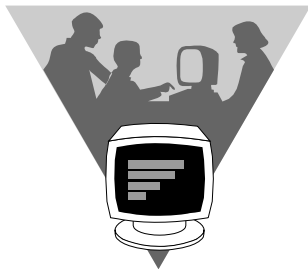


5-8 LIS Specifications (ASTM E 1381-95 Protocol)



ASTM LLP CM STS

Revision History: (Printed: 01/Sep/2000 16:09)

Author	Date	Version	Comment
Berenguer Torelló	September 1, 2000	R0.1	Initial version
Berenguer Torelló	February 5, 2001	R0.1.1	Minor style changes added to change from SRS to STS.
Berenguer Torelló	March 23, 2001	R0.1.2	Comments from Carolina Altafulla added.
Xavier Ramirez	November 26, 2001	R0.1.3	Some minor changes added after first implementation.
Néstor Silveira	July 4, 2002	R0.1.4	Baud rate has been extended to match Window's configuration.
Xavier Ramirez	October 11, 2002	R 1.0	Updated diagram with a new state when the instrument don't accept the connection Futura data removed and redirected to apendix A where still needs to be added the futura required changes

Xavier Ramirez	December 9, 2002	R 1.1	Added Section 3.6 with information about the pooling performed by TOP to know the status of the connection. Section 4 updated with Futura mode information
Xavier Ramirez	February 10, 2003	R 1.2	New socket physical layer added
Xavier Ramirez	March 5, 2003	R 1.2.1	Fixed two typos

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1. OVERVIEW

1.1 PURPOSE

This document is intended to be a guide for implementing the protocol referred as ASTM E 1381-95 (reference R1) for the TOP device.

Also, note that TOP supports the Futura compatible mode that allows TOP to communicate with external systems using the same protocol as Futura. See appendix A for the differences between the Futura implementation and the new implementation of the driver.

1.2 REFERENCES

Ref	Description
R1	ASTM E 1381-95 <i>Standard specification for low-level protocol to transfer messages between clinical laboratory instruments and computer systems</i> Approved Oct. 10, 1995 – Published January 1996
R2	ISO 7498-1984 (E), Information Processing Systems – Open Systems Interconnection – Basic Reference Model
R3	ACL Futura Host Communication Message Protocol

R4	ACL-Futura II Control Module Laboratory Information System (LIS) Interface Software Requirements – ASTM Low Level Protocol (RS-232)
R5	LIS Control Module Software Functional Specification (LIS CM SFS)

2. PHYSICAL LAYER

TOP can be connected to an external system using a RS-232 serial connector or a RJ45 network connector using sockets. These are the details of each type of connectivity.

2.1 SERIAL CONNECTION

2.1.1 OVERVIEW

This section describes those issues related to mechanical and electrical connection between the CLI and the LIS. The topology is point-to-point, a direct connection between both devices. This section referred as “Physical layer” matches the Physical layer established in the ISO Reference model for Open Systems Interconnection (OSI) (see reference R2).

2.1.2 CHARACTER STRUCTURE

The method of data transmission is serial-by-bit start/stop. A character is compound by the following bit sections: start bit, data bits, parity bit and stop bit(s).

The configurable bit sections are:

Bit sections	Parameter	Allowed values					
Data bits	Number of data bits coding a character	8			7		
Parity bit	Parity type	No parity	Odd	Even	Mark	Space	
Stop bit(s)	Number of stop bits	1			2		

The default character structure consists of one start bit, eight data bits, no parity bit, and one stop bit.

2.1.3 SPEED – BAUD RATE

The data transmission rate for the instrument can be configured. The allowed values are showed below:

Baud rate	300	1200	2400	4800	9600	19200	38400
	57600	115200					

The default baud rate is 9600 baud.

2.1.4 INTERFACE CONNECTIONS

The serial port of the instrument is a PC-standard DB-25 (EIA/TIA 232-E) or a DB-9 (EIA/TIA 574) male connector (also known as RS-232 connectors both of them).

The following are the PIN connections for a standard PC serial communications interface. Note that these ports are wired as DTE (Data Terminal Equipment), role that corresponds to the instrument.

Mnemonic	EIA/TIA Name	CCITT V.24	Signal direction	DB-9 Pin	DB-25 Pin	Description	Used by the Instrument
TD	BA	103	Out	3	2	Transmitted Data	Yes

RD	BB	104	In	2	3	Received Data	Yes
RTS	CA/CJ	105/133	Out	7	4	Request To Send	Yes
CTS	CB	106	In	8	5	Clear To Send	Yes
DSR	CC	107	In	6	6	Data Ready Set	Yes
SG	AB	102	-	5	7	Signal Ground	Yes
DCD	CF	109	In	1	8	Carrier Detect	No
DTR	CD	108/1, /2	Out	4	20	Data Terminal Ready	Yes
RI	CE	125	In	9	22	Ring Indicator	No

2.1.5 SERIAL PORTS

The instrument allows one of the following serial ports: COM1, COM2, COM3 and COM4.

2.2 NETWORK CONNECTION

When top is connected to a network, it uses the TCP/IP sockets as its transport layer. TOP can act as a client or a server depending on a configuration parameter. When TOP is configured to act as a client, you have to specify the IP address of the server you want to connect to and the port number. When TOP is used as a server, you only have to specify the port number clients use to connect to the TOP instrument. Only one client can connect to the TOP instrument as a server.

3. DATA LINK LAYER

3.1 OVERVIEW

This section covers the services described in the Data link and Transport layers, of the ISO Reference model for Open Systems Interconnection (OSI) (see reference R2). Network services, as the ISO/OSI Reference model describes, are not required because this protocol works over a point-to-point topology.

The content for this section is a set of procedures for link connection and release, delimiting and synchronizing, sequential control, error detection, and error recovery, which are briefly described below.

- Link connection and release enables and disables respectively the system, for sending and receiving information.
- Delimiting and synchronizing provide for data framing and frame recognition.
- Sequence control maintains the sequential order of information across the connection.
- Error detection senses transmission or format errors.
- Error recovery attempts to recover from detected errors by retransmitting defective frames or returning the link to a neutral state from otherwise unrecoverable errors.

The data link layer uses a character-oriented protocol to send messages between directly connected systems.

The data link mode of operation is one-way transfer of information with alternate supervision. Information flows in one direction at time. Replies occur after information is sent, never at the same time. It is a simplex stop-and-wait protocol.

There are three distinct phases in transferring of information between instrument (ACL TOP) and the computer system (HOST). In each phase one system directs the operation and is responsible for continuity of the communication. The three phases assure the actions of the sender and the receiver are coordinated. The three phases are establishment, transfer and termination.

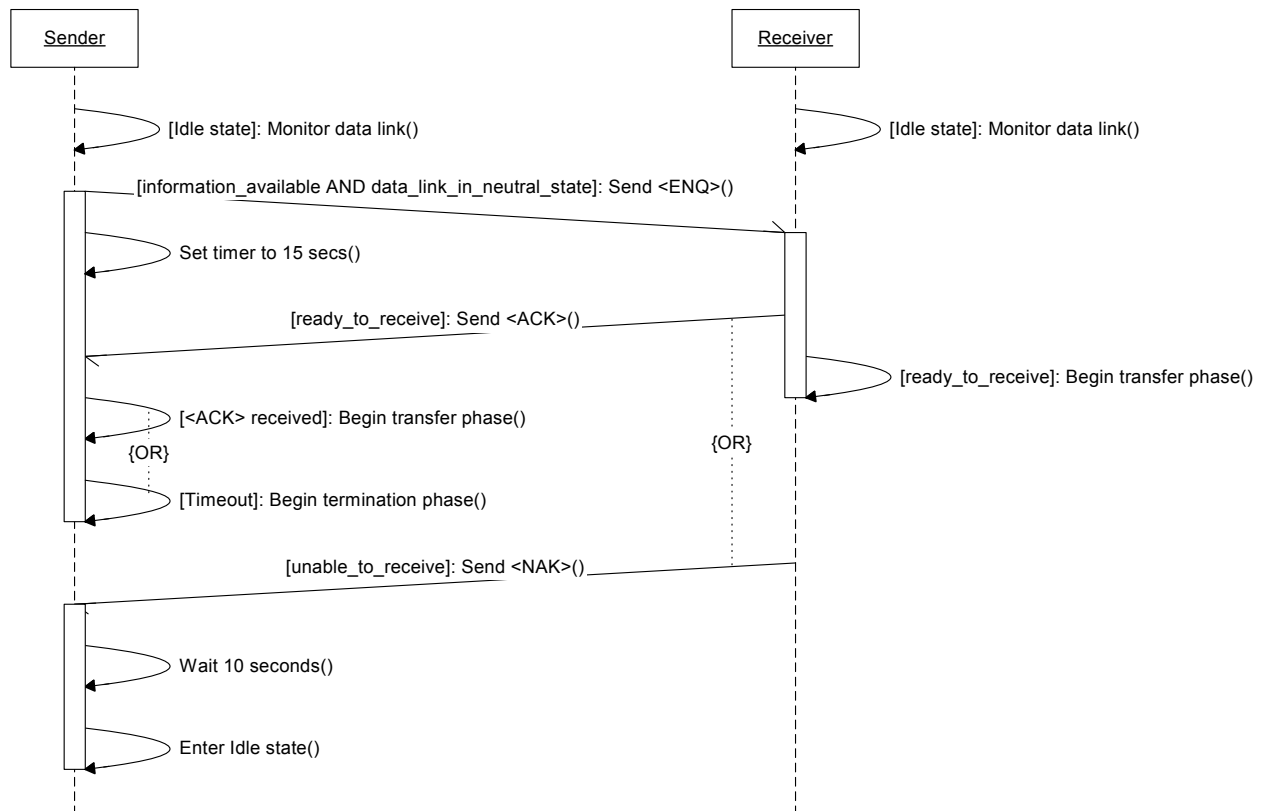
3.2 ESTABLISHMENT PHASE – LINK CONNECTION

3.2.1 OPERATION

The establishment phase determines the direction of the information flow and prepares the receiver to accept the information.

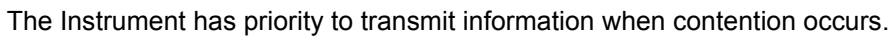
The sender notifies the receiver that information is available sending an <ENQ>. The receiver responds that it is prepared to receive transmitting an <ACK> before any information is transmitted. A receiver that cannot immediately receive information replies to the sender with the <NAK> transmission control character.

A system, which does not have information to send, normally monitors the data link to detect the establishment phase. It acts as a receiver, waiting for connections of the other system.



3.2.2 CONTENTION

Contention takes place when both systems (Instrument and LIS host) simultaneously try to establish link connection by transmitting an <ENQ> transmission control character.



3.3.1 OPERATION

3.3.2 FRAMES

Messages with a text longer than 240 characters are divided between two or more frames.

There are two kinds of frames, the intermediate frames and the end frames. Their only difference relies on one transmission control character, but they are semantically different.

End frame → <STX> FN Text <ETX> C1 C2 <CR> <LF>

A message containing 240 characters or less is sent in a single end frame.

Longer messages are sent in intermediate frames with the last part of the message sent in an end frame.

Each message is transmitted in a new connection. This means ACL TOP never sends two consecutive messages without restarting the connection with an <ENQ>.

A brief description for every part of a frame is given in the table below.

Frame part	Frame part description
<STX>	Start of <u>T</u> ext transmission control character
FN	Frame <u>N</u> umber (single digit comprised in the range 0-7) – See details in section Frame Number
Text	Data content of Message
<ETB>	End of <u>T</u> ransmission <u>B</u> lock transmission control character
<ETX>	End of <u>T</u> ext transmission control character
C1	Most significant character of checksum (belonging to {0-9, A-F}) – See details in section Checksum
C2	Least significant character of checksum (belonging to {0-9, A-F}) – See details in section Checksum
<CR>	Carriage <u>R</u> eturn ASCII character
<LF>	Line <u>F</u> eed ASCII character

3.3.3 FRAME NUMBER

The frame number (FN) permits the receiver to distinguish between new and retransmitted frames.

The frame number begins at 1 with the first frame of the Transfer phase. The frame number is incremented by one for every new frame transmitted. After 7, the frame number rolls over to 0, and continues in this fashion.

