SIEMENS

ADVIA Centaur® XPT
Immunoassay System

ADVIA Centaur® XPT Immunoassay System

Interface Specification Guide

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CE

The ADVIA Centaur XPT system is for *in vitro* diagnostics use.

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If the system is used in a manner differently than specified by Siemens Healthcare Diagnostics, the protection provided by the equipment may be impaired. See warning and hazard statements.

10815950 Rev. A

1 Using This Guide

This guide provides information on connecting the ADVIA Centaur® XPT system to a Laboratory Information System (LIS) or a Laboratory Automation System (LAS).

The LIS section of this guide provides information about:

- Verifying and changing the Laboratory Information System (LIS) communication status
- Performing diagnostics and clearing result and query queues
- Configuring general settings such as Protocol and System IDs used for communication
- Configuring application layer settings
- Configuring values used in datalink layers
- Configuring physical connection settings

Configuration varies depending on the selected protocol. Some functionality described in this guide may not be supported by all systems. See the system online help for additional information.

The LAS sections of the guide provide the connectivity and set up information for the ADVIA Centaur XPT systems with an LAS system. An LAS is any external transport system, such as the ADVIA LabCell system, which is connected to an ADVIA Centaur XPT system.

For additional information, refer to the system operator's guide for online help.

Intended Use

ADVIA Centaur® XPT System is an automated immunoassay analyzer designed to perform in vitro diagnostic immunochemical assay analysis on clinical specimens. The system menu includes endocrine, anemia, allergy, reproductive, cardiovascular, oncology, adrenal, bone metabolism, therapeutic drug, and infectious disease assays. All assays are based on chemiluminescent technology.

As with all diagnostic tests, a definitive clinical diagnosis is not based on the results of a single test. Only a physician can make a diagnosis after evaluating all clinical and laboratory findings.

Comprehensive assay groups provide for cost-effective workstation consolidation. The assay groups include fertility, thyroid function, oncology, cardiovascular, anemia, therapeutic drug monitoring, infectious disease, adrenal function, and metabolic.

Document Conventions

The following table explains the use of text and symbol conventions in this guide.

Convention	Description
BIOHAZARD	Biohazard statements alert you to potentially biohazardous conditions.
LASER WARNING	Laser Warning statements alert you to the risk of exposure to lasers.
WARNING	Warning statements alert you to conditions that may cause personal injury.
CAUTION	Caution statements alert you to conditions that may cause product damage or loss of data. On the system, this symbol indicates that you should refer to the online help or operator's guide for more information.
Note	Note statements alert you to important information that requires your attention.
Bold	Bold type indicates commands on the user interface, keys, or the exact text that an operator needs to type. For example, if the word save appears as **Save** (bold), it refers to the selecting the Save button on the user interface. Another example is typing a specific entry into a text box. If the word welcome appears as **welcome** (bold), it means that you should type that word into the specified field.
Italic	Italic type refers to the title of a document or a section title in this operator's guide.

Terminology

The following table explains some of the special terminology used in this guide and the specific actions that you need to take when you see the terminology.

Term	Description
Select	To select an item, use your finger to touch the item on the touch-screen monitor or select the item with the system pointing device. The background of the item changes color or displays a black frame to indicate that you selected the item.
Enter	Type the specified information using the keyboard and then press the Enter key.
Command Bar	The tools on the command bar enable you to perform and manage laboratory activities. The command bar icons display at the top of the window.
Status Bar	The Workstation Status Bar reports current system information and has selectable icons that enable quick access to functions. The Status bar appears at the bottom of the window.
Scan	Move the external barcode scanner over the specified barcode to enter the information.

Examples

All examples provided in this guide illustrate the field populated with ADVIA Centaur system specific data (CEN:NG). Actual instrument field values will vary depending on the attached system.

2 Laboratory Information System

The ADVIA Centaur XPT System can connect to a laboratory information system (LIS) to exchange data.

The primary functions supported by the LIS are receiving a worklist into the system and transmitting results from the system. These transfers are initiated by the system, the operator, or the LIS.

The system can also send result data automatically to the LIS. Automatic requests for worklist data are generated when the system detects a new sample. The transfers are incremental (a single result or query for a single worklist entry) or batch. Batch and incremental transfers are exchanged between the system and the LIS.

Operator-Initiated Transfers

Once communication has been established, the system operator can transfer data by selecting a single sample or multiple samples. The system sends the data, associated with the selected samples, to the LIS.

The system sends a request for all worklist entries to the LIS, which responds by sending the requested data. The operator can transfer data as required.

LIS-Initiated Transfers

Once communication has been established, the LIS can send worklist entries to the system. This transfer can take place at any time.

The LIS can also send a request for worklist entries or result data to the system. The request specifies the identifiers for the data requested. The system responds by transferring the requested data. The LIS can request information at any time.

Automatic system-Initiated Transfers

Once communication has been established, the system can automatically transfer result data when the results are generated. This transfer takes place if the automatic transfer option is enabled and the system is configured according to result review criteria. Each result is sent as it is generated. If result data is on hold, the system automatically transfers result data when the operator releases the results.

- If the option Transmit by Sample is selected, the results are sent when all the test results are available.
- If the option Transmit by Sample is not selected, the test results are sent as they are generated.

The system can automatically request worklist entries from the LIS. This request occurs if the automatic worklist request option is enabled.

The system can transfer data for a single sample or multiple samples. The system sends the data, associated with the selected samples, to the LIS.

Transfer occurs when the system detects a sample being added to the inprocess queue. The system sends a request for tests to the LIS for that sample only.

Limitations

The system does not support:

- More than 1 LIS at a time
- Communications protocols other than the ASTM protocol

Establishing Communication

Configure the settings for the LIS communications at **Setup > LIS Configuration**. Settings are protocol specific.

Enabling LIS Configuration Settings

1. On the command bar, select **Setup > LIS Configuration**.
2. Select **Enable LIS Communication**.
3. Continue to each **LIS Configuration** area:
    a. Complete the **General Settings** area.
    b. Complete the **Application Layer** area.
    c. Complete the **Data Link Layer** area.
    d. Complete the **Physical Layer for TCP/IP Connection** area.

4. Select **Save**.

Configuring Basic LIS Settings

You must configure the Basic LIS settings in Setup > LIS Configuration, detailed in the following sections, before configuring the application layer settings.

Completing the General LIS Configuration Settings

1. On the command bar, select **Setup > LIS Configuration**.
2. After enabling LIS Configuration, select **Start LIS Client Automatically**.
3. In the **System Name** text box, enter the name to use for your system identifier.
4. In the **LIS ID** text box, enter the name to use for your LIS identifier.
5. Select **Discard Host Specimen Type** to ignore all specimen types sent to the system from the LIS.

   Note If your LIS is sending specimen types, leave this feature unchecked. When checked, this feature is used with the **Treat Blank Specimen Type** setting to process order requests. See the *Using the Centaur XPT Compatibility Operation*, page 18 and the online help for information about how enabling the Discard Host Specimen Type feature affects the Reference Ranges and Delta checks.
6. In the **Treat Blank Specimen Type As** area, select a specimen type to allow the system to handle an order sent by the LIS that contains a blank specimen type.

   For example, select **Unknown** and the system fills in the blank specimen type with Unknown.
7. In the **Protocol** area, select the protocol used for your connection:

   ASTM protocol uses 8-bit, single-byte characters.

   Note Using ASTM protocol and sending non-8 bit ASCII values in the records to the LIS causes invalid data in those fields.
8. Continue with the next section.

Completing the Data Link Layer LIS Configuration Settings

1. On the command bar, select **Setup > LIS Configuration**.
2. To set the number of seconds the system waits for the LIS to reply to a command or response, enter a value for No Response Timeout.

   Acceptable values are from 15 seconds to 99999 seconds.

3. To set the number of seconds the system waits if a timeout occurs when the receiver is waiting for a frame, enter an **Interframe Timeout** value.

   Acceptable values are from 10 seconds to 99999 seconds.

4. To set the number of seconds the system waits when it receives a busy message from the LIS, enter a **Busy Timeout** value.

   Acceptable values are from 10 seconds to 99999 seconds.

5. To set the amount of time given before the system checks the local database, enter a **Query Timeout** value.

   ASTM protocol allows only one outstanding query at a time.

6. Continue with the **Physical Layer for TCP/IP Connection** area.

Completing the Physical Layer Settings

The ASTM protocol can be configured to communicate via a serial port connection or a TCP/IP connection.

To establish a serial port connection:

1. On the command bar, select **Setup > LIS Configuration**
2. In the Physical Layer area, select, select **Serial Connection**.
3. In the **Port Name** drop-down list, select a communications port.
4. Ensure the following configurations match your LIS configuration:
   a. Parity
   b. Stop Bits
   c. Baud Rate
   d. DataBits

To establish a TCP/IP connection:

1. On the command bar, select **Setup > LIS Configuration**
2. In the Physical Layer area, select or clear the **Use Network Client Socket** check box.
   - Selecting the Use Network Client Socket check box causes the system to use the port number to connect to the LIS computer.
   - Clearing the **Use Network Client Socket** check box means the system uses the port number to connect to the local port.
3. To use an IP address rather than a port number, enter the **IP address** of the local LIS computer.
4. Enter the **Port** number.

Note Do not use a port that is already in use.

You can enter a value from 1 to 10000.

Note The LIS configuration at the LIS and the system LIS configuration systemmust match exactly.

Configuring the Application Layer

After the basic LIS configuraton settings have been established, complete the Application Layer settings using your laboratory preferences.

Preliminary and Final test results can be sent to the LIS. Examples of Preliminary test results are:

- All replicates of meaned tests
- All results from dilution profile

You can postpone the transmittal of workorder results (patient or QC sample) until the results ar available for the entire workorder.

Completing the Application Layer LIS Configuration Settings

1. On the command bar, select **Setup > LIS Configuration.**
2. In the Application Layer area, select each option that applies to your LIS.
3. In the General Settings area of the Application Layer, select each option that applies to your LIS.

Automatically Send Status	The system sends reagent status messages to the LIS.
Perform Diagnostics at Startup	The system sends diagnostic messages to the LIS when the system starts up. By default, the system does not transmit diagnostic messages to the LIS.
Send Rack IDs with Results	The system includes the rack ID with the sample ID to the host LIS.

4. In the Query Settings area, select each option that applies to your LIS connection:

Query First	Select Host LIS or Instrument (system) to specify which system is queried first for an order. The default is to query the LIS first.
Automatically Query Host to LIS	The system queries the Host LIS for worklist entries as the system identifies each sample. **Note** A query is not sent to the LIS for QC samples.
Respond to Query for Results	The system sends results in response to a query from the Host LIS.
Respond to Query for Orders	The system sends an order in response to a query from the LIS.

5. In the Patient Result Settings area, select each option that applies to your LIS.

Automatically Send All Results Except Results on Hold	The system automatically sends all patient final results to the LIS computer except results on hold.
Automatically Send All Patient Results and Additional Data Except Results on Hold	The system automatically sends all preliminary and final results, except results on hold.
Send Unresulted Test Status	The system sends information to the LIS computer about any test that could not be resulted. This option is not available if you select Automatically Send All Results Except Results on Hold.
Notify LIS for non-transmitted Orders: Deleted or Moved to Historical	The system sends a message to the LIS when any untransmitted orders (Pending New, InProcess, Intervention Needed, Completed Sample States) are deleted or moved to Historical.

6. In the QC Result Settings area, select each option that applies to your LIS.

Automatically Send All QC Results Except Results on Hold	The system automatically sends all QC final results to the LIS except results on hold.
Automatically Send All QC Results and Additional Data Except Results on Hold	The system sends all preliminary and final QC results, except results on Hold.
Send Unresulted Test Status	The system sends information to the LIS computer about any test that could not be resulted.
Notify LIS for non-transmitted Orders: Deleted or Moved to Historical	The system sends a message to the LIS when any untransmitted orders (Pending New, InProcess, Intervention Needed, Completed Sample States) are deleted or moved to Historical.

7. In the Patient and QC Result Settings area, select each option that applies to your LIS.

Send Ratio Components	The system sends the results of ratio test components with the ratio test result to the LIS computer.

Send Components of a Multicomponent	The system sends the results of the component tests with the multicomponent test result to the LIS computer. **Note** By default, the system does not send the component results with the ratio or multicomponent test result to the LIS computer.
Transmit Results by Sample	The system transmits results for patient or QC tests only when all tests in each sample order have final results. The system send the order record once, followed by all the results for each test result. The system does not resend the order prior to each test result. If you do not select this option, the system transmits test results for a patient or QC order as the final test results become available (test-by-test). The default setting is unselected (results are transmitted test by test).

Requesting Previous Test Results from the LIS

You can enable the system to request previous test results from the LIS (Delta Checks).

1. On the command bar, select **Setup > Settings**.
2. Select **Operator Setup**.
3. Select **LIS** in the Delta Check Previous Result from area.

Using the Centaur XPT Compatibility Operation

Your system can be configured to run in the ADVIA Centaur XP System compatibility mode. Running in compatibility mode means that certain features and defaults will work similar to the ADVIA Centaur XP System.

Siemens Healthcare Diagnostics recommends that you contact your Siemens technical support representative for assistance prior to changing the compatibility settings.

Compatibility with the ADVIA Centaur XPT System

The system is configured to send and receive records similar to the records sent and received on the ADVIA Centaur XP system.

Records

These features are On for the compatibility mode. The record field identifier is included in parenthesis. Contact your technical support provider to change these record settings.

Note If the XP Compatibility mode is OFF, the opposite of these actions occur.

XP Mode ON (Default), System LIS will:	XP Mode OFF (Need TAS to Enable), System LIS will:
Consider Blank Order Priority as Routine For LIS	Reject Order without a valid Priority from Host LIS (blank not allowed)
Discard Order Date Field For LIS Orders	Accept Order Date Field For LIS Orders
Discard Collection Date Field For LIS Orders	Accept Collection Date Field For LIS Orders
Discard Received Date Field For LIS Orders	Accept Received Date Field For LIS Orders
Discard Replicate For LIS Orders	Accept Replicate For LIS Orders
Discard Instrument Section ID For LIS Orders	Accept Instrument Section ID For LIS Orders
Discard Verified Result Status For LIS	Accept Verified Result Status For LIS
Discard Operator Identifier For LIS Result	Accept Operator Identifier For LIS Result
Discard Verification Identifier For LIS Result	Accept Verification Identifier For LIS Result
Discard Lab Assigned PID Field For LIS	Accept Lab Assigned PID Field For LIS
Discard Physician Name For LIS	Accept Physician Name For LIS Orders
Discard Manual Dilution For LIS	Accept Manual Dilution For LIS Orders

XP Mode ON (Default), System LIS will:	XP Mode OFF (Need TAS to Enable), System LIS will:
Discard Container Type For LIS	Accept Container Type For LIS Orders
Not Send Reference Range Limits in Result Records to Host LIS	Send Reference Range Limits in Result Records to Host LIS
Send Patient Demographics For Manual Orders To Host LIS	Not send Patient Demographics for Manual Orders to Host LIS
Not Send Reagent Info To Host LIS	Send Reagent Information to Host LIS
Allow a configurable max size PID by TAS (Current setting: 20)	Allow a max PID Length For LIS of: 20

These Error Codes/LIS Error Code Mapping collections should be updated for the compatibility mode:

XP Mode On	XP Mode Off
EJECTED_ON_REQUEST	EJECT_ON_REQUEST
SAMPLE_ID_NOT_FOUND	BAD_MESSAGE_FIELD
UNABLE_TO_DO	SYSTEM_PROBLEM
CNTRL_NOT_IN_USE	PAT_CNTRL_ID_MISMATCH
CONFLICING_RATIO_CONSTITUENT_AND_SINGLE_TEST_DILUTION	INVLIAD_DILUTION_SPEC

Discard Host LIS Specimen Type Mode

The system accepts specimen types for LIS orders, while the system always discards the specimen types field.

For ADVIA Centaur XPT System compatibility, in the **Setup > Settings > LIS Configuration** window, select:

- Discard Host LIS Specimen Type

  The specimen type sent by some systems may not be compatible. This feature allows the host LIS specimen type to be discarded and uses a specimen type defined by the Treat Specimen Type As parameter.

  If this feature is enabled, this impacts the results flagging in the Reference and Delta Check ranges. For example, the demographic specimen types must be All or Unknown for the ranges to trigger, if the Treat Specimen Type is set to Unknown. See *Discard Host LIS Specimen Type Settings*, page 22.

  Note If the Host LIS is sending the specimen type, it is recommend that you allow the Host LIS to send this information and do not enable this feature.

  Note If Discard Host LIS Specimen Type is enabled, the specimen type is not sent to the Result Record. The system ignores the specimen type sent by the LIS.

- Treat Blank Specimen Type (Preferred Specimen)

  Setting the parameter for this field provides a specimen type for order processing when the specimen type is discarded, or the Host LIS sends a blank specimen type.

- Send Specimen in Result Record

  The system does not send specimen information back to the Host LIS with the Result Record.

The following table provides examples of the LIS configuration with the Discard Host LIS Specimen type enabled and disabled.

Table 1: Discard Host LIS Specimen Type Settings

Test Supports	Displayed Result Type	Displayed Result (String in Overview, Printed Reports)	Test Details	Automatic Reports for Conc and Index	TDef > Calcuation > Units TDef Setting for Host LIS Result Record	Summary of Usage for TDef < Calculation > Units TDef setting
Conc	Conc	Conc plus TDef/ Calculation/ Units	Conc with NO Units. Index row is <blank>.	Conc with NO units. Index is <blank>.	DOSE with TDef/ Calculation/ Units COFF with TDef/ Calculation	Used for Displayed Result reporting, plus DOSE and COFF over LIS.
Conc and Index	Conc	Conc plus Tdef/ Calculation/ Units	Conc and Index with NO units	Conc and Index with NO units	DOSE with TDef/ Calculation/ Units INDX with “hard coded” Index as Units COFF with TDEF/ Calculation/ Units	Used for Displayed Result Reporting, plus DOSE and COFF over LIS.

Test Supports	Displayed Result Type	Displayed Result (String in Overview, Printed Reports)	Test Details	Automatic Reports for Conc and Index	TDef > Calcuation > Units TDef Setting for Host LIS Result Record	Summary of Usage for TDef < Calculation > Units TDef setting
Conc and Index	Index	Index with “hard coded” Index as units	Conc and Index with NO units	Conc and Index with NO units	DOSE with TDef/ Calculation/ Units INDX with “hard coded” Index as units COFF with TDef/ Calculation/ Units	Only used for DOSE and COFF over LIS.
Index	Index	Index plus TDef/ Calculation/ Units	Index with NO Units. Conc row is <blank>.	Index with NO Units. Conc row is <blank>.	INDX with Tdef/ Calculation/ Units COFF with TDef/ Calculation/ Units	Used for Displayed Result Reporting, plus INDX and COFF over LIS.

Ordering Multiple Replicates

The ADVIA Centaur XPT System requires that you download the test multiple times to run multiple replicates. If you order multiple replicates on the system, you can specify the replicate number with the test (Orders > Create Patient Order). If you downloaded the test multiple times, on the system, these actions occur:

- If the test is processing, the request is rejected.
- If the test has not started processing, the orders will be merged if there are any changes.
- If the test has resulted, the test will not be rejected. The test will be repeated.

Dilution Protocols

The reserved words for the dilution protocols: N, neat only, and D or dilute only are always honored as well as sending the supported modes. For example, x2, x5.

Layered Communications Protocol

The system uses a 3-layered communications protocol for ASTM. Each layer performs a related subset of the functions that the system requires to communicate with another system.

- Layer 1 is the physical layer. This layer directs the transmission of the bit stream across the physical medium.
- Layer 2 is the data link layer. This layer ensures that the incoming and outgoing application messages are received and transmitted correctly. This layer transfers information across the physical medium. Layer 2 sends blocks of data with additional synchronization and error control information to ensure a reliable transfer.
- Layer 3 is the application layer. This layer provides the information services of the system.

Communication protocol standards are defined for each layer. For the system to communicate with a laboratory information system (LIS), both systems must conform to the same 3-layered protocol. The communications protocol used by the system is an open, non proprietary communication standard developed by the American Society for Testing Materials (ASTM). If the LIS conforms to this protocol, it can communicate with any other system that also uses the standardized ASTM protocol.

The physical layer and data link layer protocols are defined in ASTM document E1381-95, *Specification for Low-Level Protocol to Transfer Messages Between Clinical Laboratory Instruments and Computer Systems*. The application layer protocol is defined in ASTM document E1394-91, *Standard Specification for Transferring Information Between Clinical Instruments and Computer Systems*.

Layers and Messages

The system and the LIS are physically connected only at the physical layer and they logically communicate with each corresponding layer. The application layer sends messages to the LIS application layer and receives messages from the LIS application layer. The same is true for the corresponding data link layers.

Messages are passed down or up from layer to layer, with each layer adding or removing its own protocol data to or from the given message. The term message is used generically to show that each layer has its own definition of a message. The following sections describe the application and data link messages.

Application Messages

At the application layer, the logical unit of transferred data is an application message. Application messages contain data that pertain to the computer system's application. An example of an application message sent from the LIS to the system is an order to perform a specific test on a specific sample.

In the ASTM communication protocol, an application message consists of an ASTM header record, followed by any number of other ASTM records, such as patient and order records, and ends with an ASTM termination record. A simple ASTM application message that requests a T4 test for sample S19255 is shown below. Each ASTM record is a variable length record terminated by a carriage return character (<CR>).

```
H| \^& | <CR>

P| 1 <CR>

O| 1 |S19255 | |^^^T4 | R | | | | | | | | | | | | | | | | | | | | O <CR>

L| 1<CR>
```

This application message consists of the following elements:

- H (header) record
- P (patient) record
- O (order) record
- L (termination) record

For a complete description of application messages, see ASTM document E1394-91. For a complete description of the implementation of the ASTM application layer by the system, see the *Application Layer Protocol*, page 55.

When the system receives the application message, as shown above, the system creates a worklist entry for the sample identified as S19255. This sample has a T4 test with routine priority. The worklist entry does not have patient demographic information.

Data Link Messages

At the data link layer, the logical unit of data transferred or received is called a data link message. The data link message can consist of 1 character to thousands of characters. When the data link layer receives an application message to transmit as 1 message that contains multiple records, messages longer than 240 characters are divided into multiple intermediate frames followed by 1 final frame. Each frame is variable in length and has a maximum size of 240 characters that includes all data and protocol characters. The data link layer sends the message using as many frames as required.

Backus-Naur Form (BNF) notation is used to define a data link message that contains data link message symbols and ASCII mnemonics.

<Frame Header> ::= <STX> <Frame Sequence Number>

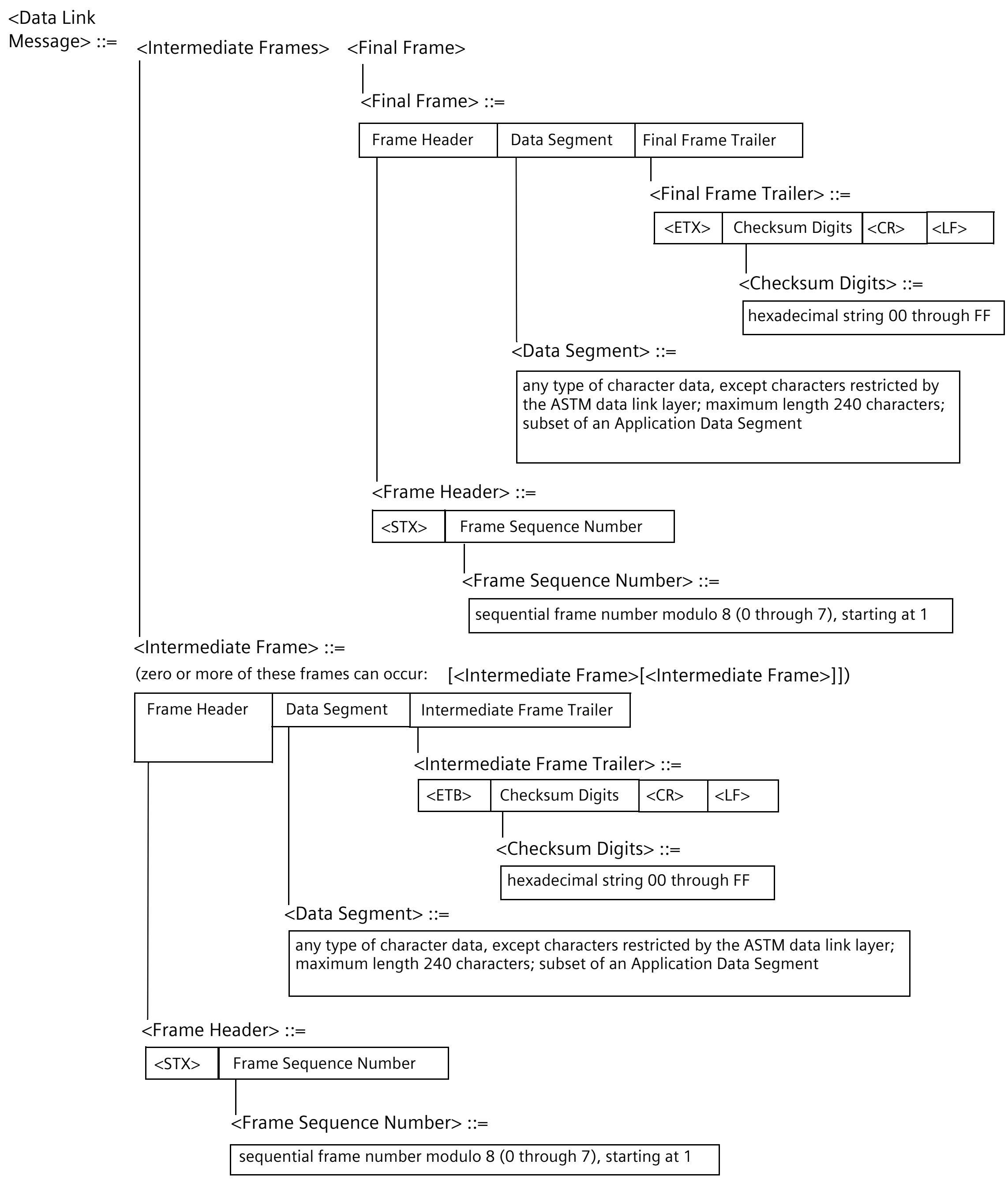
means

<Frame Header> is defined as an <STX> ASCII character followed by <Frame Sequence Number>

Note The ASCII character mnemonics are not the same as data link message symbols. Data link message symbols contain multiple words of uppercase and lowercase letters and the ASCII mnemonics contain all uppercase letters.

The following figure shows the definitions of a data link message.

Figure 1: Data Link Message Definitions



The ASTM data link protocol involves more than just adding and removing protocol characters to a given data stream. The ASTM data link protocol is a half-duplex (ANSI definition) or simplex (CCITT definition) stop-and-wait protocol. This means that either the system or the LIS system can transmit data to each other, but only 1 at a time. Because of this requirement, the ASTM data link protocol has the following 3 handshaking phases that define an ASTM data link session:

- link establishment phase
- message transfer phase
- link release phase

The link establishment phase and the message transfer phase require a transfer of the character(s) initiated by the sender followed by a response by the receiver. The link release phase only requires a transfer by the sender. The messages used in each phase of an ASTM data link session are shown below. A message transfer phase can consist of multiple data link messages. For a complete description of the ASTM data link layer specification, see ASTM document E1381-95.

Both the sender and the receiver send characters across the physical medium, but the sender is the only side that sends actual data. The data is contained in the data segments of the intermediate and final frames sent by the sender to the receiver. The sender and receiver terminology is based on the sender and the receiver of these data segments. Sender and receiver are abbreviated as S for sender and R for receiver.

Figure 2: ASTM Data Link Session Phases

Link Establishment Phase
S:<Request Session message> ::= <ENQ>
R:<Grant Session Message> ::= <ACK>
<Deny Session Message> ::= <NAK>
Message Transfer Phase
S:<Frame> ::= <Intermediate Frame> or <Final Frame>
R:<Positive Acknowledgment Message> ::= <ACK>
<Negative Acknowledgment Message> ::= <NAK> or anything else except <ACK> or <EOT>
<Positive Acknowledgment with Interrupt Message> ::= <EOT>
Link Release Phase
S:<Terminate Session Message> ::= <EOT>

The message definitions are used to establish an ASTM data link session. The following figure is an ASTM data link session using these messages.

Figure 3: ASTM Data Link Layer Session

	Sender	**Receiver**
Link Establishment	<Request Session Message> →	
	←	<Grant Session Message>
Message Transfer Phase:	<Frame Header> <Data Segment> <Intermediate Frame Trailer> →	
	←	<Positive Acknowledgment Message>
	⋮	
	<Frame Header> <Data Segment> <Intermediate Frame →	
	←	<Positive Acknowledgment Message>
	<Frame Header> <Data Segment> <Final Frame Trailer> →	
	←	<Positive Acknowledgment Message>
	⋮	
	<Frame Header> <Data Segment> <Intermediate Frame →	
	←	<Positive Acknowledgment Message>
	⋮	
	<Frame Header> <Data Segment> <Intermediate Frame →	
	←	<Positive Acknowledgment Message>
	<Frame Header> <Data Segment> <Final Frame →	
	←	<Positive Acknowledgment Message>
	⋮	
Link Release Phase:	<Terminate Session Message> →	

For a complete description of the ASTM data link layer, see ASTM document E1381-95. This ASTM document explains ASTM data link layer protocol phases, message formats, timing constraints, restricted characters, error recovery, and a state transition diagram.

The following example shows an ASTM data link layer session with actual data. In this figure, an application message of 250 A characters needs to be sent from 1 system to another (250 is used since the maximum ASTM frame size is 240). Actual ASCII character mnemonics replace all of the ASTM data link symbols.

Figure 4: ASTM Data Link Layer Session with Data

	Sender	Receiver
Link Establishment Phase:	→	<ENQ>
	←	<ACK>
Message Transfer Phase:	<STX>1AAAAAAAAAAAAAAAAAAAAAAAAAAAAAAA AAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAA AAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAA AAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAA AAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAA AAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAA <ETB>38<CR><LF> →	
	←	<ACK>
	<STX>2AAAAAAAAAA<ETX>BF<CR><LF> →	
	←	<ACK>
Link Release Phase:	→	<EOT>

The following table describes the software events that take place at each phase.

Phase	Description
Link Establishment Phase	The data link layer of the sender begins the link establishment phase once it recognizes that it has an application data segment to transfer. The sender transmits a request session message (<ENQ>) and waits for a response. The receiver recognizes the received message as an <ENQ>. Because the receiver is idle, the receiver sends a grant session message (<ACK>). The sender receives this <ACK>, which establishes the link between the sender and the receiver. The link establishment phase ends and the message transfer phase begins.
Message Transfer Phase	Messages are sent in frames. Each frame contains a maximum of 247 ASCII characters, 240 of which are data and 7 of which are frame overhead characters. Messages longer than 240 characters must be divided between two or more frames. Multiple messages are never combined in a single frame. Every message must begin in a new frame. There are two types of frames: • Intermediate • End Frame An intermediate frame terminates with the characters <ETB>, a 2-character checksum, <CR>, and <LF>. The frame structure is: <STX> FN text <ETB> C1 C2 <CR> <LF> An End Frame terminates with the characters <ETX>, a 2-character checksum, <CR> and <LF>. The frame structure is: <STX> FN text <ETX> C1 C2 <CR> <LF>
Link Release Phase	The sender constructs a terminate session message (<EOT>) and transmits this message. The sender then returns to an idle state, waiting for an application data segment to transmit or receive. The receiver receives the <EOT> and also returns to an idle state, waiting for an application data segment to transmit or receive.

Physical Layer

The physical layer transmits and receives a bit stream of data across the physical medium. Transmitted data is passed down by the data link layer to the physical layer. The physical layer transforms this data into a sequence of electrical signals that are monitored by the physical layer at the remote system. The physical layer at the remote system transforms these electrical signals back into character form and sends these characters to the data link layer at the remote system.

The ASTM communications protocol uses a standard RS-232, point-to-point connection between the 2 systems. The system supports various signal synchronization parameters, including the following:

- 5 baud rates (19200, 9600, 4800, 2400, 1200)
- 3 parity bit checking schemes (Odd, Even, or None)
- 7 or 8 data bits
- 1 or 2 stop bits

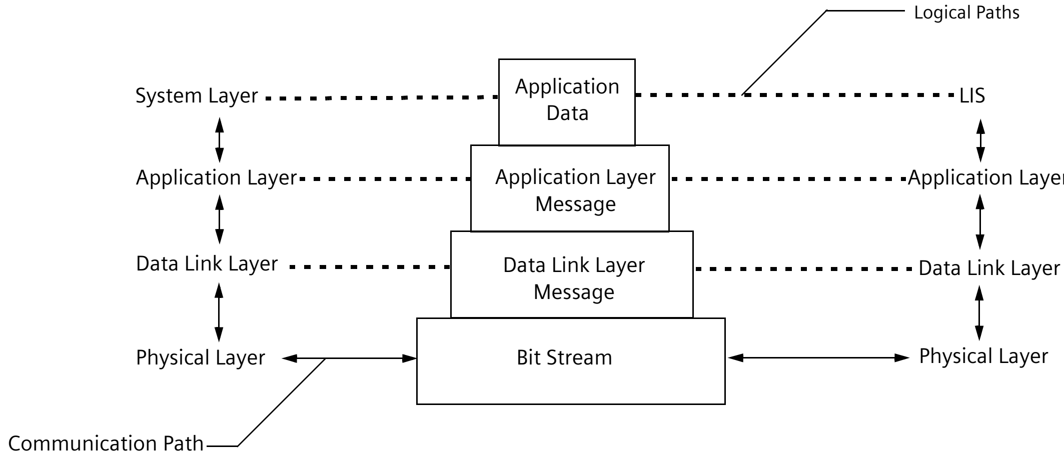
For a complete description of the ASTM physical layer specification, see ASTM document E1381-95.

Interaction Between Layers

Each layer at a system logically communicates with the corresponding layer at the other system. For example, the application layer at the system logically communicates with the application layer at the LIS by using application messages. However, the actual communication path is different than the logical communication path.

An application message is passed down to the data link layer and physical layer on the sending system, across the physical medium to the physical layer at the receiving system, up to the data link layer at the receiving system, and then up to the application layer at the receiving system. As the application message is passed through each layer, each layer adds or removes its corresponding protocol data.

Figure 5: Communication Path



Functionality of the 3 layers of the ASTM protocol is important to understanding this protocol. Specific layer implementation is independent of the functionality of the other layers.

Each layer has its own purpose. The purpose of the application layer software is to generate and transmit messages to the other layers. The only purpose of the data link and physical layers is to transmit messages to the remote system.

In the example shown in *Figure 4* the ASTM session transmitted 250 A characters. If this is what the application layer wants to transmit, the data link layer must attempt to transmit it. The data link layer needs to look at the data to determine the number of frames and to calculate checksums, but the software that performs data link layer services is not concerned with the construction or content of the application data segments.

Some implementation dependencies between layers do exist, such as the reporting of errors between adjacent layers, but this dependency is limited to the interface between the layers. In a special case required to configure some physical layer parameters, the application layer passes down the operator-selected physical layer parameters through the data link layer to the physical layer. Other than these few cases, the interaction between the application layer software, the data link layer software, and the physical layer firmware is highly cohesive and independent.

ASTM Application and Data Link Layer Interaction

The ASTM protocols defined for the application and data link layers do not specify what interface to use between these 2 layers. The ASTM application message and record format enables the application layer at the receiving system to handle application messages as a stream. The application layer at the receiving system accepts data from the data link layer at the receiving system on any data segment boundary. Also, the application layer at the transmitting system can transfer data to the data link layer at the transmitting system on any character boundary.

Interaction Between Layers on Incoming Messages

The application layer at the receiving system processes incoming data on a record by record basis. If the data link layer passes a partial application record, the application layer should not process the partial record until the data link layer passes enough data segments to complete the record. Once the application layer receives a complete ASTM record, the application layer can process the record on the basis of the record type and the current status of the ASTM application message hierarchy.

The system ASTM data link layer passes data segments to the application layer as it successfully receives each intermediate or final frame. Because the system ASTM application layer can accept application messages as a stream, the system ASTM data link layer does not have to concatenate individual data segments from intermediate and final frames to rebuild the original application data segment. Handling concatenation at the data link layer requires an unknown amount of memory at the data link layer because a single application data segment can contain thousands of characters, but the longest data link layer data segment can have only 240 characters.

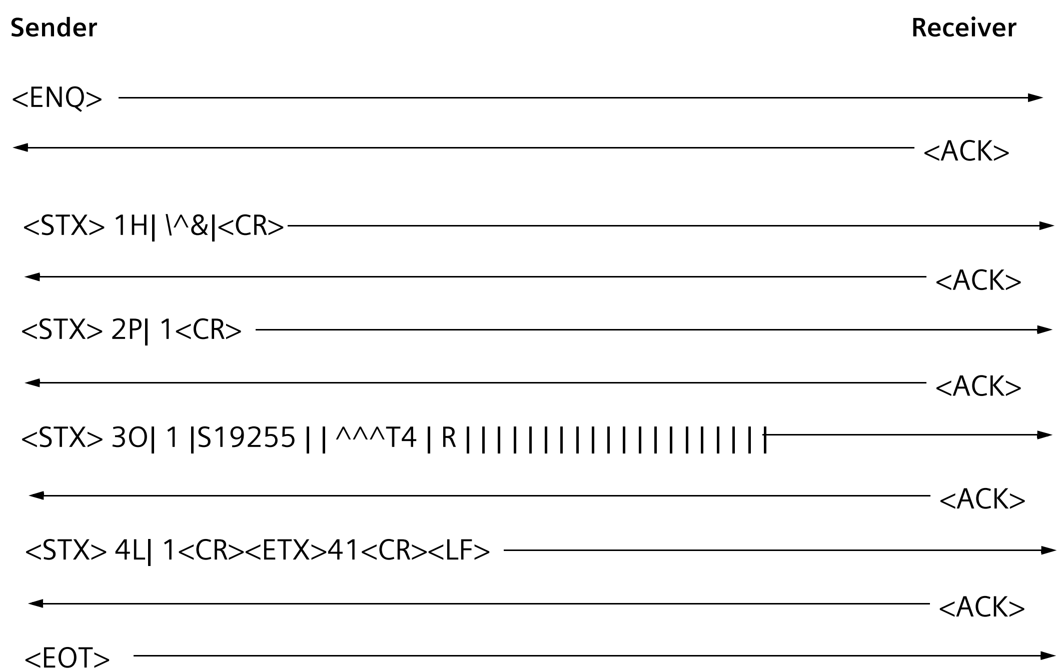
Implementations of Incoming Messages

The system generally passes ASTM application messages to the data link layer on a message-by-message basis. This message-by-message implementation on the system supports batch transfers of up to 25,000 results.

Implementation of ASTM application messages on the LIS is similar to the implementation of outgoing messages on the system.

Implementation is not required to conform to the message by message implementation on the system. For example, another implementation is to pass the message down to the data link layer on a record-by-record basis. The following example shows an ASTM test order message session using this implementation. This method is suitable if there are memory constraints and an entire message cannot be completely generated before being transmitted.

Figure 6: ASTM Test Order Message Session



Interaction Between Layers on Outgoing Messages

The software that processes incoming ASTM application layer messages must process these messages as a stream. The specifications, however, do not describe the interface between the ASTM application and data link layers on outgoing messages. Each implementation is responsible for defining its own interface.

Implementation of Outgoing Messages

Based on the type of message being generated, the outgoing application layer software constructs a single ASTM application message and passes it to the ASTM data link layer software. These messages generally consist of multiple ASTM application records. The system transmits a separate message for the data in each sample. A system data link layer message can contain multiple ASTM application records within its intermediate frame and final frame data segment fields.

The following figure is a complete ASTM test order message session with a sequence of software events.

Figure 7: ASTM Test Order Message Session with Software Events

Sender **Receiver**

<ENQ> →

← <ACK>

<STX>1H|\^&|<CR>P|1<CR>O|1|S19255| |^^^T4 | R | | | | | | | | | | | | | | | | | | | |O<CR>L
| 1<CR><ETX>41<CR><LF> →

← <ACK>

<EOT> →

Physical Layer

This section describes electrical connections and signal characteristics of the physical interface. Supported connections are TCP/IP and Serial connections. This physical interface conforms to ASTM specifications. The interface supports point-to-point and network topologies. It does not support multi-drop topology.

TCP/IP Connection

The interface uses a TCP/IP protocol to exchange data between the system and LIS servers.

Serial Connection

The interface uses a serial binary data interchange. The topology is point-to-point with a direct connection between the devices.

Electrical Characteristics

The electrical characteristics conform to the EIA-232-D-1986 (RS-232) Standard. A marking condition (binary one) corresponds to a voltage more negative than -3 volts with respect to signal ground. A spacing condition (binary zero) corresponds to a voltage more positive than +3 volts with respect to signal ground. The interface connection uses 3 contacts of a 9-pin connector as shown in the following table.

Pin	Used for
Pin 1	shield ground to system frame; open at LIS.
Pin 2	transmitted data output from the system.
Pin 3	received data input to the system.
Pin 7	signal ground.

Note The LIS connects to the system through a serial RS-232 port. This RS-232 port has standard 9-pin, D-type, male connectors (DB-9P). Connect the system to the LIS using a standard 9-pin, D-type, female connector (DB-9S).

Note The RS-232 cabling should be a fully shielded type to minimize radio frequency emissions from the system.

Signal Characteristics

The data transmission is asynchronous by character and serial by bit within a character. The order of bits in a character is as follows:

- one start bit (binary zero)
- character data bits (least significant bit first)
- parity bit
- stop bit(s) (binary one)

The circuit is in a marking condition between characters. The operator can select 7 or 8 character data bits and the parity bit as odd, even, or none. Odd parity corresponds to an odd number of one bits in the sequence of data and parity bits. Even parity corresponds to an even number of one bits in that sequence. The operator can also select 1 or 2 stop bits.

Transmission and reception operate at the same baud rate. The operator can select the baud rate. The interface allows selection of the following baud rates:

- 1200 baud
- 2400 baud
- 4800 baud

- 9600 baud
- 19200 baud

Data Link Layer

The data link layer provides an error-free exchange of data between 2 systems. The data link layer is not concerned with the contents of the exchanged data. The system supports standard data link layer protocol as described in ASTM document E1381-91. This section describes the protocol supported by the system.

ASTM Data Link Layer Protocol

The ASTM data link layer protocol provides methods for the following:

- Link establishment
- Message framing
- Message frame sequence control
- Link release
- Flow control
- Error detection and recovery

Link establishment and link release determine the sender and the receiver of data. Message framing ensures that the receiver recognizes the data. Message frame sequence control provides a mechanism to ensure that the system receives data in the correct order. Flow control allows the receiver to control the rate at which data is accepted. Error detection and recovery ensure that correct data is received.

The ASTM data link protocol is limited to half-duplex transmission. This means that both sides can transmit, but only 1 at a time. The ASTM data link protocol transfers messages generated by the application layer. This protocol is not concerned with the content of the application messages. Some restrictions are placed on characters allowed in the data message. These restrictions avoid confusing application data with data link protocol control sequences.

Link Establishment

When data becomes available for transmission, the sender (either the LIS or the system) attempts to establish control over the data link. If the link is already controlled, the message is queued for transmission. If the other system has control of the data link, the message must wait until the other system relinquishes control; otherwise, the system enters the establishment phase.

During the establishment phase, the sender requests control of the data link by transmitting a request session message. When the receiver detects a request session message, the receiver determines whether it can receive data. The receiver can receive data if it has no data to send or if it is blocked from sending by a re-establishment delay. The sender must deal with these possible outcomes.

- The first outcome is that the sender receives a grant session message from the receiver. The receiver has determined that it can receive data and grants control of the data link to the sender by replying with a grant session message. After transmitting the grant session message, the receiver enters the receive side of the message transfer phase. When the sender detects a grant session reply to the request session message, it enters the sender side of the message transfer phase.
- The second outcome is that the sender receives a deny session message from the receiver. The receiver has determined that it cannot receive data. When the sender detects a deny session reply, it returns to the idle state and does not attempt to re-establish the data link for a specified period of time (governed by the busy timer). This delay allows the receiver time to clear the condition that caused it to deny the session. The receiver should deny a session when it cannot currently receive data. The busy timeout option is defined, in seconds, at the Setup > LIS Configuration tab.
- The third outcome is that the sender receives a request session message from the receiver. Contention has occurred; the receiver is attempting to start a session at the same time as the sender. The sender returns to the idle state and refrains from attempting to re-establish the data link for a specified period of time (governed by the contention delay timer). The other system detects the same situation and behaves similarly.

  To avoid a second contention situation, the contention delay timers on the 2 systems are significantly different. The system uses a 1 second delay, and assumes that the LIS uses a significantly longer delay. The current ASTM protocol describes suggested settings for this option for each system.
- The fourth outcome is that the sender times out without detecting a grant session, deny session, or request session. Other characters or characters with errors such as parity errors are not recognized. The sender considers such replies as though no characters were received.

  After a timeout occurs, the sender enters the termination phase (link release). The sender sends a terminate session message (EOT).

Message Transfer

The message transfer phase allows the sender to transmit data to the receiver. This transfer phase remains in effect as long as the sender has data to transmit and the receiver can accept more data. When the sender has transmitted all data, the sender enters the termination phase (link release).

Message Framing

Messages are sent in frames that consist of a frame header, a data segment, and a frame trailer. The frame header is a control sequence used to signal the start of the message and contains a frame sequence number. The data segment contains the message text generated by the application layer. The frame trailer is a control sequence used to signal the end of the frame and contains a frame checksum, a carriage return (<CR>), and a line feed (<LF>).

If the application frame text is longer than 240 characters, the text is split into multiple transmitted message frames. Text is copied from the application message buffer to the transmit buffer. If the entire application message text fits in a single frame, the message is sent as a final frame message. If the entire application message text does not fit in a single frame, the part of the message that does fit is sent as an intermediate frame message.

When the intermediate frame message is successfully transferred to the receiving side, more of the message text is copied to the transmit buffer. This process repeats until all of the application message text is received, the last frame being a final frame.

The data link layer receives the outgoing application messages as 1 message; then the data link layer sends the message using as many frames as required.

Frame Sequence Numbers

Frame sequence numbers are used to assure that data is accepted in the correct order by the receiver. A sequence number is formatted as the ASCII representation of its decimal value in 1 digit.

The first message after link establishment is given the initial sequence number of 1. All subsequent frames (intermediate or final) are given sequence numbers computed by adding 1 to the previous sequence number. If the number exceeds the high value of 7, the sequence number resets to the low value of zero (modulo 8 arithmetic). A retransmitted frame is sent with its original sequence number. After link release and a new link establishment, sequence numbers start again with the initial sequence number.

Frame Checksum

Frame checksum is used to detect errors in the frame that are not detected by character parity checking. The frame checksum coverage ranges from the second character of the header (the frame sequence number) to the last character of the trailer before the checksum itself. The algorithm used is binary sum, formatted as the ASCII representation of its hexadecimal value (modulo 256) in 2 digits with leading zeros, a range of 00−FF.

Frame Acknowledgment

When a receiver receives a complete frame, it responds to the sender with an acknowledgment. If the frame contains an error, the receiver sends a negative acknowledgment message. If the frame is valid, the receiver sends 1 of 2 positive acknowledgment messages:

- a positive acknowledgment with interrupt message, if the receiver has data to send
- a positive acknowledgment message

If the transmitting system receives a positive acknowledgment with interrupt, the system can enter the termination phase (link release). If the transmitting system releases the link, the system should wait for at least 15 seconds or wait for the other system to initiate and terminate a session.

If the transmitting system does not receive a positive acknowledgment with interrupt for the last frame or if the system does not wish to release the link, the next frame is started. When there are no additional frames to transmit, the transmitting system enters the termination phase (link release).

When the sender detects a negative acknowledgment, the sender increments the retry count. If it sent the maximum number of retries (6) for 1 frame, the message is noted as not sent, and the sender enters the termination phase (link release). If the sender does not exceed the maximum number of retries, the sender retransmits the frame. If the sender does not detect a reply within the no response time interval, the sender considers the remote system down, and then enters the termination phase (link release). If the sender receives a character other than a positive acknowledgment, positive acknowledgment with interrupt, or negative acknowledgment, the sender assumes a negative acknowledgment.

