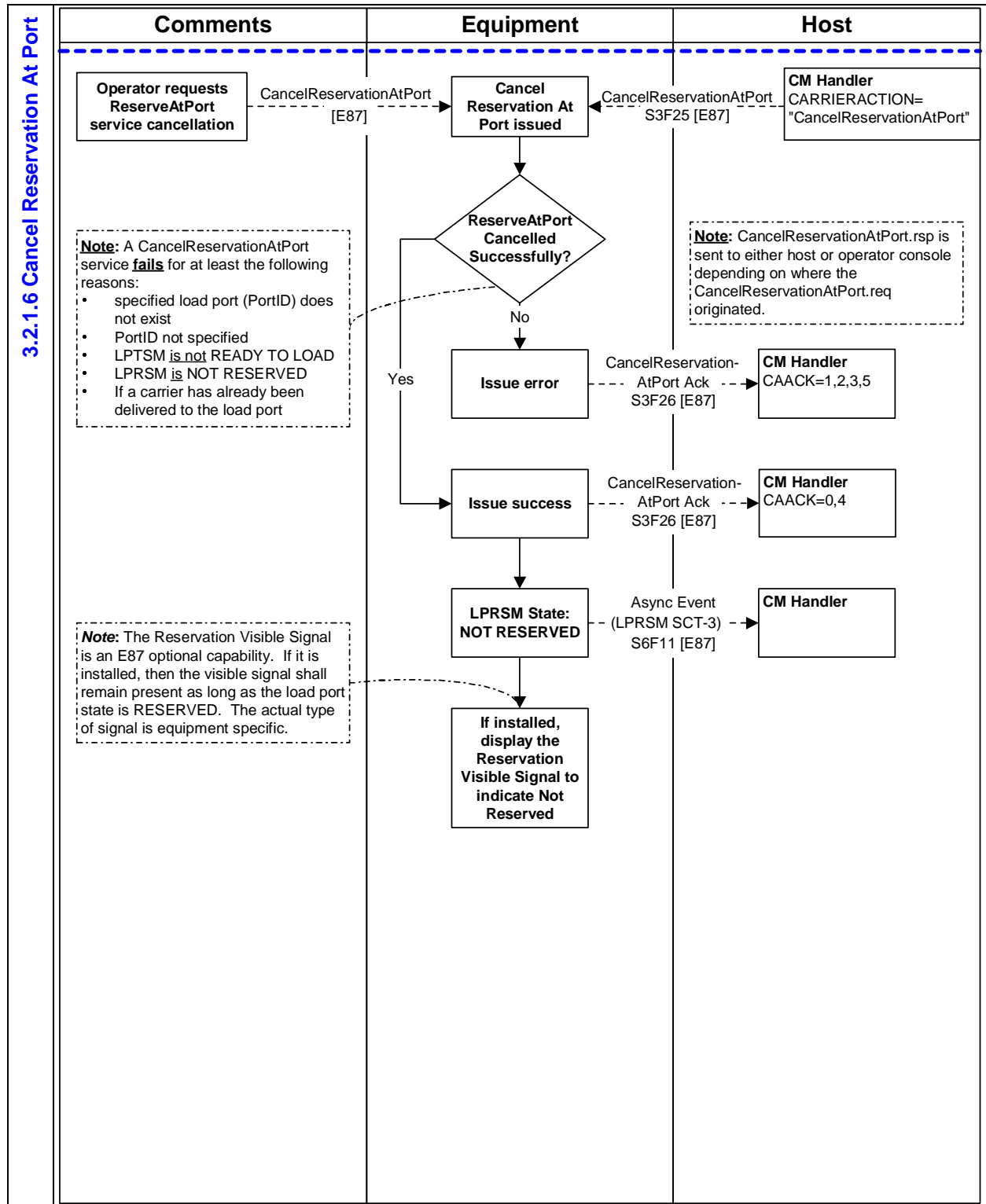
### 3.2.1 Material Movement – Move In – Assignment

#### 3.2.1.5 Cancel Carrier Notification



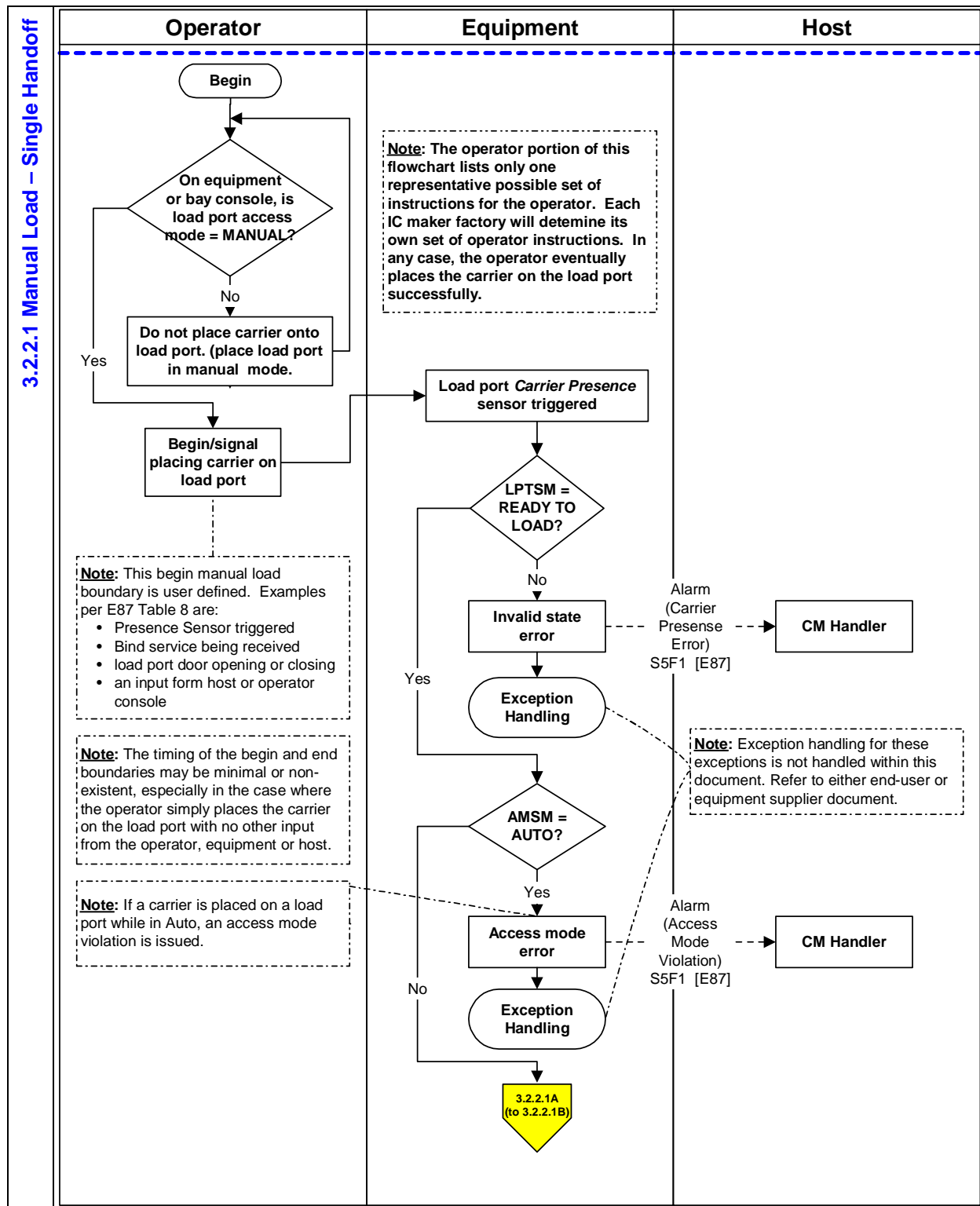
### 3.2.1 Material Movement – Move In – Assignment

#### 3.2.1.6 Cancel Reservation At Port



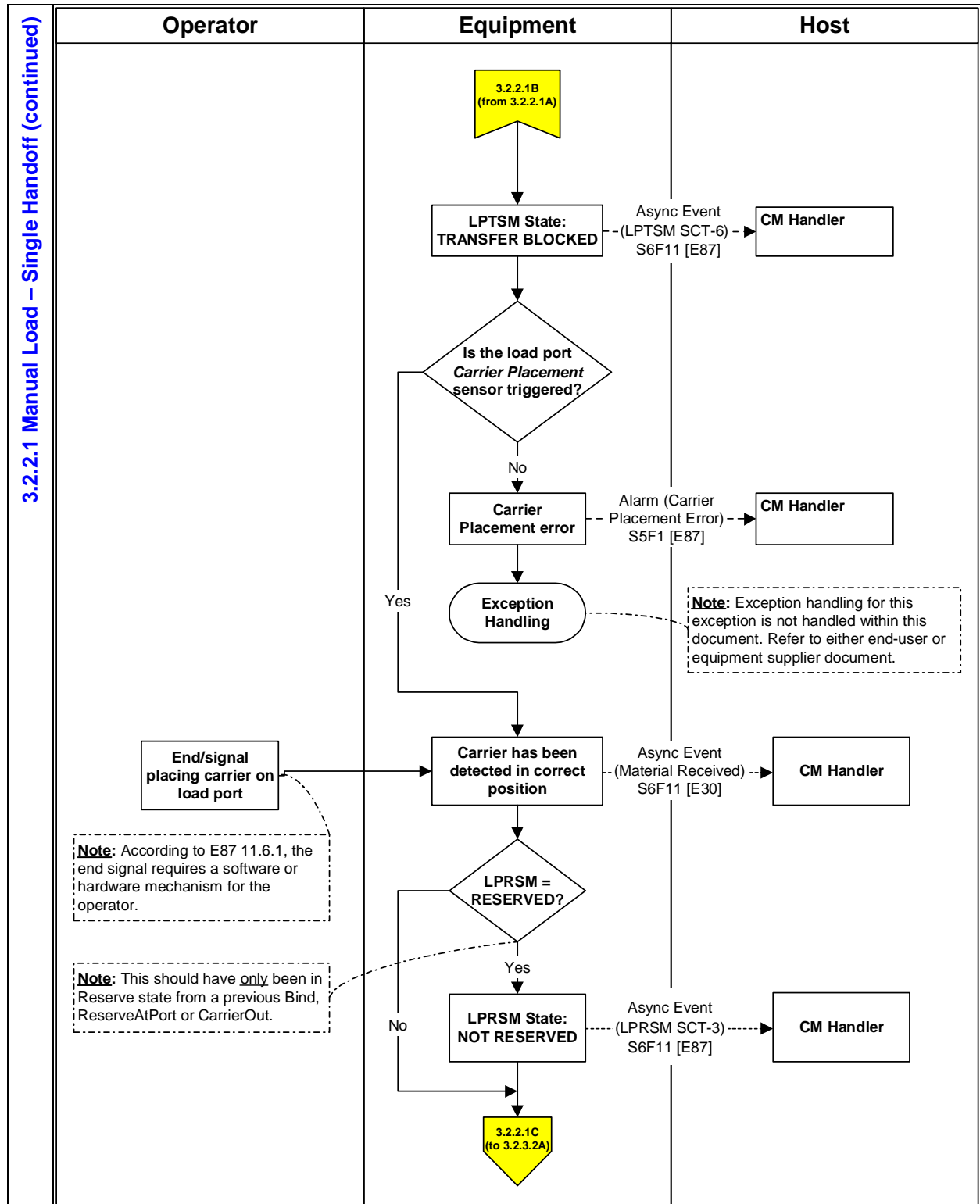
### 3.2.2 Material Movement – Move In – Carrier Placement

#### 3.2.2.1 Manual Load – Single Handoff



### 3.2.2 Material Movement – Move In – Carrier Placement

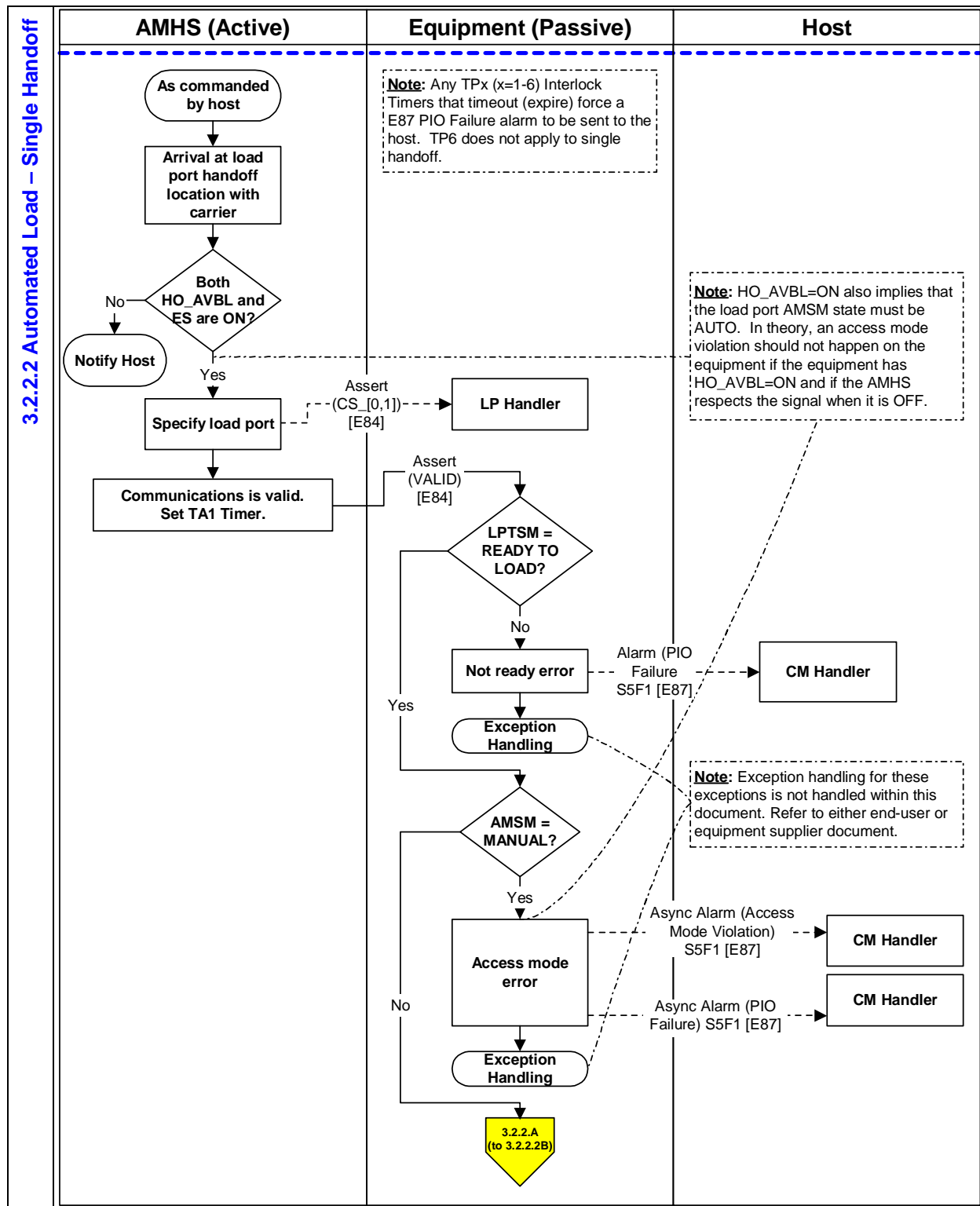
#### 3.2.2.1 Manual Load – Single Handoff (continued)





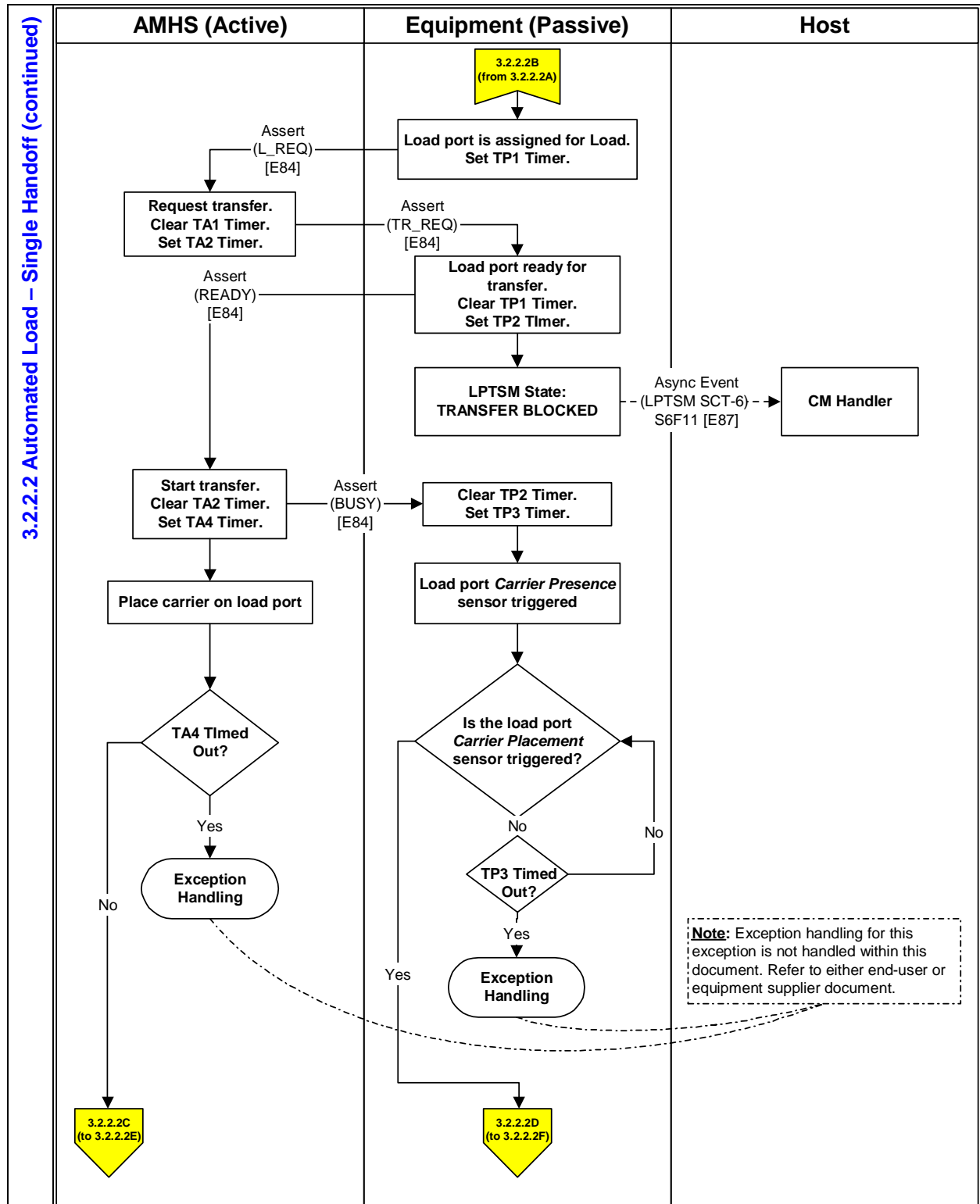
### 3.2.2 Material Movement – Move In – Carrier Placement

#### 3.2.2.2 Automated Load – Single Handoff



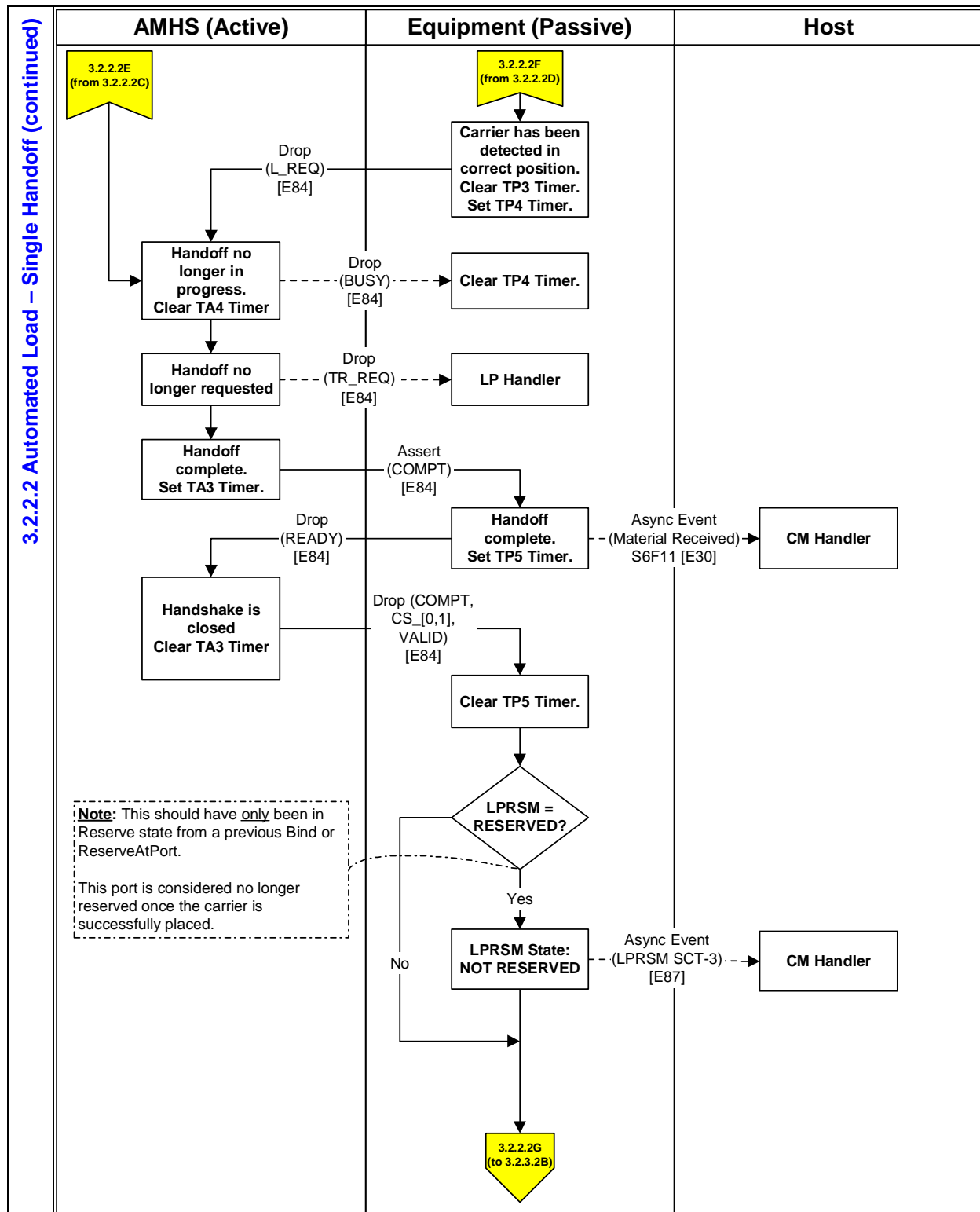
3.2.2 Material Movement – Move In – Carrier Placement

3.2.2.2 Automated Load – Single Handoff (continued)



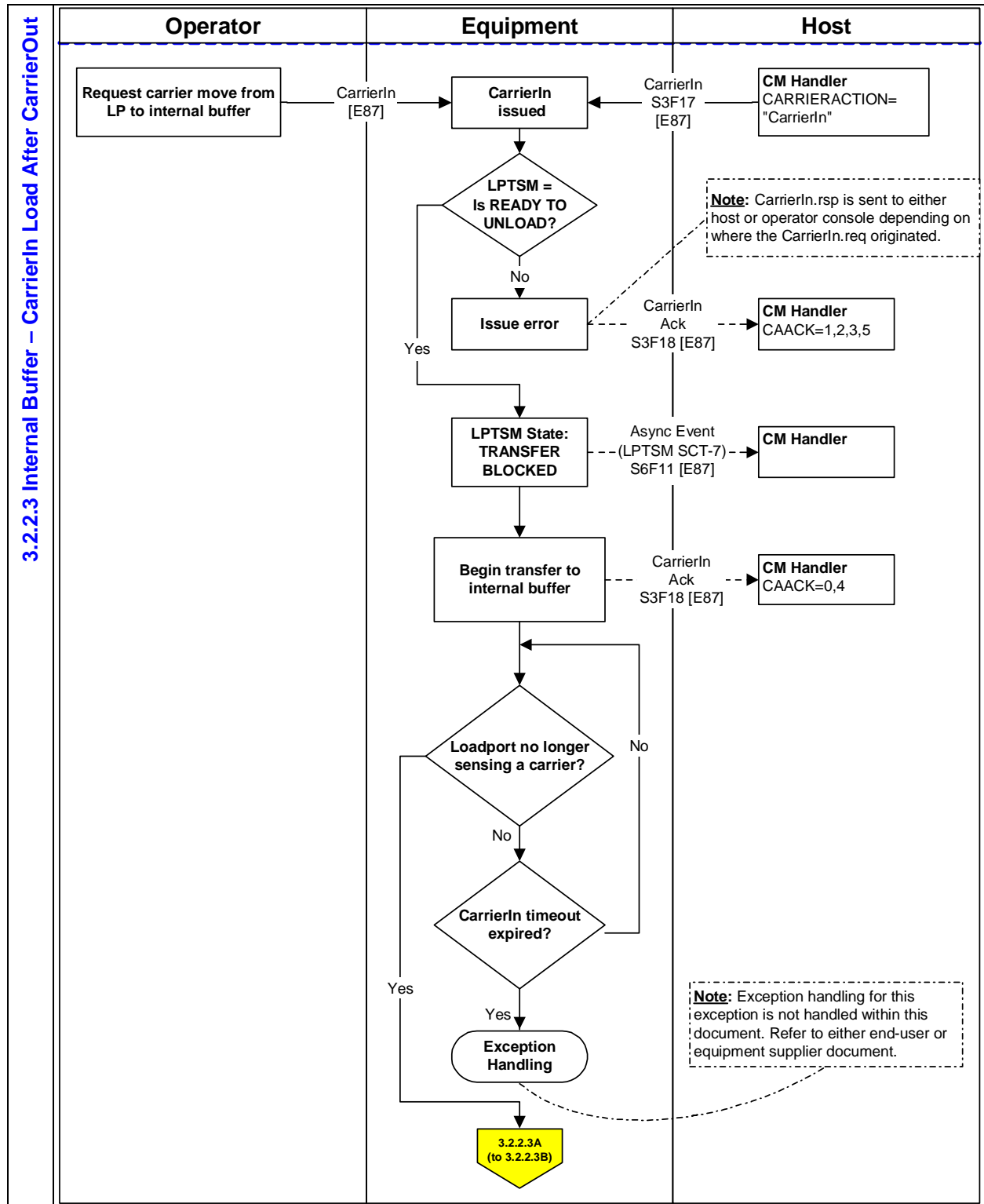
### 3.2.2 Material Movement – Move In – Carrier Placement

#### 3.2.2.2 Automated Load – Single Handoff (continued)



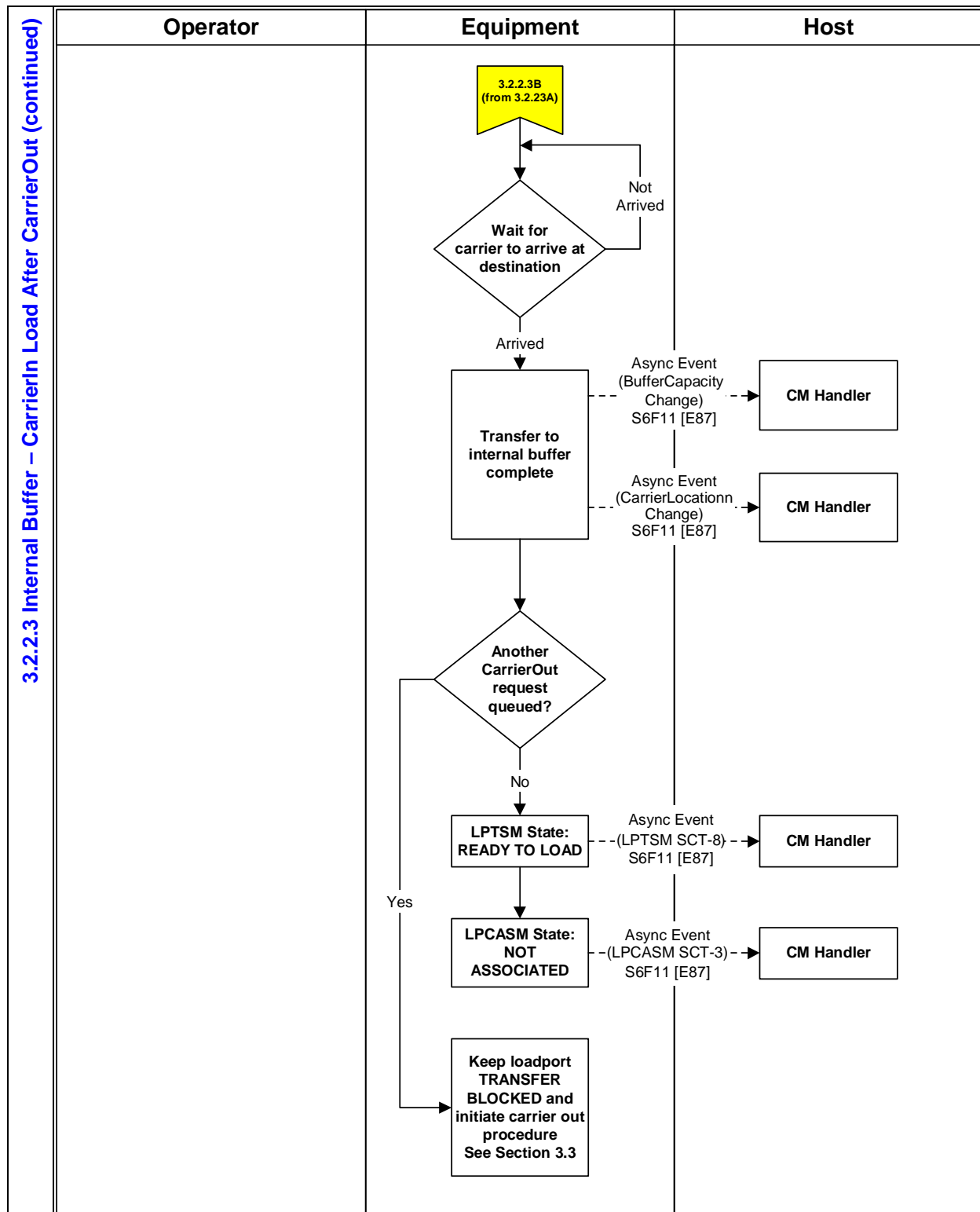
### 3.2.2 Material Movement – Move In – Carrier Placement