3.3.4 CHECKSUM

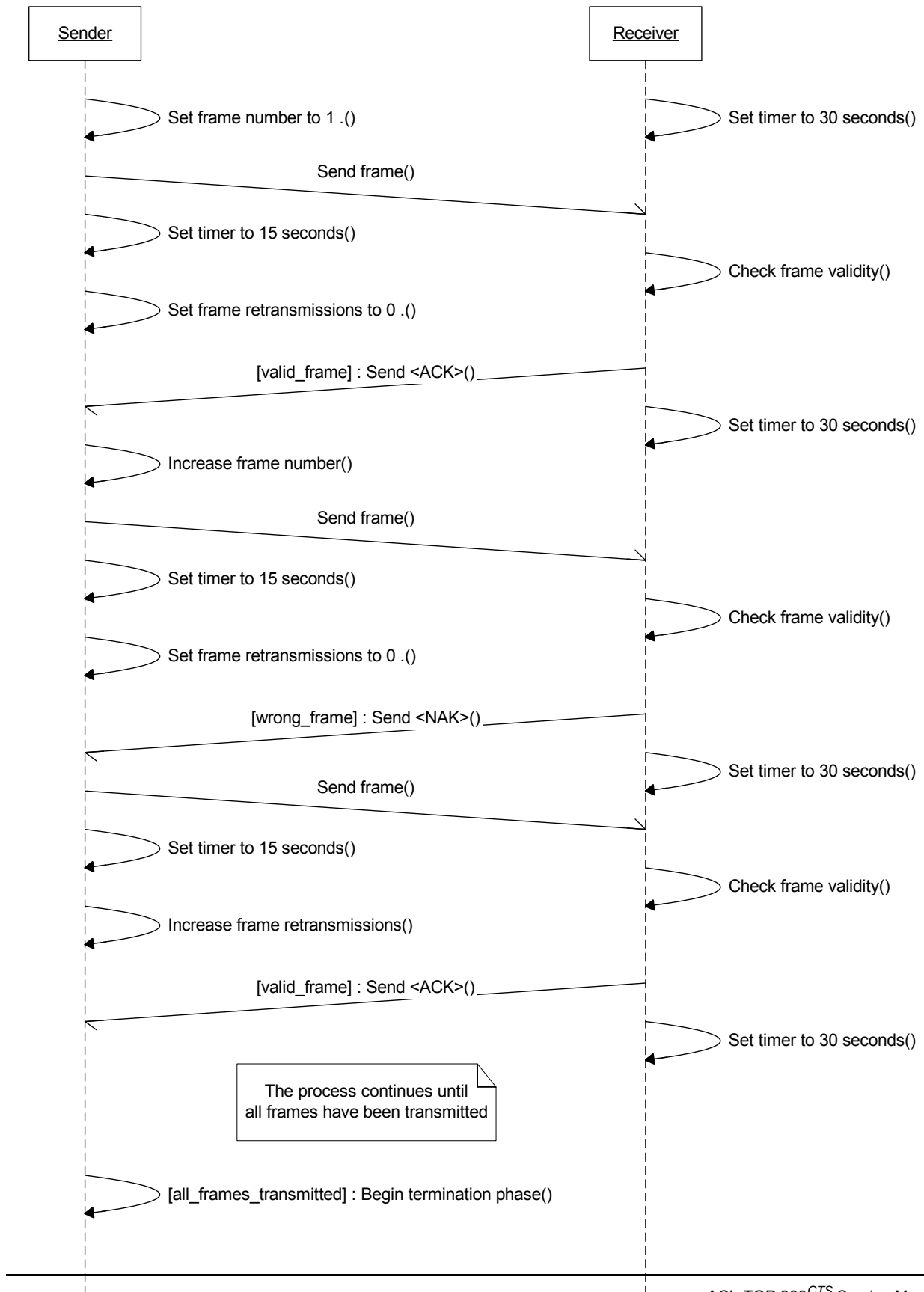
The checksum permits the receiver to detect a defective frame. The checksum is encoded as two characters.

The checksum is computed by adding the binary values of the characters, and keeping the least significant eight bits of the result. It is an addition module 256.

The checksum is initialized to zero with the <STX> character. The checksum computation uses the FN, all characters belonging to Text and <ETB> or <ETX>. The computation for the checksum does not include <STX>, the checksum characters, or the trailing <CR> and <LF>.

The checksum is an integer of eight bits, and can be considered as two groups of four bits. Both groups of four bits are converted to the ASCII characters of the hexadecimal representation, and transmitted as the message checksum.

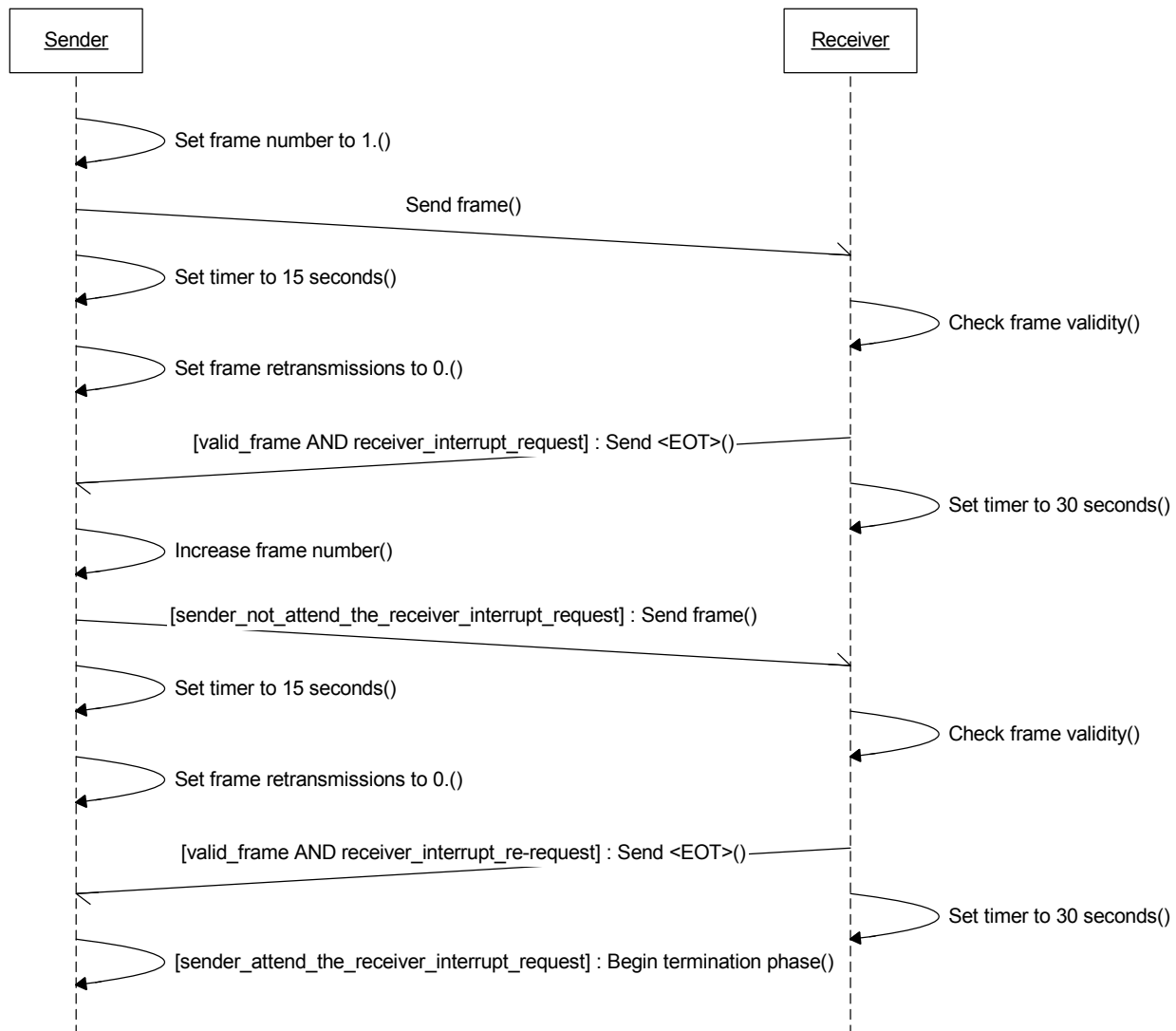
Example: A checksum of 89 can be represented as 01011011 in binary or 5B in hexadecimal. The checksum is transmitted as the ASCII character 5 followed by the ASCII character B.



3.3.5 ACKNOWLEDGEMENTS

After a frame is sent, the sender stops transmitting until a reply is received (stop-and-wait protocol). The receiver can reply to each frame in three ways.

- A reply of <ACK> means the last frame was successfully received and the receiver is ready to receive the next one. The sender must send a new frame or terminate.
- A reply of <NAK> signifies the last frame was not successfully received and the receiver is prepared to receive the frame again.
- A reply of <EOT> means the last frame was successfully received and the receiver is ready to receive the next one, but is also a request to the sender to stop transmitting. The ACL TOP instrument sends an <EOT> only when it wants to send a message with high priority. ACL TOP instrument dismisses <EOT> until the message is finished. Once the message is finished, the ACL TOP allows the other system to retrieve the message.



3.3.6 RECEIVER INTERRUPTS

The receiver can request to the sender to stop transmitting messages by sending an <EOT>, in place of the usual <ACK>. The sender does not have to stop transmitting after receiving the <EOT>.

If the sender chooses to ignore the <EOT>, the receiver must re-request the interrupt for the request to remain valid.

If the receiver chooses to honor the <EOT>, it must first enter the termination phase to return the data link to the neutral state. The original sender must not enter the establishment phase for at least 15 seconds or until the receiver has sent a message and returned the data link to the neutral state.

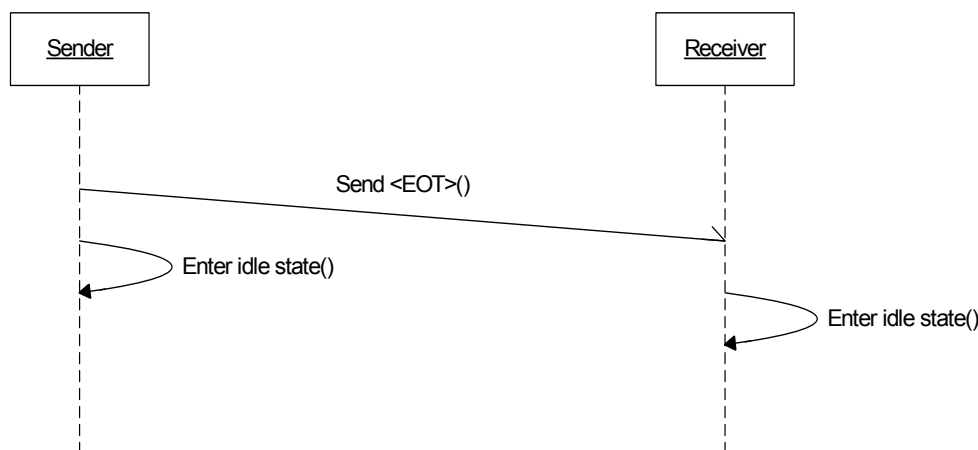
ACL TOP ignores the <EOT> until the message transmission is completed. If ACL TOP receives and <EOT> as an answer to the last frame, it waits 15 seconds until it goes to the establishment phase.

3.4 TERMINATION PHASE – LINK RELEASE

3.4.1 OPERATION

The termination phase returns the data link to the neutral state.

The sender notifies the receiver that all messages have been sent, by sending an <EOT>, and then sets up the data link to be in a neutral state.



The receiver, upon receiving <EOT>, also considers the line to be in a neutral state.

3.5 ERROR RECOVERY

3.5.1 DEFECTIVE FRAMES

A receiver checks every frame to guarantee it is valid. A reply of <NAK> is transmitted for invalid frames. Upon receiving the <NAK>, the sender retransmits the last frame with the same frame number.

A frame should be rejected because take place some of the following situations:

- Any character errors are detected (parity errors, framing error...).

- The frame checksum does not match the checksum computed on the received frame.
- The frame number is not the same as the last accepted frame or one number higher (module 8).
- There are invalid characters in the message body. See section 3.6 for invalid characters

Any characters occurring before <STX> or <EOT>, or after the end of the block characters (<ETB> or <ETX>), are ignored by the receiver when checking for frame validity.

3.5.2 RETRANSMISSIONS

Every time the sender tries to transmit a particular frame, and receives a <NAK> or any other character different from <ACK> or <EOT> (a <NAK> condition), a retransmission counter for the given frame is increased. If this counter shows a single frame was sent and not accepted six times, the sender must abort this message by proceeding to the termination phase.

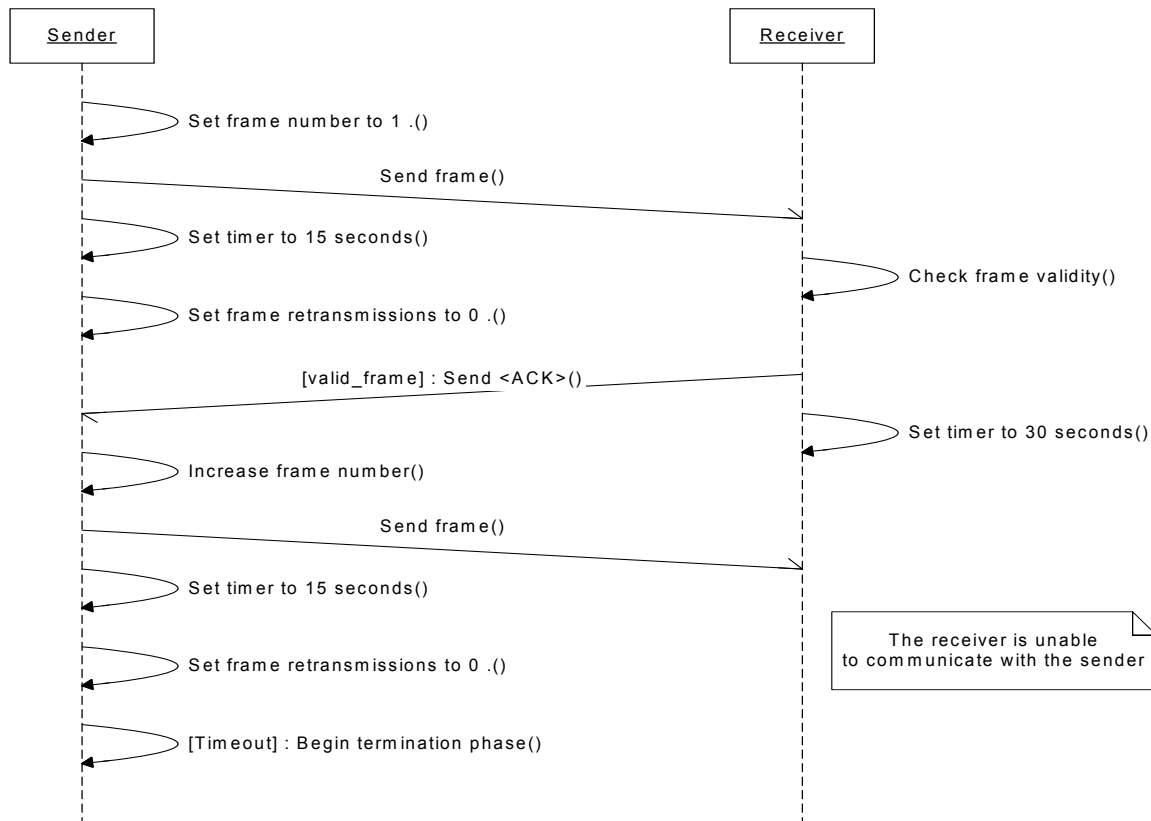
3.5.3 TIME-OUTS

The sender and the receiver use timers to detect loss of coordination between them. ACL TOP uses the time-out specified for instruments.

