HORIBA Medical

Yumizen H550

Hematology Analyzer

Output Format for Host Connection

Ref: RAA066AEN

Yumizen H550

Output Format for Host Connection

CE IVD

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Contents

1. Foreword

1.1. Revisions

Internal Reference	Software Version	Document Date Issued
RAA066AEN	1.0.x	May 2017

2. Connection

2.1. Serial Connection (RS232)

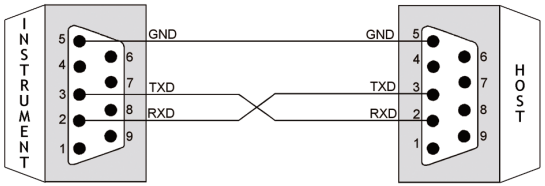
2.1.1. RS232 Connection Overview

The RS232 connection mode is available only for the ASTM format on the Yumizen H550.

Communications can use the RS232 communication protocol, based on the Electronics Industries Association (EIA) standard RS232-C. As part of the conformance to this standard, the Yumizen H550 Data Management System is configured as Data Terminal Equipment (DTE).

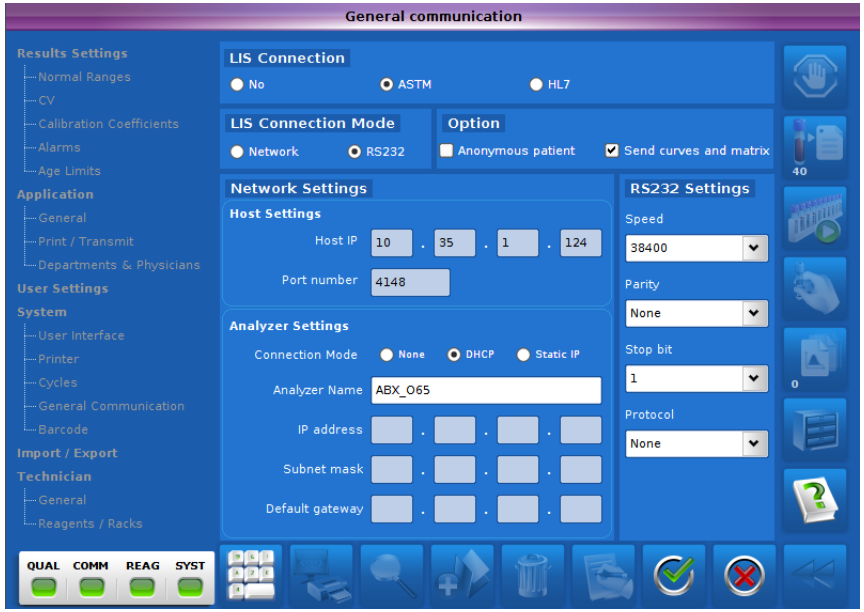
The Yumizen H550 should be connected to the LIS via the DB-9 connector of the instrument computer connection.

Pin (DB9) data management	LIS port configuration	LIS cable must provide
2	RXD	TXD
3	TXD	RXD
5	Ground	Ground



2.1.2. Instrument Connection

*Access: **Main Screen** > **Settings** > **General Communication***



Select **ASTM** in the ***LIS Connection*** area and select the **RS232** connection mode.

The instrument communication port must be set up in the ***RS232 Settings*** area:

- The speed value
- The parity value
- The stop bit value
- The protocol value

2.2. Ethernet Connection

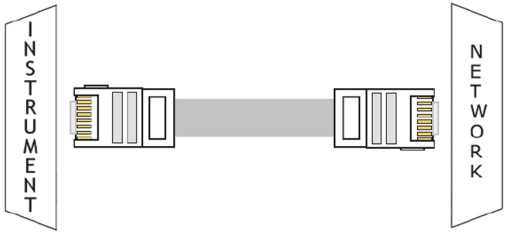
2.2.1. Ethernet Connection Overview

The network connection mode is available for the ASTM and HL7 formats on the Yumizen H550.