#### 3.2.2.3 Internal Buffer – CarrierIn Load After CarrierOut



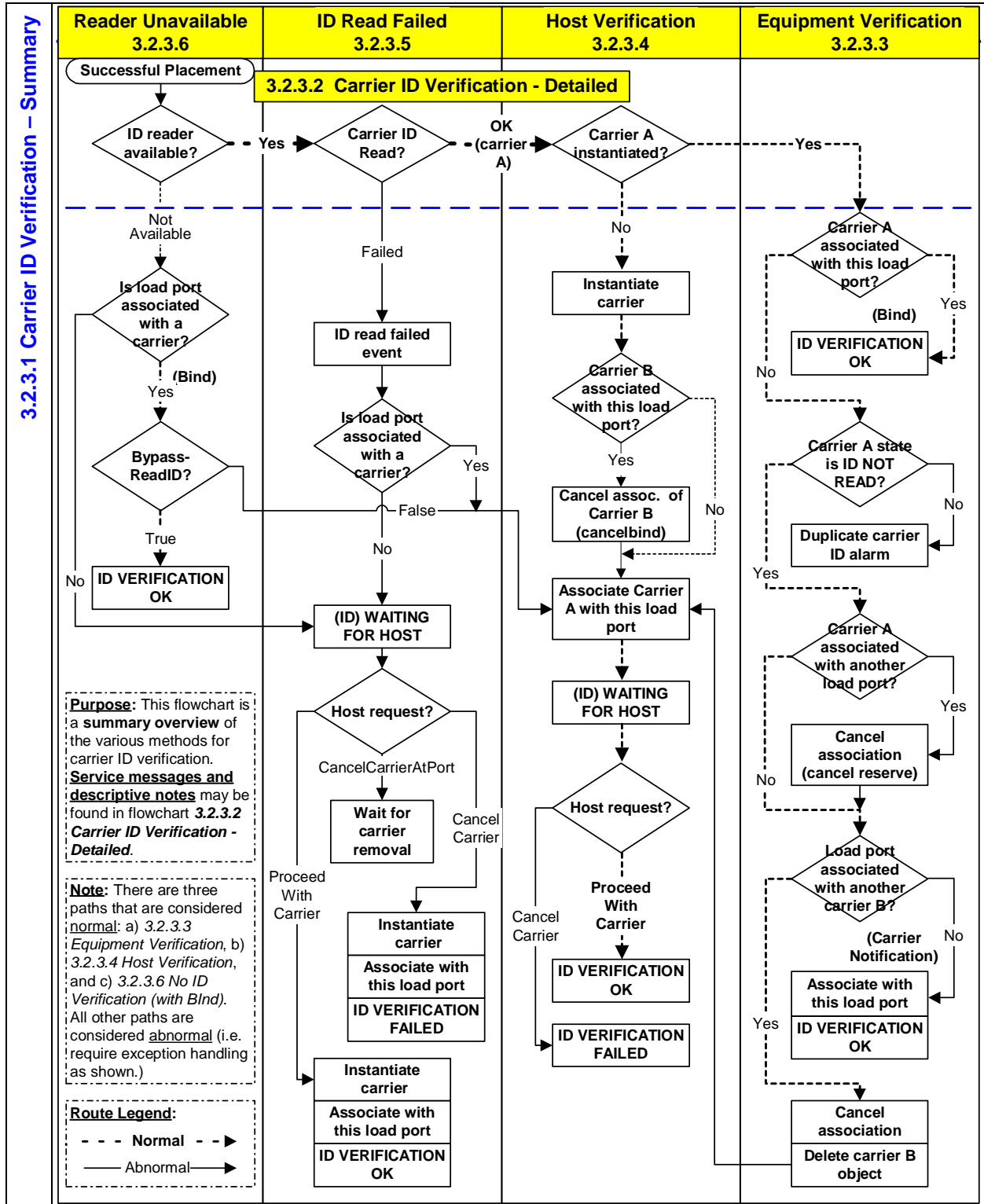
3.2.2 Material Movement – Move In – Carrier Placement

3.2.2.3 Internal Buffer – CarrierIn Load After CarrierOut (continued)



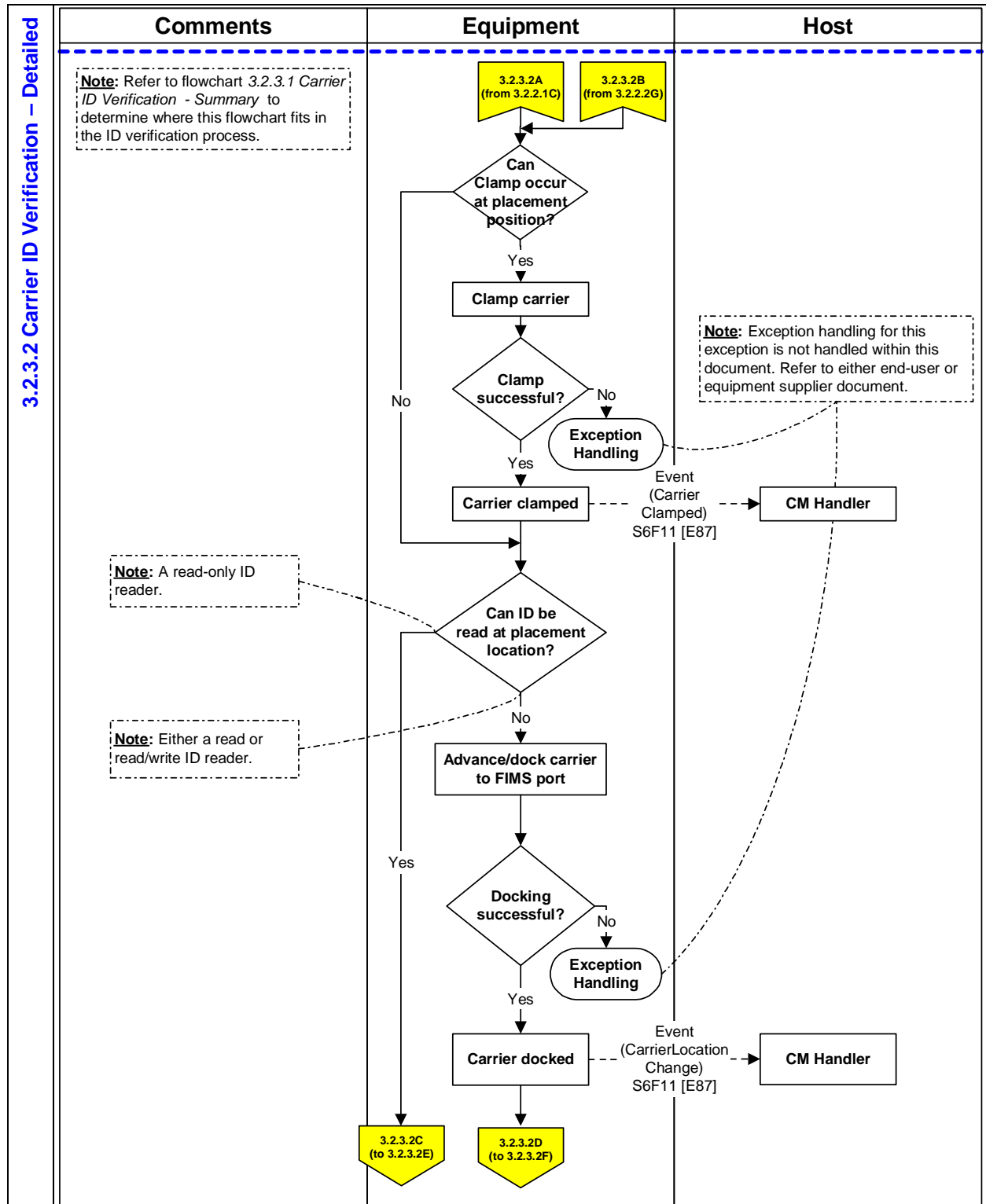
### 3.2.3 Material Movement – Move In – Verification

#### 3.2.3.1 Carrier ID Verification – Summary



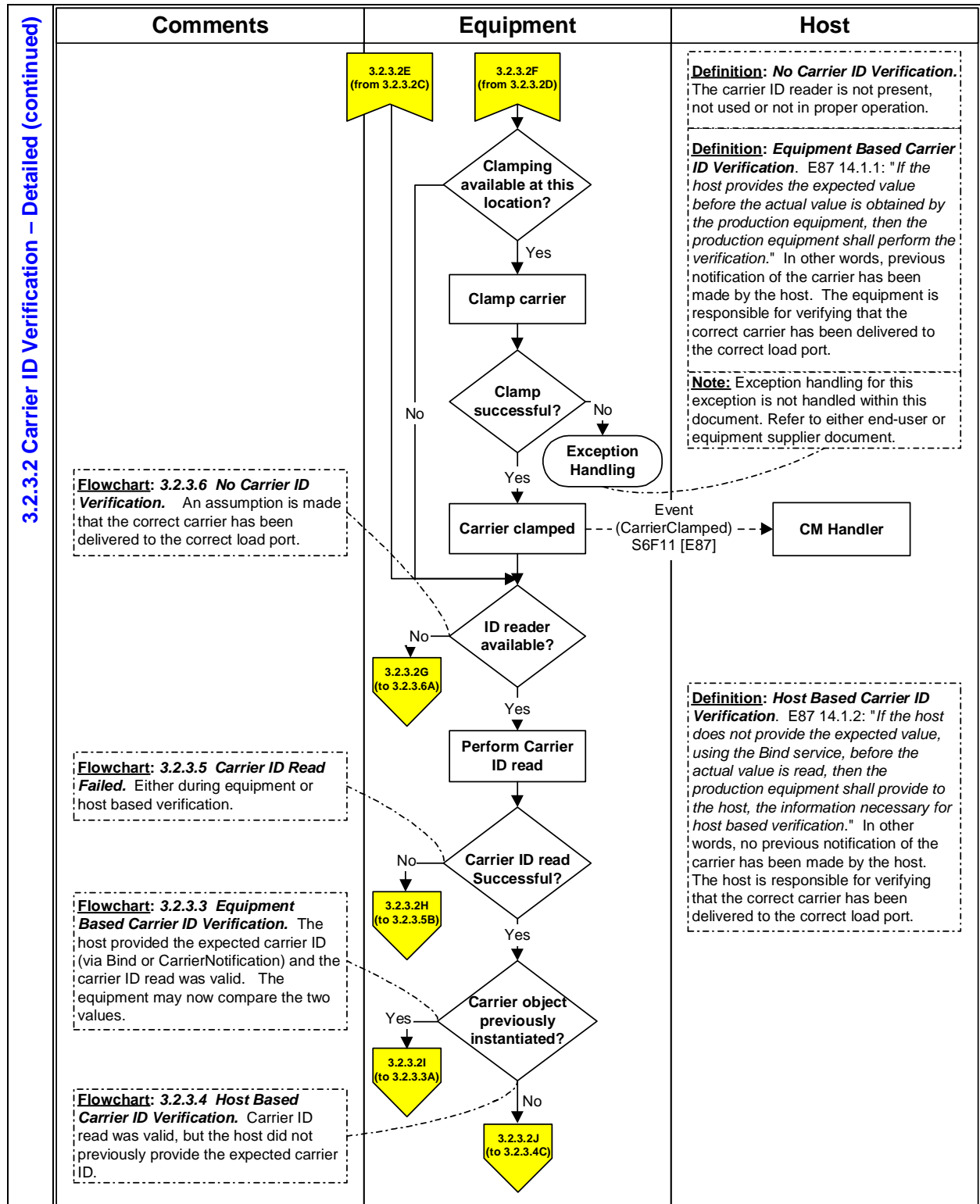
3.2.3 Material Movement – Move In – Verification

3.2.3.2 Carrier ID Verification – Detailed



### 3.2.3 Material Movement – Move In – Verification

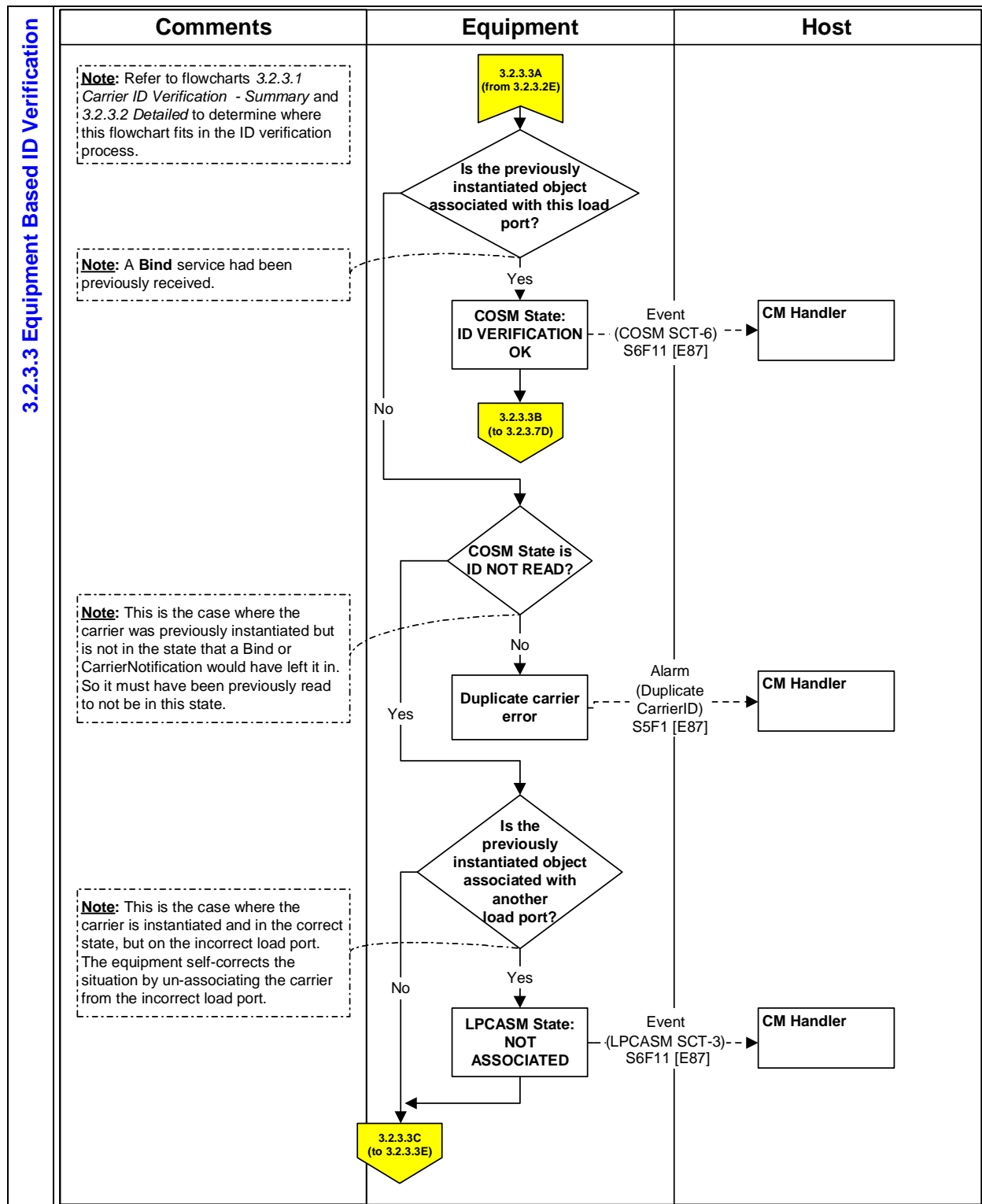
#### 3.2.3.2 Carrier ID Verification – Detailed (continued)





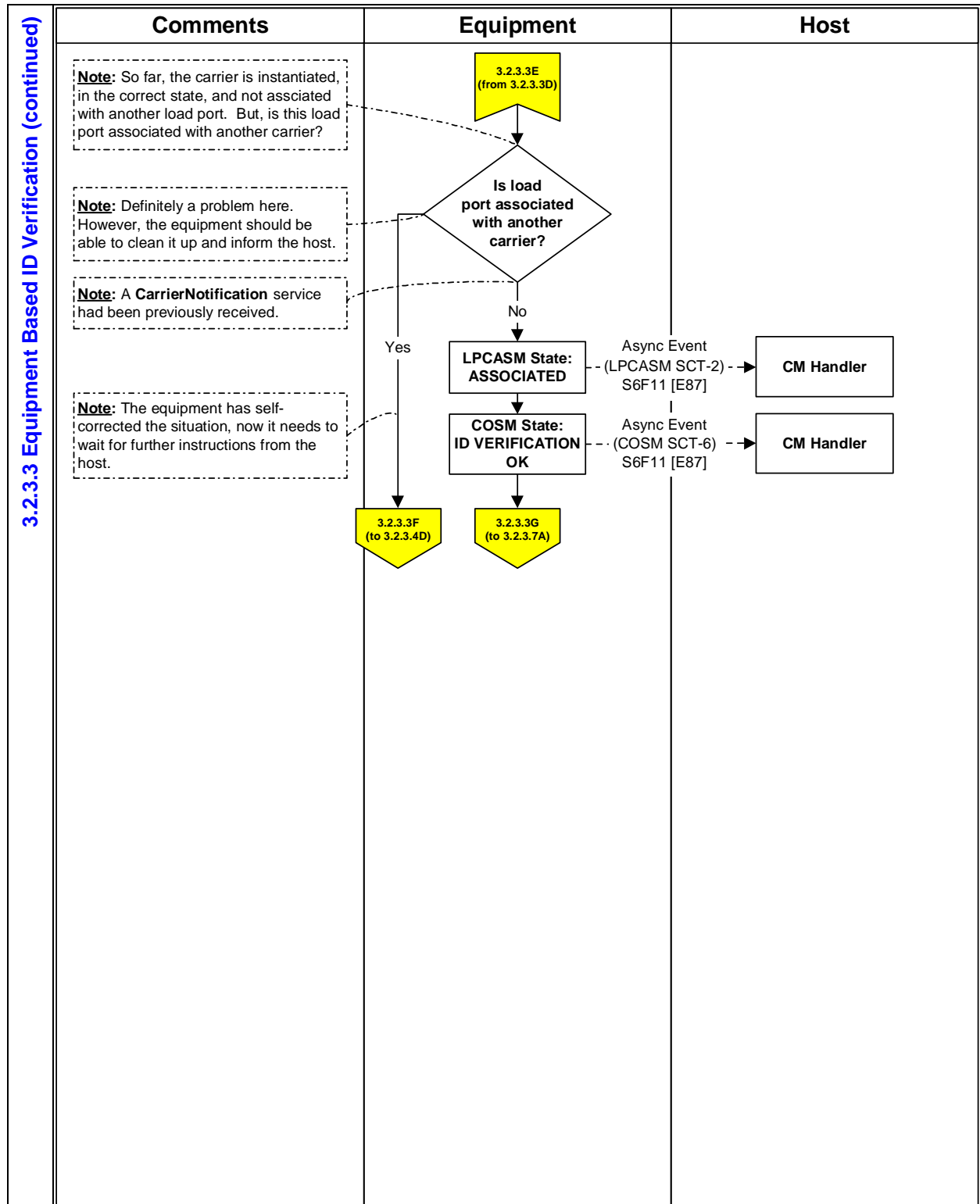
### 3.2.3 Material Movement – Move In – Verification

#### 3.2.3.3 Equipment Based ID Verification



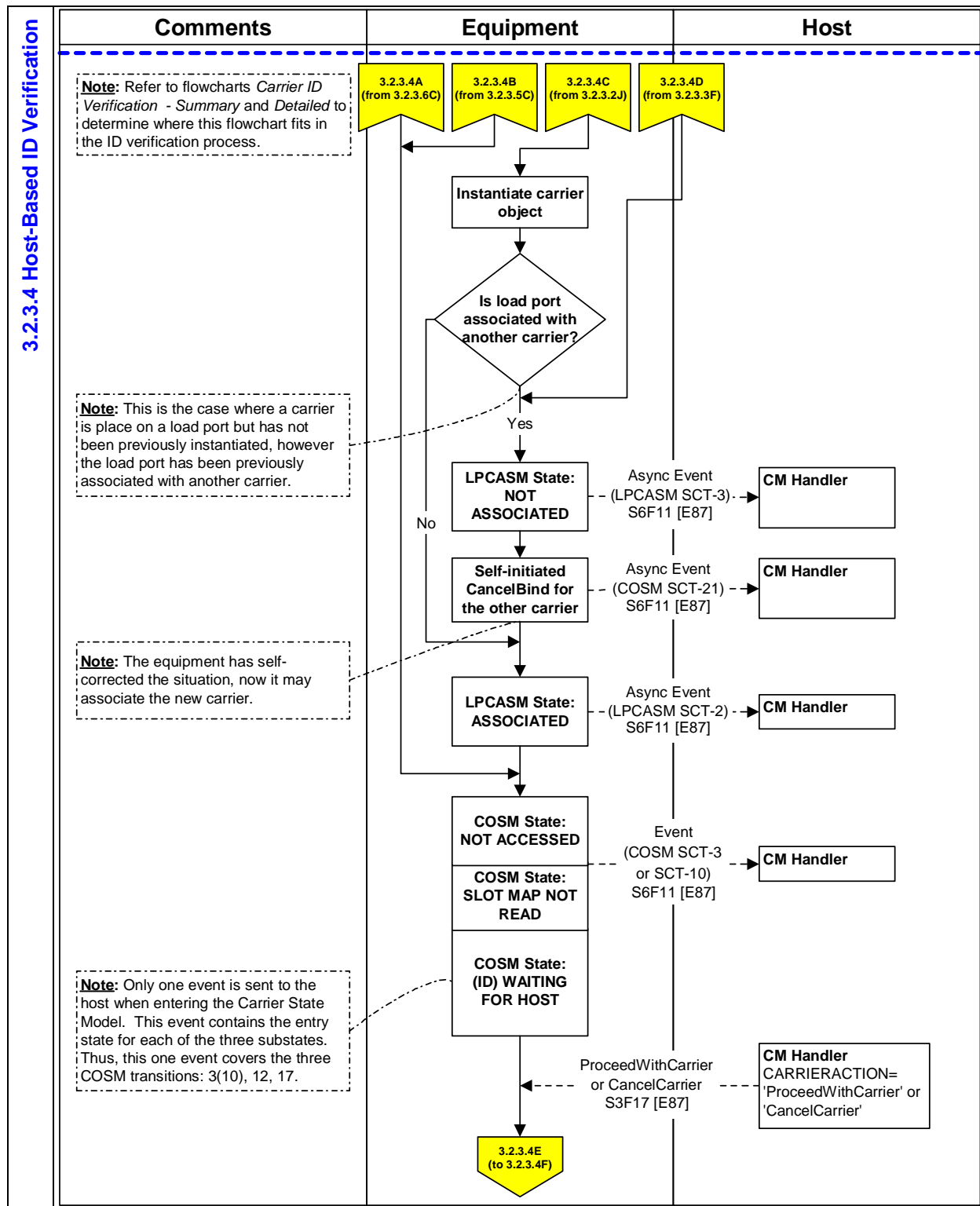
### 3.2.3 Material Movement – Move In – Verification

#### 3.2.3.3 Equipment Based ID Verification (continued)



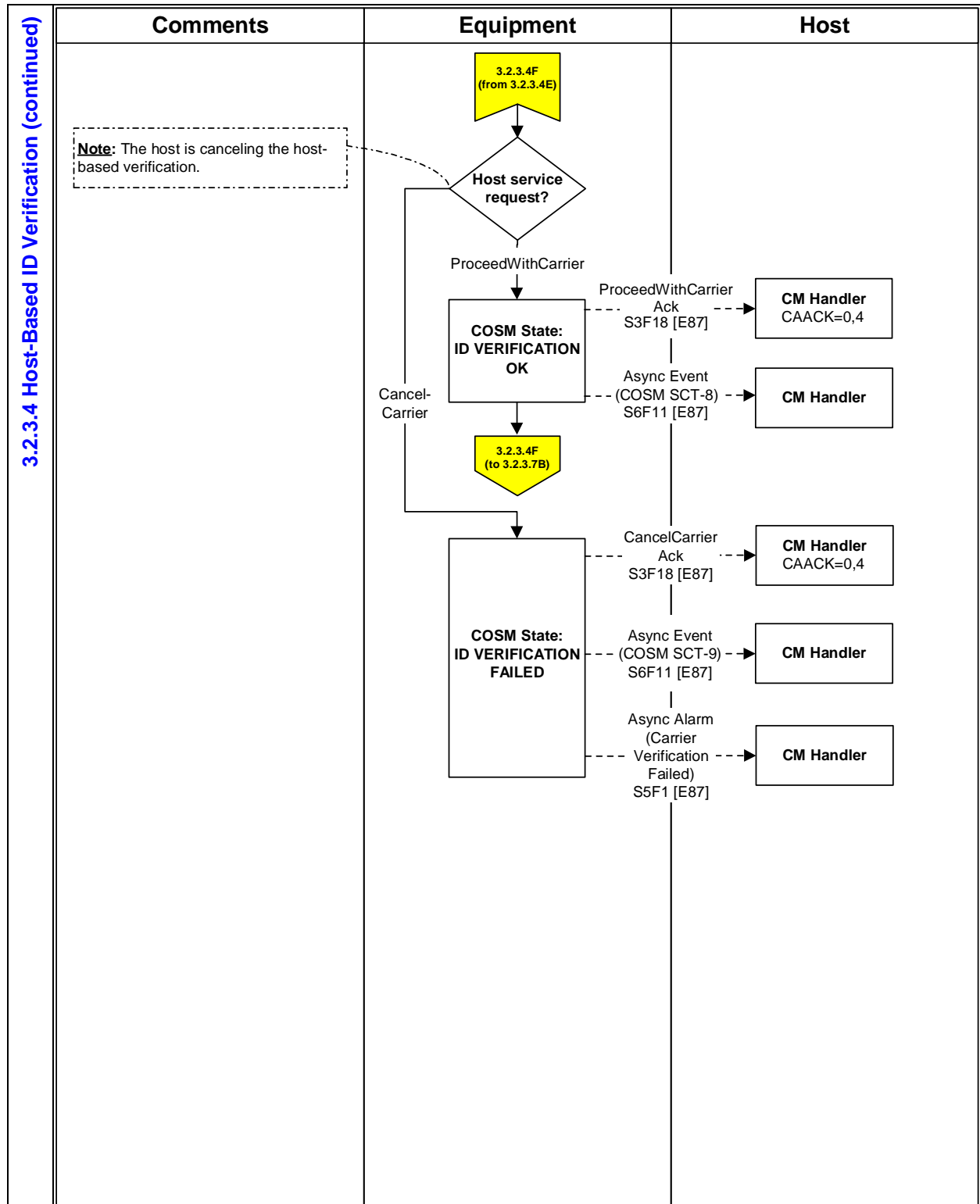
### 3.2.3 Material Movement – Move In – Verification

#### 3.2.3.4 Host-Based ID Verification



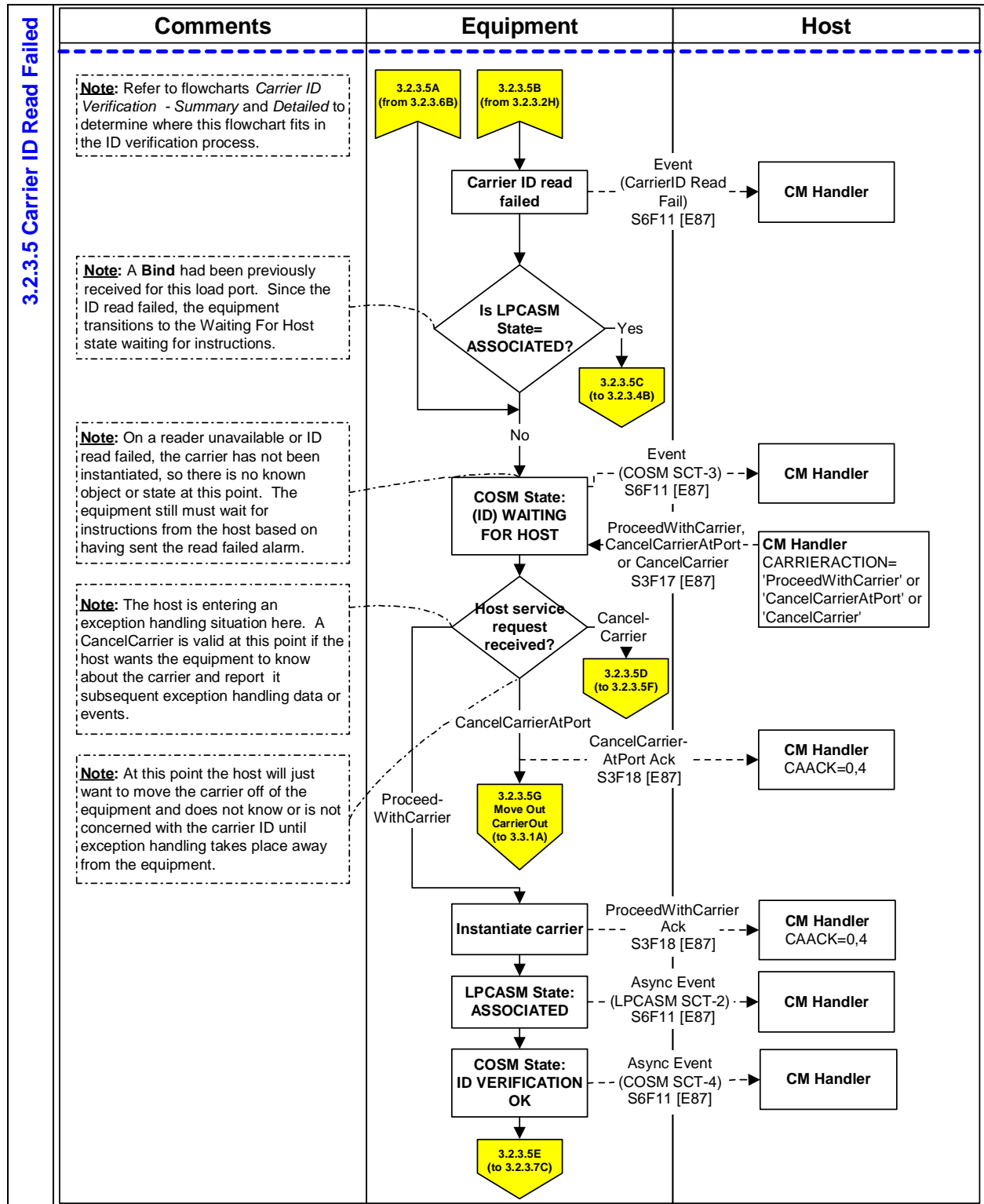
### 3.2.3 Material Movement – Move In – Verification