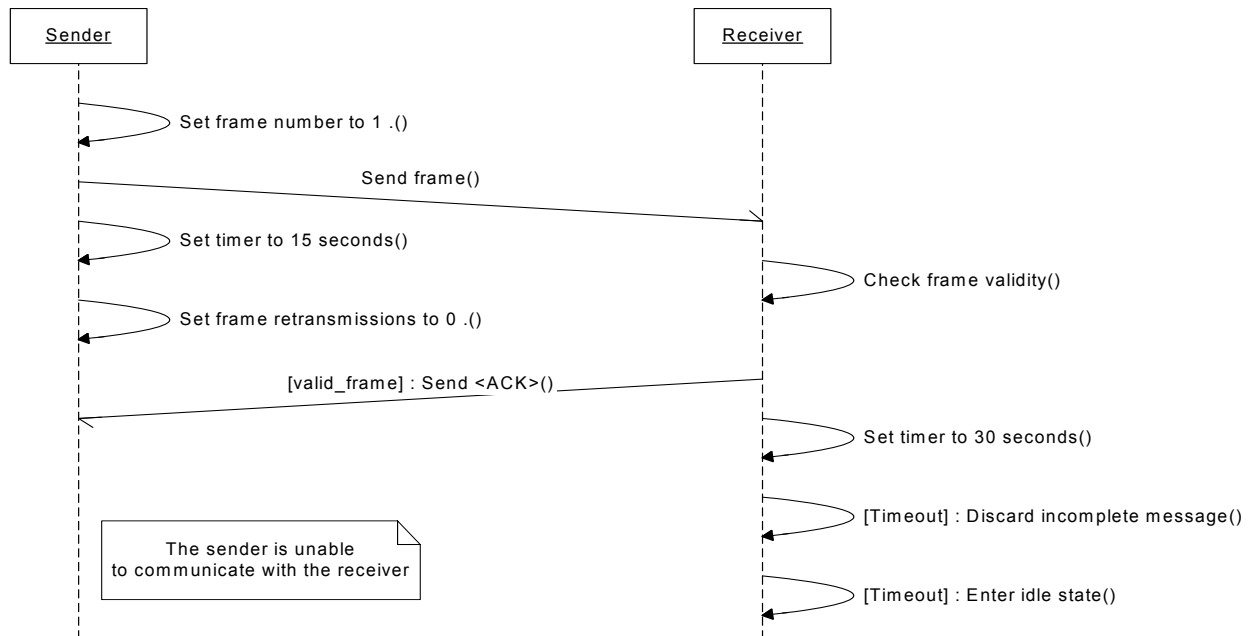
3.5.3.1 ESTABLISHMENT PHASE

The sender sets a timer when transmitting the <ENQ>. A time-out occurs if a reply of an <ACK>, <NAK> or <ENQ> is not received within 15 seconds. After a time-out, the sender enters the termination phase.

3.5.3.2 TRANSFER PHASE



The sender sets a timer when transmitting the last character of a frame. If a reply is not received within 15 seconds, a time-out occurs. After a time-out, the sender aborts the message by entering to the termination phase.



The receiver sets a timer when first entering the transfer phase or when replying to a frame. If a frame or an <EOT> is not received within 30 seconds, a time-out occurs. After a time-out, the receiver discards the last incomplete message and regards the line to be in the neutral state.

3.6 CHECKING CHANNEL STATUS

One of the major goals we wanted to achieve with the connectivity with external systems was to allow TOP to know the status of the connection. The status of the connection allows users of TOP to know if there is a physical connection or not with the LIS system, or if the connection is being rejected.

To allow this feature we have used the rules in ASTM to detect this status. This is how we did it:

- When the LIS connectivity is started TOP send and <ENQ> until an <ACK> is received.
 - If an <ACK> is received TOP assumes the connection is established. If no messages are pending to send an <EOT> is sent.
 - If a <NAK> is received TOP assumes the connection is rejected by the LIS and retries every 10 seconds as specified in the standard until the connection is accepted.
 - If no data is received the application assumes there is no connection with the LIS system. The <ENQ> is sent every 15 seconds as specified in ASTM until the connection is enabled
- When the connection is accepted, TOP sends and accepts any messages exchanged with the LIS. If the connection is idle for more than 60 seconds TOP checks whether the channel is still up sending and <ENQ> and after receiving the response sends an <EOT> to finish the transmission.

3.7 RESTRICTED MESSAGE CHARACTERS

The data link protocol is designed for sending character-based message text. Some restrictions are placed on the characters that can appear in the message content. The following characters must not appear in the message text:

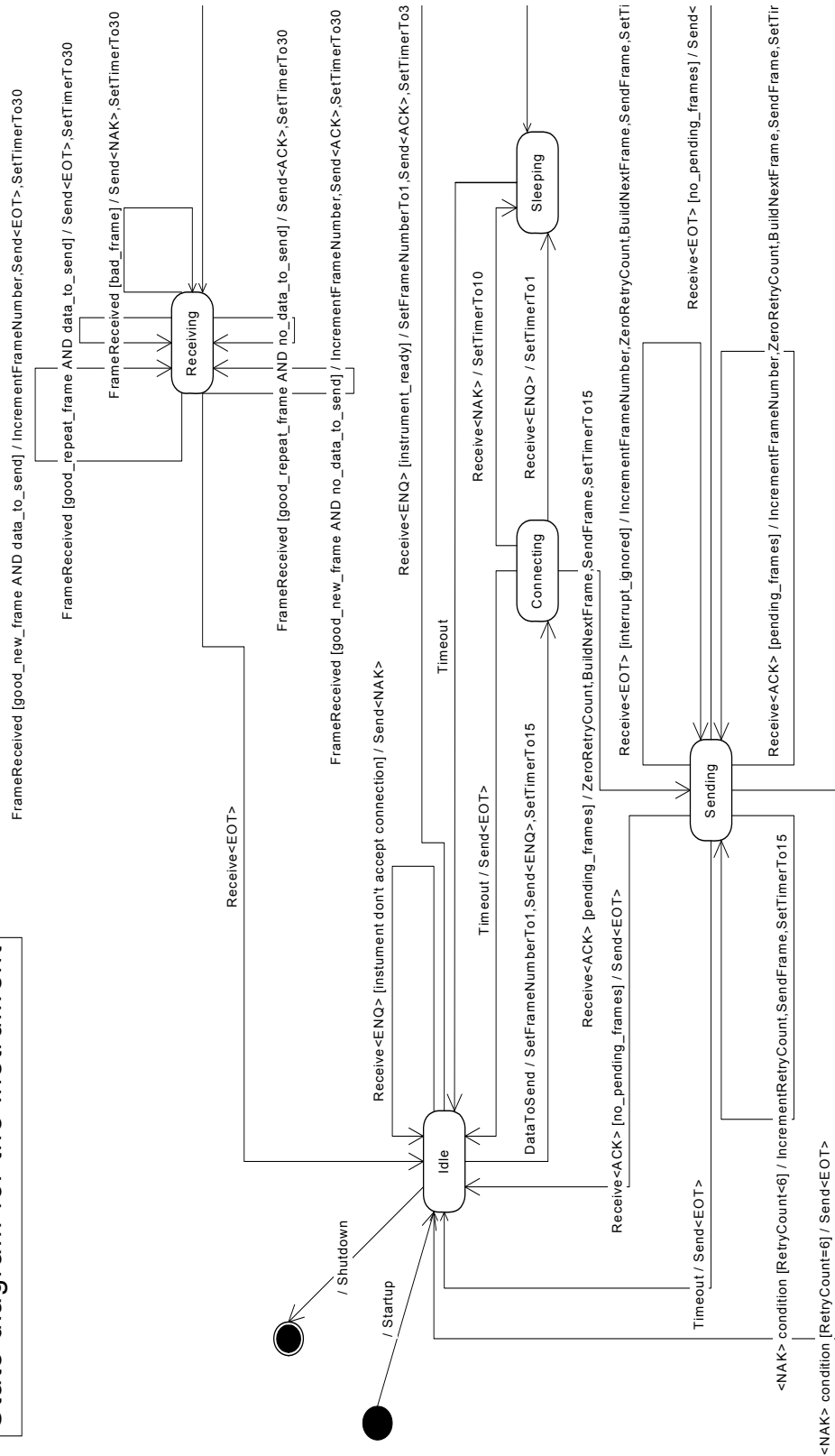
Transmission control characters	Format effector control character	Device control characters
<SOH>, <STX>, <ETX>, <EOT>, <ENQ>, <ACK>, <DLE>, <NAK>, <SYN>, <ETB>	<LF>	<DC1>, <DC2>, <DC3>, <DC4>

The <LF> character can appear only as the last character of a frame.

3.8 STATE DIAGRAM FOR THE INSTRUMENT

Following is the state diagram for the instrument. Note that the figure is side reading and can be viewed online by clicking on **View > Rotate View > Clockwise** or pressing **Shift+Ctrl+Plus**.

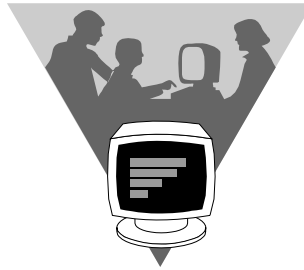
State diagram for the Instrument



APPENDIX A – FUTURA COMPATIBILITY MODE

The low-level protocol implementation of TOP acting in Futura mode is fully compliant with the last implementation of the Futura device.

ASTM HLP CM STS



Revision History: (Printed: 22/Jul/2004 12:06)

Author	Date	Version	Comment
Berenguer Torelló	October 10, 2000	R0.1	Initial version
Berenguer Torelló	December 22, 2000	R0.1.1	<ul style="list-style-type: none"> · Section 5. <i>Transmission scenarios</i> reorganized. · Minor modifications in section 2.4. <i>Delimiters</i>. · Sections 4.6. <i>Manufacturer information record</i> and 5.2.1. <i>Test results delivery carried out by the instrument</i> reworked to accommodate the uploading of calibration mathematical models to the LIS host. · Scenarios using “Test Order” record, revised to accommodate the use of the field “Instrument Specimen ID”. · Diagrams belonging to Section 6. <i>Transmission scenarios relationships</i>, reworked.
Berenguer Torelló	February 5, 2001	R0.1.2	Minor style modifications to change from SRS to STS.
Xavier Ramirez	June 28, 2002	R 1.0	Document updated with TOP implementation
Francesc Fernandez	July 10, 2002	R1.1	<ul style="list-style-type: none"> · Section Demographic Data updated. · Section Sample Identification added. · Table of contents updated.
Francesc Fernandez	July 29, 2002	R1.2	Updated after NTE internal review.
Xavier Ramirez	July 31, 2002	R 1.2.1	Errors section updated. Some fields added to give at least the same functionality delivered by Futura.
Francesc Fernandez	August 30, 2002	R 1.2.2	Describe logic for setting ordered date and time to current date when ordered date and time received from the LIS is empty.
Maite Burrel	September 04, 2002	R 1.3	Add changes in instrument test order autocancelation message. Section 4.1.2 Update in Header Record specification the correct ASTM version field max length to 7.
Xavier Ramirez	September 08, 2002	R 1.4	Added comments about the futura driver
Xavier Ramirez	October 11, 2002	R 1.5	Changes to note that error messages sent to the HOST can be disabled Field 012 removed in 4.5.1 – Instrument uploads test result
Xavier Ramirez	December 9, 2002	R 1.6	Removed an incorrect field in the sample in section 4.5.1 Added Patient laboratory ID in messages coming from the LIS. This field is still not used in TOP, but may be used in the future

Xavier Ramirez	January 7, 2003	R 1.7	Section 4.1.3 and section 4.2 removed option 'N' from field 12 in order record. The field has also been changed from mandatory to optional.
Xavier Ramirez	January 31, 2003	R 1.8	Length of field O5 has been change to 6 characters. Title in section 4.1.4 has been changed to a more understandable title. Added comment in 4.3.3 specifying that anything is required when in a multiple host query there is not data for one of the specimens.
Xavier Ramirez	February 7, 2003	R 1.8.1	Section 2.3.3 added
Xavier Ramirez	March 5, 2003	R 1.8.2	Updated 2.2.3 with the information of codepages Updated 2.3.2 with allowed escape values and use of the local escape delimiter Updated 2.3.3 with the detail of the possible escaped characters Updated 2.3.4 with how local escape delimiter works Section 6 added units mapping between TOP and Futura (still not completed)
Xavier Ramirez	April 8, 2003	R 1.8.3	Section 3.3 added that the consistency among values in different fields is not checked. Added information about the tracing system Section 4.5. Result unit max size have changed from 50 chars to 15 chars Section 6 has been updated with more differences between TOP and Futura compatible driver and the final units mapping from TOP to Futura.
Francesc Fernandez	June 17, 2003	R 1.8.4	Updated section 2.4 Patient Demographics for specifying that Patient demographics are not updated from LIS unless Samples are identified through Instrument Sample Id.
Xavier Ramírez	June 27, 2003	R 1.8.5	Appendix A: added restriction to reject messages with t sample id bigger than 16 characters in Futura mode Updated section 4.5: A new flag has been added in R9 and O26 to allow TOP to send preliminary results. Preliminary results are tests that will rerun on the instrument. Updated section 3.3: Notification of response when no request is performed is also notified to TOP.
Xavier Ramírez	July 2, 2003	R 1.8.6	Appendix A: Futura does not support 'V' flag in R9
Maite Burrel	July 2, 2003	R 1.8.7	Appendix A: ERRORS Add the exemption of non-validation of H14 date field.
Xavier Ramírez	July 15, 2003	R 1.8.8	Max length for Attending physician ID has changed from 30 to 14 as specified in TOP Changed the way reruns are notified in section 4.5.1
Xavier Ramírez	November 26, 2003	R 1.9	Added field "Laboratory patient ID" in TOP uploaded messages (section 4.4.1, 4.5.1, 4.7.2) that is uploaded by TOP when has previously sent by the LIS host
Daniel Moncusí	January 27, 2004	R 1.10	Documented use of message storage by TOP (section 3.3) Section 3.1 and 3.2 has been unified in a single one (take it into account when consulting Revision History references)
Daniel Moncusí	July 22, 2004	R 1.11	Added clarifying note to section 4.3.3 Changed diagrams of section 5

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1. OVERVIEW

1.1 PURPOSE

This document is a guide for implementing the protocol ASTM E 1394-97 for the TOP device. In this guide, you will find detailed information of all the data that can be exchanged between TOP and laboratory information systems (LIS).