The implementation of network-based communication is based on the Windows Socket standard.

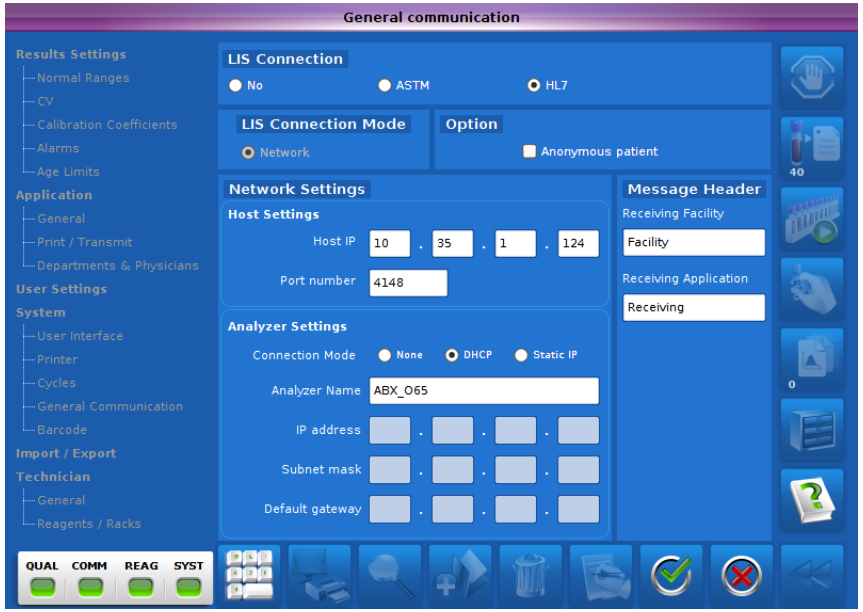
The data transmitted between the client and the server takes the form of ASTM or HL7 high level packets.

This connection is made through the RJ45 connector on the instrument.



2.2.2. Instrument Connection

*Access: **Main Screen** > **Settings** > **General Communication***



Select **ASTM** or **HL7** in the ***LIS Connection*** area and select the **Network** connection mode.

In the ***Host Settings*** area, you must indicate:

- The host IP address
- The port number where the host is awaiting connection

In the ***Analyzer Settings*** area, you must indicate:

- The connection mode
- The analyzer name
- The IP address
- The subnet mask
- The default gateway

If the HL7 format is used, you must also indicate:

- The receiving facility
- The receiving application

3. ASTM Format

The HORIBA Medical analyzers format corresponds to the ASTM specifications LIS01-A2 & LIS2-A2:

- LIS01-A2: Standard specification for low level protocol to transfer messages between clinical and laboratory instruments and computer systems.
- LIS2-A2: Standard specification for transferring information between clinical and laboratory instruments and computer systems.

3.1. Introduction

A connection between a computer (host) and a HORIBA Medical instrument can be performed when the protocol, the format description and the connection mode have been properly setup.

Term	Definition
<ACK>	Acknowledgment (ASCII decimal 6)
[C1]	The most significant character of checksum
[C2]	The least significant character of checksum
[DATA]	The data contents of the record
<ENQ>	Inquire (ASCII decimal 5)
<ETB>	End of transmission block (ASCII decimal 23). For use only when a single record is too large to fit into one frame.
<ETX>	End of text (ASCII decimal 3). Required at the end of each record.
[frame number]	Single digit frame number "0" to "7", starts with "1".
<LF>	Line feed (ASCII decimal 10).
<NAK>	Negative acknowledgment (ASCII Decimal 21).
<STX>	Start of frame (ASCII decimal 2).