#### 3.2.3.4 Host-Based ID Verification (continued)



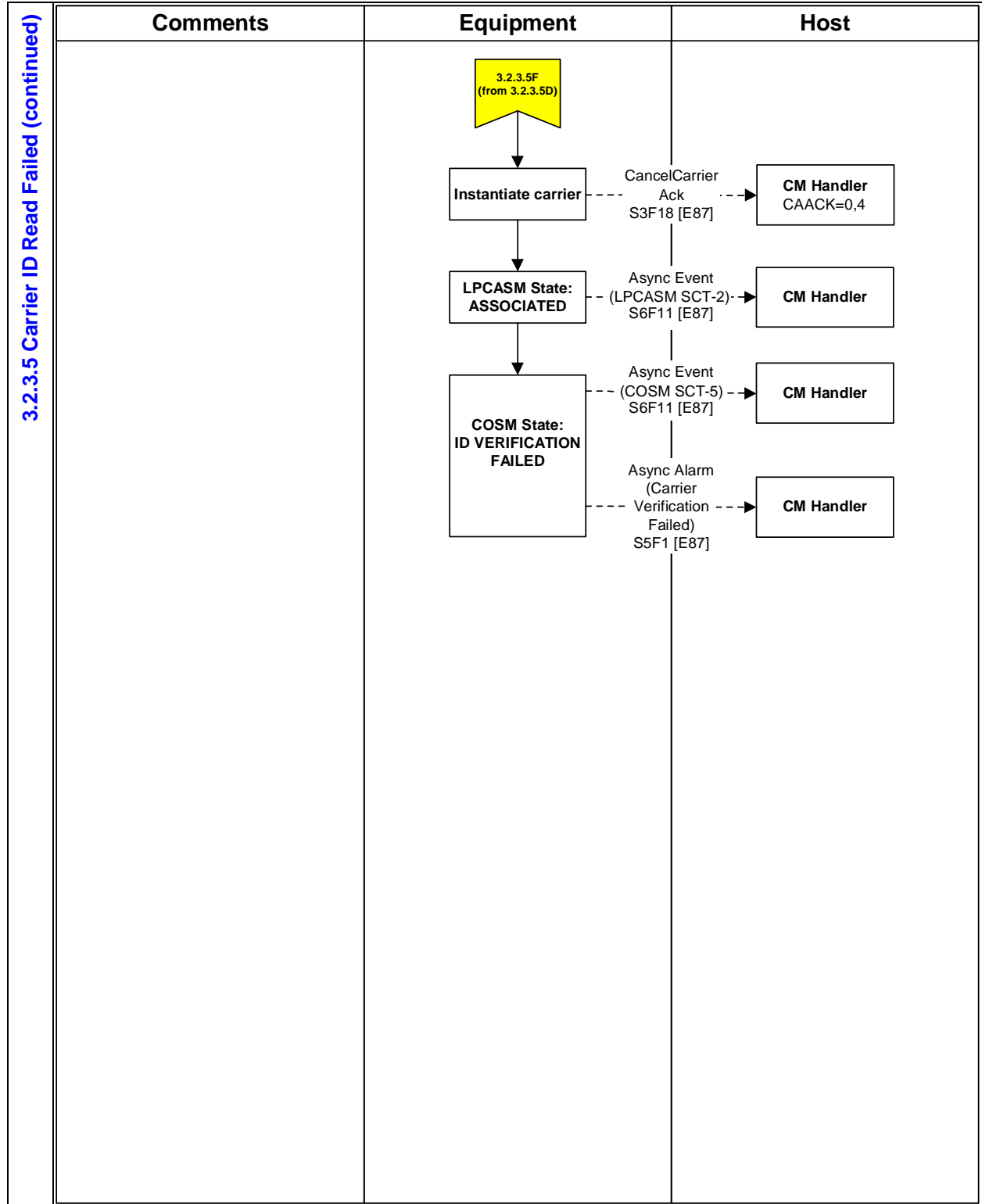
### 3.2.3 Material Movement – Move In – Verification

#### 3.2.3.5 Carrier ID Read Failed



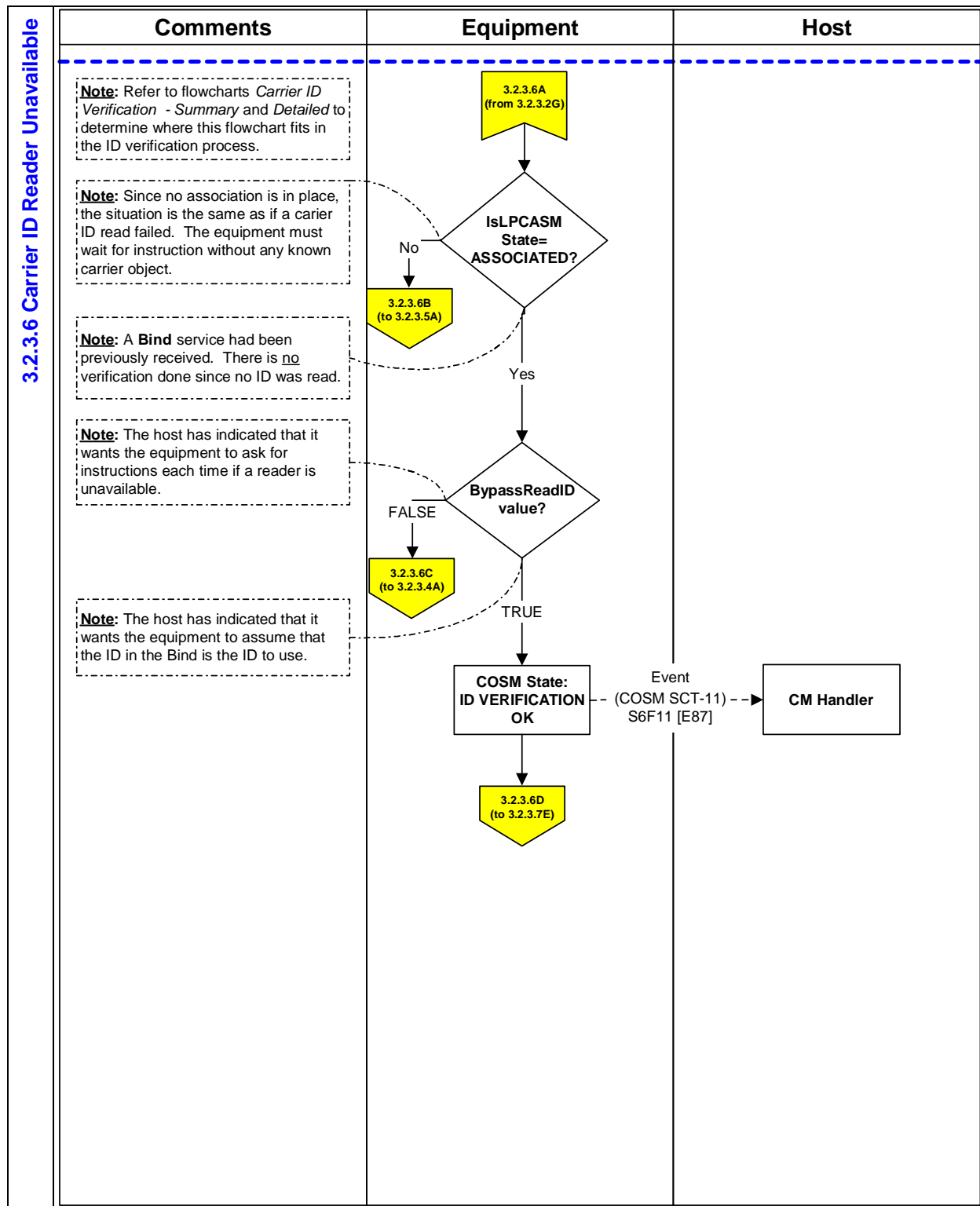
3.2.3 Material Movement – Move In – Verification

3.2.3.5 Carrier ID Read Failed (continued)



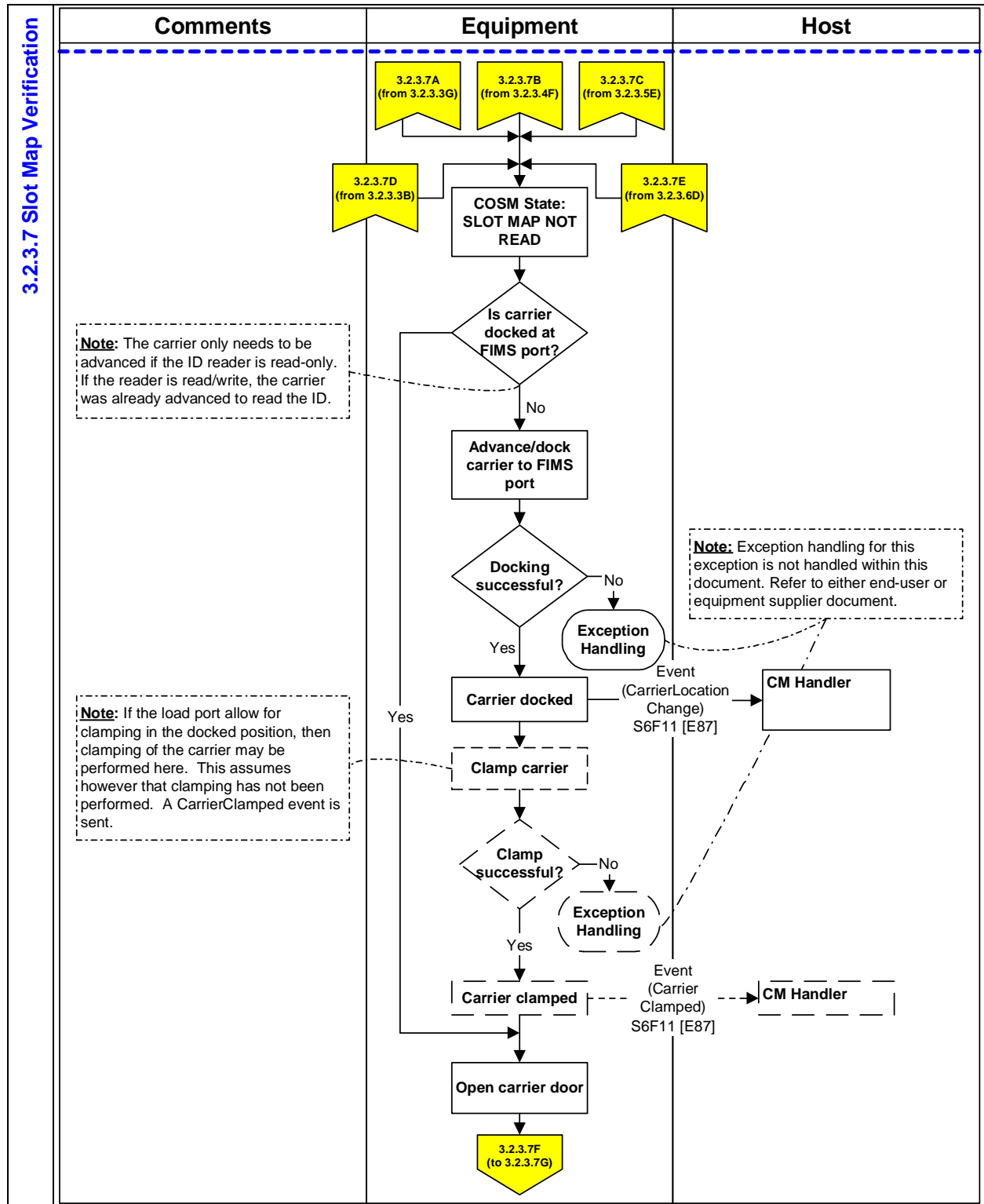
### 3.2.3 Material Movement – Move In – Verification

#### 3.2.3.6 Carrier ID Reader Unavailable



### 3.2.3 Material Movement – Move In – Verification

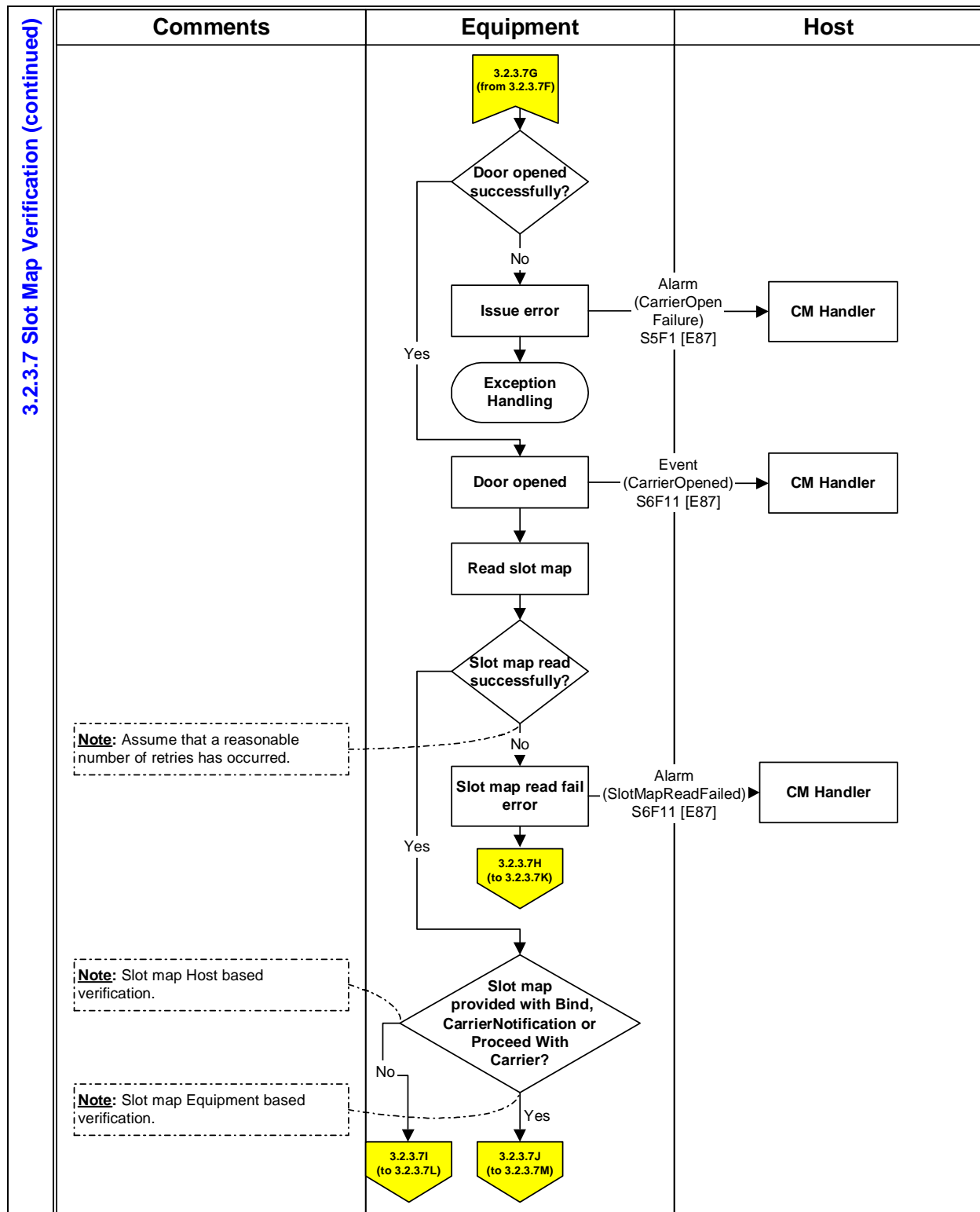
#### 3.2.3.7 Slot Map Verification





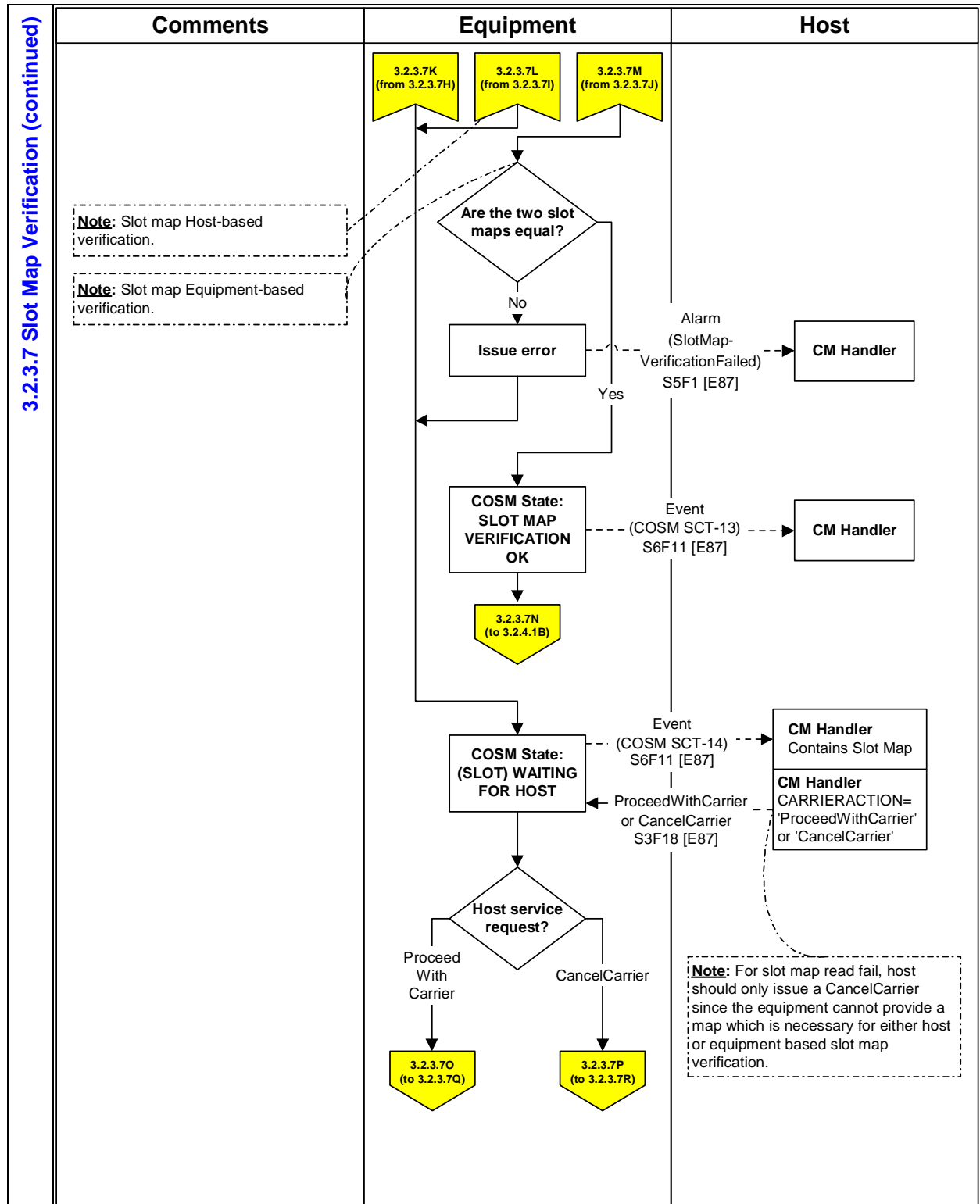
### 3.2.3 Material Movement – Move In – Verification

#### 3.2.3.7 Slot Map Verification (continued)



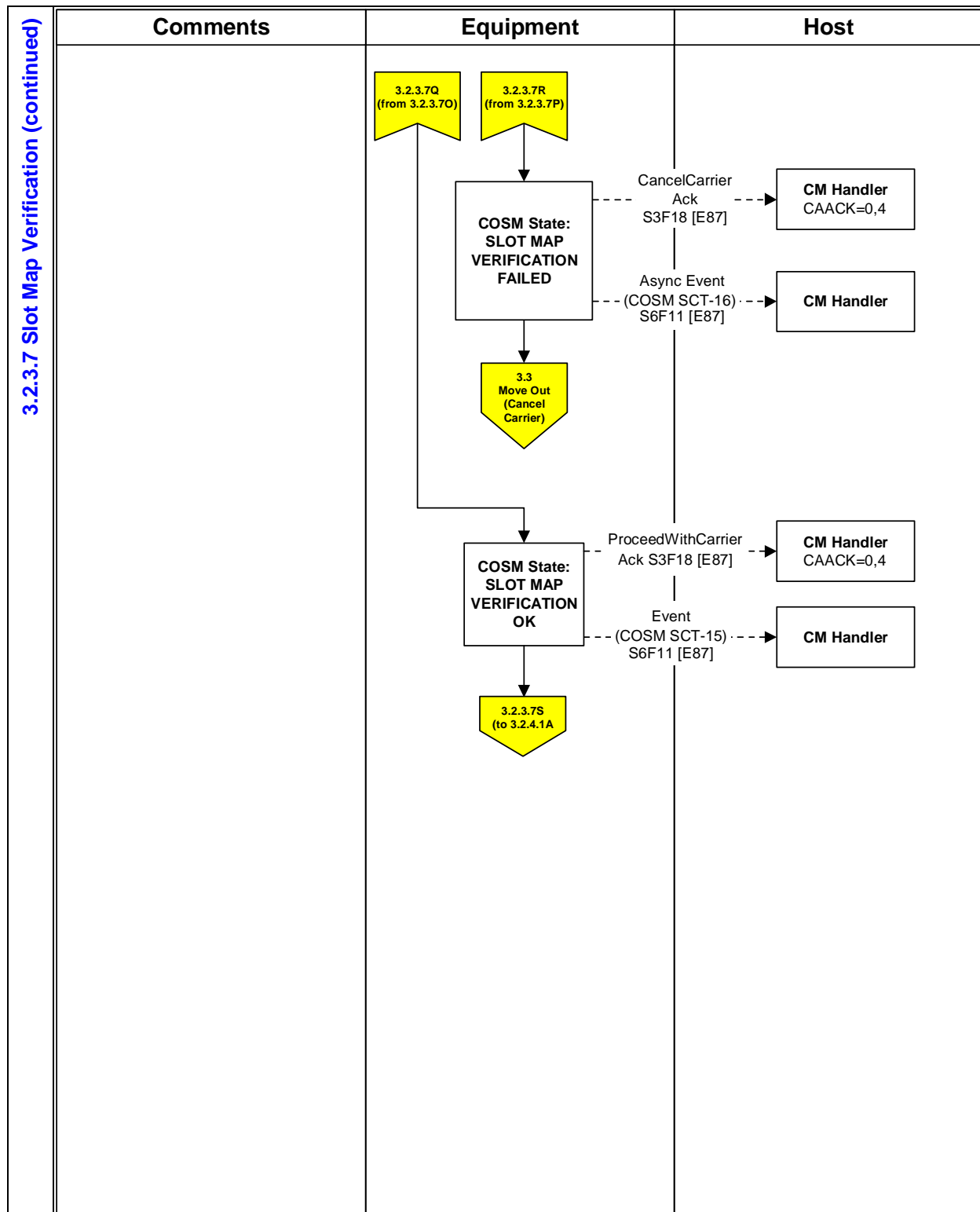
### 3.2.3 Material Movement – Move In – Verification

#### 3.2.3.7 Slot Map Verification (continued)



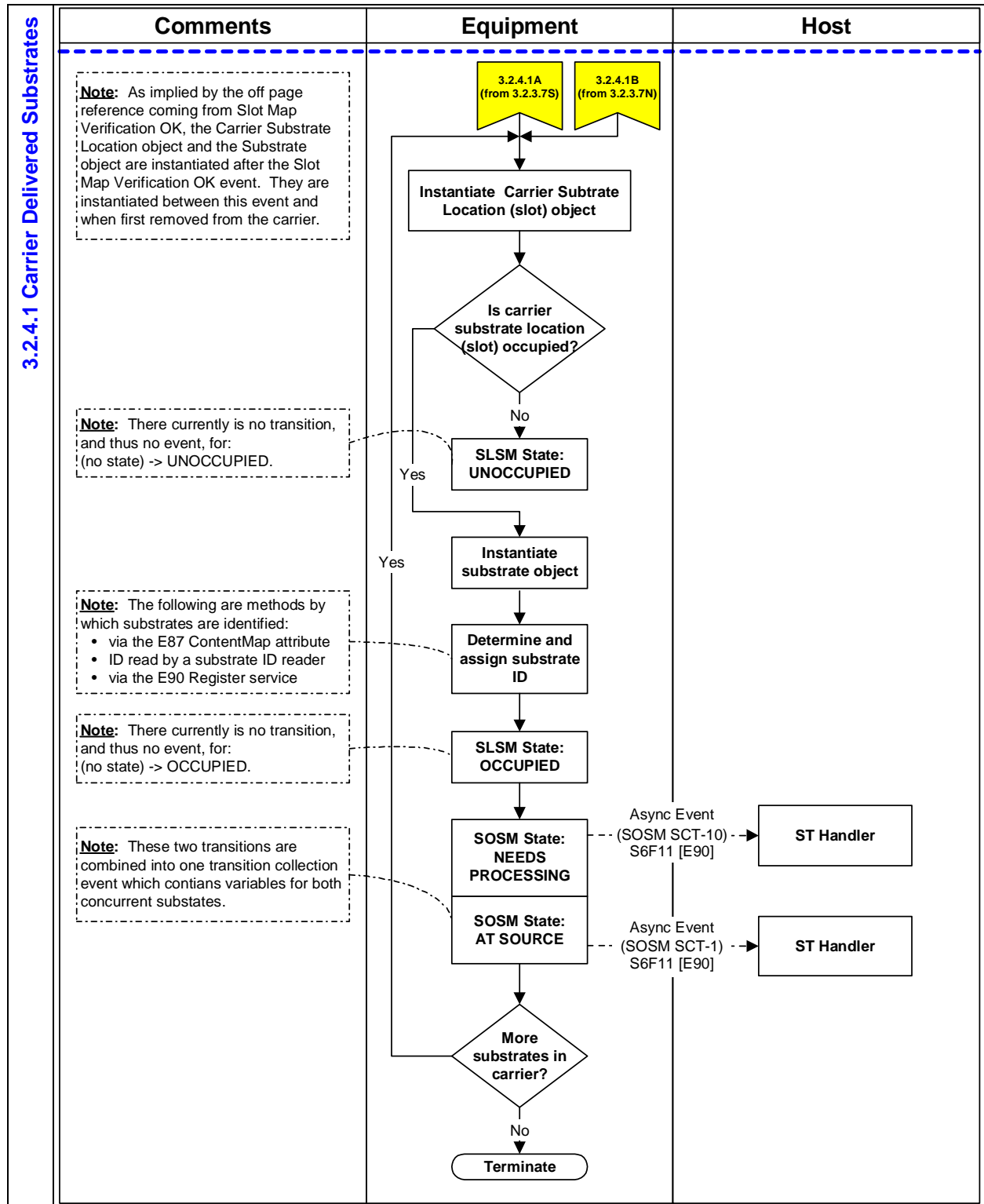
3.2.3 Material Movement – Move In – Verification

3.2.3.7 Slot Map Verification (continued)



### 3.2.4 Material Movement – Move In – Substrates

#### 3.2.4.1 Carrier Delivered Substrates



### 3.3 Material Movement – Move Out

#### Purpose

This cross-functional operational flowchart describes the equipment's communication interface behavior from the host's and AMHS' point of view and within the following criteria during carrier move out:

- Delivery method (**AUTOMATIC/MANUAL**)
- Buffer type (**FIXED/INTERNAL**)

#### Applicable Documents

This operational flowchart conforms to the following industry standards and specifications:

- SEMI E39 – *Object Services*
- SEMI E84 – *Enhanced Carrier Handoff PI/O*
- SEMI E87 – *Carrier Management*

#### Assumptions

1. <none>

#### Flowchart Organization

- 3.3.1 Carrier Complete and Undock
- 3.3.2 Manual Unload – Single Handoff
- 3.3.3 Automated Unload – Single Handoff
- 3.3.4 Internal Buffer – CarrierOut Unload
- 3.3.5 Cancel Carrier
- 3.3.6 Cancel Carrier At Port
- 3.3.7 Cancel Carrier Out
- 3.3.8 Cancel All Carrier Out