Link Release

The link release phase returns the data link to the idle state. When the sender transmits a terminate session message, the sender enters an idle state. When the receiver detects a terminate session message, the receiver enters an idle state. If the receiver has data to transmit, link establishment can start.

Error Detection and Recovery

Several types of communications errors are detected with the ASTM protocol:

- character errors
- checksum errors
- sequence errors
- timeouts

Character errors are detected on individual characters in a message. They include parity, framing, and overrun errors. These errors result in the invalidation of the individual character and the data link frame that contains the character. Any frame containing a character error is considered a bad frame and is responded to with a negative acknowledgment.

Checksum errors occur on messages that contain checksums. If the computed checksum does not match the received checksum, 1 or more of the characters in the message had an undetected parity error (2-bit error). These errors result in the invalidation of the frame. Any frame containing a checksum error is considered an invalid frame and is responded to with a negative acknowledgment.

Sequence errors occur when the sequence numbers of frame messages are not the next number in sequence. If the sequence number is the number of the previously accepted and acknowledged frame, the frame is assumed to be a retransmission and positively acknowledged. Otherwise, the sender and receiver are out of synchronization. Any frame containing a frame synchronization error is considered an invalid frame and is responded to with a negative acknowledgment.

Timeouts can occur whenever one system is waiting for the other to perform an action. These conditions include:

- receiver waiting for a frame
- sender waiting for a reply to a session request
- sender waiting for a reply to a frame

If the timeout occurs when the receiver is waiting for a frame (governed by the interframe timer), the receiver assumes the sender is no longer operating. The receiver returns to its idle state.

If the timeout occurs when the sender is waiting for a reply to a session request (governed by the no response timer), the sender enters the termination phase.

If the timeout occurs when the sender is waiting for a reply to a frame (governed by the no response timer), the sender assumes the receiver is no longer operating. The sender enters the termination phase (link release).

When the data link layer fails to successfully send a message (bid failure, excessive retries), it notifies the application layer. A status code indicates the reason for the failure. The application layer handles and logs the error.

Flow Control

The ASTM data link protocol does not support XON/XOFF flow control. The system uses an acknowledgment delay to allow itself more time to process data already received.

Flow control is used by the receiver to limit the rate of sending characters. When the receiver detects that its receive buffers are filling up after receiving a frame, the receiver can wait for a specified time before sending the positive or negative acknowledgment message.

ASTM Data Link Layer Protocol Events

The ASTM data link layer protocol consists of several types of events:

- messages
- timers

- frame limits
- miscellaneous characters

The ASTM data link protocol events are defined in the following tables.

Table 2: ASTM Data Link Messages - Sender

Event	Definition
request session message	The potential sender uses the request session message to gain control of the data link. ASTM protocol defines it as the single character <ENQ>, ASCII value of 5.
intermediate frame message	All but the last packet of text from a data link message uses the intermediate frame message. This message contains a sequence number and a checksum. This message must contain message text. ASTM protocol defines it as beginning with the character <STX>, ASCII value of 2, followed by a 1-character frame sequence number (See *Frame Sequence Numbers*, page 42). The data segment is next, with 1–240 ASCII characters, no restricted characters allowed. After the data segment is the character <ETB>, ASCII value of 23, which is followed by a 2-character frame checksum (See *Frame Checksum*, page 43). Next is the carriage return character <CR>, ASCII value of 13. The frame ends with the line feed character <LF>, ASCII value of 10.

Event	Definition
final frame message	The final frame message is used for the last packet of text from a data link message. It contains a sequence number and a checksum. It must contain message text. ASTM protocol defines it as beginning with the character <STX>, ASCII value of 2, followed by a 1-character frame sequence number. The data segment is next, with 1 – 240 ASCII characters, no restricted characters allowed. After the data segment is the character <ETX>, ASCII value of 3, which is the only difference between a final frame and an intermediate frame. Next is a 2-character frame checksum. Next is the carriage return character <CR>, ASCII value of 13. The frame ends with the line feed character <LF>, ASCII value of 10.
terminate session message	The terminate session message is used by a sender to relinquish control over the data link. ASTM protocol defines it as the single character <EOT>, ASCII value of 4.

Table 3: ASTM Data Link Messages - Receiver

Event	Definition
grant session message	The receiver uses the grant session message to grant control of the data link to the requester. ASTM protocol defines this message as the single character <ACK>, ASCII value of 6.
deny session message	The receiver uses the deny session message to deny the request to take control of the data link. ASTM protocol defines this message as the single character <NAK>, ASCII value of 21.
positive acknowledgment message	The receiver uses the positive acknowledgment message to notify the sender that the last frame was successfully received. ASTM protocol defines this message as the single character <ACK>, ASCII value of 6.

Event	Definition
positive acknowledgment with interrupt message	The receiver uses the positive acknowledgment with interrupt message to notify the sender that the last frame was successfully received and the receiver has data to send. ASTM protocol defines it as the single character <EOT>, ASCII value of 4.
negative acknowledgment message	The receiver uses the negative acknowledgment message to notify the sender that the last frame from the sender was not successfully received. Using the ASTM protocol, the sender uses any message other than a positive acknowledgment (with or without interrupt) as a negative acknowledgment message. ASTM protocol defines it as the single character <NAK>, ASCII value of 21.

Note Senders and receivers use timers to provide blocking delays following unsuccessful line bids and to recover from a failure (watchdogs) on the part of the other system. Each timer uses 1 value in seconds.

Table 4: ASTM Data Link Timers - Sender

Timer	Definition
no response timer	The sender uses the no response timer to limit the amount of time it waits for a reply to a request for session message or an intermediate or final frame.
busy timer	The sender uses the busy timer to prevent itself from rebidding for the line when its last request session was denied.

Table 5: ASTM Data Link Timers - Receiver

Timer	Definition
interframe timer	The receiver uses the interframe timer to limit the amount of time it waits for the next frame (or session termination) following session establishment or after sending an acknowledgment to a previous frame. If this timer expires, the receiver returns to an idle state.

Table 6: ASTM Data Link Frame Limits

Event	Definition
frame retry limit	The frame retry limit is the maximum number of attempts the sender can retransmit a frame before it terminates the session. ASTM protocol uses 5 retries for a maximum of 6 attempts.
frame text size limit	The frame text size limit is the maximum number of message text characters allowed in a data segment of a single frame. ASTM protocol uses 240 characters as the limit.

ASTM Data Link Miscellaneous Characters

Character	Definition
restricted characters	Restricted characters are those characters not allowed in the data segment text. If any restricted characters are present, the message is not sent. The ASTM data link protocol restricts the characters with ASCII values of 1, 2, 3, 4, 5, 6, 10, 16, 17, 18, 19, 20, 21, 22, and 23. Although the protocol permits the null character (ASCII value 0), the system considers this character a restricted character due to its common usage as a string termination character. The 8-bit characters with ASCII values of 129−256, are mapped to their 7-bit equivalents.

Data Transfer and Processing

Data is transferred from a source system to a destination system. If the system is the source, then the LIS is the destination, or if the LIS is the source, then the system is the destination.

System as Data Source

When the system is the source of worklist entries and result data, it can perform the following actions:

- respond to remote requests for a worklist or result data
- initiate the transfer of results automatically or by operator command

  Automatic transfer occurs when new results are available (system readings or operator-entered), the operator has enabled the automatic results transfer option, and the results are not on hold.
- initiate requests for worklist data automatically or by operator command

Transferring Data

If **Automatically Send All Patient Results except Results on Hold** is selected at the **Setup > LIS Configuration** window, the system sends only final results. The system does not send calibrator results and invalid results from samples.

The system does not send final results with 1 or more of the following flags:

- Signal Error 1
- Signal Error 2
- Signal Error 3
- Signal Error 4
- Signal Error 5
- No Calculation

If **Automatically Send All Patient Results except Results on Hold** or Automatically Send All Patient Results and Additional Data Except Results on Hold are selected at the Setup > LIS Configuration window, the system sends preliminary and final results. Final results are defined in the paragraph above. Examples of preliminary results include:

- Replicate results
- Results of all of the levels in a dilution profile
- Dilution results that are out of range or overdiluted
- Results that the system cannot calculate because the RLUs are above or below the Master Curve
- Results of the tests used to calculate the result of a ratio test. Ratio test components are only sent if **Send Ratio Components to LIS** is selected the Setup > LIS Configuration window. Combination test components are never sent.

Preliminary results do not include invalid manual dilution results and RLU-only results.

CAUTION

Do not select Send Ratio Components to LIS without confirming that your LIS can distinguish between interim and final results and interpret them appropriately.

If Send Ratio Components to LIS is selected at the Setup > LIS Configuration window, the system sends both ratio test results, and component test results.

If Send Ratio Components to LIS is deselected at the Setup > LIS Configuration window, the system sends only ratio test results, the component test results are not transmitted.

Transmitting Results

The system does not send all worklist entries. It does not send calibrator results, only patient sample and control results.

Test names are a single value or a list. If any of the tests in the list are found in an entry, the entry is selected (subject to other selection criteria). However, the system sends only those test names in the list. If the system finds other tests in the selected entries, it does not send them.

Transmitting Results Selected by the Operator

The operator cannot select results that are on hold.

Querying for Results from the Remote System

A request for data message query from the LIS uses the following selection criteria:

- Specimen ID (SID, Rack ID, or both)
- Patient ID (PID)
- Tests
- Date

Ranges are not supported.

Test names are a single value or a list. The system sends only those test names listed in the query. If the system finds other test results in the selected replicates, the system does not send these other tests.

Note SID, PID, and Rack ID and Position information for samples are not sequential. Therefore, queries based on any of these data items are for a single sample only and not by batch.

The following table displays some examples of incoming Query data fields (Q3) and validity.

PID Sent	SID Sent	RID Sent	Test	Date Range	Valid
Yes	Empty	Empty	All, Empty	Empty	Yes
Yes	Empty	Empty	All, Empty	Start and/or End date range	Yes

PID Sent	SID Sent	RID Sent	Test	Date Range	Valid
Yes	Yes	Empty	Empty	Empty	Yes
Yes	Yes	Empty	Empty	Start and/or End date range	Yes
Empty	Empty	Empty	Single Test Name	Start and/or End date range	Yes
Empty	Yes	Empty	Single Test Name	Empty	Yes
Empty	Empty	Empty	All	Empty	No
Empty	Empty	Empty	All, Empty	Start and/or End Date Range	No
Empty	Empty	Empty	All	Empty	No
Empty	Yes	Empty	All, Empty	Start and/or End Data Range	Yes
Empty	Empty	Yes	Single Test name, All, or Empty	Empty or Start and/or End Date Range	Yes
Yes	Empty	Yes	Single Test Name, All, or Empty	Empty or Start and/or End Date Range	Yes

PID Sent	SID Sent	RID Sent	Test	Date Range	Valid
Empty	Yes	Yes	Single Test Name, All, or Empty	Empty or Start and/or End Date Range	Yes
Yes	Yes	Yes	Single Test Name, All, or Empty	Empty or Start and/or End Date Range	Yes
Yes	Yes	Empty	All	Empty	Yes
Empty	Yes	Empty	Single Test Name	Start and/or End Data Range	Yes

System as Data Destination

When the system is the destination of worklist entries, the system can perform the following actions:

- Accept a remote worklist transmission.
- Automatically request worklist data from the other system during sample processing.

  The system transmits an automatic request when it detects a new sample being loaded in the inprocess queue.

As samples are loaded into the inprocess queue, the system requests information for the newly added samples by using one query for each sample. Each query receives a reply or is canceled before the next query is issued.

The system accepts a worklist from the LIS without requesting it. The system accepts unsolicited messages when communications are enabled.

Processing Received Data

When the system receives data from an external system, the system internally processes the data before adding the data to the system database. This section describes this process and the data required to perform it.

Processing Worklists

When the system receives a worklist entry from an external system, the system checks the entry against the worklist database. Matching is based on SID. If the SID field is not present in the external entry, the system rejects the entry. If the SID field is present, the system uses the SID to search the database. If the worklist entry is not found, the system accepts the data and creates a new record in the database. If the worklist entry is found, the system uses the external data to update the database record. The updating is also subject to order action codes.

When the system uses external data to update an existing record in the database, the system uses any non-null incoming fields pertaining to patient demographics or sample identification to overwrite existing data. Incoming fields with the ASTM erase sequence (“”) erase the field in the database. The system ignores null incoming fields.

The action code of the order record determines whether to select or deselect the test in the worklist database. If the system recognizes any of the incoming tests, the system adds patient demographic data and recognized tests to the worklist. If the system does not recognize some of the tests, it returns an error message, and adds the recognized tests to the worklist. If the system recognizes none of the tests, it does not change the worklist. This enables the remote system to send a blanket worklist to several systems with each running only those tests it recognizes.

Processing Results

If the source of previous results is the LIS, then results from the LIS are used for delta checking.

Application Layer Protocol

The system application layer protocol conforms to the E1394-91 ASTM specification, *Standard Specification for Transferring Information Between Clinical Instruments and Computer Systems*. This section describes how messages are structured and identifies the contents of the message fields. This section also explains minor exceptions to the protocol.

Messages

Messages consist of a series of hierarchically structured records. The records are:

- header record (level 0)
- patient record (level 1)
- order record (level 2)
- result record (level 3)
- query record (level 1)
- comment records (levels 1 through 4)
- manufacturer’s records (levels 1 through 4)
- scientific record (level 1)
- termination record (level 0)

A message begins with a header record and ends with a termination record. The protocol allows multiple patient, query, and scientific records within a message. Multiple order records may occur with each patient record. Multiple result records may occur with each order record. Multiple comment records may occur at any place in the message. They are associated with the immediately preceding record other than another comment record or a manufacturer’s record. Manufacturer’s records may occur at any place in the message. They are associated with the immediately preceding record other than a comment record or another manufacturer’s record.

The system attempts to conform to the E1394-91 ASTM standard in its most general form. On incoming messages, the system allows the intermixing of worklist entries, results, and queries. Normally, only 1 type of transaction occurs in a given message. In general, level 1 records (patient and query) correspond to the specific transactions (database update or query). Patient records are updates to the worklist. The action that takes place depends on the existence of subsidiary records (order, result) and the status or action codes in them. Query records initiate a response. The response is normally to send worklist entries or result data.

The system scans all record types on incoming messages. The system scans and validates all record sequence numbers. Any invalid record types or any invalid sequence numbers cause an error. All fatal parse errors immediately close the current application message. The system processes any records received prior to the record containing the fatal parse error. The system ignores scientific records on all incoming messages. In order records, if the error is localized, the system rejects only the affected test order. If the error extends to the entire order record, the system rejects the whole record.

The system scans manufacturer’s record to see if the third field indicates a record generated for a system (the first field component is SHD and the second field component is CEN:NG). If the first and second field components indicate a record generated for a system, and the third and fourth field components match the SHD version (V1) and record type, the system scans the remainder of the record in accordance with the formats indicated for incoming records. The system ignores other manufacturer’s records.

Except for the header record, each record in an ASTM message has a sequence number that reflects the hierarchical structure of the message. The system uses the number that is the *n*th occurrence of the record type at the same hierarchical level. This number is reset to 1 whenever the system transmits a record of greater hierarchical significance (lower number) or if the system uses the same record at a different hierarchical level, such as comment and manufacturer’s records. Comment and manufacturer’s records have no explicit level, but the system considers them as 1 level of significance less (higher number) than the associated non-comment, non-manufacturer’s record.

The following table shows an example of a message structure.

Record Type	**Hierarchical Level**	**Sequence Number**
Header	0	no sequence number
Patient	1	1
Comment	2	1
Order	2	1
Result	3	1
Comment	4	1
Result	3	2
Result	3	3
Comment	4	1
Comment	4	2
Patient	1	2
Order	2	1
Result	3	1
Query	1	1
Patient	1	3
Order	2	1
Result	3	1
Termination	0	1

The following table describes the types of messages the system sends and receives.

Message Type	Description
Worklist	The worklist message consists of a header record, a patient record for each worklist entry, a number of optional patient comment records for each entry, 1 or more order records for each entry, an optional manufacturer's order record for each order record, and a termination record. A worklist message is a response to a query. **Note** Manufacturer's Order Record is only applicable to control orders.
Result Data	The result data message consists of the following records: • a header record • a patient record for each sample • a number of optional patient comment records for each sample • 1 or more order records for each sample • an optional manufacturer's order record for the order record • 1 or more result records for each test ordered • a number of optional result comment records for each result record • a termination record **Note** Manufacturer's Order Record is only applicable to control orders.
Request for Worklist Entries or Results	A request for worklist entries or results message consists of a header record, a query record, and a termination record. The other system should respond with a message containing worklist entries, results, or an empty message (header and termination records only) with codes indicating failure to find the requested information.
Response to Query in error	A response to a query that contains an error consists of a header record and a termination record. The other system should respond by closing the query and logging the error or notifying the operator of a query in error.

Message Type	Description
Response to Messages in Error	A response to a message that contains an error, such as ordering an unknown test or a patient record with no specimen ID, consists of all records in the hierarchy up to the record in error, followed by a comment record, and a termination record. The comment record describes the error.
Cancellation of Query	A cancellation of query message consists of a header record, a query record, and a termination record. The other system should respond by canceling any transmission in progress that is in response to the canceled request. Then the other system sends a message that ends with a termination record. The termination record has a status indicating the message was canceled at the receiver's request.
Communication Diagnostics	The communication diagnostics message consists of a header record, a manufacturer's test record, and a termination record. The other system should respond by acknowledging the frames of the message at the data link layer. No response is required at the application layer, but the application layer data should be verified by the remote system and a success or failure status logged or reported by the remote system to its operator.

ASTM Record Structure

ASTM protocol uses 8-bit characters with values 7, 9, 11, 12, and 13 and values in the range of 32–126, which are defined by the ASCII standard (ANSI X3.4-1986). The system permits the transfer of values in the range of 129–254, but transfers them to their corresponding 7-bit values. The ASCII value 13 (carriage return) is reserved as a record terminator. The record structure does not allow unused values in ASTM records, but transmits the unused values through the use of escape sequences supported by ASTM.

ASTM records are composed of fields separated by field delimiters; the character **|** is the default field delimiter. Each field is identified by its position in the record, which is determined by the number of field delimiters that precede a field. Fields are repeated if they are separated by repeat delimiters; the character **** is the default repeat delimiter. If there are no characters between 2 field delimiters, the field is empty (null). A null field is an indication that a corresponding field in the database of the system receiving the record should remain unchanged or that the field is unused. A field that contains 2 double quotes (**""**) indicates that the system receiving the record should delete the corresponding field in the database (the database field is emptied). Any fields after the last field containing data can be left out of the record, that is, the system truncates unused fields from the record. The system assumes any field not present in the record to be null. An ASCII carriage return is used to indicate the end of the record.

Fields are separated into components, separated by component delimiters; the character **^** is the default component delimiter. Individual field components are not repeated. Only the entire field is repeated. Component delimiters are only required up to the last non-empty component. The system truncates unused components from the field. Empty or absent components are null and indicate that a corresponding component or field in the database of the receiving system should not change or that the component is unused. A pair of double quotes in a component does not delete the component. Double quote pairs mean deletion only at the field level.

Escape sequences are supported by ASTM and use the character **&** as the default escape delimiter. The system does not support the escape sequences to start highlighting text (**&H&**), stop highlighting text (**&N&**), or the manufacturer defined escape sequence (**&Zcccc&**). The system does not send such escape sequences and, if they are received, removes them from data.

The system supports the ASTM escape sequences for delimiters and hexadecimal data. The delimiter escape sequences allow embedding the delimiter characters in data without interpreting the characters as delimiters. The characters **&F&** represent the field delimiter, the characters **&S&** represent the component delimiter, the characters **&R&** represent the repeat delimiter, and the characters **&E&** represent the escape delimiter. The characters **&Xhhhh&** represent the hexadecimal data escape sequence, begun by **&X**, followed by any number of pairs of hexadecimal digits (0–9, A–F), and ended by the escape delimiter (**&**). If there is an odd number of hexadecimal digits, the system considers the last hexadecimal digit as the least significant digit of a pair of hexadecimal digits. For example, the characters **&XA&** represent the ASCII linefeed character. The system converts each pair of hexadecimal digits to an ASCII value. For example, the system converts characters **&X40&** to the ASCII character **@**.

If an escape sequence converts to an ASCII character not allowed in the database, the system replaces the character with a single ASCII space character. The ASCII characters allowed are 32–126, 161–163, 165, 167–171, 176–179, 181–183, 185–189, 191–207, 209–221, 223–239, and 241–253. If the database field of the system is more restrictive (date and sex fields), the system considers the field in the record as null. If the field is Rack ID, the system reports a non-fatal parse error and ignores the associated records, but processing of following records continues.

The contents and field sizes of records generated by the system and the worklist and results databases define the records accepted by the system. Refer to *page 67* through *page 148* for maximum sizes. The record descriptions indicate the source and special formatting of the field contents. The field number within the record is listed as T#, where T is the record type and # is the field number. Field, repeat, component, and escape delimiters are the characters **|**, ****, **^**, and **&**, respectively. Fields not listed are null.

Record Data Contents

This section describes the contents of record data fields for both incoming and outgoing (generated by the system) records.

The following table is a summary of the Application Layer messages.

Table 7: ASTM Application Layer Messages Summary

Message Record	LIS to System	System to LIS	Description
Message Header	Yes	Yes	Always the first record in an application message. The message header contains general sender and receiver information. Hierarchical Level: 0
Patient Information	Yes	Yes	This record supplies patient demographic information for the order and results records that follow. Hierarchical Level: 1
Patient Comment	Yes	Yes	An optional record that supplies additional patient demographic in free text. This record is present if the Comment field in the worklist database is not null. The patient comment record always follows the patient record. Hierarchical Level: 2
Test Order	Yes	Yes	This record supplies information on a specific samples's test requests. This information is necessary either for ordering tests on a specific sample or for reporting results for tests on a specific sample. A test order record is associated with the previous patient record. Hierarchical Level: 2

Message Record	LIS to System	System to LIS	Description
Manufacturer's Order	Yes	Yes	This record supplies additional information about quality control samples. The additional information regarding controls is critical for control sample identification and includes the name and lot number of the control. This record is used only when the preceding order record is tied to a control sample. Hierarchical Level: 3
Result	Yes	Yes	This record supplies the test result information for a single test of a specific sample. Results of multiple tests are specified in separate result records. The result record is associated with the previous test order record. The incoming result record provides previous results used for Delta Checking. Hierarchical Level: 3

Message Record	**LIS to System**	**System to LIS**	**Description**
Result Comment	No	Yes	This record communicates additional flags beyond those supported by the Result Abnormal Flags field of the result record. This record is optional. It is used if a flag other than high (H), low (L), critical high (HH), critical low (LL), over range (>), or under range (<) is associated with the result. Each flag generates an additional result comment record. The result comment record always follows a result record. Hierarchical Level: 4
Request Information (Query)	Yes	Yes	The request information (query) record requests data from remote systems. The system processes only one received query at a time. If a second query is received while the first is processing, then the system cancels both queries. Hierarchical Level: 1
Manufacturer's Test	Yes	Yes	The manufacturer's test record used for communication diagnostics to determine whether or not the physical, data link, and application layers are functioning correctly. Hierarchical Level: 1

Message Record	LIS to System	System to LIS	Description
Communications Error Comment	No	Yes	This record is an optional record used to report a number of data specific error conditions to the LIS. The system uses the record if some data specific error occurs that prevents the system from performing the requested operation. When the system uses this record, the system transmits all data records in the hierarchy through the record that had the error, with the comment immediately following the record that has the error. Hierarchical Level: Dependent upon the error.
General Manufacturer	No	No	This record allows a system or computer system manufacturers to communicate information that does not fit into the ASTM standard. If the system does not recognize a manufacturer’s record as a manufacturer’s order record or a manufacturer’s test record, then it considers the record as a General manufacturer’s record. The system does not transmit a general manufacturer’s record and, other than determining that it follows message structure rules, it ignores incoming general manufacturer’s records.

Message Record	LIS to System	System to LIS	Description
Reagent Status	No	Yes	This record allows system or computer system manufacturers to communicate information that does not fit into the ASTM standard. If the system does not recognize a manufacturer’s record as a manufacturer’s order record or a manufacturer’s test record, then the system considers the record as a general manufacturer’s record. The system does not transmit a general manufacturer’s record and, other than determining that it follows message structure rules, it ignores incoming general manufacturer’s records.
Termination	Yes	Yes	The last record of a message and closes the message. This record provides an explanation for ending the message.

Header Record

The header record is always the first record in an application message. The header record contains general sender and receiver information. The hierarchical level for the header record is 0. The following table describes the values each field can contain.

Field Number	Field Name	Incoming Value	Outgoing Value
H1	Record Type	1 character: H or h	1 character; always H
H2	Delimiter character (Field, Repeat, Component, Escape)	0–4 characters; default |\^&. Recommend using |\^& to match system outgoing delimiters, but can use any 4 of the ASCII characters allowed.	Always |\^&, respectively.
H5	Sender ID	0–10 characters. Not used for incoming message processing.	1–10 characters; default UIW_LIS. Set to System Name at the Setup > LIS Configuration window.

Field Number	Field Name	Incoming Value	Outgoing Value
H10	Receiver ID	0–10 characters. The Receiver ID is used to ensure that the received message was addressed to the system. If the Receiver ID field is empty, the system assumes that it is to process the received message. If the Receiver ID field exists and is not null, the system compares it to the System Name at the Setup > LIS Configuration window. If the 2 fields are equal (case-sensitive comparison, for example, A does not equal a), the system accepts the message for processing. If the 2 fields are different, the system rejects the entire application level message, and returns an error message to the LIS.	1–10 characters; default LIS_ID. Set to LIS ID field at the Setup > LIS Configuration window

Field Number	Field Name	Incoming Value	Outgoing Value
H12	Processing ID	0 or 1 character; default value P. If the Processing ID is P, the incoming application message is parsed and all the data is processed. If the Processing ID is D, the incoming application message is parsed, but no data is processed. Debug mode is used for testing the ASTM application message format in a transmission between 2 systems.	Always 1 character; either P (Production) or D (Debug). Debug mode is used for testing the ASTM application message format in a transmission between 2 systems.

Field Number	Field Name	Incoming Value	Outgoing Value
H13	Version Number	0 to any number of characters; default value is 1. The format of the Version Number is a Major Version Number followed by an optional period and an optional Minor Version Number. Major and Minor Version Numbers have a range of 0 through 255. The following are examples of Version Numbers: 1, 1.0, 2.12, 255.255. The following Version Numbers are equivalent: 1, 1., 1.0, 1.00. If the Version Number is equal to the version supported by the system, the current incoming message is accepted for processing. If the Version Number is greater than the version supported by the system, the current incoming message is ignored.	Always 1

The following is an example of a header record.

H|\^&| | |system_LIS| | | | |LIS_ID| |P|1<CR>

The following table identifies the values in each field in the previous example.

<table>
<tr><th>Field Number</th><th>Field Name</th><th>Value</th></tr>
<tr><td>H1</td><td>Record Type</td><td>H (Header)</td></tr>
<tr><td>H2</td><td>Delimiter Characters:
Field Delimiter</td><td>
|</td></tr>
<tr><td></td><td>Repeat Delimiter</td><td>\</td></tr>
<tr><td></td><td>Component Delimiter</td><td>^</td></tr>
<tr><td></td><td>Escape Delimiter</td><td>&</td></tr>
<tr><td>H5</td><td>Sender ID</td><td>system_LIS</td></tr>
<tr><td>H10</td><td>Receiver ID</td><td>LIS_ID</td></tr>
<tr><td>H12</td><td>Processing ID</td><td>P (Production)</td></tr>
<tr><td>H13</td><td>Version Number</td><td>1</td></tr>
</table>

Patient Information Record

The patient information record supplies patient demographic information for order and result records that follow. The hierarchical level for the patient information record is 1. The following table describes the values each field can contain.

.

Field Number	Field Name	Incoming Value	Outgoing Value
P1	Record Type ID	1 character; can be P or p.	1 character; always P.
P2	Sequence Number	1 to any number of characters, with a default value of 0, which is always an invalid Sequence Number. Formatted as a string of ASCII numeric characters. Equal to the nth occurrence of a patient record within the current incoming application message. If the current Sequence Number does not equal the Sequence Number of the expected record, an error is reported.	1–5 characters. Formatted as a left justified number with a range from 1 through 65535. Equal to the nth occurrence of a patient record within the current outgoing application message. Used for validating the integrity of the application message by ensuring that the message contains all records.

Field Number	Field Name	Incoming Value	Outgoing Value
P3	PID (Practice Assigned Patient ID)	0–20 characters. Written to the PID field of imported worklist entries. An empty field causes no change to the database field. A value of 2 double quotes (“”) deletes the database field. This field is used only for user information. The system worklist allows the same PID field to exist in multiple worklist entries.	0–20 characters. Set to the Patient ID (PID) field of an outgoing system worklist or result entry.
P4	Laboratory ID	0-20 characters	0-20 characters

Field Number	Field Name	Incoming Value	Outgoing Value
P6	Patient Name	0–3 components. (Components 4 and up are ignored.) Written to the patient Name field of the worklist entry or result. Total length of the field is 0–30 characters. An empty field causes no change to the database field. A value of 2 double quotes ("") causes the database field to be deleted.	0–3 components. Total length of the field is 0–30 characters. Set to the patient Name field of the worklist entry or result. Each name component is separated by the Component Delimiter character (^), for example, Smith^John^A. Trailing empty name components and trailing Component Delimiter characters are not included. For example, Patient Name is set to Smith for a patient worklist entry with the last name Smith.
P6.1	Last Name	0–20 characters	0–20 characters
P6.2	First Name	0–16 characters	0–16 characters
P6.3	Middle Name	0–16 characters	0–16 characters

Field Number	Field Name	Incoming Value	Outgoing Value
P8	DOB (Date of Birth)	0 or 8 characters representing ANSI X3.30 date format. Written to date of birth (DOB) field in the worklist entry. The date format is set per the system localization settings. An empty field causes no change to the database field. A value of 2 double quotes ("") deletes the database field. Invalid dates cause the order to be are rejected and an error message logs in the Event log. This field is used for establishing normal ranges for the sample.	0 or 8 characters. Set to ANSI X3.30 format of patient date of birth (DOB) in worklist entry or result, for example, 197210050000 for October 5, 1972. If the patient DOB field is not specified in the worklist or result entry, this field is empty. The allowed range is 100101010000 through 210012310000 (January 1, 1001 through December 31, 2100).

Field Number	Field Name	Incoming Value	Outgoing Value
P9	Sex (Patient Sex)	0 or 1 character. Written to the Patient Sex field in worklist entry. The values are: M, F, U, Empty, or Invalid. If Patient Sex value is M, database field is set to male. If Patient Sex value is F, database field is set to female. If Patient Sex value is U, database field is set to blank. An empty field causes no change to the database field. A value of 2 double quotes ("") causes the database field to be set to unknown sex. An invalid Patient Sex value causes the database field to be set to blank. This field is used for establishing normal ranges for the sample.	0 or 1 character. Value set by the Patient Sex field in worklist entry or result. The values are M, F, or U. If sex is male, field is set to M. If sex is female, field is set to F. If the sex is unknown, the field is set to U. If the sample type is a control, field is blank.

Field Number	Field Name	Incoming Value	Outgoing Value
P14	Attending Physician ID	0–2 components. Written to the Physician field of imported worklist entry. An empty field causes no change to the database field. A value of 2 double quotes ("") deletes the database field. This field is used only for user information.	0–2 components. Set to the Physician field of worklist or result entry.
P14.1	Physician ID	0–10 characters	0–10 characters
P14.2	Physician Name	0–30 characters	0–30 characters
P15	Species	0–12 characters	0–12 characters
P25	Patient Status	0–12 characters	0–12 characters
P26	Location	0–20 characters. Written to the Location field of imported worklist entry. An empty field causes no change to the database field. A value of 2 double quotes ("") deletes the database. This field is for user information only.	0–20 characters. Set to the Location field of worklist entry or result.

The following is an example of a patient record.

P|12|A123-45-6789| | |Jones^Mary^A| |19540601|F| | | | |201| | | | | | | | |
| | | IP | ICU<CR>

The following table identifies the values in each field in the previous example.

Field Number	Field Name	Value
P1	Record Type ID	P (Patient)
P2	Sequence Number	12
P3	PID (Practice Assigned Patient ID)	A123-45-6789
P6	Patient Name	blank
P6.1	Last Name	Jones
P6.2	First Name	Mary
P6.3	Middle Name	A
P8	DOB	June 1, 1954
P9	Patient Sex	F (Female)
P14	Attending Physician ID	201
P25	Patient Status	IP
P26	Location	ICU

Patient Comment Record

The patient comment record is an optional record that supplies additional patient demographic information in free text. This record is present if the Comment field in the worklist database is populated (not null). The system does not generate the patient comment record for historical result records. The hierarchical level for the patient comment record is 2. The patient comment record always follows the patient record.

The system retains up to 3 patient comments. If the system sends more than 3 comments, the system retains only the last 3 comments. The following table describes the allowable values for each field.

Note The system also uses comment records as result comment records or as general comment records associated with other record types.

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Field Number	Field Name	Incoming Value	Outgoing Value
C1	Record Type ID	1 character; can be C or c	1 character; always C
C2	Sequence Number	1 to any number of characters, with a default value of 0, which is always an invalid Sequence Number. Formatted as a string of ASCII numeric characters. Equal to the nth occurrence of a patient comment record immediately following the last patient record, which is considered the current patient record. If the current Sequence Number does not equal the Sequence Number of the expected record, a fatal parse error is reported.	1 character, in the range from 1 through 3. If a patient comment record is needed, the system transmits up to a maximum of 3 patient comment records per patient record. Used for validating the integrity of the application message by ensuring that the message contains all records.
C3	Comment Source	0 or 1 character; not used for incoming message processing.	0 characters; always empty.
C4	Comment	1 component. Set to the Comment field of the worklist or result entry.	2 components. Set to the Comment field of the patient sample or worklist entry.

Field Number	Field Name	Incoming Value	Outgoing Value
C4.1	Comment Code	0–60 characters. Written to the Comment field of the imported worklist entry. An empty Comment Text field or the lack of a patient comment record causes no change to the database field. A value of 2 double quotes ("") deletes the database field. This field is for user information only.	Always empty

Field Number	Field Name	Incoming Value	Outgoing Value
C4.2	Comment Text	Not used for incoming message processing.	1–60 characters. Set to the Comment field of the outgoing worklist or result entry. If the Comment field is empty, a patient comment record is not generated for transmission.
C5	Comment Type	0 or 1 character. If the Comment Type field is empty or G (Generic), the comment record is processed as a patient comment record. If the Comment Type field is any other value, the comment record is processed as a general comment record and is ignored by the system.	1 character, G (Generic).

The following is an example of an incoming patient comment record.

C|1| |PATIENT WAITING|G<CR>

The values in this example are:

Field Number	Field Name	Value
C1	Record Type	C (Comment)
C2	Sequence Number	1
C3	Comment Source	empty
C4	Comment	
C4.1	Comment Code	PATIENT WAITING
C4.2	Comment Text	empty
C5	Comment Type	G (Generic)

Test Order Record

The Test Order record supplies information on a specific sample's test requests. This information is necessary either for ordering tests on a specific sample or for reporting results for tests on a specific sample. An order record is associated with the previous patient record. The hierarchical level for the test order record is 2.

The following table describes the allowable values for each field.

Field Number	Field Name	Incoming Value	Outgoing Value
O1	Record Type ID	1 character; can be O or o.	1 character; always O
O2	Sequence Number	1 to any number of characters, with a default value of 0, which is always an invalid Sequence Number. Formatted as a string of ASCII numeric characters. Equal to the nth occurrence of an order record since the last patient record, which is considered the current patient record. If the current Sequence Number does not equal the Sequence Number of the expected record, an error is reported.	1 to any number of characters; usually 1. Used for validating the integrity of the application message by ensuring that the message contains all records.

Field Number	Field Name	Incoming Value	Outgoing Value
O3	Specimen ID	1,2, or 3 components. The specimen identifier has 3 components: the Sample ID (field component O3.1), the Rack number identifier (field component O3.2), and the Sample Position identifier (field component O3.3). The possible specimen identifiers are the Sample ID, the Rack ID, or the Sample ID and the Rack ID. The Sample ID is the default identifier. The Rack ID consists of the rack number identifier together with the sample position identifier. Each component of the Specimen ID is separated by the Component Delimiter character (**^**), for example, **18653** (Sample ID only), **^4957^A** (Rack ID and position), or **18653^4957^A** (Sample ID and Rack ID). Refer to the individual field components (O3.1, O3.2, and O3.3) for field value information.	1,2, or 3 components. The specimen identifier has 3 components: the Sample ID (field component O3.1), the Rack number identifier (field component O3.2), and the Sample Position identifier (field component O3.3). The possible specimen identifiers are the Sample ID, the Rack ID, or the Sample ID and the Rack ID. The Sample ID is the default identifier. The Rack ID consists of the rack number identifier together with the sample position identifier. At the Setup > LIS Configuration window, select **Send Rack IDs with Results** to send the Rack ID when it is available for the sample. Each component of the Specimen ID is separated by the Component Delimiter character (**^**), for example, **18653** (Sample ID only), **^4957^A** (Rack ID and position), or **18653^4957^A** (Sample ID and Rack ID). Refer to individual field components (O3.1, O3.2 and O3.3) for field value information.

Field Number	Field Name	Incoming Value	Outgoing Value
O3.1	SID (Sample ID)	0–20 characters. Optional field. Written to Sample ID (SID) field of imported worklist entry. If no SID is included, the Rack ID and position must be included. If an SID is included, the sample is stored in the worklist as Schedule by SID. The field value is unique for all patient samples in the system worklist. Multiple quality control worklist entries can have the same Sample ID.	0–20 characters. Set to Sample ID (SID) field of worklist or result entry.
O3.2	Rack Number ID	0 or 4 characters. Optional component used for specifying the physical location of a given sample. This component is used together with the sample position identifier and is part of the Rack ID at the Patient Order window. If a value is given for the sample position identifier, then a value must be given for the rack number identifier. The rack number identifiers are numeric quantities ranging from 0001 to 9999.	0 or 4 characters, Blank. This optional component is used with the sample position identifier and is part of the Rack ID at the Patient Order window. The rack number identifiers are numeric quantities ranging from 0001 to 9999. At the Setup > LIS Configuration window, select Send Rack IDs with Results to send the Rack ID when it is available for the sample.

Field Number	Field Name	Incoming Value	Outgoing Value
O3.3	Sample Position ID	0 or 1 character. Optional component used for specifying the physical location of a given sample designated by the Sample ID field. If a value is given for the rack number identifier, then a value must be given for the sample position identifier. The value must have the format of the system Rack ID values. The sample position identifier values fall within the range of **A** through **E** (uppercase only).	0 or 1 character, Blank. This component is used with the rack number identifier and is part of the Rack ID at the Patient Order window. The sample position identifier is a value ranging from **A** to **E**.

Field Number	Field Name	Incoming Value	Outgoing Value
O5	Universal Test ID	List of tests, where each test is described by a multi-component field, separated by a Component Delimiter character (**^**). Each group of components is separated by a Repeat Delimiter character (****). If a test is unknown to the system, an error message is returned to the LIS and processing continues on the list of tests. The list of tests can contain any number of names. If a single Universal Test ID matches a ratio test, all tests associated with the ratio are automatically added to the list of tests. Refer to field O12, Action Code, for processing of updates and cancellations of the tests specified in this field. Refer to individual components (field components O5.1 through O5.6) for data format information.	List of tests, where each test is described by a multi-component field, separated by a Component Delimiter character (**^**). Each group of components is separated by a Repeat Delimiter character (****). If the current order record is for submitting a worklist request for a specific sample, this field describes the list of requested tests. If the current order record is for reporting single or multiple result values, this field describes the list of tests whose result values are reported in subsequent result records. The list of tests can contain from 1 up to the maximum number of tests the system can support including ratio and off-system tests. Refer to individual components (field components O5.1 through O5.6) for data format information.
O5.1	Universal Test ID	0 to any number of characters. This component is always ignored.	0 characters; always empty.

Field Number	Field Name	Incoming Value	Outgoing Value
O5.2	Universal Test ID Name	0 to any number of characters. This component is always ignored.	0 characters; always empty.
O5.3	Universal Test ID Type	0 to any number of characters. This component is always ignored.	0 characters; always empty.
O5.4	Manufacturer's Code	1–8 case-sensitive characters. If a value exists, this value is used to search the test definition database. The system searches the test definition database for the matching LIS code. If no match is found, the system searches for the matching test name. If a match is found, that test is selected for the sample. If no match is found, an error is reported.	1–8 case-sensitive characters. The defined LIS code name is used for the test scheduled for the sample.
O5.5	Dilutions (optional)	D or blank. D is sent if O5.6 is populated. Blank is undiluted.	D or blank. D is sent if O5.6 is populated.
O5.6	Dilutions (optional)	Dilution ratio must be defined for the test. 2, 5, 10, 20, 50, 100, 200, 500, 1000, or 2500	2, 5, 10, 20, 50, 100, 200, 500, 1000, or 2500
O5.7	Replicates (optional)	0–2 characters	0-2 characters

Field Number	Field Name	Incoming Value	Outgoing Value
O6	Priority	1 character. Written to the STAT flag in the worklist entry. If the Priority is **S**, the STAT flag is set to Yes. If the Priority is **R** or **A**, the STAT flag is set to No.	1 character. Value determined by the STAT flag in the worklist entry. If the STAT flag is Yes, the Priority field is set to **S** (Stat). If the STAT flag is No, the Priority field is set to **R** (Routine).
07	Order Date	0 or 14 characters.	0 or 14 characters.
08	Sample Collection (optional)	0 or 14 characters.	0 or 14 characters.

Field Number	Field Name	Incoming Value	Outgoing Value
O12	Action Code	0 or more instances of 1 character. For example, an **N\Q** Action Code specifies a New Request of a QC Test Specimen. If the order record is for an incoming worklist entry (refer to field O26, Report Type), this field is processed as follows: If 1 of the Action Codes is **C** (Cancel Request), the tests specified in Universal Test ID field O5 are canceled for the sample specified in field O3. If the Action Code does not specify Cancel Request, the Action Code is interpreted as a New Request or an Add Request, depending upon the existence of an entry in the system worklist for the Sample ID from field O3.1. Empty and invalid Action Code fields are interpreted as a New Request or as an Add Request, depending upon the existence of an entry in the system worklist for the Sample ID from field O3.1.	0 or more instances of 1 character. If the worklist entry or the result entry is for a control sample, the Action Code field is set to **Q** (QC Test Specimen). If the worklist entry or the result entry is for a patient sample, the Action Code field is empty.

Field Number	Field Name	Incoming Value	Outgoing Value
O15	Sample Received (Optional)	0 or 14 characters	0 or 14 characters
O16	Specimen Descriptor	2 components	2 components
O16.1	Specimen Type	Serum, Plasma, Urine, Amniotic Fluid, Other, RBC Hemolysate, Blank	Serum, Plasma, Urine, Amniotic Fluid, Other, RBC Hemolysate
O16.2	Specimen Source	Blank	Blank
O16.3	Manual Dilution (optional)	0–4 characters.	0–4 characters.

Field Number	Field Name	Incoming Value	Outgoing Value
O25	Instrument (optional)	N/A	N/A
O26	Report Type	0 or more instances of 1 character. If the Report Type field is empty and if no result records are tied to the current order record, Report Type is assumed to be O (Order). If the Report Type field is empty and if 1 or more result records are tied to the current order record, Report Type is assumed to equal F (Final Results). If 1 repetition of Report Type contains X, I, Y, or Z, the order record and any following manufacturer's, comment, or result records associated with the current order record are not processed. Otherwise, if 1 repetition of Report Type contains O, the order record is processed as an incoming worklist entry.	0 or more instances of 1 character. If the outgoing message contains rejected incoming worklist or result data, or the test is not resulted, the Report Type field contains X (Work Cannot Be Done). If the outgoing message contains worklist data, the Report Type field contains O (Order). If the outgoing message contains result data, the Report Type field contains F (Final Results). If the outgoing message contains data in response to a query, the Report Type field contains Q (Response to a Query). If the outgoing message is a response to a remote query for pending results, the Report Type field contains I (Instrument Pending).

The following is an example of an order record without a Rack ID value.

O|1|18653B| |^^^T4\^^^HCG\^^^P1234|S| | | | | || | | |Serum | | | | | | | | | |F<CR>

The following table interprets the values in each field in the previous example.

Field Number	Field Name	Value
O1	Record Type ID	O (Order)
O2	Sequence Number	1
O3	Specimen ID	
O3.1	(Sample ID)	18653
O3.2	Rack Number ID	0037
O3.3	Sample Position ID	B
O5	Universal Test ID	List of tests: T4, HCG, P1234 (P1234 is an example of a user-defined test, or the LIS code name for a test.)
O6	Priority	S (Stat)
O12	Action Code	empty
O16	Specimen Descriptor	
O16.1	Specimen Type	Serum
O26	Report Type	F (Final Result)

The following is an example of an order record with a Rack ID value.

```
O|1|18653^0037^B| |^^^T4\^^^HCG\^^^P1234|S| | | | | | | | | | | | | | | | |
| |F<CR>
```

The following table interprets the values in each field in the previous example.

Field Number	Field Name	Value
O1	Record Type ID	O (Order)
O2	Sequence Number	1
O3	Specimen ID	
O3.1	SID (Sample ID)	18653
O3.2	Rack Number ID	0037
O3.3	Sample Position ID	B
O5	Universal Test ID	List of tests: T4, HCG, P1234 (P1234 is an example of a operator-defined test, or the LIS code name for an test.)
O6	Priority	S (Stat)
O12	Action Code	empty
O26	Report Type	F (Final result)

The following is an example of an order record with a dilution.

```
O|1|18653^0037^B| |^^^HCG^dilute only^200|S| | | | | | | | | | | | | | | | |
| |F<CR>
```

The following table interprets the values in each field in the previous example.

Field Number	Field Name	Value
O1	Record Type ID	O (Order)
O2	Sequence Number	1
O3	Specimen ID	
O3.1	SID (Sample ID)	18653
O3.2	Rack Number ID	0037
O3.3	Sample Position ID	B
O5.4	Manufacturer's Code	HCG
O5.5	Dilution Protocol	dilute only
O5.6	Dilution Ratio	200
O6	Priority	S (Stat)

Field Number	Field Name	Value
O12	Action Code	empty
O26	Report Type	F (Final result)

Order Comment Record

Comments included after the order record are treated as patient comments. See *Patient Comment Record, page 78,* and *Communications Error Comment Record*, page 135 for more information.

Manufacturer's Order Record

The manufacturer's order record supplies additional information about quality control samples. The additional information regarding controls is critical for control sample identification and includes the name and lot number of the control. This record is used only when the preceding order record is tied to a control sample. The hierarchical level for the manufacturer's order record is 3. The following table describes the allowable values for each field.

Note The system also uses manufacturer's records for communication diagnostic test data or as an unsupported manufacturer's record associated with other record types.

Field Number	Field Name	Incoming Value	Outgoing Value
M1	Record Type	1 character; can be M or m.	1 character; always M.
M2	Sequence Number	1 to any number of characters, with a default value of 0, which is always an invalid Sequence Number. Formatted as a string of ASCII numeric characters. Equal to the nth occurrence of a manufacturer's order record that immediately follows the last order record, which is considered the current order record. If the current Sequence Number does not equal the Sequence Number of the expected record, an error is reported.	1 character; always 1. If a manufacturer's order record is needed, the system transmits only 1 manufacturer's order record per order record. Used for validating the integrity of the application message by ensuring that the message contains all records.

Field Number	Field Name	Incoming Value	Outgoing Value
M3	Manufacturer's Order Record ID	4 component fields used to describe the manufacturer's record as a Siemens Healthcare Diagnostics order record. Each component is separated by the defined Component Delimiter character of the current message. Refer to the individual components (field components M3.1 through M3.4) for field information.	4 component fields used to describe the manufacturer's record as a Siemens Healthcare Diagnostics order record. Each component is separated by the Component Delimiter character (^). Refer to the individual components (field components M3.1 through M3.4) for field information.
M3.1	Manufacturer	0–10 characters. If the Manufacturer component is not SHD, the record is handled as a general manufacturer's record and is not processed. If the Manufacturer component is SHD, the Instrument component is parsed.	3 characters; always SHD.