Term	Definition
Communications packet	All framing required for transmission of data. This framing includes: <STX>[frame number][DATA] [<ETB> or <ETX>][C1][C2] <LF>
Component Field	One of several related pieces of information within a field.
Field	A specific location within a record for a piece of information, indicated by a field delimiter and position.
Frame	A complete communications packet.
LIS	Laboratory Information System
Message	A collection of related information; a group of records that begins with a "Header" record and ends with a "Terminator" record. A single record could theoretically constitute a message, but within this context, a message always contains multiple records.
<EOT>	End of transmission (ASCII decimal 4)
<CR>	Carriage return (ASCII decimal 13)
Record	In reference to the low level protocol, a record is the message data (shown as [DATA]) as described within the communications packet. If the data is longer than 240 characters, then it must be split in two (or more) parts and sent in two (or more) communications packets. The intermediate packet uses the <ETB> character, and the ending packet uses the <ETX> character. No single communications packet contains more than one record. In reference to the message layer, a record can be one of the following codes: H (header), P (patient), O (order), R (result), L (terminator), C (comment).
Session	A total unit of communication activity used in this standard to indicate the events starting with the establishment phase and ending with the termination phase.
Test	A determination of a single analyte or a combination of values from other determinations or observations from which a variable or gradable result is derived.

3.2. Connection Specifications (LIS01-A2)

3.2.1. Hardware and Software Characteristics

The default format for emitted character is 1 bit start, 8 data bits, No parity, 1 bit stop.

The default communication speed is 38400 bauds.

Hardware settings of the interface:

- RS232 connection via a DB9 connector
- Ethernet connection via an RJ45 cable

3.2.2. Output Data Characteristics

- Characters: ASCII
- Maximum message length: 247 characters
- Xon/Xoff protocol

3.2.3. Communication Protocol

Standard control characters

Control String	Hexadecimal value
<ENQ>	$05
<ACK>	$06
<NAK>	$15
<STX>	$02
<ETX>	$03
<ETB>	$17
<CR>	$0D
<LF>	$0A
<EOT>	$04

Typical discussion between the instrument and the host

Instrument	<>	Host
<ENQ>	>	
	<	<ACK>
<STX>1...Data...<CR><ETX>xx <CR><LF>	>	
	<	<ACK>
<STX>2...Data...<CR><ETX>xx <CR><LF>	>	
	<	<ACK>
<EOT>	>	

Typical discussion between the host and the instrument

Instrument	<>	Host
	<	<ENQ>
<ACK>	>	
	<	<STX>1...Data...<CR><ETX>xx <CR><LF>
<ACK>	>	
	<	<STX>2...Data...<CR><ETX>xx <CR><LF>
<ACK>	>	
	<	<EOT>

Discussion with conflict between the instrument and the host

No answer from Host for an <ENQ>

- Timeout: 15 seconds
- In case of conflict: 1 second before a new transmission, up to 3 transmissions. Host timeout: 20 seconds
- In case of negative answer <NAK>: No time before a new transmission, up to 6 transmissions

Instrument	<>	Host
<ENQ>	>	
	<	<ENQ>
Wait 1 second		Wait 20 seconds
<ENQ>	>	
	<	
	...	
<EOT>	>	

Defect packet during discussion between instrument and host

Instrument	<>	Host
<ENQ>	>	
	<	<ACK>
<STX>1...Data...<CR><ETX>xx <CR><LF>	>	
	<	<NAK>
<STX>1...Data...<CR><ETX>xx <CR><LF>	>	
	<	<ACK>
<STX>2...Data...<CR><ETX>xx <CR><LF>	>	
	<	<ACK>
<EOT>	>	

3.2.4. ASTM Data Frame Format

A sequential number located after the <STX> character is inserted into each data frame. The frame number is set to 1 when the transfer phase is initialized and is incremented by 1 for each frame up to 7 and then returns to 0.

The frame number allows the receiver to distinguish new and re-transmitted frames. In case of re-transmitted frame (after a <NAK> response from the host), the frame number is not incremented: <STX>1...Data...<CR><ETX>xx<CR><LF>.