Also, note that TOP supports the Futura compatible mode that allows TOP to communicate with external systems using the same protocol as Futura did. See appendix A for the differences between the Futura implementation and the new implementation of the driver included in TOP.

1.2 OVERVIEW

The implementation of the TOP protocol follows as much as possible the rules described in the ASTM standard, but some interpretation of it has been done when the standard was not detailed enough to complete the implementation. This guide describes any interpretation done in the development of TOP connectivity in order to ease the development of any interface.

1.3 REFERENCES

Ref	Description
R1	ASTM E 1394-97 <i>Standard specification for transferring information between clinical instruments and computer systems</i> Approved December 10, 1997 – Published March 1998
R2	ACL-Futura manual
R3	LIS Functional Specifications

2. MESSAGE STRUCTURE AND CONTENT

2.1 RECORDS

2.1.1 ORGANIZATION AND HIERARCHY OF RECORDS

Messages consist of a hierarchy of records of various types. A record can be defined as an aggregate of fields describing one aspect of the complete message. A field can be seen as a specific attribute of a record, which may contain aggregates of data elements further refining the basic attribute.

The hierarchy of records is composite by several levels. The record types allowed in each hierarchy level, and the hierarchical dependencies between record types, are showed below.

Level 0 records	Level 1 records	Level 2 records	Level 3 records	Level 4 records
Message Header (H)				
	Comment (C)			
	Request Information (Q)			
		Comment (C)		
	Patient Information (P)			
		Comment (C)		
		Test Order (O)		
			Comment (C)	
			Result (R)	
				Comment (C)
Message Terminator (L)				

Due to the use of this hierarchical structure, some rules have been established:

- A message shall be always headed by a message header record (H), and finished by a message terminator record (L).
- An order record (O) may never appear without a preceding patient information record (P).
- A result record (R) may never appear without a preceding order record (O).
- Comment records (C) may be inserted at any level in the hierarchy (except after a Message Terminator), and it refers to the prior higher-level record.

An example of a message structure and content, according to the records hierarchy described before, is the following:

```

(Level 0)MESSAGE HEADER
(Level 1)    PATIENT_1
(Level 2)    COMMENT_1
(Level 2)    ORDER_1
(Level 3)    COMMENT_1
(Level 3)    RESULT_1
(Level 3)    RESULT_2
(Level 4)    COMMENT_1
(Level 4)    COMMENT_2
.
.
.
(Level 3)    RESULT_N
(Level 2)    ORDER_2
(Level 3)    RESULT_1
(Level 3)    RESULT_2
.
.
.
(Level 3)    RESULT_N
.
.
.
(Level 2)    ORDER_N
(Level 3)    RESULT_1
.
.
.
(Level 1)    PATIENT_2
.
.
.
(Level 1)    PATIENT_N
(Level 0)MESSAGE TERMINATOR

```

A sequence of patient information records, order records, or result records at one level, is terminated by the appearance of a record type of the same or higher level.

2.1.2 LENGTH

The standard does not impose a maximum record length. The implementation within the IL instruments restricts the maximum length for incoming messages to 200 KB. Outgoing messages can be of any size.

2.2 FIELDS

2.2.1 STRUCTURE

A field can be seen as a specific attribute of a record, which may contain aggregates of data elements further refining the basic attribute. There are two kinds of aggregates within a message, the repeat field and the component field.

Repeat field – a single data element that expresses a duplication of the field definition. Each element of a repeat field is to be treated as having equal priority to associated repeat fields.

Component field – single data element or data elements that express a finer aggregate or extension of data elements, which precede it.

Example: A patient's name is recorded as last name, first name, and middle initial, each of which is separated by a component delimiter.

2.2.2 LENGTHS

The standard does not impose a maximum field length, and assumes that all fields are variables in length. The implementation within the IL instruments scope restricts the maximum field length to a concrete value depending on the field, but never uses more characters than required by the given field value (according to the standard).

Example: For a ten characters length field, only ten characters space will be used in the message to allow the field content, delimiters space apart.

2.2.3 CHARACTER CODES

All data is represented as eight bit values and single-byte as defined in ISO 8859-1:1987. The eight-bit values within the range from 0 to 127 of ISO 8859-1:1987 correspond to the ASCII standard character set (ANSI X3.4-1986). Values between 128 and 255 are undefined by this standard and are sent using the codepage specified in the configuration of TOP. The use of different codepages allows characters from different cultures to be exchanged without problems. Other characters not representable using the specified codepage are sent escaped using UTF-16 as described in Hexadecimal escaping

Allowed characters in the message: **9, 13, 32-126, 128-254**

Disallowed characters in the message: **0-8, 10-12, 14-31, 127, 255**

The Latin-1 character 13 is reserved as the record terminator.

2.3 DELIMITERS

2.3.1 TYPES

Delimiters are used to establish separate sections within a message. There are five different delimiters.

- **Record delimiter:** It signals the end of any of the defined record types. It is fixed to carriage return character Latin-1 (13) (ASCII 13).
- **Field delimiter:** It is used to separate adjacent fields. It is configurable, and is specified in the message header record. It shall be a single character excluding Latin-1 (13) (ASCII 13).
- **Repeat delimiter:** Used to separate variable number of descriptors for fields containing parts of equal members of the same set. It is configurable, and is specified in the message header record. It shall be a single character, excluding Latin-1 (13) (ASCII 13) and the value used by the field delimiter.
- **Component delimiter:** It is used to separate data elements of fields of a hierarchical or qualifier nature. It is configurable, and is specified in the message header record. It shall be a single character, excluding Latin-1 (13) (ASCII 13), the value used by the field delimiter and the value used by the repeat delimiter.
- **Escape delimiter:** Used within text fields to signify special case operations. It is configurable, and is specified in the message header record. It has a complex structure, but mainly use a single character. The chosen character shall be different from Latin-1 (13) (ASCII 13) and the field, repeat, and component delimiter values.

2.3.2 CONSIDERATIONS

Alphanumeric characters should not be used as delimiters, according to the standard. The implementation within the IL instruments allows the use of the following characters as delimiters. (Boundary values are also included)

- Any value from ASCII (33) to ASCII (47)
- Any value from ASCII (58) to ASCII (64)
- Any value from ASCII (91) to ASCII (96)
- Any value from ASCII (123) to ASCII (126)

The default delimiters used within the IL instruments scope is the following set (this values can be changed from TOP):

- Record delimiter – carriage return Latin-1 (13) (ASCII 13)
- Field delimiter – vertical bar (|) Latin-1 (124) (ASCII 124)
- Repeat delimiter – at (@) Latin-1 (64) (ASCII 64)
- Component delimiter – caret (^) Latin-1 (94) (ASCII 94)
- Escape delimiter – backslash (\) Latin-1 (92) (ASCII 92)

Fields shall be identified by their position, obtained by counting field delimiters from the front of the record. This position-sensitive identification procedure requires that when the contents of the field are null, its corresponding field delimiter must be included in the record to ensure the i'th field can be found by counting (i-1) delimiters. Delimiters are not included for trailing null fields.

The following escape sequences are pre-defined.

- \H\ (*)start highlighting text
- \N\ (*) normal text (end highlighting)
- \F\embedded field delimiter character
- \S\embedded component field delimiter character
- \R\embedded repeat field delimiter character
- \E\embedded escape delimiter character
- \Xhhhh\hexadecimal data See Hexadecimal escaping for more information
- \Zcccc\Local defined escape sequences, used to send characters not representable in the configured codepage. See Local escape sequence for more information.

No escape sequence contains a nested escape sequence, according to the standard.

(*) The following escaping sequences are ignored by TOP

2.3.3 HEXADECIMAL ESCAPING

The escaping of ASTM disallowed characters happens when TOP wants to send a character that is not allowed in ASTM. Characters that can be escaped are the ASCII characters 10, 13, 127, 255. In this case, the character will be escaped using the hexadecimal escaping. For example, if TOP wants to send the character 127 it will be escaped to \X7F\.

2.3.4 LOCAL ESCAPE SEQUENCE

Local escape sequence is used to exchange characters not representable using the configured codepage. For example, if TOP wants to send a Japanese character (for example the Unicode character U+34C8) using the English codepage, the character would be lost in a normal transmission because it cannot be represented in that specific codepage.

To avoid losing any character, characters not representable in the selected codepage are escaped using the local escape sequence. In that case, the Japanese character will be sent in four hexadecimal digits as \Z34C8\.

Also note, that many non-representable codepage characters can be added in the same escape sequence.

2.4 DEMOGRAPHIC DATA

Given a sample, patient demographics shall never be updated from the LIS Host. Patient Demographics can only be updated through the application unless Samples are identified through Instrument Sample ID (see [R3] for further information).

2.5 SAMPLE IDENTIFICATION

ACL TOP instrument shall be capable to support LIS hosts that reuse Specimen ID(s). Reusing Specimen ID(s) means that different patients can have the same Specimen Id in different periods. If this period is short enough, for instance two consecutive days, some care is required in samples management.

Usually, these laboratories reuse their Specimen Id(s) every day, every week, or even several times in a day. If laboratory operates in this way, it is possible to find different samples with the same Specimen Id in the normal operation of ACL TOP. In order to support these potential situations, TOP uses the concepts “Instrument Specimen ID” and “Sample Life” to avoid conflicts in correct samples identification.

Thus, samples can be identified from the LIS host either through the Instrument Specimen Id or the Specimen Id + Sample Life.

2.5.1 SPECIMEN ID

Since the Specimen ID can be reused by the LIS host for different patients, the TOP uses the concept Sample Life for determining whether new test orders shall be added to an existing sample or not.

Given a Specimen ID, test orders received from the LIS are added to the same sample if the time frame since the sample was created till the test order was ordered (Requested/Ordered Date and Time) is < Sample Life and all patient demographic (First Name, Last Name, Birth Date, Gender, Sender ID) information is the same.

Given a Specimen ID, test orders received from the LIS are added to a new same sample if the time frame since the sample was created till the test order was ordered (Requested/Ordered Date and Time) is \geq Sample Life or one or more fields belonging to the patient demographic information are different.

2.5.2 INSTRUMENT SPECIMEN ID

The rules defined above section regarding the Sample Life are not applicable if the application and the LIS Host are identifying samples by means of the Instrument Specimen ID. In this way, new test orders can be programmed for existing expired samples.

Instrument Specimen ID is generated by the TOP and reused by the LIS Host. Through the TOP, the user will be able to disable the usage of the Instrument Specimen ID. If disabled, the TOP will not provide to the LIS Host any Instrument Sample ID as feedback of incoming test orders.

Instrument Specimen ID is unique within the scope of one instrument. Although in practice it is almost impossible to reproduce, different samples might have the same Instrument Specimen ID in different instruments.

If Instrument Specimen ID is used, no comparison of patient demographics shall be performed.

If Instrument Specimen ID received from the LIS does not match any Instrument Specimen Id kept by the system, test order shall be rejected.

2.5.3 CONCLUSION

The use of the instrument Specimen ID is recommended due to the following reasons:

- Instrument Specimen ID is not reused and therefore test orders are always properly assigned to the corresponding sample.
- New tests can be ordered for existing and expired Specimen Ids.
- Patient demographics are not compared because Instrument Specimen Id is not reused and it always identifies univocally a sample.

3. MESSAGE TRANSMISSION CONTROL

3.1 ERROR RECOVERY

In order to ensure proper error logging and error recovery, the next rule is followed according to the standard.

Storage Rule: Since data content is structured in hierarchical fashion, any decreasing change in the hierarchical level triggers storage of all data transmitted prior to said level change, and not previously saved.

An example of the prior rule application is the following.

Record #	Record Type	Level	(level variation)	Storage action
1	Message Header	L0	(0)	
2	Patient1	L1	(+1)	
3	Order1	L2	(+1)	
4	Result1	L3	(+1)	
5	Order2	L2	(-1)	{ Save 1 – 4 }

6		Order3	L2	(0)	
7	Patient2		L1	(-1)	{Save 5 – 6}
8		Order1	L2	(+1)	
9		Comment1	L3	(+1)	
10		Result1	L3	(0)	
11		Comment1	L4	(+1)	
12		Result2	L3	(-1)	{Save 7 – 11}
13		Order2	L2	(-1)	{Save 12}
14	Patient3		L1	(-1)	{Save 13}
15		Order1	L2	(+1)	
16		Result1	L3	(+1)	
17	Message Terminator		L0	(-3)	{Save 14 – 16}

Note: Record # 17 is assumed as saved by virtue of the record type function

If a transmission failure occurs, transmission starts at the last record not presumed saved as outlined in section 3.1 (Storage), but under one restriction. In order to fulfill hierarchical record level requirements, all records necessary to reach the restart record point are repeated prior to transmitting the record where the line failure originally occurred.

An example of required retransmissions is showed below.

