SIEMENS Healthineers

Atellica™ Solution

Atellica™ Solution

LIS Interface Guide

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The information in the printed customer documentation was correct at the time of issue. See *Accessing Product Information in the Document Library* for current information.

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1 Using This Guide

2 Laboratory Information Systems

3 ASTM Protocol

4 HL7 Protocol

5 LIS Troubleshooting

1 Using This Guide

This guide provides information on connecting Atellica ™ Solution to a Laboratory Information System (LIS):

- 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 the operator uses for communication
- Configuring application layer settings
- Configuring values the operator uses in datalink layers
- Configuring physical connection settings

Configuration varies depending on the selected protocol. All systems may not support some of the functionality this guide describes. See Atellica Solution online help for additional information.

Document Conventions

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

Convention	Description
NOTE:	Additional information that requires the operator's attention.
Bold	Bold type indicates commands on the user interface. For example, if the word save appears as **Save** (bold), it refers to the selecting the Save button on the user interface. If the word welcome appears as **welcome** (bold), 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 describes terminology in this guide and the specific actions that the operator needs to take.

Term	Notes
Select	To select an item, the operator uses a finger to touch the item on the touch-screen monitor or selects the item with the system pointing device. The background of the item changes color or displays a black frame to indicate the selected item.
Enter	The operator can 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 are for guidance only. Actual instrument field values will vary depending on the attached system.

Accessing Product Information in the Document Library

1. In a browser, such as Internet Explorer, enter siemens.com/document-library.
2. Login following the on-screen instructions.
3. Search for assay or system information.

2 Laboratory Information Systems

About Types of Information Transfer

Atellica Solution can connect to a laboratory information system (LIS) to exchange data.

Atellica Solution receives worklists and transmits results to the LIS.

Atellica Solution, the operator, or the LIS initiates these transfers.

Atellica Solution can also send result data automatically to the LIS. Atellica Solution generates automatic requests for worklist data when it detects a new sample. The transfers are incremental (a single result or query for a single worklist entry) or batch. Atellica Solution and the LIS exchange incremental and batch transfers.

About Operator-Initiated Transfers

When Atellica Solution establishes communication, the operator can transfer data by selecting a single sample or multiple samples. Atellica Solution sends the data, associated with the selected samples, to the LIS.

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

About LIS-Initiated Transfers

When Atellica Solution establishes communication, the LIS can send worklist entries to Atellica Solution. This transfer can take place at any time.

About Automatic System-Initiated Transfers

When Atellica Solution establishes communication, it can automatically transfer diagnostic, query, order, and results messages,. based on availability.

- If Transmit Results by Sample is selected, Atellica Solution sends test results when all results are final for the current order.
- If Transmit Results by Sample is not selected, Atellica Solution sends results to the LIS as tests get resulted which are not on hold. Atellica Solution does not wait for all the test results.

Atellica Solution can automatically request worklist entries from the LIS.

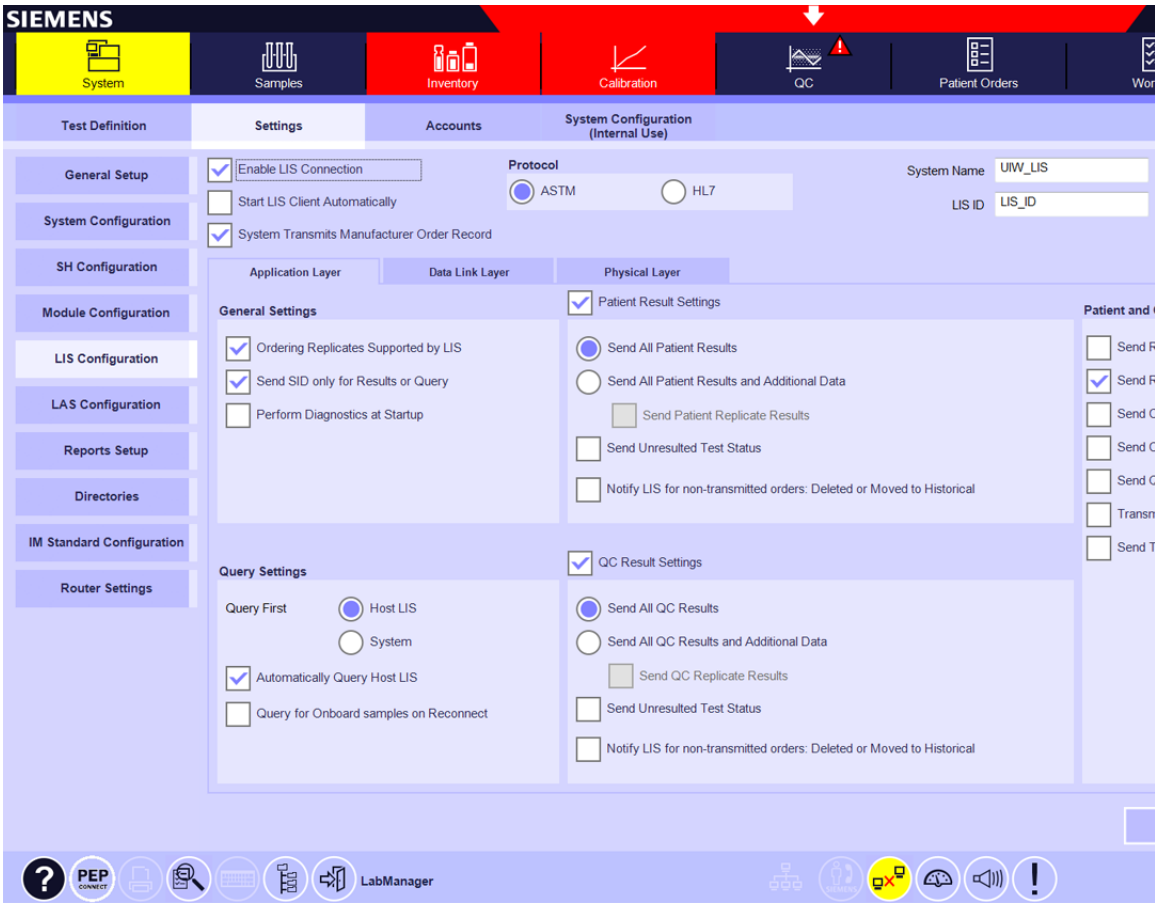
Atellica Solution can transfer data for a single sample or multiple samples. Atellica Solution sends the data, associated with the selected samples, to the LIS.

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

Establishing LIS Communication Settings

NOTE: Throughout this document, settings apply to both ASTM and HL7 protocol unless otherwise specified.

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



- Settings are protocol specific. All options are not available on all connected instruments.

- Atellica Solution retains the most recently-saved communication settings the next time the operator opens the user interface. The Audit Trail log captures any changes to these settings.
- Atellica Solution prompts the operator when making a change. Select Yes to confirm or No to cancel. A message displays that Atellica Solution saves any changes.
- Change configuration settings only when LIS Communication is turned off. Atellica Solution applies any changes when LIS Communication is turned on.

User Types, Permissions and Auditing

User Type	Default Security Access	Possible Privileges
Laboratory Manager	FA	FA, RO, NA
Customer Service Engineer	FA	FA, RO, NA
Chief Technician	FA	FA, RO, NA
Day Time Operator	FA	FA, RO, NA
Night Time Operator	FA	FA, RO, NA

All new users are granted full access rights (FA). Administrators can change these rights to read only (RO) or no access (NA).

The audit (trail?) log captures all changes the operator makes to Atellica Solution configuration. The audit log documents the current user, the change made, and time and date of the action.

Completing the LIS Configuration Settings

Enable LIS Connection specifies whether Atellica Solution is configured to connect to the LIS or middleware computer.

When the Enable LIS Connection check box is checked (on), a **Data sent to the LIS is not encrypted** message displays.

When the check box is unchecked (default) none of the LIS related features are available and the LIS Communication dialog window Status area displays the message: **Disabled.**

1. On the Command bar, select **Setup > Settings > LIS Configuration**.
2. Select **Enable LIS Connection**.
3. After enabling LIS Configuration, select **Start LIS Client Automatically**.

NOTE: This option is enabled by default. If this option is selected, the LIS will automatically connect on system startup. If this option is not selected, manually restart the LIS when restarting Atellica Solution.

4. (ASTM only) Select System Transmits Manufacturer Order Record. Defines if the system transmits and receives the Manufacturers Order Record for QC samples using the American Society for Testing and Materials (ASTM) protocol.

   By default, this option is selected, and the rules specified for Manufacturer's Order Record apply. If Atellica Solution does not receive the Manufacturer's Order Record when this option is selected, the message is rejected.

   When this option is not selected, Atellica Solution does not transmit the Manufacturer's Order Record to the LIS and does not expect to receive the Manufacturer's Order Record from the LIS. Atellica Solution uses only the Sample ID and the Action Code in the incoming Test Order Record to identify the sample. If Atellica Solution receives a Manufacturer's Order Record while this mode is unselected, it ignores the record.

5. In the Protocol area, select the protocol for the connection.

   NOTE: ASTM protocol uses 8-bit, single-byte characters. Sending non-8 bit ASCII values in the ASTM records to the LIS causes invalid data in those fields.

6. In the System Name text box, enter the name of the Atellica Solution identifier.
7. In the LIS ID text box, enter the name to use for your LIS identifier.
8. **(HL7 Only)** Atellica Solution **Facility** is required for HL7.
9. **(HL7 Only)** The **LIS Facility** is required for HL7.

Completing the Application Layer Settings

1. On the Command bar, select **Setup > Settings > LIS Configuration.**
2. In the Application Layer area, select each option that applies to the LIS.

3. In the General Settings area of the Application Layer, select each option that applies to the LIS.

Ordering Replicates Supported by LIS	If the LIS supports the ordering of replicates, maintain the default setting of ON. If the LIS does not support the ordering of replicates, turn this setting off. Atellica Solution ignores the replicate field coming from LIS. See *About the Test Order Record* section O5.7 for details about the replicates field.
Send Sample ID (SID) only for Results or Query (ASTM protocol only)	Atellica Solution includes the rack ID with the SID to the host LIS. This data item defines whether Atellica Solution sends Rack IDs with the sample results or query to the LIS computer. When this option is selected (the default setting), Atellica Solution does not send the Rack ID with the results or query. When this option is NOT selected, Atellica Solution sends the Rack ID with the results/query.
Perform Diagnostics at Startup (ASTM only)	Atellica Solution sends diagnostic messages to the LIS when Atellica Solution starts. By default, this option is disabled and Atellica Solution does not transmit diagnostic messages to the LIS.

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

Query First	Select Host LIS or System to specify which system is queried first for an order. The default is to query the LIS first. When the user selects System, and the Atellica Solution queries and finds a specific order on the local database first, the Atellica System does not query the LIS for the same order. If the order is not found on the local database, the LIS is queried. The local order downloads to the instrument. The Atellica Solution does not send a query to the LIS, even when the LIS setting of Automatically Query LIS Host is also enabled. When the user selects Host LIS, the Atellica Solution queries the LIS first for a specific order and the order does not download from the LIS, the local database should be checked for the order, and if present, process that order.
Automatically Query Host LIS	Atellica Solution queries the Host LIS for worklist entries as Atellica Solution identifies each sample. When this is selected, the Atellica Solution must wait for the response from the LIS to a query for work before the system sends any record to the LIS. A transmission from the Atellica Solution cannot interrupt the query response from the LIS. If Automatically Query Host LIS and LIS Query First are enabled, the system queries the Host LIS for order entries as the system identifies each sample.
Query for Onboard Samples on Reconnect	If Automatically Query Host LIS check box is selected, the Query for Onboard Samples on Reconnect check box is enabled and selectable. When checked, Atellica Solution automatically queries the LIS for orders for all onboard samples at the time the LIS connection failed.

5. Select each option in the Patient Result Settings check box that applies to the LIS.

   NOTE: If this check box is not selected, Atellica Solution does not send Patient results to the LIS.

Send All Patient Results	Atellica Solution automatically sends all Patient final results to the LIS except results on hold. By default, this option is selected.
Send All Patient Results and Additional Data	Atellica Solution automatically sends all preliminary and final results, except results on hold, to the LIS. The operator can select this check box to transmit replicate results with the patient result. When Send All Patient Results and Additional Data is selected, the Send Patient Replicate Results check box is enabled.
Send Patient Replicate Results	When the Send All Patient Results and Additional Data is checked, the Send Patient Replicate Results check box is enabled. If this check box is not checked, additional data does not include the patient replicate results.

Send Unresulted Test Status	Atellica Solution sends information to the LIS about any test that the system could not result. By default, this option is not selected and the Atellica Solution does not send this information to the LIS.
Notify LIS for non-transmitted Orders: Deleted or Moved to Historical	Atellica Solution sends a notification message to the LIS when the operator deletes or moves any untransmitted orders (Pending New, InProcess, Intervention Needed, Completed Sample States) to Historical. **Note** The system only sends notification to the LIS when the operator selects the deletion or move to historical operation from the Worklist. The system does not send notification to the LIS when the delete order command is system-initiated (for example, from the LIS) or the operator performs the Move to Historical maintenance activity.

6. Select each option in the QC Result Settings area that applies to the LIS.

   NOTE: If this check box is not selected, Atellica Solution does not send QC results to the LIS.

Send All QC Results	By default, Atellica Solution automatically sends all final QC results to the LIS computer except results on hold.
Send All QC Results and Additional Data	Atellica Solution sends all preliminary and final QC results, except results on hold. By default, this item is not selected.

Send QC Replicate Results	When the operator selects the previous Send All QC Results and Additional Data, this check box is enabled. Select Send QC Replicate Results to have QC replicate results transmitted with the QC result.
Send Unresulted Test Status	Atellica Solution sends information to the LIS computer about any test that could not be resulted. When this option is selected and the operator can no longer do work for a test, the system transmits a Test Order record to the LIS with an "X" in the Report Type field. The system also transmits an Error Comment record that describes a general reason why the test has no result.
Notify LIS for non-transmitted Orders: Deleted or Moved to Historical	Atellica Solution 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. Select each option in the Patient and QC Result Settings area that applies to the LIS.

Send Reagent	Atellica Solution transmits the reagent information used to generate the result to the LIS.
Send Ratio Components	Atellica Solution sends the results of ratio test components with the ratio test result to the LIS.

Send Components of a Multicomponent	Atellica Solution sends the results of the component tests with the multicomponent test result to the LIS. **Note** By default, Atellica Solution does not send the component results with the ratio or multicomponent test result to the LIS computer.
Send Calibration	Atellica Solution transmits the most current Calibration information (Calibration Lot, Calibration Date/Time, Calibration Status) used to generate the result to the LIS in a result's associated Result Comment record.
Send QC	Atellica Solution transmits the most current QC information (Control Lot, Control Name, Control Level(s), Control Result, Control Result Date/Time) used to generate the result to the LIS in a result's associated Result Comment record.

Transmit Results by Sample	Atellica Solution transmits results for patient or QC tests only when all tests in each sample order have final results. If the operator does not select this option, Atellica Solution 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 on a test-by-test basis).
Send Transmitted Results	Tests results only automatically retransmit (transmitted again) if the operator checks this option. The default setting for the Send Transmitted Results option is OFF, and Atellica Solution does not retransmit automatically. If Send Transmitted Results is ON and Additional Data is ON, All Results (Preliminary, Repeats: (Auto, LIS, Manual) transmit when all tests in the sample are complete.

Completing the Data Link Layer Settings

1. On the Command bar, select **Setup > Settings > LIS Configuration**.
2. Enter a Frame Size between 240 and 64000 (ASTM only).

   NOTE: The frame size must match the connected LIS. Consult with the LIS documentation to determine the LIS frame size.
3. To set the amount of time given before Atellica Solution checks the local database, enter a Query Timeout value.
4. **ASTM Only:** To set the number of seconds Atellica Solution 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.
5. To set the number of seconds Atellica Solution waits if a timeout occurs when the receiver is waiting for a frame, enter an Interframe Timeout value.(ASTM only)

   NOTE: Acceptable values are from 30 seconds to 99999 seconds.
6. To set the number of seconds Atellica Solution waits when it receives a busy message from the LIS, enter a Busy Timeout value. (ASTM only)

   Acceptable values are from 10 seconds to 99999 seconds.

   NOTE: ASTM protocol allows only one outstanding query at a time.
7. Continue with the Physical Layer.

Completing the Physical Layer Settings

The operator can configure ASTM protocol to communicate via a a TCP/IP connection.

To establish a TCP/IP connection:

1. On the Command bar, select **Setup > Settings > LIS Configuration**.
2. Enter the LIS IP address of the local LIS computer.
3. Enter an LIS Port number between 1 and 10000.

   NOTE: Do not use a port that is already in use.

   NOTE: The LIS configuration at the LIS and Atellica Solution must match exactly.
4. Enter a System Port number between 1 and 10000.
5. **Send Keep Alive** (ASTM Only) is selected by default. When checked, Atellica Solution will periodically monitor the TCP/IP connection status.

NOTE: HL7 protocol has 2 communication channels so Atellica Solution requires two network connections. The LIS Port is the network connection that supports LAB-27 Query for AWOS Transactions and LAB-29 Status Change Transactions from Atellica Solution. The System Port is the network connection that supports the LAB-28 Order Transactions from the LIS.

Requesting Previous Test Results from the LIS

If you have selected the ASTM Protocol, you can enable Atellica Solution to request previous test results from the LIS (Delta Checks).

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

About Communications Diagnostics

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

- LIS Communication

  The operator can select the LIS Communication icon on the Task bar to display the current status of the LIS connection. Using this tool the operator can change the status and run diagnostics on the connectivity between Atellica Solution and the LIS or other remote devices.

- LIS Logs

  The operator can view the log of LIS activity selecting **System > Logs > LIS Logs**.

About LIS Communication Status

The operator uses the LIS Communication Status dialog box to view and change the current status of the LIS. When a communication error occurs, Atellica Solution puts LIS communication into an automatic standby state, and Atellica Solution queues all results and queries until the connection status changes to online.

The LIS status access button on the Status Bar displays the current LIS communication status and the LIS Communication Display Window displays status messages.

The connection status can be 1 of the following:

- A solid yellow background indicates that the LIS connection is in Standby.

- A green checkmark indicates that Atellica Solution and LIS are in Connected state.
- A red X on a yellow background indicates that Atellica Solution is disconnected from the LIS.

The operator can request the LIS communication status to be connected (online) or to be disconnected (shutdown) from the LIS Communication dialog window.

- Change the connection state from the Standby or Disconnected to Connected by selecting **Connect to LIS** in the LIS Communication dialog window.
- Change the connection state from Connected state or Standby state to Disconnected by selecting **Disconnect** in the LIS Communication dialog window.

  Note If the operator selects **Disconnect** and there are pending queries and messages, a message displays prompting the operator to confirm the disconnection.

Using the LIS Communication Status Window

1. On the Status bar, select the **LIS Communication** icon. (ASTM only)
   The LIS Communication icon displays with the color indicating the current status.
2. On the LIS connection window, select the options as needed:
   - To open a connection to the LIS, select **Connect to LIS**.
   - 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

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

3. Select **Diagnostics**.

   Atellica Solution sends a diagnostic message 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.

Message	Description
Diagnostics in progress	Atellica Solution is sending a diagnostic message to the LIS.
OK	The LIS acknowledges the message indicating a successful communication.
Sent	Atellica Solution successfully sent a message to the remote system.
Failed to Receive	Atellica Solution received an invalid diagnostic message.

4. If no status messages appears or if a Failure message appears, check the Operator Event Log.

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 *ASTM Application and Data Link Layer Interaction*, page 36. Atellica Solution sends this diagnostic message to the remote system using the data link protocol.

The diagnostic message ensures:

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

3 ASTM Protocol

About Layered Communications Protocol

Atellica Solution uses a 3-layered communications protocol. Each layer performs a related subset of the functions that Atellica Solution 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 Atellica Solution receives and transmits incoming and outgoing application messages 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 Atellica Solution.

Communication protocol standards are defined for each layer. For Atellica Solution to communicate with a laboratory information system (LIS), both systems must conform to the same 3-layered protocol.

About Layers and Messages

Atellica Solution and the LIS are connected at the physical layer and 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.

Atellica Solution passes messages down or up from layer to layer, with each layer adding or removing its own protocol data to or from the given message. The following sections describe the application and data link messages.

About 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 the LIS sends to Atellica Solution 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 other ASTM records, and ending with an ASTM termination record. Each ASTM record is a variable length record terminated by a carriage return character (<CR>). The following is a simple ASTM application message that requests a T4 test for sample S19255.

H| \^& | <CR>

P| 1 <CR>

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

L|1|F<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 Atellica Solution, see the *About ASTM Application Layer Protocol*.

When Atellica Solution receives the application message, as shown above, Atellica Solution 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 that Atellica Solution transfers or receives is called a data link message. The data link message can consist of 1-1000 characters. When the data link layer receives an application message to transmit 1 message that contains multiple records, Atellica Solution divides messages longer than the configured frame size into multiple intermediate frames followed by 1 final frame.

ASTM Protocol using TCP/IP supports data frame sizes between 240-64000 characters. The operator enters a value in the text box between 240 to 64000. An error displays if the operator enters a value less than 240 or greater than 64000.

Each frame is variable in length and has a maximum size of the configured frame size that includes all data and protocol characters. The data link layer sends the message using as many frames as appropriate. See *Completing the Data Link Layer Settings*.