Field Number	Field Name	Incoming Value	Outgoing Value
M3.2	Instrument	0–10 characters. If the Instrument component is not CEN:NG, the record is handled as a general manufacturer's record and is not processed. If the Instrument component is CEN:NG, the Record Version component is parsed.	0–10 characters. Always CEN:NG.
M3.3	Record Version	0–10 characters. If the Record Version component is not V1, the record is handled as a general manufacturer's record and is not processed. If the Record Version component is V1, the Record Type component is parsed.	2 characters; always V1.

Field Number	Field Name	Incoming Value	Outgoing Value
M3.4	Record Type	0–10 characters. If the Record Type component is O, the remainder of the record is parsed as a manufacturer's order record. If the Record Type component is T, the remainder of the record is parsed as a manufacturer's test record. If the Record Type component is not O, or T, the record is handled as a general manufacturer's record and is not processed.	1 character; always O.

Field Number	Field Name	Incoming Value	Outgoing Value
M4	Control Name	0–11 characters for Kit controls. 0-20 characters for routine controls. Used to verify that the Sample ID designated in the previous order record is associated with the proper control definition. If the Sample ID and the Control Name are not associated with a defined control, the entry is rejected. Otherwise, the Control Lot Number field is processed.	1–11 characters for Kit controls. 1-20 for routine controls. Set to the Control Name field of the Control Definition of the specific control Sample ID designated in the previous order record.
M5	Control Lot	0–10 characters for kit or routine controls. Used to verify that the Sample ID designated in the previous order record is associated with the proper control definition. If the Sample ID and the Control Name are not associated with a defined control, the entry is rejected. Otherwise, the Control sample is processed a worklist entry or result entry.	1–10 characters for Kit or routine controls. Set to the Control Lot Number field of the Control Definition of the specific control Sample ID designated in the previous order record.

The following is an example of a manufacturer’s order record for a quality control sample.

M|1|SHD^CEN:NG^V1^O|LIG1|016101<CR>

The values in this example are:

Field Number	Field Name	Value
M1	Record Type	M (Manufacturer’s)
M2	Sequence Number	1
M3	Manufacturer’s Order Record ID	
M3.1	Manufacturer	SHD
M3.2	Instrument	CEN:NG
M3.3	Record Version	V1
M3.4	Record Type	O (Order)
M4	Control Name	LIG1
M5	Control Lot Number	016101

Result Record

The Result Record supplies the final test result information for a single test of a specific sample. Results of multiple tests are specified in separate result records. The system rejects incoming result records from a remote system. The hierarchical level for the result record is 3. The result record is associated with the previous order record. The following table describes the allowable values for each field.

Field Number	Field Name	Incoming Value	Outgoing Value
R1	Record Type	1 character; can be **R** or **r**.	1 character; always **R**.
R2	Sequence Number	Equal to the *n*th occurrence of an order record since the last order record; 1. . .65535.	1–5 characters, formatted as a left justified number, with a range from **1** through **65535**. Equal to the *n*th occurrence of a result record since the last order record. Used to verify the integrity of an application message by ensuring that the message contains all records.

Field Number	Field Name	Incoming Value	Outgoing Value
R3	Universal Test ID	A single test name described by 8 components, where each component is separated by a component delimiter character (**^**). The Universal Test ID specifies the name of the test associated with the result. Refer to the individual components (field components R3.1 through R3.8) for data format information.	A single test name described by 8 components, where each component is separated by a component delimiter character (**^**). The Universal Test ID specifies the name of the test associated with the result. Refer to the individual components (field components R3.1 through R3.8) for data format information.
R3.1	Universal Test ID	0 characters; always empty.	0 characters; always empty.
R3.2	Universal Test ID Name	0 characters; always empty.	0 characters; always empty.
R3.3	Universal Test ID Type	0 characters; always empty.	0 characters; always empty.
R3.4	Manufacturer's Code	1–8 case-sensitive characters. The LIS code of the test.	1–8 case-sensitive characters. The LIS code of the test.
R3.5	Dilutions (optional)	Discarded	Any of the system supported protocols. Blank is Undiluted.
R3.6	Dilutions (optional)	Discarded	Undiluted 2, 5, 10, 20, 50, 100, 200, 500, 1000, or 2500

Field Number	Field Name	Incoming Value	Outgoing Value
R3.7	Replicate Number	Not processed	0–2 characters. Integer value assigned by the system to each replicate test result to track its relative position within the sequence of all results generated by the replicate runs of the associated tests on a given sample. Only sent for unmeaned tests.
R3.8	Result Aspect	Not processed	0–4 characters. 1 of 7 possible text strings used to identify the specific aspect of the result being transmitted. The following are possible values and their interpretations: ALGC - Allergen code CLSS - Allergy class COFF - Cut off (in Master Curve units) DOSE - Result concentration value (in Master Curve units) INDX - Result index value INTR - Result interpretation RLU - Value used in result calculation
R3.9	Primary Reagent Lot Number	Empty	3 Characters. Contains the Primary Reagent lot number that generated the test result.

Field Number	Field Name	Incoming Value	Outgoing Value
R3.10	Ancillary Reagent Lot Numbers	Empty	0–4 characters. Contains the Ancillary reagent lot number that generated the test result. If additional Ancillary Reagent fields are present, the delimiter between the ancillary lot numbers is \. A maximum of 4 ancillary reagents per test transmit to the LIS.
R3.11	Diluent Lot Number	Empty	0–4 characters. Contains the diluent lot number that generated the test result
R4	Result	1–15 characters. Set to the previous result for the same patient. This is used for delta checking only.	1–15 characters. Depending on the result aspect, several result formats are available at the Data Value field: number: concentration value number: class value qualitative: text string alphanumeric: < value alphanumeric: > value
R5	Units	0–6 characters.	0–6 characters. If the Data Value field (R4) represents a quantitative result, this field is set to the Units field of the definition of the associated test. If the Data Value field represents a qualitative result, the Units field is empty.

Field Number	Field Name	Incoming Value	Outgoing Value
R6	Reference Ranges	Not processed. If the result is flagged as critical high range, this field contains **HH** (Below Panic Normal Range).	0–34 characters. The Reference Ranges field (R6) of the outgoing Result Record contains the reference range of the allergy class if the Result Aspect field contains CLSS. Otherwise, the Reference Range field contains the reference range for the test, if defined.

Field Number	Field Name	Incoming Value	Outgoing Value
R7	Reference Range Flags	Not processed	0–2 characters. The repetitions represent some system result flags and are one of the following: • If the result is flagged as low, this field is **L** (Below Normal Range). • If the result is flagged as high, this field is **H** (Above Normal Range). • If the result is flagged as critical low range, this field is **LL** (Below Panic Normal Range). • If the result is flagged as critical high range, this field is **HH** (Below Panic Normal Range). • If the result is flagged as under range, this field contains **<** (Below Concentration Range). • If the result is flagged as over range, this field contains **>** (Above Concentration Range).

Field Number	Field Name	Incoming Value	Outgoing Value
			These flags can occur in combination, separated by repeat delimiters (\), if the test has multiple replicates with widely varying results. See *Result Comment Record*, page 111, and *Communications Error Comment Record*, page 135 for other system result flags.

Field Number	Field Name	Incoming Value	Outgoing Value
R9	Result Status	Not processed	1 or more instances of 1 character. The Result Status field has a value of **F** (Final) or **P** (Preliminary). Other values can occur, separated by the repeat delimiter (****). If the result is sent in response to a query, the field has a value of **Q.** If a previously sent result was changed by the system operator and not sent after the change, the result status field has a value of **C** to indicate correction of a previously transmitted result. If a result was sent previously, the Result Status field has a value of **R**. Values of **R** and **C** do not occur in combination. If the Result Status field is manually validated by the operator, the field has a value of **V**. The **V** value is not applicable if the result is re-transmitted by the user and the result was originally automatically accepted and transmitted to the LIS.
R11	User ID	2 component fields.	2 component fields.

Field Number	Field Name	Incoming Value	Outgoing Value
R11.1	Instrument operator who performed the test	Not processed.	4-20 characters. This field displays the ID of the user signed into the system when the test is performed. If no user is signed in at the time, the field displays **System**.
R11.2	Validator for the test	Not processed.	4–20 characters. This field displays the ID of the user logged in the system when the test result is validated. If the test result is automatically accepted, then the field displays **System**. If the Review None review mode is selected, then the field displays **No Review**.
R13	Date Test Completed	14 characters. Set to the previous result for the same patient. Is used for delta checking only.	14 characters. Set to ANSI X3.43 format of date and time values. The system transmits a 14-character string in YYYYMMDDHHMMSS form. Hours are in military (24-hour) form. For example, **19980805140315** represents August 5, 1998, 14:03:15 (2:03:15 p.m.).
R14	Instrument	Not processed.	0-20 characters.

The following is an example of a result record.

R|1|^^^FER^^^^DOSE|45.0|ng/mL| 12 to 300 |L| |F\Q\R| | |
|20070731153415 | |<CR>

The following table interprets each field in the previous example.

Field Number	Field Name	Value
R1	Record Type ID	R (Result)
R2	Sequence Number	1
R3	Universal Test ID	
R3.4	Manufacturer's Code	FER (Siemens LIS code for the Ferritin assay)
R3.8	Result Aspects	DOSE
R4	Data Value	45.0
R5	Units	ng/mL (nanograms per milliliter)
R6	Reference Ranges	12 to 300
R7	Result Abnormal Flags	L (Low, below reference range)
R9	Result Status	F (Final result)
		Q (Sent in response to a query)
		R (Result previously transmitted)
R13	Date Test Completed	July 31, 2007, 3:34:15 (3:34:15 p.m.)

Result Comment Record

The result comment record is used to communicate additional flags beyond those supported by the Result Abnormal Flags field of the result record. The record is optional. It is used if a flag other than high (**H**), low (**L**), over range (**>**), or under range (**<**) is associated with the result. Each flag generates an additional result comment record. The system ignores result data from a remote system. The system rejects incoming result comment records. The hierarchical level for result comment records is 4. The result comment record always follows a result record.

The system retains up to 3 result comments entered by the operator. The system transmits each comment in its own result comment record. The following table describes the allowable values for each field.

Note The system also uses comment records as patient comment records or as general comment records associated with other record types.

Field Number	Field Name	Incoming Value	Outgoing Value
C1	Record Type ID	Not processed.	1 character; always C.
C2	Sequence Number	Not processed.	1–5 characters, formatted as a left justified number, with a range from 1 through 65535. Equal to the nth occurrence of a result comment record within the current outgoing application message. Used to verify the integrity of an application message by ensuring that the message contains all records.
C3	Comment Source	Not processed.	0 or 1 character. If the comment is a result flag, the Comment Source field is set to I. If the comment is a operator-entered comment, this component is blank.
C4	Comment	Not processed.	2 components. Set to the Comment field of the test result record.

Field Number	Field Name	Incoming Value	Outgoing Value
C4.1	Comment Code	Not processed.	0–60 characters. Result flags map to the values in the following table. If the flags do not exist for the result record, then result comment records are not generated for transmission. If the comment is a operator-entered result comment, this component is blank.
C4.2	Comment Text	Not processed.	1–60 characters. The text for any operator-entered comments. If the comment is an internal result flag, this component is blank.
C5	Comment Type	Not processed.	1 character; either G or I. If there is a result flag, this component is I. If there is a operator-entered comment, this component is G.

The following table shows the correspondence of text transmitted in the comment code field of the result comment record to the result flags in the result database.

Note This table does not represent a complete list of comments and flags.

Table 8: Comment Code Field of the Result Comment Record

Result Comment Code	Database Flag
Above Check	Above Check
Above Linearity	Above Linearity

Result Comment Code	Database Flag
AIFU	AIFU
Autorepeat	Autorepeat
Below Check	Below Check
Below Linearity	Below Linearity
Cal Accepted	Cal Accepted
Cal Assigned	Cal Assigned
Cal Expired	Cal Expired
Cal Invalid	Cal Invalid
Canceled	Canceled
Ctrl Bracketed	Ctrl Bracketed
Diluted	Diluted
> Dilution Pt	> Dilution Pt
< Dilution Pt	< Dilution Pt
Edited	Edited
Excluded	Excluded
High CV	High CV
Investigational	Investigational
Manual Dilution	Manual Dilution
No Mitigation	No Mitigation
Omitted	Omitted
Operator Entered	Operator Entered
Out	Out
Overdiluted	Overdiluted
Repeated	Repeated
Replicate Excluded	Replicate Excluded
Waived	Waived

The system does not transmit the following result flags:

- Signal Error 1
- Signal Error 2
- Signal Error 3
- Signal Error 4
- Signal Error 5
- No Calculation

The following is an example of a result comment record.

C|1|I|Above Check|I<CR>

The following table interprets the values in each field in the previous example.

Field Number	Field Name	Value
C1	Record Type	C (Comment)
C2	Sequence Number	1
C3	Comment Source	I (Instrument)
C4	Comment	
C4.1	Comment Code	Above Check
C4.2	Comment Text	empty
C5	Comment Type	I (Instrument flag)

Request Information Record (Query Record)

The Request Information Record, or query record, is used to request data from a remote system. The hierarchical level for the query record is 1. The system processes only 1 received query at a time. If a second query is received while the first is processing, the system cancels both queries. See the description of field Q13 for proper cancellation of queries

The following table describes the allowable values for each field.

Field Number	Field Name	Incoming Value	Outgoing Value
Q1	Record Type	1 character; can be Q or q.	1 character; always Q.
Q2	Sequence Number	1 to any number of characters, with a default value of 0, which is always an invalid Sequence Number. Formatted as a string of ASCII numeric characters. Equal to the nth occurrence of a query record within the current incoming application message. If the current Sequence Number does not equal the Sequence Number of the expected record, an error is reported.	1 character; always 1. The system always ends an application message before transmitting another query record. Used to verify the integrity of an application message by ensuring that the message contains all records.

Field Number	Field Name	Incoming Value	Outgoing Value
Q3	Starting Range ID Number	0, 1, 2, or 4 components. If the field is empty, invalid, or ALL, no restrictions are made on Patient ID or Sample ID. Otherwise, the field has 1, 2, or 4 components, separated by the component delimiter (^) and is a single value. For data format information, see the individual components (field components Q3.1 and Q3.2) for data format information.	0, 1, 2, or 4 components. If the query is a query cancellation of an outstanding query, this field is empty. If the operator requested a worklist, the Patient ID or Sample ID have no restrictions and the field is set to ALL. If the system has initiated the worklist requests automatically, the field has 2 or 4 components. The first is the Patient ID, which is always empty and separated by the component delimiter (^) from the Sample ID. If the instrument is configured to schedule by SID and the sample has a barcoded label, then the SID is sent as the second component.
Q3.1	Patient ID (PID)	0–20 characters. The Patient ID is used as a criterion for matching the PID field in worklist or result entries.	0-20 characters.

Field Number	Field Name	Incoming Value	Outgoing Value
Q3.2	Sample ID (SID)	0–20 characters. The Sample ID is used as a criterion on matching the SID field in worklist or result entries.	1–20 characters. The Sample ID is selected from the Create Patient Order SID field.
Q3.3	Rack Number ID	0 or 4 characters. The number of the rack that contains the sample. This component is used together with the sample position identifier. A value must also be specified for the sample position identifier component. The rack number identifiers are numeric quantities ranging from **0001** to **9999**.	0 or 4 characters. The number of the rack that contains the sample. This component is used together with the sample position identifier quantities ranging from **0001** to **9999**. This component is only sent if the instrument is configured to schedule by Rack ID.
Q3.4	Sample Position ID	0 or 1 character. The position, on the rack, that the sample occupies. This component is used together with the rack number identifier and is part of the Rack ID at the **Create Patient Order** window. If a value is specified for this component, a value must also be specified for the rack number identifier component. The sample position identifier is a value ranging from **A** to **E**.	0 or 1 character. The position, on the rack, that the sample occupies. This component is used together with the rack number identifier and is part of the Rack ID at the **Create Patient Order** window. The sample position identifier is a value ranging from **A** to **E**. This component is only sent if the instrument is configured to schedule by Rack ID.

Field Number	Field Name	Incoming Value	Outgoing Value
Q4	Ending Range ID Number	Only single SID query is supported.	0, 1, 2, or 4 components.
Q4.1	Patient ID (PID)	0–20 characters. The Patient ID is used as a criterion for matching the PID field in worklist or result entries.	0–20 characters.
Q4.2	Sample ID (SID)	0–20 characters. The Sample ID is used as a criterion for matching the SID field in worklist entries or results	0–20 characters.
Q4.3	Rack Number ID	0 or 4 characters. The number of the rack that contains the sample. If a value is specified for this component, a value must also be specified for the sample position identifier component.	0 or 4 characters. The number of the rack that contains the sample. This component is only sent if the instrument is configured to schedule by Rack ID.
Q4.4	Sample Position ID	0 or 1 character. The position, on the rack, that the sample occupies. If a value is specified for this component, a value must also be specified for the rack number identifier component.	0 or 1 character. This is the position, on the rack, that the sample occupies.

Field Number	Field Name	Incoming Value	Outgoing Value
Q5	Universal Test ID	0, 1, or 4 components. If empty, invalid, or ALL, there are no restrictions of record selection based on test. Otherwise, the field is a single value or list of test names. Each test is 4 components and each group of 4 components is separated by a repeat delimiter character. If a name is unknown to the system, the test name is ignored and processing continues on the list of test names. The list of test names can contain any number of names. For data formation information, see the individual components (field components Q5.1 through Q5.4).	0 or 1 component. If the record is for a query cancellation message, this field is empty. If the operator requests a worklist, no restrictions are made on test IDs and the field is set to ALL. If the system initiates the worklist requests automatically, the field is set to ALL.
Q5.1	Universal Test ID	0 to any number of characters. This component is always ignored.	0 characters; always empty.
Q5.2	Universal Test ID Name	0 to any number of characters. This component is always ignored.	0 characters; always empty.

Field Number	Field Name	Incoming Value	Outgoing Value
Q5.3	Universal Test ID Type	0 to any number of characters. This component is always ignored.	0 characters; always empty.
Q5.4	Manufacturer’s Code	0–8 case-sensitive characters. If a value exists, this value is used to search the test definition database. The system searches the test definition database for the matching LIS code. If no match is found, the system searches for the matching test name.	0–8 case-sensitive characters; or ALL.
Q6	Nature of Request Time Limits	0 or 1 character. If blank or R, the dates and times in Q7 and Q8 are used to match result entries. If invalid or S, the dates and times in Q7 and Q8 are ignored.	0 or 1 character.

Field Number	Field Name	Incoming Value	Outgoing Value
Q7	Beginning Request Results Date	0–14 characters. This field is used as a criterion for matching the date and time a test was completed in result entries. Set to ANSI X3.43 format of date and time values. This is up to a 14-character string in YYYYMMDDHHMMSS form. The ignores seconds. Hours are in military (24-hour) form. The system matches the portions of the date and time supplied. Valid examples: 201307 (YYYYMM) matches all result entries completed in July of 2013; 2013080123 (YYYYMMDDHH) matches all result entries completed in the twenty-third hour (11:00 to 11:59 p.m.) of August 1, 2013. Invalid examples: 201323 (YYYYHH) and 2013 01 (YYYY DD).	0–14 characters.

Field Number	Field Name	Incoming Value	Outgoing Value
Q7	Beginning Request Results Date (continued)	A Beginning Request Results Date and an Ending Request Results Date define a range. If a value is present in the Beginning Request Results Date field without a matching Ending Request Results Date, an open-ended date range is assumed. The range includes all results with a date greater than the Beginning Request Results Date. If a value is present in the Ending Request Results Date field without a matching Beginning Request Results Date, an open-ended date range is assumed. The range includes all results with a date less than the Ending Request Results Date. Date ranges can be listed by specifying a number of values for the Beginning Request Results Dates and the Ending Request Results Dates, separated by the repeat delimiter. For example, the first Beginning Request Results Date matches with the first Ending Request Results Date.	

Field Number	Field Name	Incoming Value	Outgoing Value
Q8	Ending Request Results Date	0–14 characters. This field is used as a criterion for matching the date and time a test was completed in result entries. Set to ANSI X3.43 format of date and time values. The value of the field is processed similarly to the beginning request results date and time. The field is empty, contains a single date and time, or contains a list of dates and times.	0-14 characters.

Field Number	Field Name	Incoming Value	Outgoing Value
Q13	Request Information Status Code	0 or 1 character. If the field is empty, **P** (Preliminary), **F** (Final), or **S** (Partial), the system transmits final results in response. If the field is **R**, the system transmits final results, restricted to results transmitted previously. If the field is **N**, the system transmits final results, restricted to those that are new (never transmitted) and those that are edited (transmitted previously or not). If the field is **O** (Request Tests) or **I** (In Instrument Pending), the system transmits worklist entries in response. The order records in the response to a query with an I in field Q13, have an I in the Report Type field, field O26. If the field is C, X, M, or D, the transmits a response that the query is in error.	1 character. If the field is F, final results are sent. If the query is a cancellation of an outstanding (unfinished) query from the system, the value is **A**. When the LIS receives a query cancellation from the instrument, it should stop sending data intended as a response to the initial query. For an operator request for work or for a system-initiated automatic request for work, the value of the request information status code is **O**, which is a request for tests and demographics only.

The following is an example of a system-initiated worklist request query record.

Q|1|^SID12-A|^SID12-A |ALL| | | | | | | |O<CR>

The following table interprets the values in each field in the previous example.

Field Number	Field Name	Value
Q1	Record Type	Q (Query)
Q2	Sequence Number	1
Q3	Starting Range ID Number	
Q3.1	Patient ID	empty (no restrictions)
Q3.2	Sample ID	SID12-A (starting value of the range)
Q4	Ending Range ID Number	
Q4.2	Sample ID	SID12-A (ending value of the range)
Q5	Universal Test ID	ALL (request all tests; no restrictions)
Q7	Beginning Request Results Date	empty (no restrictions)
Q8	Ending Request Results Date	empty (no restrictions)
Q13	Request Information Status Code	O (request tests)

The following is an example of a worklist request query record that cancels any outstanding queries.

Q|1| | | | | | | | | | |A<CR>

The following table interprets the values in each field in the previous example.

Field Number	Field Name	Value
Q1	Record Type	Q (Query)
Q2	Sequence Number	1
Q3	Starting Range ID Number	empty (no restrictions)
Q4	Ending Range ID Number	empty (no restrictions)
Q5	Universal Test ID	empty (no restrictions)
Q7	Beginning Request Results Date	empty (no restrictions)
Q8	Ending Request Results Date	empty (no restrictions)
Q13	Request Information Status Code	A (cancel previously transmitted query)

Manufacturer’s Test Record

The manufacturer’s test record is used for communication diagnostics to determine whether or not the physical, data link, and application layers are functioning correctly. The hierarchical level for the manufacturer’s test record is 1. The following table describes the allowable values for each field.

Note The system also uses manufacturer’s records for manufacturer’s order record data, or as an unsupported manufacturer’s record associated with other record types.

Note

Field Number	Field Name	Incoming Value	Outgoing Value
M1	Record Type	1 character; can be M or m.	1 character; always M.

Field Number	Field Name	Incoming Value	Outgoing Value
M2	Sequence Number	1 to any number of characters, with a default value of 0, which is always an invalid Sequence Number. Formatted as a string of ASCII numeric characters. Equal to the nth occurrence of a manufacturer’s test record that immediately follows the last header record, which is considered the current header record. If the current Sequence Number does not equal the expected record’s Sequence Number, a fatal parse error is reported.	1 character; always 1. If a manufacturer’s test record is needed, the system transmits only 1 manufacturer’s order record per diagnostic message. Used to verify the integrity of the diagnostic message by ensuring that the message contains all records.
M3	Manufacturer’s Test Record ID	4 component fields used to describe the manufacturer’s record as a Siemens manufacturer’s test record. Each component is separated by the current message’s defined Component Delimiter character. For field information, see the individual components (field components M3.1 through M3.4).	4 component fields used to describe the manufacturer’s record as a Siemensmanufacturer’s test record. Each ID component is separated by the Component Delimiter character (^). For field information, see the individual components (fields M3.1 through M3.4).

Field Number	Field Name	Incoming Value	Outgoing Value
M3.1	Manufacturer	0–10 characters. If the Manufacturer component is not SHD, the record is handled as a general manufacturer's record and is not processed. If the Manufacturer component is SHD, the Instrument component is parsed.	3 characters; always SHD.
M3.2	Instrument	0–10 characters. If the Instrument component is not CEN:NG, the record is handled as a general manufacturer's record and is not processed. If the Instrument component is CEN:NG, the Record Version component is processed.	6 characters; always CEN:NG.
M3.3	Record Version	0–10 characters. If the Record Version component is not V1, the record is handled as a general manufacturer's record and is not processed. If the Record Version component is V1, the Record Type component is parsed.	2 characters; always V1.

Field Number	Field Name	Incoming Value	Outgoing Value
M3.4	Record Type	0–10 characters. If the Record Type component is O, the remainder of the record is parsed as a manufacturer's order record. If the Record Type component is T, the remainder of the record is parsed as a manufacturer's test record. If the Record Type component is not O or T, the record is handled as a general manufacturer's record and is not processed.	1 character; always T.
M4	Communication Diagnostic Test Data	128 characters. ASCII character values from 0 through 127. Characters that are restricted from the data link and application layers must be transmitted by use of ASTM escape sequences.	128 characters. ASCII character values from 0 through 127. Characters that are restricted from the data link and application layers are transmitted by use of ASTM hexadecimal and delimiter escape sequences.

The following is an example of a manufacturer’s test record.

M|1|SHD^CEN:NG^V1^T|&X00&&X0!&&X02&&X03&&X04&&X05&&X
06&&X07&&X08&&X09&&X0A&&X0B&&X0C&&X0D&&X0E&&X0F&&X
10&&X11&&X12&&X13&&X14&&X15&&X16&&X17&&X18&&X19&&X
1A&&X1B&&X1C&&X1D&&X1E&&X1F&<SP>!”#$%&E&’()*+,-./
0123456789:;<=>?@ABCDEFGHIJKLMNOPQRSTUVWXYZ[&R&]&S&_ab
cdefghijklmnopqrstuvwxyz{&F&}~&X7F&<CR>

The following table interprets the values in each field in the previous example.

Field Number	Field Name	Value
M1	Record Type	M (Manufacturer’s)
M2	Sequence Number	1
M3	Manufacturer’s Order Record ID	
M3.1	Manufacturer	SHD
M3.2	Instrument	CEN:NG
M3.3	Record Version	V1
M3.4	Record Type	T (Test)
M4	Communication Diagnostic Test Data	&X00&&X01&&X02&&X03&&X04&&X05& &X06&&X07&&X08&&X09&&X0A&&X0B& &X0C&&X0D&&X0E&&X0F&&X10&&X11& &X12&&X13&&X14&&X15&&X16&&X17& &X18&&X19&&X1A&&X1B&&X1C&&X1D& &X1E&&X1F& !”#$%&E&’()*+,/ 0123456789:;<=>?@ABCDEFGHIJKLMNOP QRSTUVWXYZ[&R&]&S&_abcdefghijklmno pqrstuvwxyz{&F&}~&X7F& (Note hexadecimal escape sequences for restricted characters and escape sequences for delimiter characters.)

General Manufacturer’s Record

The manufacturer’s record allows instrument or computer system manufacturers to communicate information that does not fit into the ASTM standard. If the system does not recognize a manufacturer’s record as a manufacturer’s order record or a manufacturer’s test record, it considers the record as a general manufacturer’s record.

The system does not transmit a general manufacturer's record and, other than determining that it follows message structure rules, the system ignores incoming general manufacturer's records. The general manufacturer's record has no hierarchical level. The following table describes the values each field can contain.

Field Number	Field Name	Incoming Value	Outgoing Value
M1	Record Type	1 character; can be M or m.	Never sent.
M2	Sequence Number	1 to any number of characters, with a default value of 0, which is always an invalid Sequence Number. Formatted as a string of ASCII numeric characters. Equal to the nth occurrence of a manufacturer's general record that immediately follows the last non-comment, non-manufacturer's record. If the current Sequence Number does not equal the Sequence Number of the expected record, a fatal parse error is reported.	Never sent.

The following is an example of a general manufacturer’s record.

M|1|BCD^CEN:NG^V1^O<CR>

The following table interprets the values in each field in the previous example.

Field Number	Field Name	Value
M1	Record Type	M (Manufacturer’s)
M2	Sequence Number	1
	Custom Data (any number of fields of any size and format)	BCD^CEN:NG^V1^O (BCD does not match SHD, which makes this a general manufacturer’s record. The system ignores this field and any other data.)

General Comment Record

The general comment record transmits free text from an instrument or computer system. The system uses comment records to transmit result flags other than those explicitly provided by ASTM, to transmit and receive additional patient demographic information or result comments in free text, and to transmit LIS error information.

If a comment record is not recognized as a patient comment record or a result comment record, it is treated as a general comment record. The system does transmit a general comment record and, other than determining that it follows message structure rules, it ignores incoming general comment records. The general comment record has no hierarchical level. The following table describes the allowable values for each field.

Note The system also uses comment records as result comment records, as general comment records associated with other record types, or to report errors.

Note

Field Number	Field Name	Incoming Value	Outgoing Value
C1	Record Type	Not processed.	1 character; always C.
C2	Sequence Number	Not processed.	1 to any number of characters, with a default value of 0, which is always an invalid Sequence Number. Formatted as a string of ASCII numeric characters. Equal to the nth occurrence of a general comment record that immediately follows the last non-comment, non-manufacturer's record. If the current Sequence Number does not equal the Sequence Number of the expected record, a fatal parse error is reported.
C3	Comment Source	Not processed.	Never sent.
C4	Comment	Not processed.	Never sent.
C4.1	Comment Code	Not processed.	Never sent.
C4.2	Comment Text	Not processed.	Never sent.
C5	Comment Type	Not processed.	Never sent.

The following is an example of a general comment record.

C|1| |^LIS programmer debugging message.|T<CR>

The following table interprets the values in each field in the previous example.

Field Number	Field Name	Value
C1	Record Type	C (Comment)
C2	Sequence Number	1
C3	Comment Source	empty
C4	Comment	
C4.1	Comment Code	empty
C4.2	Comment Text	LIS programmer debugging message.
C5	Comment Type	T (not recognized)

Communications Error Comment Record

The communications error comment record is an optional record used to report a number of data specific error conditions to the LIS. The system uses the record if some data specific error occurs that prevents the system from performing the requested operation. The hierarchical level for the communications error comment record is dependent on the error. When the system uses this record, the system transmits all data records in the hierarchy through the record that had the error, with the comment immediately following the record that has the error. The following table describes the allowable values for each field.

Note The system also uses comment records as result comment records or as general comment records associated with other record types.

Field Number	Field Name	Incoming Value	Outgoing Value
C1	Record Type ID	1 character; can be C or c.	1 character; always C.
C2	Sequence Number	1 to any number of characters, with a default value of 0, which is always an invalid Sequence Number. Formatted as a string of ASCII numeric characters. Equal to the nth occurrence of a general comment record that immediately follows the last non-comment, non-manufacturer’s record. If the current Sequence Number does not equal the Sequence Number of the expected record, a fatal parse error is reported.	1–5 characters, with a default value of 0, which is always an invalid Sequence Number. Formatted as a string of ASCII numeric characters. Equal to the nth occurrence of a general comment record that immediately follows the last non-comment, non-manufacturer’s record. If the current Sequence Number does not equal the Sequence Number of the expected record, a fatal parse error is reported.
C3	Comment Source	Not processed.	1 character; always I.

Field Number	Field Name	Incoming Value	Outgoing Value
C4	Comment		Description of the data error. The comment field consists of 2 components separated by a component delimiter character (^). If the error does not exist for the data record, communications error comment records are not generated for the transmission.
C4.1	Comment Code	Not processed.	1–21 characters. Communication errors map to the values in the following table.
C4.2	Comment Text	Not processed.	1 to any number of characters. Free text describing the nature of the error.
C5	Comment Type	Not processed.	1 character; G (Generic) or I (Unresulted Test).

The following is an example of a communications error comment record.

C|1|I|UNKNOWN_TEST^Test/Profile name refers to no active test definition|G<CR>

The following table interprets the values in each field in the previous example.

Field Number	Field Name	Value
C1	Record Type	C (Comment)
C2	Sequence Number	1
C3	Comment Source	I
C4	Comment	
C4.1	Comment Code	UNKNOWN TEST
C4.2	Comment Text	Test/Profile name refers to no active test definition
C5	Comment Type	G

Reagent Status Record

One or more manufacturer's records are sent to the LIS with reagent status information. The additional information provides an early warning to the operator that the amount of reagents required to perform testing on the system are below the threshold or are not onboard. If lot-locked tests are scheduled, the system issues 1 status message per lot. The hierarchical level for the reagent status record is 1.

The following table shows the general structure of reagent status messages sent from the system to the LIS.

Field Number	Field Name	Incoming Value	Outgoing Value
M1	Record Type	Not processed.	1 character; always M.
M2	Sequence Number	Not processed.	1 character; always 1.

Field Number	Field Name	Incoming Value	Outgoing Value
M3	Manufacturer's Reagent Status Record ID	Not processed.	4 component fields used to describe the manufacturer's record as a Siemensmanufacturer's reagent status record. Each component is separated by the Component Delimiter character (^). For field information, see the individual components (field components M3.1 through M3.4).
M3.1	Manufacturer	Not processed.	3 characters; always SHD.
M3.2	Instrument	Not processed.	6 characters; always CEN:NG.
M3.3	Record Version	Not processed.	2 characters; always V1.
M3.4	Record Type	Not processed.	1 character; always S (status).
M3.5	Severity	Not processed.	1 character; W (warning).
M4	System Serial Number	Not processed.	0–8 characters.
M5	Message Identifier	Not processed.	1 character; T (test record).

Field Number	Field Name	Incoming Value	Outgoing Value
M6	Status Identifier	Not processed.	6 component fields used to describe the record. Each component is separated by the Component Delimiter character (^). If there are multiple packs of the same reagent, this field is repeated to list all known packs. For field information, see the individual components (field components M6.1 through M6.6).
M6.1	Universal Name	Not processed.	LIS Code from Test Definition.
M6.2	Reagent Lot Identifier	Not processed.	Lot-locked test record: barcoded reagent lot number. Non lot-locked test record: empty.
M6.3	Reagent Pack Serial Number	Not processed.	Barcoded reagent pack label.
M6.4	Position ID	Not processed.	Specific position in the primary or compartment.
M6.5	Reagent Area	Not processed.	Test record: reagent area (A = ancillary, P = primary).
M6.6	Availability Measure	Not processed.	Available pack volume (# of tests for primaries, mL for ancillaries)

Field Number	Field Name	Incoming Value	Outgoing Value
M7	Status	Not processed.	Test record: use Reagent Status messages for primary and ancillary reagents.
M8	Grand Total	Not processed.	A quantifiable attribute (value) or empty.

The following is an example of a test status.

M|1|SHD^CEN:NG^V1^S^W|1602|T|TSH|Not Onboard|13<CR>

The following table interprets each field in the previous example.

Field Number	Field Name	Value
M1	Record Type	M (Manufacturer)
M2	Sequence Number	1
M3	Manufacturer's Reagent Status Record ID	
M3.1	Manufacturer	SHD
M3.2	Instrument	CEN:NG
M3.3	Record Version	V1
M3.4	Record Type	S (status)
M3.5	Severity	W
M4	Serial Number	1602
M5	Message Identifier	T
M6	Status Identifier	
M6.1	Universal Name	TSH
M6.2	Reagent Lot Identifier	empty
M6.3	Reagent Pack Serial Identifier	empty
M6.4	Position ID	empty
M6.5	Reagent Area	empty
M6.6	Availability Measure	empty

Field Number	Field Name	Value
M7	Status	Not Onboard
M8	Grand Total	13

The following is an example of a test status that has multiple packs onboard for a test.

M|1|SHD^CEN:NG^V1^S^W|1602|T|TSH^^03303312230008^08^P^23\TSH^^
03303314050009^03^P^12\TSH^^03303313650008^11^P^14|Low Reagent |49<CR>

The following table interprets each field in the previous example.

Field Number	Field Name	Value
M1	Record Type	M (Manufacturer)
M2	Sequence Number	1
M3	Manufacturer’s Reagent Status Record ID	
M3.1	Manufacturer	SHD
M3.2	Instrument	CEN:NG
M3.3	Record Version	V1
M3.4	Record Type	S (status)
M3.5	Severity	W
M4	Serial Number	1602
M5	Message Identifier	T
M6	Status Identifier	
M6.1	Universal Name	TSH
M6.2	Reagent Lot Identifier	empty
M6.3	Reagent Pack Serial Identifier	03303312230008, 03303314050009, 03303313650008
M6.4	Position ID	08, 03, 11
M6.5	Reagent Area	P
M6.6	Availability Measure	23, 12, 14
M7	Status	Low Reagent
M8	Grand Total	49

The following is an example of a lot-locked reagent that has multiple packs onboard for a test.

M|1|SHD^CEN:NG^V1^S^W|1602|T|TSH^033033^03303310012345^08^P^23\TSH^033033^03303310012300^03^P^12\TSH^033033^03303310012323^11^P^14| Low Reagent|49<CR>

The following table interprets each field in the previous example.

Field Number	Field Name	Value
M1	Record Type	M (Manufacturer)
M2	Sequence Number	1
M3	Manufacturer's Reagent Status Record ID	
M3.1	Manufacturer	SHD
M3.2	Instrument	CEN:NG
M3.3	Record Version	V1
M3.4	Record Type	S (status)
M3.5	Severity	W
M4	Serial Number	1602
M5	Message Identifier	T
M6	Status Identifier	
M6.1	Universal Name	TSH
M6.2	Reagent Lot Identifier	033033
M6.3	Reagent Pack Serial Identifier	03303310012345, 03303310012300, 03303310012323
M6.4	Position ID	08, 03, 11
M6.5	Reagent Area	P
M6.6	Availability Measure	23, 12, 14
M7	Status	Low Reagent
M8	Grand Total	49

The following table shows the correspondence of text transmitted in the status field of the reagent status record to the reagent status messages in the database.

Status Message	**Database Message**
Low reagent	Low Reagent
Not onboard	Not Onboard

Sample Comment Record

The Sample Comment record follows the Order record. The system saves up to 3 sample comments. The system only sends comments that contain non-null text.

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Field Number	Field Name	Incoming Value	Outgoing Value
C1	Record Type ID	1 character; can be C or c	1 character; always C
C2	Sequence Number	1 to any number of characters, with a default value of 0, which is always an invalid Sequence Number. Formatted as a string of ASCII numeric characters. Equal to the nth occurrence of a patient information record immediately following the last patient information record. If the current Sequence Number does not equal the Sequence Number of the expected record, a fatal parse error is reported.	1 character, in the range from 1 through 3. If a patient comment record is needed, the system transmits up to a maximum of 3 patient comment records per patient record. Used for validating the integrity of the application message by ensuring that the message contains all records.
C3	Comment Source	0 or 1 character; not used for incoming message processing.	0 characters; always empty.
C4	Comment	1 component. Set to the Comment field of the worklist or result entry.	1 component. Set to the Comment field of the patient sample or worklist entry.

Field Number	Field Name	Incoming Value	Outgoing Value
C4.1	Comment Code	Always empty	Always empty
C4.2	Comment Text	1–60 characters	1–60 characters. This field is written to the to Sample comment field in the order. There is no change to the order field if the Comment Text field is empty or there is not a Sample Comment Record,
C5	Comment Type	0 or 1 character. If the Comment Type field is empty or G (Generic), the comment record is processed as a Sample Comment record. If the Comment Type field is any other value, the comment record is processed as a General Comment record and is ignored by the system.	1 character, G (Generic).

Scientific Record

The scientific record exchanges test data on instrument performance, quality assurance, or test method development. Some ASTM field specifications for this record are under development. For this reason, the system uses manufacturer’s records to transmit QC information.

The system does not transmit a scientific record and, other than determining that it follows message structure rules, it ignores incoming scientific records. The hierarchical level of the scientific record is 1.

Field Number	Field Name	Incoming Value	Outgoing Value
S1	Record Type	1 character; can be S or s.	Never sent.
S2	Sequence Number	1 to any number of characters, with a default value of 0, which is always an invalid Sequence Number. Formatted as a string of ASCII numeric characters. Equal to the nth occurrence of a scientific record that immediately follows the last header record, which is considered the current header record. If the current Sequence Number does not equal the Sequence Number of the expected record, a fatal parse error is reported.	Never sent.

The following is an example of a scientific record.

S|1|anything<CR>

The following table interprets the values in each field in the previous example.

Field Number	Field Name	Value
S1	Record Type	S (Scientific)
S2	Sequence Number	1
S3	all other fields are ignored	anything

Termination Record

The termination record is the last record of a message and closes the message. It provides an explanation for ending the message. The hierarchical level for the termination record is 0.

The following table describes the allowable values for each field.

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Field Number	Field Name	Incoming Value	Outgoing Value
L1	Record Type	1 character; can be L or l.	1 character; always L.
L2	Sequence Number	1 to any number of characters, with a default value of 0, which is always an invalid Sequence Number. Formatted as a string of ASCII numeric characters. If the current Sequence Number does not equal the Sequence Number of the expected record, a fatal parse error is reported. This value should always be 1 because multiple termination records not separated by a header record generate a fatal parse error.	1 character; always 1.

Field Number	Field Name	Incoming Value	Outgoing Value
L3	Termination Code	0 or 1 character, with a default value of N (normal). If the Termination Code is null or N, the system closes the incoming message and logs the message as normally terminated. If the value is T, the system closes the incoming message and logs the message as canceled by the sender. If the value is R, the system closes the incoming message and logs the message as canceled by the receiver. If the value is E, the system closes the incoming message and logs the message as canceled due to an unknown system error. The current query on the port is closed out, which allows any pending query to transmit.	0 or 1 character. If the ending of the message is normal, this field is absent or N (Normal). A Termination Code of F (Final) is used in reply to a query to indicate that all available information is sent in response. A Termination Code of I. (No Information Available) is used in reply to a query if no information is available to send in response to the query. A Termination Code of Q (Query in Error) is used in reply to a query when another query is still outstanding or the Request Information Status Code of the query record is invalid. After sending a termination record with a Termination Code of F, I, or Q, the system considers all external queries closed and is ready to process new queries.

Field Number	Field Name	Incoming Value	Outgoing Value
		If the termination code is F (Final), the system closes the incoming message and logs the message as the end of the query response. The current query on the port is closed out, which allows any pending query to transmit. If the code is I, the system closes the incoming message and logs the message as having no information found in response to the current query.	A Termination Code of E is used if normal completion of the message is prevented by system errors, such as timeouts at the data link layer and memory allocation errors. If the system is sending worklist entries or results in response to a query from a remote system and the remote system cancels the query, the system stops sending data and the termination record ending the message has a Termination Code of R.

Field Number	Field Name	Incoming Value	Outgoing Value
		The current query on the port is closed out, which allows any pending query to transmit. If the code is Q, the system closes the incoming message and logs the message as stating that the current query that was sent by the system to the remote system was in error. The current query on the port is closed out, which allows any pending query to transmit. The system handles all other character values as having an unknown message termination status. The incoming message is closed out, but no message closing status is logged.	

The following is an example of a termination record.

L|1|F<CR>

The following table interprets the values in each field in the previous example.

Field Number	Field Name	Value
L1	Record Type	L (Termination)

L2	Sequence Number	1
L3	Termination Code	F (final record of query response)

Data Link Layer Interaction

Outgoing application messages are sent to the data link layer on a message basis. Since a message consists of a number of records, the application layer sends all of the records for a message together. This enables the data link layer to block data in the most efficient manner.

There is no connection between the application messages and the link establishment phase and the link release phase of the physical connection. The data link layer can release the link in the middle of an application message, and send multiple application messages during a single session. The operator cannot influence when data link sessions terminate.

The application layer is solely responsible for parsing the messages from the incoming stream. The application layer views incoming data as a character stream.

ASTM Protocol Exceptions

The system implementation of the ASTM protocol deviates from the ASTM standard in several minor ways:

- The practice fields in the patient record and the user fields in the order record are not part of the instrument database. The system does not record or return these fields with results.
- The system does not support highlight sequences, unhighlight sequences, and local (manufacturer) escape sequences. The system receives these escape sequences, ignores them, and does not transmit these sequences.
- The system accepts null application records, which are ignored, letting processing continue normally.

The system uses and recognizes all other predefined sequences during transmission.

Query Timer

The sender uses the query timer to limit the amount of time to wait for a reply to a query. If the wait is longer than the timeout specified, a query timeout occurs and the sender cancels the outstanding query. ASTM protocol allows only 1 outstanding query at a time.

Communications Diagnostics

To help identify and correct any communications problems that may arise, the system provides the following features:

- LIS Communication

  Select the LIS Communication icon on the system task bar to display the current status of the LIS connection. Using this tool, you can change the status, and run diagnostics on the connectivity between the system and the LIS, or other remote devices such as a general purpose computer or other system.
- LIS Logs

  Select **Events > LIS Logs** to view the log of LIS activity.

LIS Communication Status

Use the LIS Communication Status dialog box to view and change the current status of the LIS. When a communication error occurs, the system puts LIS communication into an automatic standby state. When this occurs, all results and queries are queued in the system until the connection status is changed to online.

Using the LIS Communication Status Window

1. On the Status bar, select the **LIS Communication** icon.

   The LIS Communication icon displays with the color indicating the current status.

   - Red indicates the LIS connection is offline.
   - Gray indicates the system LIS is connecting and awaiting initialization.
   - Yellow indicates the LIS connection is in Standby. This state occurs when a transmission is not sent or received in a timely manner.
   - Green indicates the LIS connection is Online.

2. On the LIS connection window, select the options as needed:

   - To open a connection to the LIS, select **Online**.
   - To change from Routine to Development mode, select the **Shutdown** state and then change modes.
   - To clear the Results queue, put the LIS connection in an Online or Standby status and select **Clear Results**.
   - To clear the Queries queue, put the LIS connection in an Online or Standby status and select **Clear Queries**.

Performing Communication Diagnostics

To perform a diagnostic of LIS communication problems and to test the interface between the system and the LIS, perform the following steps:

1. On the Status bar, select the **LIS Communication** icon.
2. On the LIS dialog box, select **Online**.
3. Select **Diagnostics**.

   A diagnostic message is sent to the LIS and Diagnostics in Progress appears in the Status field. When the diagnostics are complete, the Status field displays one of the following messages indicating the status of the link.

Figure 8: Diagnostic Messages

Message	Description
Diagnostic in progress	The system is sending a diagnostic message to the LIS.
OK	The LIS acknowledged the message indicating a successful communication.
Sent	The system successfully sent a message to the remote system.
Failed to Send	The system unsuccessfully sent a message to the remote system.
Failed to Receive	The system received an invalid diagnostic message.
Failed to Send or Receive	The system did not send or receive any message.

4. If no status messages appears or if a Failure message appears, check the Operator Event Log.
5. To clear the results in the results queue, select **Clear Results**.
6. To clear the queries in the queries queue, select **Clear Queries**.

Diagnostic Messages

The diagnostic message consists of an ASTM header record, a manufacturer's test record, and a termination record. For a description of the ASTM application layer format, see *Application Layer Protocol*, page 55. This diagnostic message is sent to the remote system using the data link protocol.

The diagnostic message is ensures:

- The physical link is connected.
- The data link layer protocol interface between the system and the remote system is functional.
- The application layer protocol between the system and the remote system is functional.

The following figure displays an ASTM diagnostic application message.

H | \^& | | |system_LIS| | | | |LIS_ID| | P | 1 <CR>

M| 1 | SHD^CEN:NG^V1^T |
&X00&&X01&&X02&&X03&&X04&&X05&&X06&07&X08&09&X0A&0
B&0C&X0D&&X0E&&X0F&&X10&&X11&&X12&&X13&&X14&&X15&&
X1
6&&X17&&X18&&X19&&X1A&&X1B&&X1C&&X1D&&X1E&X1F&<SP>
!"#$%&E&'()*+,-./
0123456789:;<=>?@ABCDEFGHIJKLMNOPQRSTUVWX
YZ[&R&]&S&_'abcdefghijklmnopqrstuvwxyz{&F&}~&X7F&<CR>

L| 1<CR>

The following figure displays the same ASTM diagnostic application message and also shows the ASTM data link protocol. These examples show what occurs across the communications link when the system sends a diagnostic message. The remote system may encode the ASTM escape sequence fields differently in an incoming diagnostic message.