Line failure at:	Record Type	Level (variation)	Storage action	Retransmission of:
1	Message Header	L0	(0)	1
2	Patient1	L1	(+1)	1, 2
3	Order1	L2	(+1)	1, 2, 3
4	Result1	L3	(+1)	1, 2, 3, 4
5	Order2	L2	(-1)	{Save 1 – 4} 1, 2, 3, 4, 5
6	Order3	L2	(0)	1, 2, 5, 6
7	Patient2	L1	(-1)	{Save 5 – 6} 1, 2, 5, 6, 7
8	Order1	L2	(+1)	1, 7, 8
9	Comment1	L3	(+1)	1, 7, 8, 9
10	Result1	L3	(0)	1, 7, 8, 9, 10
11	Comment1	L4	(+1)	1, 7, 8, 9, 10, 11
12	Result2	L3	(-1)	{Save 7 – 11} 1, 7, 8, 9, 10, 11, 12
13	Order2	L2	(-1)	{Save 12} 1, 7, 8, 12, 13
14	Patient3	L1	(-1)	{Save 13} 1, 7, 13, 14
15	Order1	L2	(+1)	1, 14, 15
16	Result1	L3	(+1)	1, 14, 15, 16
17	Message Terminator	L0	(-3)	{Save 14 – 16} 1, 14, 15, 16, 17

3.2 ERROR MESSAGES

Any error detected by TOP is traced in the UDC folder in the 'Windows Event Viewer' in Settings\Control Panel\Administrative Tools. If you have any problem, this is the first place you have to check to find error information.

Optionally TOP can notify the HOST of any incorrect message received by the LIS host. Check the "Report errors to LIS" check box in the HOST configuration screen in TOP if you want to activate this feature.

If error notification is active, TOP sends ASTM messages with information about the error occurred (see Upload message – Request rejected by the instrument for detailed information about the message). Top distinguishes the syntactic and semantic errors and they are treated differently:

Syntactic errors happen when the ASTM received by TOP doesn't follow the general ASTM rules, or the more specific rules defined by TOP. This is the list of errors TOP notifies to the LIS host:

Invalid message: The incoming message is invalid and TOP doesn't know what information is being delivered. This may happen when there are invalid characters in the message, or when an unexpected message is received. For example, when TOP receives a response and has not done any request.

Invalid syntax: The incoming message has an invalid syntax, for example if the hierarchy of records is not followed appropriately

Invalid value: The incoming message has a value that is not supported by TOP. Consistency among values in different fields is not checked.

Missing mandatory value: The incoming message doesn't provide a value for a TOP mandatory field

Incomplete message: The incoming message was uncompleted

Semantic errors are errors that are syntactically correct, but the action cannot be executed by the instrument. This is the list of semantic errors TOP notify to the LIS host:

- Invalid host ID: The host ID received in the message is not the same as the one specified in TOP. The message is discarded
- Invalid instrument ID: The instrument ID received in the message is not the same as the one specified in TOP. The message is discarded
- Duplicated test: A test has been received twice. The test is removed.
- Invalid test: The test ordered by the LIS host is unknown to TOP. The order is removed.
- Disabled or inconsistent test: The test ordered by the LIS host is disabled or is inconsistent. The order is removed.
- Invalid instrument sample id: The LIS host retrieved an invalid instrument sample id. The test is removed.
- Cancellation of pending test request could not be performed: The LIS host can cancel a previously ordered test if this has not been executed yet. This message specifies the test could not be cancelled because its execution has started. The result will be delivered to the LIS host as any other test.
- LIS request not allowed: TOP doesn't allow the LIS host to perform requests for any data. If a request from the LIS is received, the request is cancelled and no data is retrieved.

When any of the previous errors is found, TOP skips the wrong part of the message, and continues interpreting it as if no error existed. For extended error information for the skipped part, check the TOP communication tracing system where you will get the ASTM part of the message discarded and the reason.

These are the rules followed that describe the part of the message rejected when an error is found:

- An error in a header record invalidates the whole message.
- An error in a patient record invalidates all the orders below that patient in the ASTM hierarchy.
- An error in a order record invalidates only that order record.

An error in a comment record invalidates only the comment record but the patient or order record is accepted if more orders or results exist for that patient/order.

3.3 MESSAGE STORAGE

Messages that need to be uploaded to the LIS are physically persisted when the communications cannot be performed due to hardware or software problems. This is done to avoid losing any message even if the application is shut down. If necessary, the user can delete all the stored messages clicking the specific button in the communications configuration screen.

These are the more specific rules implemented by TOP to manage the storage of messages:

- The maximum number of messages that are allowed in the storage is 7200 messages.
- Once the storage is at 75% of its capacity TOP triggers the alarm < LIS Message Storage Full> providing information of the percentage of the storage that is full. This alarm is reported during start-up as well and every time there is a 5% increment or decrement between 75% and 100%.
- Once the storage is 100% full TOP triggers the alarm < LIS Message Storage Overloaded> and no more messages are accepted in the storage. This alarm will also be reported every time the communications are restored.
- Once the storage is full (100% of its capacity) the upload of any new messages will be rejected and TOP triggers the following two alarms < Upload Message Rejected> and < LIS Message Storage Overloaded>

4. TRANSMISSION SCENARIOS

This section details all the possible scenarios to exchange data between TOP and a LIS host.

4.1 TOP REQUEST TEST ORDERS TO HOST

This scenario takes place when the instrument, via a manual or an automatic command, launches a request to the LIS host with the intention to download all available test orders.

4.1.1 UPLOAD MESSAGE – TEST ORDER REQUEST PERFORMED BY THE INSTRUMENT

Message structure

Level 0 records	Level 1 records	Level 2 records	Level 3 records	Level 4 records
Message header (H)				
	Request information (Q)			
Message terminator (L)				

Message Header Record

Field No.	Field Name	Description	Component	Data type	Max. Length	Req	Allow Repeat	Allowed values
-----------	------------	-------------	-----------	-----------	-------------	-----	--------------	----------------

1	Record Type ID	Identifies the record	1	String	1	Y	N	H
2	Delimiter Definition	Define the delimiters to be used throughout the subsequent records of the message	1	String	4	Y	N	See section Delimiters for more information
3	Message ID	Uniquely identifies the message	1	String	50	Y	N	
5	Sender Name or ID	Name or ID of the sender	1	String	14	Y	N	The value defined in TOP configuration's
10	Receiver ID	Name or ID of the receiver	1		14	Y	N	The value defined in TOP configuration's
12	Processing ID	Indicates how this message is to be processed.	1	String	1	Y	N	P (Production)
13	Version No.	Version level of the current ASTM version specification.	1	String	7	Y	N	1394-97
14	Date and Time of Message	Date and time the message was generated	1	ASTM Date		Y	N	

Request Information Record

Field No.	Field Name	Description	Component	Data type	Max. Length	Req	Allow Repeat	Allowed values
1	Record Type ID	Identifies the record	1	String	1	Y	N	Q
2	Sequence Number	Defines the i'th occurrence of the associated record type	1	String	1	Y	N	1
3	Starting Range ID Number		3	String		Y	N	ALL
13	Request Information Status Codes		1	String	1	Y	Y	O (req. test order and demogs), N (request new/edited results)

Message Terminator Record

Field No.	Field Name	Description	Component	Data type	Max. Length	Req	Allow Repeat	Allowed values
1	Record Type ID	Identifies the record	1	String	1	Y	N	L
2	Sequence Number	Defines the i'th occurrence of the associated record type	1	String	1	Y	N	1
3	Termination Code	Provides explanation of end of session	1	String	1	Y	N	N (normal termination)

Example

```
H | @ ^ \ | <0_0> <1025080549_50> || ACL TOP-07 || || || LIS-HOST-06 || P | 1394-97 | 20000913174650 <CR>
Q | 1 | ALL || || || || || || O@N <CR>
L | 1 | N <CR>
```

4.1.2 UPLOAD MESSAGE— TEST ORDER REQUEST CANCELLED BY THE INSTRUMENT

The instrument can cancel the last request performed while it has not received any message from the LIS host. The cancellation for the last request allows the instrument to perform another request with higher priority.

Note: Remember that only one request can be performed at the same time. The sender cannot transmit another request until the previous one has been answered by the receiver or cancelled by the sender. TOP will automatically cancel the request when no answer is received in 60 seconds.

Message structure

Level 0 records	Level 1 records	Level 2 records	Level 3 records	Level 4 records
Message header (H)				
	Request information (Q)			
		Comment (C)		
Message terminator (L)				

Message Header RecordField No.Request Information Record

Field No.	Field Name	Description	Component	Data type	Max. Length	Req	Allow Repeat	Allowed values
1	Record Type ID	Identifies the record	1	String	1	Y	N	Q
2	Sequence Number	Defines the i'th occurrence of the associated record type	1	String	1	Y	N	1
13	Request Information Status Codes		1	String	1	Y	N	A (abort last request)

Comment Record

Field No.	Field Name	Description	Component	Data type	Max. Length	Req	Allow Repeat	Allowed values
1	Record Type ID	Identifies the record	1	String	1	Y	N	C
2	Sequence Number	Defines the i'th occurrence of the associated record type	1	String		Y	N	1,2,3 ... n
3	Comment Source	Comment origination point	1	String	1	Y	N	I
4	Comment Text	Comment id	1	String	50	N	N	timeout
		Comment description	2	String	500	N		last request has been cancelled
5	Comment Type	Comment type qualifier	1	String	1	Y	N	P (information)

Message Terminator Record Field No. Example

```
H | @ ^ | | <0_0> <1025080549_50> | | ACL TOP-11 | | | | LIS-HOST-93 | | P | 1394-97 | 20010414182154 <CR>
Q | 1 | | | | | | | | | | A <CR>
C | 1 | I | timeout ^ last request has been cancelled | P <CR>
L | 1 | N <CR>
```

4.1.3 DOWNLOAD MESSAGE – TEST ORDER DELIVERY BY THE LIS HOST

Message structure

Level 0 records	Level 1 records	Level 2 records	Level 3 records	Level 4 records
Message header (H)				
	Patient Information (P)			
		Test Order (O)		
		...		
	...			
Message terminator (L)				

Message Header Record

Field No.	Field Name	Description	Component	Data type	Max. Length	Req	Allow Repeat	Allowed values
1	Record Type ID	Identifies the record	1	String	1	Y	N	H
2	Delimiter Definition	Define the delimiters to be used throughout the subsequent records of the message	1	String	4	Y	N	See section Delimiters for more information
3	Message ID	Uniquely identifies the message	1	String	50	N	N	
5	Sender Name or ID	Name or ID of the sender	1	String	14	Y	N	The value defined in TOP configuration's
10	Receiver ID	Name or ID of the receiver	1		14	Y	N	The value defined in TOP configuration's
12	Processing ID	Indicates how this message is to be processed.	1	String	1	Y	N	P (Production)
13	Version No.	Version level of the current ASTM 1394-91 specification.	1	String	7	Y	N	1394-97
14	Date and Time of Message	Date and time that the message was generated	1	ASTM Date		N	N	

Patient Information Record

Field No.	Field Name	Description	Component	Data type	Max. Length	Req	Allow Repeat	Allowed values
1	Record Type ID	Identifies the record as PIR	1	String	1	Y	N	P
2	Sequence Number	Defines the i'th occurrence of the associated record type	1	Numeric		Y	N	1,2,3 ... n
4	Laboratory patient ID	A unique processing number assigned to a patient by the LAB	1	String	15	N	N	
6	Patient Name	Patient last name	1	String	20	N	N	
		Patient first name	2	String	20	N	N	
8	Birth date	Date of birth	1	ASTM Date		N	N	
9	Patient Sex	Sex	1	String	1	N	N	M (male), F (female), U (unknown)
14	Attending physician ID	Id of the attending physician	1	String	14	N	N	

Test Order Record

Field No.	Field Name	Description	Component	Data type	Max. Length	Req	Allow Repeat	Allowed values
1	Record Type ID	Identifies the record	1	String	1	Y	N	O
2	Sequence Number	Defines the i'th occurrence of the associated record type	1	Numeric		Y	N	1,2,3 ... n
3	Specimen ID	A unique identifier for the specimen assigned by the HOST	1	String	16	Y	N	
4	Instrument Specimen ID	A unique identifier for the specimen assigned by TOP. This must be retrieved from the LIS if it is known.	1	String	30	N	N	
5	Universal Test ID	TOP defined Test ID	4	Numeric	6	Y	Y	0 - 999999
6	Priority		1	String	1	N	N	S (Stat), R (normal)
7	Requested/Ordered Date and Time	Date and time the order was received or recorded	1	ASTM Date		N	N	If empty, Requested/Ordered Date and Time is set to current date and Time.
12	Action code	The action that needs to be taken with the order	1	String	1	N	Y	A (Added in previous specimen or creates a new specimen following the rules of the sample life cycle), C (Cancel a previous test request)
16	Specimen Descriptor	Sample type	1	String	1	Y	N	P (plasma)
26	Report Type	Intention of the information contained in the record	1	String	1	Y	Y	Q (Response to query),

Message Terminator Record

Field No.	Field Name	Description	Component	Data type	Max. Length	Req	Allow Repeat	Allowed values
1	Record Type ID	Identifies the record as MTR	1	String	1	Y	N	L
2	Sequence Number	Defines the i'th occurrence of the associated record type	1	String	1	Y	N	1
3	Termination Code	Provides explanation of end of session	1	String	1	Y	N	F (last request processed)

Example

```

H | @ ^ \ | <0_0> <1025080549_50> || LIS-HOST-03 || || | ACL TOP-21 || P | 1394-97 | 20000614080500 <CR>
P | 1 | 80501 | Anderson ^ Jim | 19800228 | M | || || | 542 <CR>
O | 1 | 6483 | ^ ^ ^ 211 @ ^ ^ ^ 063 | R | 20000614043211 || || | A || | P | || || || || | Q <CR>
O | 2 | 8651 | ^ ^ ^ 310 | S | 20000614043514 || || | A || | P | || || || || | Q <CR>
P | 2 | || | Foster ^ Rene | 19740717 | F | || || | 374 <CR>
O | 1 | 0012 | ^ ^ ^ 512 | R | 20000614044212 || || | A || | P | || || || || | Q <CR>
O | 2 | 0012 | ^ ^ . ^ 254 | R | 20000614044325 || || | A || | P | || || || || | Q <CR>
P | 3 | || | Clinton ^ Jeremy | 19580223 | M <CR>
O | 1 | 6537 | 310648 | ^ ^ ^ 076 | S | 20000614044212 || || | A || | P | || || || || | Q <CR>
O | 2 | 6537 | 310648 | ^ ^ ^ 098 | R | 20000614045021 || || | C || | P | || || || || | Q <CR>
O | 3 | 6912 | ^ ^ ^ 301 @ ^ ^ ^ 357 | R | 20000614052158 || || | A || | P | || || || || | Q <CR>
P | 4 | || | Turner ^ Jim | 19890821 | M | || || | 271 <CR>
O | 1 | 0509 | 479481 | ^ ^ ^ 002 | 20000614055734 || || | C || | P | || || || || | Q <CR>
L | 1 | F <CR>

```

4.1.4 DOWNLOAD MESSAGE – TEST ORDER RESPONSE WHEN NO DATA AVAILABLE FROM THE LIS HOST

It can happen when there is no information to download. Also note, that if the LIS host doesn't transmit anything and the timeout is reached (60 seconds), the instrument will assume that the LIS host has no test orders to program. In that case, TOP will cancel the request as specified in Upload message– test order request cancelled by the instrument.