Backus-Naur Form (BNF) notation defines a data link message that contains data link message symbols and ASCII mnemonics:

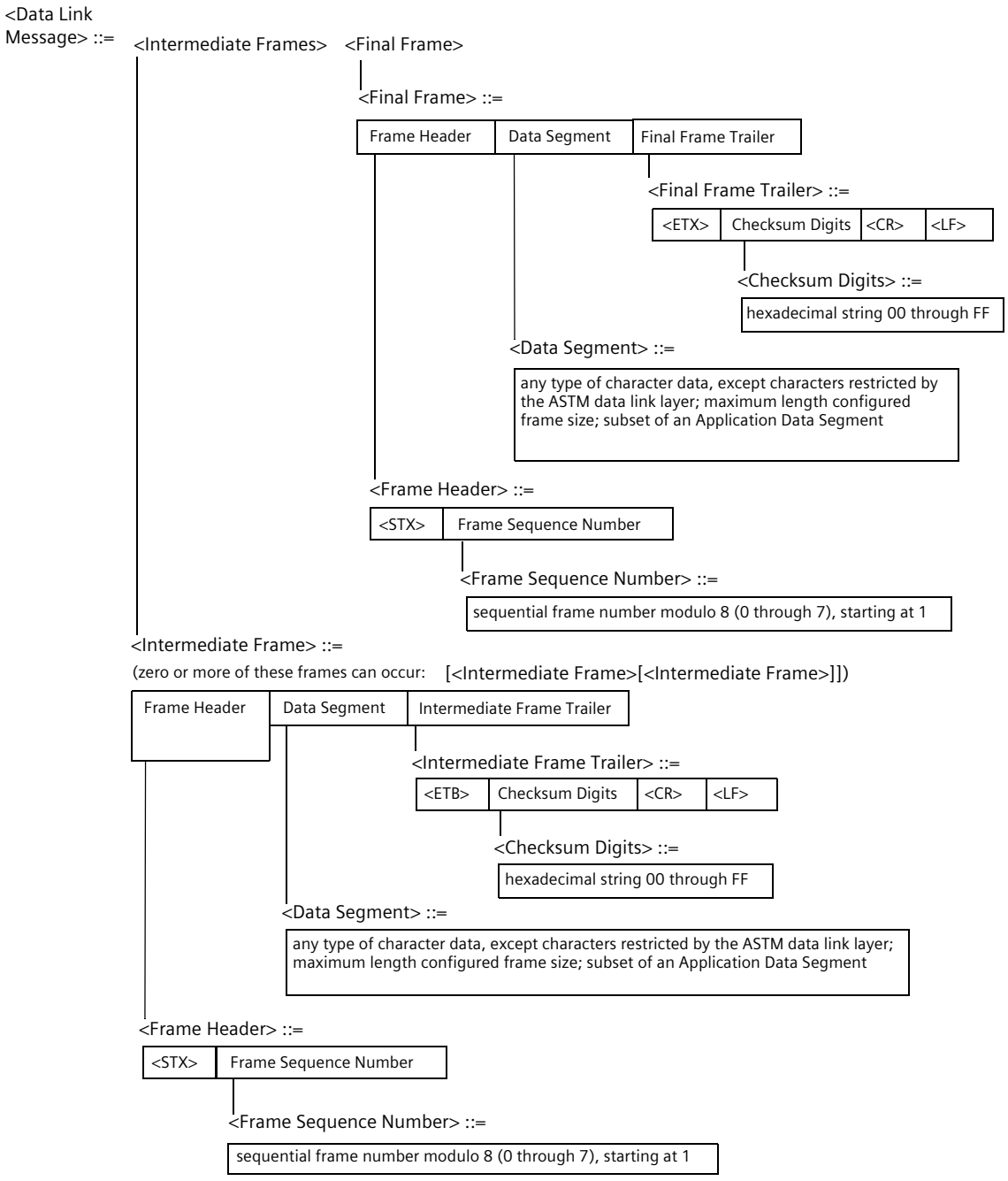
<Frame Header> ::= <STX> <Frame Sequence Number>

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.



The ASTM data link protocol is a half-duplex (ANSI definition) or simplex (CCITT definition) stop-and-wait protocol. Atellica Solution or the LIS system can transmit data to each other, but only 1 at a time. The ASTM data link protocol has the following 3 handshaking phases that define an ASTM data link session:

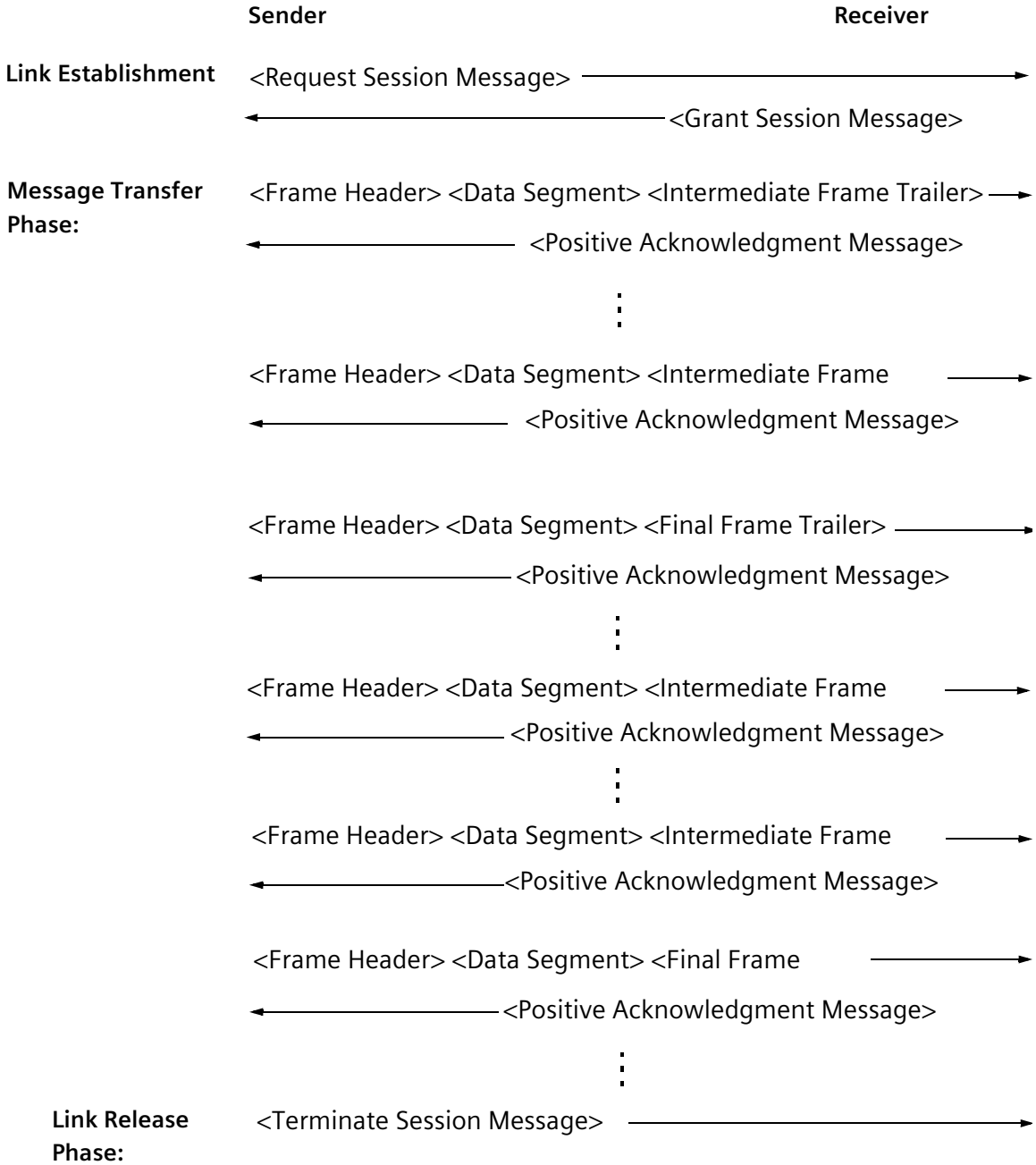
- link establishment phase
- message transfer phase
- link release phase

The link establishment phase and the message transfer phase require a transfer of the character(s) the sender initiates, followed by a response by the receiver. The link release phase only requires a transfer by the sender. 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. Sender and receiver are abbreviated as S for sender and R for receiver.

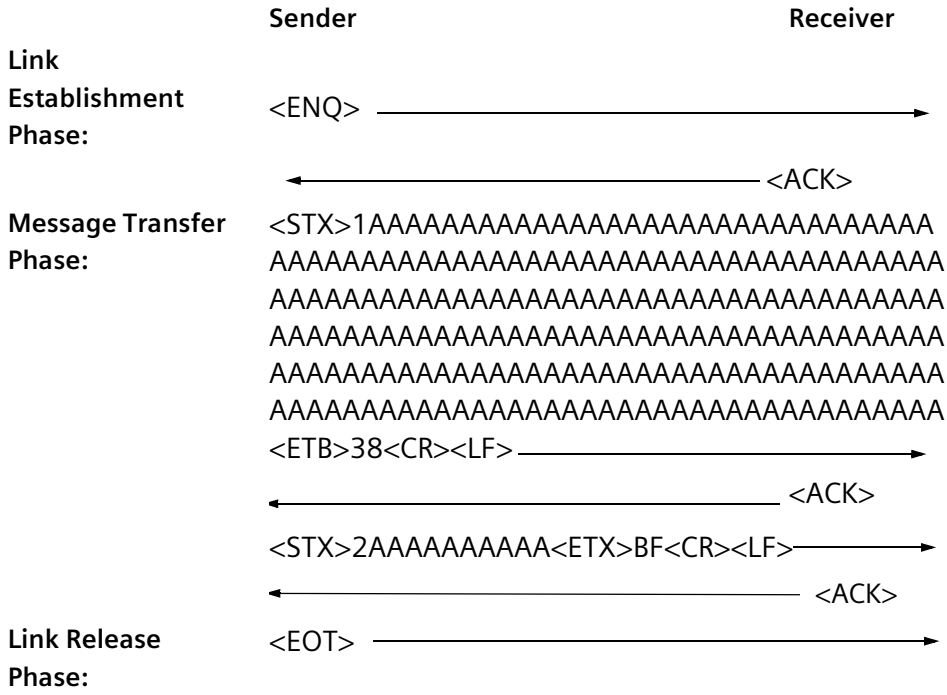
Link Establishment Phase
S:<Request Session message> ::= <ENQ>
R:<Grant Session Message> ::= <ACK>
<Deny Session Message> ::= <NAK>
Message Transfer Phase
S:<Frame> ::= <Intermediate Frame> or <Final Frame>
R:<Positive Acknowledgment Message> ::= <ACK>
<Negative Acknowledgment Message> ::= <NAK> or anything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

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



For a complete description of the ASTM data link layer, see ASTM document E1381-95.

The following example shows an ASTM data link layer session with actual data. In this figure, Atellica Solution needs to send an application message of 250 A characters from 1 system to another. Actual ASCII character mnemonics replace all of the ASTM data link symbols.



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	Atellica Solution sends messages in frames. The ASTM Protocol using TCP/IP supports data frame sizes from 240--64,000 characters. Atellica Solution divides messages longer than the configured frame size must be divided between 2 or more frames. Atellica Solution never combines multiple messages in a single frame. Every message must begin in a new frame. There are 2 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.

About the Physical Layer

The physical layer transmits and receives a bit stream of data across the physical medium. The data link layer passes down transmitted data 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.

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

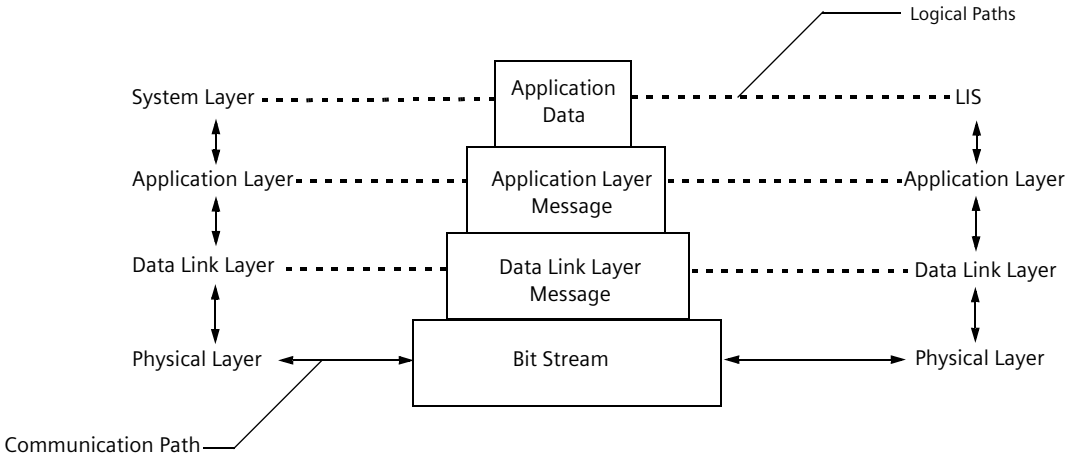
Interaction Between Layers

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

Atellica Solution passes down an application message 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 Atellica Solution passes the application message through each layer, each layer adds or removes its corresponding protocol data.

The application layer software generates and transmits messages to the other layers. The data link and physical layers transmit messages to the remote system.

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 cohesive and independent.



In the example shown on page 29 the ASTM session transmits 250 A characters. If this is what the application layer needs to transmit, the data link layer attempts to transmit it. The data link layer looks at the data to determine the number of frames and to calculate checksums, but the software that performs data link layer services is not involved with the construction or content of the application data segments.

ASTM Application and Data Link Layer Interaction

The ASTM protocols for the application and data link layers do not specify what interface to use between these 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. The application layer at the transmitting system can transfer data to the data link layer at the transmitting system on any character boundary.

Atellica Solution 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.

Atellica Solution passes messages down or up from layer to layer, with each layer adding or removing its own protocol data to or from the given message. Each layer has its own definition of a message. The following sections describe the application and data link messages.

About 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 does not process the partial record until the data link layer passes enough data segments to complete the record. When 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 Atellica Solution ASTM data link layer passes data segments to the application layer as it successfully receives each intermediate or final frame. Because the Atellica Solution ASTM application layer can accept application messages as a stream, the Atellica Solution ASTM data link layer does not have to concatenate individual data segments from intermediate and final frames to rebuild the original application data segment.

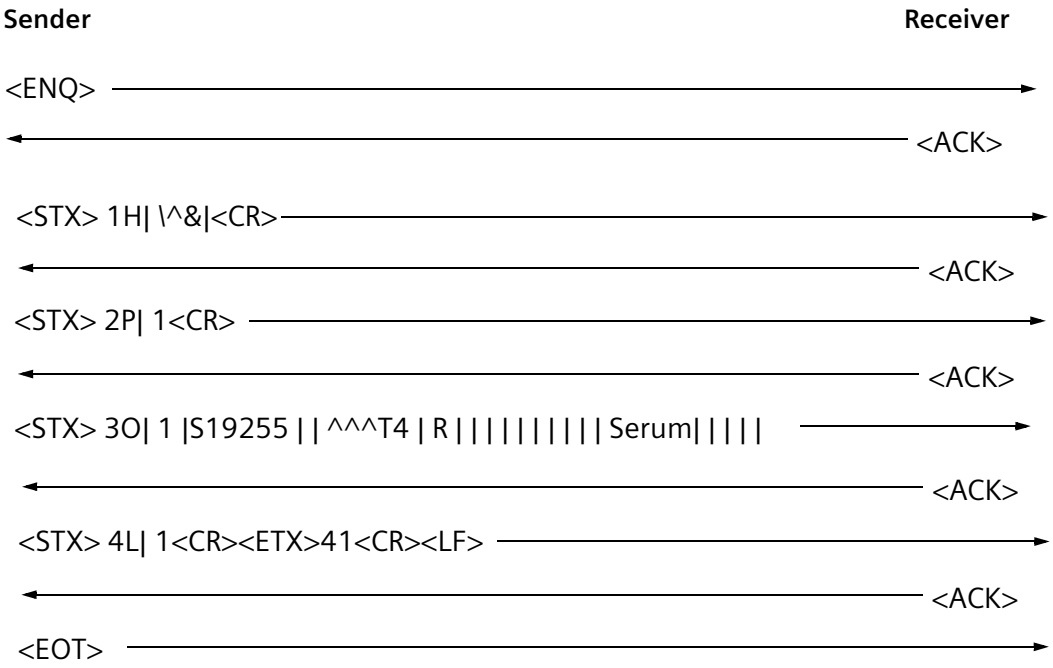
Handling concatenation at the data link layer requires an unknown amount of memory at the data link layer because a single application data segment can contain thousands of characters, but the longest data link layer data segment can have only the maximum configured frame size.

About Implementation of Incoming Messages

Atellica Solution usually passes ASTM application messages to the data link layer on a message-by-message basis, which 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 Atellica Solution.

Implementation is not required to conform to the message-by-message implementation on Atellica Solution. For example, the operator could configure Atellica Solution to pass the message down to the data link layer on a record-by-record basis. *About ASTM Application Layer Protocol* shows an ASTM test order message session using this implementation, which is suitable if there are memory constraints and an entire message cannot be completely generated before transmitting it.



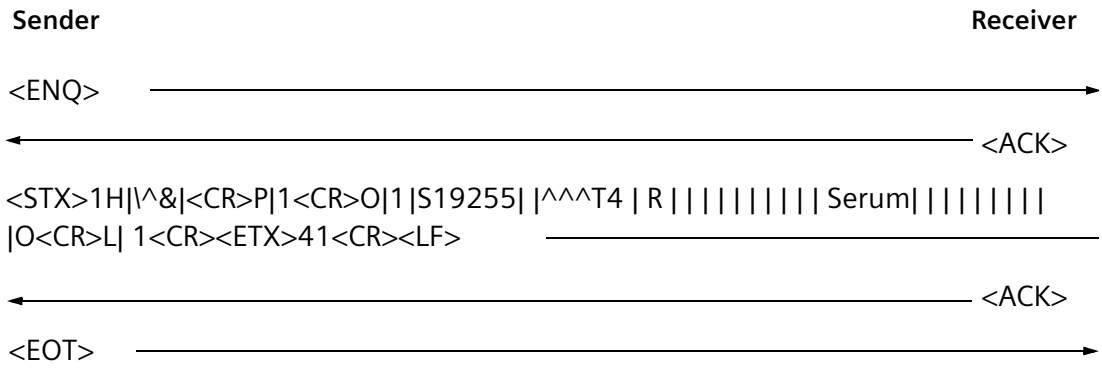
About Interaction Between Layers on Outgoing Messages

Atellica Solution must process incoming ASTM application layer messages as a stream. The specifications 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.

About Implementation of Outgoing Messages

Based on the generated message, the outgoing application layer software constructs a single ASTM application message and passes it to the ASTM data link layer software. These messages consist of multiple ASTM application records. Atellica Solution 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.

ASTM Test Order Message Session with Software Events



About the Physical Layer

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

About TCP/IP Connection

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

About ASTM Data Link Layer Protocol

Atellica Solution supports standard data link layer protocol as described in ASTM document E1381-91. This section describes the protocol supported by Atellica Solution.

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 Atellica Solution receives data in the correct order. Flow control allows the receiver to control the rate at which Atellica Solution accepts data. Error detection and recovery ensure that Atellica Solution receives correct data.

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 that the application layer generates. Some restrictions are placed on characters allowed in the data message. These restrictions avoid confusing application data with data link protocol control sequences.

About Link Establishment

When data becomes available for transmission, the sender (either the LIS or Atellica Solution) 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 waits until the other system relinquishes control. Otherwise, Atellica Solution 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 determines 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 determines 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.
- The third outcome is that the sender receives a request session message from the receiver. Contention occurs. 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.

  Note To avoid a second contention situation, the contention delay timers on the 2 systems are significantly different. Atellica Solution 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. Atellica Solution does not recognize other characters or characters with errors such as parity errors. The sender considers such replies as though Atellica Solution has received no characters.

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

About 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).

About Message Framing

Atellica Solution sends messages 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 that the application layer generates. The frame trailer is a control sequence that signals 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 the configured frame size, the text is split into multiple transmitted message frames. Atellica Solution copies text from the application message buffer to the transmit buffer. If the entire application message text fits in a single frame, Atellica Solution sends the message as a final frame message. If the entire application message text does not fit in a single frame, Atellica Solution sends the part of the message that does fit as an intermediate frame message.

When Atellica Solution successfully transfers the intermediate frame message to the receiving side, it copies more of the message text to the transmit buffer. This process repeats until the receiving side receives all of the application message text, the last frame being a final frame.

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

Frame Sequence Numbers

Atellica Solution uses frame sequence numbers to ensure that the receiver accepts data in the correct order. 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 are given sequential numbers If the number exceeds the high value of 7, the sequence number resets to the low value of zero. Atellica Solution sends a retransmitted frame with its original sequence number. After link release and a new link establishment, sequence numbers start again with the initial sequence number.

About Frame Checksum

Frame checksum detects errors in the frame that character parity checking does not detect. The frame checksum coverage ranges from the second character of the header to the last character of the trailer before the checksum itself. Atellica Solution uses a binary sum algorithm, formatted as the ASCII representation of its hexadecimal value (modulo 256) in 2 digits with leading zeros, a range of 00–FF.

About 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, Atellica Solution can enter the termination phase (link release). If the transmitting system releases the link, Atellica Solution waits for at least 15 seconds, or 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 Atellica Solution does not wish to release the link, the next frame starts. 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 Atellica Solution sent the maximum number of retries (6) for 1 frame, Atellica Solution notes the message 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.

About 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.

About Error Detection and Recovery

Types of communications errors:

- Character errors
- Checksum errors
- Sequence errors
- Timeouts

Atellica Solution detects character errors 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. Atellica Solution responds with a negative acknowledgment to any frame containing a character error.

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, Atellica Solution defines the frames as a retransmission and positively acknowledges it. Otherwise, the sender and receiver are out of synchronization. Atellica Solution considers any frame containing a frame synchronization error as an invalid frame and is responds with a negative acknowledgment.

Timeouts can occur whenever 1 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.

About Flow Control

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

The receiver uses flow control 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.

About ASTM Data Link Layer Protocol Events

The ASTM data link layer protocol consists of the following event types:

- Messages
- Timers
- Frame limits
- Miscellaneous characters

The following tables define ASTM data link protocol events:

Table 1: 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 240–64000 ASCII characters only. Next is the character <ETB>, ASCII value of 23, which is followed by a 2-character frame checksum (See *About Frame Checksum*, page 42). 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	Atellica Solution uses final frame message 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 only. 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 sender uses the terminate session message is used to relinquish control over the data link. ASTM protocol defines it as the single character <EOT>, ASCII value of 4.

Table 2: 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 Atellica Solution successfully received the last frame. ASTM protocol defines this message as the single character <ACK>, ASCII value of 6.

Event	Definition
Positive acknowledgment with interrupt message	The positive acknowledgment with interrupt message notifies the sender that the receiver successfully received the last frame and 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 on the part of the other system. Each timer uses 1 value in seconds.

Table 3: 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 4: 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 5: 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 64,000 characters as the limit.

About 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), Atellica Solution 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.

About Data Transfer and Processing

Data transfers from a source system to a destination system. If Atellica Solution is the source, then the LIS is the destination, or vice versa.

About Atellica Solution as Data Source

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

- 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 enables the automatic results transfer option, and the results are not on hold.
- Initiate requests for worklist data automatically or by operator command

About Transferred Data

If Send All Patient Results is selected at the LIS Configuration window, Atellica Solution sends only final results. Atellica Solution does not send calibrator results and invalid results from samples.

Atellica Solution 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 Send All Patient Results or Automatically Send All Patient Results and Additional Data are selected at the LIS Configuration window, Atellica Solution sends preliminary and final results. Examples of preliminary results include:

- Replicate results
- Results of all of the levels in a dilution profile, except selected result
- Dilution results that are out of range or overdiluted
- Results that Atellica Solution 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. Atellica Solution only sends ratio test components if Send Ratio Components to LIS is selected the LIS Configuration window.
- Results of all of the levels in a dilution profile/STMD except the selected result.
- Initial result when an auto-repeat is triggered.
- AFRR+ unselected results (only the selected result is considered as Final.)

Preliminary results do not include 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 LIS Configuration window, Atellica Solution sends both ratio test results, and component test results.