Frame format

ASTM field	Definition	Transmitted data	# of bytes	Comments
0	STX	$02	1	
1	Frame number	1 to 7, 0, ...	1	Frame number is set to 1, incremented by 1 for each frame up to 7, and then returns to 0
2	Data message		240 max.	Header, Patient, Order, Result and Comment messages
3	End of data message ETX if end frame		1	
4	Checksum		2	
5	CRLF	$0D $0A	2	

Frame checksum

According to LIS01-A2, the frame checksum (<STX>1...Data...<CR><ETX>xx<CR><LF>) is defined as modulo 256 of ASCII values sum between <STX> not included and <ETX> included characters: 1...Data...<CR><ETX>.

3.3. Records General Format Specifications (LIS2-A2)

Data frames encapsulate records defined by the LIS-A2 norm, records themselves encapsulate ASTM fields.

Record ID	ASTM Definition
H	Header
P	Patient
O	Order
R	Result
C	Comment
Q	Query (Request information order)
M	Manufacturer information
L	Terminator record

3.3.1. Structure of Records

Structure of records for order transmission

- H (Header)
- P (Patient)
- C (Patient Comments) optional
- .. O (Order)
- .. C (Order Comments) optional
- L (Terminator)

The transmission of an order without patient record, even if not allowed in LIS2-A2, is accepted and managed in the Yumizen H550.

Instrument patient file modification by host

- H (Header)
- P (Patient)
- C (Patient Comments) optional
- L (Terminator)

Structure of records for result transmission

- H (Header)
- P (Patient)
- C (Patient Comments) optional
- .. O (Order)
- .. C (Order Comments) optional
- .. M (Curves and Matrix points)
- .. M (Curves and Matrix points)
- ... . R (Result)
- ... . C (Flag Result) optional
- ... . R (Result)
- ... . C (Flag Result) optional
- .....
- .....
- ... . R (Result)
- ... . C (Flag Result) optional
- L (Terminator)

3.3.2. Description of Records

Only fields described with their specified length are used by HORIBA Medical instruments.

The length of a field can be less than the maximum value but must not be more.

Delimiters must be used even if a field is empty.

Field inside records are separated by "|" (ASCII $7C).

Component inside fields are separated by "^" (ASCII $5E).

Repeated fields inside records are separated by "\" .

3.3.2.1. Alphanumeric Data

UTF-8 encoding is used for alphanumeric fields.

When alphanumeric data is sent, all the characters below 0x20 are replaced by an escape sequence with the following format: &Xhhh&.

"hhhh" is the hexadecimal value of ASCII character completed with zero on 4 digits.

For example, <ETB> should be replaced by: <&X0017&>.

When alphanumeric data is received, the escape sequence &Xhhhh& is converted to the corresponding characters.

When alphanumeric data is transmitted, all delimiters characters they can contain must be replaced by their corresponding escape sequence as below:

Delimeter	Escape sequence
Field delimiter	&F&
Component delimiter	&S&
Repeat delimiter	&R&
Escape delimiter	&E&

3.3.2.2. Records to Send

Fields that are not used are sent empty.

When sending records, the ASTM-CI sends only non-empty components, ie. without component delimiters for the last empty components of the field.

3.3.2.3. Received Records

If a field value, length, delimiter of a received record does not correspond to the required input type, the instrument generates an error log, and can ignore the record and its following ones (depending on the error and the message).

Received records high level errors

Message	Definition
HL_UNEXPECTED_RECORD_ERROR	An unexpected (at wrong place in the frame) record has been received and ignored
HL_NOT_MANAGED_RECORD_ERROR	A record not managable has been received and ignored
HL_IGNORED_RECORD_ERROR	A record has been ignored (following a previous error)
HL_BYPASSED_RECORD_ERROR	A record of upper level has been ignored (following a previous error)
HL_TERMINATOR_MISSING_ERROR	The Terminator record of a message is missing
HL_INVALID_ORDER_RECORD_ERROR	Order in response to a query is invalid, record ignored
HL_FIELD_LENGTH_ERROR	Invalid field length, field truncated or record ignored
HL_FIELD_REPEAT_DELIMITER_ERROR	Not allowed field repeat delimiter, record ignored
HL_FIELD_COMPONENT_DELIMITER_ERROR	Not allowed field component delimiter, field truncated