Note: It is recommended to the LIS host implementers to always response to a request from TOP, otherwise the communication will be stopped until the 60 seconds timeout is reached.

Message structure

Level 0 records	Level 1 records	Level 2 records	Level 3 records	Level 4 records
Message header (H)				
Message terminator (L)				

Message Header RecordField No.Message Terminator Record

Field No.	Field Name	Description	Component	Data type	Max. Length	Req	Allow Repeat	Allowed values
1	Record Type ID	Identifies the record as MTR	1	String	1	Y	N	L
2	Sequence Number	Defines the i'th occurrence of the associated record type	1	String	1	Y	N	1
3	Termination Code	Provides explanation of end of session	1	String	1	Y	N	I (no info from last query)

Example

```
H | @ ^ \ | <0_0> <1025080549_50> | | LIS-HOST-04 | | | ACL TOP-12 | | P | 1394-97 | 20030330033003 <CR>
L | 1 | I <CR>
```

4.2 LIS HOST INITIATED TEST ORDERS DELIVERY

This scenario takes place when the LIS host, decides to download all available test orders to the instrument.

4.2.1 DOWNLOAD MESSAGE – LIS HOST INITIATED TEST ORDER DELIVERY

Message structure

Level 0 records	Level 1 records	Level 2 records	Level 3 records	Level 4 records
Message header (H)				
	Patient Information (P)			
		Test Order (O)		
		...		
	...			
Message terminator (L)				

Message Header RecordField No.Patient Information Record Field No.Test Order Record

Field No.	Field Name	Description	Component	Data type	Max. Length	Req	Allow Repeat	Allowed values
-----------	------------	-------------	-----------	-----------	-------------	-----	--------------	----------------

1	Record Type ID	Identifies the record	1	String	1	Y	N	O
2	Sequence Number	Defines the i'th occurrence of the associated record type	1	Numeric		Y	N	1,2,3 ... n
3	Specimen ID	A unique identifier for the specimen assigned by the HOST	1	String	16	Y	N	
4	Instrument Specimen ID	A unique identifier for the specimen assigned by TOP	1	String	30	N	N	
5	Universal Test ID	TOP defined Test ID	4	Numeric	6	Y	Y	0 - 999999
6	Priority		1	String	1	N	N	S (Stat), R(normal)
7	Requested/Ordered Date and Time	Date and time the order was received or recorded	1	ASTM Date		N	N	If empty, Requested/Ordered Date and Time is set to current date and Time.
12	Action code	The action that needs to be taken with the order	1	String	1	N	Y	A (Added in previous specimen or creates a new specimen following the rules of the sample life cycle), C (Cancel a previous test request)
16	Specimen Descriptor	Sample type	1	String	1	Y	N	P (plasma)
26	Report Type	Intention of the information contained in the record	1	String	1	Y	Y	O (Order record)

Message Terminator RecordField No. Example

```

H | @ ^ \ | <0_0> <1025080549_50> || LIS-HOST-11 || || | ACL TOP-09 || P | 1394-97 | 20000715180000 <CR>
P | 1 | || | Dillon ^ Jennifer || 19820414 | F <CR>
O | 1 | 8201 || ^ ^ ^ 900 | S | 20000715143243 || || | N || || | P || || || || || | O <CR>
O | 2 | 8201 || ^ ^ ^ 444 @ ^ ^ ^ 666 | R | 20000715143725 || || | N || || | P || || || || || | O <CR>
P | 2 | || | Carter ^ Rudy || 19620121 | F || || | 985 <CR>
O | 1 | 5438 | 690008 | ^ ^ ^ 369 | R | 20000715143912 || || | A || || | P || || || || || | O <CR>
O | 2 | 5438 | 690008 | ^ ^ ^ 963 | R | 20000715144127 || || | A || || | P || || || || || | O <CR>
P | 3 | || | Stendal ^ Jeremy || 19321002 | M <CR>
O | 1 | 5009 | 324879 | ^ ^ ^ 209 || 20010913215702 || || | C || || | P || || || || || | O <CR>
L | 1 | N <CR>

```

4.3 HOST QUERY PERFORMED BY THE INSTRUMENT

This scenario is triggered when the user performs the host query functionality in the instrument. Host query allows selective downloading of test orders, taking as input, a single Specimen ID (Sample ID) or a set of them.

4.3.1 UPLOAD MESSAGE – HOST QUERY PERFORMED BY THE INSTRUMENT

Message structure

Message Header Record

Level 0 records	Level 1 records	Level 2 records	Level 3 records	Level 4 records
Message header (H)				
	Request information (Q)			
Message terminator (L)				

Field No. Request Information Record

Field No.	Field Name	Description	Component	Data type	Max. Length	Req	Allow Repeat	Allowed values
1	Record Type ID	Identifies the record	1	String	1	Y	N	H

2	Delimiter Definition	Define the delimiters to be used throughout the subsequent records of the message	1	String	4	Y	N	See section 2.3 for more information
3	Message ID	Uniquely identifies the message	1	String	50	Y	N	
5	Sender Name or ID	Name or ID of the sender	1	String	14	Y	N	The value defined in TOP configuration's
10	Receiver ID	Name or ID of the receiver	1		14	Y	N	The value defined in TOP configuration's
12	Processing ID	Indicates how this message is to be processed.	1	String	1	Y	N	P (Production)
13	Version No.	Version level of the current ASTM version specification.	1	String	7	Y	N	1394-97
14	Date and Time of Message	Date and time the message was generated	1	ASTM Date		Y	N	

Field No.	Field Name	Description	Component	Data type	Max. Length	Req	Allow Repeat	Allowed values
1	Record Type ID	Identifies the record	1	String	1	Y	N	Q
2	Sequence Number	Defines the i'th occurrence of the associated record type	1	String	1	Y	N	1
3	Starting Range ID Number	Specimen ID	2	String	16	Y	Y	
		Instrument specimen ID	3	String	30	N		
13	Request Information Status Codes		1	String	1	Y	Y	O (req. test order and demogs), N (request new test orders still not downloaded)

Message Terminator RecordField No. Example

```
H | @ ^ \ | <0_0> <1025080549_50> | | ACL TOP-03 | | | LIS-HOST-04 | | P | 1394-97 | 19990913174650 <CR>
Q | 1 | ^ 4243 ^ 876271 @ ^ 0434 @ ^ 0435 @ ^ 6742 ^ 878432 | | | | | | | | O@N <CR>
L | 1 | N <CR>
```

4.3.2 UPLOAD MESSAGE – TEST ORDER REQUEST CANCELLED BY THE INSTRUMENT

See section Upload message– test order request cancelled by the instrument for more information.

4.3.3 DOWNLOAD – HOST QUERY RESPONSE FROM LIS HOST

The LIS host retrieves data for the specified sample IDs. See section Download message – test order delivery by the lis host for more information. Note that if in a multiple host query, there are specimens that have pending orders and there are others that don't, the host query response only need to retrieve the pending specimens. TOP will assume that there are no orders for the specimens no listed in the host query response. If multiple messages are send as response only the first will be processed and the rest will be discarded.

If the LIS host doesn't have anything to answer, because it doesn't know the sample IDs or because there are no test orders to retrieve, it must follow the same rules described in section Download message – test order response when no data available from the lis host.

4.4 INSTRUMENT UPLOADS INSTRUMENT SPECIMEN ID TO LIS HOST

This scenario takes place when the instrument receives a list of test orders from the LIS host. For every new sample received, the instrument generates an internal sample ID (known as “Instrument Specimen ID” in ASTM terminology) and sends it back to the LIS host.

Future LIS host references to these samples will be performed using both identifiers: “Specimen ID” and “Instrument Specimen ID”. In the same way, all information sent back to the LIS host by the instrument will be accompanied by both identifiers.

This scenario can be launched after tests orders are delivered to the instrument.

4.4.1 UPLOAD MESSAGE – INSTRUMENT UPLOADS INSTRUMENT SPECIMEN ID TO LIS HOST

Message structure

Level 0 records	Level 1 records	Level 2 records	Level 3 records	Level 4 records
Message header (H)				
	Patient Information (P)			
		Test Order (O)		
	...			
Message terminator (L)				

Note: Only one test order record will be placed under a patient information record.

Message Header RecordField No. Patient Information Record

Field No.	Field Name	Description	Component	Data type	Max. Length	Req	Allow Repeat	Allowed values
1	Record Type ID	Identifies the record as PIR	1	String	1	Y	N	P
2	Sequence Number	Defines the i'th occurrence of the associated record type	1	Numeric		Y	N	1,2,3 ... n
4	Laboratory patient ID	A unique processing number assigned to a patient by the LAB	1	String	15	N	N	
6	Patient Name	Patient last name	1	String	20	N	N	
		Patient first name	2	String	20	N	N	
8	Birth date	Date of birth	1	ASTM Date		N	N	
9	Patient Sex	Sex	1	String	1	N	N	M (male), F (female), U (unknown)
14	Attending physician ID	Id of the attending physician	1	String	14	N	N	

Test Order Record

Field No.	Field Name	Description	Component	Data type	Max. Length	Req	Allow Repeat	Allowed values
1	Record Type ID	Identifies the record	1	String	1	Y	N	O
2	Sequence Number	Defines the i'th occurrence of the associated record type	1	Numeric		Y	N	1,2,3 ... n
3	Specimen ID	A unique identifier for the specimen assigned by the HOST	1	String	16	Y	N	

4	Instrument Specimen ID	A unique identifier for the specimen assigned by TOP	1	String	30	Y	N	
5	Universal Test ID	TOP defined Test ID	4	Numeric	6	Y	Y	0 - 999999
6	Priority		1	String	1	N	N	S (Stat), R(normal)
7	Requested/Ordered Date and Time	Date and time the order was received or recorded	1	ASTM Date		N	N	If empty, Requested/Ordered Date and Time is set to current date and Time.
12	Action code	The action that needs to be taken with the order	1	String	1	Y	Y	P (pending specimen)
16	Specimen Descriptor	Sample type	1	String	1	Y	N	P (plasma)
26	Report Type	Intention of the information contained in the record	1	String	1	Y	Y	O (Order record), I (Pending in instrument)

Message Terminator RecordField No. Example

```
H | @ ^ \ | <0_0> <1025080549_50> | | ACL TOP-21 | | | | LIS-HOST-03 | | P | 1394-97 | 20000614080624 <CR>
P | 1 | | | Anderson ^ Jim | | 19800228 | M | | | | 542 <CR>
O | 1 | 6483 | 312890 | ^ ^ ^ 063 | R | 20000614043211 | | | | P | | | | P | | | | | | O@I <CR>
P | 2 | | | Foster ^ Rene | | 19740717 | F | | | | 374 <CR>
O | 1 | 0012 | 312892 | ^ ^ ^ 512 | R | 20000614044212 | | | | P | | | | P | | | | | | O@I <CR>
L | 1 | N <CR>
```

4.5 INSTRUMENT UPLOADS TEST RESULTS

This scenario takes place when the instrument is requested to send available test results to the LIS host. This scenario can be executed because the action is triggered manually or automatically. This scenario cannot be triggered by a request from the LIS host. Remember, IL instruments do not support a request message for test results uploading.

4.5.1 UPLOAD MESSAGE – TEST RESULTS DELIVERY CARRIED OUT BY THE INSTRUMENT

Message structure

Level 0 records	Level 1 records	Level 2 records	Level 3 records	Level 4 records
Message header (H)				
	Patient Information (P)			
		Test Order (O)		
			Result (R)	
				Comment (C)
				...
		