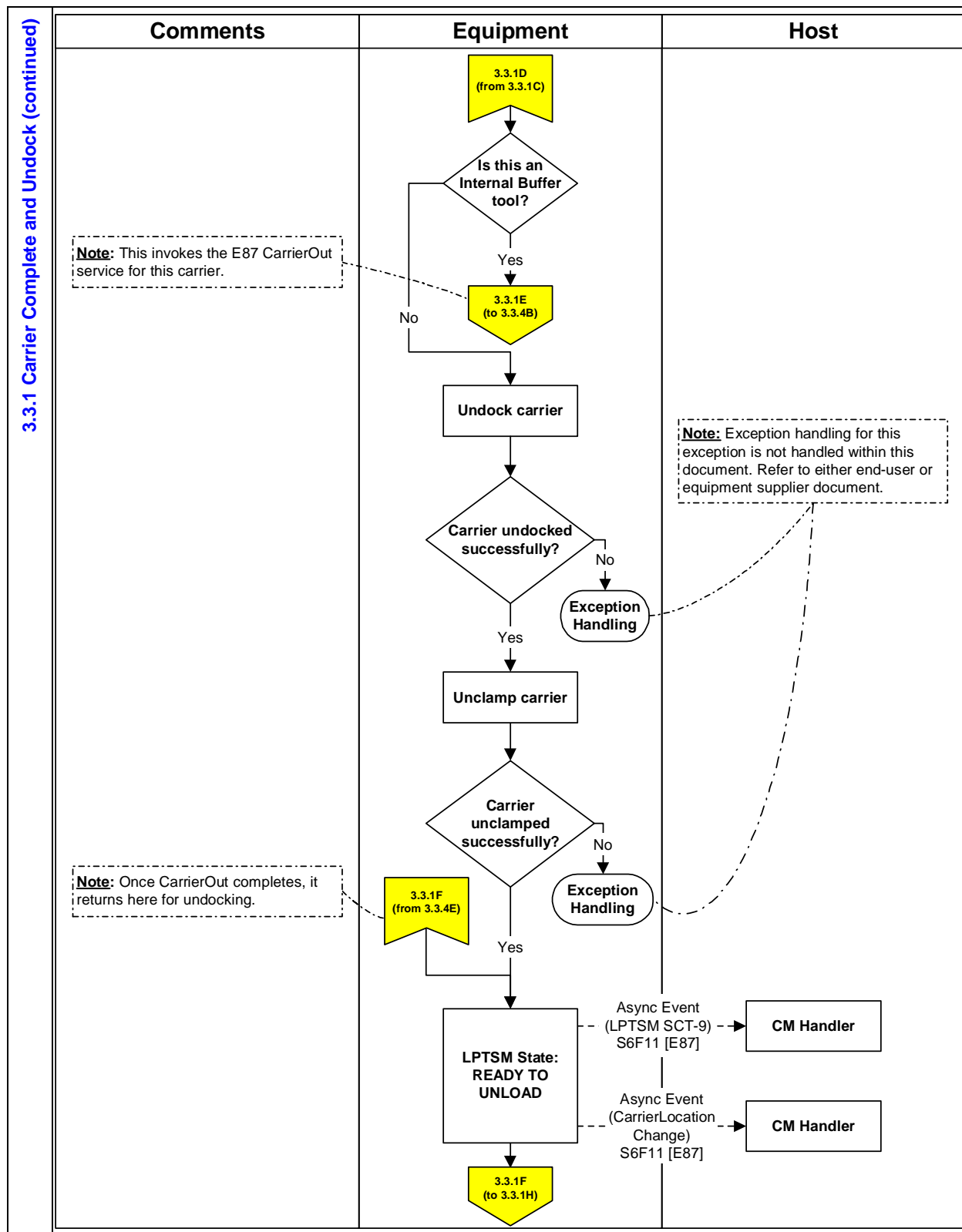
#### Legend

|               |   |              |   |
|---------------|---|--------------|---|
| <b>AMSM</b>   | Access Mode State Model [E87]             | <b>LPTSM</b> | Load Port Transfer State Model [E87]    |
| <b>COSM</b>   | Carrier Object State Model [E87]          | <b>SCT-#</b> | State Change Transition - <transition#> |
| <b>LP</b>     | Load Port                                 | <b>SLSM</b>  | Substrate Location State Model [E90]    |
| <b>LPCASM</b> | Load Port/Carrier Asso. State Model [E87] | <b>SOSM</b>  | Substrate Object State Model [E90]      |
| <b>LPRSM</b>  | Load Port Reservation State Model [E87]   |              |   |

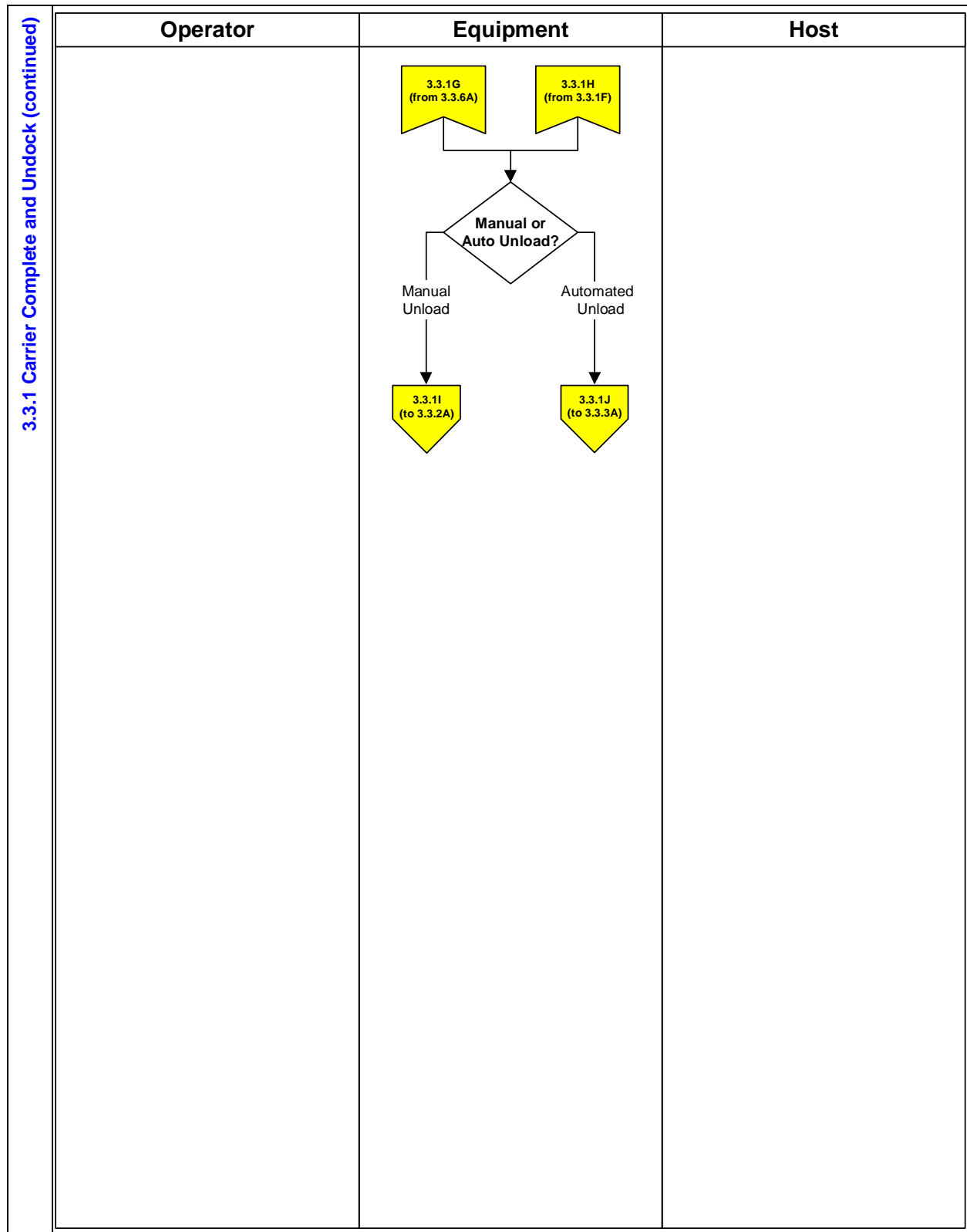




3.3.1 Carrier Complete and Undock (continued)

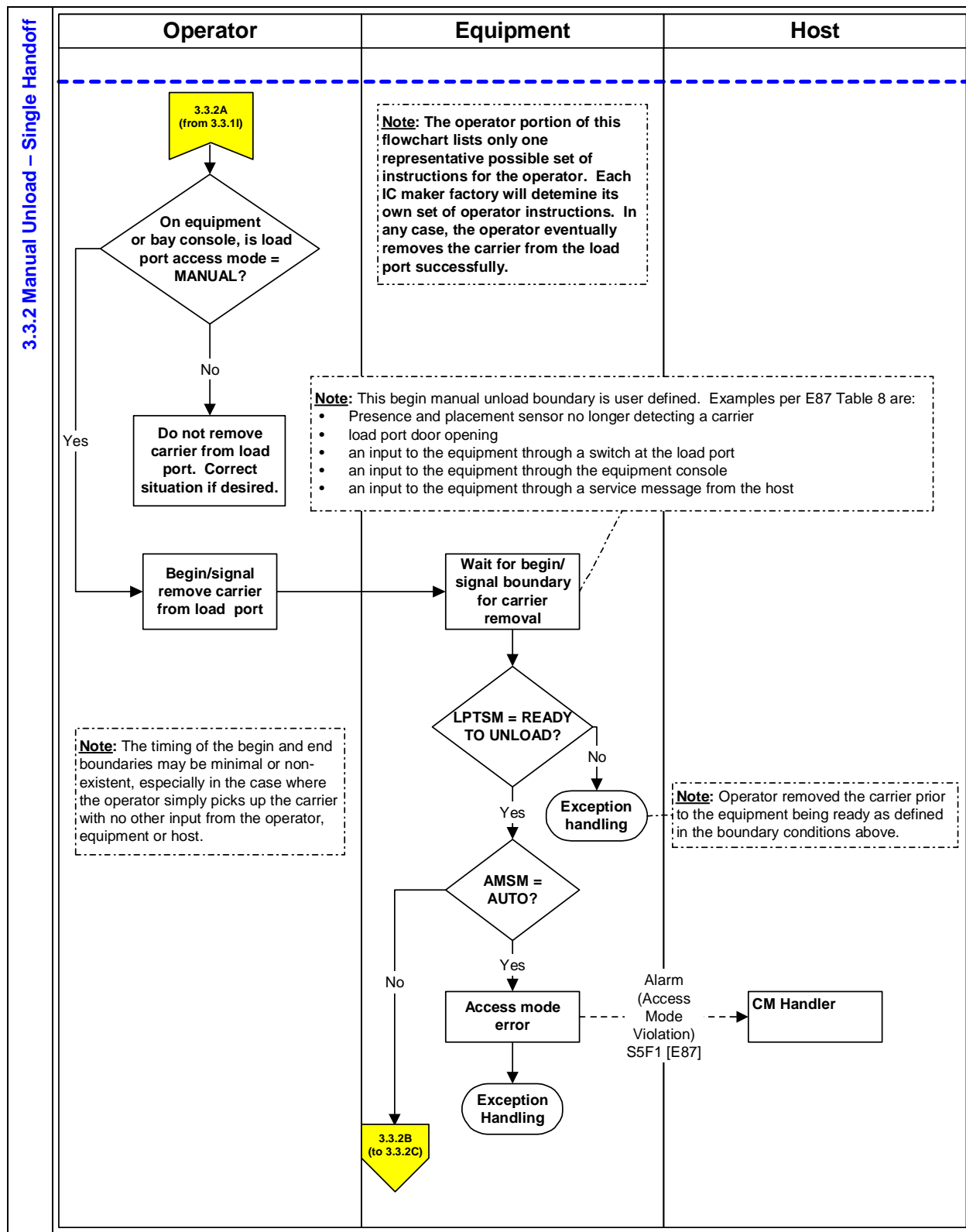


**3.3.1 Carrier Complete and Undock (continued)**

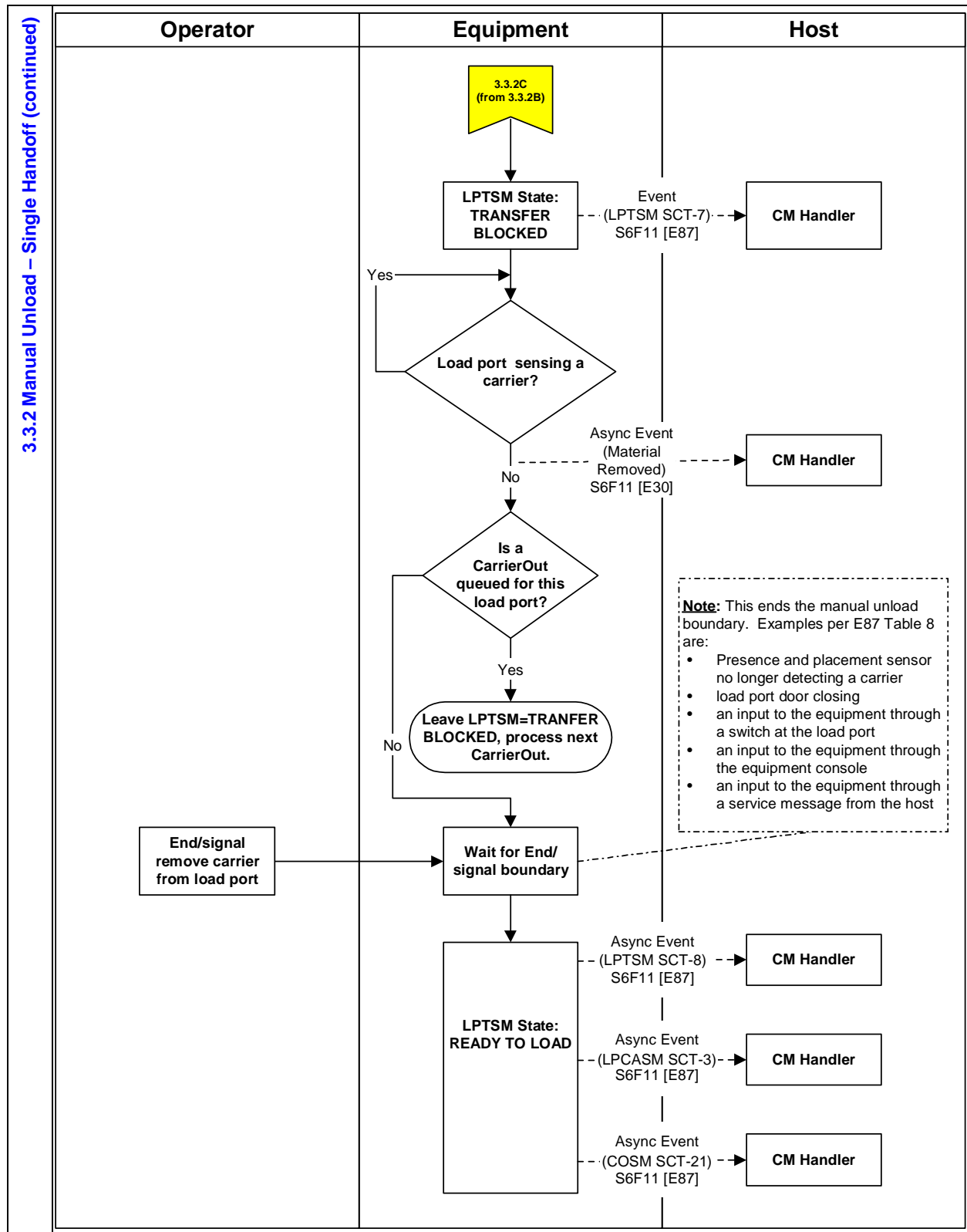




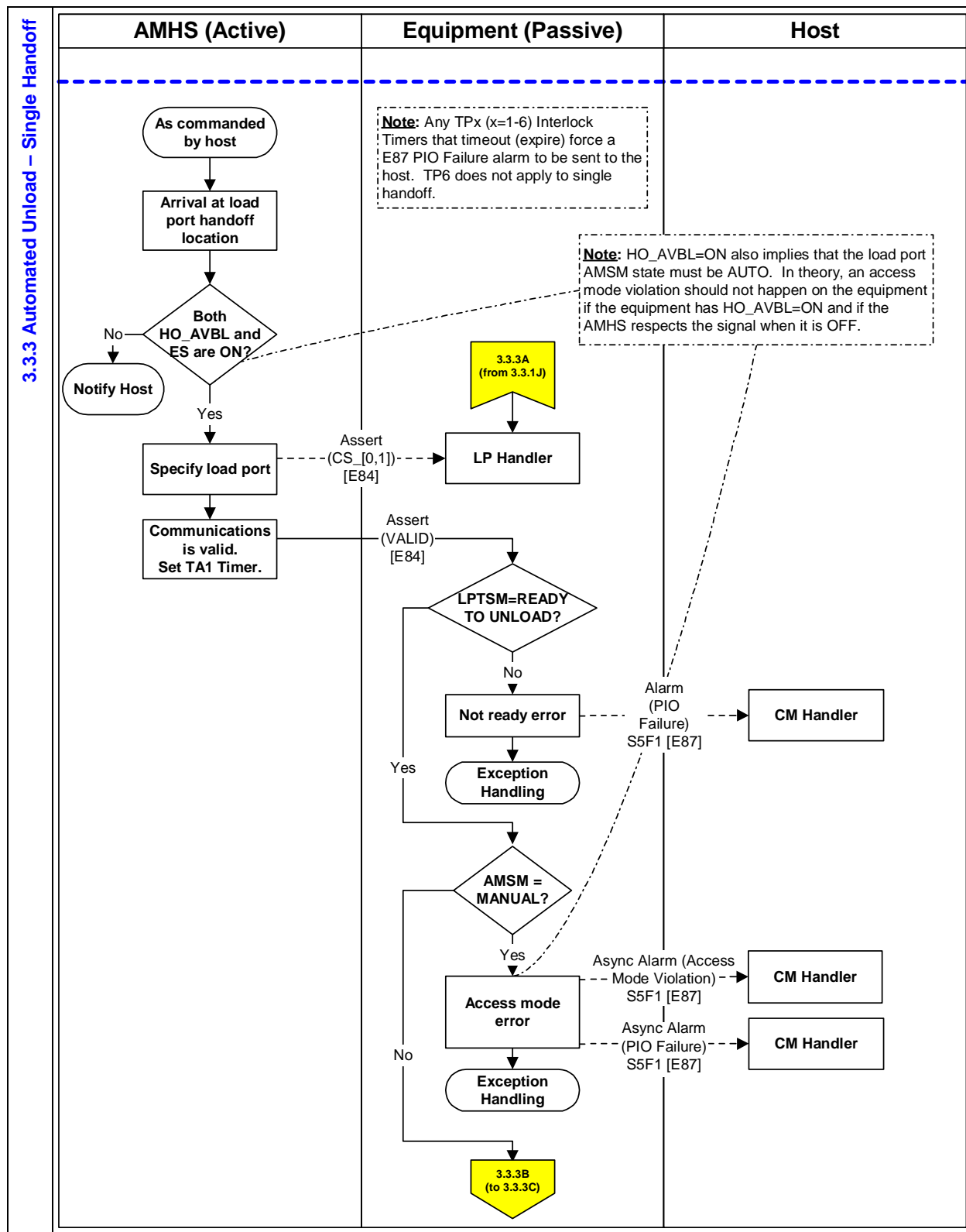
### 3.3.2 Manual Unload – Single Handoff



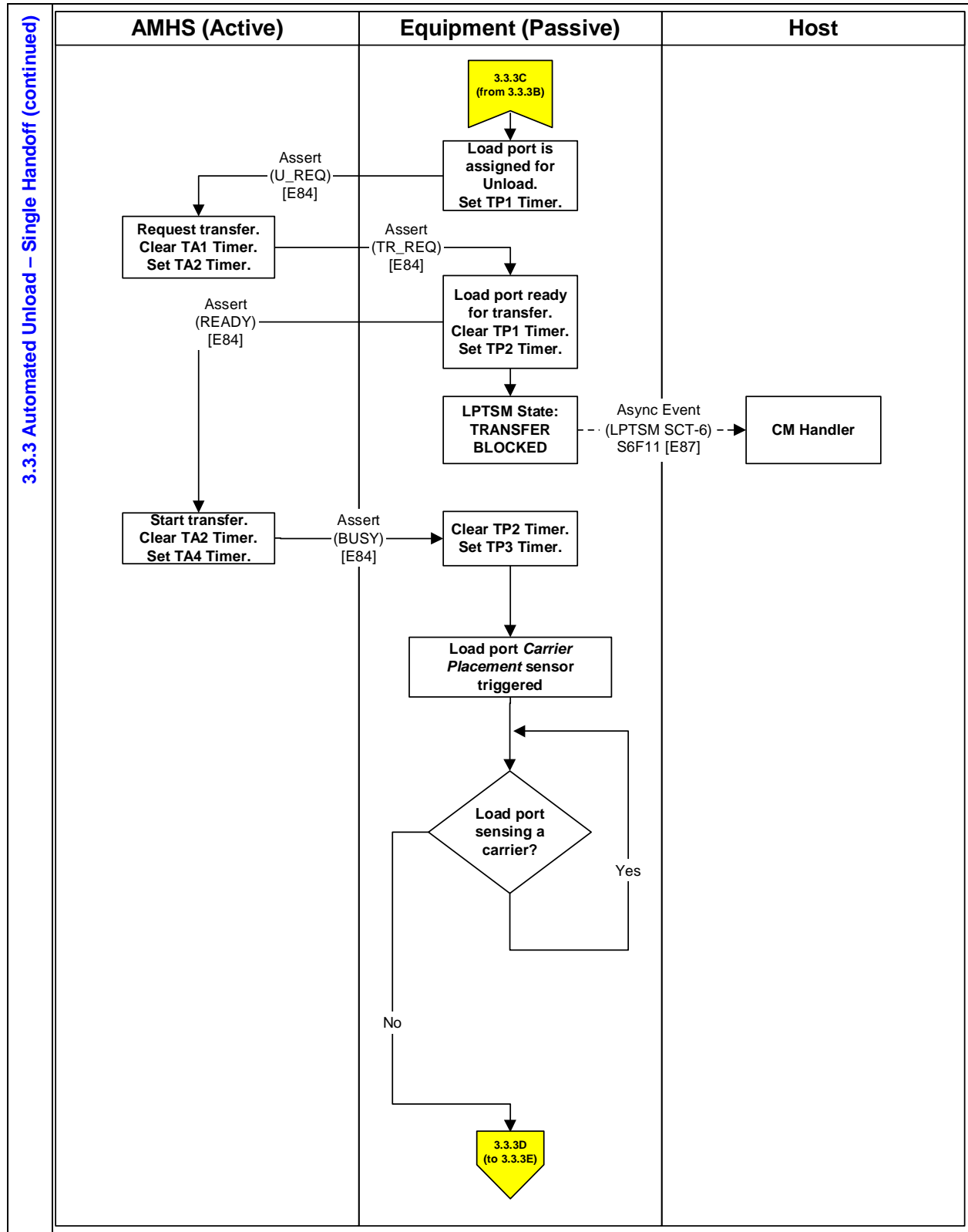
3.3.2 Manual Unload – Single Handoff (continued)



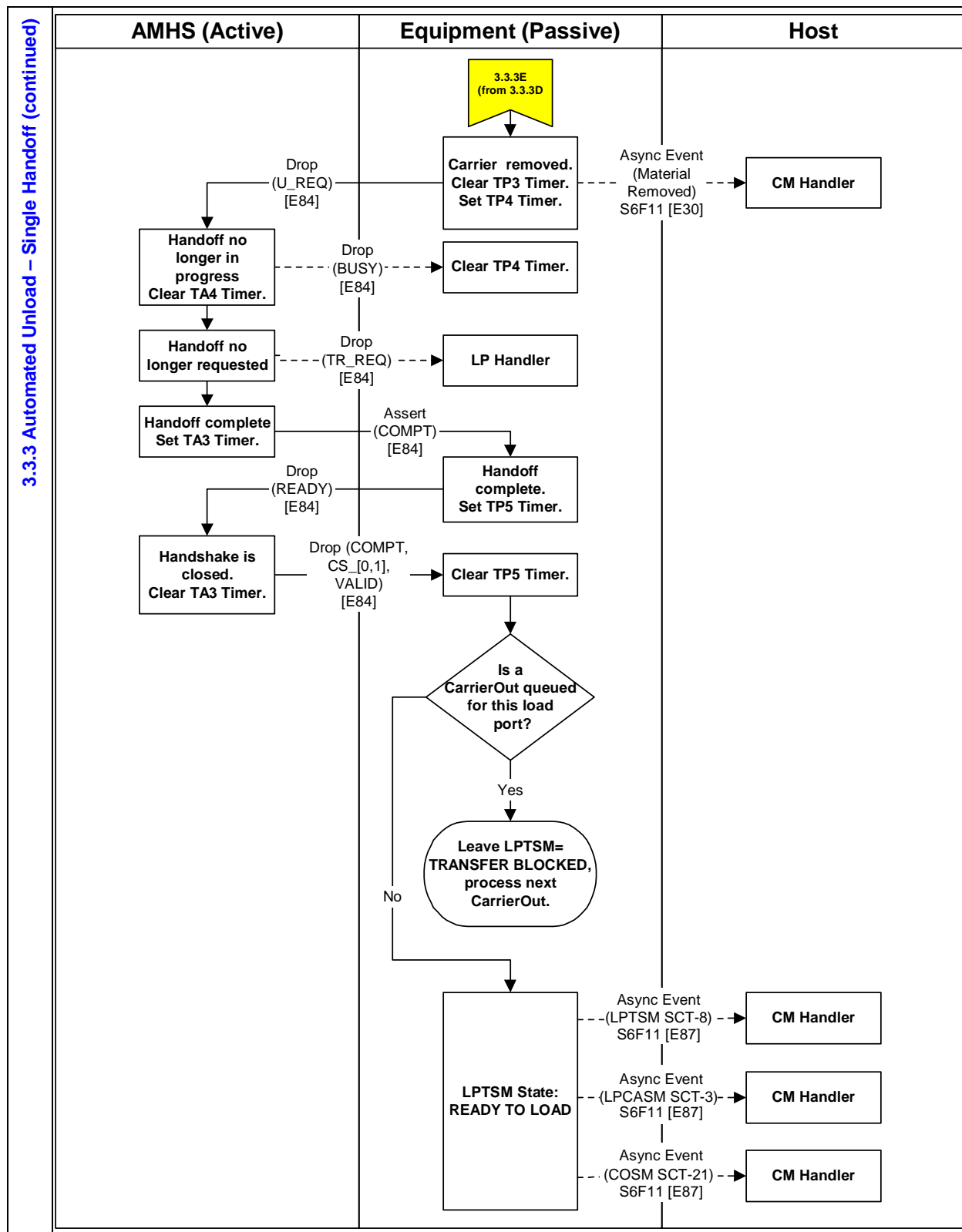
### 3.3.3 Automated Unload – Single Handoff



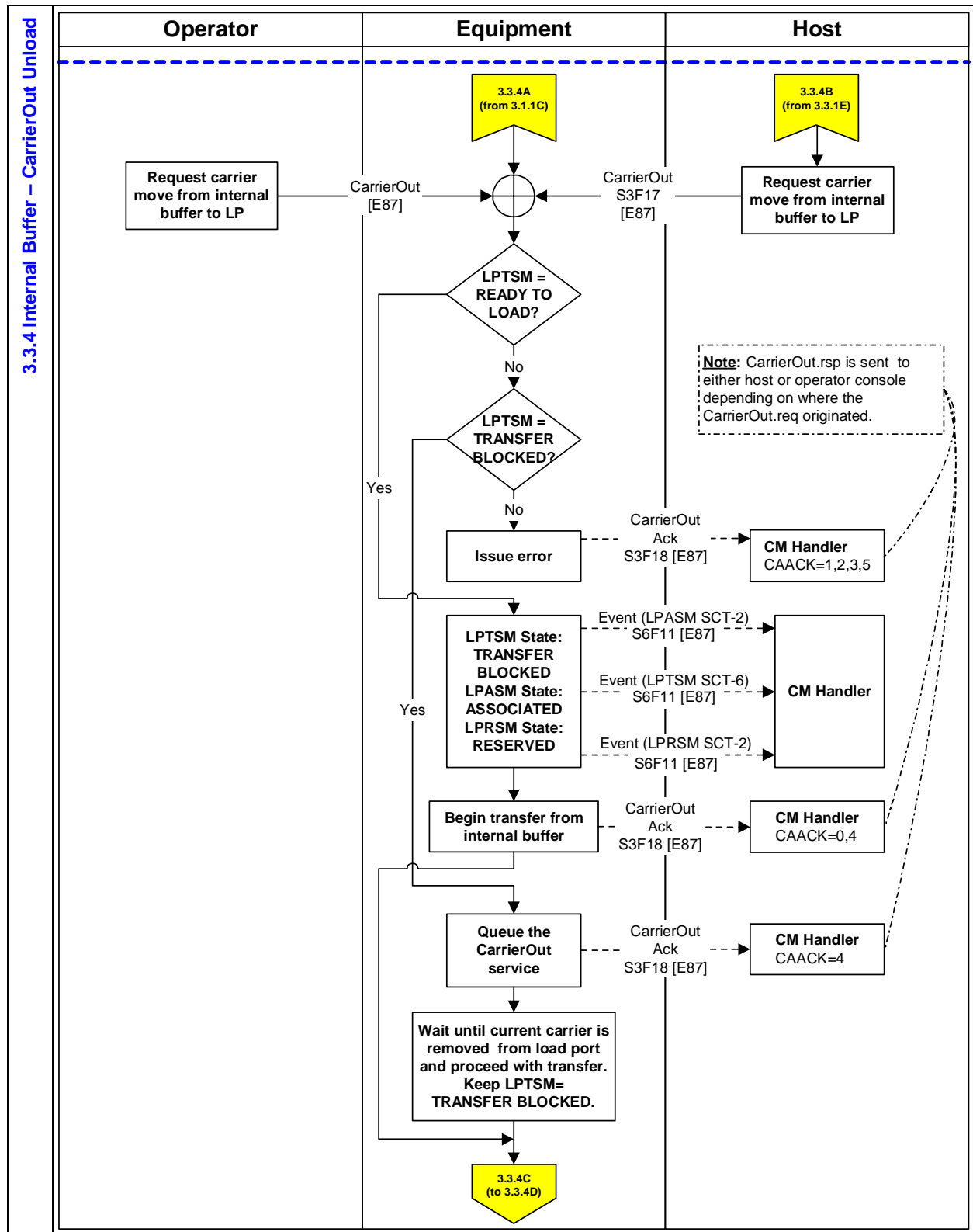
3.3.3 Automated Unload – Single Handoff (continued)