Sender **Receiver**

<ENQ> →

← <ACK>

<STX>1H|\^&|||system_LIS|||||LIS_ID||D|1<CR>M|1|SHD^CEN:NG^V1^T|&X00&&X01
&&X02&&X03&&X04&&X05&&X06&07&X08&09&X0A&0B&0C&X0D&&X0E&&X0F&
&X10&&X11&&X12&&X13&&X14&&X15&&X16&&X17&&X18&&X19&&X1A&&X1B
&&X1C&&X1D&&X1E&&X1F&<SP>!"#$%&E&'()*+,-_/0123456<ETB>
3D<CR><LF> →

← <ACK>

<STX>2789:;<=>?@ABCDEFGHIJKLMNOPQRSTUVWXYZ[&R&]&S&_'abcdefghijklmnop
qrstuvwxyz{&F&}~&X7F&<CR>L|1<CR><ETX>3D<CR><LF> →

← <ACK>

<EOT> →

Diagnostic Logs

The system provides features to help identify and correct communication problems. There are 4 types of logs available to view event messages, communication status and information about operator actions.

Log Tab	Description
Operator Event Log	Displays information about communication errors and user accesses as well as information about possible causes and corrective actions posted by the system.
LIS Logs	Displays communication messages between the Laboratory Information System (LIS) and the system.
LAS Log	Displays communication messages between the Laboratory Automation System (LAS) and the system.
Audit Trail Log	Displays operator actions that create, modify and delete records.

Each of the diagnostic logs are accessed by selecting **Events** on the command bar.

Operator Event Log

The Operator Event Log identifies errors and online information about possible causes and corrective action procedures.

1. On the command bar, select **Events**.
2. Select the **Operator Event** tab.

There are 3 types of Event Codes that display in the Operator Event log:

Event Type	Color	Definition
Error	Red	A communication error has occured.
Warning	Yellow	A problem exists with the subassembly or a supply. The system continues to process samples.
Information	No color	A normal operation has occurred.

When the system posts a message with a severity of caution or a warning, the Events button on the main tool bar flashes in a color corresponding to the severity of the message. Select the Events button and the Events button stops flashing. When the issue that caused the event is resolved, the color of the button returns to normal. If, after resolving the event, the Events button does not return to a normal color, it means that another event has occurred. The Events button always displays the color of the highest unresolved event.

The following table describes the fields that appear on the Operator Event Log. .

Column Head	Description
Code	A code unique to this type of event.
Event	Message containing information about the cause of the event.
Date	A date and time stamp of when the event occurred.
Cycle	The point at which the event occurred according to the incremental system cycle.
Module	The module on which the event occurred.
SubSystem	The subsystem in which the event occurred.
User	The identification of the user that was signed in when the event occurred.

For information about filtering the data shown in the Operator Event Log, see the operator’s guide.

LIS Logs

The LIS Logs contain the data exchanges between the system and the LIS. The Log can be viewed by selecting Events > LIS Logs. Each Log file contains all the data exchanges collected from the time Capture is enabled until the time that **Off** is selected or the system restarts. Selecting the **On** button in the Capture area to enable data capture and create LIS logs.

Note If the Protected Health Information (PHI) Encryption Key is enabled, the system encrypts the entire LIS log because the log contains the Patient Name and PID. You cannot view the LIS Log without the key.

The Log Files drop-down, located at the top of the tab, contains a list of all the captured log files, listed in descending order by date. The files are stored in the database for 1 week and then the oldest is deleted when a new one is captured. To save a log file, select export or print to file. For more information about printing or exporting the log, see the online help.

The Legend area contains a list of the type of data that the system can display in the LIS Logs fields. The message color identifies the type of communication that occurred:

Data Type	Color
Received Data	Red
Transmitted Data	Black
Received Control Codes	Blue
Transmitted Control Codes	Green

Log files can be printed or exported (txt or xml files). For information about the LIS Log, refer to the online help.

LIS Capture Settings

The Capture Setting dialog box can be set to determine what data is captured by the system for the LIS Log. The Capture settings also can be set to add a customized prefix to the system-assigned file name.

The Capture area enables or disables data capture by selecting On or Off in the Capture Settings dialog box.

1. On the command bar, select **Events > LIS Logs**.
2. In the Capture area, select **On**.
3. Select **Capture Settings**.
4. Select the settings to capture in the LIS Log:
   a. Select an option in Message Direction.
   b. Select an option in Communication Layer.
   c. Optionally, you can enter up to 10 in **L**og Filename Prefix as a prefix for the system to add to the system-generated LIS Log.
5. Select **Save**.

   The system records the date and time you start Capture Settings. The system includes the start date and time in the name of all information recorded until you turn off Capture Settings**.**

Error Handling

The system communications software uses the logs in the Events window to report errors. The LIS Communication icon on the system task bar also displays information associated with the LIS communications.

The communications software handles special situations during in the course of communicating with a remote system. These situations include failure to process incoming records, transmission errors, abnormal message termination codes, unrecognized message record sequences (and other parse errors), and a query cancellation.

The system attempts to recover from most input message errors. The system may reject an erroneous query and test order partially and totally based on the level of security of the detected error. For example, an error in one specimen identifier of an order record causes the system to reject all tests ordered on that specimen. In contrast, an invalid test identifier causes the system to reject only that test order. A very severe error such as an invalid header record in an order message causes the system to reject the whole message. A fatal error in a query record causes the system to reject the entire query. As for order errors, if the effect of the error is localized, the system only rejects the affected test requests.

The system communications software prepares a reply message to send to the remote system. The interface returns as much data as it can salvage of every erroneous item that it rejects to the LIS host. It consists of a header, a patient record containing the rejected data, an order record containing the rejected data with a report type of **X** (cannot process), a comment record describing the reason for the rejection, and a termination record. The exception to this rule is the case of unrecognized messages. For these, the error messages consist of a header record, a comment record, and a termination record. ASTM provides no error codes for this case. LIS hosts have only the contents of the comment record to process the error.

The following table describes the reasons the system rejects an incoming record.

Reason	Description
Database mismatch	An order record specifies a sample ID and a Rack ID, and the worklist database has the same sample ID in a different rack.
Invalid control	An order record specifies a control with a name not in the control definition database; a control with a matching name, but a mismatched lot; a control with a matching name and lot, but a mismatched sample ID; a control with an expired lot; a control that is not defined for the test specified; or a controllers usage type **Not in Use**.
Calibrator	An order record has a sample ID that is used for a calibrator sample or in a calibrator definition.

Reason	Description
Patient Sample with Control Sample ID	An order record for a patient sample has a sample ID that matches a control Sample ID, but is not followed by a manufacturer's order record and the system is configured to transmit and receive the manufacturer's order record.
Control Sample with Patient Sample ID	An order record for a control, followed by a manufacturer's order record, has a Sample ID that matches a patient sample ID in the worklist.
Invalid Sample ID	An order record has a sample ID of **""** or the Sample ID is absent.
Rack in Use	An order record has a Sample ID that does not match any other Sample ID in the worklist, but has a Rack ID that matches the Rack ID of an entry in the worklist.

A transmission error occurs when the data link layer driver reports that it is unsuccessful in sending a record to the remote system. The application may attempt additional transmissions. An event is logged.

Two classes of abnormal termination codes are possible in a received termination record. The first class (with a termination code of **T**, **R**, or **E**) indicates an error in data processing. The current incoming message is closed and the received data is processed according to standard rules. The second class of abnormal terminations relates to responses to queries.
A **Q** code indicates a query was sent that the receiver cannot process.
An **I** code indicates that no data was found in response to a query.
An **F** code is a normal termination of a response to a query indicating that all data is sent.

A fatal parse error in a record is treated like an abnormal termination. The current message is closed and any correctly received data is processed according to standard rules.

If the remote system sends a query message with a cancel status code, it cancels the reply in process in the following manner.

- If the system does not send a response, the remote system cancels it.
- If the system sends a response (no reply in process), the system ignores the cancellation.
- If the system is currently sending a reply, the remote system stops it and sends a termination record with a termination code of **R**.

The ASTM application layer only permits 1 outstanding query for a system. If the remote system sends a second query message to the system before the first query is complete, the system automatically cancels the first query. The system rejects the second query and responds to it as an invalid query. The system sends a message containing a header record and a termination record with a termination code of **Q**. This resets the pending query states on both the system and the LIS.

3 Laboratory Automation System

The system is designed to readily integrate with a laboratory automation system (LAS). An LAS is an automated sample transport system that is designed to move patient samples throughout the laboratory and deliver samples to automated testing systems, such as the ADVIA Centaur XPT system, for sample processing.

A typical LAS uses a transport system that consists of a main conveyor and a series of secondary conveyors that deliver samples to each of the automated clinical analyzers in the laboratory. The secondary conveyor moves the samples from the main conveyor to the analyzer. The LAS directs the sample to the required secondary conveyors for testing by the analyzers.

If testing is required on an analyzer system, such as the ADVIA Centaur XPT system, the sample is routed from the main conveyor to the secondary conveyor. The sample then moves down the secondary conveyor to the analyzer for testing. When the sample is routed on a secondary conveyor to the system, the secondary conveyor also becomes the sample queue. The secondary conveyor moves the samples in the queue to the sample access position. After the sample arrives at the sample access position, the system sample probe moves out over the sample access position and aspirates the sample for testing.

The following sequence is a detailed description of the interaction between the system and the LAS beginning with an empty system queue.

Establishing the Physical Interface

Note A kit is available to assist you in installing the LAS with an ADVIA Centaur XPT system. The kit includes sample probe cover pieces, an air deflector for the system warm air exhaust and installation instructions. Contact your local technical support provider or distributor for additional information and for installation of the kit.

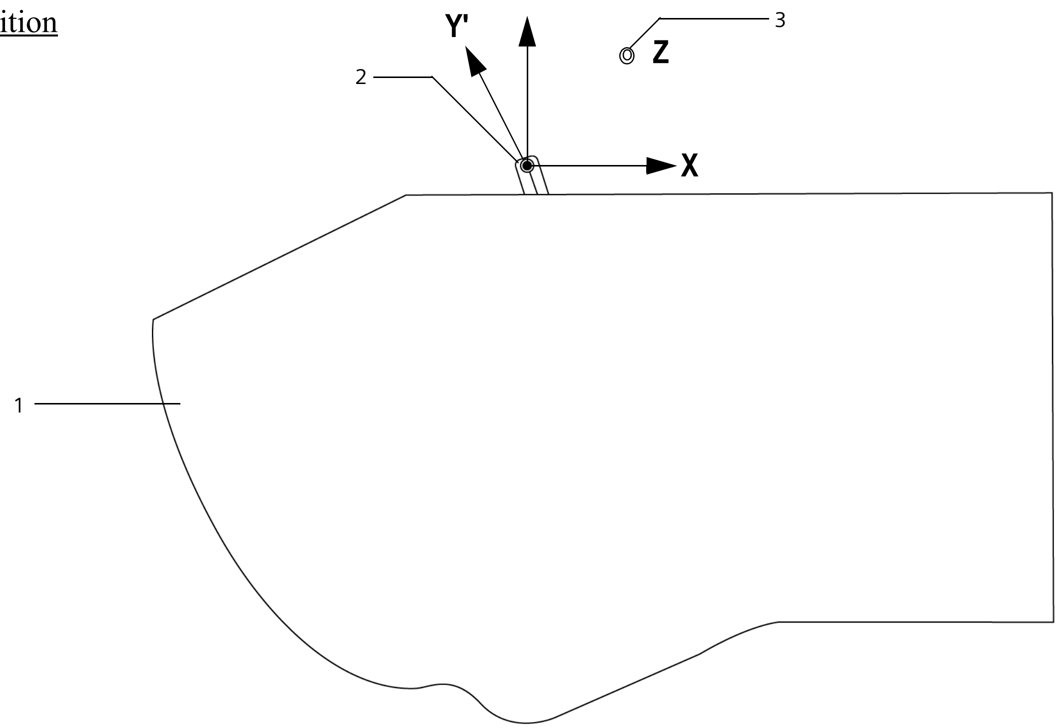
The system has a sample probe mechanism that can extend horizontally beyond the back of the system and then move vertically into a sample tube to aspirate the required volume of sample. The LAS positions sample tubes at this location. Refer to the diagram on the following page to view the sample tube access position and specific surfaces and features of the system. Siemens Healthcare Diagnostics recommends that you generate combined layout drawings showing the system, the sample probe access position, and the LAS tube position for each unique interface.

Defining X, Y, Z Positioning

The physical positioning requirements of the sample tube for access by the system are described as follows:

- The X-axis, which is often the axis of tube travel on the LAS, is a plane parallel to the back of the system.
- The Y-axis is a plane perpendicular to the back of the system.
- The Y'-axis is a plane rotated 25° counterclockwise from the Y-axis as viewed from the top of the system.
- The Z-axis is a plane that extends vertically from the floor.

xyzposition



1	Top View of the System
2	Sample Tube Access Point
3	Vertical Z-axis In and Out of Horizontal Plane

Figure 9: Positioning requirements of sample tube

Any layout and three-dimensional drawings should describe the travel of the system sample probe using this coordinate system. The combined layout drawing should show the location of the tube bottom as positioned by the LAS. The tube bottom for an LAS tube must be at approximately the same level as the bottom of a tube in a rack in the system sample entry queue.

Accuracy Requirements

Along the Y'-axis, the system repeatedly positions the probe tip within ± 0.0508 cm (0.020 inches). Along the X-axis, the ADVIA Centaur XPT repeatedly positions the probe tip within ± 0.0254 cm (0.010 inches).

To achieve the minimum sample volume requirements defined for the system, the LAS must repeatedly position the tube center axis within ± 0.0508 cm (0.020 inches) in the X direction and within ± 0.0254 cm (0.010 inches) in the Y direction. The LAS should position the tube bottom within ± 0.0254 cm (0.010 inches) in the Z-axis. These tolerances also ensure that the tube is vertically aligned.

Note Siemens Healthcare Diagnostics recommends that you use a bracket or other device to maintain the required tolerances. It is critical that the LAS maintain the required tolerances for the ADVIA Centaur XPT to meet cycle time requirements.

The following factors affect the minimum sample volume requirements:

- calibration of the system tube bottom value
- accuracy and precision of the system fluid level sensing
- vertical positioning of the tube by the LAS

Control of the unusable volume in each tube is a significant issue in LAS installations that send only a minimum volume of sample to the system in a secondary tube.

Adjusting the Alignment

You can calibrate the system probe position along the Y'-axis using the system software. For calibration instructions, refer to the system online help.

Perform the calibration procedure after the system and LAS spur track are positioned. The calibration range is 3.81 to 6.35 cm (1.5 to 2.5 inches) from the back of the system. Align the probe tip with the nominal center of the tube as positioned by the LAS.

A change in the calibration also changes the probe location in the X-axis because the probe axis is not perpendicular to the X-axis.

You can also change the alignment in the Y-axis by moving the system towards or away from the LAS track.

You can change the alignment in the X-axis by adjusting the tube stop location on the LAS track or by moving the system parallel to the track.

You can change the alignment in the Z-axis by raising or lowering the ADVIA Centaur XPT or the LAS. The system has leveling feet that allow you to adjust the height of the system a small amount. You can calibrate the allowable vertical stroke of the probe using the system software to prevent the probe tip from hitting the bottom of the tube.

Note The calibration of the vertical stroke of the probe is critical in laboratories that require very low unusable volume in each tube.

Note Any system height adjustments must keep the system level so the vertical stroke of the probe tip is truly vertical.

Connecting the LAS to the System

The frame of the system has a connection point that you can use to establish a mechanical connection between the system and the LAS conveyor.

Communicating Tube Types

The system supports up to four different tube types, as described in the *Operator's Guide*.

Table 9: Supported tube types

If the LAS uses . . .	Then . . .
more than one tube type	the LAS must communicate the tube type for a sample when it is presented to the system. Refer to the Add Tube command described in *Reset Queue Response*, page 184.

If the LAS uses . . .	Then . . .
one tube type	The system handles the tube as Tube Type 1 of the four tube types established during the setup of the system. The system handles the tube as LAS Tube Type during the setup of the system. NOTE:For ADVIA Centaur XPT system, if the LAS omits the tube type information in the Add Tube command, ensure that the tube type selected for Tube Type 1 reflects the tube being used by the LAS. The laboratory can use Tube Types 2 through 4 for tubes presented at the sample entry queue in the front of the system. For more information, refer to the *ADVIA Centaur Operator's Guide*. NOTE:For ADVIA Centaur XPT system, if the LAS omits the tube type information in the Add Tube command, ensure that the tube type selected for Tube Type 1 reflects the tube being used by the LAS. The laboratory can use Tube Types 1 through 4 and LAS Tube Type for tubes presented at the sample entry queue in the front of the system. For more information, refer to the *ADVIA Centaur XPT Operator's Guide*.

Avoiding Restricted Areas

The back of the system has several restricted areas that must not be occupied by the LAS conveyor system. Do not position any section of the LAS near the following restricted areas:

- Sample probe mechanism and cover
- Air flow inlets and outlets
- Cable access area
- Power cord and direct plumbing tubing area

The restricted areas are described in the following sections.

Sample Probe Mechanism and Cover

The sample probe mechanism extends farther beyond the back of the system than the sample probe. A protruding cover protects the mechanism and also protects the operator from the mechanism and the probe tip. Do not position any section of the LAS above the tallest sample tube used with the sample probe mechanism.

Air Flow Inlets and Outlets

The back of the system has several air flow inlets and outlets. Do not allow the LAS to obstruct the air flow at these openings. Warm air from the outlets can damage sensitive electronics on the LAS and the integrity of the sample tubes. In addition, the inlets are designed to draw in room temperature air. If the LAS is placed near an inlet, heat generators from the LAS can warm the air and cause system errors.

Note The optional System Lab Automation Kit includes an air deflector for the warm air exhaust from the system electronics module. You can use the air deflector to direct warm air from the electronics module above the tubes on the LAS conveyor.

Cable Access Area

The system has an access location for routing cables to other systems such as the LIS, a computer network, and the LAS. You must allow room to route the cables out of the system to the appropriate connection points.

Power Cord and Direct Plumbing Tubing

The system allows direct plumbing for water and waste, an option that is typical in high volume automated laboratories. The direct plumbing tubing and the power cord are located in the far left of the back of the system. Since they are on a vertical surface that angles away from the large back surface of the system, they usually do not interfere with LAS mechanisms.

Defining Sample Tube Transport

For typical LAS installations, the system is positioned along a separate side track off the main conveyor line through the laboratory. At the entrance to the side track, the LAS stops tubes on the main conveyor line and checks the sample ID. If the LAS controller determines that the tube requires a test on the system, the LAS routes the tube down the side track so the sample can be aspirated.

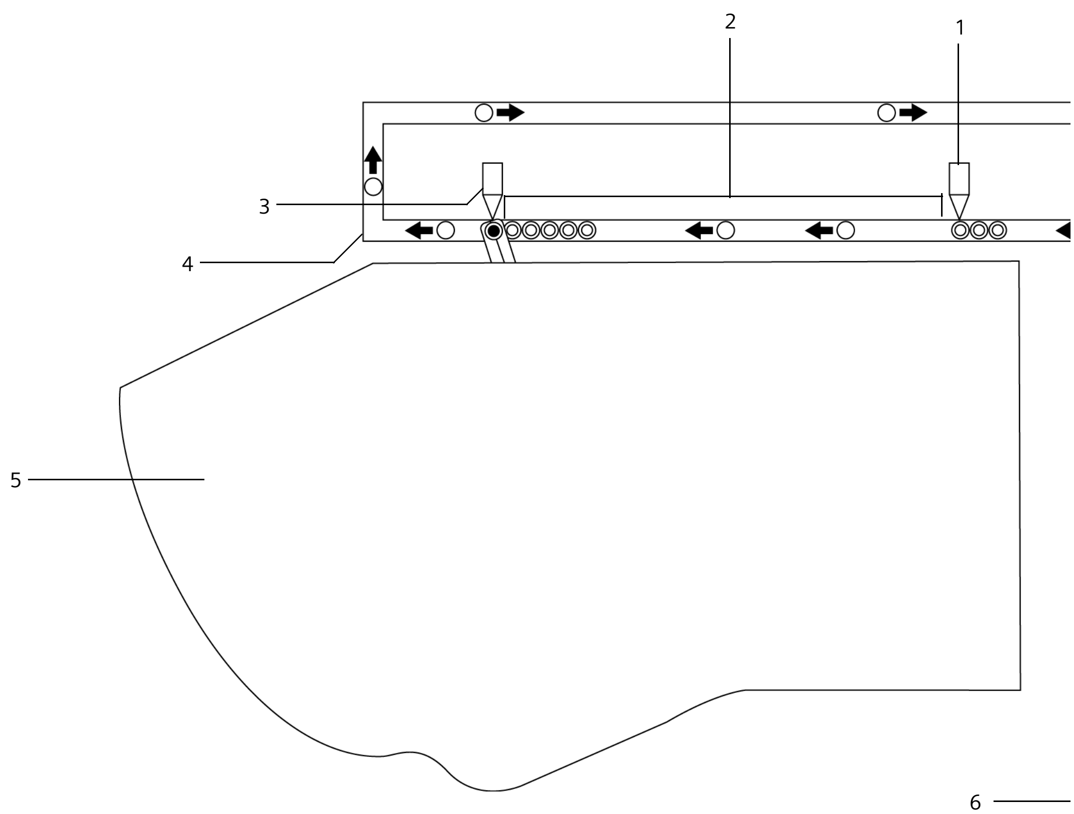
The system software includes a scheduler that determines when a test sample is aspirated from the tube. Before aspirating sample from a tube, the system requires advance notice of at least three cycles (45 seconds). For this reason, to achieve maximum throughput on the system, LAS needs to provide a queue of sample tubes instead of one tube at a time. The configurations and queuing requirements described in the following sections address this issue.

Recommended Configurations

Note The tube direction arrows in the suggested configurations are for illustration only. Tube travel can be in either direction.

A configuration showing the side track perpendicular to the main tube conveyor line is shown below.

spur_perpendicular

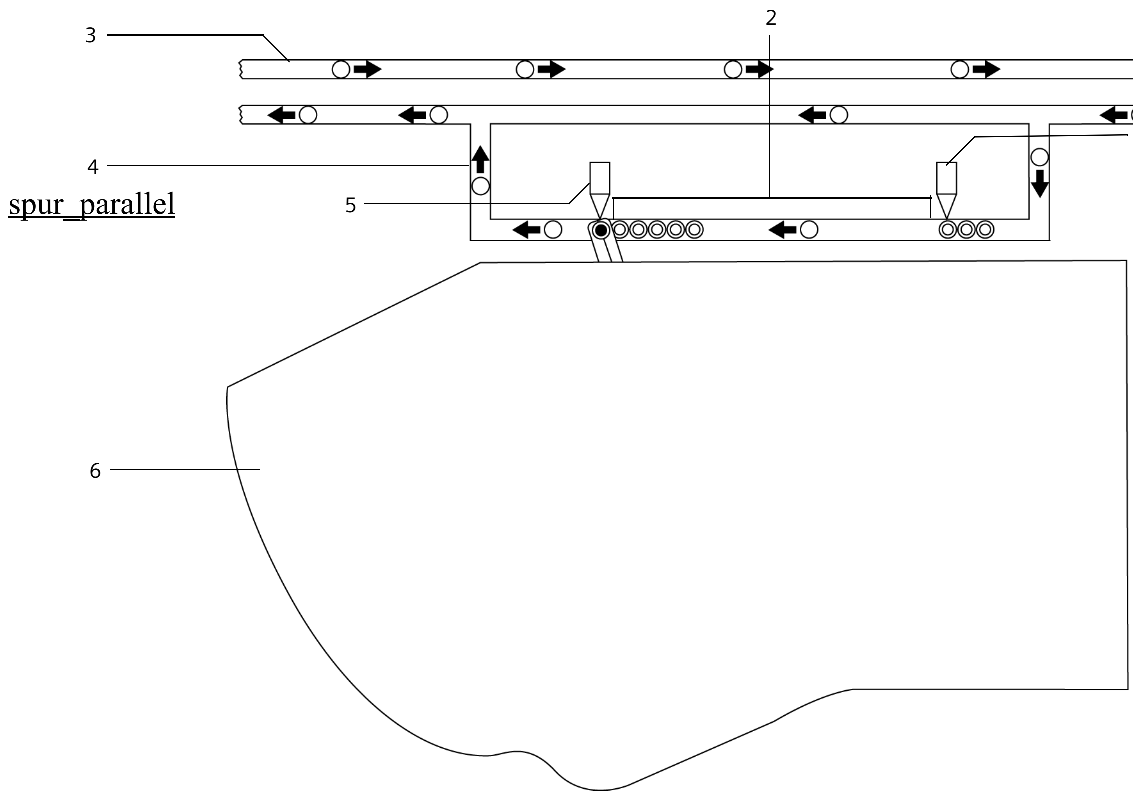


1	First Barcode Reader or Other Mechanism for Indicating Sample ID
2	Sample Queue
3	Second Barcode Reader or Other Mechanism for Indicating Sample ID
4	Side Track

5	Top View of System
6	Main Tube Conveyor Line

Figure 10: Side track perpendicular to main tube conveyer line

A configuration showing the side track parallel to the main line is shown below.



1	First Barcode Reader or Other Mechanism for Indicating Sample ID
2	Sample Queue
3	Main Tube Conveyor Line
4	Side Track
5	Second Barcode Reader or Other Mechanism for Indicating Sample ID
6	Top View of System

Figure 11: Side track parallel to main line

Each configuration includes a method of identifying the sample ID, for example, a barcode reader, that is located a distance away from the sample aspiration point. At the sample identification point, the LAS notifies the system that the tube is ready to be loaded into the queue. The time required for the tube to travel the length of track between the first sample identification point and the sample aspiration point is the required advance notice time of at least three cycles.

Note An acceptable alternative is to use the sample identification point at the intersection of the side track and the main conveyor line as the entry to the queue.

Queue Size

The physical queue size is determined by the length of track between the first sample identification point and the sample aspiration point. A minimum queue size is three positions to allow for the three-cycle advance notice required by the system. If the installation uses the LIS or host query method of acquiring test requests rather than a batch download of test requests, you need to increase the queue size by the worst-case LIS response time divided by the system cycle time, which is 15 seconds.

In addition to the physical queue in the LAS, the ADVIA Centaur XPT maintains a software queue of sample IDs loaded into the physical queue. The default software queue allows a maximum of 200 tubes. This setting is adjustable by the customer. See the ADVIA Centaur XPT online help for additional information.

Physical Queue Overflow

Depending on the tests, ADVIA Centaur XPT throughput, the number of tubes on the side track, and the rate of loading tubes on the side track, the physical queue can become overloaded with tubes. Since the ADVIA Centaur XPT does not monitor the size of the physical queue, the LAS must ensure that the queue does not become overloaded with tubes.

Communicating the Sample ID

The LAS is responsible for reading the sample ID on each tube and communicating the sample ID to the ADVIA Centaur XPT. The LAS must communicate the sample ID in the same format as the sample ID in the ADVIA Centaur XPT worklist, as if the user was entering the ID from the user interface.

Note When loading sample tubes from the sample entry queue instead of the LAS, you can use a SID mapping option described in the *ADVIA Centaur XPT Operator's Guides*. In the mapping option, the system can extract the sample ID from a longer barcode read by the ADVIA Centaur XPT barcode scanner. When receiving sample ID information from the LAS, the ADVIA Centaur XPT does not use the SID mapping option. The LAS must communicate the sample ID exactly the same as the sample ID in the worklist.

Note Since the ADVIA Centaur XPT does not read the sample ID barcode, refer to the individual LAS requirements for barcode symbologies. The barcode symbologies described as acceptable for the ADVIA Centaur XPT in the *ADVIA Centaur XPT Operator's Guides* may not apply for the LAS.

Sample ID Format

The ADVIA Centaur XPT requires the sample ID format to be a string of 7-bit ASCII characters.

Sample ID Communications

The LAS should communicate the sample ID to the ADVIA Centaur XPT through a serial communications channel when the sample tube is routed to the spur track that services the ADVIA Centaur XPT.

Sample ID Confirmation

The LAS sends sample IDs to the ADVIA Centaur XPT a few minutes before the ADVIA Centaur XPT process the sample tubes. A number of events can interfere with the order of samples, resulting in an unexpected tube presenting at the sample aspiration port. Examples of such events are as follows:

- communication errors
- software errors
- tube transport errors
- intervention by laboratory personnel

To ensure accurate sample identification, it is recommended that the LAS verify the sample ID at the sample access point just before sample aspiration. The ADVIA Centaur XPT will request verification of the sample ID. In response, the LAS should reacquire the sample ID through another barcode read and then communicate the sample ID to the ADVIA Centaur XPT. For message formats, refer to *Defining the Control Communications*, page 174.

Defining the Control Communications

The software interface requires the following messages between the LAS and ADVIA Centaur XPT for the control and transfer of sample ID information:

- a message to reset the ADVIA Centaur XPT system software queue.

  Note Whenever possible utilize the Skip Tube feature in place of a Reset Queue.

- a message for the LAS to communicate the sample ID of a tube added to the ADVIA Centaur XPT queue
- a message for the LAS to communicate the sample ID of a tube at the sample aspiration point
- a message for the ADVIA Centaur XPT to inform the LAS to release the tube that the ADVIA Centaur XPT just accessed and position the next tube in the queue at the sample aspiration point
- skip tube (optional)

Serial Channel

The ADVIA Centaur XPT uses separate serial interface connections to communicate with the LIS and with the LAS. The ADVIA Centaur XPT and the LAS communicate through a dedicated RS-232 interface with the following character format:

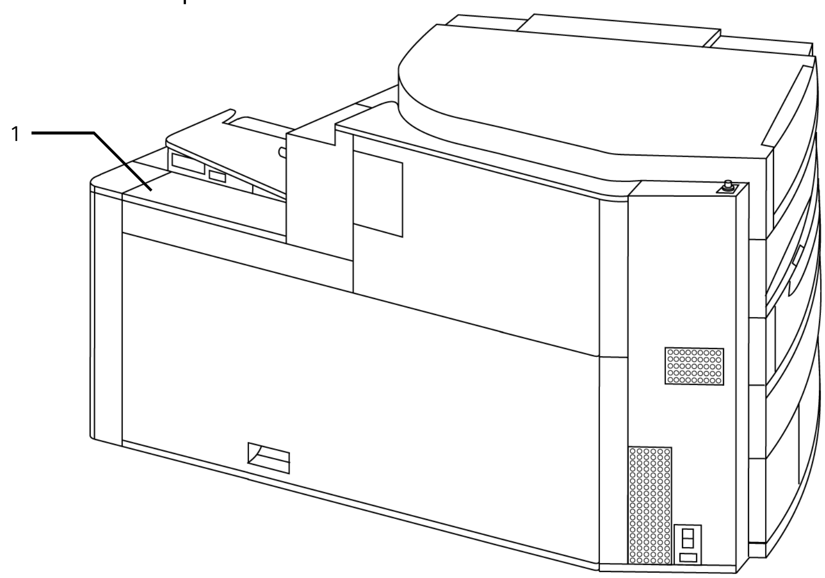
- the highest baud rate possible, not exceeding 19,200
- eight character data bits
- no parity
- one stop bit
- full duplex
- handshaking or no handshaking

Accessing the LAS Interface Connector

The connector for the LAS interface is located in the input/output (I/O) panel located at the back of the ADVIA Centaur XPT.

1. Lift the I/O panel cover.

cerf193

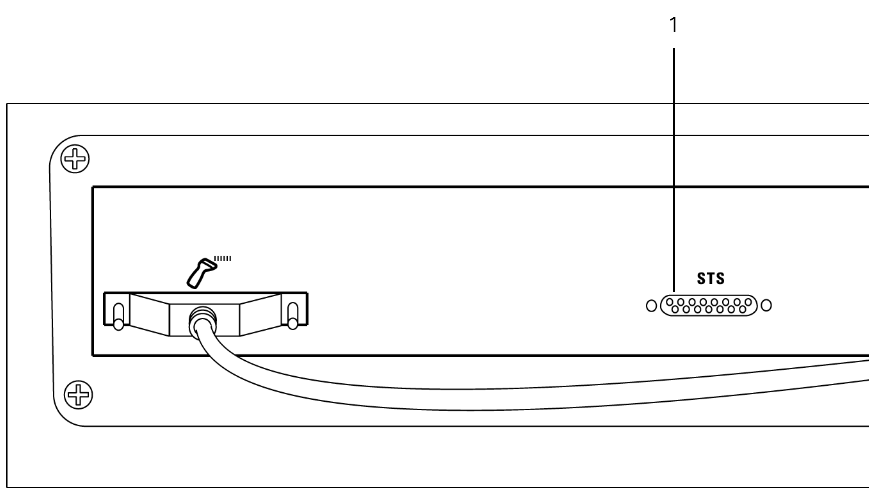


1 I/O Panel Cover

Figure 12: **Connector for LAS interface**

2. Locate the LAS cable connector, which is labeled STS (sample transport system).

cerf221



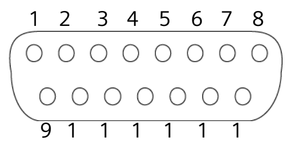
1 Lab Automation Cable Connector

Figure 13: LAS cable connector

Interface Connections

The ADVIA Centaur XPT provides a 15-pin male subminiature-D interface connector from Positronic Industries, Inc., #SD15M00J00 or equivalent, as shown below.

cerf076



Cable Recommendation

Connect the ADVIA Centaur XPT to an LAS using an appropriate 15-pin, D-type, female connector. Recommendations are as follows:

- double-shielded, braided shield, 65 to 75% coverage
- 360° shield termination at both ends

Pin Functions

The interface connection uses five pins of a 15-pin connector as shown in the following table.

Table 10: Five pin connections

Pin	ADVIA Centaur XPT Signal	LAS Signal
Pin 2	receives data input to the ADVIA Centaur XPT	transmits data output from the LAS
Pin 3	transmits data output from the ADVIA Centaur XPT	receives data input to the LAS
Pin 5	signal ground	signal ground
Pin 7	request to send signal for the ADVIA Centaur XPT (RTS)	clear to send signal for the LAS (CTS)*
Pin 8	clear to send signal for the ADVIA Centaur XPT (CTS)	request to send signal for the LAS (RTS)*

* This function is performed only if the LAS interface uses hardware handshaking (RTS/CTS).

Defining LAS Communication Options

Laboratory automation is the process by which samples are brought to the analyzers in your laboratory by a sample transport system. When you enhance your ADVIA Centaur XPT with the ADVIA Centaur XPT STS sample transport system hardware and select LAS at the Setup – LAS Communications window, you enable your system to access samples from the sample transport system in addition to the sample entry queue and the Stat entry.

You can configure the communication options for the ADVIA Centaur XPT and the LAS. See the *ADVIA Centaur XPT Operator's Guide* for additional information.

Workflow

Loading the Sample

1. Samples are loaded onto the main conveyor.
2. A sample tube arrives at the junction of the main conveyor and the secondary conveyor to the ADVIA Centaur XPT.
3. The LAS controller determines that the sample is required for testing on the ADVIA Centaur XPT and the sample tube is routed to the ADVIA Centaur XPT on the secondary conveyor.
4. The LAS scans the barcode and sends an Add Tube message and the SID to the ADVIA Centaur XPT.
5. The ADVIA Centaur XPT receives the message and responds with the message **OK, add tube to queue** and allows the sampling sequence. The ADVIA Centaur XPT adds the sample to the lab automation queue.

Processing the Sample

1. The LAS releases the sample tube into the queue.
2. The ADVIA Centaur XPT determines if the sample has any tests requested.
3. After the ADVIA Centaur XPT determines the sample has test requests, it schedules the sample aspiration.

   Sample aspiration begins as early as the third cycle after the sample tube is added to the queue and the test requests are received. This process depends on the amount of primes required before sample aspiration.

4. While waiting for this first tube access, the LAS continues to deliver samples to the secondary conveyor.

   As each sample tube is scanned at the first barcode reader, the LAS sends an Add Tube command to the ADVIA Centaur XPT. The sample tubes are placed in the queue, as they wait to get to the sample access position.
5. Before aspirating a sample, the ADVIA Centaur XPT requests the SID of the first tube for verification using the Send SID command.
6. The LAS scans the SID a second time at the sample access position and sends the SID to the ADVIA Centaur XPT.
7. If the two SID readings match, the ADVIA Centaur XPT aspirates the sample.

   If the sample tube requires multiple aspirations, the ADVIA Centaur XPT accesses the sample tube for the remaining aspirations on a following cycle.

Releasing the Sample

1. After the final test is aspirated, the sample probe releases the sample tube and the ADVIA Centaur XPT sends an Index Queue message to the LAS to move the sample tube from the access position.
2. The LAS indexes the sample tubes in the queue.

   The LAS releases the sample tube from the sample access position and returns it to the main conveyor. Then the LAS moves the next sample tube in the queue to the sample access position.

Processing the Next Sample

1. The LAS reads the SID of the next tube and sends a response message to the ADVIA Centaur XPT that the next sample tube is at the sample access position. The LAS must complete this step in less than 10 seconds to maintain maximum throughput.
2. The ADVIA Centaur XPT aspirates the required tests from the sample tube.

   The sample processing continues until the queue is empty.
3. When the queue is empty, the LAS informs the ADVIA Centaur XPT that a tube is not present at the access location.
4. The sequence is completed.

Lab Automation Diagnostics

The ADVIA Centaur XPT provides features to help you identify and correct LAS communication problems.

- The event log provides information about communication errors and accesses information about possible causes and corrective actions.
- At the System – Lab Automation Communication window, the operator can send a diagnostic message.
- At the System – Lab Automation Communication window, the operator can also view the communication messages and correct communication problems.

Using the Event Log

The Operator Event Log displays information about communication errors and user accesses as well as information about possible causes and corrective actions posted by the system.

Performing Lab Automation Diagnostics

You can use the system to monitor LAS communications. The system can send diagnostic command messages for you to test the LAS communications interface. You can view the incoming and outgoing messages and use this information when you call for technical assistance.

The system also provides features to correct communication problems. You must have the appropriate level of security to perform any functions at the System – Lab Automation Communications window.

1. On the command bar, select Events.
2. Select the Operator Event tab.

Messages

The ADVIA Centaur XPT utilizes hexadecimal notation for LAS communication messages. The general message consists of a start character, sequence number, a command or response byte, data bytes, checksum digits, and a stop character. Messages contain commands or responses that pertain to the protocol for LAS communication.

Commands and responses use the following message format.

Table 3-3 Message format

Byte	Description
0	Start Character; always **F0**.

1	Sequence Number (01 – 06); normally **01**.
2	Command or Response byte.
3 – 14	Data Block, if required.
3 + n (number of bytes of data block)	High Checksum character; the most significant digit in the range from **0** to **9** and **A** to **F**.
4 + n	Low Checksum character; the least significant digit in the range from **0** to **9** and **A** to **F**.
5 + n	Stop Character; always **F8**.

The following example shows an Add Tube Command message that contains an SID of SID1.

F0 01 90 53 49 44 31 41 32 F8

The following table interprets each byte in the above example.

Table 4: Add Tube Command message

Byte	Description	Value
0	Start Character	F0
1	Sequence Number	01
2	Add Tube Command	90
3 – 6	Data for SID1	53 49 44 31
7	High Checksum	41
8	Low Checksum	32
9	Stop Character	F8

Initially, a command message is sent to the receiver. If the message has the correct checksums and the supported command byte, the receiver responds with an acknowledge character. Once the command message is received and acknowledged, the receiver sends a response message.

The following table displays the message protocol for LAS communications.

Table 5: Message protocol for LAS communications

Line Direction	Message
Sender ⇒ Receiver	Command
Receiver ⇒ Sender	ACKnowledge
Receiver ⇒ Sender	Response
Sender ⇒ Receiver	ACKnowledge

Enhanced LAS Protocol

The system also supports an enhanced ACK/NAK format. You can enable or disable the two-byte ACK/NAK message format. This format adds the command type byte (of the command being ACKed or NAKed) to each ACK and NAK returned by the LAS that has received a command or response message. The enhanced format must be enabled to use the following options:

- Skip Tube
- Send Sample Status
- Send Reagent Status
- Send Request for Sample
- Send Detailed System Status Automatically and in Response to LAS Request

An example of the difference between the regular and enhanced protocol is illustrated in the following tables:

Table 6: Regular vs. enhanced protocol

Line Direction	Standard Message	Description
LAS ⇒ Analyzer	F0 01 84 38 35 F8	Reset Queue Command (84)
Analyzer ⇒ LAS	06	ACKnowledge (ACK)

Line Direction	Enhanced Message	Description
LAS ⇒ Analyzer	F0 01 84 38 35 F8	Reset Queue Command (84)
Analyzer ⇒LAS	06 84	ACKnowledge (ACK)

Commands and Responses

You can view commands and responses between the ADVIA Centaur XPT and the LAS using the Lab Automation Communications window. This section provides command syntax, message specifications and example sequences of the specific interactions between the ADVIA Centaur XPT and the LAS.

Note All examples are shown with the enhanced protocol active.

Reset Queue Command

The LAS directs the ADVIA Centaur XPT to reset the lab automation queue to empty. This command is used for initialization and error recovery.

CAUTION

Following a reset queue command, the sample aspiration probe may be in the LAS position until processing of this command is complete The LAS system must NOT index any tubes until completion of the reset queue command in order to prevent damage to the sample aspiration probe.

Message Specifications

Specification	Description
Message Name	Reset Queue Command
Transmission Direction	LAS ⇒ Analyzer
Timing	Message allowed anytime the LAS is On.
Processing	Do not send any other queue management commands until a Reset Queue Response is received.

Message Format

The **Reset Queue Command** format is as follows:

<STX><SEQ><CMD><CC1><CC2><ETX>

Where:

Mnemonic	Value (Hex)	Description
STX	F0	Start of text
SEQ	01	Command sequence number
CMD	84	Command Byte - Reset Queue Command
CC1		1^{st} Check Sum Digit (Most Significant Digit)
CC2		2^{nd} Check Sum Digit (Least Significant Digit)
EXT	F8	End of text, stop character

Example

The following example shows the ADVIA Centaur XPT responding with a completion code (01 hex) indicating that the lab automation queue was reset.

Table 7: Example completion code response

Line Direction	Message	Description
LAS ⇒ Analyzer	F0 01 84 38 35 F8	Reset Queue Command (84)
Analyzer ⇒ LAS	06 84	ACKnowledge (ACK)

Analyzer ⇒ LAS	F0 01 C4 01 43 36 F8	Reset Queue Response (C4)
LAS ⇒ Analyzer	06 C4	ACKnowledge

Reset Queue Response

The LAS directs the ADVIA Centaur XPT to reset the lab automation queue to empty. The Reset Queue Response message returned by the system is described below. Refer to *Appendix E, Test Map*, for more information.

Message Specifications

Specification	Description
Message Name	Reset Queue Response
Transmission Direction	Analyzer ⇒ LAS
Timing	Only sent in response to a Reset Queue Command from the LAS.
Processing	Respond with 01 (hex) completion code for successful reset.

Message Format

The **Reset Queue Response** format is as follows:

<STX><SEQ><CMD><CMP><CC1><CC2><ETX>

Where:

Mnemonic	Value (Hex)	Description
STX	F0	Start of text
SEQ	01	Command sequence number
CMD	C4	Command Byte - Reset Queue Response
CMP	01	Completion Code (01 - Successful Reset)
CC1		1^{st} Check Sum Digit (Most Significant Digit)
CC2		2^{nd} Check Sum Digit (Least Significant Digit)
EXT	F8	End of text, stop character

Add Tube Command

The LAS sends the Add Tube command to the ADVIA Centaur XPT. The LAS sends this message before adding the sample tube to the queue. When the ADVIA Centaur XPT responds **OK, add tube to queue**, the LAS releases the sample tube into the queue.

Message Specifications

Specification	Description
Message Name	Add Tube Command
Transmission Direction	LAS ⇒ Analyzer
Timing	The LAS sends this message before adding the sample tube to the queue.
Processing	Response expected from analyzer in 10 seconds or less.

Message Format

The **Add Tube Command** format is as follows:

<STX><SEQ><CMD><SID>[<FLD><TBT>]<CC1><CC2><ETX>

Where:

Mnemonic	Value (Hex)	Description
STX	F0	Start of text
SEQ	01	Command sequence number
CMD	90	Command Byte - Add Tube Command
SID	ASCII String	Sample ID
FLD	FD	Optional Field Delimiter (Optional field to follow)
TBT	01 - 04	Optional Tube Type: 1, 2, 3, or 4
CC1		1st Check Sum Digit (Most Significant Digit)
CC2		2nd Check Sum Digit (Least Significant Digit)
EXT	F8	End of text, stop character

Examples

The following example demonstrates the use of the Add Tube Command and Response messages. The bytes for the SID of P1 is 50 32.

Table 8: Example Add Tube Command and Response messages

Line Direction	Message	Description
LAS ⇒ Analyzer	F0 01 90 50 32 FD 01 31 31 F8	Add Tube Command (90)
Analyzer ⇒ LAS	06 90	ACKnowledge
Analyzer ⇒ LAS	F0 01 D0 01 44 32 F8	Add Tube Response (D0)
LAS ⇒ Analyzer	06 D0	ACKnowledge

The LAS sends the Add Tube command to the ADVIA Centaur XPT. The following command message contains an SID of SID12345 with tube type #2.

F0 01 90 53 49 44 31 32 33 34 35 FD 02 36 46 F8

The following command message contains only an SID of SID12345.

F0 01 90 53 49 44 31 32 33 34 35 37 30 F8

Add Tube Response

The LAS sends the Add Tube command to the ADVIA Centaur XPT before adding a sample tube to the queue. The ADVIA Centaur XPT responds to that command with a completion code. The Add Tube Response message is defined below.

Message Specifications

Specification	Description
Message Name	Add Tube Response
Transmission Direction	Analyzer ⟹ LAS
Timing	Only sent in response to the Add Tube Command.
Processing	Analyzer must respond in 10 seconds or less with appropriate completion code.

Message Format

The **Add Tube Response** format is as follows:

<STX><SEQ><CMD><CMP><CC1><CC2><ETX>

Where:

Mnemonic	Value (Hex)	Description
STX	F0	Start of text
SEQ	01	Command sequence number
CMD	D0	Command Byte - Add Tube Response
CMP	01 - 06	Completion Code (see table below for details)
CC1		1st Check Sum Digit (Most Significant Digit)
CC2		2nd Check Sum Digit (Least Significant Digit)
EXT	F8	End of text, stop character

Completion Codes

The following table describes the list of possible completion codes for the Add Tube Response.

Table 9: Completion codes for Add Tube Response

Completion Code	Description
01 - Tube added	The sample tube is added to the ADVIA Centaur XPT worklist. The LAS releases the sample tube into the queue.
02 - Invalid parameter	The ADVIA Centaur XPT determines that one of the parameters in the command was invalid. The system rejects the command and does not add the tube to the worklist. The LAS does not release the sample tube into the queue.
03 - Queue full	The ADVIA Centaur XPT lab automation queue is full, or the number of tubes has reached the user defined limit. A sample tube cannot be added. The LAS does not release the sample tube into the queue. (See the *ADVIA Centaur XPT Operator's Guides* for details on setting the LAS queue size.)
04 - LAS interface disabled	The ADVIA Centaur XPT interface to the LAS has been disabled by the operator. The operator does not want the ADVIA Centaur XPT to access sample tubes from the LAS. The LAS does not release the sample tube into the queue. Manual intervention is required to determine why the interface is disabled.

Completion Code	Description
05 -Not ready for sampling	The system is not ready to accept a sample tube into its software queue. As this condition may be caused by a temporary shortage of a required system resource, check the System Status at the workspace. The LAS does not release the sample tube into the queue.
06 - LAS is offline	The ADVIA Centaur XPT determines that the LAS is offline. The ADVIA Centaur XPT cannot communicate with the LAS until the offending problem is corrected. Check the Event Log. The LAS does not release the sample tube into the queue.
07 - SID Too Long	The ADVIA Centaur XPT determines that the SID provided by the LAS is longer than 13 characters. The LAS does not release the sample tube into the queue.
08 - Test Map not accepted	The Add Tube Command was received, but the tube cannot be added at this time, because a test map is required and the LAS was not able to accept it (see the Test Map Command on page 234 for details).