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

About Transmitted Results

Atellica Solution does not send calibrator results. It only sends patient sample and control results.

Atellica Solution can transmit a total minimum of 6 (six) results from up to 3 (three) different samples per second to the LIS host or middleware software. This means 6 total test results from all 3 samples.

Atellica Solution can receive 10 tests every 1.5 seconds from the LIS host or middleware software.

Transmitting Results Selected by the Operator

The operator cannot transmit results that are on hold.

System as Data Destination

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

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

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

As samples are loaded into the inprocess queue, Atellica Solution 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.

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

About Processing Data

When Atellica Solution receives data from an external system, Atellica Solution internally processes the data before adding the data to Atellica Solution database.

About Processed Worklists

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

When Atellica Solution uses external data to update an existing record in the database, Atellica Solution 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. Atellica Solution ignores null incoming fields.

The action code of the order record determines whether to select or deselect the test in the worklist database. If Atellica Solution recognizes any of the incoming tests, Atellica Solution adds patient demographic data and recognized tests to the worklist. If Atellica Solution does not recognize some of the tests, it returns an error message, and adds the recognized tests to the worklist. If Atellica Solution 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.

About ASTM Application Layer Protocol

Atellica Solution 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.

About 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, with each order record, or 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.

Atellica Solution attempts to conform to the E1394-91 ASTM standard. On incoming messages, Atellica Solution 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.

Atellica Solution scans all record types on incoming messages. Atellica Solution 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. Atellica Solution processes any records it receives prior to the record containing the fatal parse error. In order records, if the error is localized, Atellica Solution rejects only the affected test order. If the error extends to the entire order record, Atellica Solution rejects the whole record.

Atellica Solution 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, Atellica Solution scans the remainder of the record in accordance with the formats indicated for incoming records. Atellica Solution 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. Atellica Solution 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 Atellica Solution transmits a record of greater hierarchical significance or if Atellica Solution 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 Atellica Solution considers them as 1 level of significance less 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 Atellica Solution 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	A request for worklist entries message consists of a header record, a query record, and a termination record. The other system responds with a message containing worklist entries, results, or an empty message 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 responds 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, consisting 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. **NOTE:** The HL7 Protocol does not support a diagnostic test similar to that provided by the ASTM Protocol.

About 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 the ASCII standard defines (ANSI X3.4-1986). Atellica Solution permits the transfer of values in the range of 129–254, but transfers them to their corresponding 7-bit values. The ASCII value 13 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. Atellica Solution defines each field by its position in the record. Atellica Solution repeats fields if repeat delimiters separate them. 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 Atellica Solution receiving the record should remain unchanged or that the field is unused. A field that contains 2 double quotes (“”) indicates that Atellica Solution receiving the record should delete the corresponding field in the database. Any fields after the last field containing data can be left out of the record, that is, Atellica Solution truncates unused fields from the record. Atellica Solution assumes any field not present in the record null. An ASCII carriage return is used to indicate the end of the record.

Atellica Solution separates fields into components by 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. Atellica Solution 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.

ASTM supports escape sequences and uses the character & as the default escape delimiter. Atellica Solution does not support the escape sequences to start highlighting text (**&H&**), stop highlighting text (**&N&**), or the manufacturer defined escape sequence (**&Zcccc&**). Atellica Solution does not send such escape sequences and, if it receives them, removes them from data.

Atellica Solution 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, Atellica Solution 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. Atellica Solution converts each pair of hexadecimal digits to an ASCII value. For example, Atellica Solution converts characters &X40& to the ASCII character @.

If an escape sequence converts to an ASCII character not allowed in the database, Atellica Solution 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 Atellica Solution is more restrictive (date and sex fields), Atellica Solution considers the field in the record as null. If the field is Rack ID, Atellica Solution reports a non-fatal parse error and ignores the associated records, but processing of following records continues.

The contents and field sizes of records Atellica Solution generates and the worklist and results databases define the records Atellica Solution accepts. Refer to *page 63* through *page 139* 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.

About Record Data Contents

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

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

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. Atellica Solution uses this record 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. Separate result records specify the results of multiple tests. 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. Atellica Solution uses this 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)	No	Yes	The request information (query) record requests data from remote systems. Atellica Solution processes only 1 received query at a time. If Atellica Solution receives a second query while the first is processing, then Atellica Solution cancels both queries. Hierarchical Level: 1

Message Record	LIS to System	System to LIS	Description
Manufacturer's Test	Yes	Yes	Atellica Solution uses the manufacturer's test record for communication diagnostics to determine whether or not the physical, data link, and application layers are functioning correctly. Hierarchical Level: 1
Communications Error Comment	No	Yes	This record is an optional record that Atellica Solution uses to report a number of data specific error conditions to the LIS. Atellica Solution uses the record if some data specific error occurs that prevents Atellica Solution from performing the requested operation. When Atellica Solution uses this record, it transmits all data records in the hierarchy through the record that has the error, with the comment immediately following the record that has the error. Hierarchical Level: Dependent upon the error.

Message Record	LIS to System	System to LIS	Description
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 Atellica Solution 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. Atellica Solution 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.

About Header Records

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. Atellica Solution sets this to System Name at the LIS Configuration window.

Field Number	Field Name	Incoming Value	Outgoing Value
H10	Receiver ID	0–10 characters. Atellica Solution uses the Receiver ID to ensure that the received message is addressed to Atellica Solution. If the Receiver ID field is empty, Atellica Solution processes the received message. If the Receiver ID field exists and is not null, Atellica Solution compares it to the System Name at the LIS Configuration window. If the 2 fields are equal (case-sensitive comparison), Atellica Solution accepts the message for processing. If the 2 fields are different, Atellica Solution rejects the entire application level message and returns an error message to the LIS.	1–10 characters, default LIS_ID. Atellica Solution sets this to LIS ID field at the 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, Atellica Solution parses the incoming application message and processes all the data. If the Processing ID is D, system parses the incoming application message, but does not process the data. Atellica Solution uses debug mode for testing the ASTM application message format in a transmission between 2 systems.	Always 1 character, either P (Production) or D (Debug). Atellica Solution uses mode 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 0-255. 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 Atellica Solution, Atellica Solution accepts the current incoming message for processing. If the Version Number is greater than the version supported by Atellica Solution, Atellica Solution ignores the current incoming message.	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.:

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

About Patient Information Records

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 that is always an invalid Sequence Number. Atellica Solution formats this 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, Atellica Solution reports an error.	1–5 characters. Atellica Solution formats this as a left justified number with a range from 1-65,535. Equal to the nth occurrence of a patient record within the current outgoing application message. Validates 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. Atellica Solution writes this to the Patient ID (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 only for user information. The Atellica Solution worklist allows the same PID field to exist in multiple worklist entries.	0–20 characters. Atellica Solution sets this to the 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. This value is written to the patient Name field of the worklist entry or result. 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. Atellica Solution sets this 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.
P6.1	Last Name	0--50 characters. If > 50 characters, then 49 characters plus '#'.	0--50 characters. If > 50 characters, then 49 characters plus '#'.
P6.2	First Name	0--30 characters. If > 30 characters, then 29 characters plus '#'.	0--30 characters. If > 30 characters, then 29 characters plus '#'.
P6.3	Middle Name	0--30 characters. If > 30 characters, then 29 characters plus '#'.	0--30 characters. If > 30 characters, then 29 characters plus '#'.

Field Number	Field Name	Incoming Value	Outgoing Value
P8	DOB (Date of Birth)	0 or 8 characters representing ANSI X3.30 date format. These characters are written to the date of birth (DOB) field in the worklist entry. Atellica Solution sets the date format per Atellica Solution 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 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. This value is 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. This value is 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 establishes normal ranges for the sample.	0 or 1 character. This value is 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. This value is 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. This value is set to the Physician field of worklist or result entry.
P14.1	Physician ID	0–12 characters.	0–12 characters.
P14.2	Physician Name	0–112 characters If > 112 characters, then 111 characters plus '#'.	0–112 characters. If > 112 characters, then 111 characters plus '#'.
P15	Species	0–12 characters If > 12 characters, then 11 characters plus '#'.	0–12 characters If > 12 characters, then 11 characters plus '#'.

Field Number	Field Name	Incoming Value	Outgoing Value
P25	Patient Status	0–12 characters.	0–12 characters
P26	Location	0–20 characters. This value is 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. If > 20 characters, then 19 characters plus '#'.	0–20 characters. This value is 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	Mary A Jones
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

About the 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). Atellica Solution 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.

Atellica Solution retains up to 3 patient comments. If Atellica Solution sends more than 3 comments, Atellica Solution retains only the last 3 comments. The following table describes the appropriate values for each field:

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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 that is always an invalid Sequence Number. Atellica Solution formats this 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, Atellica Solution reports a fatal parse error.	1 character, in the range from 1--3. If a patient comment record is needed, Atellica Solution transmits up to a maximum of 3 patient comment records per patient record. Validates the integrity of the application message by ensuring that the message contains all records.
C3	Comment Source	0 or 1 character. Atellica Solution does not use this for incoming message processing.	0 characters, always empty.

Field Number	Field Name	Incoming Value	Outgoing Value
C4	Comment	1 component. Atellica Solution sets this to the Comment field of the worklist or result entry.	2 components. This is set to the Comment field of the patient sample or worklist entry.
C4.1	Comment Code	1-250 characters (maximum 249 plus #)	Always empty.
C4.2	Comment Text	Not used for incoming message processing.	1-250 characters (maximum 249 plus #)
C5	Comment Type	0 or 1 character. If the Comment Type field is empty or G (Generic), the comment record processes as a patient comment record. If the Comment Type field is any other value, the comment record processes as a general comment record Atellica Solution ignores it.	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)

About the Test Order Record

The Test Order record supplies information on a specific sample's test requests. This information is necessary 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 appropriate values for each field.

Rack ID Formats

The Test Order Record, sections O3.2 and O3.3, uses two formats for the Rack ID: Sample Handler (SH) and Direct Mode (DM). These are described below:

Sample Handler format:

[dddddd]-[A-E][1-11]

Sample Handler Example:

```
RackPos(Rack+tube)

123456-C1

Rack: 123456

Pos:C1
```

Direct Load format:

```
[A-H][A-H][dddddd]-[1-6]

[J-N][J-N]
```

```
[P-T][P-Z]
```

Example:

```
RackPos(Rack+tube)
AA123456-1
Rack: AA123456
Pos:1
```

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 that is always an invalid Sequence Number. Atellica Solution formats this 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, Atellica Solution reports an error.	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 ID (field component O3.2), and the Rack Position (field component O3.3). See *Rack ID Formats*, page 78. 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. The Component Delimiter character (^) separates each component of the Specimen ID. The operator can 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 LIS Configuration window, select Send Rack IDs with Results to send the Rack ID when it is available for the sample. The Component Delimiter character (^) separates each component of the Specimen ID. The operator can 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	0–20 characters. Optional field. Written to the SID field of imported worklist entry. If the worklist does not include an SID, it must include the Rack ID and position. If the worklist includes an SID, Atellica Solution stores the sample in the worklist as Schedule by SID. The field value is unique for all patient samples in the Atellica Solution worklist. Multiple quality control worklist entries can have the same Sample ID.	0–20 characters. This is set to the SID field of worklist or result entry.
O3.2	Rack ID	Format dependent on the instrument. Maximum length is 10 characters. Optional. (See *Rack ID Formats*, page 78. Atellica Solution uses this component with the Sample ID and is part of the Rack field.	Format dependent on the instrument. Maximum length is 10 characters. Atellica Solution uses this optional component with the sample position identifier and it is part of the Rack ID at the Patient Order window. At the LIS Configuration window, select Send Rack IDs with Results to send the Rack ID when it is available for the sample. **NOTE:** Atellica Solution does not send result(s) for a Rack ID Only Sample to the LIS.

Field Number	Field Name	Incoming Value	Outgoing Value
03.3	Rack Position	Dependent on the instrument. Maximum length is 4 characters. See *Rack ID Formats*, page 78. **NOTE:** If Atellica Solution receives an invalid SID or Rack Number/ Position Atellica Solution rejects the message and logs an event. specifies the physical location of a given sample designated by the Sample ID field. If Atellica Solution gives a value for the rack number identifier, then it must give a value for the rack position identifier. The value must have the format of Atellica Solution Rack ID values.	Dependent on the instrument. Maximum length is 4 characters.

Field Number	Field Name	Incoming Value	Outgoing Value
O5	Universal Test ID	List of tests where a multi-component field describes each and a Component Delimiter character (^) separates them. A Repeat Delimiter character (\) separates each group of components. If a test is unknown to Atellica Solution, it returns an error message to the LIS and continues processing the list of tests. The list of tests can contain any number of names. If a single Universal Test ID matches a ratio test, Atellica Solution automatically adds all tests associated with the ratio to the list of tests. Refer to field O12, Action Code, for processing of updates and cancellations of the tests. Refer to individual components (field components O5.1 through O5.6) for data format information.	List of tests where a multi-component field describes each and a Component Delimiter character (^) separates them. A Repeat Delimiter character (\) separates each group of components. 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 test result values that Atellica Solution reports in subsequent result records. The list of tests can contain from 1 up to the maximum number of tests Atellica Solution 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. Atellica Solution always ignores this component.	0 characters, always empty.

Field Number	Field Name	Incoming Value	Outgoing Value
O5.2	Universal Test ID Name	0 to any number of characters. Atellica Solution always ignores this component.	0 characters, always empty.
O5.3	Universal Test ID Type	0 to any number of characters. Atellica Solution always ignores this component.	0 characters, always empty.
O5.4	Manufacturer's Code	1 - 20 case-sensitive characters.	11 - 20 case-sensitive characters.
O5.5	Dilution Protocol (optional)	Dilute only, neat only, D, N, any of the supported instrument dilution protocols (e.g. x2) or <blank>. Atellica Solution sends D if O5.6 is populated. Blank is undiluted. Note: D, neat only, dilute only is reserved for XPR. When Atellica Solution sends D or dilute only, the LIS will always use the following coefficient (it cannot be <blank>).	The supported instrument dilution protocols or <blank>.
O5.6	Dilutions (optional)	The operator must define a dilution ratio 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. When the patient specimen type is not Whole Blood, Atellica Solution writes incoming orders to the Priority field in this order: S, A, R, blank. **NOTE:** Atellica Solution writes the Priority field of the incoming Test Order Record to the Priority field in the order as STAT for any patient order with a specimen type of Whole Blood, no matter the priority that the LIS sends. The priority field of a patient order with a specimen type of whole blood cannot be changed from STAT, even with an update to the priority field from the Host LIS. If the Priority field of any incoming QC Test Order Record is blank, the default priority in the order is ASAP.	1 character. This 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). Atellica Solution processes outgoing messages in the order, S, A, R (STAT, ASAP, Routine).

Field Number	Field Name	Incoming Value	Outgoing Value
O7	Order Date/Time	0 or 14 characters. A valid incoming Order Date/Time should be in the format: YYYYMMDDHHMMSS and contains a valid date and time, where time is optional. The field can be blank. If Atellica Solution specifies the date (YYYYMMDD) but not the time (HHMMSS), then the time is set to 12 AM midnight (00:00:00). If the Order Date/Time or Specimen Collection Date/Time is invalid, then Atellica Solution rejects the order.	0 or 14 characters.
O8	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), Atellica Solution processes this field as follows: If 1 of the Action Codes is C (Cancel Request), Atellica Solution cancels tests specified in Universal Test ID field O5 for the sample specified in field O3. If the Action Code does not specify Cancel Request, Atellica Solution interprets it as a New Request or an Add Request, depending upon the existence of an entry in Atellica Solution worklist for the Sample ID from field O3.1. Atellica Solution interprets empty and invalid Action Code fields as a New Request or as an Add Request, depending upon the existence of an entry in the Atellica Solution 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, Atellica Solution sets the Action Code field 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
012	Action Code (continued)	If the incoming Action Code is Cancel, Atellica Solution cancels the request for the test or tests specified in the Test Name field for the sample specified in the SID and Rack Number/ Position. Atellica Solution logs an event in the Operator event Log. The LIS cannot cancel a test that is in the In Process or higher state: Atellica Solution logs “cannot be canceled” message in the Operator event Log.	
O15	Sample Received (Optional)	0 or 14 characters.	0 or 14 characters.
O16	Specimen Descriptor	2 components.	2 components.

Field Number	Field Name	Incoming Value	Outgoing Value
O16.1	Specimen Type	A configurable set of specimen types (1 specimen type per order). For example: • Serum • Sputum • Saliva • Plasma • Urine • AmnioticFluid • RBCHemolysate • BufferBasedSolutions • Cerebal - see note below • OralFluids • WB - see note below • HDL • Other **NOTE:** Cerebal = Cerebral Spinal Fluid WB = Whole Blood	A configurable set of specimen types (1 specimen type per order). For example: • Serum • Sputum • Saliva • Plasma • Urine • AmnioticFluid • RBCHemolysate • BufferBasedSolutions • Cerebal - see note below • OralFluids • WB - see note below • HDL • Other **NOTE:** Cerebal = Cerebral Spinal Fluid WB = Whole Blood
O16.2	Specimen Source	Blank.	Blank.
O16.3	Manual Dilution (optional)	0–4 characters.	0–4 characters.
O25	Instrument (optional)	The Instrument or Instrument Module where the operator performs the requested test.	The Instrument or Instrument Module where the operator performs the requested test.
O25.1	System serial number	0-80 characters. (Optional)	0-80 characters. (Optional)

Field Number	Field Name	Incoming Value	Outgoing Value
O25.2	Module serial number	1-20 characters. (Optional) **NOTE:** If Atellica Solution downloads an Order with an invalid Module Serial number for the test, then it issues the following message: Invalid Module Serial Number {serial number} for test {test name} in SID {sampleID} or RID {rackID}. Message Code: MSG_InvalidModuleForTest	1-20 characters. (Optional)

Field Number	Field Name	Incoming Value	Outgoing Value
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, Atellica Solution defines the Report Type as O (Order). If the Report Type field is empty and if 1 or more result records are tied to the current order record, Atellica Solution assumes the Report Type is 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, Atellica Solution processes the order record 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|18653| |^^^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	Serum
O3.1	(Sample ID)	18653
O3.2	Rack Number ID	Blank
O3.3	Sample Position ID	Blank
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)

The following is an example of a dilution protocol name:

HCG^X50^50

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

O|1|18653^123456^A2| |^^^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	SID	18653
O3.2	Rack Number ID	123456
O3.3	Sample Position ID	A2
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
O16.1	Specimen Type	Serum
O26	Report Type	F (Final)

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

O|1|18653^123456^A2| |^^^HCG^dilute only^200|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	SID	18653
O3.2	Rack Number ID	123456
O3.3	Sample Position ID	A2
O5.4	Manufacturer's Code	HCG

Field Number	Field Name	Value
O5.5	Dilution Protocol	dilute only
O5.6	Dilution Ratio	200
O6	Priority	S (Stat)
O12	Action Code	empty
O16.1	Specimen Type	Serum
O26	Report Type	F (Final result)

Order Comment Record

Atellica Solution defines comments included after the order record as patient comments. See *About the Patient Comment Record, page 75,* and *Communications Error Comment Record*, page 134 for more information.

About the 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. Atellica Solution uses this record 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 appropriate values for each field:

NOTE: Atellica Solution 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 that is always an invalid Sequence Number. Atellica Solution formats this 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, Atellica Solution reports an error.	1 character, always 1. If a manufacturer's order record is needed, Atellica Solution transmits only 1 manufacturer's order record per order record. Validates the integrity of the application message by ensuring that the message contains all records.

Field Number	Field Name	Incoming Value	Outgoing Value
M3	Manufacturers Order Record ID	Atellica Solution uses 4 component fields to describe the manufacturer's record as an order record. The defined Component Delimiter character of the current message separates each component. 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 system order record. The defined Component Delimiter character (^) of the current message separates each component. 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, Atellica Solution treats the record as a general manufacturer's record and does not process it. If the Manufacturer component is SHD, Atellica Solution parses the Instrument component.	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, Atellica Solution treats the record as a general manufacturer's record and does not process it. If the Instrument component is CEN:NG, Atellica Solution parses the Record Version component.	0–10 characters, always CEN:NG.
M3.3	Record Version	0–10 characters. If the Record Version component is not V1, Atellica Solution treats the record as a general manufacturer's record and does not process it. If the Record Version component is V1, Atellica Solution parses the Record Type component.	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, Atellica Solution parses the remainder of the record as a manufacturer's order record. If the Record Type component is T, Atellica Solution parses the remainder of the record as a manufacturer's test record. If the Record Type component is not O, or T, Atellica Solution treats the record as a general manufacturer's record and does not process it.	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. Verifies that the Sample ID that Atellica Solution designates 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, Atellica Solution rejects the entry. Otherwise, Atellica Solution processes the Control Lot Number field.	1–11 characters for Kit controls. 1-20 for routine controls. This is set to the Control Name field of the Control Definition of the specific control Sample ID designated in the previous order record.

Field Number	Field Name	Incoming Value	Outgoing Value
M5	Control Lot	0–10 characters for kit or routine controls. Verifies that the Sample ID Atellica Solution designates 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, Atellica Solution rejects the entry. Otherwise, Atellica Solution processes the Control sample as a worklist entry or result entry.	1–10 characters for Kit or routine controls. This is 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

About the Result Record

The Result Record supplies the final test result information for a single test of a specific sample. Separate result records specify the results of multiple tests. Atellica Solution 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 appropriate 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 nth occurrence of an order record since the last order record; 1--65535.	1–5 characters from 1--65535. Equal to the nth occurrence of a result record since the last order record. Verifies 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	Eight components describe a single test name where a Component Delimiter character (^) separates each component. The Universal Test ID specifies the name of the test associated with the result. Refer to the individual components (field components R3.1-R3.9) for data format information.	Eight components describe a single test name where a Component Delimiter character (^) separates each component. The Universal Test ID specifies the name of the test associated with the result. Refer to the individual components (field components R3.1-R3.9) 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	1–20 case-sensitive characters. The LIS code of the test.	1–20 case-sensitive characters. The LIS code of the test.
R3.5	Dilutions (optional)	Discarded.	Any of the Atellica Solution 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 For standard tests, the replicate number can be more than 15. The instrument governs the maximum replicate number.	0–2 characters. Atellica Solution assigns an integer value to each replicate test result. This allows Atellica Solution to track its relative position within all replicate run results of the associated tests on a given sample. This value is sent only sent for unmeaned tests.
R3.8	Result Aspect	Not processed.	0–4 characters. 1 of 7 possible text strings identify the specific aspect of the transmitted result. The following are possible values and their interpretations: • COFF: Cut off (in Master Curve units) • DOSE: Result concentration value (in Master Curve units) • INDX: Result index value • INTR: Result interpretation • RLU: Value Atellica Solution uses in result calculation

Field Number	Field Name	Incoming Value	Outgoing Value
R3.9	SetID	Not processed. Atellica Solution always assigns a SetID for all result aspect(s) of the same result. **NOTE:** The LIS host or middleware can use the SetID to identify all the result aspects of the same result within the single ASTM result message.	<ResultID>#<ReplicateNumber> Maximum 15 characters. Never Blank.
R4	Result	1–15 characters. Atellica Solution sets this to the previous result for the same patient. This is 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. Atellica Solution sets this field 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 Atellica Solution flags this result 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.
R7	Reference Range Flags	Not processed.	0–2 characters. The repetitions represent some system result flags and are 1 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). These flags can occur in combination, repeat delimiters (\) separating them, if the test has multiple replicates with widely varying results. See *About the Result Comment Record*, page 108, and *Communications Error Comment Record*, page 134 for other system result flags.
R9	Result Status	Not processed	1 or more instances of 1 character.