3.3.3 Automated Unload – Single Handoff (continued)



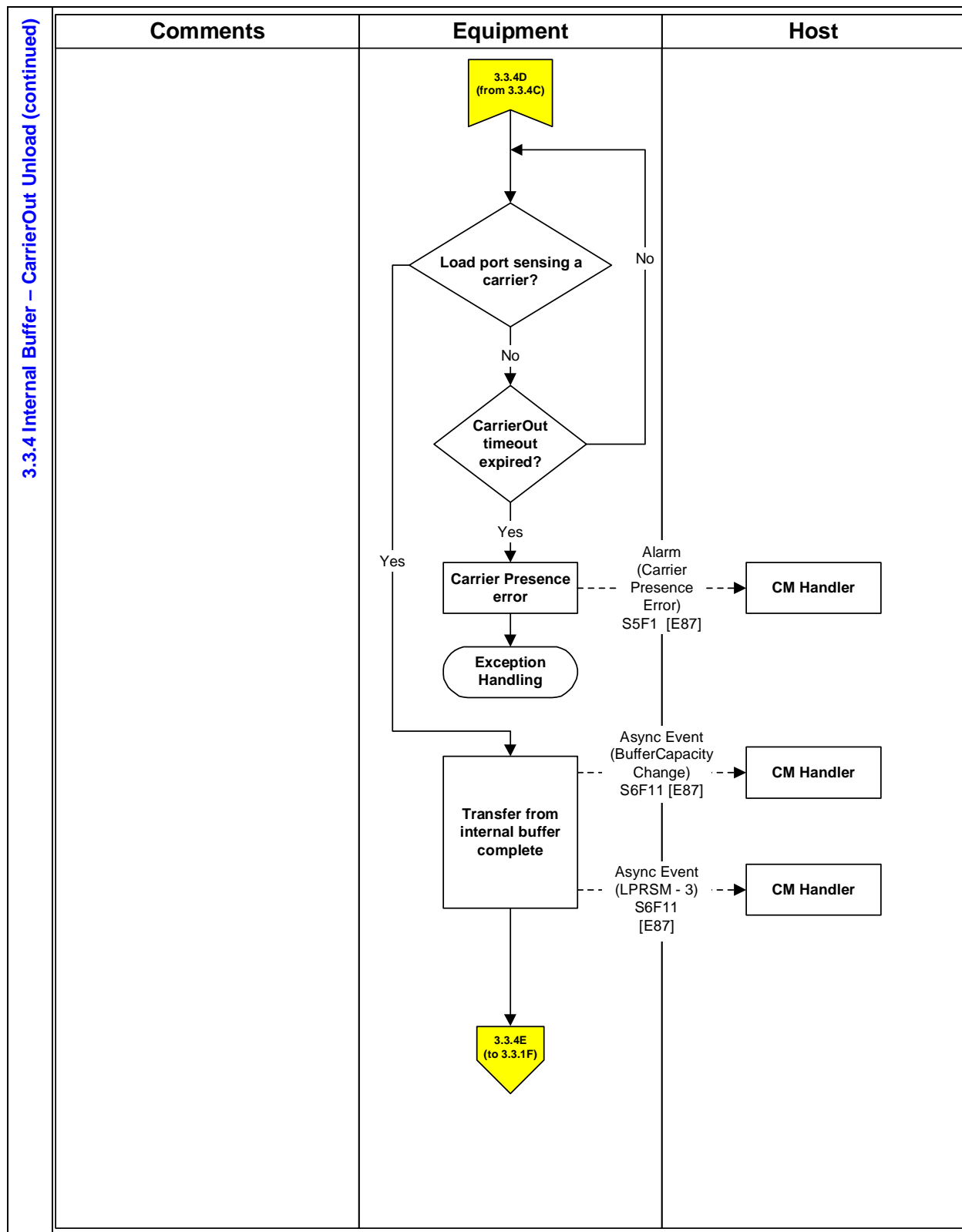
### 3.3.4 Internal Buffer – CarrierOut Unload



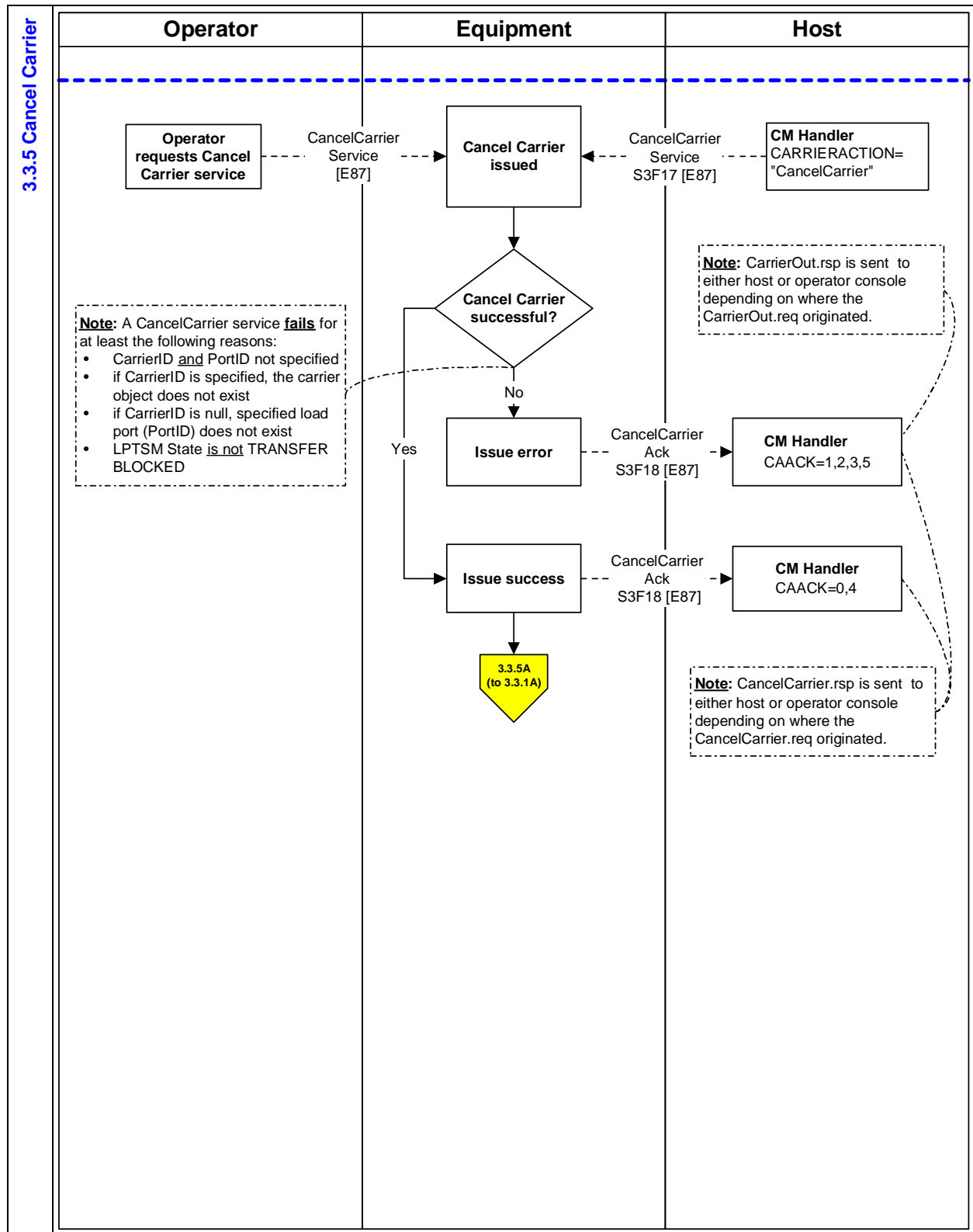
3.3.4 cont.

3.3.5

3.3.4 Internal Buffer – CarrierOut Unload (continued)

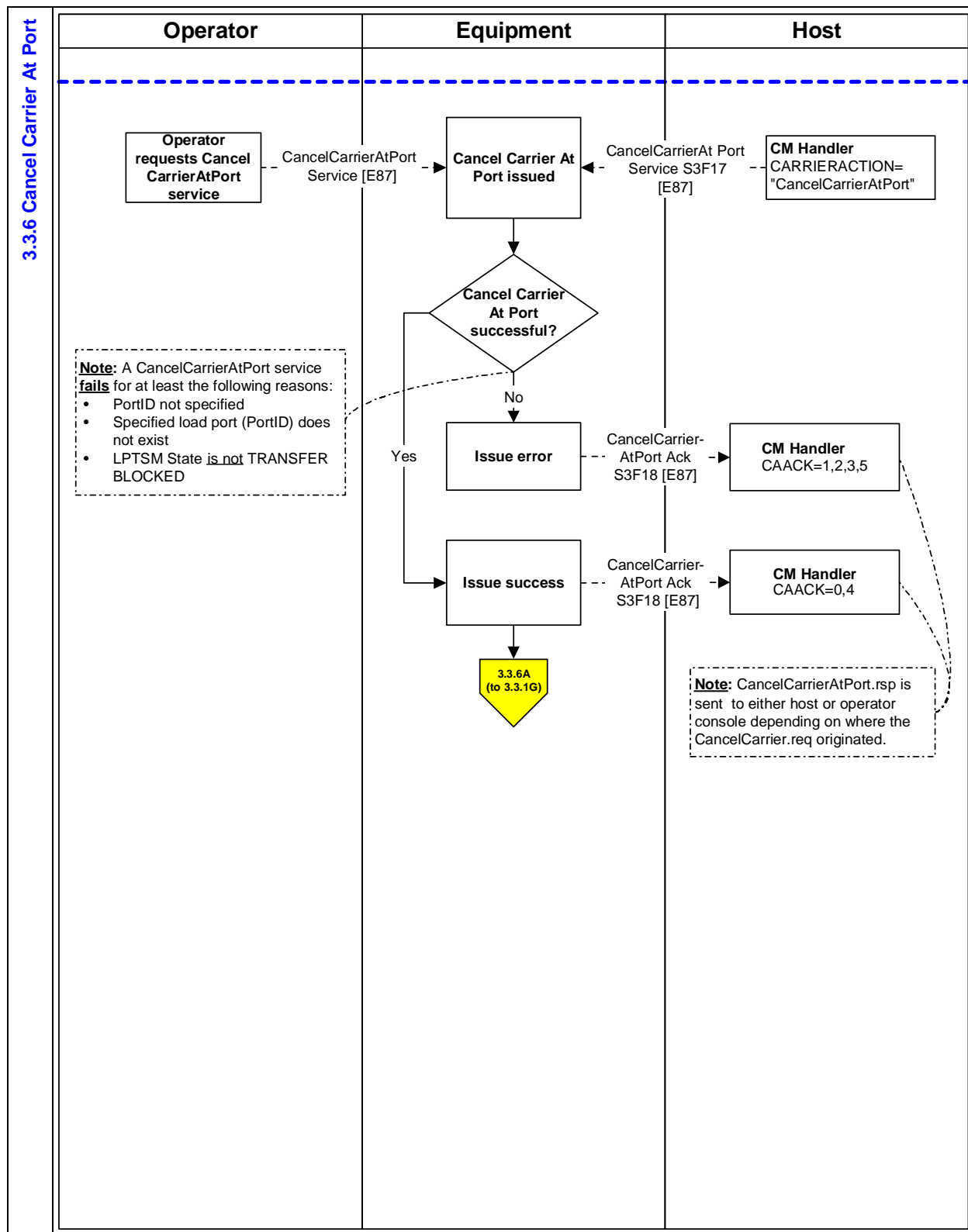


### 3.3.5 Cancel Carrier

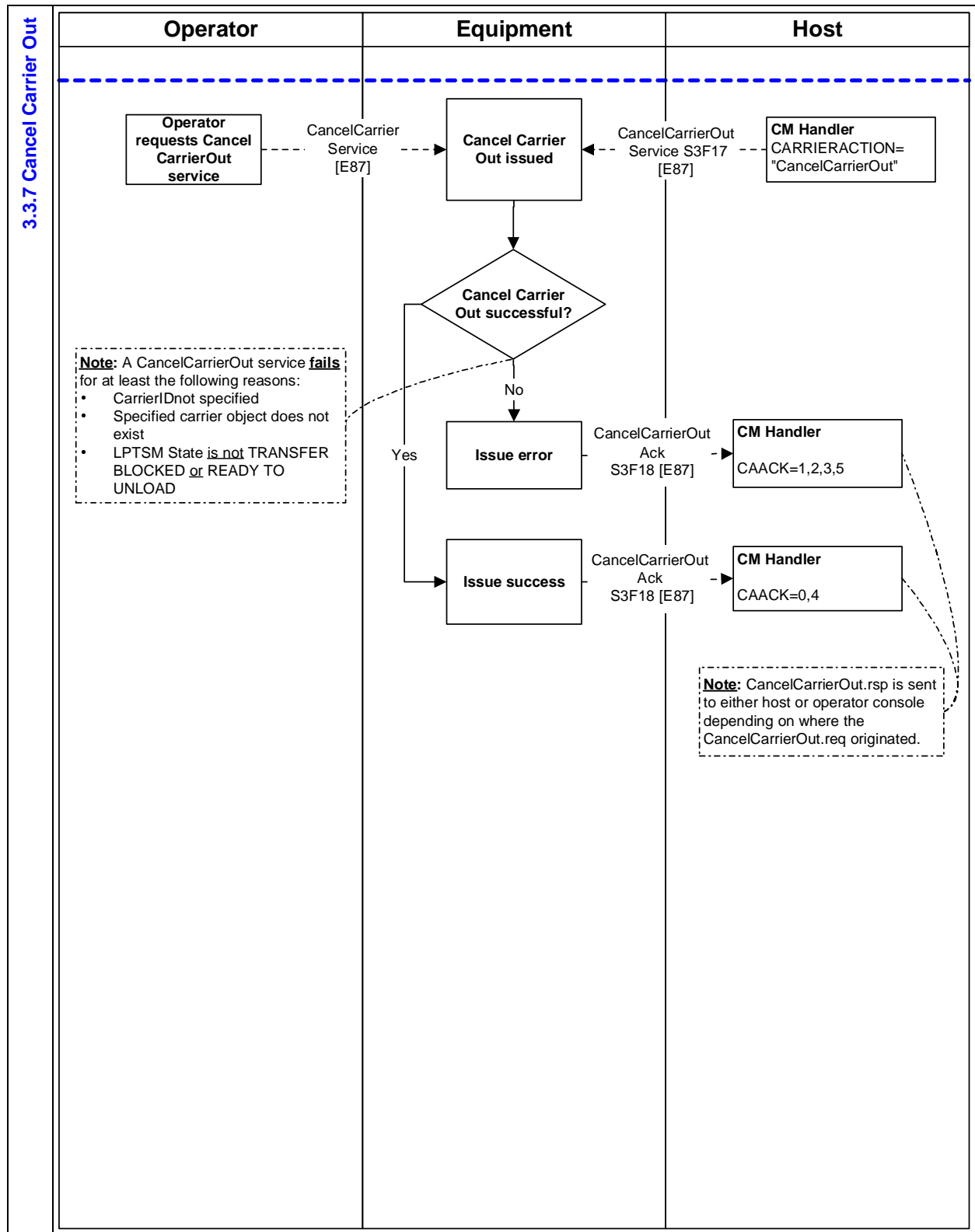




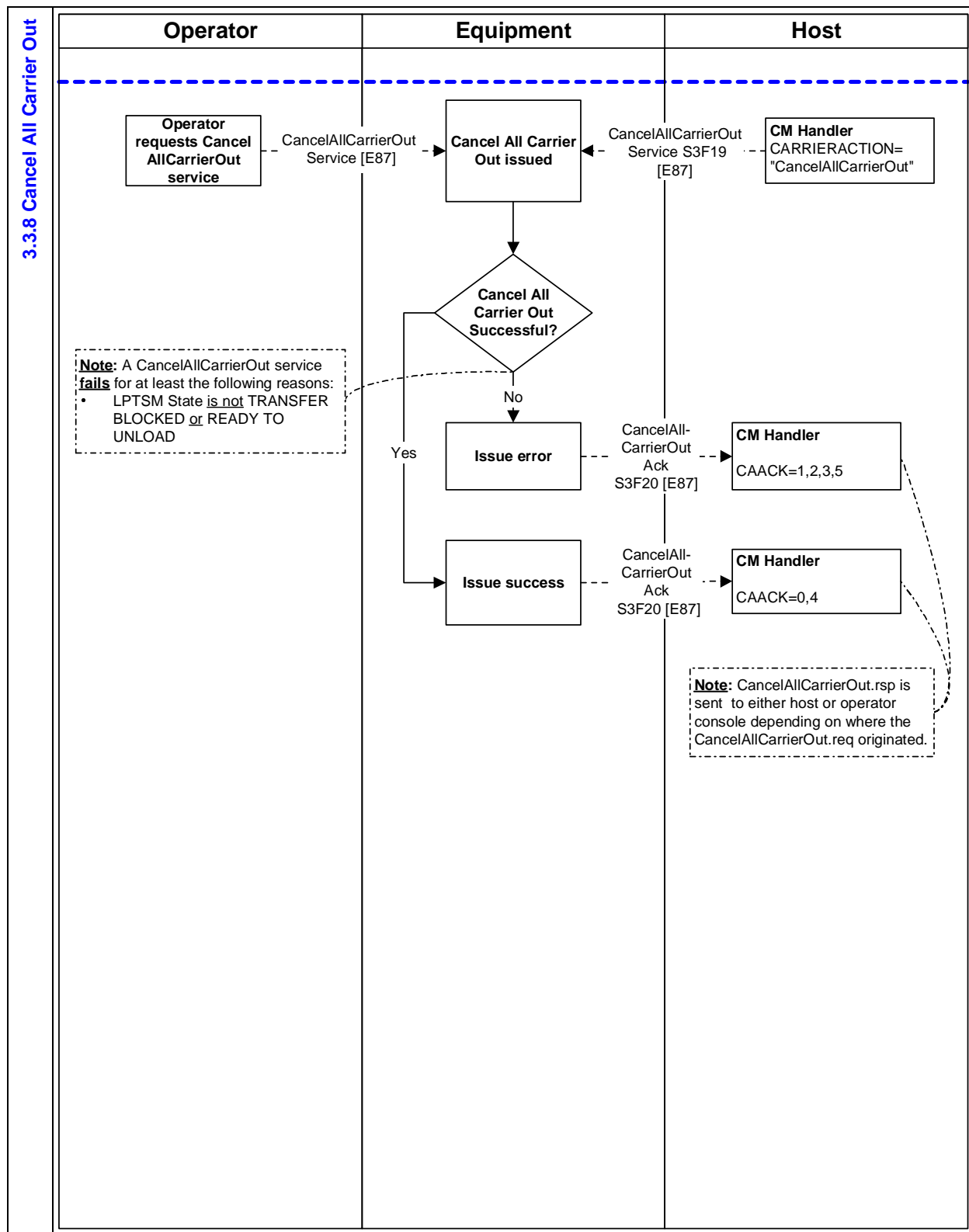
### 3.3.6 Cancel Carrier At Port



### 3.3.7 Cancel Carrier Out



### 3.3.8 Cancel All Carrier Out



## 4 FLOWCHARTS – PROCESSING

The flowcharts in this section pertain to job queue management and product processing on production equipment.

### 4.1 Processing – Queue Management

#### Purpose

This cross-functional operational flowchart describes the equipment’s communication interface behavior from the host’s point of view for process job (E40) and control job (E94) queue management.

#### Criteria

In general, the queue management flowcharts in this section should apply to all equipment within an end-user factory.

- Process job queue management has the following dependencies on control job queue management:
  - Aborting, Stopping or Canceling a Control Job will abort, stop or cancel its respective Process Jobs and possibly remove those Process Jobs from the Process Job Queue.
- Control job queue management has the following dependencies on process job queue management:
  - If only one process job is defined within a control job (a one-to-one relationship exists), then if the process job is aborted or stopped, the equipment may also abort or stop the respective control job automatically. The equipment must document this behavior since it is an additional requirement.

#### Applicable Documents

This operational flowchart conforms to the following industry standards and specifications:

- SEMI E39 – *Object Services*
- SEMI E40 – *Processing Management*
- SEMI E94 – *Control Job Management*

#### Assumptions

1. All Control and Process Job events use E30 style events. Process Job event messages related to S16F7 and F9 are not used.

#### Flowchart Organization

This flowchart is divided into the following sub-processes:

- 4.1.1 Processing – Queue Management – Process Job
  - 4.1.1.1 Process Job Queue Initialization
  - 4.1.1.2 Process Job Queue Size Request
  - 4.1.1.3 Process Job Create and Queue
  - 4.1.1.4 Process Job De-queued

- 4.1.2 Processing – Queue Management – Control Job
  - 4.1.2.1 Control Job Queue Initialization
  - 4.1.2.2 Control Job
  - 4.1.2.3 Control Job Create and Queue
  - 4.1.2.4 Control Job HOQ
  - 4.1.2.5 Control Job De-queued

## Legend

|               |   |              |   |
|---------------|---|--------------|---|
| <b>AMSM</b>   | Access Mode State Model [E87]             | <b>LPTSM</b> | Load Port Transfer State Model [E87]    |
| <b>COSM</b>   | Carrier Object State Model [E87]          | <b>SCT-#</b> | State Change Transition - <transition#> |
| <b>LP</b>     | Load Port                                 | <b>SLSM</b>  | Substrate Location State Model [E90]    |
| <b>LPCASM</b> | Load Port/Carrier Asso. State Model [E87] | <b>SOSM</b>  | Substrate Object State Model [E90]      |
| <b>LPRSM</b>  | Load Port Reservation State Model [E87]   |              |   |



4.1.1 Processing – Queue Management – Process Job

4.1.1.1 Process Job Queue Initialization

| 4.1.1.1 Process Job Queue Initialization | Comments | Equipment   | Host |
|--|----------|---|------|
|  |          | <pre> graph TD     A([Equipment Initialization]) --&gt; B[Perform Process Job Queue Initialization]     B --&gt; C[Set Process Job PRJobSpace = number of available Process Job Queued/ pooled slots [E40]]     C --&gt; D{{4.1.1.1A (to 4.1.1.3A)}}             </pre> |      |

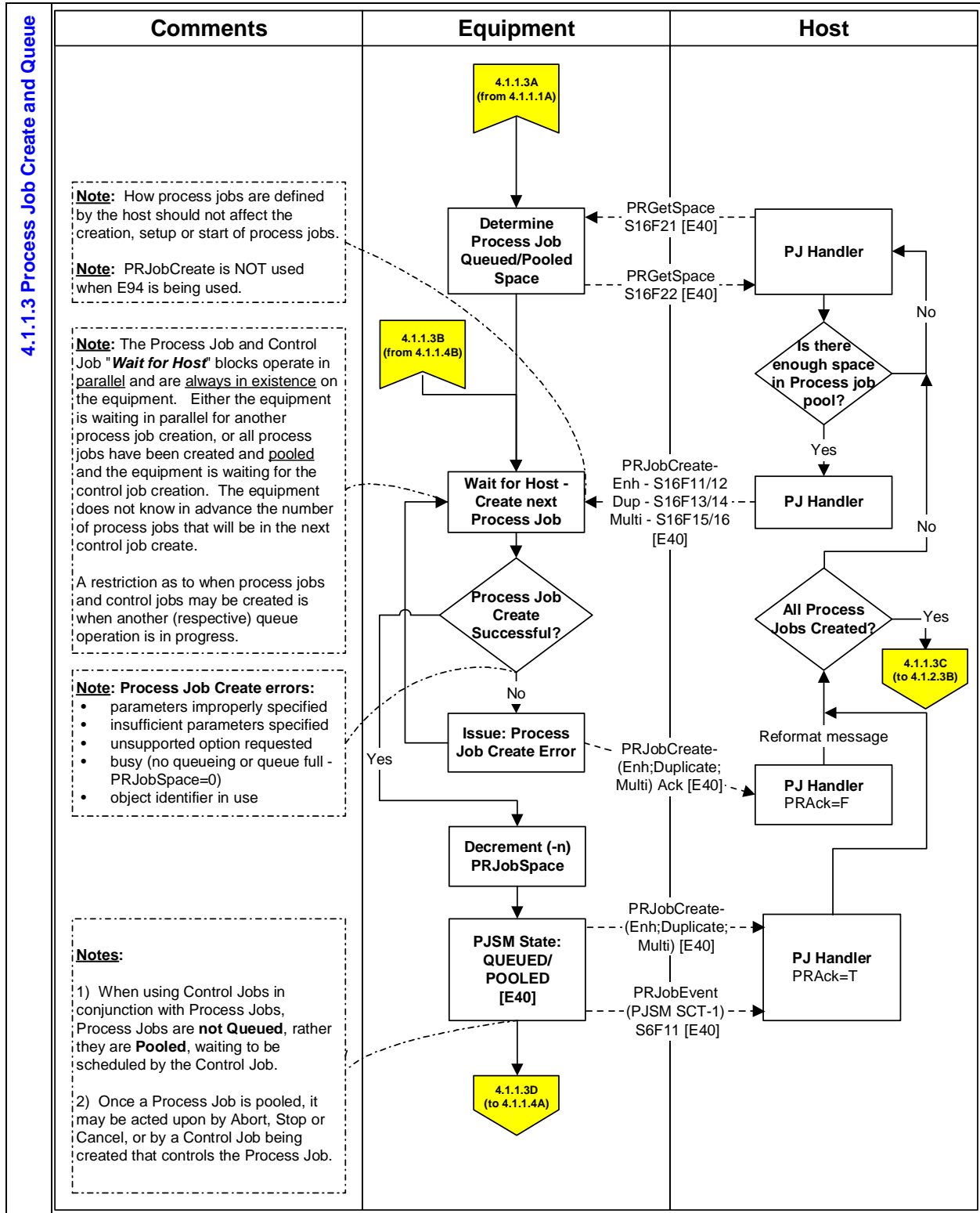
4.1.1 Processing – Queue Management – Process Job (continued)

4.1.1.2 Process Job Queue Size Request

| 4.1.1.2 Process Job Queue Size Request | Comments | Equipment   | Host |
|--|----------|---|------|
|  |          | <pre> graph TD     subgraph Equipment         D[Determine Process Job Queued/Pooled Space]         R[Report PRJobSpace]         D --&gt; R     end     subgraph Host         H1[PJ Handler]         H2[PJ Handler]     end     H1 -.-&gt; PRGetSpace S16F21 [E40]  D     H2 -.-&gt; PRGetSpace S16F22 [E40]  R     </pre> |      |