Examples

See the *Examples*, page 185 section for the Add Tube Command.

Send SID Command

The ADVIA Centaur XPT requests the LAS to acquire and send the SID of the sample tube at the sample access position.

Message Specifications

Specification	Description
Message Name	Send SID Command
Transmission Direction	Analyzer ⇒ LAS
Timing	Allowed anytime LAS is On.
Processing	Analyzer expects response in 10 seconds or less, after which a time-out is issued.

Message Format

The **Send SID Command** format is as follows:

<STX><SEQ><CMD><CC1><CC2><ETX>

Where:

Mnemonic	Value (Hex)	Description
STX	F0	Start of text
SEQ	01	Command sequence number
CMD	A4	Command Byte - Send SID Command
CC1		1st Check Sum Digit (Most Significant Digit)
CC2		2nd Check Sum Digit (Least Significant Digit)
EXT	F8	End of text, stop character

Examples

See *Examples*, page 191 for the Send SID Response.

Send SID Response

The LAS response to the ADVIA Centaur XPT requests for the SID of the sample tube at the sample access position (Send SID Command) is described below.

Message Specifications

Specification	Description
Message Name	Send SID Response
Transmission Direction	LAS ⇒ analyzer
Timing	Only issued in response to a Send SID command from the analyzer.
Processing	Response expected in 10 seconds or less. If unable to respond in 10 seconds, do NOT send a response automatically. The ADVIA Centaur XPT will wait until its time-out period has elapsed. The length of this time-out is defined through a configuration setting (refer to the *ADVIA Centaur XPT Operator's Guides*).

Message Format

The **Send SID Response** format is as follows:

<STX><SEQ><CMD><CMP>[SID]<CC1><CC2><ETX>

Where:

Mnemonic	Value (Hex)	Description
STX	F0	Start of text
SEQ	01	Command sequence number
CMD	E4	Command Byte - Send SID Response
CMP	01 - 05	Completion Code (see table below for details)
SID	ASCII String	Sample ID (Only included if Completion Code is 01 or 05)
CC1		1st Check Sum Digit (Most Significant Digit)
CC2		2nd Check Sum Digit (Least Significant Digit)
EXT	F8	End of text, stop character

Completion Codes

The following table describes the list of possible completion codes for the Send SID Response.

Table 10: Completion codes for Send SID Response

Completion Code <CMP>	Description
01 - Tube present at the sample access position	The LAS indicates that a sample tube is present at the sample access position and the reading of the SID is completed. The ADVIA Centaur XPT verifies the SID and accesses the sample tube. If the SID does not match, a queue mismatch error is generated and the LAS is taken offline. Check the Event Log.
02 - No tube present at the sample access position	The LAS indicates that a sample tube is not present at the sample access position. This occurs when a sample tube is added to the queue and has not traveled to the sample access position. The ADVIA Centaur XPT sends another Send SID command prior to the next required sample tube access.
03 - Tube present, SID read failed	The LAS indicates that a sample tube is present at the sample access position and is unable to read the SID. The ADVIA Centaur XPT takes the LAS offline. Check the Event Log. **Note** Use of this completion code should be avoided, and alternatively the skip tube completion code (05) should be used as it will NOT cause the system to take the LAS offline.

Completion Code <CMP>	**Description**
04 - Tube present, SID too long	The LAS indicates that a sample tube is present at the sample access position and the SID is too long.
05 - Skip the Next Tube	The LAS indicates that the next tube will be skipped within 30 seconds of receipt of this response code. The LAS must send a Skip Tube command to the system containing the SID of the tube to be skipped.
Any other response code	The ADVIA Centaur XPT interprets any other response code as a severe error and takes the LAS offline. Check the Event Log.

Examples

The following example shows the LAS responding with a completion code of 01, indicating that the sample tube is present. The SID of P0 is represented by the bytes 50 30.

Table 11: Example completion code response

Line Direction	Message	Description
Analyzer ⇒ LAS	F0 01 A4 41 35 F8	Send SID Command (A4)
LAS ⇒ Analyzer	06 A4	ACKnowledge
LAS ⇒ Analyzer	F0 01 E4 01 50 30 36 37 F8	Send SID Response (E4)
Analyzer ⇒ LAS	06 E4	ACKnowledge

The following example shows a response message indicating that a sample tube is not present at the sample access position.

F0 01 E4 02 45 37 F8

Index Queue Command

The ADVIA Centaur XPT requests the LAS to release the sample tube at the sample access position and move the next sample tube in the queue to the sample access position. The LAS response includes an indication of whether or not the sample tube is at the sample access position at the completion of the index, and the SID of the sample tube.

Message Specifications

Specification	Description
Message Name	Index Queue Command
Transmission Direction	Analyzer ⇒ LAS
Timing	Allowed anytime LAS is On.
Processing	Analyzer expects response in 8 seconds or less (to perform efficiently with the LAS).

Message Format

The **Index Queue Command** format is as follows:

<STX><SEQ><CMD>[SID]<CC1><CC2><ETX>

Where:

Mnemonic	Value (Hex)	Description
STX	F0	Start of text
SEQ	01	Command sequence number
CMD	A0	Command Byte - Index Queue Command
SID	ASCII String	Sample ID (SID only included if Enhanced Protocol is enabled)
CC1		1st Check Sum Digit (Most Significant Digit)
CC2		2nd Check Sum Digit (Least Significant Digit)
EXT	F8	End of text, stop character

Examples

See the *Examples* section provided for the Index Queue Response on page 195.

Index Queue Response

Following an ADVIA Centaur XPT system Index Queue command, the LAS responds and indicates whether or not the sample tube is at the sample access position at the completion of the index, and the SID of the sample tube. Details of this response follow.

Message Specifications

Specification	Description
Message Name	Index Queue Response
Transmission Direction	LAS ⟹ Analyzer
Timing	Only issued in response to an Index Queue command from the analyzer.
Processing	Response expected in 10 seconds or less. If unable to respond in 10 seconds, do NOT send a response automatically. The system will wait until its time-out period has elapsed. The length of this time-out is defined through a configuration setting (refer to the *ADVIA Centaur XPT Operator's Guides*).

Message Format

The **Index Queue Response** format is as follows:

<STX><SEQ><CMD><CMP>[<SID>]<CC1><CC2><ETX>

Where:

Mnemonic	Value (Hex)	Description
STX	F0	Start of text
SEQ	01	Command sequence number
CMD	E0	Command Byte - Index Queue Response
CMP	01 - 06	Completion Code (see table below for details)
SID	ASCII String	Sample ID (Only included if Completion Code is 01 or 06)
CC1		1^{st} Check Sum Digit (Most Significant Digit)
CC2		2^{nd} Check Sum Digit (Least Significant Digit)
EXT	F8	End of text, stop character

Completion Codes

The following table describes the list of possible completion codes to be included in the Index Queue Response.

Table 12: Index Queue Response completion codes

Index Queue Response	Description
01 - Index completed, tube present at sample access position	The LAS completes the index and there is a sample tube at the sample access position. The ADVIA Centaur XPT removes the first tube from the lab automation queue and increments all other sample tubes in the lab automation queue.
02 - Index completed, no tube present at sample access position	The LAS completes the index and the sample tube is not present at the sample access position. The ADVIA Centaur XPT removes the first tube from the lab automation queue and increments all other sample tubes in the lab automation queue.

Index Queue Response	Description
03 - Index completed, tube present, SID read failed	The LAS completes the index and is unable to read the SID of the sample tube at the sample access position. The ADVIA Centaur XPT removes the first tube from the lab automation queue and increments all other sample tubes in the lab automation queue and takes the LAS offline. **Note** Use of this completion code should be avoided, and alternatively the skip tube completion code (05) should be used, as it will NOT cause the sysetm to take the LAS offline.
04 - Index failed	The LAS is unable to complete the index due to a mechanical problem, or an SID mismatch. The ADVIA Centaur XPT removes the first tube from the lab automation queue and increments all other sample tubes in the lab automation queue and takes the LAS offline.
05 - Index completed, tube present, SID too long	The LAS completes the index and the SID of the sample tube at the sample access position is too long. The ADVIA Centaur XPT removes the first tube from the lab automation queue and increments all other sample tubes in the lab automation queue and takes the LAS offline.
06 - Skip the Next Tube	The LAS indicates that the next tube will be skipped within 30 seconds of receipt of this response code. The LAS must send a Skip Tube command to the system containing the SID of the tube to be skipped.
Any other response code	The ADVIA Centaur XPT interprets any other response code as a severe error and takes the LAS offline. Check the Event Log.

Examples

The following example shows the LAS responding with a completion code of 01, indicating that a sample tube is present. This example shows the Enhanced Protocol not enabled.

Table 13: Example completion code response - Enhanced Protocol not enabled

Line Direction	Message	Description
Analyzer ⇒ LAS	F0 01 A0 32 33 F8	Index Queue Command (A0)
LAS ⇒ Analyzer	06	ACKnowledge

Line Direction	Message	Description
LAS ⇒ Analyzer	F0 01 E0 01 50 33 36 35 F8	Index Queue Response (E0)
Analyzer ⇒ LAS	06	ACKnowledge

If the Enhanced Protocol is enabled, the SID will also be sent with the Index Queue command. The SID of P1 is represented by the bytes 50 31 and P2 by 50 32. The following example shows the same transaction with the Enhanced Protocol set.

Table 14: Example completion code response - Enhanced Protocol enabled

Line Direction	Message	Description
Analyzer ⇒ LAS	F0 01 A0 50 31 32 33 F8	Index Queue Command (A0)
LAS ⇒ Analyzer	06 A0	ACKnowledge
LAS ⇒ Analyzer	F0 01 E0 01 50 32 36 35 F8	Index Queue Response (E0)
Analyzer ⇒ LAS	06 E0	ACKnowledge

Skip Tube Command

The LAS initiates the Skip Tube command in the following instances:

- Following a Send SID Response with a 05 completion code (see Send SID Response on page 189)
- Following an Index Queue Response with a 06 completion code (see Index Queue Response on page 225)
- Asynchronously, at anytime that the LAS is online.

If the user does not want the worklists of tubes that were skipped to remain, they must be manually deleted. All old worklists with SIDs should be deleted before an SID is reused.

Message Specifications

Specification	Description
Message Name	Skip Tube Command
Transmission Direction	LAS ⇒ Analyzer
Timing	Sent within 30 seconds: following a Send SID Response with completion code 05 or Index Queue Response with completion code 06. For additional details, refer to Index Queue Response (page 225) or Send SID Responses (page 189). This command may also be sent asynchronously at anytime that the LAS in Online.

Processing	Response required in 10 seconds or less.

Message Format

The **Skip Tube Command** format is as follows:

<STX><SEQ><CMD><SID><CC1><CC2><ETX>

Where:

Mnemonic	Value (Hex)	Description
STX	F0	Start of text
SEQ	01	Command sequence number
CMD	A8	Command Byte - Skip Tube Command
SID	ASCII String	Sample ID (SID of tube to be skipped)
CC1		1^{st} Check Sum Digit (Most Significant Digit)
CC2		2^{nd} Check Sum Digit (Least Significant Digit)
EXT	F8	End of text, stop character

Examples

See the *Examples* section provided for the Skip Tube Response on page 199.

Skip Tube Response

The Skip Tube Response message is described in detail below.

Message Specifications

Specification	Description
Message Name	Skip Tube Response
Transmission Direction	Analyzer ⇒ LAS
Timing	Issued in response to a Skip Tube Command.
Processing	The Skip Tube Response is sent in10 seconds or less.

Message Format

The **Skip Tube Response** format is as follows:

<STX><SEQ><CMD><CMP><SID><CC1><CC2><ETX>

Where:

Mnemonic	Value (Hex)	Description
STX	F0	Start of text
SEQ	01	Command sequence number
CMD	E8	Command Byte - Skip Tube Response
CMP	01 - 05	Completion Code (see table that follows)
SID	ASCII String	Sample ID (SID of tube to be skipped)
CC1		1st Check Sum Digit (Most Significant Digit)
CC2		2nd Check Sum Digit (Least Significant Digit)
EXT	F8	End of text, stop character

The following table describes the list of possible completion codes for the Skip Tube Response.

Table 15: Skip Tube Response completion codes

Skip Tube Response	Description
01 - Sample skipped	The ADVIA Centaur XPT verifies that the sample tube has been skipped.
02 - LAS Offline	The LAS is offline.
03 - Tube not found	Tube not in spur.
95 - Invalid parameter	SID sent in Skip To command different from the one sent in the Send SID or Index Queue response from the LAS.

Examples

The following example shows the LAS responding to a Send SID command with a completion code of 06, indicating that an unexpected sample tube is present. The SID of P000000000006 is represented by the bytes 50 30 30 30 30 30 30 30 30 30 30 30 36.

Table 16: LAS response to Send SID command with completion code of 06

Line Direction	Message	Description
LAS ⇒ Analyzer	F0 01 E4 05 50 30 30 30 30 30 30 30 30 30 30 30 36 38 30 F8	Send SID Response (E4)
Analyzer ⇒ LAS	06 E4	ACKnowledge
LAS ⇒ Analyzer	F0 01 A8 50 30 30 30 30 30 30 30 30 30 30 30 36 33 46 F8	Skip Tube Command (with sample ID for Skipped Tube) (A8)
Analyzer ⇒ LAS	06 A8	ACKnowledge (ACK)
Action: Analyzer Skips Tube		

Line Direction	Message	Description
Analyzer ⇒ LAS	F0 01 E8 01 50 30 30 30 30 30 30 30 30 30 30 30 36 38 30 F8	Skip Tube Response (C4)
LAS ⇒ Analyzer	06 E8	ACKnowledge

The following example shows the LAS responding to an Index Queue command with a completion code of 06, indicating that an unexpected sample tube is present. The SID of P2 is represented by the bytes 50 32.

Table 17: LAS response to Index Queue command with completion code of 06

Line Direction	Message	Description
LAS ⇒ Analyzer	F0 01 E0 06 50 32 36 39 F8	Index Queue Response (E0)
Analyzer ⇒ LAS	06 E0	ACKnowledge
LAS ⇒ Analyzer	F0 01 A8 50 32 32 42 F8	Skip Tube Command (with sample ID for Skipped Tube) (A8)
Analyzer ⇒ LAS	06 84	ACKnowledge (ACK)
Action: Analyzer Skips Tube		
Analyzer ⇒ LAS	F0 01 E8 01 50 32 36 43 F8	Skip Tube Response (E8)
LAS ⇒ Analyzer	06 E8	ACKnowledge

Send Status Command

The LAS requests the ADVIA Centaur XPT to provide general system status, LAS status, or probe status information about the lab automation interface.

When using this, Send Status Command, the response includes the status of the system reagents. Whereas, the Detailed System Status Command does not report on any reagent quantities and therefore the overall status reported by the two different status commands may be different (i.e. if one reports red, the other may be yellow etc.). It is recommended that LAS systems use the Enhanced Protocol with the new Detailed System Status and associated Detail Reagent Status commands to obtain the true status of the system.

Message Specifications

Specification	Description
Message Name	Send Status Command
Transmission Direction	LAS ⟹ Analyzer
Timing	Allowed anytime LAS is On.
Processing	Response required in 15 seconds or less.

Message Format

The **Send Status Command** format is as follows:

<STX><SEQ><CMD><ITM><CC1><CC2><ETX>

Where:

Mnemonic	Value (Hex)	Description
STX	F0	Start of text
SEQ	01	Command sequence number
CMD	88	Command Byte - Send General Status Command
<ITM>	01 - 03	Status Item Select Code (see the table that follows)
CC1		1st Check Sum Digit (Most Significant Digit)
CC2		2nd Check Sum Digit (Least Significant Digit)
EXT	F8	End of text, stop character

The following table describes the possible status items in the Send Status command.

Table 18: Send Status items

Send Status Item	Description
01 - Send system status	Send the status of the ADVIA Centaur XPT.
02 - Send LAS status	Report the status of the LAS (On or Offline).
03 - Send probe status	Send status of probe position (clear of sample tube or not).

Examples

See the *Examples* section provided for the Skip Tube Response on page 199.

Send Status Response

The LAS requests the ADVIA Centaur XPT to provide general system status, LAS status, or probe status information about the lab automation interface using the Send Status Command. The response to that command is detailed below.

Message Specifications

Specification	Description
Message Name	Send Status Response
Transmission Direction	Analyzer ⇒ LAS
Timing	Only issued in response to a Send Status Command from the analyzer.
Processing	Response required in 15 seconds or less.

Message Format

The **Send Status Response** format is as follows:

<STX><SEQ><CMD><ITM><STS><CC1><CC2><ETX>

Where:

Mnemonic	Value (Hex)	Description
STX	F0	Start of text
SEQ	01	Command sequence number
CMD	C8	Command Byte - Send General Status Response
<ITM>	01 - 03	Status Item Select Code (see the table that follows)
<STS>	01 - 03	Status code for the Item Code specified in <ITM> (see tables that follow).
CC1		1st Check Sum Digit (Most Significant Digit)
CC2		2nd Check Sum Digit (Least Significant Digit)
EXT	F8	End of text, stop character

The following table describes the possible Status Codes <STS> returned for a Send Status Command for a System Status <ITM> 01.

Table 19: Status codes for Send Status Command for System Status

Send Status Item Code	Description
01 - Green	The ADVIA Centaur XPT is ready and functioning.

Send Status Item Code	Description
02 - Yellow	Yellow indicates that a warning condition exists, such as a low supply.
03 - Red	Red indicates that a failure condition exists, such as an empty supply, which may cause the system to stop aspirating or processing samples.

The following table describes the possible Status Codes <STS> returned for a Send Status Command for an LAS status <ITM> 02.

Table 20: Status codes returned for Send Status Command for LAS status

Send Status Item Code	Description
01 - Online	The LAS is online.
02 - Offline	The LAS is offline.

The following table describes the possible Status Codes <STS> returned for a Send Status Command for a sample probe position <ITM> 03.

Table 21: Status codes returned for Send Status Command for sample probe position

Send Status Item Code	Description
01 - Clear	The placement of the sample probe is known, and the probe is clear of the sample tube.
02 - Unknown	The placement of the sample probe is unknown or in the tube.

Examples

In the following example, the LAS requests a general system status, and the ADVIA Centaur XPT returns a status code of 02, indicating a yellow status condition.

Table 22: Example general system status request

Line Direction	Message	Description
LAS ⇒ Analyzer	F0 01 88 01 38 41 F8	Send Status Command (88)
Analyzer ⇒ LAS	06 88	ACKnowledge
Analyzer ⇒ LAS	F0 01 C8 01 02 43 43 F8	Send Status Response (C8)
LAS ⇒ Analyzer	06 C8	ACKnowledge

Send Detailed System Status Command

If the enhanced protocol is enabled, the ADVIA Centaur XPT will respond to a request from the LAS for a detailed system status by first sending a response indicating whether or not the request for status was accurately received. This response is sent in addition to the Acknowledgment. Then a detailed command is issued that includes a general status code (GSC) as well as one or more specific status codes (SSC). The specific status codes are the causes of all yellow and/or red status conditions.

In addition, if the ADVIA Centaur XPT is set to Send Detailed System Status **Automatically**, and the system status changes, a detailed status will be sent without a request from the LAS.

Note Status messages can be queued for up to thirty minutes if the ADVIA Centaur XPT is unable to communicate with the LAS host. In this case, the first unsolicited status message may not reflect the current state of the ADVIA Centaur XPT. Sending a solicited status request will provide the current status.

If using the "Send Status Command", the response includes the status of the system reagents. Whereas, this Detailed System Status Command does not report on any reagent quantities and therefore the overall status reported by the two different status commands may be different (i.e. if one reports red, the other may be yellow etc.). It is recommended that LAS systems use the Enhanced Protocol with the new Detailed System Status and associated Detailed Reagent Status commands to obtain the true status of the system.

Message Specifications

Specification	Description
Message Name	Send Detailed System Status Command
Transmission Direction	LAS $\Rightarrow$ Analyzer
Timing	Allowed anytime LAS is On, and at LAS startup and state change. Additional status requests are not permitted for 1 minute. If Automatic Detailed System Status is enabled, the request for detailed system status is issued automatically at system startup and upon each system status change.
Processing	Response from analyzer is expected in 10 seconds or less.

Message Format

The **Send Detailed System Status Command** format is as follows:

<STX><SEQ><CMD><CC1><CC2><ETX>

Where:

Mnemonic	Value (Hex)	Description
STX	F0	Start of text
SEQ	01	Command sequence number
CMD	96	Command Byte - Send Detailed System Status Command
CC1		1^{st} Check Sum Digit (Most Significant Digit)
CC2		2^{nd} Check Sum Digit (Least Significant Digit)
EXT	F8	End of text, stop character

Examples

See *Examples*, page 210 provided for the Detailed System Status Command.

Send Detailed System Status Response

Following a request by LAS to send a detailed system status, the analyzer will first send this response indicating whether or not the request for status was accurately received (in addition to the Acknowledgment). Once this response is ACKnowledged, a detailed status command is issued to the LAS that includes a general status code as well as one or more specific status codes (see *Detailed System Status Command*, page 206 for information).

Message Specifications

Specification	Description
Message Name	Send Detailed System Status Response
Transmission Direction	Analyzer ⇒ LAS
Timing	Only issued in response to a Send Detailed System Command (96) from LAS. This command is NOT issued in response to an automatically issued status request at system startup or upon each system status change.
Processing	Analyzer expected to send a Detailed System Status Command in 30 seconds or less.

Message Format

The **Send Detailed System Status Response** format is as follows:

<STX><SEQ><CMD><STA><CC1><CC2><ETX>

Where:

Mnemonic	Value (Hex)	Description
STX	F0	Start of text
SEQ	01	Command sequence number
CMD	97	Command Byte - Send Detailed Status Response
STA	00, 01, 03	Request Status (00 - Message not understood - please retransmit, 01 - Message understood, 03 - Feature not available)
CC1		1st Check Sum Digit (Most Significant Digit)
CC2		2nd Check Sum Digit (Least Significant Digit)
EXT	F8	End of text, stop character

Example

See *Examples*, page 210 for the Detailed System Status Command.

Detailed System Status Command

Following a request by LAS to send a detailed system status, the analyzer will first send a response indicating whether or not the request for status was accurately received (in addition to the Acknowledgment). Once that response is ACKnowledged, this Detailed Status Command is issued to the LAS which includes a general status code as well as one or more specific status codes (see tables that follow).

In addition, if the ADVIA Centaur XPT is set to Send Detailed System Status **Automatically**, and the system status changes, this Detailed System Status Command will be sent without a request from the LAS.

Note If the Detailed System Status Command returns an error of RED (03H) and "acid pump offline" (13H), the status will not change following correction of the problem until an "Add Tube" operation is performed or until the "Start" button has been pressed on the system.

Message Specifications

Specification	Description
Message Name	Detailed System Status Command
Transmission Direction	Analyzer ⇒ LAS
Timing	Issued in response to a Send Detailed System Status command (first sends the Send Detailed System Status Response), followed by this command. If Automatic Detailed System Status is enabled, this command is issued upon receipt of an automatic Send Detailed System Status Command.
Processing	Response from analyzer in expected in 30 seconds or less. The analyzer will provide the LAS with any error conditions that may exist (see tables of error codes that follow).

Message Format

The **Detailed System Status Command** format is as follows:

**<STX><SEQ><CMD><GSC>[<SSC> . . .
<SSC>]<CC1><CC2><ETX>**

Where:

Mnemonic	Value (Hex)	Description
STX	F0	Start of text
SEQ	01	Command sequence number
CMD	98	Command Byte - Detailed System Status Command
GSC	01, 02, 03	General Status Codes (see table below)
SSC		Specific Status Code (See table below). Multiple SSCs can be included if command is in response to a solicited status from the LAS. If in response to an automatic request, only one SSC can be included.

Mnemonic	Value (Hex)	Description
CC1		1st Check Sum Digit (Most Significant Digit)
CC2		2nd Check Sum Digit (Least Significant Digit)
EXT	F8	End of text, stop character

The following table describes the possible General Status Codes <GSC> included in the Detailed System Status Command (only one included per command).

Table 23: General Status Codes in Detailed System Status Command

General Status Code <GSC>	Description
01 - Green	The ADVIA Centaur XPT is ready and functioning.
02 - Yellow	Yellow indicates that a warning condition exists, such as a low supply.
03 - Red	Red indicates that a failure condition exists, such as an empty supply, which may cause the system to stop aspirating or processing samples.

In addition to the General Status Codes noted above, the following detailed status codes can be sent to the LAS.

Specific Status Codes <SSC> for yellow (02) General Status Codes:

Table 24: Specific Status Codes for yellow General Status Codes

Specific Status Code <SSC>	Description
5C	Low Tips
5D	Using Water Reserve or Water Bottle Not Present
5E	Using Acid Reserve
5F	Using Base Reserve
60	Using Wash 1 reserve
6A	Using Wash 2 reserve
61	Using Wash 3 reserve
62	Cuvette Waste > 80% Full or Cuvette Waste Container Not Present
63	Tip Waste > 80% Full
64	Tip Tray Waste > 80% Full or Tip Waste Container Not Present
65	Liquid Waste using Reserve or Liquid Waste Container bottle Not Present
2A	Ancillary Probe Offline
23	Reagent Probe 1 Offline
22	Reagent Probe 2 Offline

Specific Status Code <SSC>	Description
21	Reagent Probe 3 Offline
6B	Reagent Barcode Scanner Offline
6C	Ancillary Pack Loader Offline

Specific Status Codes <SSC> for red (03) General Status Codes:

Table 25: Specific Status Codes for red General Status Codes

Specific Status Code <SSC>	Description
13	Acid Pump Offline
14	Base Pump Offline
15	Cuvette Pusher Offline
6D	Cuvette Loader Offline
6E	Cuvette Hopper Offline
16	Reagent Mixer Offline
17	Aspirate Probe 2 Offline
18	Reagent Shutter Offline
6F	Reagent Barcode Shutter Offline
19	Tip Loader Offline
24	IPQ Offline
7B	Rack Loader Offline
7C	Stat Rack Pusher Offline
7D	Entry Queue Offline
7E	Exit Queue Pusher Offline
1A	Sample Probe Offline Up
1C	Waste Probe Offline
77	Waste Vacuum Offline
1B	Sample Probe Offline Down
1D	Aspirate Probe 4 Offline
1E	Aspirate Probe 3 Offline
1F	Aspirate Probe 1 Offline
8A	Dispense Port 1 Offline
8B	Dispense Port 2 Offline
8C	Dispense Port 3 Offline
8D	Wash 1 Reservoir Offline
8E	Wash 2 Reservoir Offline
8F	Wash 3 Reservoir Offline
9A	Wash Resuspend Offline
25	FS Wash Port Offline

Specific Status Code <SSC>	Description
9B	Ionizer Offline
26	Ancillary Queue Offline
9C	Ancillary Queue Door Offline
9D	Water Vacuum Offline
9E	Bleach Pump Offline
9F	Bleach Reservoir Offline
66	Flush Reservoir Offline
2F	Insufficient or No Water
30	No tips
31	Insufficient or No Base
32	Insufficient or No Acid
3B	Cuvette Waste Full
3C	Tip Waste Full
3D	Tip Tray Waste Full
3E	Liquid Waste Full
3F	Taking LAS Offline
67	Incubation Ring Offline
68	Cuvette Lift Offline
69	Cuvette Supply Depleted
70	Incubation Ring Index Pin
71	PMT Offline
72	Thermals Problem
73	Doing Maintenance
74	Diagnostics
75	LIS Offline
76	General Software Problem

Examples

In the following example the ADVIA Centaur XPT returns a status code of 03, indicating a red status condition. The causes of the red status are a problem with the thermals, and a general software problem. This example shows the ADVIA Centaur XPT sending a solicited system status.

Note The response to an unsolicited system status request is a Detailed Status command (98). A Send Detailed Status Response (97) would not be sent in this case.

Table 26: Example solicited system status

Line Direction	Message	Description

LAS ⇒ Analyzer	F0 01 96 39 37 F8	Send Detailed Status Command (96)
Analyzer ⇒ LAS	06 96	ACKnowledge
Analyzer ⇒ LAS	F0 01 97 01 39 39 F8	Send Detailed Status Response (97)
LAS ⇒ Analyzer	06 97	ACKnowledge
Analyzer ⇒ LAS	F0 01 98 03 72 76 38 34 F8	Detailed Status Command (98)
LAS ⇒ Analyzer	06 98	ACKnowledge
LAS ⇒ Analyzer	F0 01 99 01 39 42 F8	Detailed Status Response (99)
Analyzer ⇒ LAS	06 99	ACKnowledge

Note If Reagent Probe 1, Reagent Probe 2, and Reagent Probe 3 all go offline, then a red general status condition will be sent to the LAS along with the three specific yellow status codes in one message.

Example of GSC Codes and Detailed Status Command Processing

1. The LAS sends REQ Det System (96) status command.
2. The analyzer acknowledges the request.
3. The analyzer responds with a general status code (GSC) of 02 yellow and a specific status code (SSC) of 9F.

   An SSC of 9F indicates low bleach.
   See Tables 5-22 and 5-23 for a complete list of SSCs.
4. The LAS sends REQ Det System (96) status command.
5. The analyzer acknowledges the request
6. The analyzer responds with a general status code (GSC) of 01 green. No specific status code (SSC) is sent when the GSC is 01 green.

When the system state is not 01 green, the analyzer will continue processing samples that have been aspirated, but it may not aspirate additional samples, depending on the SSC. It is recommended that no additional tubes are sent when the system state is not 01 or green.

If the system is in an idle state, it will not aspirate or enter the inprocess state until the GSC state is green. See the following example:

```
LAS => Analyzer  f0 01 96 39 37 f8          |REQ Det St Cmd
Analyzer => LAS 06 96                       |ACK Sent
```

```
Analyzer => LAS f0 01 97 01 39 39 f8          RQ Det SS Resp
LAS => Analyzer 06 97                         |ACK Received

Analyzer => LAS f0 01 98 02 9f 33 41 f8       |Det Status Cmd
LAS => Analyzer 06 98                         |ACK Received
LAS => Analyzer f0 01 99 01 39 42 f8          |Det Stat Resp
Analyzer => LAS 06 99                         |ACK Sent
Analyzer => LAS f0 01 98 01 39 41 f8          |Det Status Cmd
LAS => Analyzer  06 98                        |ACK Received
LAS => Analyzer  f0 01 99 01 39 42 f8         |Det Stat Resp
Analyzer => LAS |  06 99                      |ACK Sent

LAS => Analyzer f0 01 96 39 37 f8             |REQ Det St Cmd

0|09:23:02|S|  06 96                          |ACK Sent
Analyzer => LAS f0 01 97 01 39 39 f8          |RQ Det SS Resp
LAS => Analyzer  06 97                        |ACK Received

Analyzer => LAS |  f0 01 98 01 39 41 f8       |Det Status Cmd
_
LAS => Analyzer 06 98                         |ACK Received
LAS => Analyzer f0 01 99 01 39 42 f8          |Det Stat Resp
```

Send Sample Status

The ADVIA Centaur XPT sends sample status after completing sample aspiration, either before or after the Index Queue command. The sample status message will include a sample status message byte, the SID, a General Status Code, Specific Status Code(s), and test identifiers for any tests that were not aspirated (if applicable). Status will only be sent for tests that are in the Test ID map (see Test Map Command and Response on page 234 for details).

If the system status is Aspirated (00), a Sample Status will be transmitted to the LAS, if the option is enabled. If there was a problem, a general sample status code that represents the category of the problem will be sent to the LAS along with a specific problem code, and test identifiers for any tests that were not aspirated.

It is possible for multiple sample status flags to be sent to the LAS for one sample. The general status code will indicate a single status or multiple status conditions. The number of specific status codes sent as part of the message is equal to the number of general status code bits set in the general status code byte. Only one specific status code will be sent per general status code category.

Message Specifications

Specification	Description
Message Name	Send Sample Status Command
Transmission Direction	LAS ⟹ Analyzer
Timing	Issued automatically at completion of sample aspiration.
Processing	Response from the analyzer is expected in 10 seconds or less. LAS must evaluate sample aspiration status and route the sample tube accordingly.

Message Format

The **Send Sample Status Command** format is as follows:

<STX><SEQ><CMD><SID><FDL><GSC>[SSC . . . <SSC>][<TST><FDL> . . . <TST><FDL>]<CC1><CC2><ETX>

Where:

Mnemonic	Value (Hex)	Description
STX	F0	Start of text
SEQ	01	Command sequence number
CMD	A1	Command Byte - Send Sample Status Command
SID	ASCII String	Sample ID
FDL	FD	Field Delimiter
GSC		General Status Code(s) (see table below for byte format)
SSC		Specific Status Codes, if any (see table below). Up to 8 SSCs can be included (see Additional Message Format Information below)
TST		Test Identifier - one for each test not aspirated, if any. Multiple test identifiers allowed, test codes obtained from Test Map Tables (see page 232)
FDL	FD	Field Delimiter follows each Test Identifier (including the last Test Identifier)
CC1		1^{st} Check Sum Digit (Most Significant Digit)
CC2		2^{nd} Check Sum Digit (Least Significant Digit)
EXT	F8	End of text, stop character

Additional Message Format Information

The format of the Sample Status Message, if the Send Sample Status option is turned on is as follows:

- The Sample Status Message will contain up to eight bytes for resource problems, one general status byte <GSC> followed by up to seven specific status code bytes <SSC>.
- Each bit set in the general status code byte indicates a general status code. The last bit (eighth bit) will not have a specific byte in the general status byte. This bit will be reserved.

The following table describes the general status codes for the Send Sample Status command.

Table 27: General status codes for Send Sample Status command

General Status Code (Binary)	General Status Code (Hex)	Description
0000 0000	Aspirated (00)	The mapped test was successfully aspirated.
0000 0001	Reagent Problem (01)	Some of the aspirations were successful but some of the aspirations were not successful due to a temporary problem with the reagents, for example: Reagent Lot expired.
0000 0010	Device Problem (02)	Aspiration could not be completed because a device is offline.
0000 0100	Supply Problem (04)	Not all aspirations were completed due to temporary problems.
0000 1000	Waste Problem (08)	Not all aspirations were completed due to temporary problems.
0001 0000	System Problem (10)	Not all aspirations were completed due to temporary problems.
0010 0000	Work Order Issue (20)	The sample was not aspirated because there was a problem affecting the work order, for example: a test was inactive, there was no request, or there was a SID mismatch.

General Status Code (Binary)	General Status Code (Hex)	Description
0100 0000	Sample Problem (40)	There is problem with the sample itself and it could not be aspirated, for example: Clot detected. It could also be related to a sample material such as Material Expired.

Therefore the bit map of the general status code for a sample with both a reagent problem and a supply problem would be:

0000 0101

Each bit set in the general status code byte will have a specific status code associated with it. The order in which the specific status code bytes are transmitted (left to right) follows the order in which the general status code bits are set in the general status code byte (right to left).

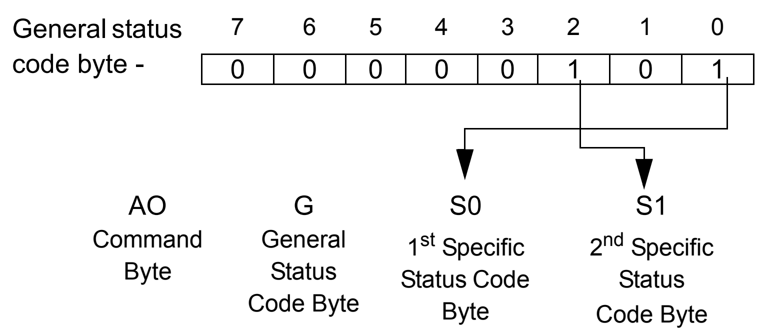


Figure 14: Status code byte vs. status code

The following table displays the general status codes and the associated specific sample status codes available for the Send Sample Status Command:

Table 28: General and specific status codes for Send Sample Status Command

General Status Code <GSC> - Reagent Problem (01)	
Specific Status Code <SSC>	***Description***
01	No Reagent, Reagent Lot Expired or Reagent or Vial Stability Expired
02	No Universal
03	No Ancillary
04	No Diluent
05	No Allergen
06	No mitigation reagent
07	Low mitigation reagent
08	No Primary Reagent Pack Present
09	No Allergen Vial Present
0A	Cal Required
0B	No Bracket
0C	Reagent Threshold Reached
OD – 12	Other Causes
General Status Code <GSC> - Device Problem (02)	
Specific Status Code <SSC>	**Description**
13	Acid Offline
14	Base Offline
15	Cuvette System Offline
16	Reagent Mixer Offline
17	Aspirate Probe 2 Offline
18	Reagent Shutter Offline
19	Tip Loader Offline
1A	Sample Probe Offline Up
1B	Sample Probe Offline Down
2A	Ancillary Probe Offline
1C	Waste Offline
1D	Aspirate Probe 4 Offline
1E	Aspirate Probe 3 Offline
1F	Aspirate Probe 1 Offline
20	Wash Dispense Offline
General Status Code <GSC> - Device Problem (02)	

Specific Status Code <SSC>	Description
21	Reagent 3 Probe Offline
22	Reagent 2 Probe Offline
23	Reagent 1 Probe Offline
24	InProcess Queue Offline
25	Forward Sandwich Offline
26	Ancillary Queue Offline
27	Wash 3 Offline
28	Reserved
29	Wash 1 Offline
2B -2E	Reserved

General Status Code <GSC> - Supply Problem (04)

Specific Status Code <SSC>	Description
2F	Insufficient or no water
30	No tips
31	Insufficient or No Base
32	Insufficient or No Acid
33	Insufficient or No Wash 3
34	Reserved
35	Insufficient or No Wash 1
36 – 3A	Reserved

General Status Code <GSC> - Waste Problem (08)

Specific Status Code <SSC>	Description
3B	Cuvette Waste Full
3C	Tip Waste Full
3D	Tip Tray Waste Full
3E	Liquid Waste Full
3F – 43	Reserved

General Status Code <GSC> - System Problem (10)

Specific Status Code <SSC>	Description
44	Priming Needed
45	Not in Restricted Mode

46	In Restricted Mode
47 – 4A	Reserved

General Status Code <GSC> - Work Order Issue (20)

Specific Status Code <SSC>	**Description**
4B	Test Inactive
4C	No Lot Match
4D	No Cal Lot Match
4E	No Request or SID Mismatch
4F- 53	Reserved

General Status Code <GSC> - Sample Problem (40)

Specific Status Code <SSC>	**Description**
54	Material Expired (cal or control lot expired)
55	Insufficient Volume
56	Clot Detected
57	Integrity Error
58	Incomplete Cal Set (not used in this version)
59	Incomplete Control Set (not used in this version)
5A	Tube Skipped
5B	Reset Queue

Example

The following example shows the ADVIA Centaur XPT sending a detailed sample status showing the tube was skipped. The SID of P1 is represented by the bytes 50 31.

Table 29: Example sample status - tube skipped

Line Direction	*Message*	*Description*
Analyzer ⇒ LAS	F0 01 A0 50 31 32 32 F8	Index Queue Command (A0)
LAS ⇒ Analyzer	06 A0	ACKnowledge
Analyzer ⇒ LAS	F0 01 A1 50 31 FD 40 5A 42 41 F8	Sample Status Message (A1)
LAS ⇒ Analyzer	06 A1	ACKnowledge
LAS ⇒ Analyzer	F0 01 CF 01 39 42 F8	Sample Status Response (CF)
Analyzer ⇒ LAS	06 CF	ACKnowledge

Send Reagent Status Command

The ADVIA Centaur XPT can send solicited or unsolicited reagent status information to the LAS, if the Send Reagent Status option is turned on. Solicited reagent status information will provide a status for every test on the system. There can be multiple reagents per test (primary and ancillary, or one reagent associated with multiple tests). Unsolicited, incremental information is sent when there is any change to the status of reagents on the system, for example reagent status severity field changes (01, 02, 03). Refer to *Detailed Reagent Status Command*, page 5-58, for more information. This command, Send Reagent Status Command, is a request from the LAS for reagent status information. Processing a confirmation response from the analyzer is expected in 10 seconds or less. The actual reagent status information will begin within 5 minutes. This command, during a run (while the analyzer is in process) is permitted, but not recommended.

Message Specifications

Specification	Description
Message Name	Send Reagent Status Command
Transmission Direction	LAS ⟹ Analyzer
Timing	This request for reagent status is sent at startup by the LAS.
Processing	A confirmation response from the analyzer is expected in 10 seconds or less. The actual reagent status information will begin within 5 minutes.

Message Format

The **Send Reagent Status Command** format is as follows:

<STX><SEQ><CMD><CC1><CC2><ETX>

Where:

Mnemonic	Value (Hex)	Description
STX	F0	Start of text
SEQ	01	Command sequence number
CMD	B3	Command Byte - Send Reagent Status Command
CC1		1st Check Sum Digit (Most Significant Digit)
CC2		2nd Check Sum Digit (Least Significant Digit)
EXT	F8	End of text, stop character

Examples

See the *Examples* section provided for the Detailed Reagent Status Command on page 224.

Send Reagent Status Response

This command is sent by the system in response to a request from the LAS for reagent status information. This response is used to inform the LAS that the analyzer has received the request for reagent status and will subsequently send the information via the Detailed Reagent Status Command (see page 221).

Message Specifications

Specification	Description
Message Name	Send Reagent Status Response
Transmission Direction	Analyzer ⇒ LAS
Timing	Message is only issued in response to a Send Reagent Status Command.
Processing	This confirmation response from the analyzer is expected within 10 seconds of receipt of the request. The actual reagent status information will begin within 5 minutes via the Detailed Reagent Status Command.

Message Format

The **Send Reagent Status Response** format is as follows:

<STX><SEQ><CMD><STA><CC1><CC2><ETX>

Where:

Mnemonic	Value (Hex)	Description
STX	F0	Start of text
SEQ	01	Command sequence number
CMD	C5	Command Byte - Send Reagent Status Response
STA	00, 01, 02, 03, 04	Request Status (00 - Message not understood - please retransmit, 01 - Message understood, 02 - System Busy/Message Ignored, 03 - Feature not available, 04 - LAS Offline)
CC1		1st Check Sum Digit (Most Significant Digit)
CC2		2nd Check Sum Digit (Least Significant Digit)
EXT	F8	End of text, stop character

Examples

See the *Examples* section provided for the Detailed Reagent Status Command on page 224.

Detailed Reagent Status Command

Using this command, the ADVIA Centaur XPT sends solicited and unsolicited reagent status information to the LAS, if the Send Reagent Status option is turned on. Solicited reagent status information will include one status message for each test on the system. Unsolicited, incremental information will be issued for each reagent status change. At startup, this command is used to send a full reagent status for each reagent to the LAS. Only status for reagents that are present on the system, and those that have sufficient volume to run tests will be sent. If a reagent volume is not sufficient to run tests, the associated tests will not be added to the Test ID Map (see Test Map Command and Response on page 234 for details) and no reagent status will be sent.

Sending Detailed Reagent Status Commands during the run (while the system is in process) is permitted, but not recommended. The recommended method for retrieving detailed status information is to process unsolicited reagent status messages from the system. The system will notify the LAS of reagent status changes during the run by issuing unsolicited detailed reagent status messages. The change is limited to the SEV field of the command.

The system will notify the LAS by issuing unsolicited detailed reagent status messages when reagent status/SEV changes due to reagent count or volume being decremented (used by a system during a run or when count or volume is modified by a user), or when a reagent pack is modified. Unsolicited messages are sent whenever a test volume changes state/SEV status (see Table 5-30, Severity codes). For example, the system will issue an unsolicited reagent status message when the number of available tests goes from above the threshold to below the threshold, from below the threshold to 0 or above the threshold, or from 0 to below the threshold or above the threshold. No reagent status message will be issued if the number of available tests is increased for a test already in state 01 / (green).

If a reagent, with sufficient volume to run tests, is added to the system, an incremental status for both the Reagent Status (see Detailed Reagent Status Command on page 221 for details) and the incremental Test ID Map will be sent to the LAS. The additional test and reagent information will be added. If a reagent is removed from the system, the reagent depleted status will be sent to the LAS. The Test ID Map will not be updated.

If an additional reagent pack is added for a test that is already on the system, no reagent status update will be sent until the total reagent volume for all packs of the same lot drops below the threshold warning level.

For non-lot locked reagents, the reagent volume is defined as the total number of tests on the system, in all packs. For lot locked reagents, reagent volume is defined as the total number of tests available in that lot. Refer to *Appendix E, Test Map*, for more information.

Message Specifications

Specification	Description
Message Name	Detailed Reagent Status Command
Transmission Direction	Analyzer $\Longrightarrow$ LAS
Timing	This message is issued for each reagent in response to a Send Reagent Status Command and at startup. This message is automatically issued for each individual reagent status change.
Processing	Detailed reagent status messages are expected to begin within 5 minutes of request (by LAS or automatic requests).

Message Format

The **Detailed Reagent Status Command** format is as follows:

<STX><SEQ><CMD><RGT><SEV>[LOT]<AREA><AVAIL><;>
<TST><FD>[. . . <AVAIL><;><TST><FD>]<CC1><CC2><ETX>

Where:

Mnemonic	Value (Hex)	Description
STX	F0	Start of text
SEQ	01	Command sequence number
CMD	B5	Command Byte - Detailed Reagent Status Command
RGT		Reagent Name
FDL	FD	Field Delimiter
SEV	01, 02, 03	Severity Code (see table below for details)
LOT	String of 1–4 digits	Reagent Lot Number - If test is not lot-locked, or control bracketed, then this field is blank.
AREA	ASCII Char.	Reagent Area ("P" - Primary, "V" - Vial, "A" - Ancillary)
AVAIL;TST		AVAIL: Availability Measure - Expressed as number of tests (system converts mL's available to tests) TST: Test Identifier - Multiple test identifiers allowed - Availability <AVAIL>, test code <TST>, and Field Delimiter <FD> fields are required for each Test Identifier included. Example of multiple AVAIL;TST pairs: f0 01 b5 54 33 54 34 56 42 31 32 fd 01 41 36 30 32 3b 32 32 fd 36 30 32 3b 38 35 fd 37 30 f8 **f0 01 b5 T 3 T 4 V B 1 2 fd 01 A 6 0 2 ; 2 2 fd 6 0 2 ; 8 5 fd 7 0 f8**
FDL	FD	Field Delimiter following each Test Identifier (including the last Test Identifier)
CC1		1st Check Sum Digit (Most Significant Digit)
CC2		2nd Check Sum Digit (Least Significant Digit)
EXT	F8	End of text, stop character

The following are the possible severity codes <SEV> for this message.

Table 30: Severity codes

Reagent Status Severity <SEV>	Description
01 - Green	The number of tests available is above the threshold level.
02 - Red	Red indicates that the reagent is depleted (the total number of tests available is zero).
03 - Yellow	Yellow indicates that the reagent volume had decreased below the threshold volume.

Example

The following example shows the ADVIA Centaur XPT sending a solicited reagent status.

Note An unsolicited reagent status would consist of the last command and response sequence only for the affected reagent. Solicited reagent status results in a status command sent for every reagent on the system.

Table 31: Solicited reagent status

Line Direction	Message	Description
LAS ⇒ Analyzer	F0 01 B3 42 34 F8	Send Reagent Status Command (B3)
Analyzer ⇒ LAS	06 B3	ACKnowledge
Analyzer ⇒ LAS	F0 01 C5 01 43 37 F8	Send Reagent Status Response (C5)
LAS ⇒ Analyzer	06 C5	ACKnowledge
Analyzer ⇒ LAS	F0 01 B5 50 57 32 FD 01 50 31 30 30 3B 36 FD 44 43 F8	Detailed Reagent Status Command (B5)
LAS ⇒ Analyzer	06 B5	ACKnowledge
LAS ⇒ Analyzer	F0 01 AF 01 42 31 F8	(AF)
Analyzer ⇒ LAS	06 AF	ACKnowledge

Detailed Reagent Status Response

This command is sent by the LAS in response to the receipt of each Detailed Reagent Status Command (see page 221 for additional detail).