Received records low level errors

Message	Definition
LL_ENQ_ERROR	Establishment phase conflict ENQ - ENQ
LL_NAK_ERROR	NAK control character received from host
LL_FRAME_STRUCT_ERROR	Invalid frame structure
LL_LENGTH_ERROR	Invalid frame length
LL_FRAME_NUMBER_ERROR	Invalid frame number
LL_CHECKSUM_ERROR	Invalid frame checksum
LL_UNEXPECTED_CTRL_ERROR	Invalid control character received while expecting a specific one inside a set
LL_RESPONSE_TIMEOUT_ERROR	Timeout occurs while expecting a control character from host
LL_FRAME_TIMEOUT_ERROR	Timeout occurs while expecting a data frame or a frame control character (EOT) from host

Other ASTM errors managed by the instrument

Message	Definition
H01	ASTM PROTOCOL ERROR ORDER
H02	ASTM CONTEXTUAL ERROR ORDER
H03	ASTM CONNECTION ERROR

3.3.2.4. Header Record

ASTM field	Definition	Transmitted data	Field max. length	Input type	Repeat delimiter	Mandatory
6.1	Record Type	H	1	Fixed	No	Yes
6.2	Delimiters definition	idem standard: ■ | field delimiter ■ \ Repeat delimiter ■ ^ Component delimiter ■ & Escape delimiter	4	Text	No	Yes
6.3	Message Control ID					
6.4	Access Password					
6.5	Sender Name (from instrument to host)	H500^SerialNumber^Software version	42 (15^15^10)	Fixed^Alphanumeric^Fixed	No	Yes
6.5	Sender Name (from host to instrument)	Host name	32	Alphanumeric	No	No
6.6	Sender Address					
6.7	Reserved					
6.8	Sender Telephone Nb					
6.9	Characteristics of Sender					
6.10	Receiver ID (from instrument to host)	Host name	32	Alphanumeric	No	No
6.10	Receiver ID (from host to instrument)	InstrumentCode^SerialNumber^Software version	42 (15^15^10)	Alphanumeric^Alphanumeric^Alphanumeric	No	No
6.11	Comments or Special Instructions					
6.12	Processing ID	P: Patient message Q: Quality control message D: Technician	1	Fixed list	No	Yes
6.13	ASTM Version Nb	LIS2-A2	9	Fixed	No	Yes
6.14	Date and Time of message	YYYYMMDDHHMMSS	14	Date and time	No	No

There should not be the field delimiter between 6.1 and 6.2 fields (as it is in the 6.2 field value).

In case of a response to a request (query, ...), the field 6.5 should be an exact copy from the 6.10 field sent in the request.

3.3.2.5. Patient Record

ASTM field	Definition	Transmitted data	Field max. length	Input type	Repeat delimiter	Mandatory
7.1	Record Type	P	1	Fixed	No	Yes
7.2	Sequence Nb	1, 2, ...	2	Numeric	No	Yes

ASTM field	Definition	Transmitted data	Field max. length	Input type	Repeat delimiter	Mandatory
7.3	Practice Assigned Patient ID					
7.4	Laboratory Assigned Patient ID	Patient Id	25	Alphanumeric	No	No
7.5	Patient ID No 3					
7.6	Patient Name This field is not transmitted if the **Anonymous patient** check box is selected in the ***General Communica*** screen.	Name^First name	41 (20^20)	Alphanumeric	No	No
7.7	Mother's Maiden Name					
7.8	Birth date	YYYYMMDD^AGE^U ■ YYYYMMDD: Date of birth- ■ AGE: Patient age ■ U: Unit of Age (Y,M or D for Year, Month or Day)	14 (8^3^1)	Date^Numeric^ Fixed List	No	No
7.9	Patient Sex	M = Male F = Female U = Unknown	1	Fixed list	No	No
7.10	Patient Race-Ethnic Origin					
7.11	Patient Address					
7.12	Reserved					
7.13	Patient Telephone Nb					
7.14	Attending Physician ID	PhysicianID^PhysicianName	20	Alphanumeric^ Alphanumeric	No	No^No
7.15	Special Field 1					
7.16	Special Field 2					
7.17	Patient Height					
7.18	Patient Weight					
7.19	Patient's Known or Suspected Diagnosis					
7.20	Patient Active Medication					
7.21	Patient's Diet					
7.22	Practice Field 1					
7.23	Practice Field 2					
7.24	Admission and Discharge Dates					
7.25	Admission Status					
7.26	Location			Alphanumeric Max length: 20	No	No
7.27	Nature of Alternative Diagnostic Code and Classifiers					
7.28	Nature of Alternative Diagnostic Code and Classifiers					
7.29	Patient Religion					
7.30	Martial status					
7.31	Isolation Status					
7.32	Language					
7.33	Hospital Service					