4.1.1 Processing – Queue Management – Process Job (continued)

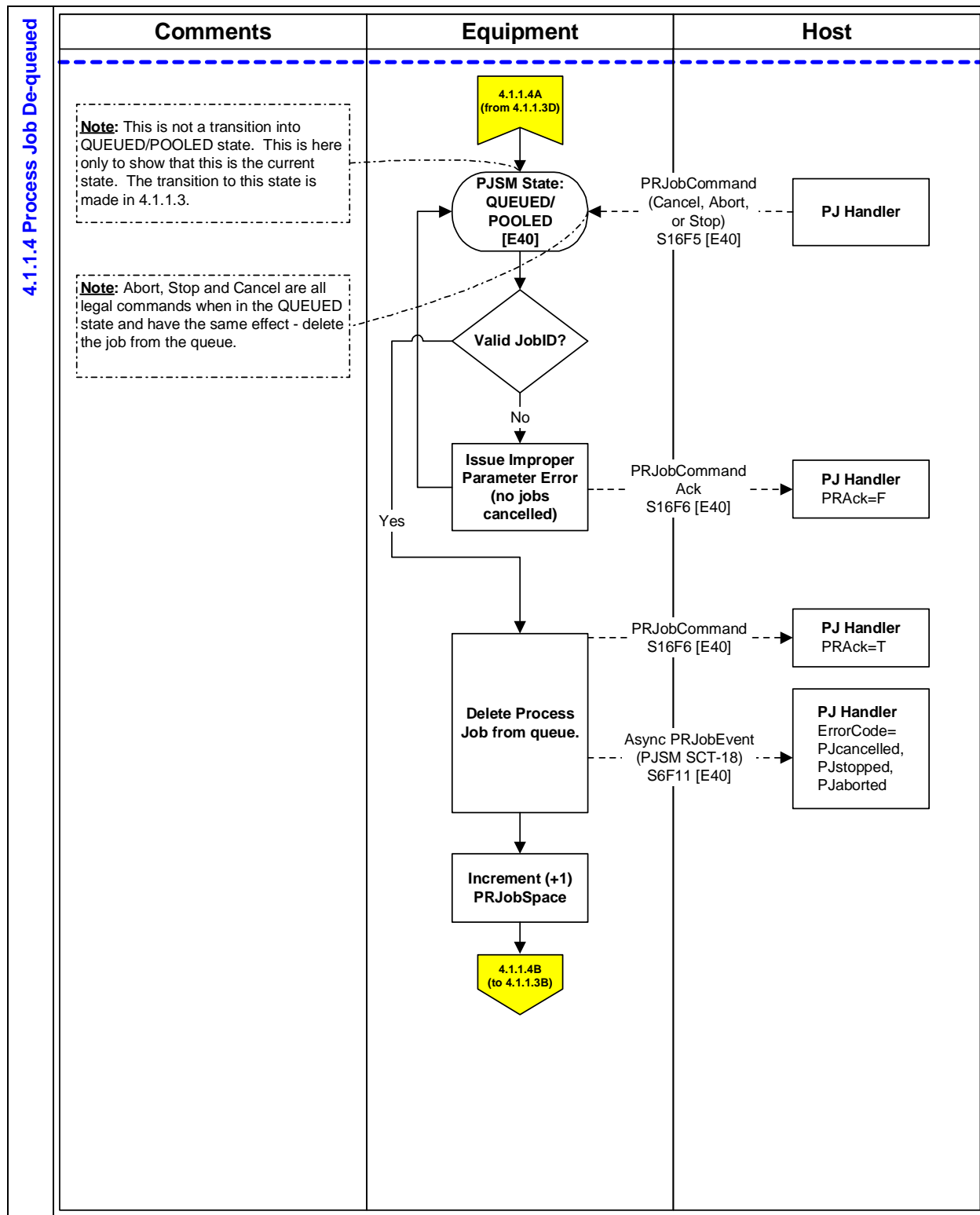
4.1.1.3 Process Job Create and Queue





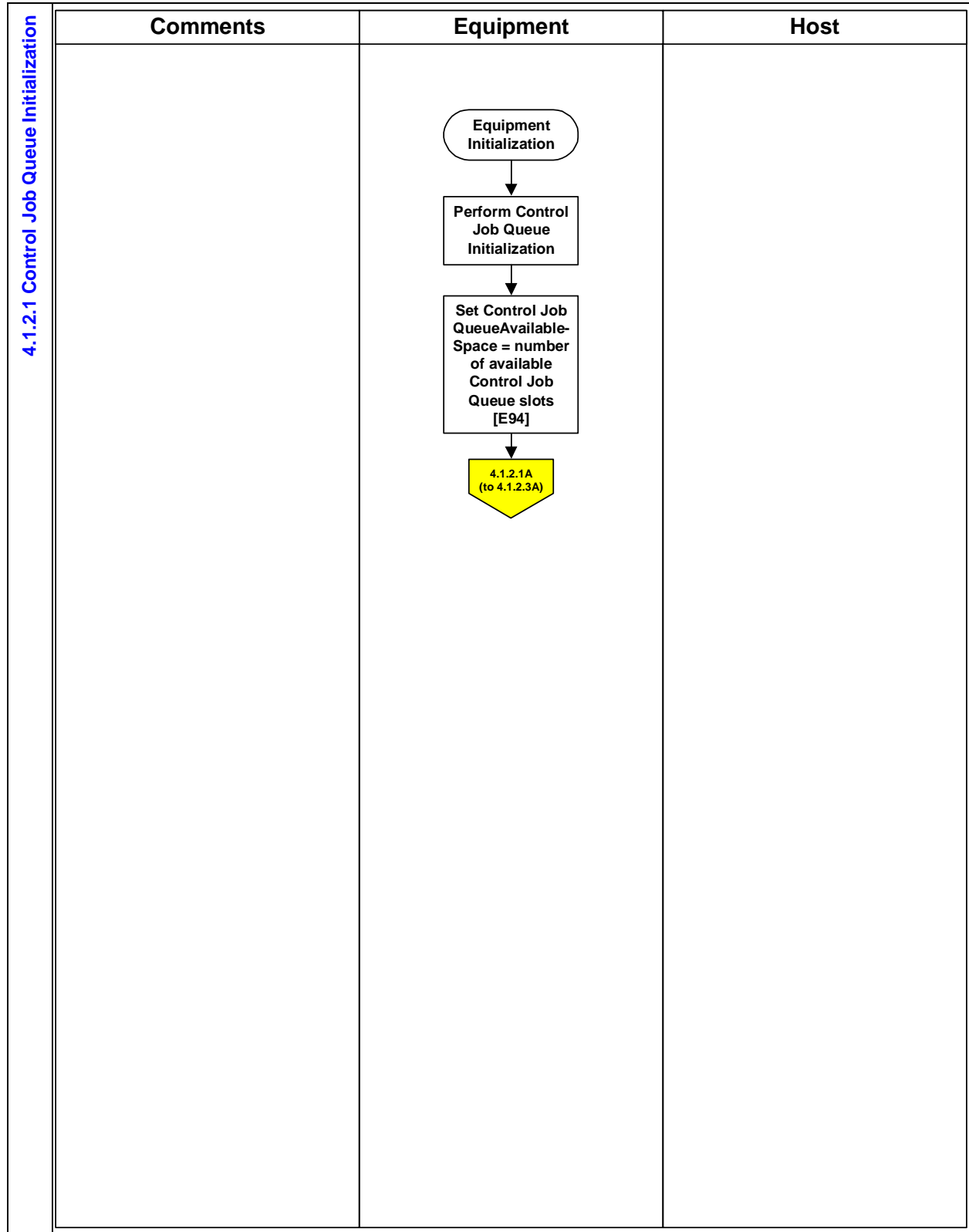
### 4.1.1 Processing – Queue Management – Process Job (continued)

#### 4.1.1.4 Process Job De-queued



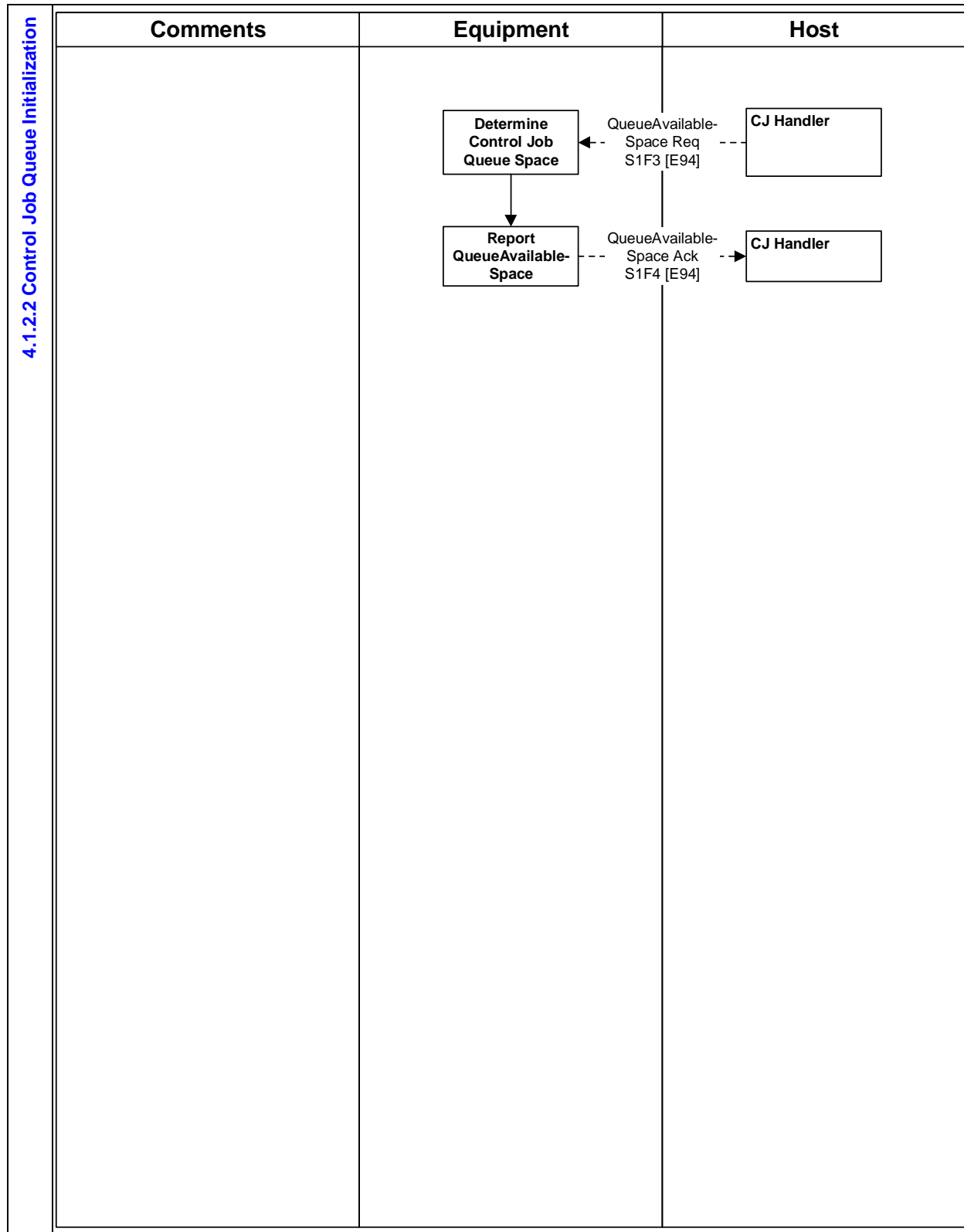
4.1.2 Processing – Queue Management – Control Job

4.1.2.1 Control Job Queue Initialization



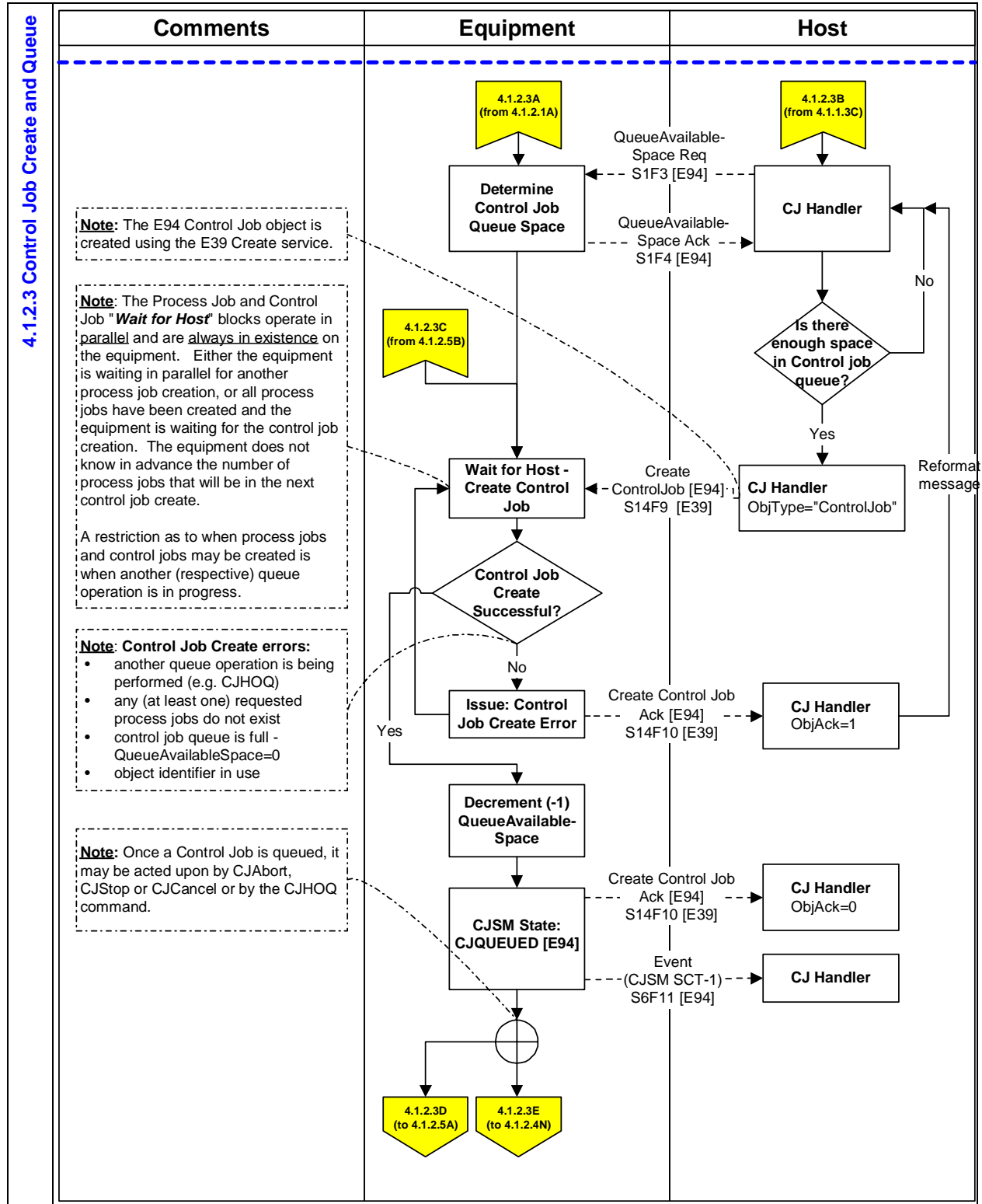
4.1.2 Processing – Queue Management – Control Job (continued)

4.1.2.2 Control Job Size Request



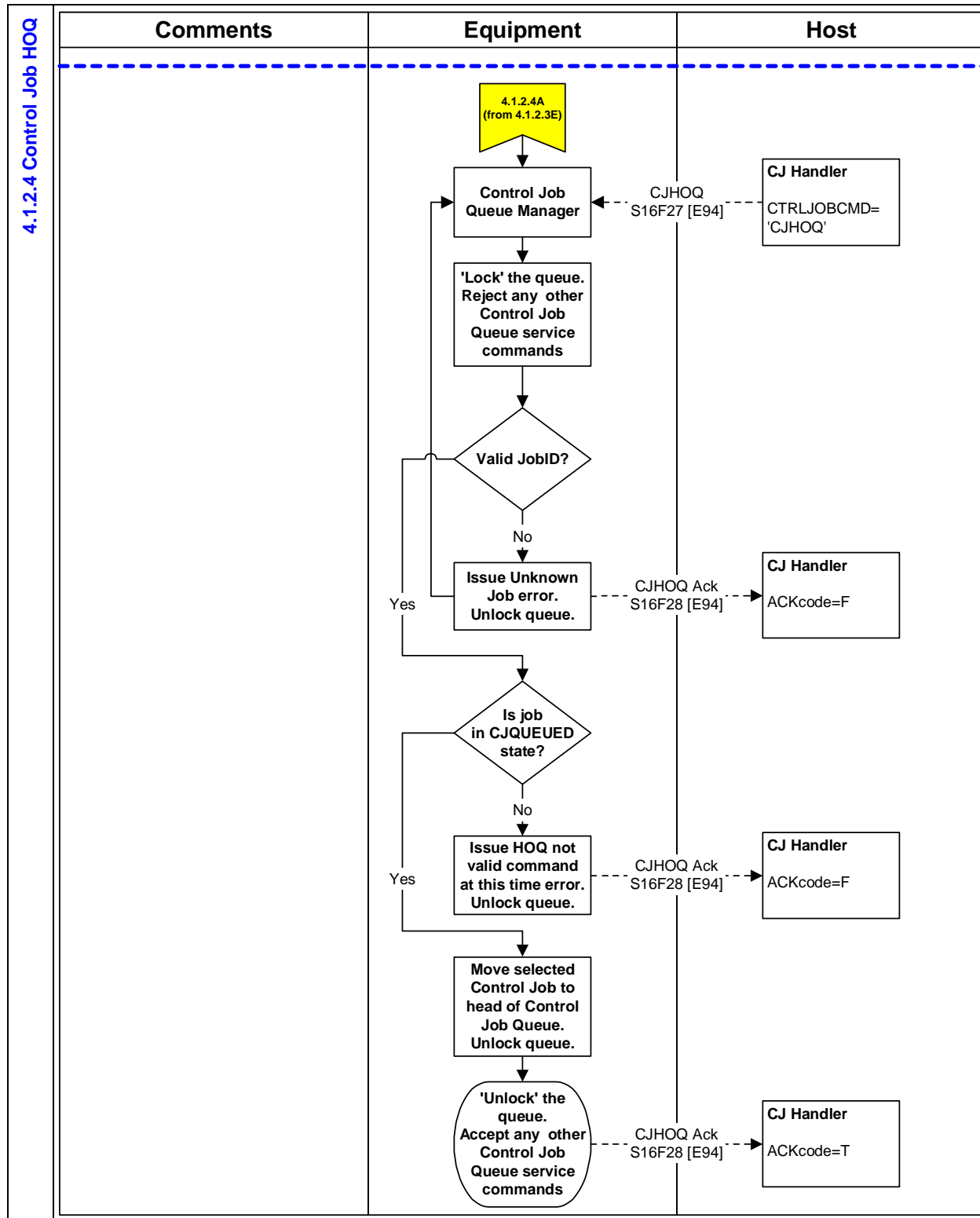
4.1.2 Processing – Queue Management – Control Job (continued)

4.1.2.3 Control Job Create and Queue



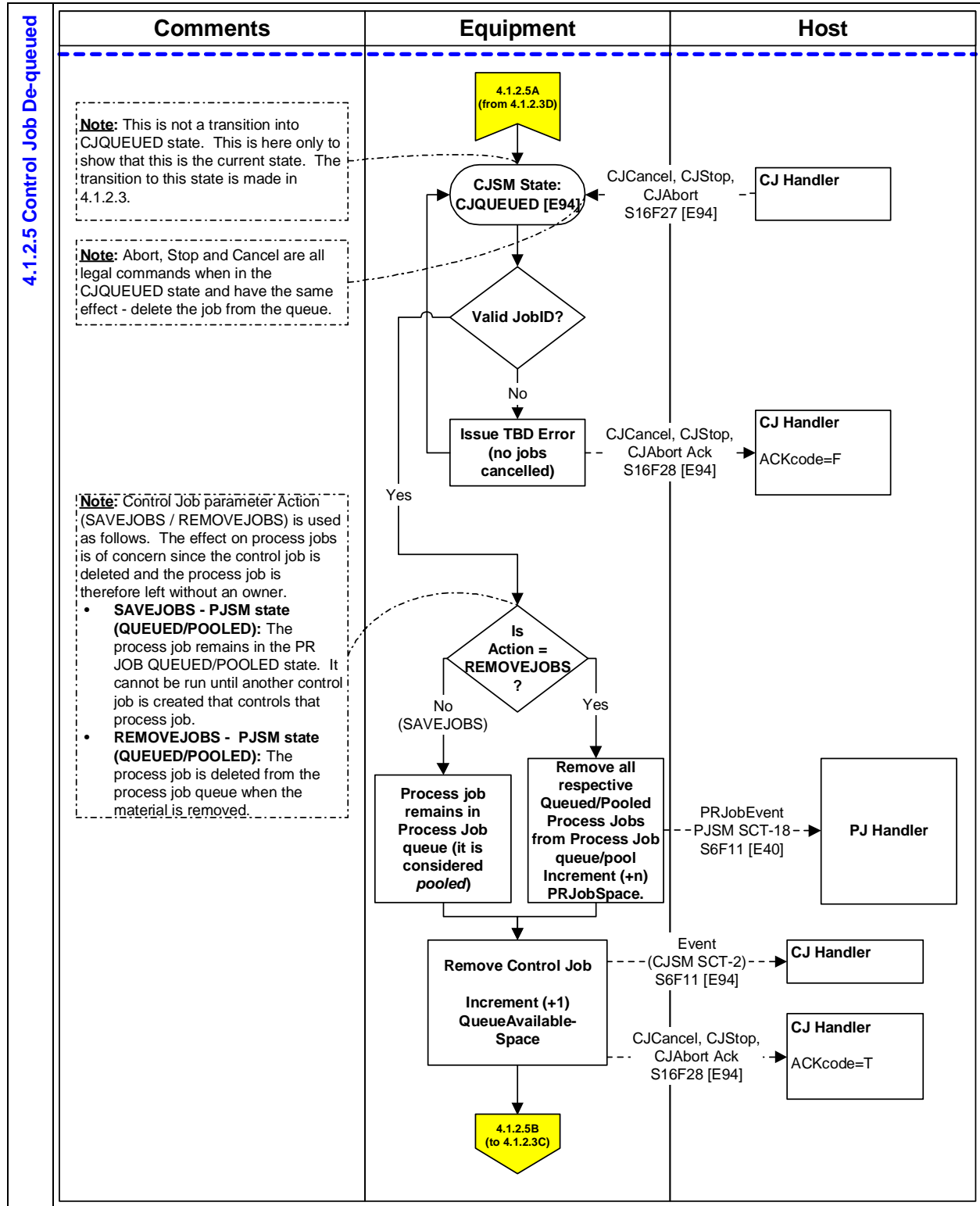
4.1.2 Processing – Queue Management – Control Job (continued)

4.1.2.4 Control Job HOQ



### 4.1.2 Processing – Queue Management – Control Job (continued)

#### 4.1.2.5 Control Job De-queued



## 4.2 Processing – Product

### Purpose

This cross-functional operational flowchart describes the equipment's communication interface behavior from the host's point of view during processing under the following criteria.

### Criteria

- Wafer process method (*batch/single wafer*): This flowchart addresses both single-wafer and batch tools.
- Buffer method (*fixed/internal*): This flowchart addresses fixed buffer and internal buffer equipment.
- Start method (*auto/manual*): Both automatic and manual start methods for both control and process jobs are addressed.
- Control job: This flowchart describes the behavior of a single control job. This flowchart does not preclude equipment from executing more than one control job at a time, since control job objects are independent from each other from the host's point of view.
- Process job: This describes one or more process jobs created using any of the E40 Job Create services. How process jobs are created by the host is not pertinent to how they are scheduled or executed on the equipment. This flowchart does not preclude equipment from executing more than one process job at a time, since process job objects are independent from each other from the host's point of view.

### Applicable Documents

This operational flowchart is based on the following industry standards and specifications:

- SEMI E30 – *GEM*
- SEMI E39 – *Object Services*
- SEMI E40 – *Processing Management*
- SEMI E87 – *Carrier Management*
- SEMI E90 – *Substrate Tracking*
- SEMI E94 – *Control Job Management*

This flowchart also depends on flowchart 4.1 *Processing – Queue Management*.

### Assumptions

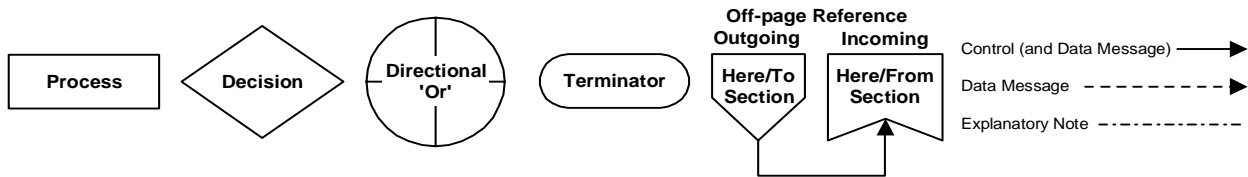
1. Carrier MoveIn flowchart is complete before Begin.
2. All carrier and substrate objects are instantiated before starting this flowchart.
3. For non Process Job events, E30 events are used. Process Job events are defined in E40.

## Flowchart Organization

- 4.2.1 Process/Control Job Queuing
- 4.2.2 Control Job Select
- 4.2.3 Control Job Start
- 4.2.4 Process Job Setup
- 4.2.5 Process Job Start
- 4.2.6 Substrate Tracking – Transport
- 4.2.7 Substrate Tracking – Processing
- 4.2.8 Process Job Complete
- 4.2.9 Control Job Complete
- 4.2.10 Process Job Abnormal Termination
- 4.2.11 Control Job Abnormal Termination

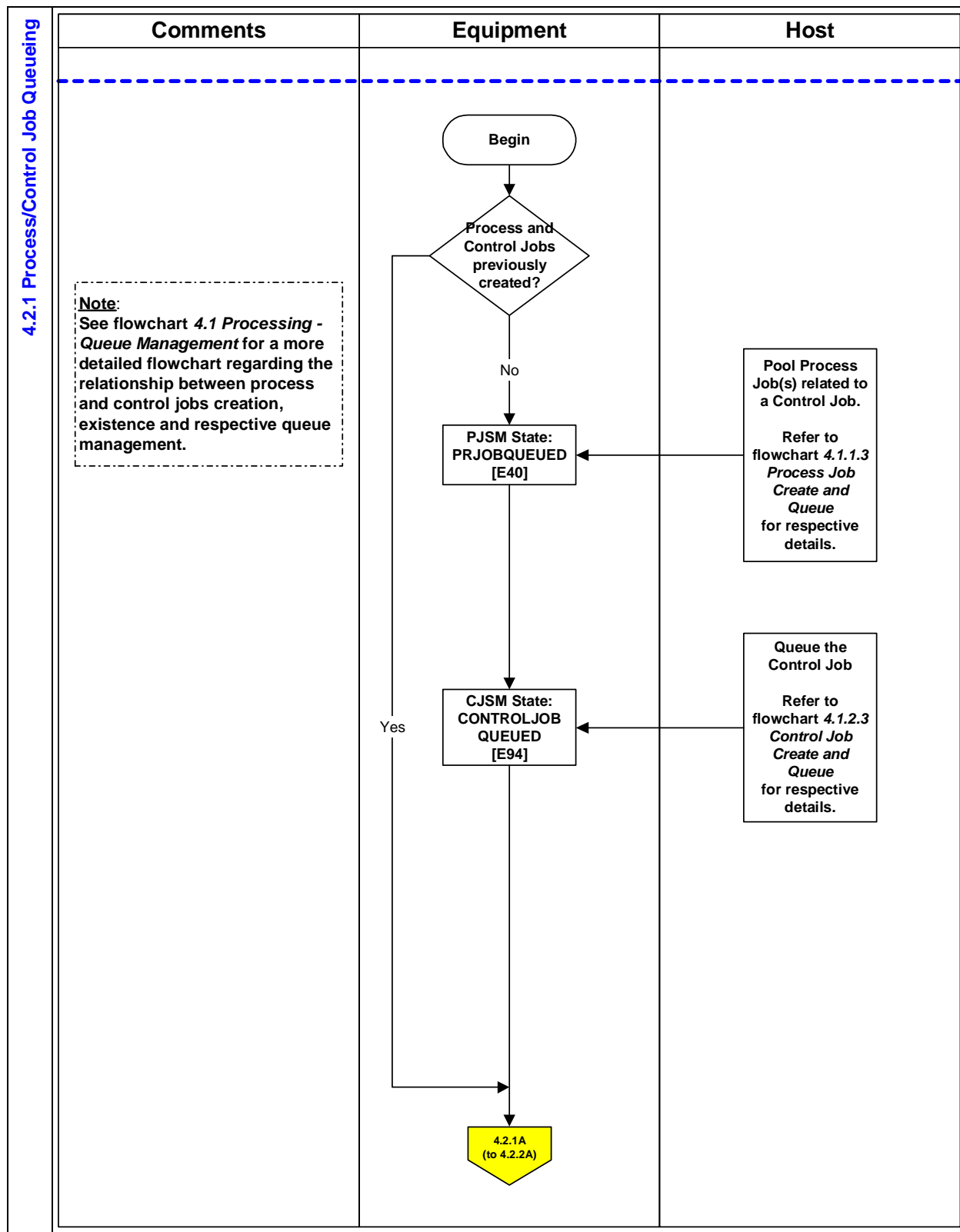
## Legend

|               |   |              |   |
|---------------|---|--------------|---|
| <b>AMSM</b>   | Access Mode State Model [E87]             | <b>LPTSM</b> | Load Port Transfer State Model [E87]    |
| <b>COSM</b>   | Carrier Object State Model [E87]          | <b>SCT-#</b> | State Change Transition - <transition#> |
| <b>LP</b>     | Load Port                                 | <b>SLSM</b>  | Substrate Location State Model [E90]    |
| <b>LPCASM</b> | Load Port/Carrier Asso. State Model [E87] | <b>SOSM</b>  | Substrate Object State Model [E90]      |
| <b>LPRSM</b>  | Load Port Reservation State Model [E87]   |              |   |