	...			
Message terminator (L)				

Message Header RecordField No. Patient Information Record Field No. Test Order Record

Field No.	Field Name	Description	Component	Data type	Max. Length	Req	Allow Repeat	Allowed values
1	Record Type ID	Identifies the record	1	String	1	Y	N	O
2	Sequence Number	Defines the i'th occurrence of the associated record type	1	Numeric		Y	N	1,2,3 ... n
3	Specimen ID	A unique identifier for the specimen assigned by the HOST	1	String	16	Y	N	

4	Instrument Specimen ID	A unique identifier for the specimen assigned by TOP	1	String	30	N	N	
5	Universal Test ID	TOP defined Test ID	4	Numeric	6	Y	Y	0 - 999999
6	Priority		1	String	1	N	N	S (Stat), R (normal)
7	Requested/ Ordered Date and Time	Date and time the order was received or recorded	1	ASTM Date		N	N	
12	Action code	The action that needs to be taken with the order	1	String	1	N	N	Q (mandatory when quality control)
16	Specimen Descriptor	Sample type	1	String	1	Y	N	P (plasma)
26	Report Type	Intention of the information contained in the record	1	String	1	Y	Y	O (Order record), F (All tests results are Final or could not be done - see R9), P (This test triggers a rerun)

Result Record

Field No.	Field Name	Description	Component	Data type	Max. Length	Req	Allow Repeat	Allowed values
1	Record Type ID	Identifies the record	1	String	1	Y	N	R
2	Sequence Number	Defines the i'th occurrence of the associated record type	1	Numeric		Y	N	1,2,3 ... n
3	Universal Test ID	TOP defined Test ID	4	Numeric		Y	N	0 – 999999999
4	Data or Measurement Value	Observed, calculated or implied result value	1	String	30	N	Y	
5	Units	Abbreviation of units for numerical results	1	String	15	N	Y	For information on specific unit values see section 6
7	Result Abnormal Flags	Indicates the normalcy status of the result	1	String	2	Y	N	L (Below low normal), H (Above high normal), N (Normal), < (Below absolute low), > (Above absolute high)
9	Result Status		1	String	1	Y	Y	F (final result), P (preliminary result, because a rerun has been set), V (result validated), X (result cannot be done)
11	Operator Identification	Operator ID for the test performer	1	String	30	N	N	
		Operator ID for the test verifier	2	String	30	N		
13	Date Time Test Completed	Date and time the instrument completed the test	1	ASTM Date		Y	N	
14	Instrument Identification	Identifies the instrument that performed this measurement	1	String	14	Y	N	Instrument ID as specified in TOP
		Rack id	2	String	2	Y	N	
		Rack position	3	String	2	Y	N	

Comment Record

Field No.	Field Name	Description	Component	Data type	Max. Length	Req	Allow Repeat	Allowed values
1	Record Type ID	Identifies the record	1	String	1	Y	N	C

2	Sequence Number	Defines the i'th occurrence of the associated record type	1	String		Y	N	1,2,3 ... n
3	Comment Source	Comment origination point	1	String	1	Y	N	I
4	Comment Text	Comment ID	1	String	50	N	N	
		Comment description	2	String	500	N		
		Comment area	3	String	50	N		
5	Comment Type	Comment type qualifier	1	String	1	Y	N	I (instrument flag comment), N (negative comment)

Message Terminator RecordField No. Example

```

H | @^ | 123 | | ACL TOP-52 | | | | LIS-HOST-31 | | P | 1394-97 | 20000614060520
P | 1 | | | | | | | | | |
O | 1 | Normal Control | <1034241923_260> | ^ ^ ^ 555 | R | | | | | | | | | | P | | | | | | | | | | O @ F
R | 1 | ^ ^ ^ 555 | 106.01 | % | | N | | F @ V | | ^ IL | | 20021211163215 | ACL TOP-21 ^ B ^ 5
C | 1 | I | 1025 ^ reagent temperature warning ^ HW | I
C | 2 | I | 1030 ^ cuvette shuttle temp warning ^ HW | I
R | 2 | ^ ^ ^ 555 | 12.65 | sec | | N | | F @ V | | ^ IL | | 20021211163215 | ACL TOP-21 ^ F ^ 3
R | 3 | ^ ^ ^ 555 | 0.97 | INR | | L | | F @ V | | ^ IL | | 20021211163215 | ACL TOP-21 ^ G ^ 2
C | 1 | I | 1017 ^ probe temperature warning ^ HW | I
L | 1 | N

```

4.5.2 DOWNLOAD MESSAGE – TEST RESULTS DELIVERY REJECTED BY THE LIS HOST

In case there is an error in the information retrieved by the instrument to the LIS host, the LIS host cannot retrieve any error information to the instrument

4.6 LIS HOST REQUEST RESULTS TO THE INSTRUMENT

This scenario takes place when the LIS host launches a request to the instrument, for uploading available test results. IL instruments do not support to operate in this way, consequently, all requests for test results received from LIS host will be rejected.

4.6.1 DOWNLOAD MESSAGE – TEST RESULTS REQUEST PERFORMED BY THE LIS HOST

Message structure

Level 0 records	Level 1 records	Level 2 records	Level 3 records	Level 4 records
Message header (H)				
	Request information (Q)			
Message terminator (L)				

Message Header RecordField No.Request Information Record

Field No.	Field Name	Description	Component	Data type	Max. Length	Req	Allow Repeat	Allowed values
1	Record Type ID	Identifies the record	1	String	1	Y	N	Q
2	Sequence Number	Defines the i'th occurrence of the associated record type	1	String	1	Y	N	I

13	Request Information Status Codes		1	String	1	Y	Y	C (correction of previous values), P (preliminary results), F (final results), X (results cannot be done), I (request results pending), S (request partial results), M (results a MIC level), R (result previously transmitted), A (abort last request), N (request new/edit results), O (request tests and demog data), D (request demographic data only)
----	----------------------------------	--	---	--------	---	---	---	---

Message Terminator RecordField No. Example

```
H | @ ^ \ | <0_0> <1025080549_50> || LIS-HOST-05 || || ACL TOP-17 || P | 1394-97 | 20010518123841 <CR>
Q | 1 | ALL || || || || || || || || I <CR>
L | 1 | N <CR>
```

4.6.2 UPLOAD MESSAGE – REQUEST REJECTED BY THE INSTRUMENT

Message structure

Level 0 records	Level 1 records	Level 2 records	Level 3 records	Level 4 records
Message header (H)				
	Comment (C)			
Message terminator (L)				

Message Header RecordField No.Comment Record

Field No.	Field Name	Description	Component	Data type	Max. Length	Req	Allow Repeat	Allowed values
1	Record Type ID	Identifies the record	1	String	1	Y	N	C
2	Sequence Number	Defines the i'th occurrence of the associated record type	1	String		Y	N	1,2,3 ... n
3	Comment Source	Comment origination point	1	String	1	Y	N	I
4	Comment Text	Comment id	1	String	50	N	N	invalidTransmissionInformation
		Comment description	2	String	500	N		Request not allowed
5	Comment Type	Comment type qualifier	1	String	1	Y	N	N (negative result/error info)

Message Terminator Record

Field No.	Field Name	Description	Component	Data type	Max. Length	Req	Allow Repeat	Allowed values
1	Record Type ID	Identifies the record as MTR	1	String	1	Y	N	L
2	Sequence Number	Defines the i'th occurrence of the associated record type	1	String	1	Y	N	1
3	Termination Code	Provides explanation of end of session	1	String	1	Y	N	Q (error in last request)

Example

```
H | @ ^ \ | <0_0> <1025080549_50> || ACL TOP-02 || || LIS-HOST-01 || P | 1394-97 | 20020421073718 <CR>
C | 1 | I | invalidTransmissionInformation ^ Request not allowed | N <CR>
L | 1 | Q <CR>
```

4.7 INSTRUMENT UPLOADS ERROR INFORMATION

This scenario takes place when the instrument receives an invalid message from the LIS host. See Error messages for more information on this topic.

4.7.1 UPLOAD MESSAGE – ERROR INFORMATION MESSAGE (1)

This message is retrieved when there is a syntactic error, or when the host ID or instrument ID doesn't match the values configured in TOP.

Message structure

Level 0 records	Level 1 records	Level 2 records	Level 3 records	Level 4 records
Message header (H)				
	Comment (C)			
Message terminator (L)				

Message Header RecordField No.Comment Record

Field No.	Field Name	Description	Component	Data type	Max. Length	Req	Allow Repeat	Allowed values
1	Record Type ID	Identifies the record	1	String	1	Y	N	C
2	Sequence Number	Defines the i'th occurrence of the associated record type	1	String		Y	N	1,2,3 ... n
3	Comment Source	Comment origination point	1	String	1	Y	N	I
4	Comment Text	Comment id	1	String	50	N	N	invalidMessage invalidSyntax invalidValue missingMandatoryValue incompleteMessage invalidTransmissionInformation
		Comment description	2	String	500	N		
5	Comment Type	Comment type qualifier	1	String	1	Y	N	N (negative result/error info)

Message Terminator Record

Field No.	Field Name	Description	Component	Data type	Max. Length	Req	Allow Repeat	Allowed values
1	Record Type ID	Identifies the record	1	String	1	Y	N	L
2	Sequence Number	Defines the i'th occurrence of the associated record type	1	String	1	Y	N	1
3	Termination Code	Provides explanation of end of session	1	String	1	Y	N	E (unknown system error)

Example

```
H | @ ^ \ | <0_0> <1025080549_50> || ACL TOP-02 || || LIS-HOST-01 || P | 1394-97 | 20020421073718 <CR>
```


C | 1 | I | InvalidTransmissionInformation ^ Invalid host ID | N <CR>
 L | 1 | E <CR>

4.7.2 UPLOAD MESSAGE – ERROR INFORMATION MESSAGE (2)

This message is retrieved when there is an action that cannot be executed by the instrument.

Message structure

Level 0 records	Level 1 records	Level 2 records	Level 3 records	Level 4 records
Message header (H)				
	Patient Information (P)			
		Test Order (O)		
			Comment (C)	
Message terminator (L)				

Message Header RecordField No.Patient Information Record Field No.Test Order Record

Field No.	Field Name	Description	Component	Data type	Max. Length	Req	Allow Repeat	Allowed values	
1	Record Type ID	Identifies the record	1	String	1	Y	N	O	
2	Sequence Number	Defines the i'th occurrence of the associated record type	1	Numeric		Y	N	1,2,3 ... n	
3	Specimen ID	A unique identifier for the specimen assigned by the HOST	1	String	16	N	N		
4	Instrument Specimen ID	A unique identifier for the specimen assigned by TOP	1	String	30	N	N		
5	Universal Test ID	TOP defined Test ID	4	Numeric	6	N	Y	0 - 999999	
6	Priority		1	String	1	N	N	S (Stat), R(normal)	
7	Requested/ Ordered Date and Time	Date and time the order was received or recorded	1	ASTM Date		N	N		
16	Specimen Descriptor	Sample type	1	String	1	N	N	P (plasma)	
26	Report Type	Intention of the information contained in the record	1	String	1	N	Y	O (Order record), X (Order cannot be done), Y (No order/test in record)	

Comment Record

Field No.	Field Name	Description	Component	Data type	Max. Length	Req	Allow Repeat	Allowed values
1	Record Type ID	Identifies the record	1	String	1	Y	N	C
2	Sequence Number	Defines the i'th occurrence of the associated record type	1	String		Y	N	1,2,3 ... n
3	Comment Source	Comment origination point	1	String	1	Y	N	I
4	Comment Text	Comment id	1	String	50	N		invalidDemographicData invalidSpecimenData invalidTestData duplicatedTest
		Comment description	2	String	500	N		
5	Comment Type	Comment type qualifier	1	String	1	Y	N	N (negative result/error info)

Message Terminator RecordField No. Example

H | @ ^ \ | 123 | | ACL TOP-02 | | | | LIS-HOST-01 | | P | 1394-97 | 20020421073718

P | 1 | | | | | | | | | |

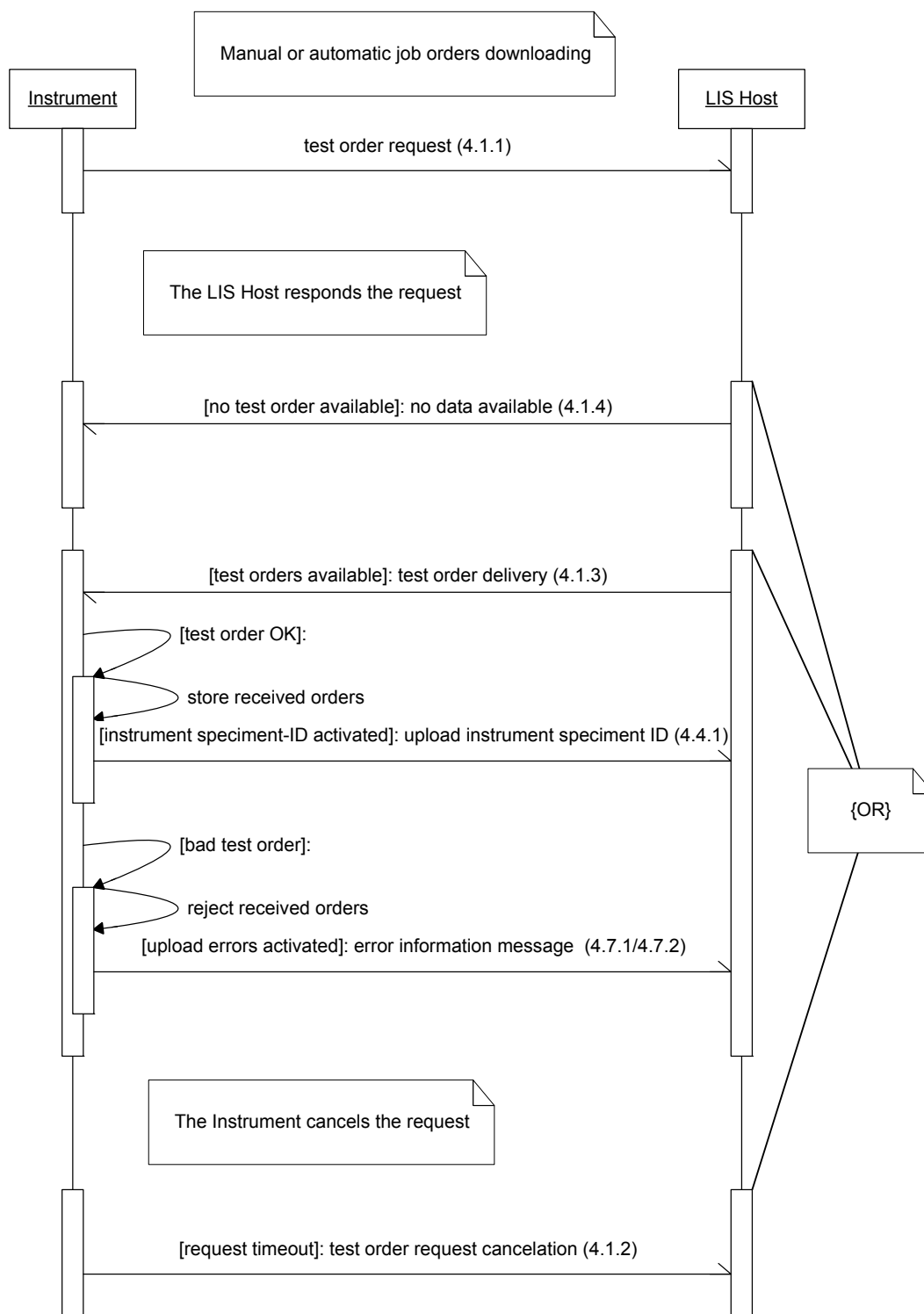
O | 1 | 8642 | | ^ ^ ^ 1234 | R | | | | | | | | | | P | | | | | | | | | | O @ Y