ASTM field	Definition	Transmitted data	Field max. length	Input type	Repeat delimiter	Mandatory
7.34	Hospital Institution					
7.35	Dosage Category			Alphanumeric CHILD1, CHILD2, CHILD3, CHILD4, CHILD5 Max length: 20	No	No

3.3.2.6. Order Record

ASTM field	Definition	Transmitted data	Field max. length	Input type	Repeat delimiter	Mandatory
8.1	Record Type	O	1	Fixed	No	Yes
8.2	Sequence Nb	1, 2, ...	2	Numeric	No	Yes
8.3	Sample ID	ABC123456	16	Alphanumeric	No	No
8.4	Instrument Specimen ID					
8.5	Universal Test ID	^^^Testname (CBC or DIF)	6 (^^^3)	Fixed list	Yes	From instrument to host: yes From host to instrument: no
8.6	Priority	R: routine S: STAT	1	Fixed list	No	No
8.7	Requested/Ordered Date and Time	YYYYMMDDH HMMSS	14	Date and time	No	No
8.8	Specimen Collection Date and Time	YYYYMMDDH HMMSS	14	Date and time	No	No
8.9	Collection End Time	YYYYMMDDH HMMSS	14			
8.10	Collection Volume					
8.11	Collector ID					
8.12	Action Code	From instrument to host: not used From host to instrument: A: add on existing order N: new order C: cancel order	1	Fixed list	No	From instrument to host: no From host to instrument: yes
8.13	Danger Code					
8.14	Relevant Clinical Information					
8.15	Date/Time Specimen Received	YYYYMMDDH HMMSS	14	Date and time	No	No
8.16	Specimen Descriptor	SpecimenType ^^SpecimenLiquid SpecimenType: ■ Blood ■ CTRL low ■ CTRL medium ■ CTRL high	26(12^^12)	Fixed list^^Alphanumeric	No	No^^No
8.17	Ordering Physician					
8.18	Physician Tel Nb					
8.19	User Field 1					
8.20	User Field 2					
8.21	Laboratory Field 1					
8.22	Laboratory Field 2					

ASTM field	Definition	Transmitted data	Field max. length	Input type	Repeat delimiter	Mandatory
8.23	Date and Time Results reported or last modified					
8.24	Instrument Charge to Computer System					
8.25	Instrument Section ID					
8.26	Report Types	From instrument to host: F: final X: order cannot be done From host to instrument: Q: response to request information Z: no record for this patient Y: no test for this record	1	Fixed list	No	Yes
8.27	Reserved					
8.28	Location or Ward of Specimen Collection					
8.29	Nosocomial Infection Flag					
8.30	Specimen Service					
8.31	Specimen institution					

The order must follow the following conditions, otherwise, the received order is ignored:

- Sample ID data of Specimen ID field (8.3) match the Sample ID data of the pending query
- At least one of Universal Test ID field (8.5) shall contain a TestName data
- In case of several Universal Test ID field (8.5), with at least one with a "DIF" TestName, and at least another one with a "CBC" TestName, the requested analysis is set to DIF
- Action code field (8.12) is "N" (New order)
- Report Types field from Host (8.26) is one of the following values: Q, Z, Y

If a received order contains a Universal Test ID (field 8.5) with a TestName different from CBC or DIF, the Yumizen H550 will send back the order with the record type field set to "X" and the received order will be ignored.