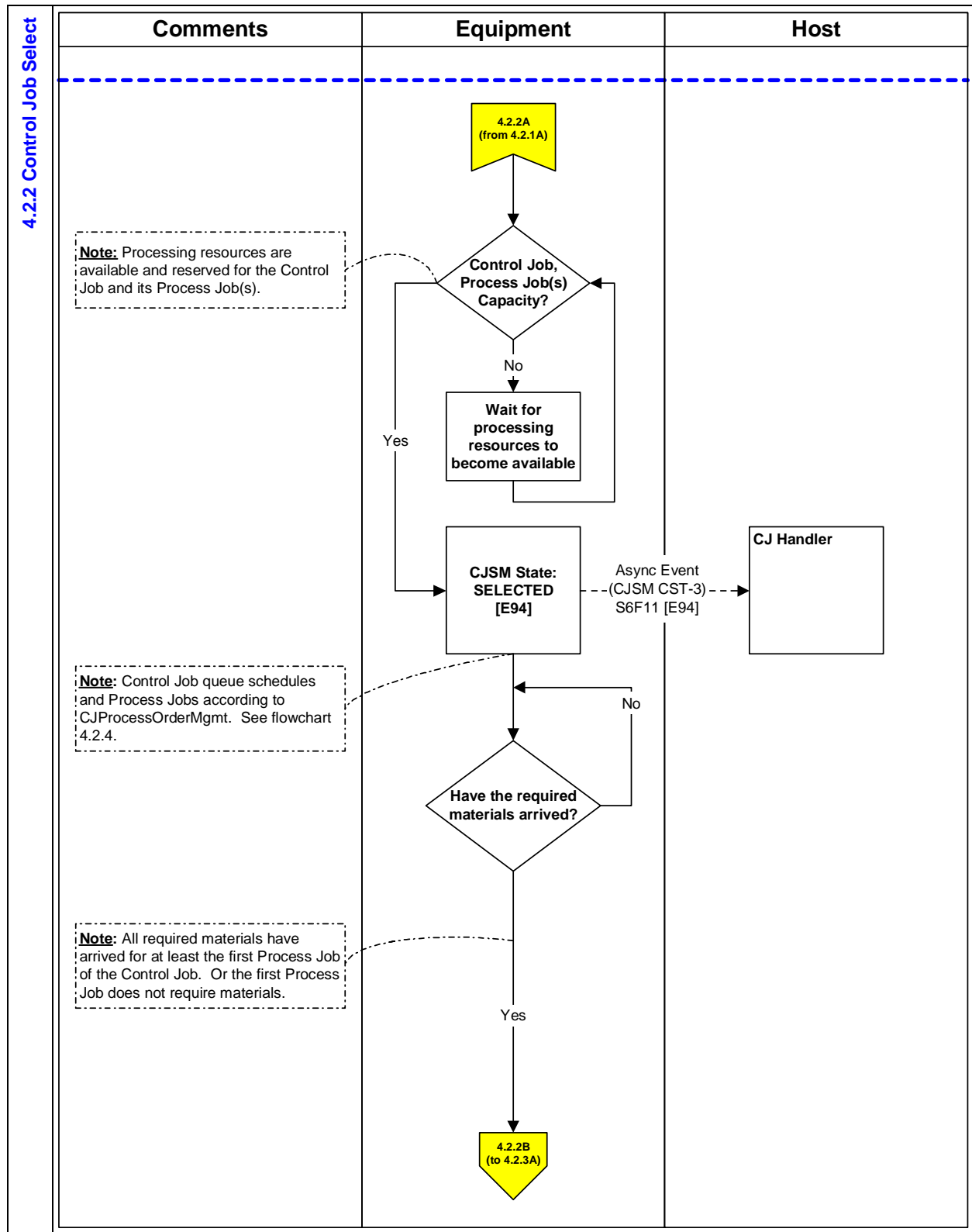




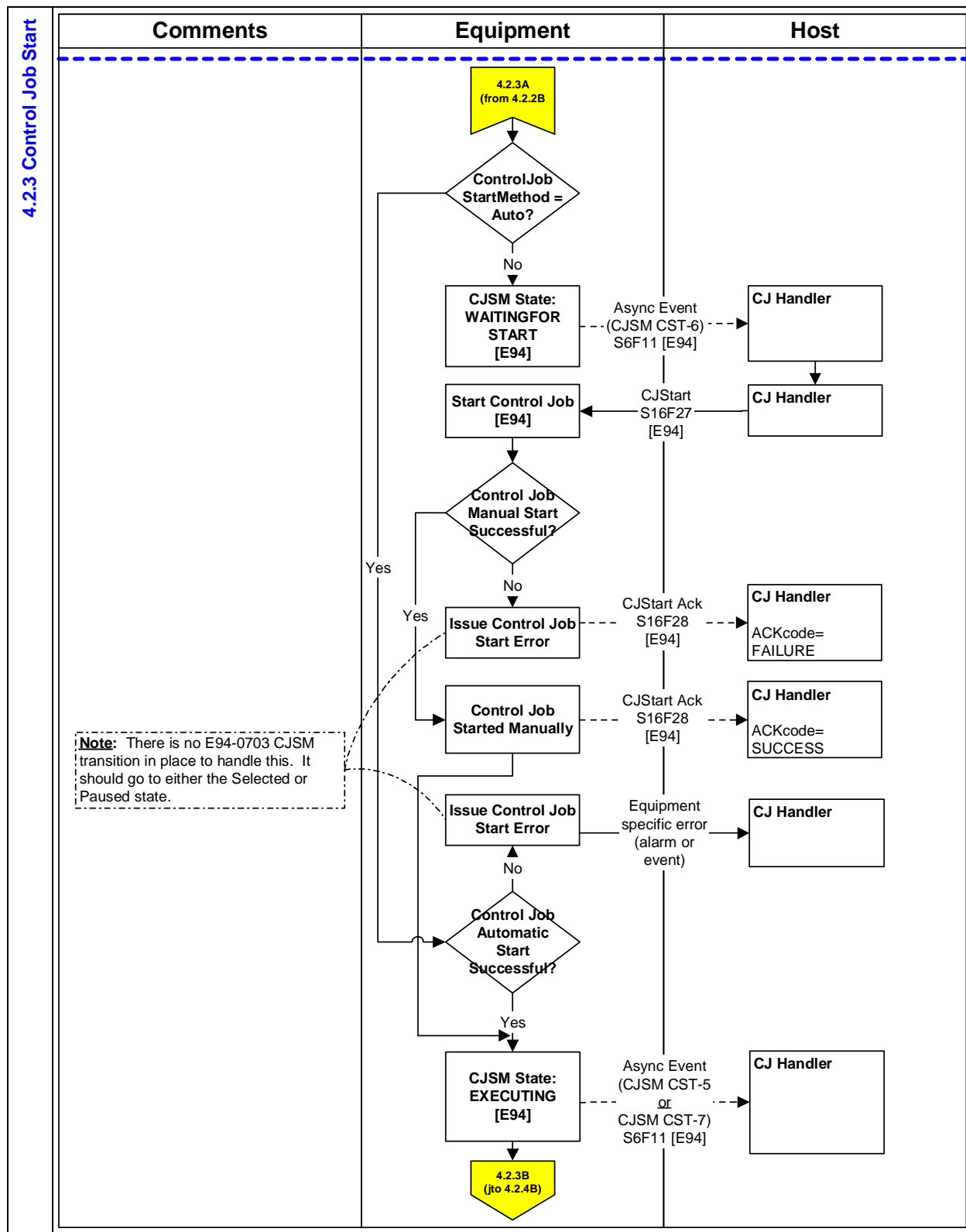
4.2.1 Process/Control Job Queueing



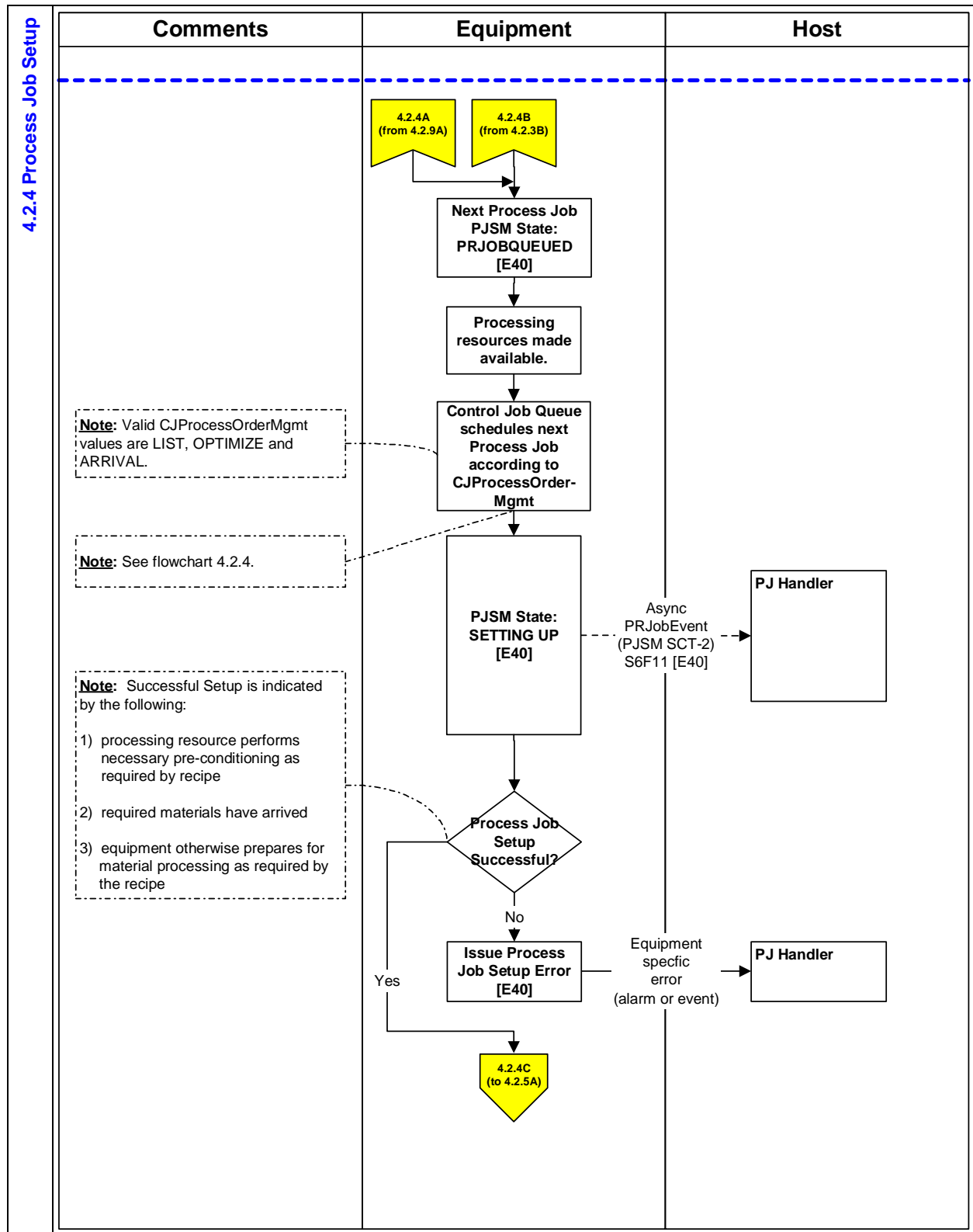
### 4.2.2 Control Job Select



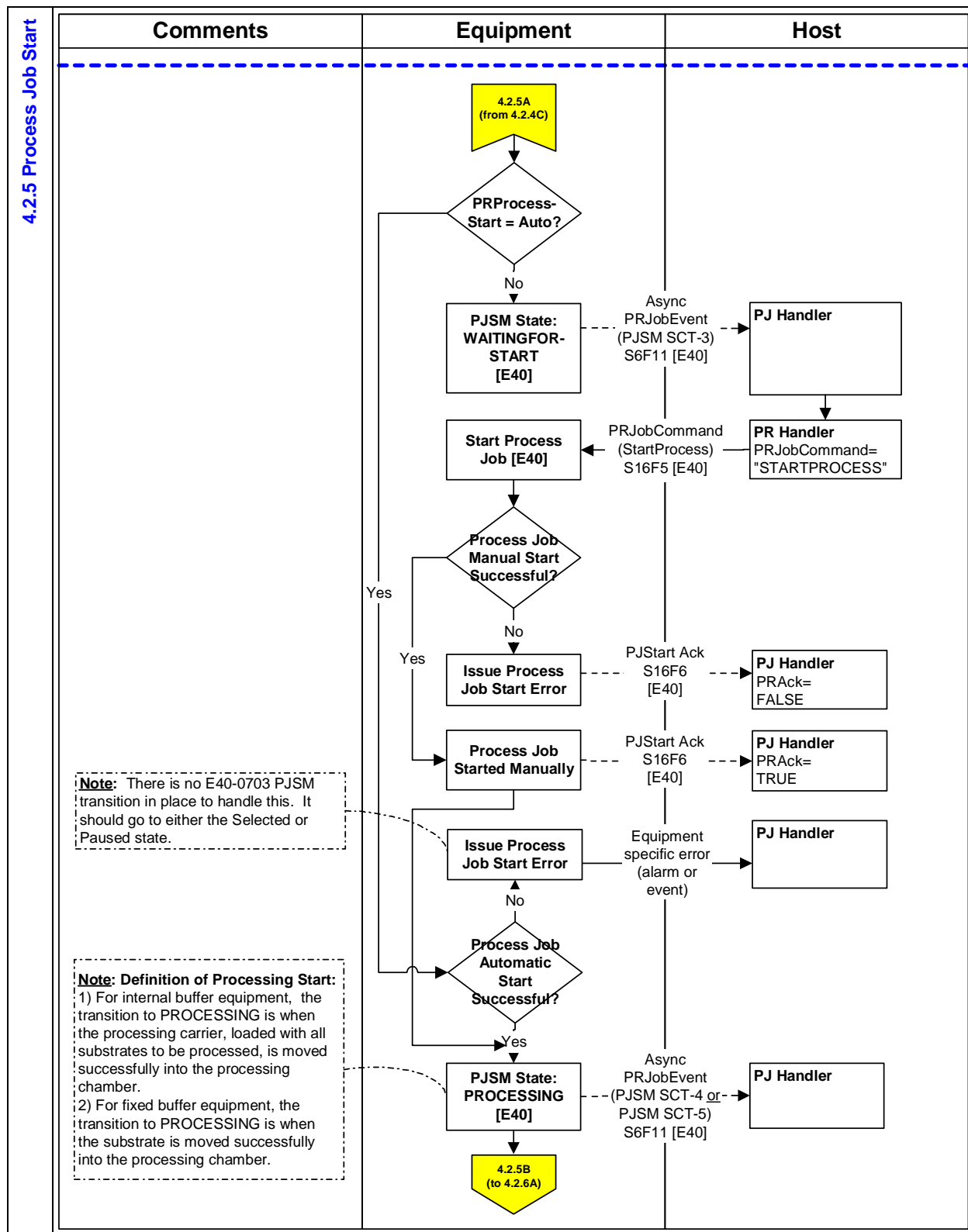
4.2.3 Control Job Start



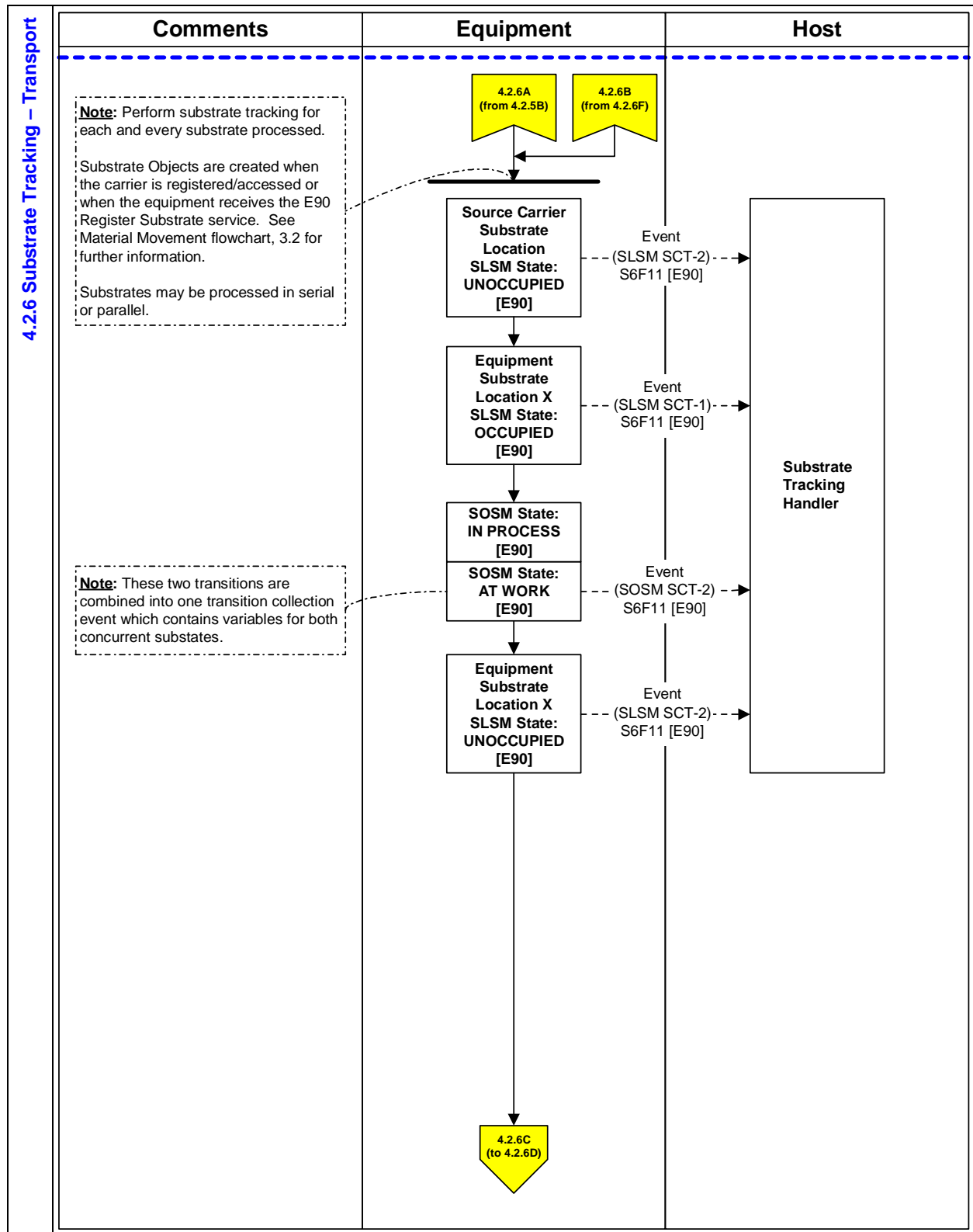
### 4.2.4 Process Job Setup



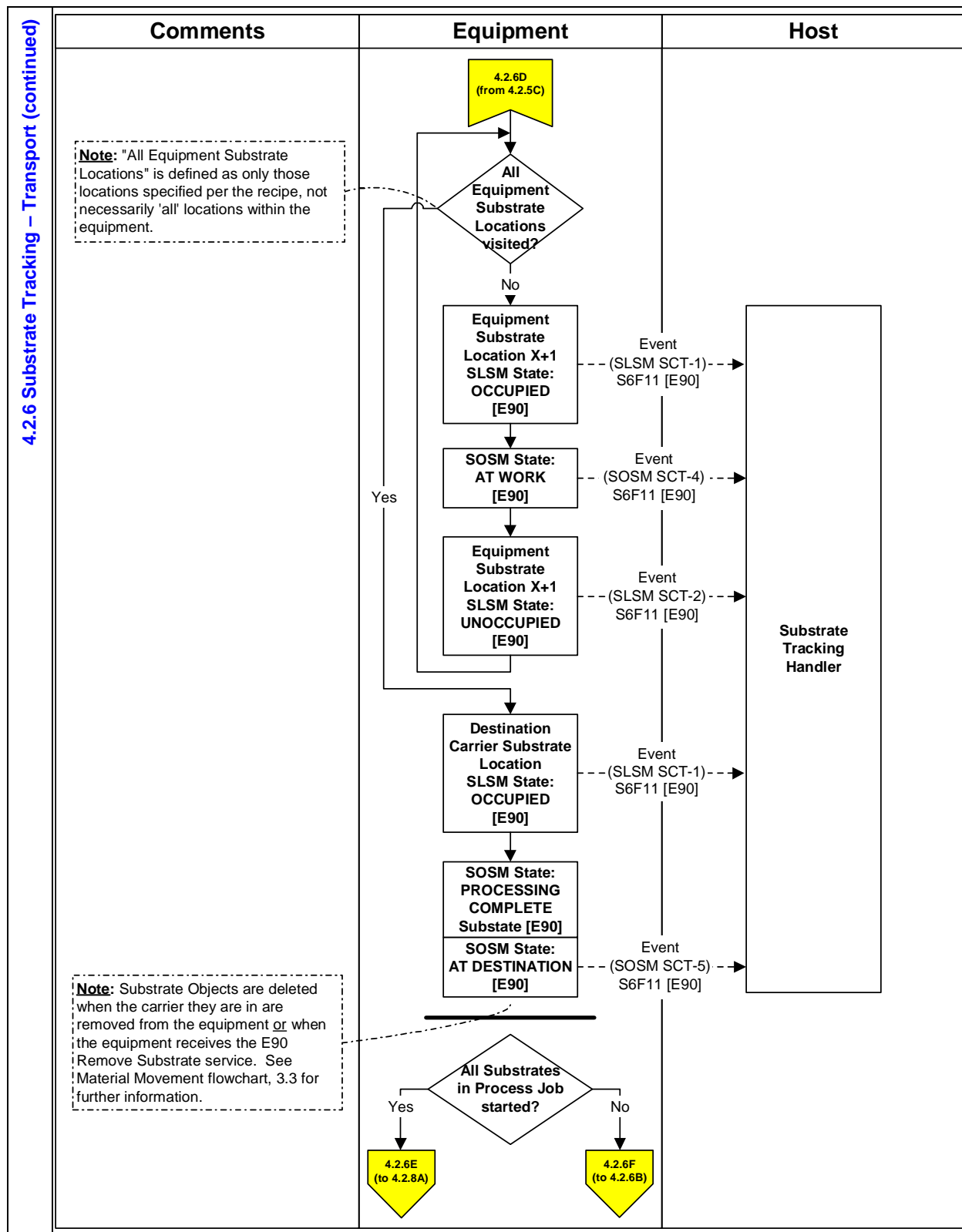
4.2.5 Process Job Start



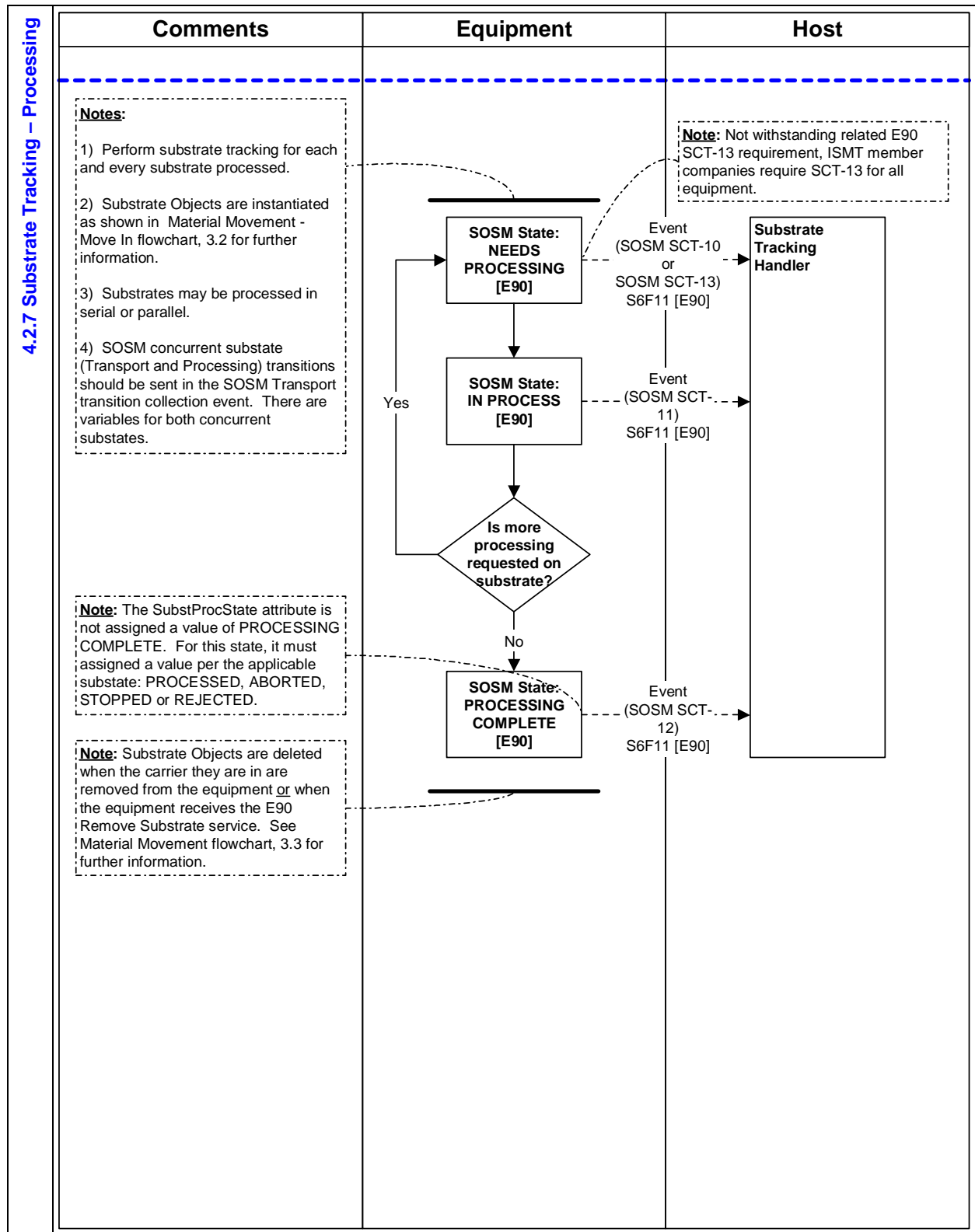
### 4.2.6 Substrate Tracking – Transport