C | 1 | I | invalidTestData ^ duplicated test | N

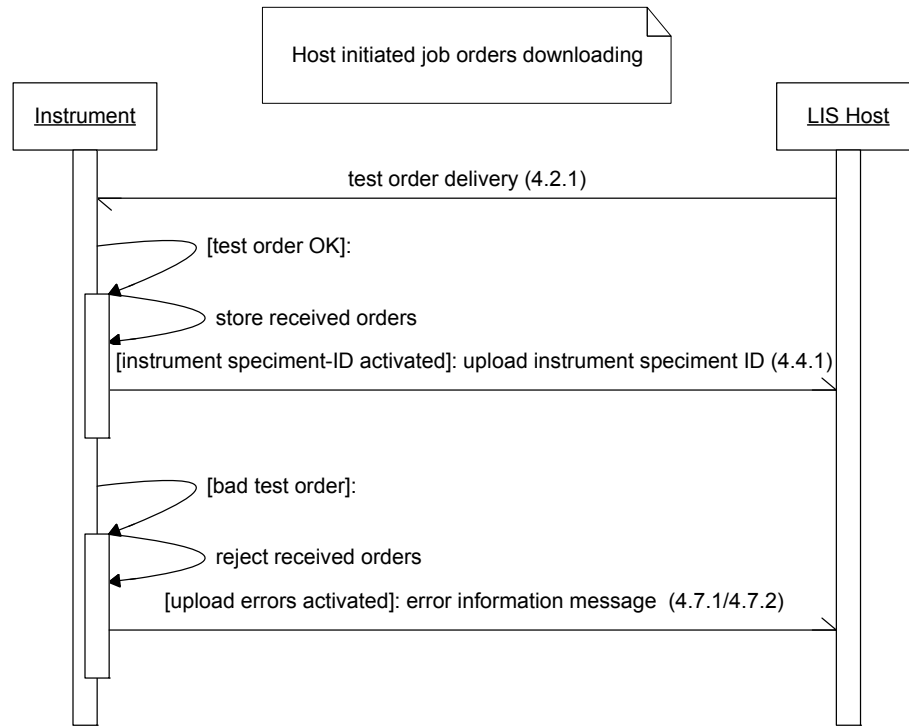
L | 1 | N

5. TRANSMISSION SCENARIOS RELATIONSHIPS

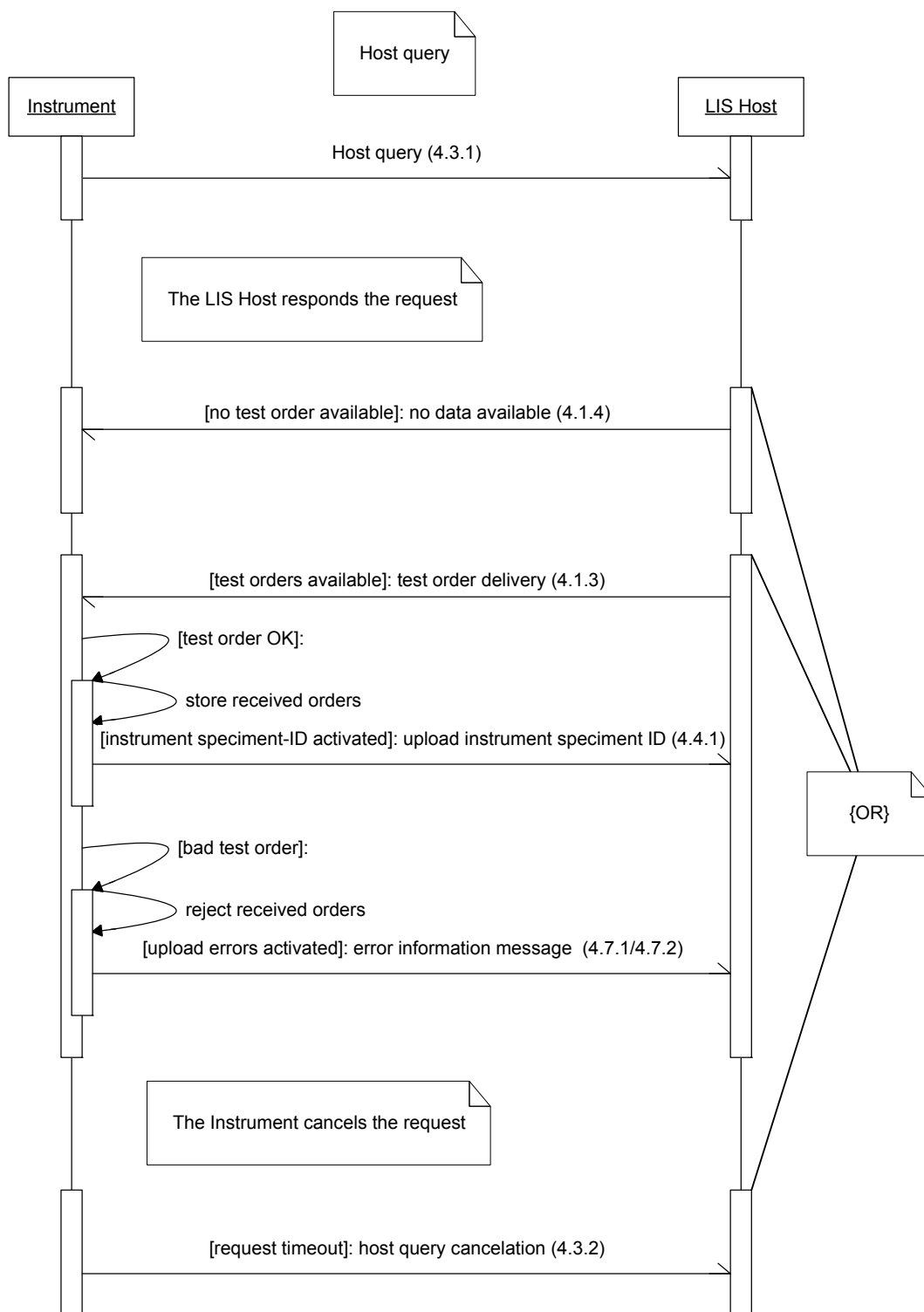
5.1 MANUAL OR AUTOMATIC JOB ORDERS DOWNLOADING



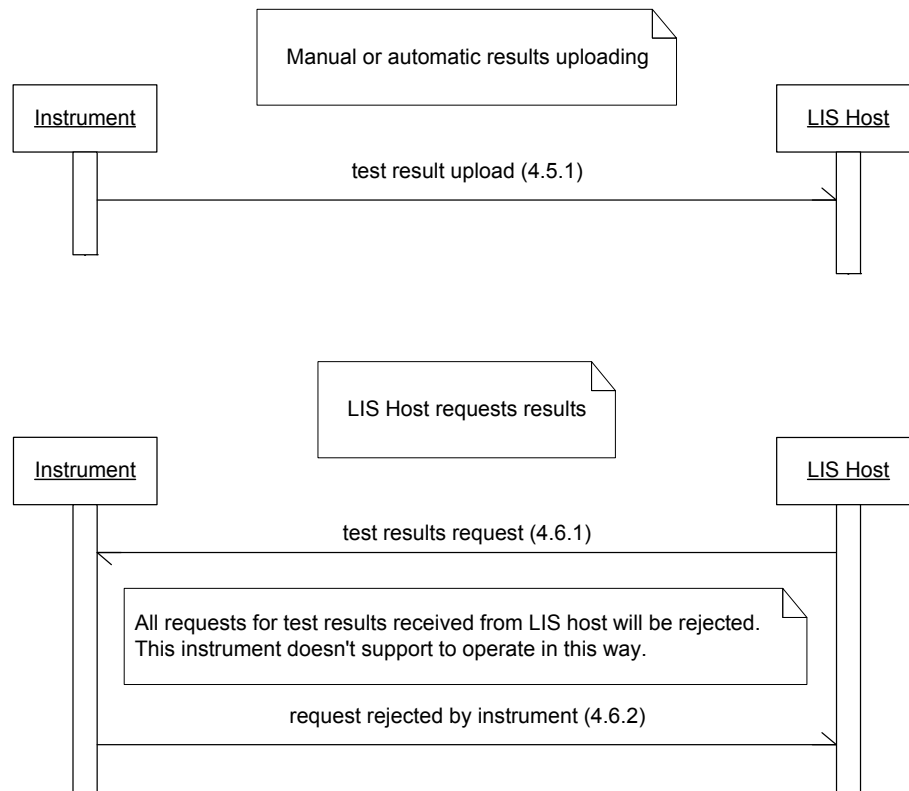
5.2 HOST-INITIATED JOB ORDERS DOWNLOADING



5.3 HOST QUERY



5.4 MANUAL OR AUTOMATIC JOB RESULTS UPLOADING



6. APPENDIX A – FUTURA COMPATIBILITY MODE

When the communication module for TOP was designed, it was thought to ease the communication for both new users, that can use a new protocol with extended capabilities, and old users who can reuse the old Futura developed driver. For any information of the Futura implementation see [R2].

The Futura driver should only be used by institutions that currently have a developed driver and can reuse it with the changes produced in this adapted version. New users should always use the new implementation of the protocol that provides more functionality.

The Futura driver for TOP works exactly as the Futura instrument except for the following issues:

GENERAL DIFFERENCES

- TOP uses the host query mechanism to request tests immediately when a rack is inserted in the instrument. Futura did not support this feature in its original version and it has been disabled in the new Futura driver implementation for TOP. To allow the Futura driver to work as originally, you have to activate the automatic downloading of test orders.
- The Futura documentation does not require LIS drivers to respond to all test orders requests by TOP. Due to that, when a request is not responded in Futura compatibility mode no error message is displayed.

DATA MAPPINGS

- Futura test IDs and TOP test IDs have changed. The communication will be performed using the new test IDs defined by TOP. Changes may be required in the LIS/driver to accommodate to these new identifiers.
- Futura result units and TOP result units have changed. Futura driver for TOP implements the required mapping to conform as much as possible to the original Futura units. Units not supported by Futura are sent in TOP original's format and the limitation of 6 digits detailed in the Futura documentation has been changed to 15 characters. These are the mappings performed by TOP in Futura mode:

	Top	Futura/ Advance	Comment
Measured	s	sec	
	Mean	Not supported	
	I	Not supported	
	%I	Not supported	
	D I	delta	"delta" for Delta Deriv. Algorithm
	I/min	ct/min	
	D %I	delta	
	%I/min	Not supported	
	mAbs	Not Supported	Used by Endpoint Algorithm - not available on Futura/ Advance
	D mAbs	mA delta	"mA" maps to Top Final - Initial Algorithm "delta" maps to Top Delta Derivative Algorithm. The use of the unit in this case is always mapped to "mA"
	mAbs/min	mA/min	
Calculated	Ratio	R	
	INR	INR	
	%	%	
Calibrated	g/L	g/L	
	mg/L	Not supported	
	mg/dL	mg/dL	
	ng/mL	ng/mL	
	U/mL	U/mL	
	IU/mL	IU/mL	
	mU/mL	Not supported	
	nmol/L	Not supported	
	%vWF:Ag	Not supported	
	User Defined	Not supported	
	Not supported	μM/L	equivalent to: nmol/l x 10 ³ (never sent by TOP in Futura mode)
	Not supported	μg/L	equivalent to: g/l x 10 ⁻⁶ (never sent by TOP in Futura mode)
Statistical	%CV	Not supported	
	SD	Not supported	
	Slope	Not supported	
Paired	IR	Not supported	
	%NTR	Not supported	
	D	Not supported	
	D N	Not supported	

Parallelism	mean of 100%	Not supported	In Futura, unit label corresponds to the Unit label selected by the user as primary unit.
	mean CR	aveCR	
	mean CR 100%	Not supported	
	slope	slope	
	r ²	Not supported	r equivalent to: $(r^2)^{1/2}$
	y-intercept	y-int	
	%CV of CR	%CV-CR	
	%CV of CR 100%	Not supported	

- Error descriptions have changed in TOP, but they will be sent using the old Futura format. Only one comment record with all flags and errors concatenated with a '+' sign. The number used to indicate the determination where the error was found has also been removed.

CHANGES IN MESSAGES

- Now the patient name and last name is now separated by a component delimiter (patient record field 6). In the original version of futura, the patient name and last name was stored in the first component.
- Specimen ID length has changed from 20 characters to 16. 16 is the maximum number of characters supported by the TOP device. In case the number of characters sent by the LIS is bigger than 16 the messages is rejected.
- When uploading test results Futura added the Rack ID and the Sample position in the field four in the ASTM Order record. This field now includes the same data but the Rack ID and Sample position has changed to the new values in TOP.
- Futura supported the uploading of calibrations and checkpoints. These features have been removed in TOP
- TOP is not capable to distinguish automatically validated and manually validated results. Futura did that sending an 'F' or an 'V' flag in R9 respectively. Due to that limitation in TOP, the driver of Futura always send results with an 'F' and 'V' is never used.

ERRORS

- Ill formed test orders messages downloaded from host are validated. If an error occurs in one message, no error information is sent to the HOST system. These are some of the actions performed:
- Fields with a maximum length longer than the value expected by TOP are truncated to the maximum length allowed.
- Invalid date in a record makes the complete record to be invalidated and error info is sent to the application. With the exemption of H14 which value won't be validated.
- Empty order date in O7 is filled with current date.
- Missing mandatory parameters are added when possible.