Message Specifications

Specification	Description
Message Name	Detailed Reagent Status Response
Transmission Direction	LAS $\Longrightarrow$ Analyzer
Timing	Message is only issued in response to a Detailed Reagent Status Command.
Processing	This confirmation response from the LAS is expected within 10 seconds of receipt of the Detailed Reagent Status Command.

Message Format

The **Detailed Reagent Status Response** format is as follows:

<STX><SEQ><CMD><STA><CC1><CC2><ETX>

Where:

Mnemonic	Value (Hex)	Description
STX	F0	Start of text
SEQ	01	Command sequence number
CMD	AF	Command Byte - Send Reagent Status Response
STA	00, 01, 03, 04	Request Status (00 - Message not understood - please retransmit, 01 - Message understood, 03 - Feature not available, 04 - LAS Offline)
CC1		1st Check Sum Digit (Most Significant Digit)
CC2		2nd Check Sum Digit (Least Significant Digit)
EXT	F8	End of text, stop character

Examples

See the *Example* section provided for the Detailed Reagent Status Command on page 224.

Examples of Detailed Reagent Status Commands for primary and ancillary tests in lot locked scenarios:

1. Analyzer sends unsolicited test map and reagent status on startup.

The test map pairs ID numbers with string names. In this example, only 3 tests will be discussed (TSTO, WetWater, and HBsII). 66;TSTO. 86;WetWater: 109;HBsII. The ID number and string pairs will not change until the system is rebooted (or mechanics off/on). TSTO primary lot 158 is lot locked with TSTO ancillary reagent lot 1673. HBsII primary reagent lot 13 is lot locked with HBsII ancillary reagent lot 1573.

2. Analyzer sends unsolicited Detailed Reagent Status Commands for status primary and ancillaries:

Reagent Name	**Severity Code**	**Lot**	**Area**	**Avail**	**TST_ID**
TSTO	1 / Green	158	P (Primary)	26	66
HBsII	1 / Green	13	P (Primary)	127	109

Reagent Name	**Severity Code**	**Lot**	**Area**	**Avail**	**Associated with**
TSTOR	1 / Green	1673	A (ancillary)	76	test used with test 66 (TSTO)
HBsIIA	1 / Green	1573	A (ancillary)	343	test for use with 109:HBsII

Line Direction	Message	Description
Analyzer ⇒ LAS	|S| f0 01 bf 46 31 3b 43 45 41 fd 32 3b 52 75 62 47 fd 36 3b 57 65 74 57 61 73 68 31 fd 31 31 3b 48 42 63 54 fd 33 30 3b 61 48 42 73 32 fd 33 31 3b 54 6e 49 55 6c 74 72 61 fd 33 33 3b 50 53 41 fd 34 31 3b 50 52 47 45 fd 34 36 3b 44 52 59 fd 35 31 3b 49 67 45 fd 35 34 3b 61 48 43 56 fd 35 35 3b 54 6f 78 47 fd 35 39 3b 61 54 47 fd 36 31 3b 46 45 52 fd 36 34 3b 43 41 31 39 39 fd 36 36 3b 54 53 54 4f ***(66;TSTO.)*** fd 36 37 3b 46 54 34 fd 37 31 3b 43 48 49 56 fd 37 32 3b 43 41 31 35 33 fd 37 33 3b 43 41 31 32 35 fd 37 34 3b 46 53 48 fd 37 35 3b 46 54 33 fd 37 38 3b 50 52 4c fd 37 39 3b 41 46 50 fd 38 31 3b 42 4e 50 fd 38 36 3b 57 65 74 57 61 74 65 72 (***86;WetWater)*** fd 39 30 3b 54 6f 78 4d fd 39 31 3b 54 53 48 33 55 4c fd 39 33 3b 69 50 54 48 fd 39 35 3b 61 54 50 4f fd 31 30 30 3b 56 69 74 44 fd 31 30 35 3b 43 4f 52 fd 31 30 39 3b 48 42 73 49 49 ***(109:HBsII***) fd 36 36 f8	|Test Map Cmd
Analyzer ⇒ LAS	f0 01 b5 54 53 54 4f fd 01 31 35 38 50 32 36 3b 36 36 fd 46 38 f8	Reagent status cmd for TSTO

Line Direction	Message	Description
Analyzer ⟹ LAS	f0 01 b5 54 53 54 4f fd 01 31 35 38 50 32 36 3b 36 36 fd 46 38 f8	Reagent status cmd for HBsII
Analyzer ⟹ LAS	f0 01 b5 ***54 53 54 4f 52*** fd ***01*** 31 36 37 33 41 37 36 3b 36 36 fd 37 33 f8	Reagent status cmd for TSTOR ancillary
Analyzer ⟹ LAS	f0 01 b5 48 42 73 49 49 41 fd 01 31 35 37 33 41 33 34 33 3b 31 30 39 fd	Reagent status cmd for HBsIIA

Note The messages above only show the analyzer response. LAS queries and responses have been removed for clarity.

This example of Detailed Reagent Status Commands shows the 2 tests (T3, T4) that use the same ancillary T3T4V12. The italicized text is not part of the message and is only shown for clarification purposes.

1
Test map show 3 test IDs: name pairs, 22 ; T3, 53 ; EHIV, 85 ; T4
Analyzer => LAS
| f0 01 bf 46 32 32 3b 54 33` fd 35 33 3b 45 48 49 56 fd 38 35 3b 54 34 fd 32 f8 |
(***F 2 2 ; T 3***) ***0xfd (5 3 ; E H I V) 0xfd (8 5 ; T 4)0xfd 2***

2
Analyzer returns unsolicited reagent status for primary T3 with 100 tests available.
Analyzer => LAS
f0 01 b5 54 33 fd 01 50 31 30 30 3b 32 32 fd 42 38 f8 |
(T 3 0xfd 0x1 P 1 0 0 ; 2 2 0xfd)

3
Analyzer returns unsolicited reagent status for primary EHIV with 100 tests available.
Analyzer => LAS
f0 01 b5 45 48 49 56 fd 01 50 31 30 30 3b 35 33 fd 36 31 f8
(E H I V ***0xfd*** 0x1 P 1 0 0 ; 5 ***3)***

4
Analyzer returns unsolicited reagent status for primary T4 with 100 tests available.
Analyzer => LAS
f0 01 b5 54 34 fd 01 50 31 30 30 3b 38 35 fd 43 32 f8
(***T 4 0xfd 0x1 P 1 0 0 ; 8 5***)

5
Analyzer returns unsolicited status for ancilary T3T4VB12. With 1000 tests for

22(T3) and 1000 tests for 85(T4).
Analyzer => LAS
f0 01 b5 54 33 54 34 56 42 31 32 fd 01 41 31 30 30 30 3b 32 32 fd 31 30 30 30 3b 38
35 fd 43 32 f8

(T 3 T 4 V B 1 2 0xfd 0x1 A 1 0 0 0 ; 2 2 0xfd 1 0 0 0 ; 8 5)

Send Request For Sample Command

If the ADVIA Centaur XPT is set to Send Request For Sample, when the system triggers any reaspiration, a request will be sent to the LAS to return the sample tube to the analyzer. The sample ID is necessary as the system requests the sample for reaspiration.

Only tests that originated at the LAS will be requested. If a Skip Tube command has been issued for the tube requested, the Send Request for Sample command will not be processed.

The LAS will confirm receipt of the request by issuing a Send Request for Sample Response. If available, the sample is returned to the instrument, but no further messaging takes place whether the sample is returned or not.

Note Only a single test to be run will be identified, even if multiple tests are requested.

Message Specifications

Specification	Description
Message Name	Send Request For Sample Command
Transmission Direction	Analyzer ⟹ LAS
Timing	This request can be sent anytime that the LAS in On.
Processing	LAS sends a response to this request within 10 seconds and, if it is available, routes the sample tube back to the instrument.

Message Format

The **Send Request For Sample Command** format is as follows:

<STX><SEQ><CMD><TST><FDL><SID<CC1><CC2><ETX>

Where:

Mnemonic	Value (Hex)	Description
STX	F0	Start of text
SEQ	01	Command sequence number

Mnemonic	Value (Hex)	Description
CMD	B0	Command Byte - Send Request For Sample Command
TST		Test Identifier - Only one test allowed, test codes obtained from Test Map Tables.
FDL	FD	Field Delimiter
SID	ASCII String	Sample ID of the sample to be returned. This is a request for a reaspiration of a specific sample.
CC1		1st Check Sum Digit (Most Significant Digit)
CC2		2nd Check Sum Digit (Least Significant Digit)
EXT	F8	End of text, stop character

Example

The following example shows the LAS responding to a request for a sample with an SID of SMP8, represented by the bytes 53 4D 50 38.

Table 32: LAS response to request for sample - SID SMP8

Line Direction	Message	Description
Analyzer ⇒ LAS	F0 01 B0 53 4D 50 38 41 31 F8	Request For Sample Command (B0)
LAS ⇒ Analyzer	06 B0	ACKnowledge
LAS ⇒ Analyzer	F0 01 BE 01 43 30 F8	Request For Sample Response (BE)
Analyzer ⇒ LAS	06 BE	ACKnowledge

Send Request For Sample Response

This command is sent by the LAS in response to the receipt of the Send Request For Sample Command (see page 229 for additional detail). This response is a confirmation that the request for sample was received by LAS, it does not indicate that the requested sample was returned. If available, the sample is returned to the instrument, but no further messaging takes place whether the sample is returned or not.

Message Specifications

Specification	Description
Message Name	Send Request For Sample Response
Transmission Direction	LAS ⇒ Analyzer
Timing	Message is only issued in response to a Send Request For Sample Command.

Processing	This confirmation response from the LAS is expected within 10 seconds of receipt of the Send Request For Sample Command.

Message Format

The **Send Request For Sample Response** format is as follows:

<STX><SEQ><CMD><STA><CC1><CC2><ETX>

Where:

Mnemonic	Value (Hex)	Description
STX	F0	Start of text
SEQ	01	Command sequence number
CMD	BE	Command Byte - Send Request For Sample Response
STA	00, 01	Request Status (00 - Message not understood - please retransmit, 01 - Message understood)
CC1		1st Check Sum Digit (Most Significant Digit)
CC2		2nd Check Sum Digit (Least Significant Digit)
EXT	F8	End of text, stop character

Examples

See the *Example* section provided for the Send Request For Sample Command on page 230.

Send Test Map Command

Test ID mapping is required if the ADVIA Centaur XPT is set to Send Sample Status or Send Reagent Status. If one or both of these options are turned on, the ADVIA Centaur XPT will not process samples until a Test Map Response status of “Understood” is received from the LAS.

The ADVIA Centaur XPT can send solicited or unsolicited test map information to the LAS. This message is used by the LAS to request that the system send test map information via the Test Map Command (see Test Map Command on page 234 for details regarding solicited and unsolicited test map information.)

Message Specifications

Specification	Description
Message Name	Send Test Map Command
Transmission Direction	LAS $\Rightarrow$ Analyzer
Timing	Message is issued at LAS startup* and may be issued at any other time when not processing.
Processing	A confirmation of receipt response from the analyzer is expected within 10 seconds of receipt of the Send Test Map Command. The Test Map Command itself begins within 5 minutes of the request (see Test Map Command on page 234).

LAS startup refers to restarting the LAS after it is, or was, down. It is suggested to issue a Reset Queue when the LAS starts up. If the analyzer does not respond, the LAS should wait for unsolicited System Status, Test Map, and Reagent Status. See Table 5-28, Severity codes, for Detailed Reagent Status Commands.

Message Format

The **Send Test Map Command** format is as follows:

<STX><SEQ><CMD><CC1><CC2><ETX>

Where:

Mnemonic	Value (Hex)	Description
STX	F0	Start of text
SEQ	01	Command sequence number
CMD	B4	Command Byte - Send Test Map Command
CC1		1st Check Sum Digit (Most Significant Digit)
CC2		2nd Check Sum Digit (Least Significant Digit)
EXT	F8	End of text, stop character

Example

See the Example section provided for the Test Map Command on page 237.

Send Test Map Response

This command is sent by the system in response to a request from the LAS for a Test Map. This response is used to inform the LAS that the analyzer has received the request for a Test Map and will subsequently send the information via the Test Map Command (see page 234).

Message Specifications

Specification	Description
Message Name	Send Test Map Response
Transmission Direction	Analyzer ⇒ LAS
Timing	Message is only issued in response to a Send Test Map Command.
Processing	This confirmation response from the analyzer is expected within 10 seconds of receipt of the request. The actual test map information will begin within 5 minutes via the Send Test Map Command.

Message Format

The **Send Test Map Response** format is as follows:

<STX><SEQ><CMD><STA><CC1><CC2><ETX>

Where:

Mnemonic	Value (Hex)	Description
STX	F0	Start of text
SEQ	01	Command sequence number
CMD	AE	Command Byte - Send Test Map Response
STA	00, 01, 03, 04	Request Status (00 - Message not understood - please retransmit, 01 - Message understood, 03 - Feature not available, 04 - LAS Offline)
CC1		1st Check Sum Digit (Most Significant Digit)
CC2		2nd Check Sum Digit (Least Significant Digit)
EXT	F8	End of text, stop character

Example

See the *Example* section provided for the Test Map Command on page 237.

Test Map Command

Test ID mapping is required if the ADVIA Centaur XPT is set to Send Sample Status or Send Reagent Status. If one or both of these options are turned on, the ADVIA Centaur XPT will not process samples until a Test Map Response status of “Understood” is received from the LAS. The ADVIA Centaur XPT can send solicited or unsolicited test map information to the LAS.

A test map should not be used to determine whether the analyzer can run a test. Use the Detailed Reagent Status to determine if a test is runnable. Refer to *Appendix E, Test Map*, for more information.

Solicited test map information will always provide a complete set of test codes. Unsolicited, incremental information may also be sent if the available tests on the system change. When the LAS receives an unsolicited test map from the analyzer, the LAS should clear its memory of the test map and reagent status for that specific test. The ADVIA Centaur XPT sends a one character indicator as to whether the update is full or incremental (F/I).

During an incremental update, a minus (-) sign before the test ID indicates that the test has been deleted from the system. Only user defined (dilution profile and ratio tests) can be deleted from the system during an incremental update. To delete other tests from the test map, the system must be rebooted. This will rescan the available reagents and resend the entire test map.

Test ID mapping information will only be sent for tests that are currently available on the system. When the ADVIA Centaur XPT sends Sample and Reagent Status to the LAS, only information on tests that are part of the test map will be sent to the LAS. If additional tests were requested by the LIS, but no reagent was loaded to run the test, the mapping information would not have been transmitted, and no test status will be sent.

Test ID mapping maps the LIS code for each test to a hexadecimal value. This allows the ADVIA Centaur XPT to send multiple test codes to the LAS without significant impact on processing time. The test name in the test map may or may not be the same as the reagent pack name (Detailed Reagent Status). The test name is communicated only in the test map. The test code is used in the Reagent Status and Sample Status. At startup, the analyzer creates a unique ID for each Siemens-defined test and user-defined test (such as a ratio test). The analyzer also assigns a unique ID when the user creates a new user-defined test after reboot.

Test map information does not contain test status or test run ability information. Tests listed in the test map may not be runnable. Test map data only equates an ID number to a test name.

It is not recommended for LAS systems to request a test map throughout the run/inprocess state, or on a periodic basis. The LAS can query the analyzer for system status via the Send Detailed Status Command to determine system status. At reboot, the analyzer sends an unsolicited test map message to the LAS. The system will update the test map information via unsolicited/incremental test map messages in any state (Warming Up, Ready, Check, or Inprocess, etc.). The system will update the test map information via unsolicited/incremental test map messages throughout the run.

Message Specifications

Specification	Description
Message Name	Test Map Command
Transmission Direction	Analyzer ⟹ LAS
Timing	This message is issued in response to a Send Test Map Command with a “Full” test map or an unsolicited “Incremental” map is sent whenever a test becomes “useable” or when a test is deleted (i.e. ratio or dilution profile).
Processing	The Test Map Command is not processed in real time, but can be expected within 5 minutes of request (by LAS or automatic requests).

Message Format

The **Test Map Command** format is as follows:

<STX><SEQ><CMD><TID>[<DEL><TST;LIS><FDL> . . . <DEL><TST;LIS><FDL>]<CC1><CC2><ETX>

Where:

Mnemonic	Value (Hex)	Description
STX	F0	Start of text
SEQ	01	Command sequence number
CMD	BF	Command Byte - Test Map Command
TID	ASCII Char	Table ID - Values are: “F” for full test map, table overlaid, or “I” for incremental test map, specific tests added or deleted from table
DEL	ASCII Char. "-" (minus sign)	Optional Delete Indicator "-" (minus sign) used in incremental map command to indicate the test that follows is to be deleted, if blank the following test is to be added.
TST;LIS		Test Code (number) and corresponding LIS Test Code (alphanumeric)

Mnemonic	Value (Hex)	Description
FDL	FD	Field Delimiter follows each set of test codes
CC1		1st Check Sum Digit (Most Significant Digit)
CC2		2nd Check Sum Digit (Least Significant Digit)
EXT	F8	End of text, stop character

Example

The following example shows the ADVIA Centaur XPT sending a solicited test map that includes all test codes. An unsolicited test map would consist of the last command and response sequence only.

Table 33: Solicited test map including all test codes

Line Direction	Message	Description
LAS ⇒ Analyzer	F0 01 B4 42 35 F8	Send Test Map Command (B4)
Analyzer ⇒ LAS	06 B4	ACKnowledge
Analyzer ⇒ LAS	F0 01 AE 01 42 30 F8	Send Test Map Response (AE)
LAS ⇒ Analyzer	06 AE	ACKnowledge
Analyzer ⇒ LAS	F0 01 BF 46 36 3b 47 45 4e 54 fd 31 38 3b 57 65 74 57 61 73 68 32 fd 32 34 3b 57 65 74 57 61 73 68 33 fd 33 33 3b 73 61 6d 70 6c 69 6e fd 33 35 3b 4f 56 fd 35 34 3b 54 53 48 fd 36 30 3b 41 46 50 fd 36 36 3b 44 52 59 fd 37 37 3b 57 65 74 57 61 73 68 31 fd 37 38 3b 57 65 74 57 61 74 65 72 fd 41 46 f8	Test Map Command (BF)
LAS ⇒ Analyzer	06 BF	ACKnowledge
LAS ⇒ Analyzer	F0 01 E9 01 45 42 F8	Test Map Response (E9)
Analyzer ⇒ LAS	06 E9	ACKnowledge

Test Map Response

This confirmation response is sent by the LAS upon receipt of a Test Map Command (see page 234 for additional detail).

Message Specifications

Specification	Description
Message Name	Test Map Response
Transmission Direction	LAS $\Rightarrow$ Analyzer
Timing	Message is only issued in response to a Test Map Command.
Processing	This confirmation response from the LAS is expected within 10 seconds of receipt of the Test Map Command.

Message Format

The **Test Map Response** format is as follows:

<STX><SEQ><CMD><STA><CC1><CC2><ETX>

Where:

Mnemonic	Value (Hex)	Description
STX	F0	Start of text
SEQ	01	Command sequence number
CMD	E9	Command Byte - Test Map Response
STA	00, 01	Request Status (00 - Message not understood - please retransmit, 01 - Message understood)
CC1		1st Check Sum Digit (Most Significant Digit)
CC2		2nd Check Sum Digit (Least Significant Digit)
EXT	F8	End of text, stop character

Example

See the *Example* section provided for the Test Map Command on page 237.

Communication Test Command and Response

The Communication Test command can be issued by the LAS or the ADVIA Centaur XPT to perform a simple check of the communications interface. The sender requests the receiver to send back a response.

Message Specifications

Specification	Description
Message Name	Communication Test Command and Response
Transmission Direction	LAS ⇒ Analyzer or Analyzer ⇒ LAS
Timing	Command can be sent at anytime that the LAS is On. The response is only sent in response to the Test Communication Command
Processing	Response to this command should be received within 2 seconds.

Message Format

The **Communication Test Command and Response** format is as follows:

<STX><SEQ><CMD><CC1><CC2><ETX>

Where:

Mnemonic	Value (Hex)	Description
STX	F0	Start of text
SEQ	01	Command sequence number
CMD	80	Command Byte - Communication Test Command
	C0	Command Byte - Communication Test Response
CC1		1st Check Sum Digit (Most Significant Digit)
CC2		2nd Check Sum Digit (Least Significant Digit)
EXT	F8	End of text, stop character

Example

The following example shows the LAS requesting the ADVIA Centaur XPT to test the communications interface.

Table 34: LAS request to test communications interface

Line Direction	Message	Description
LAS ⇒ Analyzer	F0 01 80 38 31 F8	Communications Test Command (80)
Analyzer ⇒ LAS	06 80	ACKnowledge
Analyzer ⇒ LAS	F0 01 C0 43 31 F8	Communications Test Response (C0)
LAS ⇒ Analyzer	06 C0	ACKnowledge

Checksum Error in Message Example

The following example shows the ADVIA Centaur XPT detecting a checksum error in the received message and responding with a not acknowledge message. The LAS increments the sequence number and sends another message. The ADVIA Centaur XPT acknowledges the command and communications occur normally after that point.

Table 35: Checksum error in received message with not acknowledge response

Line Direction	Message	Description
LAS ⟹ Analyzer	F0 01 80 38 31 F8	Communications Test Command (80)
	F0 01 80 3A 31 F8	
		analyzer receives
Analyzer ⟹ LAS	15	Not ACKnowledge (NAK)
LAS ⟹ Analyzer	F0 02 80 38 32 F8	Resend Communications Test Command (80)
Analyzer ⟹ LAS	06	ACKnowledge
Analyzer ⟹ LAS	F0 01 C0 43 31 F8	Communications Test Response (C0)
LAS ⟹ Analyzer	06	ACKnowledge

Note If the Enhanced Protocol is used, no acknowledgment (ACK or NACK) will be sent for a checksum error. The sender will time out.

Sample Processing Sequence Example

In the following example, a set of sample tubes arrive at the LAS. The sample tubes have SIDs of SID1, SID16, SID8, and SID9. Refer to *Commands and Responses*, page 182, for more details about messages.

The system is ready to process, the Enhanced Protocol is enabled, and the LAS has been set to online.

The following is a typical initialization sequence.

Table 36: Initialization sequence

Line Direction	Message	Description
LAS ⟹ Analyzer	F0 02 80 38 32 F8	Communications Test Command
Analyzer ⟹ LAS	06 80	ACKnowledge
Analyzer ⟹ LAS	F0 01 C0 43 31 F8	Communications Test Response (CO)
LAS ⟹ Analyzer	06 C0	ACKnowledge
LAS ⟹ Analyzer	F0 01 B4 42 35 F8	Send Test Map Command

Line Direction	Message	Description
Analyzer ⇒ LAS	06 B4	ACKnowledge
Analyzer ⇒ LAS	F0 01 AE 01 42 30 F8	Send Test Map Response
LAS ⇒ Analyzer	06 AE	ACKnowledge
Analyzer ⇒ LAS	F0 01 BF 46 36 3b 47 45 4e 54 fd 31 38 3b 57 65 74 57 61 73 68 32 fd 32 34 3b 57 65 74 57 61 73 68 33 fd 33 33 3b 73 61 6d 70 6c 69 6e fd 33 35 3b 4f 56 fd 35 34 3b 54 53 48 fd 36 30 3b 41 46 50 fd 36 36 3b 44 52 59 fd 37 37 3b 57 65 74 57 61 73 68 31 fd 37 38 3b 57 65 74 57 61 74 65 72 fd 41 46 f8	Test Map Command
LAS ⇒ Analyzer	06 BF	ACKnowledge
LAS ⇒ Analyzer	F0 01 E9 01 45 42 F8	Test Map Response
Analyzer ⇒ LAS	06 E9	ACKnowledge
LAS ⇒ Analyzer	F0 01 B3 42 34 F8	Send Reagent Status Command
Analyzer ⇒ LAS	06 B3	ACKnowledge
Analyzer ⇒ LAS	F0 01 C5 01 43 37 F8	Send Reagent Status Response
LAS ⇒ Analyzer	06 C5	ACKnowledge
Analyzer ⇒ LAS	F0 01 B5 50 57 32 FD 01 50 31 30 30 3B 36 FD 44 43 F8	Detailed Reagent Status Command
LAS ⇒ Analyzer	06 B5	ACKnowledge
LAS ⇒ Analyzer	F0 01 AF 01 42 31 F8	Detailed Reagent Status Response
Analyzer ⇒ LAS	06 AF	ACKnowledge
LAS ⇒ Analyzer	F0 01 96 39 37 F8	Send Detailed Status Command
Analyzer ⇒ LAS	06 96	ACKnowledge
Analyzer ⇒ LAS	F0 01 97 01 39 39 F8	Send Detailed Status Response

Line Direction	Message	Description
LAS ⇒ Analyzer	06 97	ACKnowledge
Analyzer ⇒ LAS	F0 01 98 03 72 76 38 34 F8	Detailed Status Command
LAS ⇒ Analyzer	06 98	ACKnowledge
LAS ⇒ Analyzer	F0 01 99 01 39 42 F8	Detailed Status Response
Analyzer ⇒ LAS	06 99	ACKnowledge

The ADVIA Centaur XPT is now initialized. The LAS sends the Reset Queue command to the ADVIA Centaur XPT.

Table 37: LAS Reset Queue command

Line Direction	Message	Description
LAS ⇒ Analyzer	F0 01 84 38 35 F8	Reset Queue Command
Analyzer ⇒ LAS	06 84	ACKnowledge
Analyzer ⇒ LAS	F0 01 C4 01 43 36 F8	Reset Queue Response
LAS ⇒ Analyzer	06 C4	ACKnowledge

Sample SID1 arrives at the entrance to the queue. The LAS sends the Add Tube command to the ADVIA Centaur XPT.

Table 38: LAS Add Tube command

Line Direction	Message	Description
LAS ⇒ Analyzer	F0 01 90 53 49 44 31 41 32 F8	Add Tube Command
Analyzer ⇒ LAS	06 90	ACKnowledge
Analyzer ⇒ LAS	F0 01 D0 01 44 32 F8	Add Tube Response
LAS ⇒ Analyzer	06 D0	ACKnowledge

Sample SID16 arrives at the entrance to the queue. The LAS sends the Add Tube command to the ADVIA Centaur XPT.

Table 39: LAS Add Tube command

Line Direction	Message	Description
LAS ⇒ Analyzer	F0 01 90 53 49 44 31 36 44 38 F8	Add Tube Command
Analyzer ⇒ LAS	06 90	ACKnowledge
Analyzer ⇒ LAS	F0 01 D0 01 44 32 F8	Add Tube Response
LAS ⇒ Analyzer	06 D0	ACKnowledge

The ADVIA Centaur XPT is ready to aspirate a sample from the sample tube, SID1.

Table 40: Ready to aspirate

Line Direction	Message	Description
Analyzer ⇒ LAS	F0 01 A4 41 35 F8	Send SID Command
LAS ⇒ Analyzer	06 A4	ACKnowledge
LAS ⇒ Analyzer	F0 01 E4 01 53 49 44 31 46 37 F8	Send SID Response
Analyzer ⇒ LAS	06 E4	ACKnowledge

Sample SID8 arrives at the entrance to the queue. The LAS sends the Add Tube command to the ADVIA Centaur XPT.

Table 41: LAS Add Tube command

Line Direction	Message	Description
LAS ⇒ Analyzer	F0 01 90 53 49 44 38 41 39 F8	Add Tube Command
Analyzer ⇒ LAS	06 90	ACKnowledge
Analyzer ⇒ LAS	F0 01 D0 01 44 32 F8	Add Tube Response
LAS ⇒ Analyzer	06 D0	ACKnowledge

The ADVIA Centaur XPT completes sampling of the first sample tube, SID1, and sends the Index Queue command to the LAS. The ADVIA Centaur XPT expects the second sample tube, SID16, to be at the sample access position when the index is completed.

Table 42: Sampling of first sample tube

Line Direction	Message	Description
Analyzer ⇒ LAS	F0 01 A0 41 31 F8	Index Queue Command
LAS ⇒ Analyzer	06 A0	ACKnowledge
LAS ⇒ Analyzer	F0 01 E0 01 53 49 44 31 36 32 39 F8	Index Queue Response
Analyzer ⇒ LAS	06 E0	ACKnowledge

The final sample tube, SID9, arrives at the entrance to the queue. The LAS sends the Add Tube command to the ADVIA Centaur XPT.

Table 43: Final sample tube arrival

Line Direction	Message	Description
LAS ⇒ Analyzer	F0 01 90 53 49 44 39 41 41 F8	Add Tube Command
Analyzer ⇒ LAS	06 90	ACKnowledge
Analyzer ⇒ LAS	F0 01 D0 01 44 32 F8	Add Tube Response
LAS ⇒ Analyzer	06 D0	ACKnowledge

The ADVIA Centaur XPT completes sampling of the second sample tube, SID16, and sends the Index Queue command to the LAS. The ADVIA Centaur XPT expects the third sample tube, SID8, to be at the sample access position when the index is completed.

Table 44: Sampling of second sample tube

Line Direction	Message	Description
Analyzer ⇒ LAS	F0 01 A0 41 31 F8	Index Queue Command
LAS ⇒ Analyzer	06 A0	ACKnowledge
LAS ⇒ Analyzer	F0 01 E0 01 53 49 44 38 46 41 F8	Index Queue Response
Analyzer ⇒ LAS	06 E0	ACKnowledge

The ADVIA Centaur XPT completes sampling of the third sample tube, SID8, and sends the Index Queue command to the LAS. The ADVIA Centaur XPT expects the fourth sample tube, SID9, to be at the sample access position when the index is completed.

Table 45: Sampling of third sample tube

Line Direction	Message	Description
Analyzer ⇒ LAS	F0 01 A0 41 31 F8	Index Queue Command
LAS ⇒ Analyzer	06 A0	ACKnowledge
LAS ⇒ Analyzer	F0 01 E0 01 53 49 44 39 46 42 F8	Index Queue Response
Analyzer ⇒ LAS	06 E0	ACKnowledge

The ADVIA Centaur XPT completes sampling of the fourth sample tube, SID9, and sends the Index Queue command to the LAS. The ADVIA Centaur XPT does not expect a sample tube to be at the sample access position when the index is completed. The sample run is completed.

Table 46: Sampling of fourth sample tube

Line Direction	Message	Description
Analyzer ⟹ LAS	F0 01 A0 41 31 F8	Index Queue Command
LAS ⟹ Analyzer	06 A0	ACKnowledge
LAS ⟹ Analyzer	F0 01 E0 02 45 33 F8	Index Queue Response
Analyzer ⟹ LAS	06 E0	ACKnowledge

4 LAS Troubleshooting

Invalid Test Order

The system receives a valid order for a test. The accepted worklist entry does not display at the Worklist – Summary window.

Possible Cause: Master Curve

At the Calibration – Summary window, the Master Curve status of the test is **No Master Curve**. This indicates that test definitions are installed, but the Master Curve data is not entered. An inactive or undefined test request is accepted and these tests display at the Worklist – Schedule window.

Solution

Enter Master Curve data for the required test.

Do not request inactive or undefined tests.

Rejected Test Order for Patient Sample

The system rejects an order for a test on a patient sample.

Possible Causes and Solutions

This section identifies the possible causes and solutions for rejected test orders for patient samples.

Table 47: Causes and solutions for rejected test orders

Possible Cause	Solution
The order record does not contain the Sample ID (SID) or the Rack ID. The SID or the Rack ID is required.	Enter the SID or the Rack ID for the patient sample in the order record.
For a control-bracketed test, the order record does not contain the SID. Control-bracketed tests require an SID in the order record.	Enter the SID for the patient sample in the order record.
The patient SID entered is the same as the SID defined for a control or a calibrator.	Check the SID for the patient sample. Edit the SID in the worklist so that it is not the same as the SID for the control or the calibrator.

Message Received Caused Fatal Parse Error

The message received by the system caused a fatal parse error. The event logged is for an unexpected sequence number, but the sequence number for the record is correct.

Possible Cause: Carriage Return

An application layer record does not terminate with a carriage return (<CR>). If a <CR> is absent, the next record appends to the previous record and the system misinterprets the rest of the message structure.

Solution

Terminate each application layer record with a <CR>.

Unexpected Data Received in Response to a Query

The remote system received unexpected data from the system in response to a query.

Possible Cause: Query Record

The query record is invalid. The following figures show examples of invalid and valid query records.

The following figure shows a query record with a missing component delimiter. A component delimiter should precede the Sample ID in the Starting Range ID Number field. In this example, the Sample ID is interpreted as a Patient ID.

Q|1|SID10768| |ALL| | | | | | | |O<CR>

The following figure shows the same query record with the missing component delimiter added.

Q|1|^SID10768| |ALL| | | | | | | |O<CR>

The following figure shows a list and a range for the same field. Do not mix lists and ranges. The remote system interprets this query as one closed range of PID 1000000 to PID 199999 that includes REQ1241 and two open-ended ranges that begin with REQ4464 and REQ4465.

Q|1|PID100000^REQ1241\^REQ4464\^REQ4465|PID199999|ALL| | | |
| | | |O<CR>

The following figure shows the same query record with a valid list.

Q|1|^REQ1241\^REQ4464|^REQ1241\^REQ4465|ALL| | | | | | | |O<CR>

The following figure shows the same query record with a valid range.

Q|1|PID100000|PID199999|ALL| | | | | | | |O<CR>

The following figure shows a query record with an unsupported Request Information Status Code field. The system does not support the ASTM option of returning only demographic data. The system replies to the query shown in the example with a header record and a termination record with a value of **Q** in the Termination Code field.

Q|1|PID1123| |ALL| | | | | | | |D<CR>

The following figure shows the same query record with a supported Request Information Status Code field.

Q|1|PID1123| |ALL| | | | | | | |O<CR>

Solution

Review the protocol for query records and revise the record. Refer to Section 3, *Implementation of ASTM Protocol,* for more information about the query record.

Delay Between Messages Sent by the System

There is a long time between messages sent by the system.

Possible Causes and Solutions

This section identifies the possible causes and solutions for delays between messages sent by the system. To analyze the problem and find the possible cause, check the communication status and event screens for data link, incoming, and outgoing messages.

Table 48: Causes and solutions for message delays

Possible Cause	Solution
The remote system does not terminate its query responses with an **F**, **Q**, or **I** code in the Termination Code field of the termination record.	Always terminate queries with the appropriate termination code.
The connecting port on the remote system is not enabled.	Enable the connecting port on the remote system.
The remote system is not terminating its last session at the data link layer.	Always use a terminate session message to relinquish line control when a session is complete.
The cable between the system and the remote system is not correctly connected.	Correctly connect the cable. Refer to Section 3, *Implementation of ASTM Protocol,* for more information about the physical layer.
The cable between the system and the remote system is damaged.	Refer to Section 3, *Implementation of ASTM Protocol*, for more information about the electrical characteristics. Check the continuity of the wires with a breakout box. Replace the cable if necessary.
The system and the remote system communication parameters do not match.	Check for multiple character errors. Ensure that the settings at the Setup – LIS Communication window match the remote system configuration.

Incremental Worklist is Malfunctioning

The incremental worklist request option is malfunctioning.

Possible Causes and Solutions

This section identifies the possible causes and solutions for incremental worklist malfunctioning.

Table 49: Causes and solutions for incremental worklist malfunctioning

Possible Cause	Solution
The System Automatically Queries Host for Worklist option is not enabled.	Select **System Automatically Queries Host for Worklist** at the Setup – LIS Communications window.
The remote system is not using Specimen IDs in its responses to incremental queries.	The remote system must use valid Specimen IDs in its order records.
The system is misinterpreting the rack barcodes.	Check and correct the settings at the Setup – Tube Type & Barcode window.

Incremental Result Reporting is Malfunctioning

The incremental result reporting is malfunctioning.

Possible Causes and Solutions

This section identifies the possible causes and solutions for incremental result reporting malfunctioning.

Table 50: Causes and solutions for incremental result reporting malfunctioning

Possible Cause	Solution
The results are not reportable. Only final results for control and patient samples with Sample IDs (SIDs) that do not have a **Signal Error** or a **No Calculation**, flag are reported.	Correct the conditions causing the flags and use SIDs in the worklist.
The System Automatically Sends All Results except Results on Hold option for result reporting is not enabled.	Select **System Automatically Sends All Results except Results on Hold** at the Setup – LIS Communications window.
The system is holding test results for operator review and release.	Release the results.

No Communications at All

The system and the LIS are not communicating.

Possible Causes and Solutions

This section identifies the possible causes and solutions for no communications at all.

Table 51: Causes and solutions for no communications

Possible Cause	Solution
The cable is connected to the wrong port.	Connect the cable to the LIS port.
The cable between the system and the remote system is not correctly connected.	Correctly connect the cable.
The system and the remote system communication parameters do not match.	Ensure that the settings for the system and the remote system match.
The cable between the system and the remote system is damaged.	Refer to Section 3, *Implementation of ASTM Protocol*, for more information about the electrical characteristics. Check the continuity of the wires with a breakout box. Replace the cable if required.
The port is malfunctioning.	Call for technical assistance.
The connecting port on the remote system is not enabled.	Enable the connecting port on the remote system.

5 LIS Troubleshooting

This section of the guide addresses troubleshooting for the LIS ASTM protocol.

Delays in Automatic Worklist Requests

When using automatic worklist requests, there are wide gaps between cuvettes in the track because each query from the system about a sample ID is separated by 1 or more minutes.

Possible Cause: Termination Record

Although the LIS responds to the query, it does not close the query. When the last message in response to a query is sent, the termination record should have a value of **F** in the Termination Code field. The system waits for a termination record with a value of **F**, **Q**, or **I** in the Termination Code field or waits until the query timer expires before issuing the next query. The **Query Timeout** field at the **Setup – LIS Configuration** window is typically set to 30 seconds and cannot be set to less than 1 second.

The following figure gives an example of an incorrect termination record. Note the absence of an **F** value in the Termination Code field in the termination record of the response from the LIS. In this example, if the LIS completes the response to a query from the system and the query timeout on the system is 5 minutes, then the system does not automatically query for the next sample until the 5 minutes elapses.

Figure 1: Incorrect Termination Record Example

```
System                                                        LIS

H|\^&| | | | | | | | | |P|1<CR>  ------------------------------>
Q|1|^REQ1241| |ALL| | | | | | | |O<CR>  ------------------------>
L|1<CR>  ------------------------------------------------------>
<-------------------------------------------------- H|\^&<CR>
P|1| PID456 | | | Jones^Alan^B | | 19560521 | M | | | | | MD ID 64 | | | | | | | | | | | WARD
<---------------------------------------------------------- 7<CR>
<------ O|1|REQ1241| |^^^T4\^^^TU\^^^fti|R| | | | | | | | | | | | | | | | | | | |O\Q  <CR>
<---------------------------------------------------------- L|1<CR>
```

Solution

Use a value of **F** in the Termination Code field of the termination record that closes the sequence of messages sent to the system in response to each query.

L|1|F<CR>

Possible Cause: LIS Response to the Query

The LIS responds very slowly to each query from the system.

Solution

Contact the LIS Administrator to check the parameters at the LIS.

Cancelled Worklist Requests

An operator requests a worklist, but the system cancels the query before it is complete.

Possible Cause: Query Timeout

The query timeout is too short or the LIS does not indicate that order records were sent in response to a query. A value of **O\Q** in the Report Type field of an order record indicates that the record is requesting tests in response to a query. The system resets the query timer every time it encounters a value of **Q** in the Report Type field of an order record. The system ignores all received result records. Each time the query timer expires, the system sends a message to the LIS, canceling the query.

LIS queries for a large quantity of results from the system does not require a long timeout if **Q** values are processed. The system sends the first result to a query within 5 minutes using Patient ID, Sample ID, Test Name, and Results Date with a system that has nearly full demographic and result databases.

The following figure shows an order record missing a **Q** in the Report Type field. In the example, the response from the LIS contains an **O** instead of **O\Q** value in the Report Type field in the order record. If the response from the LIS requires more than 5 minutes to complete and the query timeout is set to 5 minutes, the query timer expires and the system sends a query cancellation to the LIS.

Figure 2: Query for Order

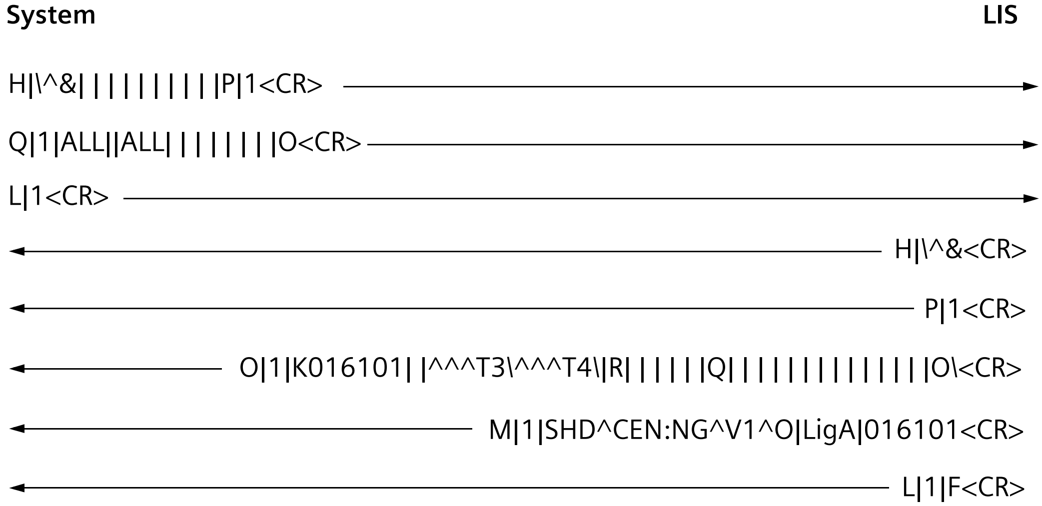
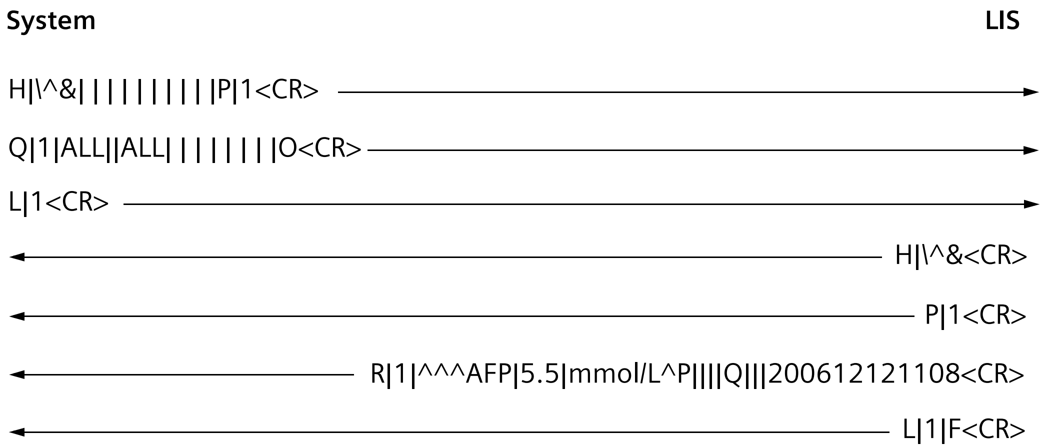


Figure 3: Query for Result



Solution

Replace **O** with **O\Q** in Report Type field of order record and in Result Status field of result record.

Invalid Test Order

The system receives a valid order for a test. The accepted worklist entry does not display at the **Test Results > Overview** window.

Possible Cause: Test is Inactive

The test has not been activated from the test definition screen.

Solution

Open the event log for additional details.

At the test definition screen, activate the test.

Do not request inactive or undefined tests.

Rejected Test Request for Control Sample

The system rejects a request for a test on a control sample.

Possible Cause: SID

The SID (Sample ID) field of the order record and the Control Name and Control Lot Number fields of the manufacturer's order record do not match the corresponding fields of a valid control definition on the system.

Solution

The system transmits a comment record explaining this condition to the LIS. Compare the responses from the system to the messages from the LIS.

Rejected Test Order for Patient Sample

The system rejects an order for a test on a patient sample.

Possible Causes and Solutions

This section identifies the possible causes and solutions for rejected test orders for patient samples.

Possible Cause	Solution
The order record does not contain the Sample ID (SID) or the Rack ID. The SID or the Rack ID is required.	Enter the SID or the Rack ID for the patient sample in the order record.
For a control-bracketed test, the order record does not contain the SID. Control-bracketed tests require an SID in the order record.	Enter the SID for the patient sample in the order record.
The patient SID entered is the same as the SID defined for a control or a calibrator.	Check the SID for the patient sample. Edit the SID in the worklist so that it is not the same as the SID for the control or the calibrator.
The SID is in use by a QC sample or calibrator.	Specify a different Sample ID.

Possible Cause	Solution
The Rack ID is in use by an active sample.	Do not specify a Rack ID or specify a different Rack ID and position.
The Rack ID was specified but a rack position was not specified.	Specify a Rack ID and position.

Test Results Transmitted with Wrong Test Name

The system sent the incorrect test name for the selected test results for a particular test.

Possible Cause: LIS Code

The LIS Code defined for the test is used in place of the test name in the Universal Test ID field of the result record. The LIS expects test names, not LIS codes.

Solution

Check the LIS Code in the test definition. Enter the correct LIS code.

Message Received Caused Fatal Parse Error

The message received by the system caused a fatal parse error. The event logged is for an unexpected sequence number, but the sequence number for the record is correct.

Possible Cause: Incorrect Sequence Number

An incorrect sequence number is sent with the application layer record.

Solution

Contact the LIS Administrator to check the LIS format.

Invalid ASTM Record Type Received

Only some of the information in a patient record received by the system displays in the worklist, and the Event Log shows the system received an invalid ASTM record type.

Possible Cause: Inactive Tests

Not all of the tests in the patient order record are active.

Solution

Verify the status of the tests in the patient order record at the **Test – Summary window**. Activate the test if necessary.

Possible Cause: Transmission Interference

The system received invalid records due to transmission interference.

Solution

The cable between the system and the LIS is damaged. Check the continuity of the wires. Replace the cable if necessary.

Possible Cause: Carriage Return

A carriage return (<CR>) is embedded in the demographic data in the fields of the patient record. This truncates the application layer record, and the system interprets the remainder as another record. The application layer level uses a <CR> to terminate an application layer record. If required elsewhere in any record, use ASTM escape sequences.

Solution

Remove the <CR> from the demographic data fields of the patient record. Use ASTM escape sequences for any required carriage returns.

Unexpected Data Received in Response to a Query

The LIS received unexpected data from the system in response to a query.

Possible Cause: Query Record

The query record is invalid. The following figures show examples of invalid and valid query records.

The following shows a query record with a missing component delimiter. A component delimiter should precede the Sample ID in the Starting Range ID Number field. In this example, the Sample ID is interpreted as a Patient ID.

Q|1|SID10768| |ALL| | | | | | | |O<CR>

The following shows the same query record with the missing component delimiter added.

Q|1|^SID10768| |ALL| | | | | | | |O<CR>

The following shows a list and a range for the same field. Do not mix lists and ranges. The LIS interprets this query as 1 closed range of PID 1000000 to PID 199999 that includes REQ1241 and 2 open-ended ranges that begin with REQ4464 and REQ4465.

Q|1|PID100000^REQ1241\^REQ4464\^REQ4465|PID199999|ALL| | | | | | | |O<CR>

The following shows the same query record with a valid list.

Q|1|^REQ1241\^REQ4464|^REQ1241\^REQ4465|ALL| | | | | | | |O<CR>

The following shows the same query record with a valid range.

Q|1|PID100000|PID199999|ALL| | | | | | | |O<CR>

The following shows a query record with an unsupported Request Information Status Code field. The system does not support the ASTM option of returning only demographic data. The system replies to the query shown in the example with a header record and a termination record with a value of **Q** in the Termination Code field.

Q|1|PID1123| |ALL| | | | | | | |D<CR>

The following shows the same query record with a supported Request Information Status Code field.

Q|1|PID1123| |ALL| | | | | | | |O<CR>

Solution

Review the protocol for query records and revise the record. Refer to *Chapter 2, Laboratory Information System*, for more information about the query record.