3.3.2.7. Result Record

ASTM field	Definition	Transmitted data	Field max. length	Input type	Repeat delimiter	Mandatory
9.1	Record Type	R	1	Fixed	No	Yes
9.2	Sequence Nb	1, 2, ...	2	Numeric	No	Yes
9.3	Universal Test ID	^^^English result name^LOINC^Dil LOINC: From instrument to host: code associated with the result frame, if available From host to instrument: not used Dil: Dilution factor (denominator)	22(^^^5 ^7^5)	^^^Open list^Open list^Numeric	No	^^^Yes^No^No
9.4	Data or Measurement Value	Test result or --,--	16	Alphanumeric	No	No

ASTM field	Definition	Transmitted data	Field max. length	Input type	Repeat delimiter	Mandatory
9.5	Unit or Set of units	Unit text (ISO 2955 or specific)	10	Open list	No	Yes but No if observation
9.6	Reference Range	From instrument to host: low range to high range From host to instrument: not used		Alphanumeric	Yes	No
9.7	Result Abnormal Flag	From instrument to host: L: below low normal H: above high normal LL: below panic normal HH: above panic normal <: below absolute low >: above absolute high N: normal From host to instrument: not used		Fixed list	No	Yes
9.8	Nature of Abnormality Testing					
9.9	Result Status	From instrument to host: W: warning (suspicion on validity) X: order cannot be done (result) F: final result From host to instrument: not used	1	Fixed list	No	Yes
9.10	Date of Change in Normative Values or Units					
9.11	Operator Identification	From instrument to host: Login^^User profile or LastName FirstName^^User profile User profile: TECHNICIAN / LABMANAGER / USER From host to instrument: not used	63(41^^ 20)	Alphanumeric ^^ Alphanumeric	No	Yes
9.12	Date/Time Test Starting	YYYYMMDDHHM MSS	14	Date	No	Yes
9.13	Date/Time Test Completed	YYYYMMDDHHM MSS	14	Date	No	No
9.14	Device Identification	From instrument to host: 9380BDED579C From host to instrument: not used	15	Alphanumeric	No	No

3.3.2.8. Comment Record

ASTM field	Definition	Transmitted data	Field max. length	Input type	Repeat delimiter	Mandatory
10.1	Record Type	C	1	Fixed	No	Yes
10.2	Sequence Nb	1, 2, ...	2	Numeric	No	Yes
10.3	Comment Source	I clinical instrument system	1	Fixed list	No	Yes
10.4	Comment Text	From instrument to host: For result comment (after R frame): alarm For order comment (after O frame): AlarmType^MeasurementType^Alarm For patient comment or sample comment (after P or O frame): Free text From host to instrument: comments	100	From instrument to host: open list Open list^Open list^Open list From host to instrument: alphanumeric	From instrument to host: Yes From host to instrument: No	Yes Yes^No^Yes Yes
10.5	Comment Type	I: Instrument flag comment	1	Fixed list	No	Yes

Alarms specifications

The Comment Text (10.4) field can contain an alarm type data as follows:

- **CONDITIONS** for alarms linked to analysis conditions such as blank failed, reagent expired, …
- **NON_COMPLIANT_DATA** for alarms linked to the calculation regarding data such as Background noise, Unstable Count, Abnormal differentiation.
- **SUSPECTED_PATHOLOGY** for suspected pathologies alarms such as Leukocytosis or Large Immature Cells.
- **CONTROL_FAILED** for alarms due to bad control result.

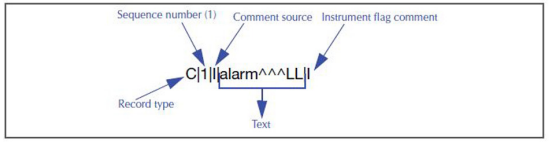
The Comment Text (10.4) field can contain a measurement type data as follows:

- **HGB** if the alarm is linked to the hemoglobin measurement.
- **WBC** if the alarm is linked to the white blood cells measurement.
- **RBC** if the alarm is linked to the red blood cells measurement.
- **PLT** if the alarm is linked to the platelets measurement.
- **RBC/PLT** if the alarm is linked to RBC and PLT measurement such as MCH.