Field Number	Field Name	Incoming Value	Outgoing Value
The Result Status field has a value of F (Final) or P (Preliminary). Other values occur with repeat delimiters (\) separating them. If the result is sent in response to a query, the field has a value of Q. If a the operator changed the previously sent result and it was 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 operator manually validates the Result Status field, the field has a value of V. The V value is not applicable if the user re-transmits the result accepted and transmitted to the LIS.			
R11	User ID	2 component fields.	2 component fields.
R11.1	Instrument operator who performed the test.	Not processed.	4-20 characters. This field displays the ID of the user signed into Atellica Solution when Atellica Solution performs the test. 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 Atellica Solution when Atellica Solution validates the test result. If Atellica Solution automatically accepts the test result, the field displays System. If the Review None review mode is selected, then the field displays No Review.

Field Number	Field Name	Incoming Value	Outgoing Value
R13	Date/Time Test Completed.	14 characters. Atellica Solution sets this to the previous result for the same patient.For delta checking only.	14 characters. Atellica Solution sets this to ANSI X3.43 format of date and time values. Atellica Solution 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 PM).
R14	Instrument	Not processed.	0--100 characters.
R14.1	System Serial Number	Not processed.	0--80 characters. Mandatory.
R14.2	Module Serial Number	Not processed.	1--20 characters. Mandatory except for ratio.

In the following example, the System Serial Number is '7878' and the Module Serial Number is '1-1-1-1-1-1':

H|\^&|||UIW_LIS|||||LIS_ID||P||20140905124046

P|1|||||||U

O|1|T1^123456^A2||^^^CA125|R|||||||||Serum|||||||||F
R|1|^^^CA125^^^1^RLU|6994|||||F\R||||20140905123950|7878^1-1-1-1-1-1-1 R|2|^^^CA125^^^1^COFF|1.00|U/
mL||||F\R||||20140905123950|7878^1-1-1-1-1-1-1-1

R|3|^^^CA125^^^1^DOSE|2.41|U/mL||||F\R||||20140905123950|7878^1-1-1-1-1-1-1-1

L|1|N

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 |5-5-5-5-5-5-5^1-1-1-1-1-1-1 <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 (system LIS code for the Ferritin assay)
R3.8	Result Aspects	DOSE
R3.9	SetID	Not processed
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 PM)
R14.1	System Serial Number	5-5-5-5-5-5-5
R14.2	Module Serial Number	1-1-1-1-1-1-1

About the Result Comment Record

The result comment record communicates additional flags beyond those supported by the Result Abnormal Flags field of the result record. The record is optional. Atellica Solution uses this record 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. Atellica Solution ignores result data from a remote system. Atellica Solution rejects incoming result comment records. The hierarchical level for result comment records is 4. The result comment record always follows a result record.

Atellica Solution retains up to 3 operator-entered result comments. Atellica Solution transmits each comment in its own result comment record. The following table describes the appropriate values for each field:

NOTE: Atellica Solution 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, from 1--65,535. Equal to the nth occurrence of a result comment record within the current outgoing application message. Verifies 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, Atellica Solution sets the Comment Source field to I. If the comment is an operator-entered comment, this component is blank.
C4	Comment	Not processed.	2 components. Atellica Solution sets this to the Comment field of the test result record.

Field Number	Field Name	Incoming Value	Outgoing Value
C4.1	Comment Code	Not processed. For QC Information, the Comment Code field of the outgoing Result Comment Record contains the QC identifier of 'QCINFO'. For Calibration Information, the Comment Code field of the outgoing Result Comment Record contains the Calibration identifier of 'CALINFO'.	0–60 characters. Result flags map to the values in the following table. If the flags do not exist for the result record, then Atellica Solution does not generate result comment records for transmission. If the comment is a operator-entered result comment, this component is blank.
C4.2	Comment Text	Not processed.	1–250 characters. (maximum is 249 plus #). 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 or generic comment, this component is G.

NOTE: Comment Code Field (C4.1):

- For IA results, when the Comment Code field contains the Reagent identifier of 'PREAG,' the Comment Text field (C4.2) contains the lot number for the primary reagent.
- For CC results, when the Comment Code field contains the Reagent identifier of 'PREAG,' the Comment Text field (C4.2) contains the lot number for the primary reagent, either Reagent 1 (R1) or Reagent 2 (R2).

  Note The Reagent 1 and Reagent 2 Result Comment Records may not appear sequentially in the list of all result comment records for the test. Reagent 2 may not always be present for a test. If not present, then Atellica Solution does not generate a Result Comment record.
- When the Comment Code field contains the Reagent identifier of AREAG, the Comment Text field (C4.2) contains the lot number for an ancillary reagent used to generate the test result. There can be a maximum of four (4) ancillary reagents per test result. Each of these ancillary reagent lot numbers transmits to the LIS in separate result comment records. When there are more than 1 ancillary reagent result comment records for a test, the ancillary reagent result comment records may not list sequentially for the test.

  Note Confirmatory tests contain the ancillary reagents used by the constituent tests.
- When the Comment Code field contains the Reagent identifier of DILU, then the Comment Text field (C4.2) contains the lot number of the diluent used to generate the test result. There can be only 1 Diluent per test.
- When the Comment Code field contains the QC identifier of CALINFO, then the Comment Text field (C4.2) contains Calibration Lot, Calibration Date/Time, and Calibration Status used to generate the result.
- When the Comment Code field) contains the QC identifier of QCINFO, then the Comment Text field (C4.2) contains Control Lot, Control Name, Control Level(s), Control Result, Control Result Date/Time Atellica Solution uses to generate the result.

For all of the Result Comment Records Atellica Solution uses to transmit Primary Reagent, Ancillary Reagent, Diluent Lot Numbers, QC information, and Calibration Information to the Host LIS or CentraLink ™ system, the Comment Type field (C.5) contains a G to indicate a generic comment.

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)

About the Request Information Record (Query Record)

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

The following table describes the appropriate 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 that is always an invalid Sequence Number. Atellica Solution formats this 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, Atellica Solution reports an error.	1 character, always 1. Atellica Solution always ends an application message before transmitting another query record. Verifies 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, Atellica Solution does not place any restrictions on PID or SID. 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 requests a worklist, the PID or SID have no restrictions and the field is set to ALL. If Atellica Solution has initiated the worklist requests automatically, the field has 2 or 4 components. The first is the PID, which is always empty. The Component Delimiter (^) separates it from the Sample ID. If Atellica Solution is configured to schedule by SID and the sample has a barcoded label, then Atellica Solution sends the SID as the second component.
Q3.1	Patient ID (PID)	0–20 characters. The PD is 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. Atellica Solution uses the Sample ID 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 Q3.4	Rack and Position	Dependent upon instrument.	Dependent upon instrument.
Q4	Ending Range ID Number	Atellica Solution only supports single SID query.	0, 1, 2, or 4 components.
Q4.1	Patient ID (PID)	0–20 characters. Atellica Solution uses the PID as a criterion for matching the PID field in worklist or result entries.	0–20 characters.
Q4.2	Sample ID (SID)	0–20 characters. Atellica Solution uses the Sample ID as a criterion for matching the SID field in worklist entries or results	0–20 characters.

Field Number	Field Name	Incoming Value	Outgoing Value
Q4.3	Rack ID	Format dependent on the instrument. Maximum length is 10 characters. Optional. (Atellica Solution uses this component with the Sample ID and is part of the Rack field.	Format dependent on the instrument. Maximum length is 10 characters. Atellica Solution uses this optional component with the sample position identifier and it is part of the Rack ID at the Patient Order window. At the LIS Configuration window, select Send Rack IDs with Results to send the Rack ID when it is available for the sample. **NOTE:** Atellica Solution does not send result(s) for a Rack ID Only Sample to the LIS.

Field Number	Field Name	Incoming Value	Outgoing Value
Q4.4	Rack Position	Dependent on the instrument. Maximum length is 4 characters. **NOTE:** If Atellica Solution receives an invalid SID or Rack Number/ Position Atellica Solution rejects the message and logs an event. specifies the physical location of a given sample designated by the Sample ID field. If a Atellica Solution gives a value for the rack number identifier, then it must give a value for the rack position identifier. The value must have the format of Atellica Solution Rack ID values.	Dependent on the instrument. Maximum length is 4 characters.

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 a repeat delimiter characters separates each group of 4 components. If a name is unknown to Atellica Solution, it ignores the test name and continues processing 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 Atellica Solution initiates the worklist requests automatically, it sets the field to ALL.
Q5.1	Universal Test ID	0 to any number of characters. Atellica Solution always ignores this component.	0 characters, always empty.
Q5.2	Universal Test ID Name	0 to any number of characters. Atellica Solution always ignores this component.	0 characters, always empty.

Field Number	Field Name	Incoming Value	Outgoing Value
Q5.3	Universal Test ID Type	0 to any number of characters. Atellica Solution always ignores this component.	0 characters, always empty.
Q5.4	Manufacturer's Code	0–8 case-sensitive characters. If a value exists, Atellica Solution uses this value to search the test definition database. Atellica Solution searches the test definition database for the matching LIS code. If it does not find a match, it 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, Atellica Solution uses the dates and times in Q7 and Q8 to match result entries. If invalid or S, Atellica Solution ignores. the dates and times in Q7 and Q8.	0 or 1 character.

Field Number	Field Name	Incoming Value	Outgoing Value
Q7	Beginning Request Results Date	0–14 characters. Atellica Solution uses this field as a criterion for matching the date and time a test completed in result entries. Atellica Solution sets this to ANSI X3.43 format of date and time values. This is up to a 14-character string in YYYYMMDDHHMMSS form. Atellica Solution ignores seconds. Hours are in military (24-hour) form. Atellica Solution matches the portions of the date and time supplied. Valid examples include 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 PM) of August 1, 2013. Invalid examples include 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, Atellica Solution assumes an open-ended date range. 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, Atellica Solution assumes an open-ended date range. The range includes all results with a date less than the Ending Request Results Date. The operator can list date ranges by specifying a number of values for the Beginning Request Results Dates and the Ending Request Results Dates. 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. Atellica Solution uses this field as a criterion for matching the date and time a test completes in result entries. Atellica Solution sets this to ANSI X3.43 format of date and time values. Atellica Solution processes the value of the field 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), Atellica Solution transmits final results in response. If the field is R, Atellica Solution transmits final results, restricted to results transmitted previously. If the field is N, Atellica Solution transmits final results, restricted to those that are new and those that are edited. If the field is O (Request Tests) or I (In Instrument Pending), Atellica Solution 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, Atellica Solution transmits a response that the query is in error.	1 character. If the field is F, Atellica Solution sends final results. If the query is a cancellation of an outstanding (unfinished) query from Atellica Solution, the value is A. When the LIS receives a query cancellation from the instrument, it stops sending data intended as a response to the initial query. For an operator request or 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)

About the Manufacturer's Test Record

The manufacturer's test record determines if 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 appropriate values for each field:

NOTE: Atellica Solution also uses manufacturer's records for manufacturer's order record 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.

Field Number	Field Name	Incoming Value	Outgoing Value
M2	Sequence Number	1 to any number of characters, with a default value of 0 that is always an invalid Sequence Number. Atellica Solution formats this 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, Atellica Solution reports a fatal parse error.	1 character, always 1. If a manufacturer's test record is required, Atellica Solution 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 describe the manufacturer's record as a Siemens manufacturer's test record. The Component Delimiter character (^) separates each component. 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 manufacturer's test record. The Component Delimiter character (^) separates each component. 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, Atellica Solution treats the record 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, Atellica Solution treats the record as a general manufacturer's record and is not processed. If the Instrument component is CEN:NG, Atellica Solution processes the Record Version component.	6 characters, always CEN:NG.

Field Number	Field Name	Incoming Value	Outgoing Value
M3.3	Record Version	0–10 characters. If the Record Version component is not V1, Atellica Solution treats the record 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.
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, Atellica Solution treats the record as a general manufacturer's record and is not processed.	1 character, always T.

Field Number	Field Name	Incoming Value	Outgoing Value
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&&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&<SP>!"#$%&E&'()*+,-./0123456789:;<=>?@ABCDEFGHIJKLMNOPQRSTUVWXYZ[&R&]&S&_abcdefghijklmnopqrstuvwxyz{&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:;<=>?@ABCDEFGHIJKLMNOPQRSTUVWXYZ[&R&]&S&_abcdefghijklmnopqrstuvwxyz{&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 Atellica Solution 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.

Atellica Solution does not transmit a general manufacturer's record and, other than determining that it follows message structure rules, Atellica Solution 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 that is always an invalid Sequence Number. Atellica Solution formats this 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, Atellica Solution reports a fatal parse error.	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	BCD^CEN:NG^V1^O
	(any number of fields of any size and format)	(BCD does not match SHD, which makes this a general manufacturer's record. Atellica Solution ignores this field and any other data.)

About the General Comment Record

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

If Atellica Solution does not recognize a comment record as a patient comment record or a result comment record, Atellica Solution treats it as a general comment record. Atellica Solution 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 appropriate values for each field.

NOTE: Atellica Solution also uses comment records as result comment records, general comment records associated with other record types, or to report errors.

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 that is always an invalid Sequence Number. Atellica Solution formats this 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, Atellica Solution reports a fatal parse error.
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 that reports a number of data specific error conditions to the LIS. Atellica Solution uses the record if some data specific error occurs that prevents Atellica Solution from performing the requested operation. The hierarchical level for the communications error comment record is dependent on the error. When Atellica Solution uses this record, Atellica Solution 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 appropriate values for each field:

NOTE: Atellica Solution 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 that is always an invalid Sequence Number. Atellica Solution formats this 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, Atellica Solution reports a fatal parse error.	1–5 characters, with a default value of 0 that is always an invalid Sequence Number. Atellica Solution formats this 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, Atellica Solution reports a fatal parse error.
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 a component delimiter character (^) separates. If the error does not exist for the data record, communications Atellica Solution does not generate error comment records 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	1--250 characters.(the maximum value of 249 is appended with a #). Not processed.	1--250 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

Sample Comment Record

The Sample Comment record follows the Order record. Atellica Solution saves up to 3 sample comments. Atellica Solution 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 that is always an invalid Sequence Number. Atellica Solution formats this 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, Atellica Solution reports a fatal parse error.	1 character, in the range from 1 through 3.
C3	Comment Source	0 or 1 character, not used for incoming message processing.	0 characters, always empty.

Field Number	Field Name	Incoming Value	Outgoing Value
C4	Comment	1 component. Atellica Solution sets this to the Comment field of the worklist or result entry.	1 component. Atellica Solution sets this to the Comment field of the patient sample or worklist entry.
C4.1	Comment Code	1–250 characters. (maximum 249 plus #)	Always empty.
C4.2	Comment Text	Not used for incoming message processing.	1–250 characters. (maximum 249 plus #)
C5	Comment Type	0 or 1 character. If the Comment Type field is empty or G (Generic), Atellica Solution processes the comment record ias a Sample Comment record. If the Comment Type field is any other value, Atellica Solution processes the comment record as a General Comment record and ignores it.	1 character, G (Generic).

About the Termination Record

The termination record is the last record of a message and therefore 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 appropriate values for each field:

Field Number	Field Name	Incoming Value	Outgoing Value
L1	Record Type	1 character, can be L or I.	1 character, always L.
L2	Sequence Number	1 to any number of characters, with a default value of 0 that is always an invalid Sequence Number. Atellica Solution formats this as a string of ASCII numeric characters. If the current Sequence Number does not equal the Sequence Number of the expected record, Atellica Solution reports a fatal parse error. 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.

L3 Termination Code

Incoming value is 0 or 1 character, with a default value of N (normal).

- If the Termination Code is Null or N, Atellica Solution closes the incoming message and logs the message that Atellica Solution terminates it.
- If the value is T, Atellica Solution closes the incoming message and logs the message that the sender cancels it.
- If the value is R, Atellica Solution closes the incoming message and logs the message that the receiver cancels it.
- If the value is E, Atellica Solution closes the incoming message and logs the message as canceled due to an unknown system error. Atellica Solution closes the current query on the port is, which allows any pending query to transmit.
- A Termination Code of F (Final) replies to a query to indicate that all Atellica Solution sent all available information in response.

- If the value is I, there is No Information Available, and Atellica Solution closes the incoming message.
- If the value is Q, there is a Query in Error, and Atellica Solution closes the message.
- If Atellica Solution has sent a query and never receives a termination record with a Termination Code of F, Q, or I, then the query remains pending until it times out. Atellica Solution does not send any subsequent queries until the pending query times out.
- Atellica Solution sends a termination record that completes a response to a query in error shall under 2 conditions:
  - Atellica Solution receives a second query (other than a query cancellation) before it completes a response to a preceding query.
  - Atellica Solution receives a query with a value in the Request Information Status Code field other than P, F, S, R, N, O, I, or A.
- Atellica Solution treats any queries received as closed and is ready to accept a new query. If received by Atellica Solution, Atellica Solution shall close any outstanding query it sent and logs the query as in error.

Outgoing value is 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, Atellica Solution considers all external queries closed and is ready to process new queries.
- If the termination code is F (Final), Atellica Solution 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, Atellica Solution closes the incoming message and logs the message as having no information found in response to the current query.
- Atellica Solution uses a Termination Code of E if system errors such as timeouts at the data link layer and memory allocation errors prevent normal completion of the message.

- If Atellica Solution is sending worklist entries or results in response to a query from a remote system and the remote system cancels the query, Atellica Solution stops sending data and the termination record ending the message has a Termination Code of R.
- Atellica Solution closes the current query on the port, which allows any pending query to transmit. If the code is Q, Atellica Solution closes the incoming message and logs the message as stating that the current query that was sent by Atellica Solution to the remote system was in error.
- Atellica Solution handles all other character values as having an unknown message termination status. Atellica Solution closes the incoming message, but does not log a closing status message.

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)

About the Data Link Layer Interaction

Atellica Solution sends outgoing application messages 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.

About ASTM Protocol Exceptions

Atellica Solution implementation of the ASTM protocol deviates from the ASTM standard in several ways:

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

Atellica Solution uses and recognizes all other predefined sequences during transmission.

About the 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 that Atellica Solution specifies, a query timeout occurs and the sender cancels the outstanding query. ASTM protocol allows only 1 outstanding query at a time.

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 Atellica Solution 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> ⟶

About Diagnostic Logs

Atellica Solution 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 that Atellica Solution posts.
LIS Logs	Displays communication messages between the Laboratory Information System (LIS) and Atellica Solution.
Audit Trail Log	Displays operator actions that create, modify and delete records.

Operator Event Log

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

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

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

When Atellica Solution 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. When the operator resolves the issue that caused the event, 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.

About LIS Logs

The LIS Logs contain the data exchanges between Atellica Solution and the LIS. Each Log file contains all the data Atellica Solution collects from the time Capture is enabled until the operator selects Off or Atellica Solution restarts. The operator can select 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, Atellica Solution 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 menu contains a list of all the captured log files, listed in descending order by date. Atellica Solution stores the files in the database for 1 week and then deletes the oldest when it captures a new one. 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 Atellica Solution can display in the LIS Logs fields. The message color identifies the type of communication:

Data Type	Color
Received Data	Red
Transmitted Data	Black

Data Type	Color
Received Control Codes	Blue
Transmitted Control Codes	Green

The operator can print or export log files (txt or xml files). For information about the LIS Log, refer to the online help.

Customizing LIS Capture Settings

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

The operator can enable or disable data capture by selecting On or Off in the Capture Settings dialog box, respectively.

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. To add to the system-generated LIS Log, you can enter up to 10 in Log Filename Prefix as a prefix for the system.
5. Select **Save**.

   Atellica Solution records the date and time the operator starts Capture Settings. Atellica Solution includes the start date and time in the name of all information Atellica Solution records until the operator turns off Capture Settings**.**

Error Handling

Atellica Solution communications software uses the logs in the Events window to report errors. The LIS Communication icon on the 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.

Atellica Solution attempts to recover from most input message errors. Atellica Solution may reject an erroneous query and test order partially or totally based on the level of security of the detected error. For example, an error in 1 specimen identifier of an order record causes Atellica Solution to reject all tests ordered on that specimen. In contrast, an invalid test identifier causes Atellica Solution to reject only that test order. A very severe error such as an invalid header record in an order message causes Atellica Solution to reject the whole message. A fatal error in a query record causes Atellica Solution to reject the entire query. For order errors, if the effect of the error is localized, Atellica Solution only rejects the affected test requests.

Atellica Solution 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 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 Atellica Solution rejects an incoming record.

Reason	Description
Database mismatch	An order record specifies an SID and a Rack ID, and the worklist database has the same SID 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 SID; 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 an SID that Atellica Solution uses 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 SID that matches a control SID, but is not followed by a manufacturer's order record and Atellica Solution 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 SID in the worklist.
Invalid Sample ID	An order record has a SID 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. Atellica Solution closes the current incoming message is closed and processes the received data according to standard rules. The second class of abnormal terminations relates to responses to queries. A Q code indicates that the receiver cannot process a sent query. An I code indicates that Atellica Solution found no data in response to a query. An F code is a normal termination of a response to a query indicating that all data is sent.

Atellica Solution treats a fatal parse error in a record 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 Atellica Solution does not send a response, the remote system cancels it.
- If Atellica Solution sends a response (no reply in process), Atellica Solution ignores the cancellation.
- If Atellica Solution 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 Atellica Solution before the first query is complete, Atellica Solution automatically cancels the first query. Atellica Solution rejects the second query and responds to it as an invalid query. Atellica Solution 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 Atellica Solution and the LIS.

Pending Work Request Query and Result Transmission have the following characteristics:

- System work request query takes precedence over transmitting results to the Host LIS.
- If any work request query is pending, then another work request query cannot be sent.
    - If Atellica Solution has sent a query and never receives a termination record with a Termination Code of F, Q, or I, then the query shall remain pending until it times out. Atellica Solution shall not send any subsequent queries until the pending query times out.
    - A termination record that completes a response to a query in error shall be sent by Atellica Solution under two conditions:

      Atellica Solution receives a second query (other than a query cancellation) before it completes a response to a preceding query.

      Atellica Solution receives a query with a value in the Request Information Status Code field other than P, F, S, R, N, O, I, or A
- If any work request query is pending and the LIS server is taking time to respond, then Atellica Solution transmits results to the Host LIS if results are available to optimize result transmission.