Delay Between Messages Sent by the system

There is a long time between messages sent by the system.

Possible Causes and Solutions

This section identifies the possible causes and solutions for delays between messages sent by the system. To analyze the problem and find the possible cause, check the communication status and LIS log for data link, incoming, and outgoing messages.

Possible Cause	Solution
The LIS does not terminate its query responses with an **F**, **Q**, or **I** code in the Termination Code field of the termination record.	Always terminate queries with the appropriate termination code.
The connecting port on the LIS is not enabled.	Enable the connecting port on the LIS.
The LIS is not terminating its last session at the data link layer.	Always use a terminate session message to relinquish line control when a session is complete.
The cable between the system and the LIS is not correctly connected.	Correctly connect the cable. Refer to *Chapter 2, Laboratory Information System*, for more information about the physical layer.
The cable between the system and the LIS is damaged.	Refer to *Chapter 2, Laboratory Information System*, for more information about the electrical characteristics. Check the continuity of the wires with a breakout box. Replace the cable if necessary.
The system and the LIS communication parameters do not match.	Check for multiple character errors. Ensure that the settings at the **Setup – LIS Configuration** window match the LIS configuration.

Result Reporting is Malfunctioning

The result reporting is malfunctioning.

Possible Causes and Solutions

This section identifies the possible causes and solutions for result reporting malfunctioning.

Possible Cause	Solution
The results are not reportable. Only final results for control and patient samples with Sample IDs (SIDs) that do not have a **Signal Error** or a **No Calculation**, flag are reported.	Correct the conditions causing the flags and use SIDs in the worklist.
The **Automatically Send All Patient Results Except Results on Hold** option for result reporting is not enabled.	Select **Automatically Send All Patient Results Except Results on Hold** at the **Setup – LIS Configuration** window.
The system is holding test results for operator review and release.	Release the results.
QC result settings not selected.	Enable QC result settings.
The option to **Send All Results Per Sample** is selected and a test is not complete.	Wait until all tests are complete.

Cannot Start LIS Communication

The system and the LIS are not communicating.

Possible Causes and Solutions

This section identifies the possible causes and solutions for LIS communication issues.

Possible Cause	Solution
The cable is connected to the wrong com-port. (ASTM only)	Connect the cable to the proper com-port.
The wrong protocol is selected.	Select proper protocol at the **Setup – LIS Configuration** window.

Possible Cause	Solution
The network cable between the system and the LIS is not connected correctly. (TCP/IP and ASTM)	If the communication channel is TCP/IP, check the network cable. Ensure that the network cable is connected correctly.
The system and the LIS communication parameters do not match.	Ensure that the settings at the **Setup – LIS Configuration** window match the LIS configuration.
The cable between the system and the LIS is damaged.	Replace the cable.
The LIS port is malfunctioning.	Call for technical assistance.
The connecting port on the LIS is not enabled.	Enable the connecting port on the LIS.
LIS connection is not enabled.	Enable LIS and bring the LIS online.
The active database, the historical database, or both databases are full to capacity.	Delete samples from the historical database.
Incorrect physical layer setting. (ASTM only)	Select proper physical layer.
Incorrect protocol selected.	Select appropriate protocol.
Incorrect physical layer selected. (ASTM only)	Select proper physical layer.
Incorrect port configuration.	Configure port to match LIS.
Incorrect IP address specified.	Specify LIS IP address.
Incorrect port specified.	Specify port used by LIS.
No network connection.	Establish network connection.
Serial cable not null modem. (ASTM only)	Attach null modem.

6 Messages

This appendix shows examples of system and LIS messages from the data link and application layers.

LIS Messages

Automatic Worklist Request and Response for a Patient Sample

The following example shows an automatic worklist request and response for a patient sample. In this example, the **O\Q** value in the order record of the LIS reply, indicates a worklist entry that is transmitted to the system in response to a query. The absence of **F** in the termination record indicates that this is not the last item in response to the query and no additional queries are sent.

System ***LIS***

```
H|\^&|||ADVCNT_LIS||||LIS_ID||P|1<CR>
Q|1|^P0650||ALL||||||||O<CR>
L|1<CR>
H|\^&<CR>
P|1|20|||Jones^Alan^B||19560519|M|||||Jones^Alan^B|||||||||||General_Ward<CR>
O|1|REQ1241||^^^T4\^^^TU\^^^fti|R||||||||||||||||||||O\Q  <CR>
```

Figure 4: **Automatic worklist request and response for patient sample**

Automatic Worklist Request and Response for a Control Sample

The following example shows an automatic worklist request and response for a control sample. In this example, the presence of **F** in the termination record indicates that this is the last item in response to the query.

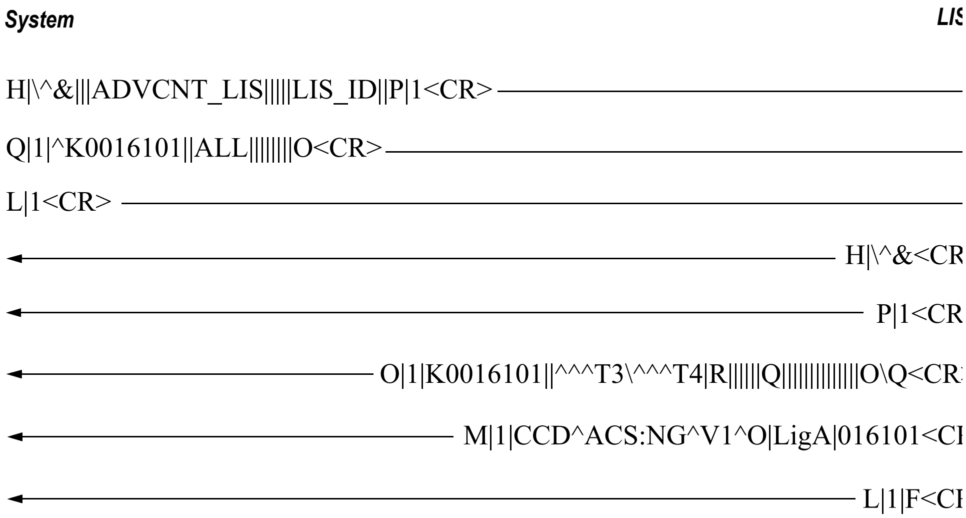


Figure 5: **Automatic worklist request and response for control sample**

Automatic Worklist Request and Response with No Demographic or Pending Test Information

The following example shows an automatic worklist request and response when the remote system has no demographic or pending test information. The request specifies sample ID SID10768. In this example, the presence of **I** in the termination record from the LIS indicates that no information is available to send in response to the query.

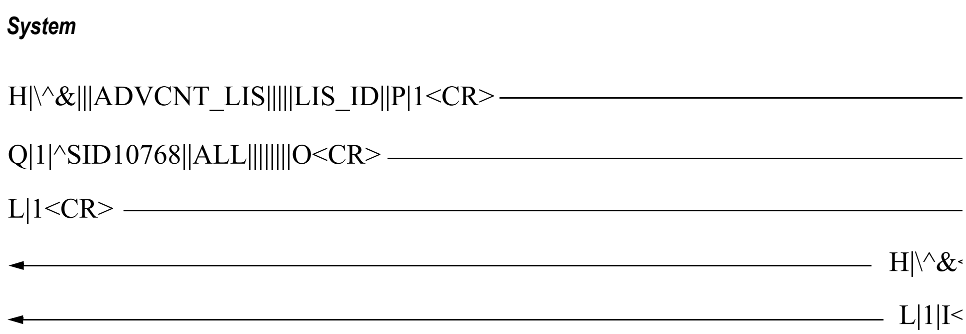


Figure 6: Automatic worklist request and response with no demographic or pending test information

Operator-Initiated Worklist Query

System

```
H|\^&|||ADVCNT_LIS|||||LIS_ID||P|1<CR>
Q|1|ALL||ALL||||||||O<CR>
L|1<CR>
H|\^&|||LIS_ID|||||ADVCNT_LIS<
P|1|PID1123|||Peters^Cassie||19721221|F|||||DR1265A<
O|1|REQ1241||^^^T3\^^^T4\^^^TSH|R||||||||||||||||||||O\Q<
O|2|REQ1241||^^^HCG|R||||||||||||||||||||O\Q<

O|2|REQ4465||^^^PSA|R||||||||||||||||||||O\Q<
```

Figure 7: Operator-initiated worklist query

LIS Query for a Worklist with a Single Value

System

```
H|\^&|||LIS_ID|||||ADVCNT_LIS<
Q|1|PID1123^REQ1241|1123^REQ1241||||||||O<
L|1<
H|\^&|||ADVCNT_LIS|||||LIS_ID||P|1<CR>
P|1|PID1123|||Peters^Cassie||19721221|F|||||DR1265A<CR>
O|1|REQ1241||^^^T3\^^^T4\^^^TSH\^^^ThCG|R||||||||||||||||||||O\Q<CR>
L|1|F<CR>
```

Figure 8: LIS query for worklist with a single value

LIS Query for a Worklist with an Open-Ended Range

The following example shows an LIS query for a worklist that is an open-ended range. All worklist entries with an SID greater than REQ1241 are in response to the query. Note that the system sends worklist entries with the same Patient ID and a different Sample ID in separate patient and order record pairs.

System

```
<──────────────────────────────── H|\^&|||LIS_ID|||||ADVCNT_LIS
<──────────────────────────────────── Q|1|^REQ1241||ALL|||||||O
<────────────────────────────────────────────────────── L|1<
H|\^&|||ADVCNT_LIS|||||LIS_ID||P|1<CR> ──────────────────────
P|1|PID1123|||Peters^Cassie||19721221|F|||||DR1265A<CR> ────────
O|1|REQ1241||^^^T3\^^^T4\^^^TSH\^^^ThCG|R|||||||||||||||||O\Q<CR> ──────
P|2|PID4423|||Jacobs^Hal^M||19660822|M||||DR4267J||||||||| ||WARD 3<CR> ───
O|1|REQ4464||^^^CEA|R|||||||||||||||||O\Q<CR> ──────────────────
O|2|REQ4465||^^^PSH|R|||||||||||||||||O\Q<CR> ──────────────────
L|1|F<CR> ──────────────────────────────────────────────────
```

Figure 9: LIS query for worklist with open-ended range

LIS Query for a Worklist with Multiple Open Ranges

The following example shows an LIS query for a worklist with multiple open ranges. Note that the system treats components of the Starting Range ID Number field of the query record as independent ranges. Each component present in the first instance of the field determines the lower bound of a range for that component. The Patient ID and the Sample ID are present in the first repeat of the Starting Range ID Number field, which creates a Patient ID range and a Sample ID range.

The system returns a worklist entry that is in the range defined by the Patient ID and the Sample ID from the first instance of the field. The system selects a worklist entry that belongs in at least one of the ranges defined by the values in the list specified by the query.

For example, the system does not return a worklist entry with a Sample ID of SID0465 because the SID is out of the range specified in the query.

System

```
<———————————— H|\^&|||LIS_ID|||||ADVCNT_LIS
<———————————— Q|1|PID2121^SID4464\PID2889^SID4465||ALL|||||||O<
<———————————— L|1<
H|\^&|||ADVCNT_LIS|||||LIS_ID||P|1<CR> ————————————
P|1|PID2889|||Posner^Carrie||19701109|F<CR> ————————————
O|1|SID4464||^^^T3\^^^T4\^^^TSH\^^^ThCG|R||||||||||||||||||O\Q<CR> ————————————
L|1|F<CR> ————————————
```

Figure 10: **No worklist entry returned for out-of-range SID**

LIS Query for a Worklist with a Closed Range

The following example shows an LIS query for a worklist with a closed range.

System

```
<———————————— H|\^&
<———————————— Q|1|^REQ4400|^REQ4499|ALL|||||||O
<———————————— L|1<
H|\^&||||||||||P|1<CR> ————————————
P|1|PID4423|||Jacobs^Hal^M||19660822|M|||||DR4267J|||||||||| ||WARD 3<CR> ————————————
O|1|REQ4464||^^^CEA|R|||||||||||||||||O\Q<CR> ————————————
L|1|F<CR> ————————————
```

Figure 11: LIS query for worklist with closed range

LIS Cancellation of a Scheduled Test

The following example shows a cancellation by an LIS of a scheduled test for a specific sample.

Figure 12: LIS test cancellation for a specific sample

Automatic Result Reporting

The following example shows automatic result reporting.

```
H|\^&|||ADVCNT_LIS|||||LIS_ID||P|1<CR>----------------------------
------◊
P|1|PID4423|||Jacobs^Hal^M||19660822|M||||DR4267J||||||
|||||WARD 3<CR>-◊
C|1||Repeat draw.|G<CR>-------------------------------------------
------------------◊
O|1|REQ4464||^^^CEA|R||||||||||||||||||||F<CR>--------------------
------◊
R|1|^^^CEA^^^1^DOSE|6.62|ng/mL||H||F||||199209270807<CR>----------
----------------------------------◊
C|1|I|Repeated|I<CR>----------------------------------------------
------◊
C|2|I|Above Check|I<CR>-------------------------------------------
------------------◊
R|2|^^^CEA^^^1^COFF|1.00|ng/mL||||F||||199209270807<CR>-----------
----------------------------------◊
C|1|I|Repeated|I<CR>----------------------------------------------
------◊
C|2|I|Above Check|I<CR>-------------------------------------------
------------------◊
R|3|^^^CEA^^^1^RLU|36632|||||F||||199209270807<CR>----------------
------◊
C|1|I|Repeated|I<CR>----------------------------------------------
------◊
C|2|I|Above Check|I<CR>-------------------------------------------
------------------◊
```

```
L|1<CR>--------------------------------------------------------------
------◊
```

Figure 13: Automatic result reporting

Operator-Initiated Transmission of Results

The following example shows an operator-initiated transmission of results from the system.

System

```
H|\^&|||ADVCNT_LIS|||||LIS_ID||P|1<CR>
P|1|PID1123|||Peters^Cassie||19721221|F|||||DR1265A<CR>
O|1||REQ124||^^^T4\^^^T3\^^^TU\^^^ThCG|R||||||||||||||||| ||||F<CR>
R|1|^^^T4^^^1^DOSE|5.8|ug/dL||||F||||199209270807<CR>
R|2|^^^T4^^^1^COFF|1.0|ug/dL||||F||||199209270807<CR>
R|3|^^^T4^^^1^RLU|54688|||||F||||199209270807<CR>
R|4|^^^T3^^^1^DOSE|1.27|ng/mL|||||F||||199209270807<CR>
R|5|^^^T3^^^1^COFF|1.00|ng/mL||||F||||199209270807<CR>
R|6|^^^T3^^^1^RLU|14527|||||F||||199209270807<CR>
R|7|^^^TU^^^1^DOSE|11.626|uIU/mL||||F||||199209270808<CR>
R|8|^^^TU^^^1^COFF|21.00|uIU/mL|||||F||||199209270808<CR>
R|9|^^^TU^^^1^RLU|337704|||||F||||199209270808<CR>
R|10|^^^ThCG^^^1^DOSE|4.2|mIU/mL||||F||||199709270808<CR>
R|11|^^^ThCG^^^1^COFF|1.0|mIU/mL||||F||||199709270808<CR>
R|12|^^^ThCG^^^1^RLU|24342||||F||||199709270808<CR>
L|1<CR>
```

Figure 14: Operator-initiated transmission of system results

LIS Query for Results by Starting Range

The following example shows an LIS query for results with a single value in the Starting Range ID Number field. The system transmits all results with a PID greater than or equal to PID1123 to the LIS.

System

```
H|\^&
Q|1|PID1123||ALL||||||||F
L|1
H|\^&|||ADVCNT_LIS|||||LIS_ID||P|1<CR>
P|1|PID1123|||Peters^Cassie||19721221|F|||||DR1265A<CR>
O|1|REQ1241||^^^T4\^^^T3\^^^TU\^^^ThCG|R|||||||||||||| ||||F<CR>
R|1|^^^T4^^^1^DOSE|5.8|ug/dL||||F\R||||199709270807<CR>
R|2|^^^T4^^^1^COFF|1.0|ug/dL||||F\R||||199709270807<CR>
R|3|^^^T4^^^1^RLU|54688|||||F\R||||199709270807<CR>
R|4|^^^T3^^^1^DOSE|1.27|ng/mL||||F\R||||199709270807<CR>
R|5|^^^T3^^^1^COFF|1.00|ng/mL||||F\R||||199709270807<CR>
R|6|^^^T3^^^1^RLU|14527|||||F\R||||199709270807<CR>
R|7|^^^TU^^^1^DOSE|11.626|uIU/mL||||F\R||||199709270808<CR>
R|8|^^^TU^^^1^COFF|21.00|uIU/mL||||F\R||||199709270808<CR>
R|9|^^^TU^^^1^RLU|337704|||||F\R||||199709270808<CR>
R|10|^^^ThCG^^^1^DOSE|4.2|mIU/mL||||F\R||||199709270808<CR>
R|11|^^^ThCG^^^1^COFF|1.0|mIU/mL||||F\R||||199709270808<CR>
R|12|^^^ThCG^^^1^RLU|24342|||||F\R||||199709270808<CR>
L|1|F<CR>
```

Figure 15: **LIS query for results with a single value in Starting Range ID Number field**

LIS Query for Results by Open Range and List of Tests

The following example shows an LIS query for results by specifying an open range on the SIDs and a list of tests. Note that the order of tests in the order record and the order of result records returned are not necessarily the same. Note the **F\R** in the Result Status field of the result records, which indicates final results, previously transmitted.

System

```
←———— H|\^&
←———— Q|1|^REQ1241||^^^T4\^^^T3\^^^TSH|||||||F
←———— L|1
H|\^&|||ADVCNT_LIS|||||LIS_ID||P|1<CR> ————
P|1|PID1123|||Peters^Cassie||19721221|F|||||DR1265A<CR> ————
O|1|REQ1241||^^^T4\^^^T3\^^^TSH|R|||||||||||||||||F<CR> ————
R|1|^^^T4^^^1^DOSE|5.8|ug/dL||||F\R||||199209270807<CR>————
R|2|^^^T4^^^1^COFF|1.0|ug/dL||||F\R||||199209270807<CR>————
R|3|^^^T4^^^1^RLU|54688|||||F\R||||199209270807<CR> ————
R|4|^^^T3^^^1^DOSE|1.27|ng/mL||||F\R||||199209270807<CR> ————
R|5|^^^T3^^^1^COFF|1.00|ng/mL||||F\R||||199709270807<CR> ————
R|6|^^^T3^^^1^RLU|14527|||||F\R||||199709270807<CR>————
R|7|^^^TSH^^^1^DOSE|11.626|uIU||||F\R||||199709270808<CR> ————
R|8|^^^TSH^^^1^COFF|21.00|uIU|||F\R||||199709270808<CR> ————
R|9|^^^TSH^^^1^RLU|337704|||||F\R||||199709270808<CR>————
L|1|F<CR> ————
```

Figure 16: LIS query for results by open range and a list of tests

LIS Query for Results by a Range of Dates

The following example shows an LIS query for results by a range of dates and times.

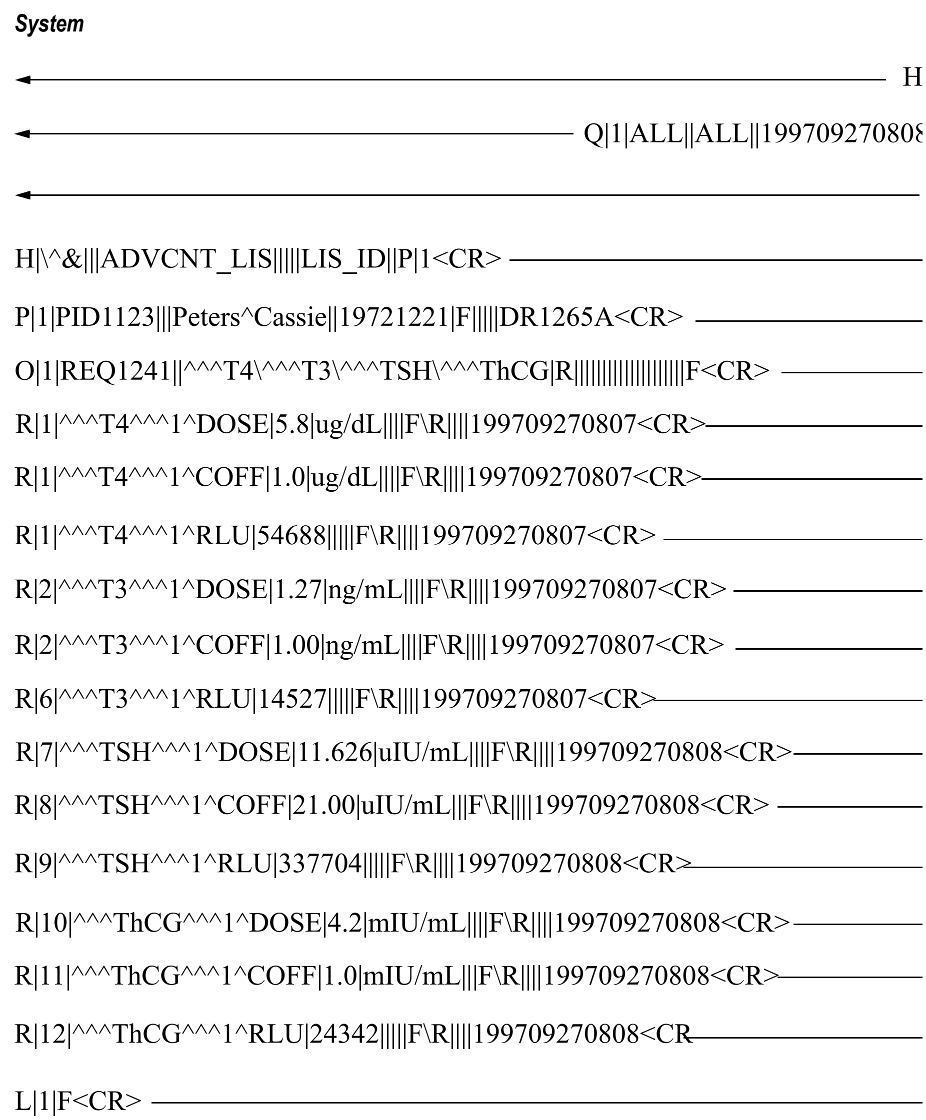


Figure 17: LIS query for results by range of dates and times

LAS Messages

System Response to a Query in Error

The following example shows a system response to an LIS query in error. Note that the value of the Request Information Status Code field of the query record is an option not supported by the system. Note also the value **Q** in the Termination Code field of the termination record.

System

← H|\^&

← Q|1|ALL||ALL||199709270807|199709270808|||||D

← L|1

H|\^&|||ADVCNT_LIS|||||LIS_ID||P|1<CR> →

L|1|Q<CR> →

Figure 18: **System response to LIS query in error**

System Response to an LIS Cancellation of Query

The following example shows the system response to an LIS cancellation of query. Note that the first query has no restrictions. If the result database is nearly full, the LIS could decide that the query timed out before the system responds with its first record.

System

← H|\^&

← Q|1|ALL||ALL|||||||F

← L|1

(Ten minutes pass. The operator of the LIS tires of waiting for data and cancels the qu
make a more selective query. Note the **A** in the Request Information Status Code field
second query record.)

Figure 19: System response to LIS cancellation of query

System Response to the LIS Cancellation of Query

The following example shows the system response when the LIS cancels a query in progress. The first query has the incorrect month for the Beginning Request Results Date field and the operator of the LIS observes that received data has incorrect dates. The operator of the LIS cancels the query with a query cancel. Note that after the query cancel, the remote system may receive some data before the response to the query is canceled. Note also the **R** in the Termination Code field of the termination record from the system.

System

```
H
Q|1|ALL||ALL||199708270800|19970927120

H|\^&|||ADVCNT_LIS|||||LIS_ID||P|1<CR>
P|1|PID1123|||Peters^Cassie||19721221|F|||||DR1265A<CR>
O|1|REQ1241||^^^T4\^^^T3\^^^TSH|R|||||||||||||||||F<CR>
R|1|^^^T4^^^1^DOSE|5.8|ug/dL||||F\R||||199708270807<CR>
R|2|^^^T4^^^1^COFF|1.0|ug/dL||||F\R||||199708270807<CR>
R|3|^^^T4^^^1^RLU|54688|||||F\R||||199708270807<CR>
R|4|^^^T3^^^1^DOSE|1.27|ng/mL||||F\R||||199709270807<CR>
R|5|^^^T3^^^1^COFF|1.00|ng/mL||||F\R||||199709270807<CR>
R|6|^^^T3^^^1^RLU|14527|||||F\R||||199709270807<CR>
H
Q|1|||||||

R|7|^^^TSH^^^1^DOSE|11.626|uIU/mL||||F\R||||199708270808<CR>
R|8|^^^TSH^^^1^COFF|21.00|uIU/mL||||F\R||||199708270808<CR>
R|9|^^^TSH^^^1^RLU|337704|||||F\R||||199708270808<CR>
L|1|R<CR>
```

Figure 20: System response to LIS cancellation of query

Transmissions from the system are preceded by **A:** and transmissions from the LIS are preceded by **L:**.

The following table shows the non-printable ASCII characters that are represented by ASCII mnemonics between angle brackets.

Table 1: Non-printable ASCII characters

Mnemonic	*Decimal Value*
<STX>	2
<ETX>	3
<EOT>	4
<ENQ>	5
<ACK>	6
<BEL>	7
<HT>	9
<LF>	10
<VT>	11
<CR>	13
<NAK>	21
<ETB>	23
<SP>	32

Diagnostic Message Transmitted from the System

The following example shows the transmission of a diagnostic test message from the system. Note that the application layer manufacturer's test record does not fit into a single data link layer frame. The system transmits the record as a data link layer intermediate frame and final frame. Note the <ETB>, which designates an intermediate frame. The system breaks application layer messages that contain more than 240 characters into one or more intermediate frames and a final frame.

A: <ENQ>

L: <ACK>

A:
<STX>1H|\^&|||ADVCNT_LIS|||||LIS_ID||P|1<CR>M|1|CCD^ACS:NG^V1^T|
&X00&&X01&&X02&&X03&&X04&&X05&&X06&&X07&&X08&&X0
9&&X0A&&X0B&&X0C&&X0D&&X0E&&C0F&&X10&&X11&&X12&
&X13&&X14&&X15&&X16&&X17&&X18&&X19&&X1A&&X1B&&X
1C&&X1D&&X1E&&X1F&!”#$%&E&’()*+,-./0123456<ETB>02<CR>
<LF>

L: <ACK>

A: <STX>2789:;<=>?@ABCDEFGHIJKLMNOPQRSTUVWXYZ[&R&]&S&
_’abcdefghijklmnopqrstuvwxyz{&F&}~&X7F<CR>L|1|N<CR><ETX>40
<CR> <LF>

L: <ACK>

A: <EOT>

Query for Orders from the System

The following example shows a query for orders from the system and the subsequent order from an LIS.

A: <ENQ>

L: <ACK>

A: <STX>1H|\^&|||ADVCNT_LIS|||||LIS_ID||P|1<CR><ETX>E5<CR><LF>Q|1|
REQ3051||ALL||||||||O<CR><ETX>D7<CR><LF>L|1<CR><ETX>3C<CR><LF>

L: <ACK>

A: <EOT>

L: <ENQ>

A: <ACK>

L:
<STX>1H|\^&|||LIS_ID|||||ADVCNT_LIS||P|1<CR>P|1|P1234567015|||Jacobs^
Hal||19480612|M|||||MD_DOC||||||||||WARD<CR>C|1||^Patient
comment15|
G<CR>C|2||^Patient comment15|G<CR>O|1| REQ3051||ALL||||||||O
||^^^TSH\^^^LH\^^^THCG\^^^PRL||||||||||||||||||||O\Q<CR>

A: <ACK>

L: <STX>2L|1|F<CR><ETX>04<CR><LF>

A: <ACK>

L: <EOT>

Automatic Worklist Request Queries Transmitted from the System

The following example shows the system transmitting automatic worklist request queries and automatically reported results, while receiving worklist entries from an LIS in response to queries from the system. Note the contention for line control between the systems.

In the example, the LIS transmits a positive acknowledgement with interrupt (<EOT>) after the data link message. The system relinquishes line control if it receives a positive acknowledgment with interrupt after transmitting a final frame. The system chooses when to relinquish control, and it does not always have to relinquish control after receiving a positive acknowledgment with interrupt.

A: <ENQ>

L: <ACK>

A: <STX>1H|\^&||ADVCNT_LIS|||||LIS_ID||P|1<OD>Q|1|^P0706||ALL||||||||O
<OD>L|1<OD><ETX>83<OD><OA>

L: <ACK>

A: <EOT>

A: <ENQ>

L: <ENQ> (contention occurs)

A: <ENQ>

L: <ACK>

A:
<STX>1H|\^&|||ADVCNT_LIS|||||LIS_ID||P|1<OD>P|1|4|||Key^Harold||19560

519|M|||||Keyes&S&Harold||||||||||General_Ward<OD>O|1|P0634^0038^A|
|^^^
T4|R||||||||||||||||||||F<OD>R|1|^^^T4^^^1^DOSE|3.8|ug/
dL||||F||||199802160840
<OD>R|2|^^^T4^^^1^COFF|1.0|ug/dL|||<ETB>66<OD><OA>

L: <EOT> (positive acknowledgement with interrupt)

A: <EOT> (system ends session; relinquishes line control)

L: <ENQ>

A: <ACK>

L:
<STX>1H|\^&<OD>P|1|13|||Fitzpatrick^Rachel||19560519|F|||||Fitzpatrick^
Ra

chel||||||||||||General_Ward<OD>O|1|P0706||^^^T4|R||||||||||||||||||||O\Q<OD
>L|1
<OD><ETX>4D<OD><OA>

A: <ACK>

L: <STX>2H|\^&<OD>L|1|F<OD><ETX>AE<OD><OA>

A: <ACK>

L: <EOT>

A: <ENQ>

L: <ACK>

A:
<STX>1|F||||199802160840<OD>R|3|^^^T4^^^1^RLU|3388899|||||F||||19
980
2160840<OD>L|1<OD><ETX>OC<OD><OA>

L: <ACK>

A: <EOT>

A: <ENQ>

L: <ACK>

A:
<STX>1H|\^&|||ADVCNT_LIS|||||LIS_ID||P|1<OD>Q|1|^P1429||ALL|||||||O
<OD>L|1<OD><ETX>86<OD><OA>

L: <ACK>

A: <EOT>

L: <ENQ>

A: <ACK>

L:
<STX>1H|\^&<OD>P|1|44|||Timmons^John||19560519|M|||||Timmons^Joh
n||

||||||||||General_Ward<OD>O|1|P1429||^^^T4|R||||||||||||||||||||O\Q<OD>L|1<
OD>
<ETX>FA<OD><OA>

A: <ACK>

L: <STX>2H|\^&<OD>L|1|F<OD><ETX>AE<OD><OA>

A: <ACK>

L: <EOT>

Transmission from the System with No Response

The following example shows a transmission from the system with no response from the remote system. After the initial enquiry (<ENQ>) timeout, five more enquiries must timeout before reaching the retry limit and then an error displays at the event log.

A: <ENQ> <EOT> <ENQ> <EOT> <ENQ> <EOT> <ENQ> <EOT> <ENQ> <EOT> <ENQ> <EOT>

The system continues the enquiries until it receives a successful response (<ACK>) from the remote system.

7 Records

This appendix shows examples of the communications protocol records and messages. Refer to Section 3, *Implementation of ASTM Protocol*, for an explanation of each record type.

Header Record

The following example shows the minimum header record that the system recognizes.

H|\^&<CR>

The following example shows the minimum header record that the system transmits.

H|\^&|||ACS:NG_LIS|||||LIS_ID||P|1<CR>

The system parses received messages that have a debug mode header, but otherwise ignores these messages.

The following example shows a header record for a message in debug mode. Note the **D** (Debug) in the Processing ID field.

H|\^&|||ACS:NG_LIS|||||LIS_ID||D|1<CR>

The following example shows a header record from an LIS using Sender and Receiver ID fields.

H|\^&|||LIS_ID|||||ACS:NG_LIS<CR>

Patient Record

The following example shows the minimum patient record that the system recognizes. The system transmits the minimum record as the patient record for a control sample worklist order or a control sample result.

P|1<CR>

The following example shows the minimum patient record for a patient sample that the system transmits. Note the **U** (Unknown) in the Patient Sex field; the system requires a value in this field.

P|1|||||||U<CR>

The following example shows a patient record with all fields that the system uses.

P|1|PID456|||Smith^Gretchen^A||19760423|F|||||ID32||||||||||||ER<CR>

Patient Comment Record

The system always transmits the Comment Text field and the Comment Type field or it does not send the record. The system does not send the Comment Source field. The following example shows a transmitted patient comment record.

C|1||^Insufficient sample. Redraw.|G<CR>

The following example shows a patient comment record from an LIS with the least number of fields.

C|1||^Contact Dr. Singer, x7845|G<CR>

The following example shows a patient comment record from an LIS with the maximum number of fields.

C|1|L|^Contact x3378|G<CR>

Order Record

The following example shows the minimum order record that the system transmits. The system always transmits the Sample ID, Test Name or LIS Code, Priority, and Report Type fields or it does not send the record.

O|3|SID4728||^^^T4|S||||||||||||||||||||O<CR>

The following example shows an order record with all fields that the system uses. It illustrates an order record sent by the operator for a control sample worklist order. Note the **Q** (Q/C Test Specimen) in the Action Code field.

O|2|K016101^0007^C||^^^T3|R||||||Q||||||||||||||O<CR>

The following example shows an order record for a patient sample worklist order, sent by the system in response to a query. Note the **Q** (Response to Query) in the Report Type field.

O|1|SID895467201^0011^D||^^^T3\^^^T4\^^^TU\^^^FT4|R||||||||||||||||||||
O\Q<CR>

The following example shows an order record for a patient sample worklist order, sent by the system in response to a query about pending tests. Note the **Q** (Response to Query) and **I** (In Instrument Pending) in the Report Type field.

O|1|3A6BZ201||^^^FSH|R||||||||||||||||||||O\Q\I<CR>

The following example shows an order record for a patient sample worklist order, sent by an LIS to cancel the FSH test for the sample with a sample ID of 3A6BZ201. Note the **C** (Cancel Request) in the Action Code field.

O|1|3A6BZ201||^^^FSH|R||||||C||||||||||||||O<CR>

The following example shows an order record for the results of tests performed on a control sample, sent by the system operator. A manufacturer's record, a result record, and zero or more result comment records follow the order record. Note the **Q** (QC Test Specimen) in the Action Code field and the **F** (Final Results) in the Report Type field.

O|2|K018101||^^^T3\^^^T4|R||||||Q||||||||||||||F<CR>

The following example shows an order record for the results of tests performed on a stat patient sample, sent by the system in response to a query. Note the **S** (Stat) in the Priority field. Result records for each test and zero or more result comment records for each result record follow.

O|1|SID7201||^^^LH\^^^HCG\^^^TSH\^^^PROLACT|S||||||||||||||||||||F\Q<CR
>

The following example shows the system transmitting an order record to inform a remote system that it is rejecting the worklist order from the remote system and it is not processing the worklist order. Note the **X** (Work Cannot Be Done) in the Report Type field.

O|1|SID7201^0056^E||^^^LH\^^^HCG\^^^TSH\^^^
PROLACT|R||||||||||||||||||||X<CR>

Manufacturer's Order Record

The following example shows a manufacturer's order record with all fields that the system uses. The system always sends the control name and control lot number when they are present. The system rejects manufacturer's order records if they do not match the control name and control lot number in the system database.

M|1|CCD^ACS:NG^V1^O|Lig1|0016101<CR>

Manufacturer's Test Record

The following example shows the manufacturer's test record that the system uses for communication diagnostics. Note the following special characters:

- the escape sequence **&E&** after **%** allows the transmission of **&** as a character instead of an escape delimiter.
- the escape sequence **&R&** after **[** allows the transmission of **** as a character instead of a repeat delimiter.
- the escape sequence **&S&** after **]** allows the transmission of **^** as a character instead of a component delimiter.

- the escape sequence **&F&** after **{** allows the transmission of **|** as a character instead of a field delimiter.
- the escape sequence **&Xdd&** is used for restricted characters.

M|1|CCD^ACSNG^V1^T|&X00&&X01&&X02&&X03&&X04&&X05&&X06&
<BEL>&X08&<HT>&X0A&<LF><VT>&X0D&&X0E&&X0F&&X10&&X11&&X
12&&X13&&X14&&X15&&X16&&X17&&X18&&X19&&X1A&&X1B&&X1C
&&X1D&&X1E&&X1F&!#$%&E&'()*+,–./0123456789:;<=>?@
ABCDEFGHIJKLMNOPQRSTUVWXYZ[&R&]&S&_'abcdefghijklmnopqrstuvwx
yz{&F&}~&X7F&<CR>

Result Record

The system rejects all result records.

The following example shows the minimum result record that the system transmits. The system always sends an LIS code, result aspects, a measurement value, a result status, and a date test completed. This result is sent in response to a query.

R|1|^^^TU^^^^INDX|0.822|||||F\Q||||19970823213815<CR>

The following example shows a result record with all fields that the system uses. In addition to the fields always sent, the Units and Result Abnormal Flags fields have values. The result is low. Note the **L** (Below Reference Range) in the Result Abnormal Flags field.

R|1|^^^T4^^^1^DOSE|4.2|ug/dL||L||F||||19970906090215<CR>

The following example shows a result record in which the result is a value beyond the range of the Master Curve, a value in the Result Abnormal Flags field, and an empty Units field. This result is greater than the maximum range of the Master Curve. It was previously transmitted; note the **R** (Results Previously Sent) in the Result Status field.

R|1|^^^T4^^^1^DOSE|>21.00|ug/mL||>||F\R||||19970906090215<CR>

Result Comment Record

The system transmits additional result abnormal flags in the Comment Text field. The system always transmits the Comment Source, Comment Text, and Comment Type fields. The following example shows a result comment record that the system transmits. Note the **I** in the Comment Type field when the system reports a result flag. The system ignores all result comment records.

C|1|I|Repeated|I<CR>

The following example shows an operator-entered result comment record that the system transmits. Note the **G** in the Comment Type field when the system reports a user-entered comment.

C|1|I|^Gross hemolysis may affect result|G<CR>

Query Record

The following example shows a query record initiated from the system by an operator. This record requests all worklist information from a remote system and always has the same field values. Note the **O** (Only test Orders and Demographics) in the Request Information Status Code field.

Q|1|ALL||ALL||||||||O<CR>

The following example shows a query record initiated automatically from the system after it reads sample barcodes. The system sends a query for each sample identified by the system, whether or not an entry exists in the database. These queries always request worklist orders for all tests for a sample, whether patient sample or control sample.

Q|1|^SID0782|^SID0782|ALL||||||||O<CR>

The following example shows a query record sent by the system for each rack identified. The system queries for Rack ID only when it is configured to schedule by rack.

Q|1|^^1459^B|^^1459^B|ALL||||||||O<CR>

The following example shows a query record accepted by the system that searches the database for worklist entries with several restrictions. The search returns all test orders for a sample with a patient ID (PID) of P2938475 and all test orders within the PID range from P4798621 through P4800000. Note the **S** in the Nature of Request Time Limits field. The system ignores the date range fields in worklist entries that have no date.

Q|1|P2938475\P4798621|P2938475\P4800000|ALL|S|1992083123|19920
90104|||||O <CR>

The following example shows a query record accepted by the system that searches the database for final results with several restrictions. The search returns all results for a sample with a sample ID (SID) of S1234 and all results for a sample with a SID of S4321 completed within the date range from 11:00 p.m. on 31 August 1997, through the hour of 4:00 a.m. on 01 September 1997.

Q|1|^S1234\^S4321|^S1234\^S4321|ALL||1997083123|1997090104|||||F
<CR>

The following example shows a query record accepted by the system that searches the database for final results with several restrictions. The search returns all results for samples within the SID range of S1234 through S1321 and all results for a samples within the SID range of S4321 through S4510. The results for all samples must be completed after 8:00 p.m. on 31 August 1997, and before 6:00 a.m. on 01 September 1997.

Q|1|^S1234\^S4321|^S1321\^S4510|ALL||1997083120|1997090106|||||F <CR>

The following example shows a query record accepted by the system that searches the database for final results with several restrictions. The search returns all results for samples within the Rack ID range of 1234A through 2300A and all results for samples within the Rack ID range of 4321B through 4510C. The results for all samples must be completed after 8:00 p.m. on 31 August 1997, and before 6:00 a.m. on 01 September 1997.

Q|1|^^1234^A\^^4321^B|^^2300^A\^^4510^C|ALL||1997083120|1997090106|||||F<CR>

The following example shows a query record accepted by the system that searches the database for final results with several restrictions. Note the **F** (Final Results) in the Request Information Status Code field. The case-sensitive search returns all t4 final result replicates within the PID range of P1234 through R and the SID range of SID0600 through SID0700, and resulted on or after the month of June, 1997.

Q|1|P1234^SID0600|R^SID0700|^^^t4||1997072308\199706||||||F<CR>

The following example shows a query record accepted by the system that searches the database for final results for a specific shift. The search returns all results for all samples completed within the date and time range from 8:00 a.m. on 01 October 1997, through the hour of 4:00 p.m. on 01 October 1997.

Q|1|ALL||ALL||1997100108|1997100116|||||F<CR>

The following example shows a query record accepted by the system that searches the database for final results for a specific day for archiving by the LIS. The search returns all results for all samples completed for the day of 14 September 1997.

Q|1|ALL||ALL||19970914|19970914|||||F<CR>

The following example shows a query record accepted by the system that searches the database for final results for specific tests for a month for quality control (QC) analysis. The search returns all results for all T4 and FT4 final results completed for the month of September, 1992.

Q|1|ALL||^^^T4\^^^FT4||199709|199709|||||F<CR>

The following example shows a query record accepted by the system that searches the database for final results for a range of SIDs. The search returns all results for all tests performed on SIDs from REQ1241 through REQ1300.

Q|1|^REQ1241|^REQ1300|ALL||||||||F<CR>

The following example shows a query record accepted by the system that searches the database for final results for a single PID. The search returns all results for all tests performed on samples associated with the PID 275-47-0149.

Q|1|275-47-0149|275-47-0149|ALL||||||||F<CR>

The following example shows a query record accepted by the system that searches the database for final results for a specific test. The search returns all TSH final results in the database.

Q|1|ALL||^^^TSH||||||||F<CR>

The following example shows a query record accepted by the system that searches the database to determine which ordered tests are still pending. Note the **I** (In Instrument Pending) in the Request Information Status Code field.

Q|1|ALL||ALL||||||||I<CR>

Reagent Status Record

The following example shows a reagent status record transmitted by the system.

M|1|CCD^ACS:NG^V1^S^W|c2177a|T|TSH|Not Onboard|13<CR>

The following example shows a reagent status record that has multiple packs onboard for a test.

M|1|CCD^ACS:NG^V1^S^W|c2177a|T|TSH^^03303312230008^08^P^23\
TSH^^
03303314050009^03^P^12\TSH^^03303313650008^11^P^14|Low
Reagent |49<CR>

The following example shows a lot-locked reagent that has multiple packs onboard for a test.

M|1|CCD^ACS:NG^V1^S^W|c2177a|T|TSH^0333314^033033140856^08
^P^23\
TSH^0333314^033033140901^03^P^12\TSH^0333314^033033140883
^11^P^14| Low Reagent|49<CR>

Termination Record

The following example shows the minimum termination record that the system recognizes. It is parsed and logged as a normal termination. If the system sends a termination record in a message that is in response to a query, the system has not completed its response.

L|1<CR>

The following example shows a termination record that completes the response to a query. When the system sends this record, the system considers its response to be complete, and it is ready to accept a new query.

When the system receives a termination record with a termination code of **F**, the system closes any outstanding query it sent and logs the query as complete. If the system has sent a query and never receives a termination record with a Termination Code of **F** (Final Record), **Q** (Query in Error), or **I** (No Information Available), the query remains pending until it times out. The system does not send any subsequent queries until the pending query times out.

L|1|F<CR>

The following example shows a termination record that completes a query response that has no data. When sent by the system, the system has no data to send and considers its response to be complete. It is ready to accept a new query. When received by the system, the system closes any outstanding query it sent and logs the query as receiving no data.

L|1|I<CR>

The following example shows a termination record that completes a response to a query in error. This is sent by the system under two conditions:

- the system receives a second query (other than a query cancellation) before it completes a response to a preceding query.
- the system receives a query with a value in the Request Information Status Code field other than **P** (Preliminary), **F** (Final), **S** (Partial), **R** (Results Previously Transmitted), **N** (New or Edited Results), **O** (Request Test Orders), **I** (In Instrument Pending), or **A** (Cancel Transmitted Data).

The system treats any queries received as closed and is ready to accept a new query. If received by the system, the system closes any outstanding query it sent and logs the query as in error.

L|1|Q<CR>

8 Invalid Characters

This section lists the invalid data characters in ASTM messages at the data link and the application layers. If any invalid characters are present in an ASTM message at the data link or the application layer, the message is not accepted. For more information, refer to *Data Link Messages* in chapter 2.

An X in the data segment or the application layer indicates an invalid character. Characters not listed in this appendix are valid.

Table 2: Invalid characters in ASTM messages

Hexadecimal Character	Decimal Character	ASCII Character	Data Segment	Application Layer
00	0	NUL		X
01	1	SOH	X	X
02	2	STX	X	X
03	3	ETX	X	X
04	4	EOT	X	X
05	5	ENQ	X	X
06	6	ACK	X	X
08	8	BS		X
0A	10	LF	X	X
0E	14	SO		X
0F	15	SI		X
10	16	DLE	X	X
11	17	DC1	X	X
12	18	DC2	X	X
13	19	DC3	X	X
14	20	DC4	X	X
15	21	NAK	X	X
16	22	SYN	X	X
17	23	ETB	X	X
18	24	CAN		X
19	25	EM		X
1A	26	SUB		X
1B	27	ESC		X
1C	28	FS		X
1D	29	GS		X
1E	30	RS		X
1F	31	US		X

Hexadecimal Character	Decimal Character	ASCII Character	Data Segment	Application Layer
7F	127	DEL		X
FF	255			X

9 Safety Information

This section provides information about the following hazards:

- Biohazards
- Scanner lasers
- Moving components

This summary is based on the guidelines developed by the Centers for Disease Control, the Clinical and Laboratory Standards Institute Document M29-A3, Protection of Laboratory Workers from Occupationally Acquired Infections, and the Occupational Safety and Health Administration's Bloodborne Pathogens Standard.[1-3]

Safety Information

Use this summary for general information only. It is not intended to replace or supplement your laboratory or hospital biohazard control procedures.[1-3]

By definition, a biohazardous condition is a situation involving infectious agents biological in nature, such as the hepatitis B virus, the human immunodeficiency virus, and the tuberculosis bacterium. These infectious agents may be present in human blood and blood products and in other body fluids.

The following are the major sources of contamination when handling potentially infectious agents:

- Needlesticks
- Hand-to-mouth contact
- Hand-to-eye contact
- Direct contact with superficial cuts, open wounds, and other skin conditions that may permit absorption into subcutaneous skin layers
- Splashes or aerosol contact with skin and eyes

To prevent accidental contamination in a clinical laboratory, strictly adhere to the following procedures:

- Wear gloves while servicing parts of the instrument that have contact with body fluids such as serum, plasma, urine, or whole blood.
- Wash your hands before going from a contaminated area to a noncontaminated area, or when you remove or change gloves.
- Perform procedures carefully to minimize aerosol formation.

- Wear facial protection when splatter or aerosol formation are possible.
- Wear personal protective equipment such as safety glasses, gloves, lab coats or aprons when working with possible biohazard contaminants.
- Keep your hands away from your face.
- Cover all superficial cuts and wounds before starting any work.
- Dispose of contaminated materials according to your laboratory's biohazard control procedures.Keep your work area disinfected.
- Disinfect tools and other items that have been near any part of the instrument sample path or waste area with 10% v/v bleach.
- Do not eat, drink, smoke, or apply cosmetics or contact lenses while in the laboratory.
- Do not mouth pipet any liquid, including water.
- Do not place tools or any other items in your mouth.
- Do not use the biohazard sink for personal cleaning such as rinsing coffee cups or washing hands.