4.2.6 Substrate Tracking – Transport (continued)

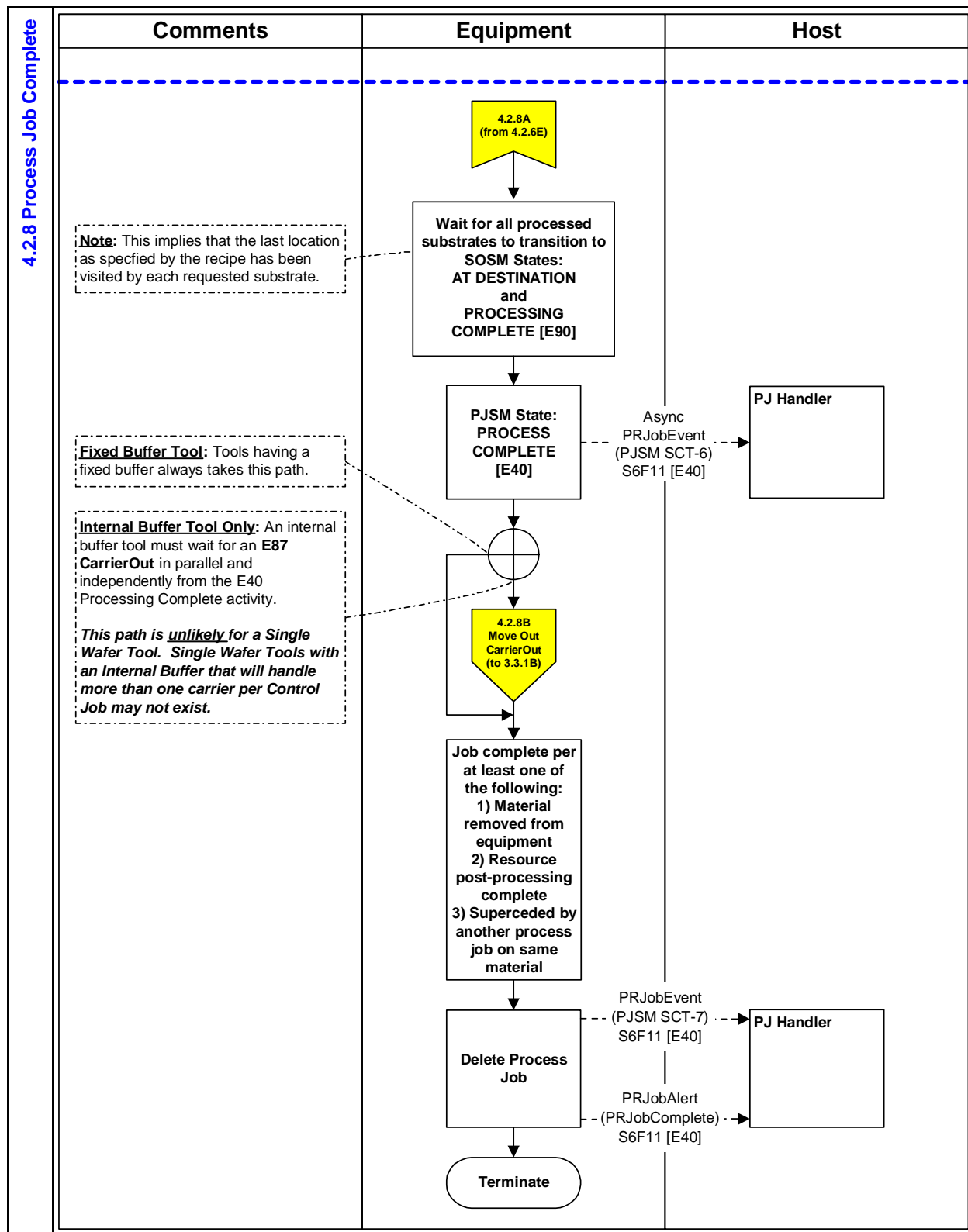


### 4.2.7 Substrate Tracking – Processing

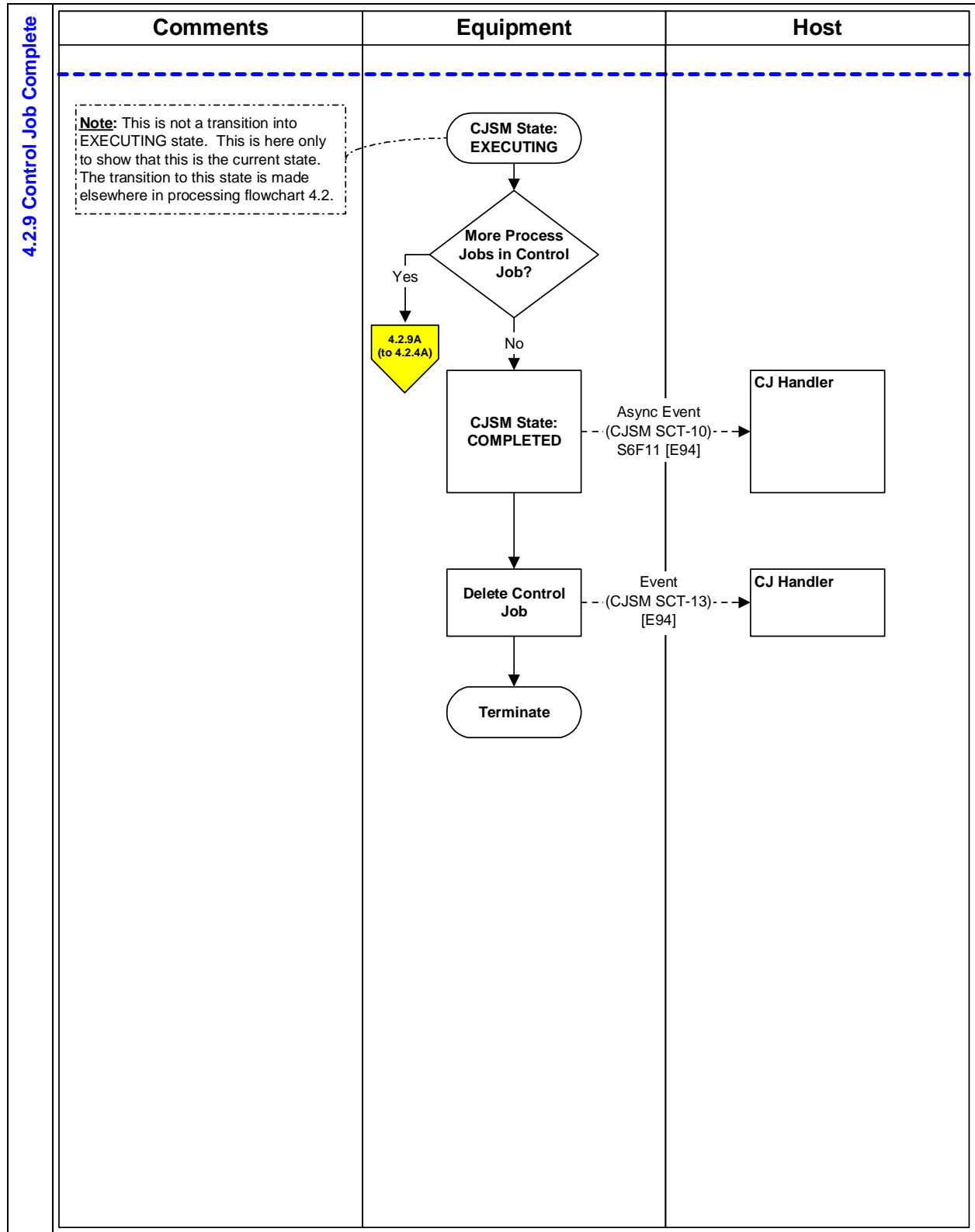




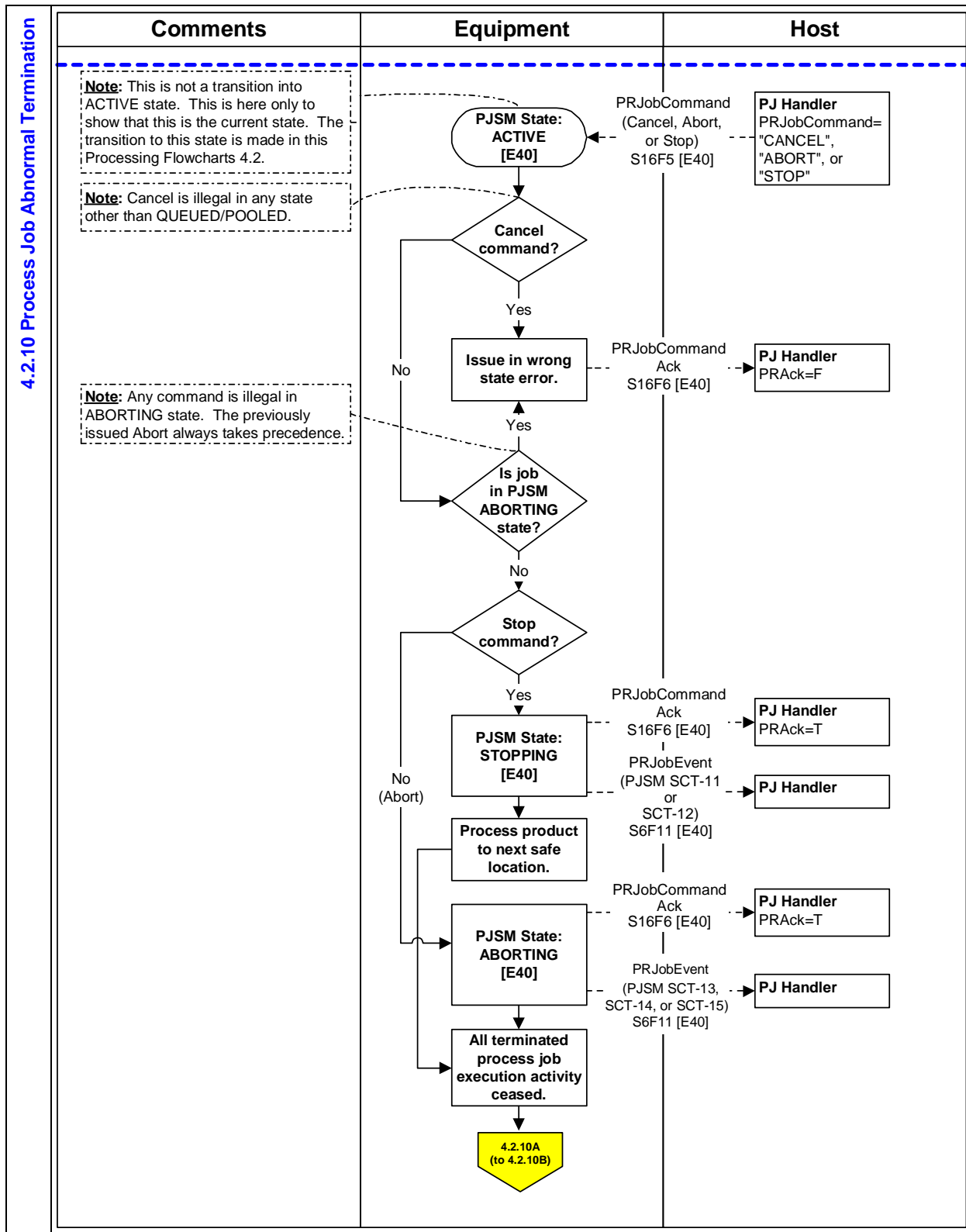
### 4.2.8 Process Job Complete



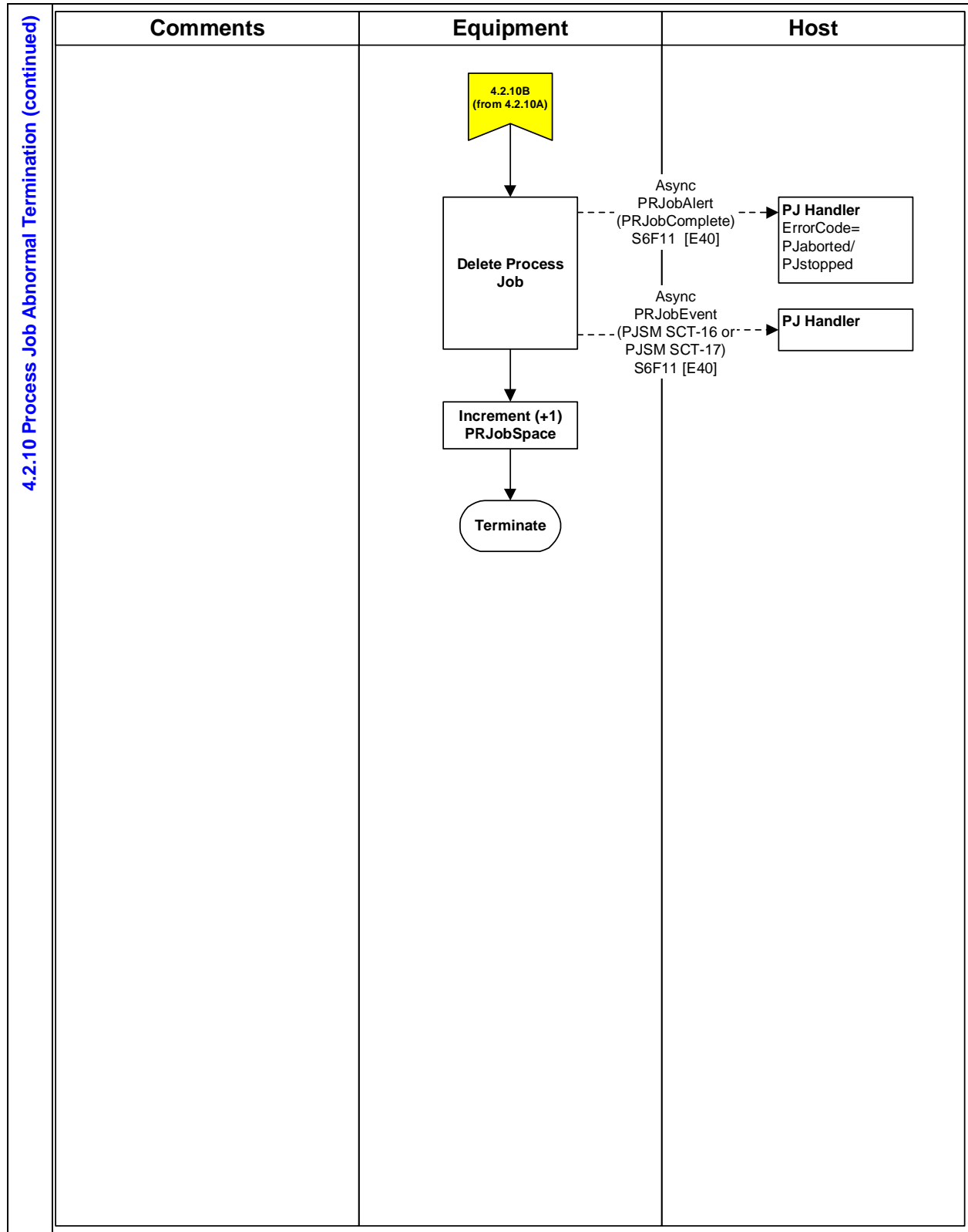
4.2.9 Control Job Complete



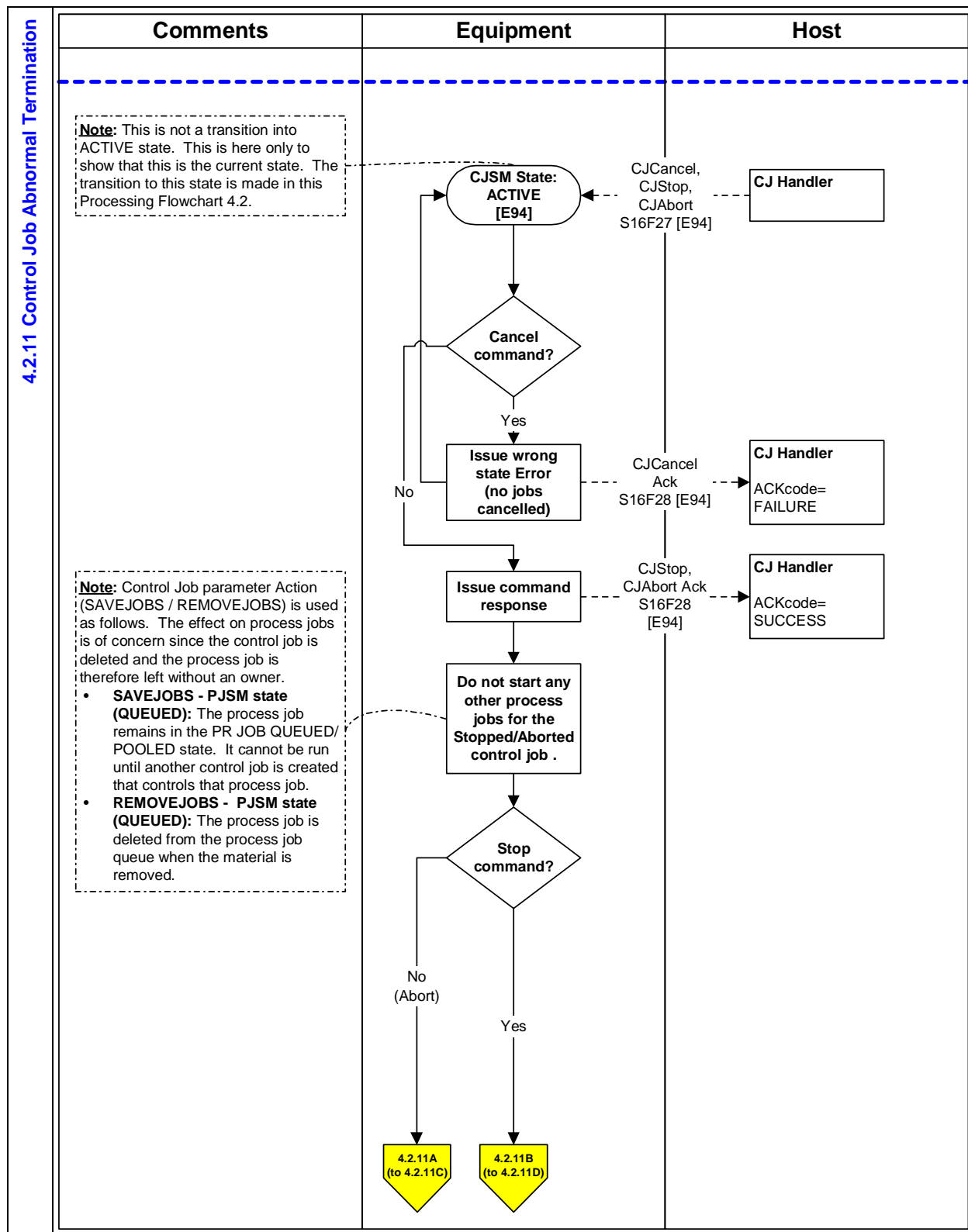
### 4.2.10 Process Job Abnormal Termination



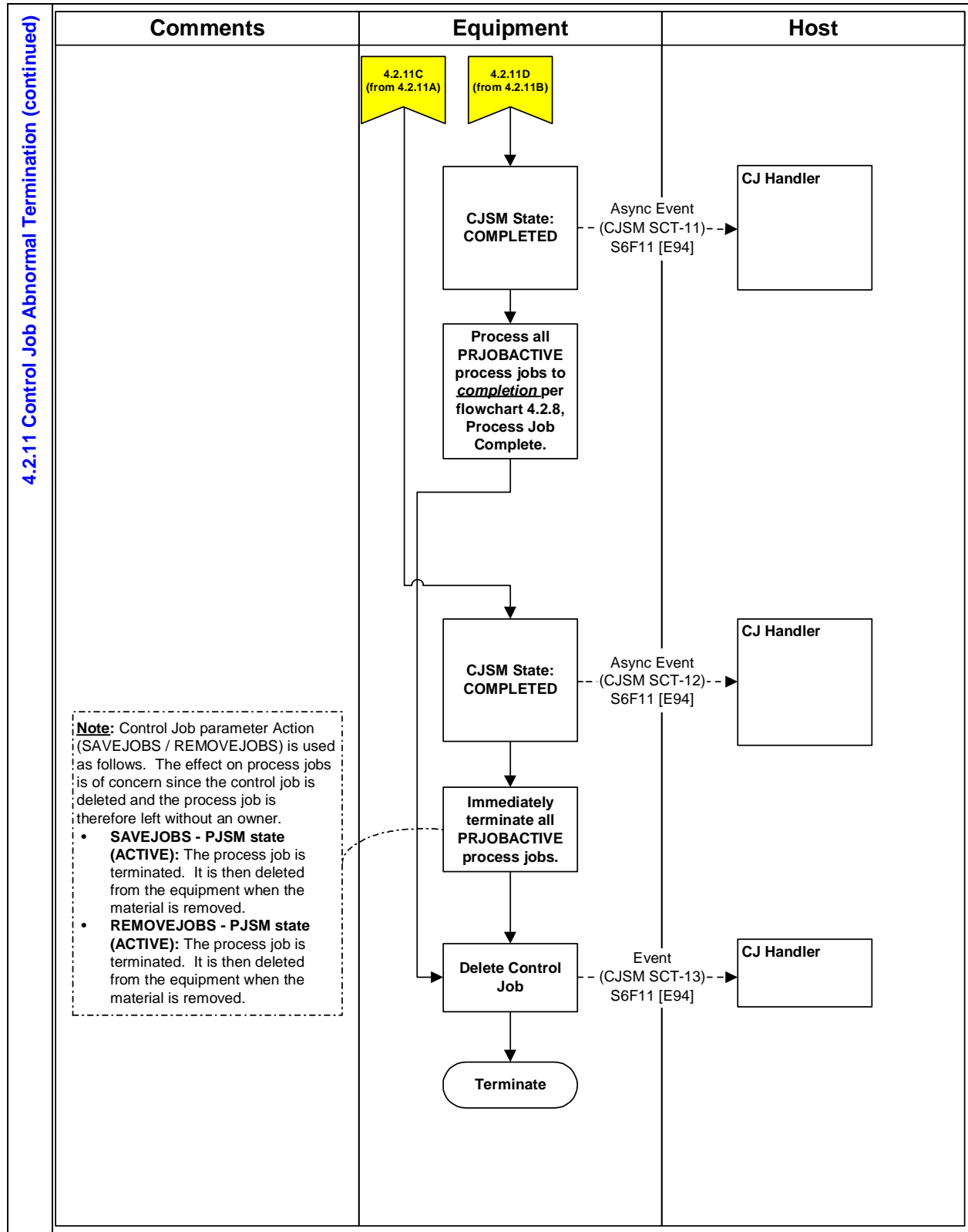
4.2.10 Process Job Abnormal Termination (continued)



### 4.2.11 Control Job Abnormal Termination



4.2.11 Control Job Abnormal Termination (continued)



## 5 FLOWCHARTS – ROUND TRIPS

The flowcharts and scenarios in this section pertain to reference material such as one-page round trip reference flowcharts and ISMT base scenarios.

### 5.1 Round Trips and Base Scenarios

#### Purpose

This cross-functional operational flowchart presents one-page summary references of different round trip scenarios.

#### Applicable Documents

Refer to the individual flowcharts.

#### Assumptions

1. <none>

#### Flowchart Organization

5.1.1 Round Trip Summary – Equipment Verification

5.1.2 Round Trip Summary – Host Verification

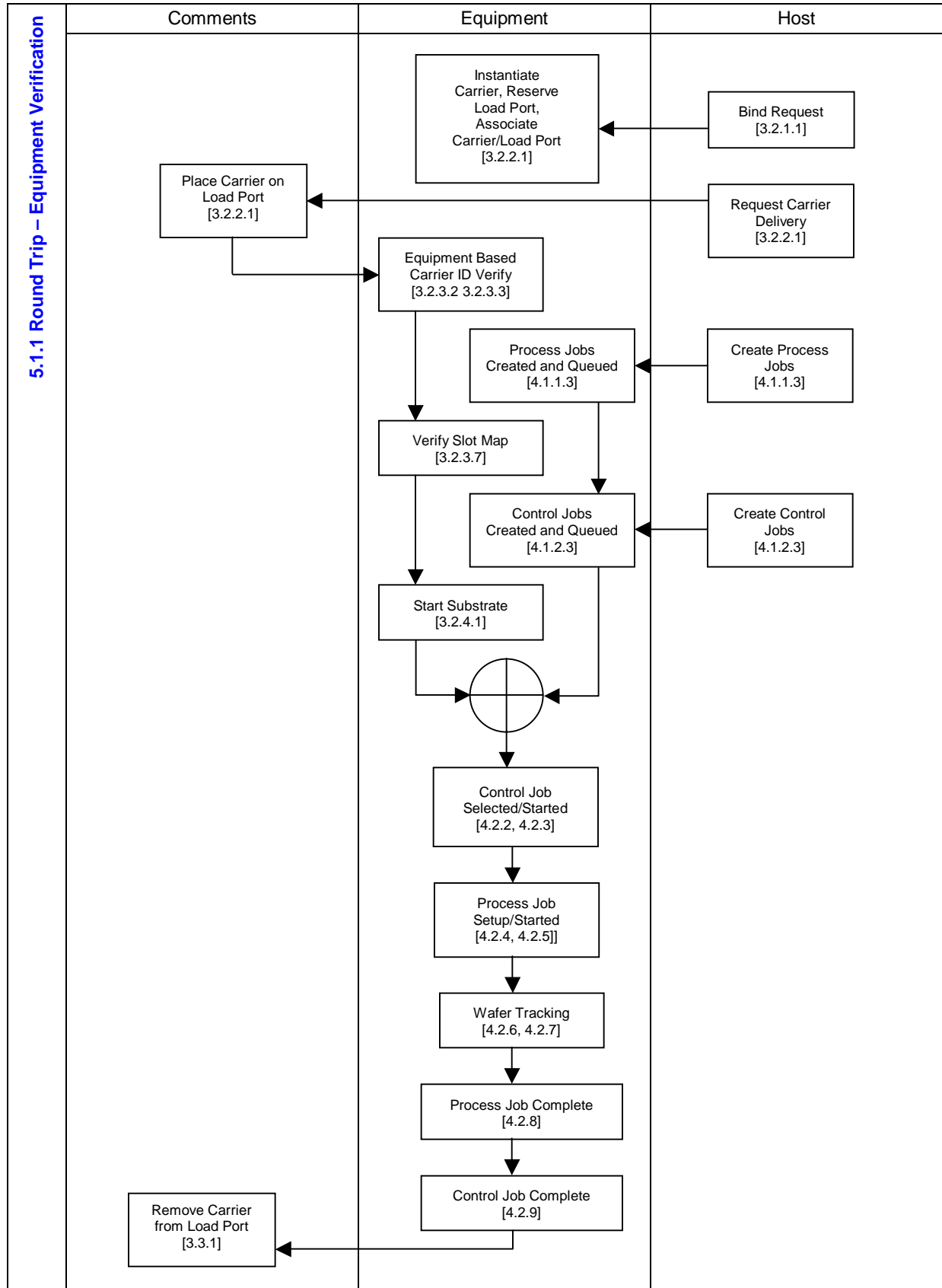
5.1.3 Round Trip Summary – No ID Verification

#### Legend

|               |   |              |   |
|---------------|---|--------------|---|
| <i>AMSM</i>   | Access Mode State Model [E87]             | <i>LPTSM</i> | Load Port Transfer State Model [E87]    |
| <i>COSM</i>   | Carrier Object State Model [E87]          | <i>SCT-#</i> | State Change Transition - <transition#> |
| <i>LP</i>     | Load Port                                 | <i>SLSM</i>  | Substrate Location State Model [E90]    |
| <i>LPCASM</i> | Load Port/Carrier Asso. State Model [E87] | <i>SOSM</i>  | Substrate Object State Model [E90]      |
| <i>LPRSM</i>  | Load Port Reservation State Model [E87]   |              |   |

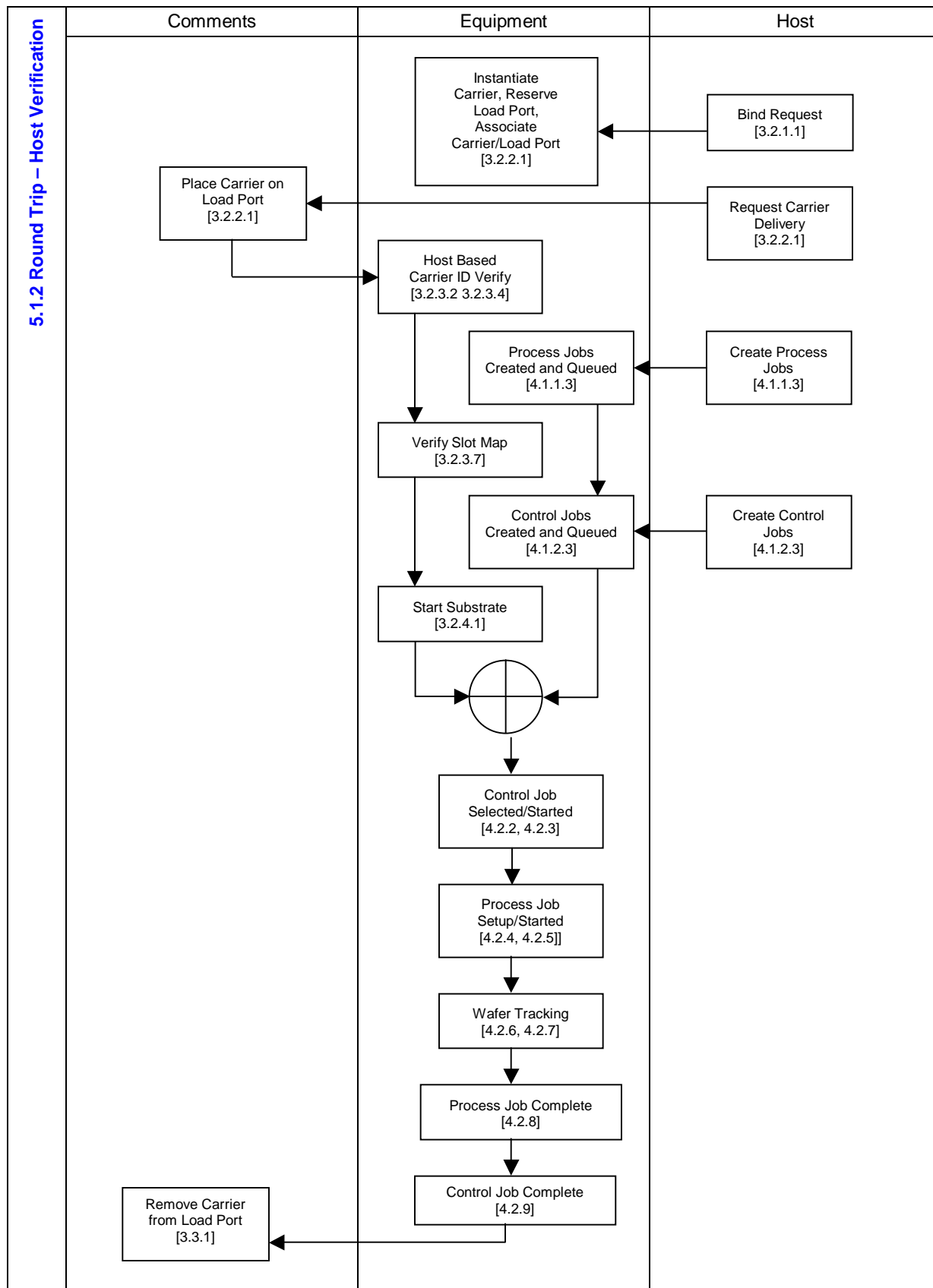


### 5.1.1 Round Trip – Equipment Verification

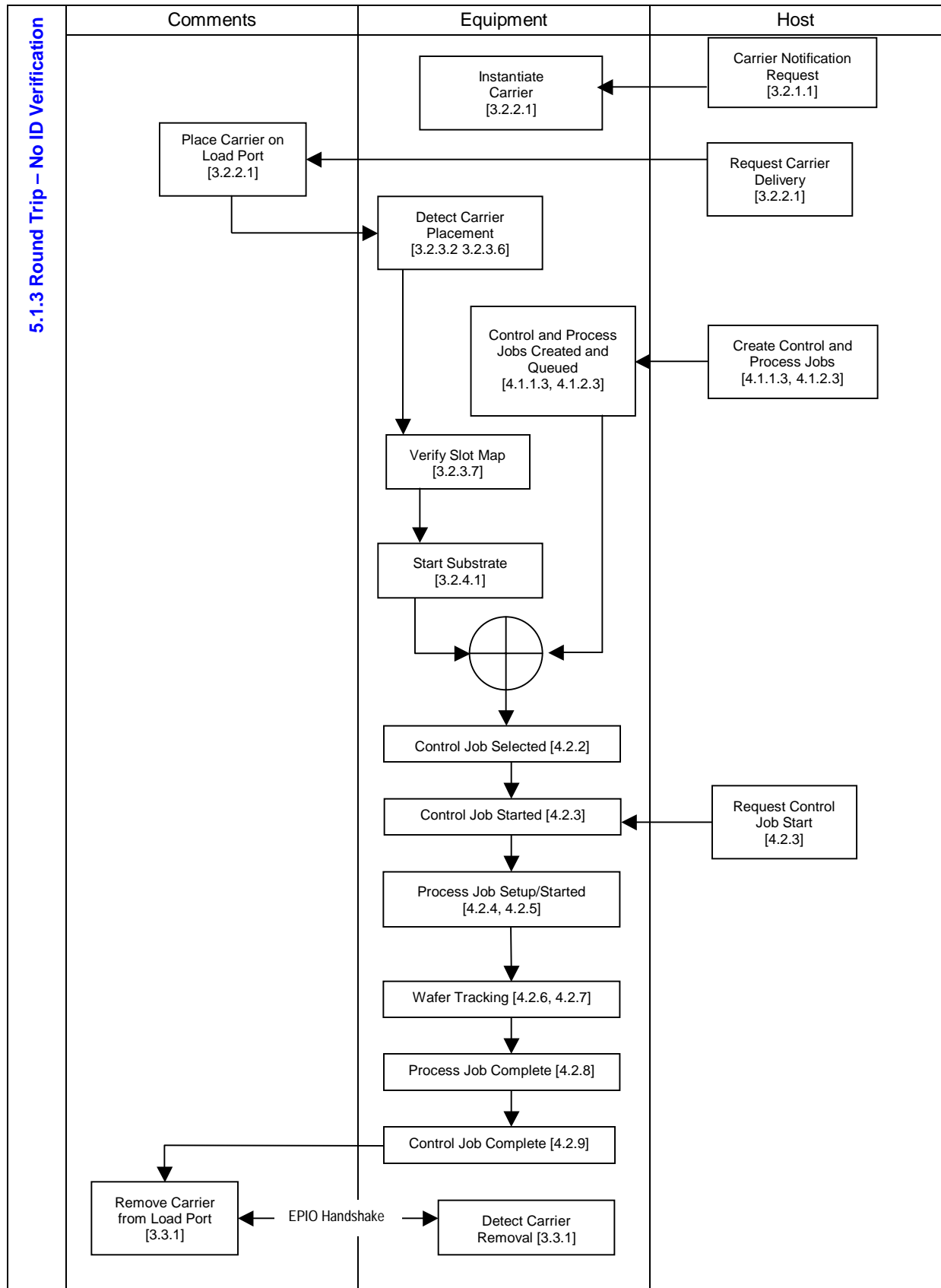




### 5.1.2 Round Trip – Host Verification



### 5.1.3 Round Trip – No ID Verification





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