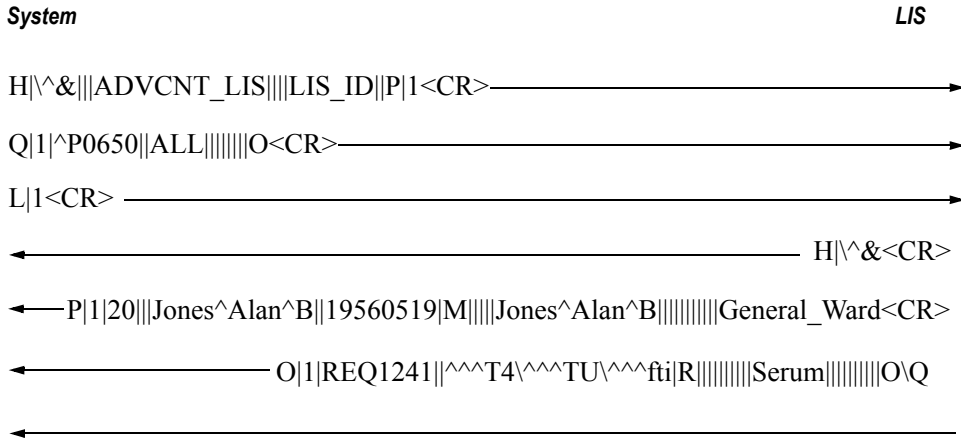
About ASTM Messages

This appendix shows examples of system and LIS messages from the data link and application layers.

About LIS Messages

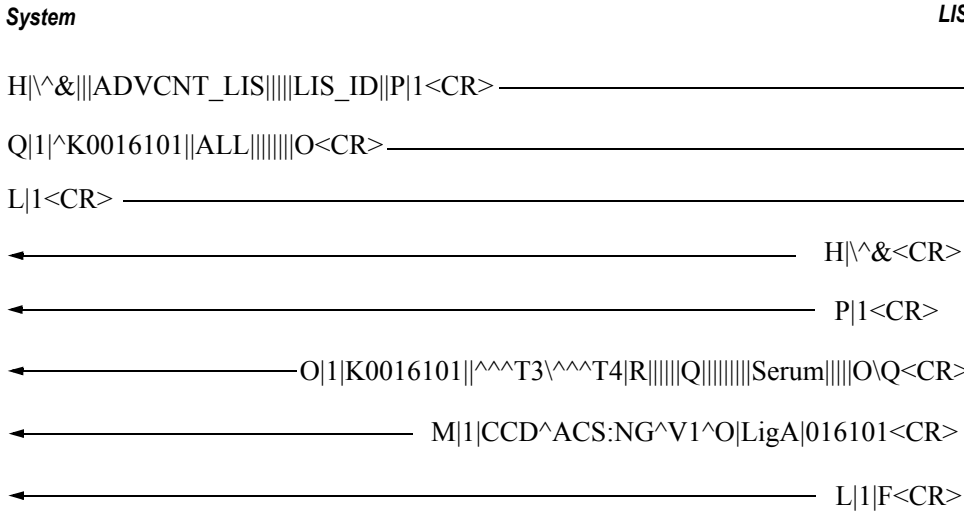
Automatic Worklist Request and Response for a Patient Sample

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 the LIS transmits to Atellica Solution 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 Atellica Solution does not send additional queries.



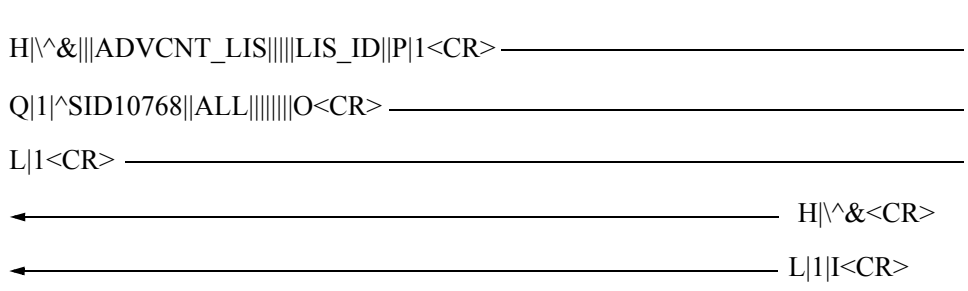
Automatic Worklist Request and Response for a Control Sample

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.



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 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.



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<CR> ——————————

P|1|PID1123|||Peters^Cassie||19721221|F|||||DR1265A<CR> ——————

O|1|REQ1241||^^^T3\^^^T4\^^^TSH|R|||||||||Serum|||||||||O\Q<CR> ————

O|2|REQ1241||^^^HCG|R|||||||||||||||||O\Q<CR> ——————————

O|2|REQ4465||^^^PSA|R|||||||||||||||||O\Q<

Example: Operator-Initiated Transmission of Results

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|||||||||Serum|||||| ||||F<CR>

R|1|^^^T4^^^1^DOSE|5.8|ug/dL||||F||||199209270807|EP19-SH^EP19-IA|<CR>

R|2|^^^T4^^^1^COFF|1.0|ug/dL||||F||||199209270807|EP19-SH^EP19-IA|<CR>

R|3|^^^T4^^^1^RLU|54688|||||F||||199209270807|EP19-SH^EP19-IA|<CR>

R|4|^^^T3^^^1^DOSE|1.27|ng/mL|||||F||||199209270807|EP19-SH^EP19-IB|<CR>

R|5|^^^T3^^^1^COFF|1.00|ng/mL||||F||||199209270807|EP19-SH^EP19-IB|<CR>

R|6|^^^T3^^^1^RLU|14527|||||F||||199209270807<CR>|EP19-SH^EP19-IB|<CR>

R|7|^^^TU^^^1^DOSE|11.626|uIU/mL||||F||||199209270808|EP19-SH^EP19-IC|<CR>

R|8|^^^TU^^^1^COFF|21.00|uIU/mL|||||F||||199209270808|EP19-SH^EP19-IA|<CR>

R|9|^^^TU^^^1^RLU|337704|||||F||||199209270808|EP19-SH^EP19-IC|<CR>

R|10|^^^ThCG^^^1^DOSE|4.2|mIU/mL||||F||||199709270808|EP19-SH^EP19-ID|<CR>

R|11|^^^ThCG^^^1^COFF|1.0|mIU/mL||||F||||199709270808|EP19-SH^EP19-ID|<CR>

R|12|^^^ThCG^^^1^RLU|24342||||F||||199709270808<CR>|EP19-SH^EP19-ID|<CR>

L|1<CR>

Example ASTM LIS Messages

Negative Query Response

(When order is not available at LIS server for that requested sample or sample is available but none of the tests are supported by the instrument.)

Instrument=>LIS Server	H|\^&|||UIW_LIS|||||LIS_ID||P||20161019103956
	Q|1|^SIDXXXXXX|^SIDXXXXXX|ALL|||||||OL|1|N
LIS Server=>Instrument	H|\^&|||||||||P|1L|1|I

Positive Query Response

(When order is available for test(s) for requested sample for the instrument at LIS server.

Instrument=>LIS Server	H|\^&|||UIW_LIS|||||LIS_ID||P||20161019103956
	Q|1|^SIDXXXXXX|^SIDXXXXXX|ALL|||||||OL|1|N
LIS Server=>Instrument	|\^&|||||||||P|1
	P|1|1012|||Bonner^Allan^j||19930711|M||||JB|Human|||||||||Pregnant|Room 141
	O|1|Sample10001||^^^AFP\^^^AAG|R|20161019113849|20161018000000||||N||||Serum||||||||LIS|Q
	L|1|F

Order with Dilution

Instrument=>LIS Server	H|\^&|||UIW_LIS||||LIS_ID||P||20161019125829 Q|1|^Sample10001|^Sample10001|ALL|||||||O L|1|N
LIS Server=>Instrument	H|\^&||||||||||P|1 P|1|1012|||Bonner^Allan^j||19930711|M||||JB|Human|||||||||Pregnant|Room 141 O|1|Sample10001||^^^COR^X2^2|R|20161019113849|20161018000000||||N||||Serum|||||||||SH|Q L|1|F

Order with Replicates

Instrument=>LIS Server	H|\^&|||UIW_LIS||||LIS_ID||P||20161019125829 Q|1|^Sample10001|^Sample10001|ALL|||||||O L|1|N
LIS Server=>Instrument	H|\^&||||||||||P|1 P|1|1012|||Bonner^Allan^j||19930711|M||||JB|Human|||||||||Pregnant|Room 141 O|1|Sample10001||^^^COR^^^3|R|20161019113849|20161018000000||||N||||Serum||||||||SH|Q L|1|F

Order with Replicates and Dilution

Instrument=>LIS Server	H|\^&|||UIW_LIS|||||LIS_ID||P||20161019125829 Q|1|^Sample10001|^Sample10001|ALL|||||||O L|1|N
LIS Server=>Instrument	H|\^&|||||||||P|1 P|1|1012|||Bonner^Allan^j||19930711|M||||JB| Human||||||||||Pregnant|Room 141 O|1|Sample10001||^^^COR^^^3|R|201610191 13849|20161018000000||||N||||Serum||||||||SH |Q L|1|F

Order for Targeted Module

Instrument=>LIS Server	H|\^&|||UIW_LIS|||||LIS_ID||P||20161019125829 Q|1|^Sample10001|^Sample10001|ALL|||||||O L|1|N
LIS Server=>Instrument	|\^&|||||||||P|1 P|1|1012|||Bonner^Allan^j||19930711|M||||JB| Human||||||||||Pregnant|Room 141 O|1|Sample10001||^^^COR|R|2016101911384 9|20161018000000||||N||||Serum||||||||EP19- SH^EP19-IA|Q O|2|Sample10001||^^^Crea|R|2016101911384 9|20161018000000||||N||||Serum||||||||EP19- SH^EP19-CC|Q L|1|F F

Patient Results with only Final Results

Instrument=>LIS Server	H|\^&|||UIW_LIS||||LIS_ID||P||20161019125829 Q|1|^Sample10001|^Sample10001|ALL|||||||O L|1|N ServerH|\^&|||UIW_LIS||||LIS_ID||P||20161019131303 P|1|1057|LD00001||Beck^Alexandrea^j||20050411|F||||P H000003|Human|||||||||Critical|ER C|1||^Patient is in critical condition|G O|1|Sample20001||^^^CA125^^^3|R|20161019131046| 20161018120914||||||20161018130957|Serum^^^1||||| ||||F C|1||^Sample is good|G R|1|^^^CA125^^^3^RLU^171#0|57395||||F||SiemensInte rnal^No Review||20161019131301|5-5-5-5-5-5-5^1-1-1- 1-1-1-1|1|I|Operator Interpretation OP|I C|2||PREAG^103|G R|2|^^^CA125^^^3^COFF^171#0|1.0|U/ mL|||F||SiemensInternal^No Review||20161019131301|5-5-5-5-5-5-5^1-1-1-1-1-1-1 C|1|I|Operator Interpretation OP|I C|2||PREAG^103|G R|3|^^^CA125^^^3^DOSE^171#0|25.91|U/ mL|||F||SiemensInternal^No Review||20161019131301|5-5-5-5-5-5-5^1-1-1-1-1-1-1 C|1|I|Operator Interpretation OP|I C|2||PREAG^103|G R|4|^^^CA125^^^3^INTR^171#0|Pos||||F||SiemensIntern al||20161019131301|5-5-5-5-5-5-5^1-1-1-1-1-1- 1|1|I|Operator Interpretation OP|I C|2||PREAG^103|G L|1|N

Patient Results with Final Results and 3 replicate results

Instrument=>LIS Server	P|1|1057|LD00001||Beck^Alexandrea^j||20050411|F||||PH000003|Human|||||||||Critical|ER C|1||^Patient is in critical condition|G O|1|Sample20001||^^^CA125^^^3|R|20161019131046|20161018120914||||||20161018130957|Serum^^^1|||||||||F C|1||^Sample is good|G R|1|^^^CA125^^^1^RLU^168#1|33968|||||P\R||||20161019131254|5-5-5-5-5-5-5^1-1-1-1-1-1-1 C|1||PREAG^103|G R|2|^^^CA125^^^1^COFF^168#1|1.0|U/mL|||P\R||||20161019131254|5-5-5-5-5-5-5^1-1-1-1-1-1-1 C|1||PREAG^103|G R|3|^^^CA125^^^1^DOSE^168#1|15.02|U/mL|||P\R||||20161019131254|5-5-5-5-5-5-5^1-1-1-1-1-1-1 C|1||PREAG^103|G R|4|^^^CA125^^^2^RLU^169#2|53456|||||P\R||||20161019131254|5-5-5-5-5-5-5^1-1-1-1-1-1-1 C|1||PREAG^103|G R|5|^^^CA125^^^2^COFF^169#2|1.0|U/mL|||P\R||||20161019131254|5-5-5-5-5-5-5^1-1-1-1-1-1-1 C|1||PREAG^103|G R|6|^^^CA125^^^2^DOSE^169#2|24.10|U/mL|||P\R||||20161019131254|5-5-5-5-5-5-5^1-1-1-1-1-1-1 C|1||PREAG^103|G R|7|^^^CA125^^^3^RLU^170#3|84762|||||P\R||||20161019131257|5-5-5-5-5-5-5^1-1-1-1-1-1-1 C|1||PREAG^103|G R|8|^^^CA125^^^3^COFF^170#3|1.0|U/mL|||P\R||||20161019131257|5-5-5-5-5-5-5^1-1-1-1-1-1-1 C|1||PREAG^103|G R|9|^^^CA125^^^3^DOSE^170#3|38.61|U/mL|||P\R||||20161019131257|5-5-5-5-5-5-5^1-1-1-1-1-1-1

Results for Control Order

LIS Server=>Instrument	H|\^&|||UIW_LIS||||LIS_ID||P||20161019143043 P|1 O|1|Q1||\^\^\^CA125\^\^\^1|R|20161019142951||||Q|||Serum|||||||||F M|1|SHD\^CEN:NG\^V1\^O|QOne|4444 R|1|\^\^\^CA125\^\^\^1\^RLU\^172#0|2803|||L||F||SiemensInternal\^No Review||20161019143039|5-5-5-5-5-5-5\^1-1-1-1-1-1-1 C|1|I|Low|I C|2||PREAG\^103|G C|3||CALINFO\^Lot=C015;DateTime=20161013101022;Status=Due;|G R|2|\^\^\^CA125\^\^\^1\^COFF\^172#0|1.0|U/mL||L||F||SiemensInternal\^No Review||20161019143039|5-5-5-5-5-5-5\^1-1-1-1-1-1-1 C|1|I|Low|I C|2||PREAG\^103|G C|3||CALINFO\^Lot=C015;DateTime=20161013101022;Status=Due;|G R|3|\^\^\^CA125\^\^\^1\^DOSE\^172#0|0.44|U/mL|2 - 100|L||F||SiemensInternal\^No Review||20161019143039|5-5-5-5-5-5-5\^1-1-1-1-1-1-1 C|1|I|Low|I C|2||PREAG\^103|G C|3||CALINFO\^Lot=C015;DateTime=20161013101022;Status=Due;|G R|4|\^\^\^CA125\^\^\^1\^INTR\^172#0|Neg|||L||F||SiemensInternal||20161019143039|5-5-5-5-5-5-5\^1-1-1-1-1-1-1 C|1|I|Low|I C|2||PREAG\^103|G C|3||CALINFO\^Lot=C015;DateTime=20161013101022;Status=Due;|G L|1|N

Patient Results with Reagent, QC and Calibration Information

LIS Server=>Instrument	H|\^&|||UIW_LIS||||LIS_ID||P||20161019143626 P|1||||||U O|1|Sample20003||\^\^\^CA125\^\^\^1|R|20161019143538||||||||Serum\^\^\^1|||||||||F R|1|\^\^\^CA125\^\^\^1\^RLU\^173#0|45161|||||F||SiemensInternal\^No Review||20161019143625|5-5-5-5-5-5-5\^1-1-1-1-1-1-1 C|1|I|Operator Interpretation OP|I C|2||PREAG\^103|G C|3||AREAG\^104|G C|4||DILU\^105|G C|5||CALINFO\^Lot=C015;DateTime=20161013101022;Status=Due;|G C|6||QCINFO\^(Name;Level;Lot;Result;DateTime)=(QOne;1;4444;0.44;20161019143039)|G R|2|\^\^\^CA125\^\^\^1\^COFF\^173#0|1.0|U/mL||||F||SiemensInternal\^No Review||20161019143625|5-5-5-5-5-5-5\^1-1-1-1-1-1-1 C|1|I|Operator Interpretation OP|I C|2||PREAG\^103|G C|3||AREAG\^104|G C|4||DILU\^105|G C|5||CALINFO\^Lot=C015;DateTime=20161013101022;Status=Due;|G C|6||QCINFO\^(Name;Level;Lot;Result;DateTime)=(QOne;1;4444;0.44;20161019143039)|G R|3|\^\^\^CA125\^\^\^1\^DOSE\^173#0|20.24|U/mL||||F||SiemensInternal\^No Review||20161019143625|5-5-5-5-5-5-5\^1-1-1-1-1-1-1 C|1|I|Operator Interpretation OP|I C|2||PREAG\^103|G C|3||AREAG\^104|G C|4||DILU\^105|G C|5||CALINFO\^Lot=C015;DateTime=20161013101022;Status=Due;|G C|6||QCINFO\^(Name;Level;Lot;Result;DateTime)=(QOne;1;4444;0.44;20161019143039)|G R|4|\^\^\^CA125\^\^\^1\^INTR\^173#0|Pos||||F||SiemensInternal||20161019143625|5-5-5-5-5-5-5\^1-1-1-1-1-1-1 C|1|I|Operator Interpretation OP|I C|2||PREAG\^103|G C|3||AREAG\^104|G C|4||DILU\^105|G C|5||CALINFO\^Lot=C015;DateTime=20161013101022;Status=Due;|G C|6||QCINFO\^(Name;Level;Lot;Result;DateTime)=(QOne;1;4444;0.44;20161019143039)|G L|1|N

The following table shows the non-printable ASCII characters that ASCII mnemonics represent between angle brackets.

Table 6: 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

Example: Diagnostic Message Transmitted from Atellica Solution

The following example shows the transmission of a diagnostic test message from the system. The application layer manufacturer's test record does not fit into a single data link layer frame. Atellica Solution transmits the record as a data link layer intermediate frame and final frame. <ETB> designates an intermediate 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>

Example: Query for Orders from Atellica Solution

The following example shows a query for orders from Atellica Solution 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|||||||||Serum||||||||||O\Q<CR>

A: <ACK>

L: <STX>2L|1|F<CR><ETX>04<CR><LF>

A: <ACK>

L: <EOT>

Example: Automatic Worklist Request Queries

The following example shows Atellica Solution transmitting automatic worklist request queries and automatically reported results while receiving worklist entries from a LIS in response to queries from Atellica Solution.

In the following example, the LIS transmits a positive acknowledgement with interrupt (<EOT>) after the data link message. Atellica Solution relinquishes line control if it receives a positive acknowledgment with interrupt after transmitting a final frame. Atellica Solution 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|||Ke
y^Harold||19560

519|M|||||Keyes&S&Harold||||||||||General_Ward<OD>O|1
|P0634^0038^A||^^^

T4|R||||||||||Serum|||||||||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||||
||||||Serum||||||||||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||||19980
   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|||||T
immons^John||

||||||||||General_Ward<OD>O|1|P1429||^^^T4|R||||||||||
Serum||||||||||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 Atellica Solution with No Response

The following example shows a transmission from Atellica Solution 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>
```

Atellica Solution continues the enquiries until it receives a successful response (<ACK>) from the remote system.

About ASTM Records

This appendix shows examples of the communications protocol records and messages. For an explanation of each record type see *Implementation of ASTM Protocol*.

About the Header Record

The following example shows the minimum header record that Atellica Solution recognizes:

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

The following example shows the minimum header record that Atellica Solution transmits:

```
H|\^&|||ACS:NG_LIS|||||LIS_ID||P|1<CR>
```

Atellica Solution 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>

About the Patient Record

The following example shows the minimum patient record that Atellica Solution recognizes. Atellica Solution 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 Atellica Solution transmits. Atellica Solution requires a value in the U (Unknown) Patient Sex 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>

About the Patient Comment Record

Atellica Solution always transmits the Comment Text field and the Comment Type field or it does not send the record. Atellica Solution 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>

About the Order Record

The following example shows the minimum order record that Atellica Solution transmits. Atellica Solution transmits the SID, Test Name or LIS Code, Priority, and Report Type fields or it does not send the record.

O|3|SID4728||^^^T4|S|||||||||Serum|||||||||F<CR>

The following example shows an order record with all fields that Atellica Solution uses. It illustrates an order record sent by the operator for a control sample worklist order:

O|2|K016101^0007^|S|||||||||Serum|||||||||F<CR>

The following example shows an order record for a patient sample worklist order the LIS sends to cancel the FSH test for the sample with a SID of 3A6BZ201. Note the **C** (Cancel Request) in the Action Code field:

O|1|3A6BZ201||^^^FSH|R|||||||C||Serum||||||||||O<CR>

The following example shows an order record for the results of tests performed on a control sample, sent by the Atellica Solution 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||Serum||||||||||F<CR>

The following example shows Atellica Solution 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.

O|1|SID7201^0056^E||^^^LH\^^^HCG\^^^TSH\^^^
PROLACT|R|||||||||Serum|||||||||X<CR>

About the Manufacturer's Order Record

The following example shows a manufacturer's order record with all fields that Atellica Solution uses. Atellica Solution sends the control name and control lot number when they are present. Atellica Solution rejects manufacturer's order records if they do not match the control name and control lot number in Atellica Solution database.

M|1|CCD^ACS:NG^V1^O|Lig1|0016101<CR>

About the Manufacturer's Test Record

The following example shows the manufacturer's test record that Atellica Solution uses for communication diagnostics. The operator should note the following special characters:

- escape sequence &E& after % allows the transmission of & as a character instead of an escape delimiter.
- escape sequence &R& after [allows the transmission of \ as a character instead of a repeat delimiter.
- escape sequence &S& after] allows the transmission of ^ as a character instead of a component delimiter.
- escape sequence &F& after { allows the transmission of | as a character instead of a field delimiter.
- 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&&X12&&X13&&X14&&X15&&X16&&X17&&X18&&X19&&X1A&&X1B&&X1C&&X1D&&X1E&&X1F&!#$%&E&'()*+,–./0123456789:;<=>?@ABCDEFGHIJKLMNOPQRSTUVWXYZ[&R&]&S&_'abcdefghijklmnopqrstuvwxyz{&F&}~&X7F&<CR>

About Result Records

Atellica Solution rejects all result records.

The following example shows the minimum result record that Atellica Solution transmits. Atellica Solution sends an LIS code, result aspects, a measurement value, a result status, and a completed date test. Atellica Solution sends this result 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 Atellica Solution 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>

About the Result Comment Record

Atellica Solution transmits additional result abnormal flags in the Comment Text field. Atellica Solution transmits the Comment Source, Comment Text, and Comment Type fields. The following example shows a result comment record that Atellica Solution transmits. There is an **I** in the Comment Type field when Atellica Solution reports a result flag.

C|1|I|Repeat|I<CR>

The following example shows an operator-entered result comment record that Atellica Solution transmits. There is a **G** in the Comment Type field when Atellica Solution reports a user-entered comment.

C|1|I|^Gross hemolysis may affect result|G<CR>

Atellica Solution ignores incoming result comment records.

About the Query Record

The following example shows a query record from Atellica Solution initiates automatically after it reads sample barcodes. Atellica Solution sends a query for each sample Atellica Solution identifies, whether or not an entry exists in the database. These queries 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 Atellica Solution sends for each rack it identifies. Atellica Solution queries for Rack ID only when it is configured to schedule by rack.

Q|1|^^123456^A1|^^123456^A1|ALL|||||||O<CR>

About the Termination Record

The following example shows the minimum termination record that Atellica Solution recognizes. Atellica Solution parses and logs it as a normal termination. If Atellica Solution sends a termination record in a message that is in response to a query, Atellica Solution has not completed its response.

L|1<CR>

The following example shows a termination record that completes the response to a query. When Atellica Solution sends this record, Atellica Solution considers its response complete, and it is ready to accept a new query.

When Atellica Solution receives a termination record with a termination code of F, Atellica Solution closes any outstanding query it sent and logs the query as complete. If Atellica Solution sends 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. Atellica Solution 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 Atellica Solution sends a termination record, Atellica Solution has no data to send, considers its response complete, and is ready to accept a new query. When Atellica Solution receives such a response, Atellica Solution closes any outstanding sent query, and logs the query as receiving no data.

L|1|I<CR>

About 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, Atellica Solution does not accept the message. For more information, refer to *Data Link Messages*, page 28.

An X in the data segment or the application layer indicates an invalid character. Characters not listed in this appendix are valid.

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
7F	127	DEL	--	X
FF	255	--	--	X

4 HL7 Protocol

Scope of HL7 and IHE-LAW Usage in this Document

Support for the HL7 protocol with IHE-LAW is available to interfaced instruments. see the interfaced instrument for information regarding use of HL7.

This section covers the transactions and segments in the messages required for Atellica Solution to communicate with the LIS.

About HL7 Conventions Used in this Document

Note This guide does not detail all Data, Usages, and Cardinality Types. For the full list of HL7 element characteristics, see a full set of HL7 Specifications.

HL7 Data Types

Data Type Code	Data Type Definition
CE	Coded Element.
CWE	Coded with Exceptions.
CX	Coded Extended composite ID with check digit. Specifies an identifier with its associated administrative detail.
DR	Date/Time Range.
DT	Date – always YYYYMMDD.
EI	Entity Identifier.
EIP	Entity Identifier Pair.
FN	Family name.
FT	Formatted Text.
HD	Hierarchic Designator.
ID	Coded Value (drawn from a table of legal values, for example: Sex).
IS	Coded value for user defined tables.
MSG	Message.
NA	Numeric Array.

NM	Numeric.
OG	Observation Grouper.
PL	Patient Location.
PT	Processing type. Indicates whether to process a message according to HL7 Application Processing rules.
PN	Person Name.
SI	Sequence ID.
SN	Structured Numeric.
ST	String (left justified with trailing blanks optional).
TM	Time – always HHMM[SS[.SSSS]] using a 24-hour clock.
TS	Time stamp.
TX	Text Data.
VID	Version Identifier.
XCN	Extended composite ID number and name.
XPN	Extended person name.

HL7 Usage Types

Usage Type	Usage Definition
C	Conditional.
M	Mandatory.
NS or X	Not Supported.
O	Optional.
R	Required.
RE	Required, if available.

HL7 Cardinality

Cardinality is the number of elements in a set and is shows how many times an element appears in an HL7 message. The cardinality shows a minimum and a maximum instance required. For example: [0..1], where optional minimum number and non-repeating, [1..1], where 1 required and non-repeating; [1..*], where 1 required and repeating.

HL7 Field Element Length and Truncation

HL7 defines the conformance length for fields. If Atellica Solution can truncate a field element the HL7 tables in this document show a conformance length as the field length plus '#'. For example: 20#.

When Atellica Solution truncates a field, it includes the field value up to the conformance length minus 1 and the addition of #. For example, 20# means 12345678901234567890# is the maximum appropriate characters for this field (19 characters plus #).

About LAW Transactions

According to the IHE-LAW Supplement, "The Laboratory Analytical Workflow (LAW) integration profile supports the analytical workflow of IVD test work order steps and their results between IVD analyzers and the systems driving their work (LIS or LAS)." In accordance with the IHE-LAW standard, messages are sent between an Analyzer and an Analyzer Manager. In this section, the analyzer is Atellica Solution and the analyzer manager is the LIS (or middleware).

IHE-LAW standards use transactions. A transaction contains a set of messages. A message contains various segments. A segment has various fields. This section describes the IHE-LAW transactions, messages, and segments that communicate between Atellica Solution and the LIS:

- A message is the atomic unit of data that transfers between systems. A message is composed of a group of segments in a defined sequence, and each message has a message type that defines its purpose.
- A segment is a logical grouping of data fields. Segments of a message may be required, and may occur once in a message or may repeat. Segments may be organized as a logical unit called a segment group. A segment group may also be required and might not repeat.
- Segments, Segment Groups, and Message Description Tables are detailed in *NTE|1|A|Patient presenting with chest pains*.

About LAW Message Transactions

The common LAW message transaction identifiers are: LAB-27, LAB-28, and LAB-29. Atellica Solution supports the following IHE-LAW Transactions:

Transaction LAB-27: *Query for AWOS*

The following 2 messages below are a message pair:

QBP^Q11^QBP_Q11 (LAB-27) – system Query for Order from LIS *(message 1)*

RSP^K11^RSP_K11 (LAB-27) – Query Acknowledgement from LIS to Atellica Solution *(message 2)*

Transaction LAB-28: *AWOS Broadcast*

The following 2 messages are a message pair:

OML^O33^OML_O33 (LAB-28) – Laboratory Order message is sent by LIS to Atellica Solution *(message 1)*

ORL^O34^ORL_O42 (LAB-28) – Order acknowledgement from system to LIS *(message 2)*

Transaction LAB-29: *AWOS Status Change (the 2 messages below are a message pair)*

OUL^R22^OUL_R22 (LAB-29) – Result transmitted to LIS *(message 1)*

ACK^R22^ACK (LAB-29) – Acknowledgment Message for Result *(message 2)*

Profile Options that IHE-LAW supports

Transactions	Profile Option Identifier	Notes
LAB-27 LAB-28	LAW_BIDIR	Bi-directional communication (AWOS Transfer)
LAB-27	LAW_QUERY_RACK	Query by Rack
LAB-27	LAW_QUERY_ALL	Query All
LAB-29	LAW_CONTRIB_SUB	Contributing Substances
LAB-28 LAB-29	LAW_DILUTIONS	Dilutions
LAB-28 LAB-29	LAW_PAT_DEM	Patient Demographics
LAB-29	LAW_ REFLEX	Reflex
LAB-29	LAW_ RERUN	Rerun
LAB-28 LAB-29	LAW_AWOS_PRIORITY	AWOS Priority
LAB-28	LAW_SPECIMEN	Specimen Details
LAB-28	LAW_CONTAINER	Container Details
LAB-28	LAW_PRIOR_RES	Prior Results
LAB-28	LAW_REL_OBS	Related Observations

About HL7 Segments

About the HL7 Message Segment Header (MSH)

The Message Segment Header (MSH) segment defines the intent, source, destination and some specifics of the syntax of a message. see IHE Technical Framework Supplement for more detail, Reference no. 30.

```
MSH|^~\&|Siemens Analyzer|Siemens Test
Lab|OM_LAB_ANAYLYZER_MGR|IHE|

20150630141251-
0400||OUL^R22^OUL_R22|8b326e4464ed46b6bcd49a6c1bf47114

|P|2.5.1|||NE|AL||UNICODE UTF-8|||LAB-29^IHE
```

MSH Segment Table

SEQ	LEN	Data Type	Usage	Cardinal-ity	Element name	Value	Notes
1	1	SI	M	[1..1]	Field Separator	'|'	--
2	4	ST	M	[1..1]	Encoding Characters	'^~\&'	Component Separator (^), Repetition Separator (~), Escape Separator(\), Subcomponent Separator(&).
3	20	HD	M	[1..1]	Sending Application	--	if name is unknown, value is "" (Null)
4	20	HD	M	[1..1]	Sending Facility	--	If name is unknown, value is "" (Null).
5	20	HD	M	[1..1]	Receiving Application	--	If name is unknown, value is "" (Null) See Section 2.8.4.3 below and Section 2.5.1.1.2 Table 6 for message when Receiving Application is Unknown.
6	20	HD	M	[1..1]	Receiving Facility	--	if name is unknown, value is "" (Null)
7	26	TS	M	[1..1]	Date/Time of Message	YYYYMMDDHHMMSS+/-ZZZZ, where ZZZZ = time zone	Sending Message Date/Time that Atellica Solution creates the message. Example: 20150630141251-0500.

SEQ	LEN	Data Type	Usage	Cardinal-ity	Element name	Value	Notes
9	15	MSG	M	[1..1]	Message Type	QBP^Q11^QBP_Q11 RSP^K11^RSP_K11 OML^O33^OML_O33 ORL^O34^ORL_O42 OUL^R22^OUL_R22 ACK^R22^ACK	The operator can see IHE-LAW Transactions.
10	50	ST	M	[1..1]	Message Control ID	--	GUID: Unique value to identify the message, responsibility of sender application to make this value unique.
11	3	PT	M	[1..1]	Processing ID	P	Production
12	60	VID	M	[1..1]	Version ID	2.5.1	HL7 version
15	2	ID	C (M/X)	[0..1]	Accept Acknowledgement Type	NE	Never

SEQ	LEN	Data Type	Usage	Cardinal-ity	Element name	Value	Notes
16	2	ID	C (M/ X)	[0..1]	Application Acknowledgement Type	AL or Empty	For Acknowledgement Messages the value is empty (blank).
18	16	ID	M	[1..1]	Character Set	'UNICODE UTF-8'	IHE-LAW recommends using UNICODE UTF-8', ignore the length of 4 as IHE-LAW recommends to use the specified value.
21	427	EI	M	[1..*]	Message Profile Identifier	<domain> or <transaction number> ^IHE	Mandatory: LAB-xx^IHE MSH-21 can have multiple options depending on the Profile Options the Analyzer or the Analyzer Manager supports. Example: LAB-29^IHE~LAW_REFLEX^ IHE~LAW_SPECIMEN^IHE

Receiving Application Message Behavior

If the incoming Receiver Application exists, is not null, and equals the System Name at the LIS Communications Configuration interaction space, Atellica Solution processes the message. If the two fields are different, Atellica Solution accepts the message, returns an error message to the LIS, and an logs an event.

About the Message Acknowledgement Segment (MSA)

The Message Acknowledgement (MSA) segment contains fields Atellica Solution sends when acknowledging another message.

Table 7: MSA Segment Table)

SEQ	LEN	DT	Usage	Cardinality	Element name	Value	Comments
1	2	ID	M	[1..1]	Acknowledgment Code	AA, AE, AR	AA - Application Accept AE - Application Error AR - Application Reject
2	50	ST	M		Message control ID		Values contained in MSH-10 (message control ID)

MSA|AA|89a5af4b483e43be94e9007f5961de98

About the Error Information Segment (ERR)

The Error Information (ERR) segment adds error information to acknowledgement messages. The IHE-LAW Supplement states “The HL7 Enhanced Acknowledgment Mode allows a receiving application to not accept a message because the message contains an error. or to reject the contents of the message for processing.”

Atellica Solution software logs the appropriate event in the Operator event Log and responds accordingly.

The HL7 protocol follows the same rules of behavior as the ASTM protocol in logging messages in the Operator event Log and transmitting Application Error Codes in the ERR Segment.

SEQ	LEN	DT	Use	cardinal.	Element name	Val.	Notes
3	705	CWE	M	[1..1]	HL7 Error Code		First Component contains the Identifier Code of the Error. For Atellica Solution, this identifier code is 207. Second Component contains the Descriptive Text: 'Application Internal Error.' Third Component contains: 'HL70357.' Example: 207^Application Internal Error.^HL70357
4	2	ID	M	[1..1]	Severity	'E'	Transaction is unsuccessful.
5	705	CWE	RE	[0..1]	Applica-tion Error Code		Atellica Solution-defined error code. For example UNKNOWN_TEST. Description: additional info whenever available. For example AWOS ID is written for the invalid test Vendor coding system: 99SiemensHDXApplicationError
8	250 #	TX	RE	[0..1]	User Message		Error Description Example: Unsupported or Disabled Test (Testx) from Host LIS for Sample (Sample ID)

```
ERR|||207^Application internal
error.^HL70357|E|UNKNOWN_TEST
^3407b0769e152781665ea7f5b71183a3^99SiemensHDXApplicat
ionError|||Unsupported or disabled test (14682-9) from
Host LIS for sample SID: 31000214 Rack: A000001.
```

About the Inventory Detail Segment (INV)

The Inventory Detail (INV) segment contains:

- Control material information when Atellica Solution transmits QC results
- Reagents Atellica Solution uses to produce a patient or QC result

INV|ControlName1^Control^99SiemensHDX|NA^Not applicable^HL70383|

CO^Control^HL70384||||||||||||4444

The following is an example of a Reagent INV segment:

INV|PREAG^Single test reagent^99SiemensHDX|NA^Not applicable^HL70383||SR^Single test reagent^HL70384||||||||||||103

About the Notes and Comments Segment (NTE)

The Notes and Comments (NTE) Segment is limited to human-readable comments the LIS operator exchanges with Atellica Solution operator. Atellica Solution considers all comments to be internal remarks. Atellica Solution uses NTE segment specifically for Patient, Sample and Result comments. The entire segment repeats when there is more than one comment for a patient, sample or results.

Component/ Sub-Component	System Data	Data Type	USE	LEN	Notes
Identifier	Comment Type	ST	R	20	Atellica Solution will not transmit Patient and Sample Comments to the LIS as per the HL7 Protocol. Vendor-defined Code, for example: • Patient • Sample • Result: Range Flags, Calibration Information, Control Information
Text		ST	RE	199#	Vendor-defined description.
Name of Coding System		ID	R	12	Identifier for a vendor-defined coding system.

- Atellica Solution rejects incoming result comments.

- Atellica Solution retains up to 3 patient and sample comments. If the Analyzer Manager (LIS) sends more than 3 comments, Atellica Solution retains only the last three comments. Atellica Solution will not transmit Patient and Sample comments to the LIS as part of the Result message (OUL^R22) as per the HL7 Message Semantics.
- Atellica Solution retains up to three operator-entered result comments.
- The result flags in the NTE Comment Segment may contain the values in the tables in Section 2.5.1.7.4. However, the flags that Atellica Solution transmits to the LIS are dependent on the instrument or module type.

Examples of NTE Comments

NTE|1|Z|> Conc Range|FLAG^^99SiemensHDXResultFlag

NTE|1|Z|Result is within Range but on border of High

NTE|1|Z|Lot=C015;DateTime=20150629113137;Status=Due;
|CALINFO^^99SiemensHDX

NTE|1|Z|(Name;Level;Lot;Result;DateTime)=(QELF;1;4444;32.77;2015062
9144912) |QCINFO^^99SiemensHDX

NTE|1|A|Low Turbidity

NTE|1|A|Patient presenting with chest pains

NTE Segment Table

SEQ	LEN	DT	Usage	Cardinality	Element name	Value	Notes
1	4	SI	R	[1..1]	Set ID - NTE		Sequence number
2	8	ID	R	[1..1]	Source of Comment	A, Z	A = Analyzer Manager (LIS or Middleware) Z = Analyzer (system)
3	250#	FT	R	[1..1]	Comment		Comment Text
4	250	CE	RE	[0..1]	Comment Type	See *NTE-4 Comment Type (CE) – Vendor specified information*	--

About the Patient Identification Segment (PID)

Atellica Solution uses this segment with the LAW_PAT_DEM Profile Option. All applications use the Patient ID (PID) segment as the primary means of communicating patient identification information. This segment allows an analyzer to use patient demographic information for additional clinical evaluation of a test result. This segment specifies only a minimal set of identifying data, since it is the Analyzer Manager's responsibility to maintain patient demographic information. For more information, see the IHE Laboratory Technical Framework Supplement – LAW, Reference no. 30.

PID Segment Table

SEQ	LEN	Data Type	Usage	Cardinality	HL7 Element Name	System	Value	Notes
3	250	CX (coded with exception)	R	[1..1]	PID List	PID	--	See *PID-3 – Patient Identifier List (CX)*.
5	250	XPN (expanded name)	R	[1..1]	Patient Name	Patient Name	--	See
	26	TS	RE (Required if Availabl e)	[0..1]	Date/Time of Birth	DOB	YYYYMM DDHHMM SS	Optional field.
8	1	IS	RE	[0..1]	Gender	Sex	M, F, U	Male, Female, Unknown.
10	250	CE	RE	[0..1]	Race	--	--	Not used in Siemens system
35	12#	ST	O	[0..1]	Species	Species	--	Example: Mice, Human.

PID-3 – Patient Identifier List (CX)

Component/ Sub-Component	System Data	Data Type	Usage	LEN	Notes
ID	PID	ST	R	20	Patient ID
Assigning Authority		HD	RE	227	System does not use
Namespace ID		IS	RE	20	System does not use.
Universal ID		ST	RE	199	System does not use.
Universal ID Type		ID	C R/X)	6	System does not use.

PID 5 – Patient Name Element (XPN)

Component/ Sub-Component	System Data	Data Type	USAGE	LEN	Comments
Surname	Last Name	ST	RE	50#	Example: Lincoln^Abraham^GoodGuy Lincoln=Last Name Abraham=First Name GoodGuy=Middle Name
Given Name	First Name	ST	RE	30#	
Second Name	Middle Name	ST	RE	30#	

Atellica Solution converts the incoming Date of Birth from ANSI format (YYYYMMDD) into the date format as per the regional settings of the Siemns system and writes to the DOB field in the order. The Date of Birth field may be blank. If the Date of Birth field is invalid, then Atellica Solution rejects the order logs a parsing error in the event log.

The following is an example of a PID segment:

PID|||PIDXYZ221||Adams^John^Quincy||19880110|M

Patient Visit Segment (PV1)

The Patient Visit (PV1) supports the LAW_PAT_DEM Profile Option (see Section W.1.3.5 Patient Demographics in the IHE Laboratory Technical Framework Supplement – LAW, Reference no. 30). The PV1 segment communicates patient location information.

SEQ	LEN	Data Type	Usage	Cardinality	Element name	System	Value	Comments
2	1	IS	R	[1..1]	Patient Class		B: Obstetrics 'E' - Emergency 'I' - Inpatient 'O' - Outpatient 'P' - Preadmit 'R' - Recurring Patient	Patient Status in Atellica Solution. Recommended to have 1 character according to HL7 Patient Class Table, but Atellica Solution will accept up to 12 characters and truncates any more characters with a #.
3	80	PL	RE	[0..1]	Patient Location	Location	See *Assigned Patient Location (PL)*	Assigned Patient Location
7	250	XCN	O		Attending Doctor	Physician ID/ Physician Name	See *PV1-7: Attending Doctor (XCN)*	--

Assigned Patient Location (PL)

Component/Sub-Component	System Data	Data Type	USAGE	LEN	Comments
POC		IS	O		System does not use.
Room No.	Location	IS	R	20#	--

PV1-7: Attending Doctor (XCN)

Component/Sub-Component	System Data	Data Type	USAGE	LEN
ID Number	Physician ID	ST	O	12
Surname	Last Name	ST	O	50#
First Name	First Name	ST	O	30#
Second Name	Middle Name	ST	O	30#

PV1||P|^103||||DOCID123^Hernandez^Diomedes^Nolberto

Observation Request Segment (OBR)

The Observation Request (OBR) segment transmits order information to the LIS. This segment identifies the tests Atellica Solution performs on the sample.

OBR Segment Table

SEQ	LEN	Data Type	Usage	Cardinality	Element name	Value	Notes
1	4	SI	R	[1..1]	Set ID	--	Sequence Number
2	50	EI	M	[1..1]	Placer Order Number (AWOS ID)	Unique Order Number or "" (NULL), if unknown	Unique AWOS ID – identifies instance of a test the analyzer runs. For Rerun of same test the LIS orders, the LIS must send a different AWOS ID.
4	250	CE	M	[1..1]	Universal Service Identifier	See *OBR-4 – Universal Service Identifier*	Test Ordered; this is the LIS Test Code.
11	1	ID	RE	[0..1]	Specimen Action Code	'G'	Analyzer-generated order is a reflex, otherwise empty.
46			RE		Placer Supplemental Service Information On system: System and Module Identifier	See *OBR-46 – System/ Module Identifier*	Both System and Module Serial Numbers are in 3 parts within the OBR-46 Field. The first and third parts of both Atellica Solution and Module Serial Numbers are fixed and the second part is variable.

OBR-4 – Universal Service Identifier

Component/ Sub-Component	System Data	Data Type	USAGE	LEN	Notes
Identifier	Test Code	ST	R	20	Test Identifier
Text	Test Name	ST	R	199	Name for the test
Name of Coding System		ID	R	12	Name of the coding system "LN" for LOINC®, "JC10" for JLAC10, or "99zzz" for a vendor-defined coding system (where z is an alphanumeric character)

OBR-46 – System/Module Identifier

The OBR-46 targets an order to a particular module. OBR-46 is the order record and field that contains the specification for both System and Module Serial Number. The System and Module Serial Numbers are in 3 parts within the OBR-46 Field. The first and third parts of the System and Module Serial Numbers are fixed and the second part is variable as follows:

System: |**SystemSN^***system serial number*^**99SiemensHDXTargetDevice**

Module: ~**ModuleSN^**module serial number^**99SiemensHDXTargetDevice**

Atellica Solution uses the value in the Test Name/Test Code field to search the test definition database for the matching LIS code. If Atellica Solution finds no match or the TDEF test is disabled, then Atellica Solution logs an event.

OBR Test Requests and Sort Tests

The order can contain from one up to 329 tests, including ratio, off-system tests, and [NXG] sort tests.

Note A sort test does not have the same LIS Code and Display Name. See Assumption no. 1.2.6.

Current Order Date/Time

Atellica Solution saves the current date/time upon receipt of the OBR message a as the Order Date/Time.

See *About the Test Order Record* and the O7 record for more information on Order Date/Time.