To prevent needlestick injuries, needles should not be recapped, purposely bent, cut, broken, removed from disposable syringes, or otherwise manipulated by hand.

References

1. Centers for Disease Control. 1988. Update: Universal precautions for prevention of transmission of human immunodeficiency virus, hepatitis B virus and other bloodborne pathogens in healthcare settings. MMWR, 37:377–382, 387, 388.
2. Clinical and Laboratory Standards Institute (formerly NCCLS). *Protection of Laboratory Workers from Occupationally Acquired Infections; Approved Guideline—Third Edition*. CLSI Document M29-A3. [ISBN 1-56238-567-4]. Clinical and Laboratory Standards Institute, 940 West Valley Road, Suite 1400, Wayne, Pennsylvania 19087-1898 USA, 2005).
3. Federal Occupational Safety and Health Administration. Bloodborne Pathogens Standard. 29 CFR 1910. 1030.

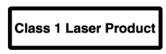
Protecting Yourself from Barcode Scanner Lasers

To avoid damage to the eyes, never look directly at the laser beam or at its reflection from a shiny surface. Never point a hand-held barcode scanner at anyone.

Laser Safety Classification of the ADVIA Centaur XPT System

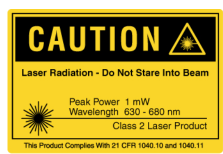
During normal operation with all of the protective housings in place, the ADVIA Centaur XPT system is classified as CDRH Class I and EN 60825-1 Class 1. No direct exposure to laser hazard exists for persons in the immediate area.

Figure 21: CDRH Class 1 Label



Some field service procedures require the removal of the protective housings that prevent human access to the laser radiation. The removal of the protective housings may change the classification of the system to CDRH Class 2 and EN60825-1 Class 2. All field service procedures must be followed precisely. Only Siemens-trained field service personnel should perform procedures related to laser assemblies.

Figure 22: CDRH class 2 Label



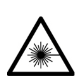
The laser labels are positioned on the instrument as shown below.

Laser Safety Classification of the Barcode Scanners

The laser safety classification of the reagent and sample barcode scanners when they are unprotected by the system housings is CDRH Class 2 and EN 60825-1 Class 2. The laser safety classification of the hand-held barcode scanner used with the system is CDRH Class 2 and EN 60825-1 Class 2.

Reagent and Sample Barcode Scanners

Operator's guide procedures for testing the reagent or sample barcode scanners contain the following laser warning:



LASER WARNING

To avoid damage to the eyes, never look directly at the laser beam or at its reflection from a shiny surface. Only trained field service personnel should perform procedures related to laser assemblies. Refer to *Protecting Yourself from Lasers Emitted from Barcode Scanners*in the operator's guide for more information.

The specifications for the laser optical assemblies in the ADVIA Centaur XPT ancillary reagent, primary reagent, and sample barcode scanners are summarized in the following table.

Table 3: Specifications for Laser Optical Assemblies in the Reagent and Sample Barcode Scanners

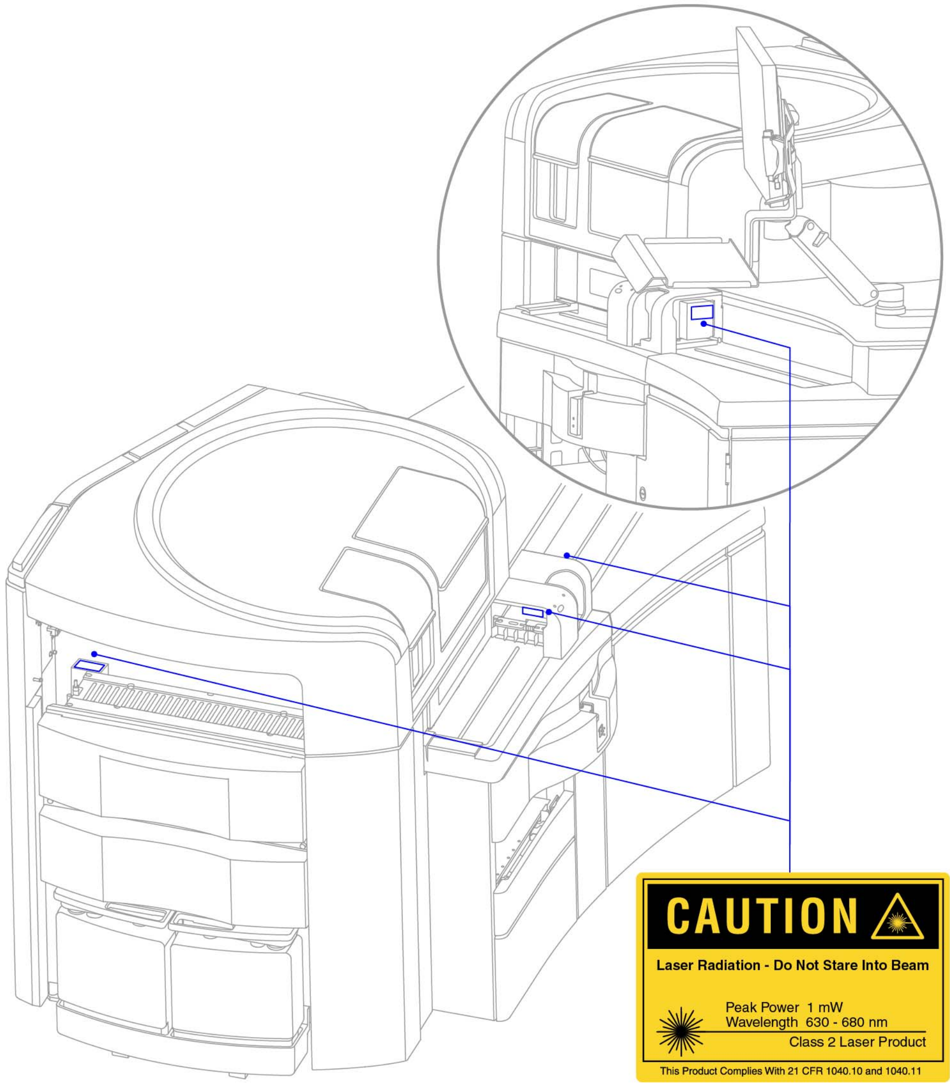
Characteristic	Specification
Maximum Power Output	1.0 mW
Wavelength	670 nm
Pulse Duration	Continuous Wave (cw)
Units of Beam Divergence	0.7 mr

The locations of the reagent and sample barcode scanners and their associated laser safety labels are shown below. The laser apertures for the sample and ancillary reagent barcode scanners are directed into the system away from the operator.

During normal operation, reflections from the sample barcode scanner laser beam may be visible to persons in the immediate area, but no laser safety hazard is associated with this exposure. The laser aperture for the primary reagent barcode scanner is directed toward the barcode labels at the end of the reagent packs inside the primary reagent compartment.

During normal operation, the barcode scanner does not scan the reagent packs until the primary reagent compartment door is closed. When the primary reagent compartment door is closed, no operator exposure to the laser exists.

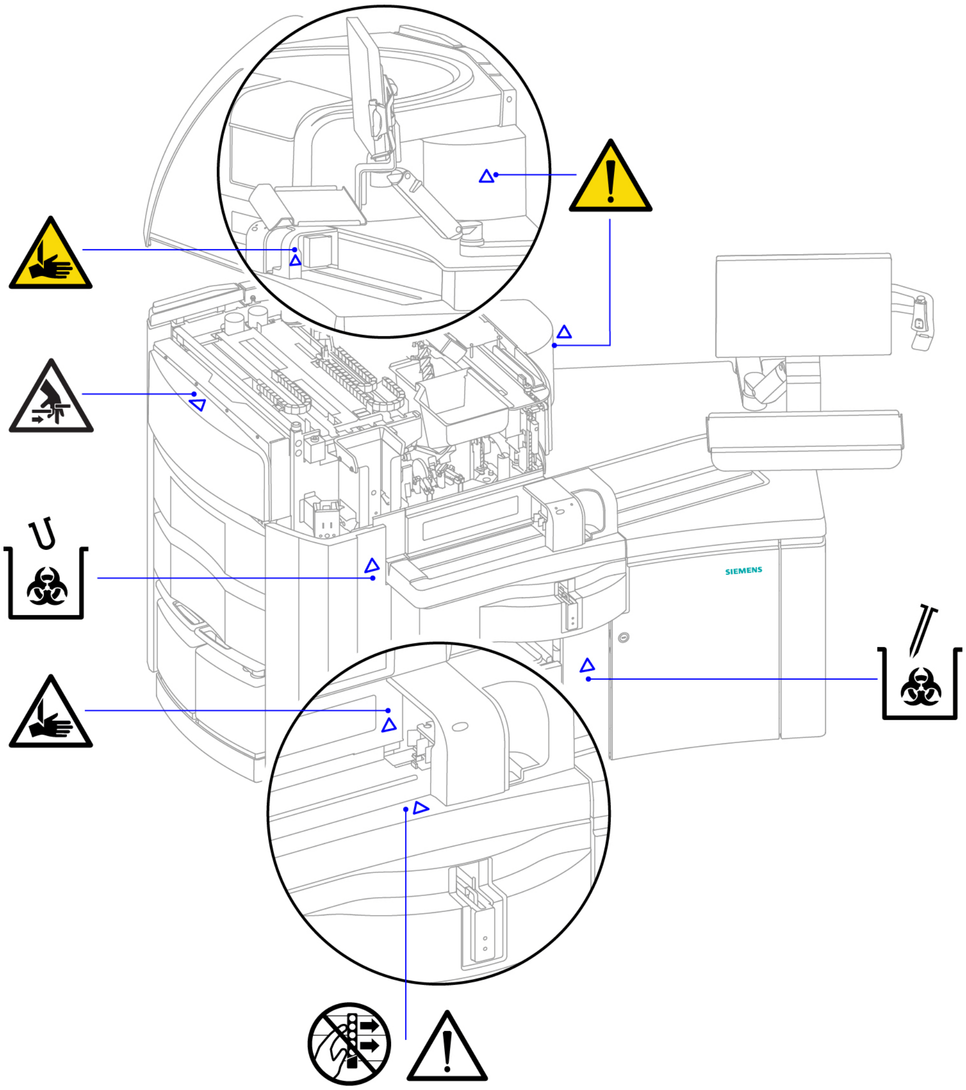
Figure 23: Class 2 Laser Hazard Labels



Symbols displayed on the exterior of the system indicate safety hazards and warnings for proper operation of the system. The locations of the symbols on the exterior of the system are shown below.

For more information refer to System Symbols.

Figure 24: Exterior System Symbols



Location of Safety Hazard Symbols on the System Interior

Symbols displayed on the interior of the system indicate safety hazards and warnings for proper operation of the system. The locations of the symbols on the interior of the system are shown below

For more information refer to System Symbols.

Figure 25: Cuvette Waste and Sample Tip Waste Areas

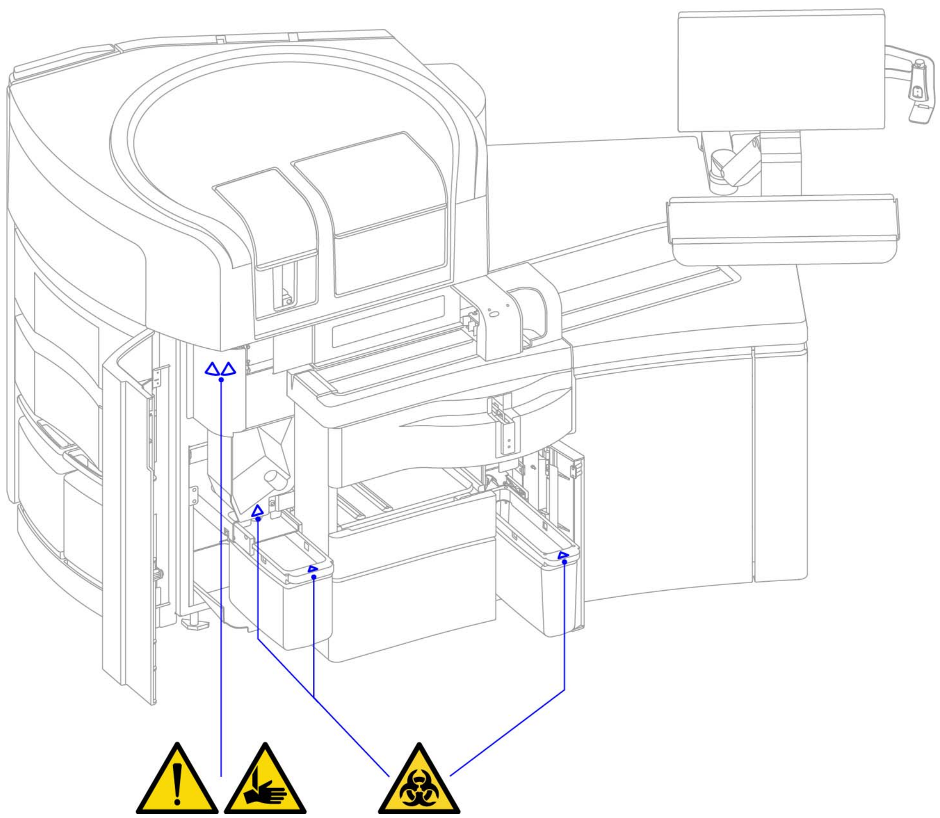
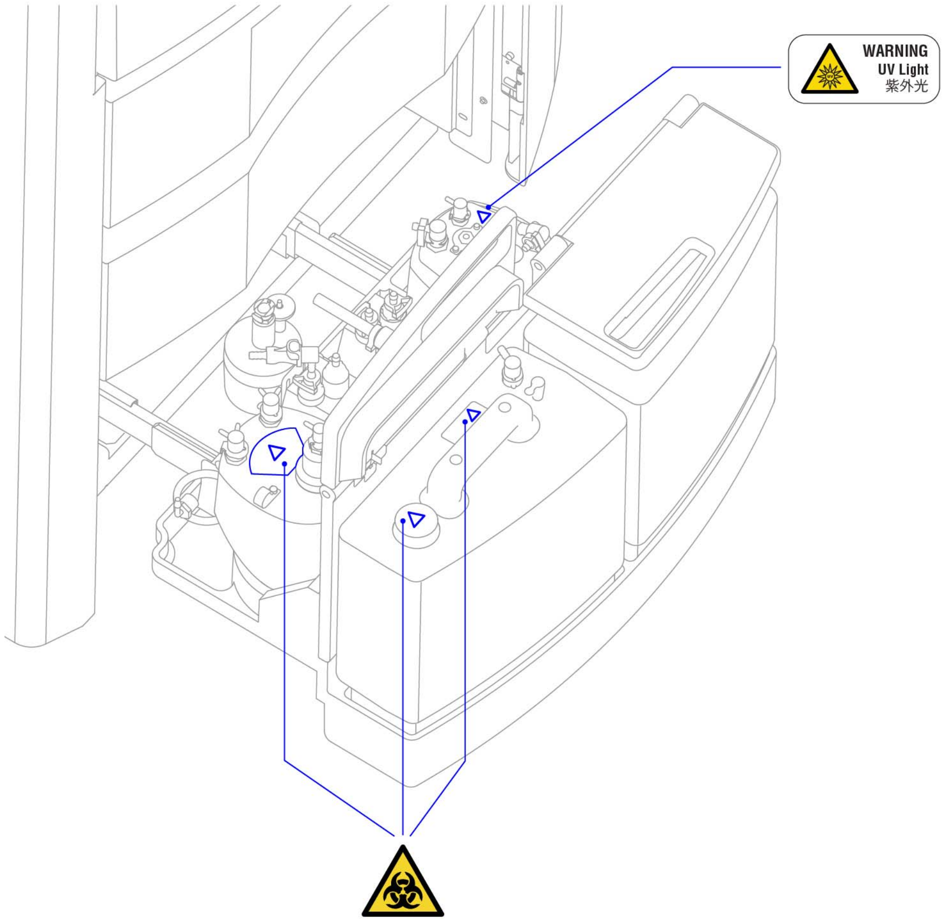


Figure 26: Water Reservoir UV Lamp and Liquid Waste Areas

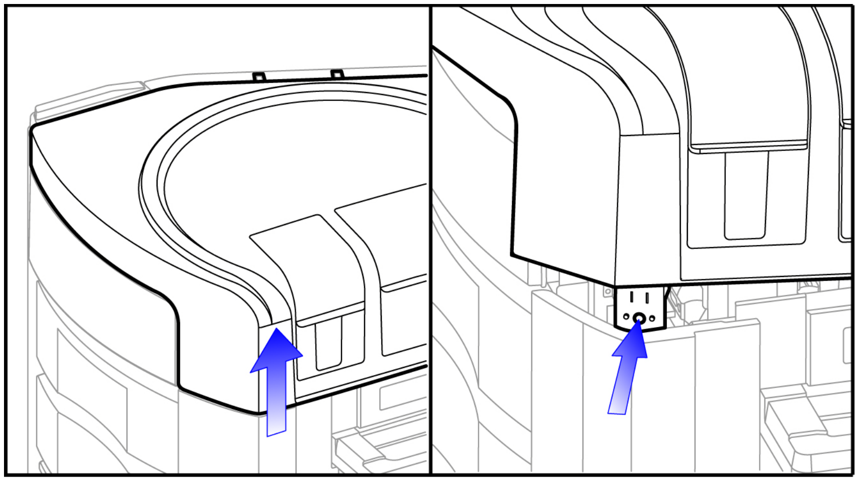


Self-Latching Top Cover

> **CAUTION**
> Do not leave the top cover open when the system is processing samples. Doing so can cause erroneous test results.

The system’s top cover includes a self-latching lock for safety during normal operation. If the top cover is open when the system is processing samples, a system alert prompts you to close the top cover. Open the lock using the key provided during system installation.

Figure 27: Self-Latching Top Cover



Location of the I/O Panels and Main Power Switch

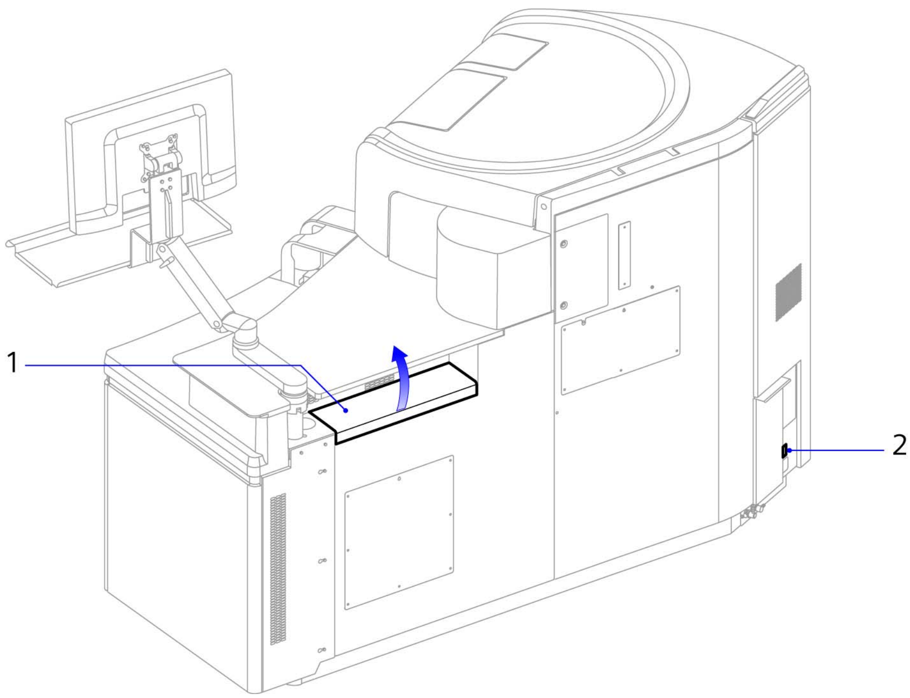
CAUTION

Do not move or install your ADVIA Centaur XPT system. Unauthorized movement or installation can damage your system and void your warranty and/or service contract. Unauthorized movement can also affect your instrument calibrations. A Siemens technical support provider should install or relocate your system.

Contact Siemens when you receive your system or if you need to relocate the system within your facility.

Cables for specific components of the system connect to 1 of the 3–input/output (I/O) panels located at the back of the system.

Figure 28: Back View of the ADVIA Centaur XPT System



1	I/O Panel at the back of the system
2	Main power switch

The I/O panel at the back of the main system contains connectors for each of the following cables:

- External barcode scanner
- Lab automation
- Video, in and out, for the Applications module and the UI module
- Touch screen, in and out, for the Applications module and the UI module
- Keyboard

To access the I/O panel, perform the following steps:

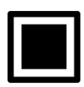
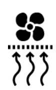
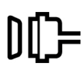
1. At the back of the system, lift the I/O panel cover.
2. Locate the appropriate cable connector.

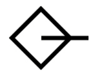
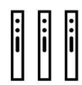
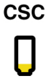
10 System Symbols

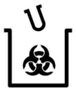
This section describes the symbols that can appear on the interior or exterior of the system or on the system packaging. The symbols on the system identify the location of certain components and, where necessary, display warnings for proper operation. The symbols on the system packaging provide you with other important information.

Table 4: Table 1: System Symbols

Symbol	Description
	This symbol is used for both Warnings and Cautions. • A Warning indicates the risk of personal injury or loss of life if operating procedures and practices are not correctly followed. • A Caution indicates the possibility of loss of data or damage to or destruction of equipment if operating procedures and practices are not strictly observed.
	This symbol alerts you to a biohazard.
	This symbol alerts you to a biohazard.
	This symbol alerts you to the risk of exposure to lasers.
	This symbol alerts you to a potential electrical hazard.
	This symbol indicates potential ultra violet lamp exposure.
	This symbol indicates a moving component that can cause injury.
	This symbol indicates a moving component that can cause injury.
	This symbol indicates a component that can cause a pinching injury.
	This symbol indicates the presence of a part emitting high temperature.

Symbol	Description
~	This symbol indicates that the input electricity is alternating current.
	This symbol identifies the location of a protective earth (GND) conductor terminal.
I O	This symbol indicates the main power switch.
I	This symbol indicates that the main power supply is on.
O	This symbol indicates that the main power supply is off.
	This symbol indicates the fast stop button.
	This symbol indicates the computer startup button.
	This symbol indicates the system hard drive.
	This symbol indicates the location of the fan filter.
	This symbol indicates the location of the cable connections.
	This symbol indicates the location of a printer port.
	This symbol indicates the location of the barcode scanner connector.
LIS	This symbol indicates the location of the laboratory information system (LIS) connector.
UPS	This symbol indicates the location of the uninterrupted power supply (UPS) connector.
	This symbol indicates the location of the external modem connector.
→ RT	**CAUTION** Do not connect external devices to the user interface (UI) to real time (RT) connector. Connecting external devices can cause system damage. This symbol indicates the location of the user interface (UI) to real time (RT) connector. This connector is for system connections only.

Symbol	Description
	This symbol indicates the location of the small computer system interface (SCSI) connector. This connector is not used at this time.
	This symbol indicates the location of the keyboard connector.
	This symbol indicates the location of the monitor connector.
STS	This symbol indicates the location of the sample transport system (STS) connector.
	This symbol indicates the location of the ethernet connector.
	This symbol indicates where primary reagent packs are loaded or removed.
	This symbol indicates where ancillary reagent packs are loaded or removed.
	This symbol indicates the sample loading area.
	This symbol indicates the Stat entry.
	This symbol indicates where cuvettes are loaded.
	This symbol indicates where sample tips are loaded.
	This symbol identifies the system fluid bottle for Acid reagent.
	This symbol identifies the system fluid bottle for Base reagent.
	This symbol identifies the system fluid bottle for wash 1 solution.
	This symbol identifies the system fluid bottle for cleaning solution.
CSC 	This symbol identifies the ADVIA Centaur Cleaning Solution concentrate used to prepare the cleaning solution.
	This symbol identifies the water bottle.

Symbol	Description
	This symbol identifies the lid that provides access to the liquid waste bottle.
	This symbol identifies the door that provides access to the sample tip tray waste.
	This symbol identifies the door that provides access to the cuvette waste bin.
	This symbol identifies the door that provides access to the sample tip waste bin.
	This symbol indicates that a sample rack should not be pushed in the sample entry queue.
	This symbol indicates that the product has a temperature limitation. In this example, you need to store the product between 2° to 8°C.
	This symbol indicates that a stacking limit is present for this product. In this example, you cannot stack more than 4 products on top of 1 another.
	This symbol indicates that you should protect the product from strong magnetic fields.
IVD	This symbol indicates an *in vitro* diagnostic device or an *in vitro* diagnostic medical device.
	This symbol indicates that you should consult instructions for use.
	This symbol indicates that the product is fragile and you need to handle it with care.
	This symbol indicates that you should keep the product dry.
REF	This symbol indicates the number used for ordering a part or product.
SN	This symbol indicates the serial number of a part or product.
Rev.	This symbol indicates the revision letter of a part or product.
	This symbol indicates the name and location of the product manufacturer.

Symbol	Description
	This symbol indicates the date of manufacture of the product.
	This symbol indicates the manufacturer’s authorized representative within the European community.
	This symbol indicates that the product or container should be oriented in the direction of the arrows.
	This symbol indicates not to use the product if the package is damaged.
	This symbol is intended to encourage recycling.
	This symbol indicates that the materials are recycled.
	This symbol is intended to facilitate recycling of corrugated materials. The number is licensed in Germany and printed on corrugated shippers.
	This symbol indicates that the package is printed with soy ink.
	This symbol indicates that the product complies with the applicable directives of the European Union.
	This symbol indicates that the product was IEC 61010-1 safety tested by TUV for conformity to global markets including Canada, US, and EU.
	This symbol indicates compliance with the restriction of hazardous substances used in electrical or electronic equipment.
	The WEEE symbol indicates that this equipment is classified as Waste Electrical and Electronic Equipment under the European WEEE Directive. It must be recycled or disposed of in accordance with applicable local requirements.

The following symbols can also appear on the exterior of the system or one of its components.

Symbol	Description
	This symbol indicates that the product is a Class 1 laser product, with no laser exposure during normal operation.
	This symbol indicates that the product is a Class 2 laser product, with potential exposure to a laser beam.

11 Warranty and Support Information

This section provides the following information:

- Address of the Siemens authorized representative, which is the Siemens contact within the European community
- Addresses for obtaining service and technical information and for ordering supplies
- System warranty and service delivery policy information

Limited Instrument Warranty and Service Delivery Policy

Siemens and its authorized distributors may provide customers who acquire new Siemens instruments with a limited warranty either in a specific agreement or in standard language on their invoices. This limited warranty is designed to protect customers from the cost associated with repairing instruments that exhibit malfunctions due to defects in materials and/or workmanship during the warranty period.

Siemens, at its election, provides warranty service either by providing repair service of the instrument on site, or by exchanging the defective instrument or component, subject to the limitations and exclusions set forth in Replacement of Parts and Warranty and Service Exclusions below. Repairs, replacements or exchanges of instruments or components provided during the warranty or any additional service period, does not extend the warranty or service period beyond the initially agreed upon period.

When the customer calls for service, the Siemens representative or authorized distributor informs the customer of the type of service available for the customer's instrument, and instructs the customer as to how to obtain that service.

Warranty Period

The limited warranty period generally commences upon installation of the original instrument at the customer's location and extends for a period of 1 year thereafter, unless otherwise specifically agreed to by and between Siemens (or its authorized distributors) and customer in a writing signed by duly authorized representatives of both parties (sales representatives are generally not authorized representatives of Siemens for these purposes).

Additional Service Period

The customers, with some exceptions, may purchase additional service coverage beyond any initial warranty period as part of the original instrument acquisition for second or subsequent years beyond the original installation date. The customer's original Purchase Invoice or appropriate Agreement Addendum must indicate the term in months for additional service coverage.

Service During Normal Hours

The customer may obtain service for instruments during normal business hours by contacting the nearest Siemens location or authorized distributor. Refer to the list of Siemens locations in this section.

Extent of a Service Call

Warranty or service calls generally include onsite repair or exchange of instruments or components, travel to the location of the instrument, and onsite labor during normal business hours. A warranty or service call is initiated by the customer by following the instructions on how to obtain service for the customer's instrument. The service call is considered complete when any defects in material or workmanship have been corrected by repair or replacement and the instrument conforms to the applicable specifications. When service is complete, the customer receives a copy of the documentation detailing all work performed by the Siemens representative or authorized distributor.

Service Outside Normal Hours

Customers, with some exceptions, may also request service to be delivered or an exchange to be initiated outside normal business hours, including evenings, weekend days, or nationally observed holidays, by contacting the nearest Siemens location or authorized distributor. Service performed outside normal hours is subject to a surcharge unless the customer has in place a service product option that provides service at the time requested.

Replacement of Parts

In performing service, Siemens or its authorized distributors provide appropriate parts to repair the instrument, or arranges for the exchange of the instrument or affected parts, at no charge with the exception of certain parts or subassemblies that are considered Customer Maintenance Items. Customer Maintenance Items include, but are not limited to, the following items: lamps, electrodes or sensors (which are covered by a separate warranty), reagents, calibrators, controls, paper, and pens. Consult the appropriate system operator’s manuals for a complete list of Customer Maintenance Items for any specific model of instrument.

Design Changes and Retrofitting of Instruments

Siemens reserves the right to change the design or construction of specific models of instruments at any time without incurring any obligation to make such changes available to individual customers or instruments. If Siemens notifies customers of a change that improves the performance or reliability of their instrument, and requests to retrofit that instrument, the customer must agree to allow Siemens or an authorized distributor, at Siemens’ expense, to retrofit components or make design changes, which does not adversely affect the instrument’s performance characteristics.

Key Operator Designation

Each customer designates a key operator who is available to Siemens representatives to describe instrument malfunctions by telephone and/or to perform simple adjustments and corrections as requested. If a key operator is not designated or is unavailable when the customer requests service, the delivery of service may be delayed.

OSHA Requirements (US only)

When service is required at a customer location, the customer must provide the Siemens representative with adequate facilities that comply with the regulations of the Secretary of Labor under the Occupational Safety and Health Act (OSHA) of 1970, as amended.

Warranty and Service Exclusions

The following exclusions are in addition to any exclusions provided for in any written warranty or service agreement.

1. IF ANY OF THE FOLLOWING EVENTS OCCUR, THE WARRANTY OR SERVICE PROVISIONS DO NOT APPLY:
2. Repairs or modifications have been made to the instrument by someone other than an authorized Siemens representative.
3. The instrument has been operated using accessories and supplies other than Siemens brand accessories, or consumable supplies and/or reagents not having the same grade, quality, and composition as defined in the system operator's manuals.
4. Siemens has notified customers of a change that improves the performance or reliability of their instrument and customer has not agreed to retrofit or make design changes to the instrument.
5. Customer did not purchase the instrument from Siemens or one of its authorized distributors.
6. The instrument has not been installed within 90 days of shipment to the customer's facility unless otherwise specified.
7. The customer has not performed appropriate customer maintenance procedures, as outlined in the system operator's manuals.
8. The instrument has been misused or used for a purpose for which it was not intended.
9. The instrument has been damaged in transit to the customer or damaged by the customer while moving or relocating it without supervision by a Siemens representative.
10. Damage was caused by floods, earthquakes, tornados, hurricanes, or other natural or man-made disasters.
11. Damage was caused by Acts of War, vandalism, sabotage, arson, or civil commotion.
12. Damage was caused by electrical surges or voltages exceeding the tolerances outlined in the system operator's manuals.
13. Damage was caused by water from any source external to the instrument.
14. The customer has purchased an alternative agreement whose terms of warranty or service supersede these provisions.

Siemens or its authorized distributors can invoice customers, at current standard labor and parts rates, for instruments repaired to correct damage or malfunctions due to any of the reasons listed above.

OTHER THAN AS STATED ABOVE, THERE ARE NO OTHER WARRANTIES, EXPRESS OR IMPLIED, WITH RESPECT TO THE INSTRUMENT, ITS SALE TO THE CUSTOMER, ITS LEASE TO THE CUSTOMER, OR THE SALE OF THE INSTRUMENT TO THE CUSTOMER AT THE EXPIRATION OR TERMINATION OF THE LEASE AGREEMENT.

SIEMENS HEALTHCARE DIAGNOSTICS SPECIFICALLY DISCLAIMS ANY AND ALL IMPLIED WARRANTIES OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR USE OR PURPOSE. SIEMENS HEALTHCARE DIAGNOSTICS' LIABILITY FOR BREACH OF ANY WARRANTY OR SERVICE AGREEMENT SHALL BE LIMITED ONLY TO THE REPAIR OR REPLACEMENT OF DEFECTIVE EQUIPMENT AND SHALL NOT INCLUDE ANY DAMAGES OF ANY KIND, WHETHER DIRECT, INDIRECT, INCIDENTAL, CONTINGENT, OR CONSEQUENTIAL. SIEMENS SHALL NOT BE LIABLE FOR DELAY FROM ANY CAUSE IN PROVIDING REPAIR OR EXCHANGE SERVICE.

ANY LIMITATIONS OR OTHER PROVISIONS NOT CONSISTENT WITH APPLICABLE LAW IN PARTICULAR JURISDICTIONS OR A SPECIFIC WRITTEN AGREEMENT DO NOT APPLY TO CUSTOMERS IN THOSE JURISDICTIONS OR SUBJECT TO THOSE AGREEMENTS.

Information for Technical Assistance

When you call for technical assistance, you may need information about the system name, serial number, and the version of software used on your ADVIA Centaur XPT system.

Use this procedure to locate system information.

1. At the workspace, select **Setup > Settings > Operator Setup**.

   System Name and **Serial Number** are displayed under **System Configuration**.

2. Select **Setup > Settings > About**.

   Version information is displayed.

Addresses

This section provides the following information:

- the address of the Siemens authorized representative, which is the Siemens contact within the European community

- the Siemens addresses for obtaining service and technical information and for ordering supplies

For technical assistance, customer service, or additional information, contact your local technical support provider or distributor.

Siemens Healthcare Diagnostics Inc.
511 Benedict Avenue
Tarrytown, NY 10591-5097 USA

EC REP Siemens Healthcare Diagnostics Ltd.
Sir William Siemens Sq.
Frimley, Camberley, UK GU16 8QD

12 Test Map

This appendix explains test mapping and detailed reagent status, and shows examples of their use.

Table 5: Test Mapping and Detailed Reagent Status

Full test map includes tests	• If test count is > 0, test is enabled (independent of master curve or calibration status), all required reagents available (primary, all ancillary, required diluents, ancillary and primary Wash Packs). If test has lot-locked materials (primary and ancillary), all required materials are present. • Test Map has TDef (LIS name/code), unique number (not associated with test product code). • Primary Reagent Pack Name and Test Name are not always the same. Example: Primary reagent “Fol”, the test name is FolBA. • It is not an indication if a test is runnable.
Incremental test map includes tests	• For any new reagent (primary, ancillary, diluent, or wash) that has been added, reevaluate associated tests for that reagent. • Reagent is compared to tests/TDefs that are associated with that pack (an ancillary reagent pack can be used for more than one test). Check that all required materials are onboard to run that test (goes through the same initial analysis). See *Full Test Map includes tests*.

Test map does not include tests	• Any required reagent is depleted, removed, or disabled. • This information is not transmitted; there is no decremental test map. • Future requests from the LAS for test map will not include the tests that have become depleted or disabled. Reagents with a depleted status are no longer included in any test map messages until state changes to yellow or green. • When a test becomes available (new pack, test is calibrated), two unsolicited messages are sent from the analyzer. The first message is the incremental test map, and the second message is a detailed reagent status for the new test.

Table 6: Detailed Reagent Status

Tests are in the Detailed Reagent Status	• All required reagents are in the system, and tests part of the test map will be sent in the reagent status. • In the reagent status, one reagent type is one message (for example, the amount of total tests for that reagent type, primary or ancillary). • Test count may not reflect the actual test count. System takes into consideration committed test count (tests that are already being scheduled). Test count that is sent reflects that exact moment in time. • Lot locked tests will get multiple messages for test status that indicate they are lot locked and will show multiple messages, appearing like separate tests. • Suggestion for lot locked tests: when a depletion message is sent to the LAS with lot information, the LAS interface should request reagent status. This will ensure that if reagent status is available, the test is runnable.

Tests are in the test map and NOT in the reagent status	• The system will send unsolicited reagent status for lot expiration, calibration expiration, and onboard stability expiration. Any of these expiration events can generate a change in test status to red/ depletion. • Any required reagent is depleted, removed, or disabled (including required wash packs). See *Full test map includes tests*. • This information is not transmitted. There is no decremental test map. • Future requests from the LAS for test map will not include the test. • A ratio test is listed in the test map when all its components are runnable. If a component test becomes unavailable, the ratio test will no longer be runnable. • When all the components of a ratio test are available, the ratio test is included in the test map. • Any reagent will not be considered for test map or reagent status evaluation if, for the pack, the calibration is already expired, onboard stability is already expired, or the reagent lost is already expired. The analyzer sends unsolicited reagent status with red status when calibration, onboard stability, or reagent lot expires for any reagent pack.

Note For a complete list of reagent statuses, refer to the *ADVIA Centaur XPT Operator’s Guide*.

Example of Initialization: Analyzer State Green when LAS Starts

The following example shows the LAS startup/reset, based on the Commands and Responses received. Each LAS may or may not behave in the same manner.

If ...	Then ...
the LAS receives a **Reset Queue Response** with a Completion Code of 01 within one minute,	the analyzer may send the unsolicited reagent status and/or test map after the **Reset Queue Response**. The LAS should ignore (do not save) these messages and must send the understood/ACKnowledge response code to the analyzer for each such message.
the LAS sends a **Send Test Map Command**,	the analyzer sends a **Send Test Map Response** within 10 seconds with Request Status 01. **NOTE:** Test map is merely a mapping between the Test Name and Test ID, and it should only be used for that purpose. Reagent status should be used to determine whether the analyzer can run a test or not. The test map should not be used for that purpose.
the analyzer starts to send a **Test Map Command** within 5 minutes,	the LAS should remove the previous test map data and use the test map data coming from the analyzer, and the LAS should remove all reagent status data. **NOTE:** When the LAS receives an unsolicited test map from the analyzer, the LAS should clear its memory of the previous test map and reagent status.
the LAS issues a **Send Reagent Status Command**,	the analyzer responds with **Send Reagent Status Response** within 10 seconds with Request Status 01. Then, the analyzer sends one **Detailed Reagent Status Command** for every runnable test (those that were in the Test Map Command) on the system with severity code 01 or 03 (green or yellow). If the reagent is depleted, the test will not be in the Test Map Command and no Detailed Reagent Status Command will be sent with a severity code 02 (red) at startup.
the LAS did not receive a **Detailed Reagent Status** from the analyzer in the last 30 seconds,	it can assume that all reagent status messages have been received. Then the LAS processes each **Detailed Reagent Status Command** as received, updating test count.

13 Glossary

This section provides definitions of terms used for and on the system.

Term	Description
access point	An entity used within an interaction space to provide a user with the facility to navigate to another interaction space or to access a system function.
algorithm	A set of rules or processes used for solving a specific problem.
ANSI	American National Standards Institute
application data segment	Subset of an application message that gets passed to or from the data link layer.
application layer	Layer 3 of the ASTM communication protocol. Provides instrument and LIS information services.
application message	Contains data concerned with the system application, such as worklist data or result data.
ASCII	American Standard Code for Information Interchange. A code for representing a set of alphanumeric characters used by information processing systems and communications systems.
ASTM	American Society for Testing and Materials
ASTM E1381-95	Standard document for the physical and data link layers of the ASTM communication protocol, which is titled Specification for Low-Level Protocol to Transfer Messages Between Clinical Laboratory Instruments and Computer Systems.
ASTM E1394-91	Standard document for the application layer of the ASTM communication protocol, which is titled Standard Specification for Transferring Information Between Clinical Instruments and Computer Systems.
automatic result reporting	A system option. When enabled, final results are transmitted from the system as soon as they are added to the results database, without any intervention by the operator.
automatic transfers	Automatic result reporting and automatic worklist entry requests.

Term	Description
automatic worklist entry requests	A system option. When enabled, a query for test orders is transmitted for each barcoded sample scanned and added to the worklist database.
Backus-Naur form	Notation used to define the syntax of a software language.
baud rate	Speed at which data is sent or received when devices are communicating through a serial channel.
BNF	See Backus-Naur form.
buffer	Data storage used to compensate for a difference in the flow rate of information or the time that events occur when transmitting data from 1 device to another.
busy timeout	The number of seconds the system waits before restarting a communication session after trying to start a session when the LIS computer is busy.
cancel query	Stop the response to a query before it is completed. This can be done by the system that sent the query and by the system that received the query.
cancel test	Unschedule a test for a sample. If a test is not running, it is not run. If a test started running, but is not finished, no result is read. If a test is finished, a cancellation has no effect.
CCITT	International Telegraph and Telephone Consultative Committee.
checksum	A variable, 2-digit, hexadecimal number included in data link message frames to support error detection.
communications parameters	Characteristics of the communications setup that are configured at the system.
communications port	The RS-232 port that is used to connect a remote device to the system.
concatenate	To link or join 2 or more character strings into a single character string.
configuration	The settings of software and hardware characteristics of a device.
control character	A character used to provide information about transmitted data or to control data transmission.

Term	Description
data bits	Physical layer parameter used to specify the number of bits that encode a single data character. Can be 7 or 8.
data link layer	Layer 2 of the ASTM communication protocol. Ensures reliable transfer of data across the physical medium.
data link message	Logical unit of data that contains application data segments along with additional data that provides transmission synchronization and error control information.
data segment	Section of a data link frame that contains application message data.
decimal digits	The base 10 number system.
define	To establish a value for a variable or symbol or to establish what the variable represents.
delimiter	The character that marks the beginning or end of a group of data.
demographics	Information about a patient. On the system, this is the patient name, patient ID, birthdate, sex, location, physician, and comments.
deny session message	Data link layer message used by the receiver during the link establishment phase when the receiver cannot immediately receive information.
device	An instrument or computer used by the communications package.
download	To send data from a remote system to the system.
duplexity	A characteristic of a communications link that relates to the direction and timing of data transmission across the physical medium.
enable	A command or condition that permits some specific event to proceed.
event	A significant system activity, warning, and error that is conveyed to interested parties via notifications.
event acknowledgment	A user’s response to an event notification. To acknowledge an event notification, a user views the event that triggered the notification.
filler	The application responding to a request for services (orders) or producing an observation.

Term	Description
flow control	Any method used to regulate incoming data in an effort to have the time and resources to process the incoming data without losing any of it.
frame	Section of a data link message. Consists of a frame header, a data segment, and a frame trailer.
frame sequence number	A number included in a frame to synchronize the proper ordering of frames.
framing error	The start or stop bits of a byte are encountered unexpectedly or are not encountered when expected by the physical layer. The condition is reported to the datalink layer as a framing error. This error is unrelated to a frame sequence number error.
grant session message	Data link layer message used by the receiver during the link establishment phase when the receiver can receive information.
half-duplex	ANSI terminology used to describe a data link duplexity where both stations may transmit, but only 1 at a time. Same as CCITT simplex.
handshaking	The mechanism for coordinating the transmission of data across a channel.
hexadecimal digits	The base 16 number system.
i2i	An enabling technology used to improve access to instrument data for Informatics features and capabilities.
incremental transfer	The process of sending a single worklist entry or result value from 1 device to another.
interaction space	A set of data items logically grouped together for system input or output. An interaction space may be rendered on any output device. The navigational maps represent logical groupings of data items. These groupings should be implemented on the same screen.
interface	A shared boundary, such as an RS-232 port, that enables the system and other devices to interact.
interframe timeout	The period of time a receiving system waits for the next frame before assuming that the sending system is disabled.
intermessage timeout	Same as interframe timeout.

Term	Description
link establishment phase	First phase of an ASTM data link session. Establishes which system has control of the communications link to transmit data.
link release phase	Third and final phase of an ASTM data link session. Control of the communications link is released during this phase.
LIS	Laboratory information system. A computer used in a clinical laboratory or hospital to store and transmit worklist requests, test results, and patient information to and from laboratory instruments.
local query	A query transmitted by the system to a remote system.
message	A data string with a specific meaning transmitted over a communications channel. Should always have a descriptive word preceding it, for example, application message.
message transfer phase	Second phase of an ASTM data link session. Application message data is transmitted during this phase.
modulo	The number of values a variable has before it returns to a value of zero and repeats the set of values. For example, a single decimal digit has 10 values, from zero to 9.
negative acknowledgment message	Response sent by the data link layer of the receiving system to indicate that a frame was invalid.
No Response Timeout	The number of seconds the sender waits for a response to an <ENQ> from the receiver.
null field	A storage area in a data structure, such as a record or database table, that is empty.
null string	An empty character string.
online	An online state of the system indicates that it is connected to the LIS computer and is in proper communication.
parity checking	A character error detection code that uses the binary digits of the data bits and any existing parity bit, in which the total number of 1s in each encoded character is even or odd. The parity bit is set to 1 or 0, or the parity bit is non-existent. The names of the 3 parity checking schemes are EVEN, ODD, or NONE, respectively.

Term	Description
parse	To associate character strings (data) with the component names of the specific message.
physical layer	Layer 1 of the ASTM communication protocol. Concerned with the electrical, mechanical, and timing aspects of signal transmission over a medium.
PID	Patient ID. Any character string used by the operators of the system to identify a patient.
placer	The application originating a request for services (order).
point-to-point	A configuration in which exactly 2 stations share a transmission path.
positive acknowledgment message	Response sent by the data link layer of the receiving system to indicate that a frame was valid.
positive acknowledgment with interrupt message	Response sent by the data link layer of the receiving system to indicate that a final frame was valid and the receiving system has a data link message to transmit.
profile	A defined group of tests selected for a sample.
protocol	The set of conventions that applies to the format and relative timing of the way messages transmit between the communicating devices.
query	A request for information from the receiving system. This may refer to the record that defines the request or to the message that contains the query record.
query timeout	The number of seconds the system waits to receive a reply to a query.
receiver	The computer system that receives data segments during a data link session.
recognized test	Any test defined on the instrument system. A recognized test may also be referred to as a valid test.
remote query	A query sent by a remote system and received by a system.
remote system	The device on the other end of the physical connection between 2 communicating devices. Generally in this document, the remote system is an LIS, a general purpose computer, or test equipment that is connected to the system.

Term	Description
replicate	A single instance of data or related set of data with a 1-to-1 relationship. In the context of a database, a single row of data in a table.
request session message	A data link layer message used by the sender during the link establishment phase to request control of the communications link.
repeat	A test that is repeated for a sample to increase confidence in the reported value or to correct an error condition that occurred the first time the test was run.
response	A reply to a query.
results database	Database on the system where the test results and demographic information are stored.
RS-232	A physical layer interface standard for the interconnection of computer systems.
sample type	The kind of sample that is scheduled and loaded on a rack. For the system, the sample types are patient, control, and calibrator.
semantics	The relationships of characters or groups of characters to their meanings. This relationship is independent of the way these symbols are interpreted and used.
sender	The computer system that sends data segments during a data link session.
severity	The rating of the seriousness of an event. A failure or error condition is the most severe (highest severity), informational messages have the lowest severity, and warnings are of medium severity.
shutdown	The state of the LIS communication indicating that the system is not connected to the LIS computer.
SID	Sample ID. A character string used by the operator of the system to identify a sample.
simplex	CCITT term used to describe a data link duplexity in which both stations may transmit, but only 1 at a time. Same as ANSI half-duplex.

Term	Description
standby	The state of the system when there is a communication error. This indicates that user intervention is required to verify the communication between the instrument and the LIS computer. During standby state, all results and queries that are sent to the LIS is queued in DM until proper connection is restored.
startup	The events that occur when the system initiates the software and the login screen displays. Also called power up or reboot.
stop bits	Bits used for character synchronization by the physical layers of the sending and receiving system. Set to 1 or 2. The default is 1. Two stop bits increase confidence in synchronization, but reduce throughput.
stop-and-wait	A flow control protocol in which the sender transmits a frame of data and then waits for an acknowledgment before transmitting the next frame.
terminate session message	Data link layer message used by the sender during the link release phase to release control of the communications link.
upload	To send data from the system to a remote system.
worklist	A list of scheduled samples, controls, and calibrators, that includes identification and requested tests for each entry.
worklist database	The database on the system in which test requests and demographic information are stored.

A