```
OBR||1a3377abab8921f854f9ec2e169dd7ce||2951-
2^NaS^LN||||||||||||01025232
```

```
OBR||OBR prior 11|OBR-3 ns|2951-2^Na-S^LN|||||||AC
11|||||01025232|||||||||||||||||||||||||||SystemSN^
System
11^99SiemensHDXTargetDevice~ModuleSN^Module11^99Siemen
sHDXTargetDevice
```

About the Observation/Result (OBX) Segment

The Observation/Result (OBX) segment transmits a single result (observation).

OBX Segment Table

SEQ	LEN	DT	Usage	Card.	Element Name	Value	Notes
1	4	SI	M	[1..1]	Set ID – OBX	--	Sequential numbering.
2	2	ID	C (M/X)	[0..1]	Value Type	NM, ST	Value Type of the result; NM (numeric result), or ST.
3	250	CE	M		Observation Identifier	See Comments	Atellica Solution adds a Result Aspect to the first part of the identifier. For example: RLU Aspect = 2951.RLU^Chloride^LN CONC Aspect = 2951.CONC^Chloride^LN INTR Aspect =2951.INTR^Chloride^LN COFF Aspect =2951.COFF^Chloride^LN INDX Aspect = 2951.INDX^Chloride^LN Empty Result Aspect = 2951^Chloride^LN
4	20	OG	M	[0..1]	Observation Sub-ID	See *OBX-4 Observation Sub-ID (OG – Observation Grouper)*	--
5	99999	Varies	M	[1..*]	Observation Value		Result Value see *Note on Regional Settings* for specification on when Atellica Solution applies regional settings on an instrument.

6	250	CE	M	[1..1]	Units	See Table OBX-6	Unit of measure for the result, mandatory when OBX-2 contains NM or SN.
7	70	ST	M	[0..1]	Reference Range	--	Required if available from Analyzer Manager or Analyzer. For example: [Critical High > 3]
8	5	CWE	M	[1..*]	Interpretation Codes	See Table OBX-8 with Subset of HL7 Table 0078	Contains analyzer codes (if any) assigned to the result. Null "" if no codes apply: Atellica Solution must specify if no codes apply. Field can repeat when Atellica Solution assigns multiple codes. (Abnormal Flags)
11	1	ID	M	[1..1]	Observation Result Status	See Table OBX-11 with Subset of HL7 Table 0085	Contains the status of observation.
16	250	XCN	M	[1..*]	Responsible Observer		Logged in Operator ID. Atellica Solution sends 1 Operator ID.
18	427	EI	M	[2..*]	Equipment Instance Identifier	See Table OBX-18	Repeatable field; Atellica Solution sends three instances. For example: NXGAnalyzer^SiemensHDX~5-5-5-5-5^SystemSN~1-1-1-1-1^ModuleSN
19	14	TS	M	[1..1]	Date/Time of Analysis	YYYYMMDDHHMMSS	Result Date/Time.
29	4	ID	M	[1..1]	Observation Type	'RSLT'	Always RSLT.

OBX-4 Observation Sub-ID (OG – Observation Grouper)

This component and sub-components indicates Run ID, Replicates, and Repeats.

Component/Sub-Component	System Data	Data Type	USAGE	LEN	Notes
Original	Run Number	ST	R	20	Run Identifier (starting from 1)
Group		NM	C	5	Group Identifier (Always 1)
Sequence	Replicate Number	NM	R	5	Replicate Number (starting from 1)
Identifier	Result ID	NM	O	5	A unique identifier of a result

Note on Regional Settings

The decimal separator in results is transmitted to the Host LIS/CentraLink system by applying or not applying regional settings based on the instrument manager internal configuration setting sent to Atellica Solution (for examples, XPR default will be OFF meaning the decimal separator will not be based on the regional setting; it will always be a 'period' even when the UI regional settings display a comma.) For all instruments, the default behavior uses a 'period' no matter the UIW regional settings specified. It is possible that an instrument will NOT implement an internal IM configuration setting for this option. This setting is only available internally within the software it is not directly available to the customer on the UI.

OBX-6 Units (CE)

This component specifies the standard unit coding system for measurement (Unified Code for Units of Measure).

Component/Sub-Component	System Data	Data Type	USAGE	LEN	Notes
Identifier		ST	R	20	UCUM coded unit of measure
Text		ST	R	199	Vendor readable unit
Name of Coding System		ID	C	4	Fixed UCUM (value pre-adopted from HL7 v2.6)

OBX-8 – Interpretation Code (CWE)

Component/Sub-Component	System Data	Data Type	USAGE	LEN	Notes
Identifier	--	ST	R	20	Code from Value column of HL7 Table 0078
Text	--	ST	RE	199	Text from Description column from HL7 Table 0078
Name of Coding System	--	ID	R	12	HL70078 for HL7 values or 99zzz for vendor-defined coding system

Subset of HL7 Table 0078 – Interpretation Codes

Value	Description	Comment
<	Off scale low	Below assay dynamic range
>	Off scale high	Above assay dynamic range
L	Low	Below low normal
H	High	Above high normal
LL	Critically low	Below assay panic range
HH	Critically high	Above assay panic range

OBX-11 Observation Result Status with Subset of HL7 Table 0085

Value	Description	Comment
X	System cannot obtain results	Test Exception. Atellica Solution reports the reason for failure in field OBX-5. This test will not produce any result in this run.
P	Preliminary results	The result is preliminary in a progression of results leading to the final result.
F	Final results that only a corrected result can change	The result of this run is final and a candidate that reports upstream. In case results of multiple runs have status of F and the choice of the right run is left up to the Analyzer Manager.
C	Record coming over is a correction and replaces a final result	Correction of a result Atellica Solution previously sent as final. Atellica Solution does not use this field.

OBX-18 Equipment Instance Identifier

This component indicates the system or module associated with the test result.

Component/ Sub-Component	System Data	Data Type	USAGE	LEN	Notes
Entity Identifier	Model or System Serial Number or Module Serial Number	ST	R R O	50	First instance: Model Second instance: Serial number Subsequent instances: Vendor or site defined
Namespace ID	SiemensHDX/ SystemSN/ModuleSN	IS	R R O	20	First instance: Manufacturer Second instance: Manufacturer Subsequent instances: Vendor or site defined
Universal ID	Atellica Solution does not use	ST	O X	199	First instance: UID Subsequent instances: Not supported
Universal ID Type	Atellica Solution does not use	ID	O X	6	First instance: ISO Atellica Solution does not support subsequent instances.

Preliminary and final results shall include all results except invalid manual dilution results, RLU results only, and results of tests in which the Hold option is selected in the TDef.

The following are considered to be Preliminary results:

1. Replicate results of a meaned test if the number of replicates is greater than 1.
2. Results of all of the levels in a dilution profile or STMD except the selected result.
3. Initial result when Atellica Solution triggers an auto-repeat.
4. AFRR+ unselected results (only the selected result is considered as Final)

   For more information on when Atellica Solution transmits and retransmits Preliminary and Final Results, see Send Transmitted Results and *OBX-18 Equipment Instance Identifier*.

- Results on hold are automatically transferred when the operator releases the results.
- Atellica Solution will transmit preliminary results in temporal order by Result Date/Time and then the final result.

- When a dilution profile is ordered, Atellica Solution transmits the corresponding result record with the LIS code for the constituent test used for the dilution profile.

  For example, if MYDILPROF is the LIS code for the dilution profile, MYSID is the SID, and the definition for the dilution profile MYDILPROF is TnlUltra (x2, x10).

  This example is with Additional Data OFF*:

  ```
  H|\^&|||NG_LIS|||||LIS_ID||P|1
  P|1|||||||U
  O|1|MYSID||^^^TnIUltra^dilution
  profile^MYDILPROF|R||||||||||Serum||||||||||F
  R|1|^^^TnIUltra^dilution profile^2^1^DOSE|0.012|ng/
  mL||||F\R||||20140422072815
  R|2|^^^TnIUltra^dilution profile^2^1^COFF|1.000|ng/
  mL||||F\R||||20140422072815
  R|3|^^^TnIUltra^dilution
  profile^2^1^RLU|1222|||||F\R||||20140422072815
  ```

  This example is with Additional Data ON*, with a dilution of 10 as a preliminary result and dilution of 2 as the final result:

  ```
  H|\^&|||NG_LIS|||||LIS_ID||P|1
  P|1|||||||U
  O|1|MYSID||^^^TnIUltra^dilution
  profile^MYDILPROF|R||||||||||Serum||||||||||F
  R|1|^^^TnIUltra^dilution
  profile^10^1^DOSE|0.012|ng/
  mL||||P\R||||20140422072815
  R|2|^^^TnIUltra^dilution
  profile^10^1^COFF|1.000|ng/
  mL||||P\R||||20140422072815
  R|3|^^^TnIUltra^dilution
  profile^10^1^RLU|1222|||||P\R||||20140422072815
  R|4|^^^TnIUltra^dilution profile^2^1^DOSE|0.012|ng/
  mL||||F\R||||20140422072815
  R|5|^^^TnIUltra^dilution profile^2^1^COFF|1.000|ng/
  mL||||F\R||||20140422072815
  R|6|^^^TnIUltra^dilution
  profile^2^1^RLU|1222|||||F\R||||20140422072815
  ```

Note Atellica Solution does not transmit results with Signal Errors to the LIS.

OBX|1|NM|2951-2.DOSE^2951-2^99SiemensHDXTestCode

|1^1^^1016|5.00|U/mL^U/mL^UCUM||""^""^HL70078|||F|||||

siemensinternal^siemensinternal||SiemensAnalyzer^SiemensHDX~5-5-5-5-5-5-5^SystemSN|20150706092852|||||||||RSLT

About the Common Order Segment (OCR)

The Common Order Segment (ORC) segment transmits elements common to all of the tests ordered.

SEQ	LEN	DT	Usage	Card.	Element Name	Value	Notes
1	2	ID	M	[1..1]	Order Control	See ORC-1 HL7 Table 0119	Uses IHE-LAW appropriate Order Control Codes. Identifies the trigger event for order(s).
2	50	EI	M	[0..1]	Placer Order Number (AWOS ID)	--	AWOS ID. Mandatory for the analyzer and ORL^O34 response to the LIS.
4	50	EIP	RE	[0..1]	Placer Group Number	--	Number of Replicates
5	2	ID	M	[1..1]	Order Status	See ORC-5 HL7 Table 0038	Order Status of the AWOS..
8	50	EIP	RE	[0..*]	Parent	--	AWOS ID of a Parent AWOS. Required if available when the analyzer is using LAW_REFLEX. Atellica Solution sends AWOS ID of the test that causes the addition of a Reflex test .

ORC-1 Order Control with Subset of HL7 Table 0119 – Order Control Codes

The IHE Laboratory Technical Framework allows only the following subset for the LAW Profile:

Value	Description	Comment
NW	New Order	The LIS sends the event request in OML message of LAB-28
OK	Atellica Solution accepts notification or request.	Atellica Solution sends event acknowledgement in ORL message of LAB-28, responding to OML (NW).
UA	Atellica Solution is unable to accept the order or service.	Atellica Solution sends event acknowledgement in ORL message of LAB-28, responding to OML (NW).
CA	Atellica Solution cancels the order or service request.	The LIS sends event request in OML message of LAB-28
CR	Atellica Solution cancels the request.	Event acknowledgement sent by Atellica Solution in ORL message responding to OML (CA), in LAB-28.
UC	Atellica Solution is unable to cancel.	Atellica Solution sends event acknowledgement in ORL message responding to OML (CA), in LAB-28.
DC	Atellica Solution discontinues the request.	The LIS indicates a negative query response in LAB-28.
SC	Status Change.	Atellica Solution sends in OUL message of LAB-29 to indicate the message is a status change.
PR	Prior results not supported as per CR 112468.	Removed as per CR 112468.

ORC-5 Order Status with Subset of HL7 Table 0038

Value	Description	Comment
SC	In process, scheduled	Atellica Solution schedules AWOS on the Analyzer, but the Analyzer did not start the work for the AWOS. Atellica Solution can send the stastus in ORL message of LAB-28 in response to OML (NW) when it accepts the AWOS.
IP	In process, unspecified	The process of the first run of the AWOS starts on the Analyzer with the specimen. There may be some results or none. Atellica Solution can send this status in ORL message of LAB-28 in response to OML (NW) when the AWOS is accepted. Atellica Solution can send this status in ORL message of LAB-28 in response to OML (CA) when the AWOS cannot be cancelled because the AWOS work is in process. Atellica Solution can send this status in OUL message of LAB-29 to update the AWOS Status.

CM	Order complete.	The Analyzer finishes its work for the AWOS. The results may have been produced or not. No additional result is expected for this AWOS. Nonetheless, the analyzer may send a correction of some of the final results produced for this AWOS, in which case the AWOS status will remain CM. Atellica Solution can send this status in ORL message of LAB-28 in response to OML (NW) when the AWOS is accepted. This status can be sent in ORL message of LAB-28 in response to OML (CA) when it cannot cancel the AWOS because the AWOS work is complete. This status can be sent in OUL message of LAB-29 to update the AWOS Status.
CA	Order canceled.	The analyzer considers the AWOS work cancelled. Atellica Solution can send this status in ORL message of LAB-28 in response to OML (NW) when it rejects the AWOS request. The analyzer did not create an AWOS. Atellica Solution can send this status in ORL message of LAB-28 in response to OML (CA) when the AWOS is cancelled. The analyzer can cancel the AWOS before the it starts processing of the AWOS, when the AWOS status is scheduled (SC).

- If the incoming Order Status is Cancel, Atellica Solution cancels the request for the test or tests specified in the LIS Code field for the sample specified in the SID and/or Carrier ID/Tray ID and Position field. Atellica Solution software logs an event in the Operator event Log.
- The LIS cannot cancel a test that is in the In Process or higher state. In this case, Atellica Solution software logs a 'cannot be canceled' message in the Operator event Log.
- When a sample is not available for cancellation, Atellica Solution issues LIS MID-061in the Event Log.

The following are examples of ORC – Common Order Segment: New Order:

ORC|NW|||20150706154136.ORDXYZ213|||||20150706154136

Request Accepted:

ORC|OK||||CM

Unable to Accept Request:

ORC|UA|3407b0769e152781665ea7f5b71183a3|||CM

ORC|UA|4b39849423f3c9f7ca334db9bf948303|||CM

ORC|UA|79d5b4ec60375af9caa8bab4d75fd5bc|||CM

Cancelled as Requested:

ORC|CR|4f761b1788970538b3ea3cf44d5dffba|||CA

Specimen Container Detail Segment

the Specimen Container Detail segment (SAC) describes the sample containers and their carrier attributes (tray) in outgoing messages to the LIS.

SEQ	LEN	DT	Usage	Card.	Element Name	Value	Notes
3	20	EI	M	[0..1]	Container Identifier		Sample Barcode (SID) NULL "" when container identifier is not known or not applicable.
4	20	EI	M	[0..1]	Primary (parent) Container Identifier		NULL "" (Always Null).
10	20	EI	M	[0..1]	Carrier Identifier		Tray Number
11	80	NA	RE	[0..1]	Position in Carrier		Position of the container in the Tray.
13	80	EI	C (M/X)	[0..1]	Tray Identifier		For Direct Load and Sample Handler.
14	80	NA	C (M/X)	[0..1]	Position in Tray		For Direct Load and Sample Handler.
29	20	SN	RE	[0..1]	Dilution Factor		Manual Dilution; The factor of dilution the sysetm performs on the specimen; Always presented as a Ratio; For example: ^1^:^2 ^1^:^2.5 Atellica Solution does not sent or accept a value when running an undiluted sample.

The following is an example of SAC

SAC|||31000212|||||||||||||||||||||||||^1^:^0.5

- The Carrier ID/Tray ID and Position shall be optional (in either SID Mode or Tray ID Mode). However, if a value is given for the Carrier ID/Tray ID, then a value must be given for the Carrier /Tray Position. If a value is given for the Tray Position, then a value must be given for the Carrier ID /Tray ID. The values for Carrier ID/Tray ID and Position are dependent on the instrument.

- If an invalid SID or Carrier ID/Tray ID and Position is received Atellica Solution software shall reject the message and log an event.

Specimen Segment

The Specimen (SPM) Segment describes the characteristics of a sample.

SEQ	LEN	DT	Usage	Card.	Element Name	Value	Notes
1	4	SI	M	[1..1]	Set ID – SPM		Sequence Number
2	20	EIP	RE	[0..1]	Specimen ID		Entity Identifier, SID
4	20	EI	CWE	[1..1]	Specimen Type		Supported Sample Types:
						SER	• Serum
						PLAS	• Plasma
						UR	• Urine
						AMNIOTICFLUID	• Amniotic Fluid
						HEMOLYSATE	• RBC Hemolysate
						BBS	• BufferBasedSolutions
						CSF	• Cerebral Spinal Fluid
						SAL	• Oral Fluids: Saliva
						SPT	• Sputum
						WB	• Whole Blood
						OTH	• Other
						UNKNOWN	• Unknown
11	250	CWE	M	[1..1	Specimen Role	P: Patient Q: Control	Sample Type.
17	14	DR	RE	[0..1]	Specimen Collection Date/ Time	YYYYMMDDHHMMSS	Required, if available, from the LIS. The Date/Time when Atellica Solution acquires specimen from the source. Time is optional. For more information, see the bulleted after this table.
18	14	TS	RE	[0..1]	Specimen Received Date/ Time	YYYYMMDDHHMMSS	Required, if available, from the LIS. The Date/Time when the specimen was accessioned. Time is optional.

27	20	CWE	RE	[1..1]	Container Type		System Supported Container Type Codes – dependent on the instrument.

Regarding Date and Time

- A valid incoming Order Date/Time (Field O7) is in the format: YYYYMMDDHHMMSS and contains a valid date and time, where time is optional. The field can be blank. If the date (YYYYMMDD) is specified and the time (HHMMSS) is not specified, then the time will be set to 12 AM midnight (00:00:00). If the Order Date/Time is invalid, then Atellica Solution rejects the order logs an error message in the Event Log.

The following is an example of SPM:

SPM|1|55^""|""^""|SER^Serum^HL70487|||||||P^Patient specimen^HL70369

Test Code Details Segment (TCD)

The Test Code Details (TCD) segment provides additional details about the test order or the test result.

SEQ	LEN	DT	Usage	Cardinality	Element Name	Value	Notes
1	250	CE	R	[1..1]	Universal Service Identifier.	--	Same Value as OBR-4 when used by the LIS. Same Value as OBX-3 when used by Atellica Solution.
2	20	SN	NS	[0..1]	Auto-Dilution Factor.	--	Required, if available; otherwise not supported. Ratio 1:x.y
11	250	CWE	NS	[0..1]	Auto-Dilution Type.	--	Required, if available for LIS. Optional for Atellica Solution. Code of the auto-dilution factor and/or the auto-dilution protocol on the analyzer. For example: D1, D2

- If the Dilutions field specifies a dilution ratio that is not defined for the test in the TDef, then Atellica Solution rejects the order for that test is and an logs an event.

The following is an example of TCD:

```
TCD|2951-2^2951-2^99SiemensHDX||D1
```

About the Timing / Quantity Segment(TQ1)

The Timing / Quantity Segment (TQ1) segment provides the priority of the order.

SEQ	LEN	DT	Usage	Card.	Element Name	Value	Comments
9	250	CWE	R	[1..1]	Priority	R A S	R=Routine A=ASAP S=STAT

- For HL7, Atellica Solution sets and sends the Priority Field of the incoming and outgoing order Information Message, based on defaults for QC Orders, specimen types and no specification of priority.
  a. The Priority field of the incoming order Information Message is as follows for a patient order with any specimen type other than Whole Blood:

Incoming record	System
S	Stat
A	ASAP
R	Routine
<Blank>	Routine

  b. The Priority field of the incoming order Information Message is set to **STAT** for any patient order with a specimen type of Whole Blood no matter the priority sent from the LIS. The operator cannot change the priority field of a patient order with a specimen type of Whole Blood, even with an update to the priority field from the Host LIS.
  c. The Priority field of the incoming order Information Message is set to ASAP for any QC Order, no matter the specimen type. The operator can edit the priority of a QC Order either locally on Atellica Solution or from the Host LIS.

d. The Priority field of the outgoing order Information Message is set by the Priority field in the following order:

System	Outgoing record
Stat	S
ASAP	A
Routine	R

The following is an example of TQ1

```
TQ1|||||||||R^^HL70485
```

About IHE-LAW Transactions

About Transaction LAB-27: Query for Order from LIS and Query Acknowledgement

Transaction LAB-27 contains Query for Order and Response indicating Atellica Solution receives the query.

The Message Semantics for these messages are the following:

QBP^Q11^QBP_Q11 Message Semantics

Segment	Meaning	Usage	Card.
MSH	Message Header	M	[1..1]
QPD	Query Parameter Definition	M	[1..1]
RCP	Response Control Parameter	M	[1..1]

Note MSH-9 must have value of QBP^Q11^QBP_Q11.

RSP^K11^RSP_K11 Message Semantics

Segment	Meaning	Usage	Card.
MSH	Message Header	M	[1..1]
MSA	Message Acknowledgement	M	[1..1]
[ERR]	Error	C	[0..*]
QAK	Query Acknowledgement	M	[1..1]
QPD	Query Parameter Definition	M	[1..1]

Note MSH-9 must have value of RSP^K11^RSP_K11.

QPD – Query Parameter Definition Segment

SEQ	LEN	DT	Usage	Card.	Element name	System
1	60	CE	M	[1..1]	Message Query Name	Query by SID contains value: 'WOS^Work Order Step^IHELAW' Query by Rack ID contains value: 'WOS_BY_RACK^Work Order Step^IHELAW'
2	32	ST	M	[1..1]	Query Tag	--
3	80	EI	C (M/X)	[0..1]	Container Identifier	SID (Barcode)
4	80	EI	C (M/X)	[0..1]	Carrier Identifier	Tray ID
5	80	NA	C (M/X)	[0..1]	Position in Carrier	Tray Position
6	80	EI	C (M/X)	[0..1]	Tray Identifier	Tray ID
7	80	NA	C (M/X)	[0..1]	Position in Tray	Tray Position

- Atellica Solution automatically queries the LIS for worklist entries as it identifies each sample when System Automatically Queries Host for Worklist is enabled and LIS Query First is selected.

RCP- Response Control Parameter Segment

SEQ	LEN	DT	Usage	Card.	Element name
1	1	ID	M	[0..1]	Query Priority. When the instrument sends this, Atellica Solution sets this field to the value of I (Immediate).
3	60	CE	M	[0..1]	Response Modality. When the instrument sends this, Atellica Solution sets this field to the value of R^RealTime^HL70394.

The following are QBP^Q11^QBP_Q11 (Query from system to LIS) and RSP^K11^RSP_K11 (Acknowledgement from system to LIS) message pair examples:

Query by SID:

```
MSH|^~\&|Siemens Analyzer|Siemens
Lab|xyzcompany|AM_Company Name_xyzlab|

20150706113624-0400||QBP^Q11^QBP_Q11|

f0c59edde367440cb788e882de0f923a|P|2.5.1|||NE|AL||UNIC
ODE UTF-8|||LAB-27^IHE

QPD|WOS^Work Order
Step^IHELAW|d8fa0b38c26c4f91a606cd636a61246c|31000222

RCP|I||R^Real Time^HL70394

MSH|^~\&|xyzcompany|AM_CompanyName_xyzlab|Siemens
Analyzer|Siemens Lab|
20150706173523.624+0200||RSP^K11^RSP_K11|f5898c9595e76
bbddd29cc68730d6542|P|2.5.1|||||UNICODE UTF-8|||LAB-
27^IHE

MSA|AA|f0c59edde367440cb788e882de0f923a

QAK|d8fa0b38c26c4f91a606cd636a61246c|OK|WOS^Work Order
Step^IHELAW

QPD|WOS^Work Order
Step^IHELAW|d8fa0b38c26c4f91a606cd636a61246c|31000222
```

Query by Carrier ID (Tray/Position):

```
MSH|^~\&|Siemens Analyzer|Siemens
Lab|xyzcompany|AM_Company Name_xyzlab|
```

```
20150706113624-0400||QBP^Q11^QBP_Q11|

f0c59edde367440cb788e882de0f923a|P|2.5.1|||NE|AL||UNIC
ODE UTF-8|||LAB-27^IHE

QPD|WOS_BY_RACK^Work Order
Step^IHELAW|d8fa0b38c26c4f91a606cd636a61246c

||AA000001|5

RCP|I||R^Real Time^HL70394

MSH|^~\&|xyzcompany|AM_CompanyName_xyzlab|Siemens
Analyzer|Siemens Lab|
20150706173523.624+0200||RSP^K11^RSP_K11|f5898c9595e76
bbddd29cc68730d6542|P|

2.5.1||||||UNICODE UTF-8|||LAB-27^IHE

MSA|AA|f0c59edde367440cb788e882de0f923a

QAK|d8fa0b38c26c4f91a606cd636a61246c|OK|WOS_BY_RACK^Wo
rk Order Step^IHELAW

QPD|WOS_BY_RACK^Work Order
Step^IHELAW|d8fa0b38c26c4f91a606cd636a61246c|

|AA000001|5
```

About Transaction LAB-28: Order sent to system from LIS and Order Acknowledgement to LIS from system

For more information about OML^O33^OML_O33 Message Semantics, see the IHE-LAW Supplement, Reference no. 30, Section 3.R.5.2.

MSH-9 must have value of OML^O33^OML_O33.

For more information about ORL^O34^O42 Message Semantics, see the IHE-LAW Supplement, Reference no. 30, Section 3.R.5.2.2.

The following are OML^O33^OML_O33 (from LIS to system) and ORL^O34^ORL_O42 (from system to LIS) message pair examples:

```
MSH|^~\&|xyzlab|xyzcompany|OTHER_Siemens
DX_IVD|SIEMENS|

20150706173528.116+0200||OML^O33^OML_O33|a90bd77f77429
50023dd47cdbd01752e|

P|2.5.1|||NE|AL||UNICODE UTF-8|||LAB-28^IHE

PID|||PIDXYZ222||PROVA3^PROVA3^^^^^L||19880110|F

PV1||U|^103
```

```
SPM|1|31000222||SER^^HL70487|||||||P^^HL70369

SAC|||31000222

ORC|NW|||20150706172239.ORDXYZ222|||||20150706172239

TQ1|||||||||R^^HL70485

OBR||4603833e10de8e20d9d72e3293c27b39||2951-2^Na-
S^LN||||||||||||01025232

TCD|2951-2^Na-S^LN

MSH|^~\&|Siemens Analyzer|Siemens
Lab|xyzcompany|AM_Company Name_xyzlab |20150706113629-
0400||ORL^O34^ORL_O42|79ea88173ef04ef29db013b04c54b7fe

|P|2.5.1||||||UNICODE UTF-8|||LAB-28^IHE

MSA|AA|a90bd77f7742950023dd47cdbd01752e

SPM|1|31000222^""|""^""|SER^^HL70487|||||||P^^HL70369

SAC|||31000222

ORC|OK|4603833e10de8e20d9d72e3293c27b39|||SC
```

About Transaction LAB-29: Result Transmitted to LIS from Atellica Solution and Acknowledgement from LIS to Atellica Solution

For OUL^R22^OUL_R22 Message Semantics, see the IHE-LAW Supplement, Reference no. 30, Section 3.Y.5.2.

MSH-9 must have value of OUL^R22^OUL_R22.

ACK^R22^ACK Message Semantics

Segment	Meaning	Usage	Card.
MSH	Message Header	M	[1..1]
MSA	Message Acknowledgement	M	[1..1]
[{ERR}]	Error	C	[0..*]

The following is an exmple of OUL^R22^OUL_R22 (from Atellica Solution to LIS) and ACK^R22^ACK (from LIS to Atellica Solution) message pair:

```
MSH|^~\&|Siemens Analyzer|Siemens
Lab|xyzco|AM_xyzco_xyzlab|20150706094746-
0400||OUL^R22^OUL_R22|61a8d7e52e4f426dbb295d7c35b22cab
|P|2.5.1|||NE|AL||UNICODE UTF-8|||LAB-29^IHE
```

```
PID|1||PIDXYZ213^^^^PT||PROVA3^PROVA3^^^^^L||198801100
00000|F

PV1|1|U|^103

SPM|1|31000213^""|""^""|SER^Serum^HL70487|||||||P^Pati
ent specimen^HL70369

SAC|||31000213

OBR|1|38fcd339ba01a7308806de6c323d4928||2951-2^Na-S^LN

ORC|OK||||CM

OBX|1|NM|2951-2.RLU^Na-S^LN|1^1^^1017|53355|U/mL^U/
mL^UCUM||""^""^HL70078

|||F|||||siemensinternal||SiemensAnalyzer^SiemensHDX~5
-5-5-5-5-5-5^SystemSN~4-4-4-4-4-4-
4^ModuleSN|20150706094610||||||||||RSLT

TCD|2951-2^Na-S^LN

INV|PREAG^Single test reagent^99SiemensHDX|NA^Not
applicable^HL70383||SR^Single test
reagent^HL70384||||||||||||103

NTE|1|Z|Lot=C015;DateTime=20150629113137;Status=Due;

NTE|2|Z|(Name;Level;Lot;Result;DateTime)=(QELF;1;4444;
32.77;20150629144912)

OBX|2|NM|2951-2.COFF^Na-S^LN|1^1^^1017|1.0|U/mL^U/
mL^UCUM

||""^""^HL70078|||F|||||siemensinternal||SiemensAnalyz
er^SiemensHDX~5-5-5-5-5-5-5^SystemSN~4-4-4-4-4-4-
4^ModuleSN

|20150706094610|||||||||RSLT

TCD|2951-2^Na-S^LN

INV|PREAG^Single test reagent^99SiemensHDX|NA^Not
applicable^HL70383||SR^Single test
reagent^HL70384||||||||||||103

NTE|1|Z|Lot=C015;DateTime=20150629113137;Status=Due;

NTE|2|Z|(Name;Level;Lot;Result;DateTime)=(QELF;1;4444;
32.77;20150629144912)
```

```
OBX|3|NM|2951-2.DOSE^Na-S^LN|1^1^^1017|24.05|U/mL^U/
mL^UCUM|||"""^"""^HL70078|||F|||||siemensinternal^No
Review||SiemensAnalyzer^SiemensHDX~5-5-5-5-5-5-
5^SystemSN~4-4-4-4-4-4-
4^ModuleSN|20150706094610|||||||||RSLT

TCD|2951-2^Na-S^LN

INV|PREAG^Single test reagent^99SiemensHDX|NA^Not
applicable^HL70383||SR^Single test
reagent^HL70384|||||||||||103

NTE|1|Z|Lot=C015;DateTime=20150629113137;Status=Due;

NTE|2|Z|(Name;Level;Lot;Result;DateTime)=(QELF;1;4444;
32.77;20150629144912)

MSH|^~\&|xyzco|AM_xyzco_xyzlab|Siemens
Analyzer|Siemens
Lab|20150706154646.402+0200||ACK^R22^ACK|1|P|2.5.1||||
||UNICODE UTF-8|||LAB-29^IHE

MSA|AA|61a8d7e52e4f426dbb295d7c35b22cab
```

About HL7 Protocol

- If communication is lost, Atellica Solution resumes communication with the LIS without the loss of any data.
- Atellica Solution supports both the automatic and manual (at the user's request) transmission of data at any time, as long as communications are enabled.
- The software supports the transmission of a minimum of 6 results from up to 3 different samples per second from Atellica Solution to the LIS host or middleware software.
- The software shall support the receipt of 10 tests every 1.5 seconds from the LIS host or middleware software.

5 LIS Troubleshooting

This section addresses troubleshooting for common issues, as well as issues specific to the ASTM and HL7 protocols.

Common Troubleshooting Issues: ASTM and HL7

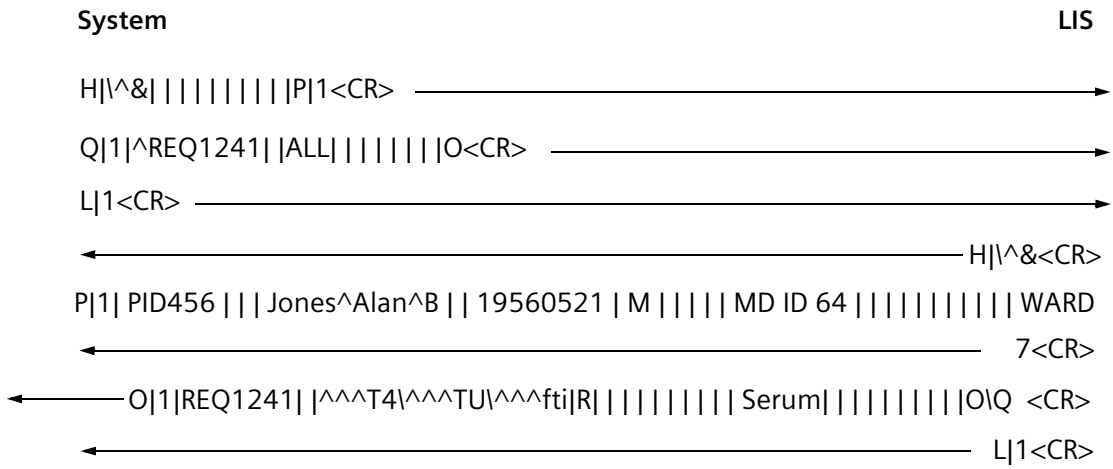
Delays in Automatic Worklist Requests

When using automatic worklist requests, wide gaps exist between cuvettes in the track because 1 or more minutes separates each query from Atellica Solution about a sample ID.

Possible Cause: Termination Record

Although the LIS responds to the query, it does not close the query. When Atellica Solution sends the last message in response to a query, the termination record has a value of F in the Termination Code field. Atellica Solution 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 LIS Configuration window is set to 30 seconds and cannot be set to less than 1 second.

The following figure gives an example of an incorrect termination record. An F value does not exist 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 Atellica Solution and the query timeout on Atellica Solution is 5 minutes, then Atellica Solution does not automatically query for the next sample until the 5 minutes elapses.



Solution

Use a value of F in the Termination Code field of the termination record to close the sequence of messages the LIS sends to Atellica Solution 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 Atellica Solution.

Solution

Contact the LIS Administrator to check the parameters at the LIS.

Invalid Test Order

Atellica Solution receives a valid order for a test. The accepted worklist entry does not display at the **Test Results** window.

Possible Cause: Test is Inactive

The test has not been activated from the test definition screen.

Solution

1. Open the event log for additional details.
2. At the test definition screen, activate the test.

   Note Do not request inactive or undefined tests.

Rejected Test Request for Control Sample

Atellica Solution rejects a request for a test on a control sample.

Possible Cause: SID

The SID 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 Atellica Solution.

Solution

Atellica Solution transmits a comment record explaining this condition to the LIS. Compare the responses from Atellica Solution to the messages from the LIS.

Rejected Test Order for Patient Sample

Atellica Solution rejects an order for a test on a patient sample.

Possible Cause	Solution
The order record does not contain the 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 SID.
The Rack ID is in use by an active sample.	Do not specify a Rack ID or specify a different Rack ID and position.
Atellica Solution specifies the Rack ID but does not specify a rack position.	Specify a Rack ID and position.

Test Results Transmitted with Wrong Test Name

Atellica Solution sent the incorrect test name for the selected test results for a particular test.

Possible Cause: LIS Code

The operator uses the LIS Code defined for the test in place of the test name in the Universal Test ID field of the result record.

Solution

Enter the correct LIS code.

Result Reporting is Malfunctioning

The result reporting is 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 LIS Configuration window.
Atellica Solution 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

Atellica Solution 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 wrong protocol is selected.	Select proper protocol at the LIS Configuration window.
The network cable between Atellica Solution and the LIS is not connected correctly.	If the communication channel is TCP/IP, check the network cable. Ensure that the network cable is connected correctly.
Atellica Solution and the LIS communication parameters do not match.	Ensure that the settings at the **LIS Configuration** window match the LIS configuration.
The cable between Atellica Solution 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 protocol selected.	Select appropriate protocol.
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.
Incorrect physical layer setting. (ASTM only).	Select proper physical layer.
Incorrect physical layer selected. (ASTM only).	Select proper physical layer.

Existing QC Order in System

When Atellica Solution receives a Patient order from the LIS with an SID that matches the control ID of an existing QC order, it issues a message in the Event Log and notifies the host LIS.

For that patient, the operator can create a new patient order with a different SID.

Control Definition Not Found

When Atellica Solution receives a Control order from the LIS, but the control material definition cannot be found,it issues a message in the Event Log and notifies the host LIS.

The operator can check at the LIS if the control ID is correct. If not, check Atellica Solution for a control material definition; if one does not exist, the operator can create one.

ASTM Protocol Troubleshooting

Cancelled Worklist Requests

An operator requests a worklist, but Atellica Solution cancels the query before it is complete.

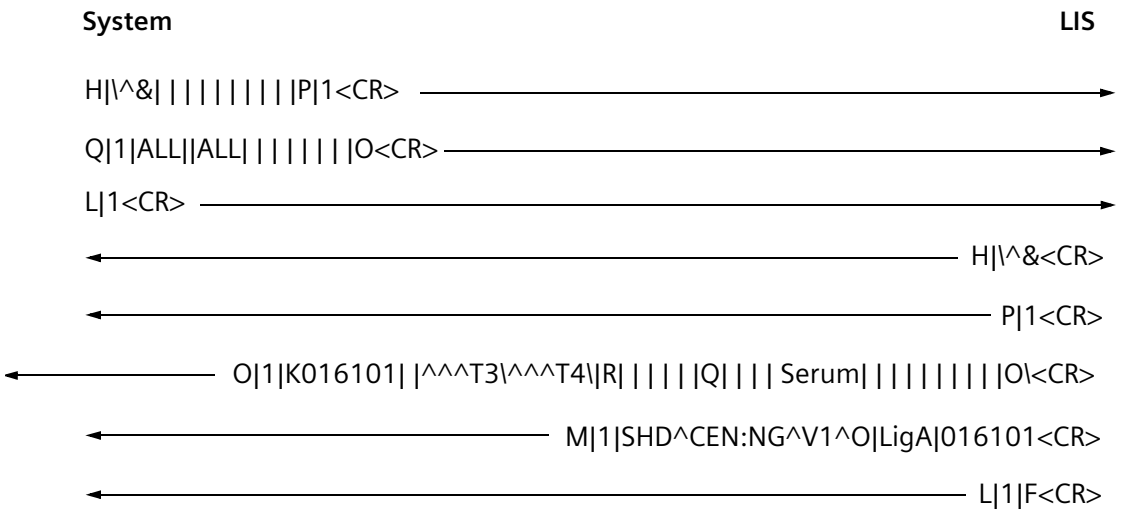
Possible Cause: Query Timeout

The query timeout is too short or the LIS does not indicate that it sends order records 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. Atellica Solution resets the query timer every time it encounters a value of Q in the Report Type field of an order record. Atellica Solution ignores all received result records. Each time the query timer expires, Atellica Solution sends a message to the LIS which cancels the query.

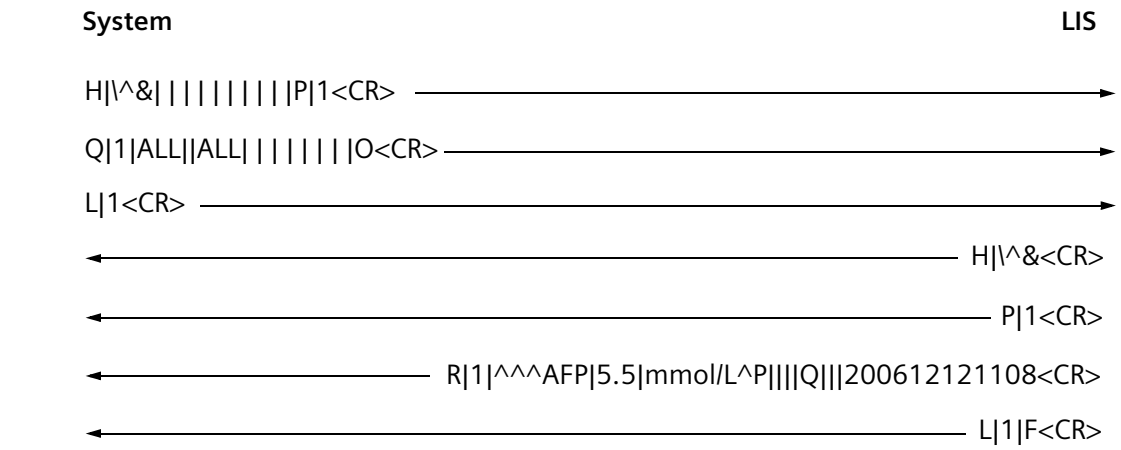
LIS queries for a large quantity of results from Atellica Solution does not require a long timeout if Q values are processed. Atellica Solution sends the first result to a query within 5 minutes using PID, SID, Test Name, and Results Date with a system that has nearly full demographic and result databases.

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 Atellica Solution sends a query cancellation to the LIS.

Query for Order



Query for Result



Solution

Replace O with O\Q in Report Type field of order record and in Result Status field of result record.

Message Received Caused Fatal Parse Error

Atellica Solution receives a message that causes a fatal parse error. The logged event is for an unexpected sequence number.

Possible Cause: Incorrect Sequence Number

Atellica Solution sent an incorrect sequence number 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 displays in the worklist, and the Event Log shows Atellica Solution 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

Atellica Solution received invalid records due to transmission interference.

Solution

The cable between Atellica Solution 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 Atellica Solution 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

1. Remove the <CR> from the demographic data fields of the patient record.
2. Use ASTM escape sequences for any required carriage returns.

Unexpected Data Received in Response to a Query

The LIS received unexpected data from Atellica Solution 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 SID in the Starting Range ID Number field. In this example, the SID is interpreted as a PID.

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. Atellica Solution does not support the ASTM option of returning only demographic data. Atellica Solution 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. For more information about the query record, refer to *Chapter 2, Laboratory Information Systems*.

Delay Between Messages Sent by Atellica Solution

There is a long time between messages Atellica Solution sends.

Possible Causes and Solutions

This section identifies the possible causes and solutions for delays between messages Atellica Solution sends. To analyze the problem and find the possible cause, the operator can 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.	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 Atellica Solution and the LIS is not correctly connected.	Correctly connect the cable. For more information about the physical layer, refer to *Chapter 2, Laboratory Information Systems*.
The cable between Atellica Solution and the LIS is damaged.	Check the continuity of the wires with a breakout box. Replace the cable if necessary.For more information about the electrical characteristics, refer to *Chapter 2, Laboratory Information Systems*.
Atellica Solution and the LIS communication parameters do not match.	Check for multiple character errors. Ensure that the settings at the LIS Configuration window match the LIS configuration.

HL7 Protocol Troubleshooting

If message is not structured per HL7 protocol, Atellica Solution logs a parsing error.

6 Glossary

Term	Description
Access Point	An entity 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 for solving a specific problem.
Analyzer	The Analytical Medical Device in the Laboratory.
Analyzer Manager	Analyzer Manager is responsible for creating the work order, the Host LIS, or middleware.
ANSI	American National Standards Institute
Application Data Segment	Subset of an application message that passes to or from the data link layer.
Application Layer	Layer 3 of the ASTM communication protocol. Provides instrument and LIS information services.
Application Message	System application data, 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
Automatic Result Reporting	A system option. When enabled, Atellica Solution transmits final results 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.
AWOS	Analytical Work Order Steps
Automatic Worklist Entry Requests	A system option. When enabled, Atellica Solution transmits a query for test orders for each barcoded sample scanned and added to the worklist database.
Backus-Naur Form (BNF)	Notation that defines the syntax of a software language.
baud rate	Speed at which data is sent or received when devices are communicating through a serial channel.

Term	Description
buffer	Data storage that compensates 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 Atellica Solution waits before restarting a communication session after trying to start a session when the LIS computer is busy.
cancel query	Stops the response to a query before it completes. Atellica Solution and the system that received the query can perform this.
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 Atellica Solution.
communications port	The RS-232 port that is used to connect a remote device to Atellica Solution.
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 that provides information about transmitted data or to control data transmission.
data bits	Physical layer parameter that 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.

Term	Description
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 Atellica Solution, this is the patient name, PID, birthdate, sex, location, physician, and comments.
deny session message	Data link layer message the receiver uses 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 Atellica Solution.
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 Atellica Solution conveys via notifications.
event acknowledgment	Response to an event notification.
filler	The application responding to a request for services (orders) or producing an observation.
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.

Term	Description
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 that improves access to instrument data for Informatics features and capabilities.
IHELAW	Integrating the Healthcare Enterprise with the Laboratory Analytical Workflow profile.
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. The navigational maps represent logical groupings of data items. These groupings are implemented on the same screen.
interface	A shared boundary, such as an RS-232 port, that enables Atellica Solution 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.
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.
LAW	Laboratory Analytical Workflow

Term	Description
LIS	Laboratory information system. A computer in a clinical laboratory or hospital which stores and transmits worklist requests, test results, and patient information to and from laboratory instruments.
local query	A query the system transmits 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.
MSH	Message Header Segment (HL7)
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 Atellica Solution 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.
parse	To associate character strings (data) with the component names of the specific message.

Term	Description
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 Atellica Solution 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 Atellica Solution 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 Atellica Solution.

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 Atellica Solution 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 Atellica Solution, 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 Atellica Solution is not connected to the LIS computer.
Sort Test	A test order that routes patient samples to specific trays after a sample has been tested.
Standby	Standby indicates that user intervention may be required to verify the communication between Atellica Solution and the LIS host/middleware.
SID	Sample ID. A character string used by the operator of Atellica Solution 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 Atellica Solution 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. Atellica Solution sets this 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.
TCD	Test Code Details Segment (HL7)
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 Atellica Solution 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 Atellica Solution in which test requests and demographic information are stored.

Index