The Comment Text (10.4) field can contain an alarm data as follows:

- One of the analytical alarms values specified in Analytical Alarms in case of **NON_COMPLIANT_DATA** or **SUSPECTED_PATHOLOGY** alarm type, truncated to 19 characters.
- The default condition in case of **CONDITIONS** alarm type, truncated to 20 characters.
- The reason of the control failure in case of **CONTROL_FAILED** alarm type, truncated to 20 characters.

An analysis alarms comment record is structured as follows:



3.3.2.9. Request Information Record

ASTM field	Definition	Transmitted data	Field max. length	Input type	Repeat delimiter	Mandatory
11.1	Record type ID	Q	1	Fixed	No	Yes
11.2	Sequence number	1..99	2	Numeric	No	Yes
11.3	Starting Range ID Number	^SampleID	17(^16)	^Alphanumeric ^^^^	No	^Yes^^
11.4	End Of identifier List					
11.5	Universal Test ID	ALL	3	Fixed	No	Yes
11.6	Time limits					
11.7	Time Max limits					
11.8	Time Min limits					
11.9	Physician Name					
11.10	Telephone Number					
11.11	Reserved for User					
11.12	Reserved for User					
11.13	Request Information Status Codes	O: request for test information	1	Fixed	No	Yes

3.3.2.10. Traceability record

ASTM field	Definition	Transmitted data	Field max. length	Input type	Repeat delimiter	Mandatory
14.1	Record type	M	1	Fixed	No	Yes
14.2	Sequence number	1..99	2	Numeric	No	Yes
14.3	Message type	"REAGENTS"	10	Closed list	No	Yes
14.4	Traceability name	Reagent name: CLEANER, DILUENT, LYSE	20	Open list	Yes	Yes
14.5	Traceability Information	120130H1*^20 120327151737 ^20120727	33 (9^14^8)	Alpha-numeric^Date and Time^Date Open list Alphanumeric	Yes Yes Yes	Yes^No^Yes Yes Yes

3.3.2.11. Terminal record

ASTM field	Definition	Transmitted data	Field max. length	Input type	Repeat delimiter	Mandatory
12.1	Record type	L	1	Fixed	No	Yes
12.2	Sequence number	1	1	Fixed	No	Yes
12.3	Termination code	N: Normal	1	From instrument to host: fixed From host to instrument: not used	From instrument to host: No From host to instrument : not used	From instrument to host: Yes From host to instrument: not used

3.4. Special characteristics for HORIBA Medical data

3.4.1. Data Presentation

The CBC code corresponds to the universal test ID field 9.3 and the units correspond to the units field 9.5.

Parameters	CBC Code	Conventional	SI (international)	mmol/L	Japan
White Blood Cell	**WBC**	$10^3/\mu L$	$10^9/L$	$10^9/L$	$10^2/\mu L$
Red Blood Cell	**RBC**	$10^6/\mu L$	$10^{12}/L$	$10^{12}/L$	$10^4/\mu L$
Hemoglobin	**HGB**	g/dL	g/L	mmol/L	g/dL
Hematocrit	**HCT**	%	L/L	L/L	%
Mean Corpuscular Volume	**MCV**	μm^3	fL	fL	fL
Mean Corpuscular Hemoglobin	**MCH**	pg	pg	fmol	pg
Mean Corpuscular Hemoglobin Concentration	**MCHC**	g/dL	g/L	mmol/L	g/dL
Red Distribution Width	**RDW-CV**	%	%	%	%
Red Distribution Width Standard Deviation	**RDW-SD** *	μm^3	fL	fL	μm^3
Platelets	**PLT**	$10^3/\mu L$	$10^9/L$	$10^9/L$	$10^4/\mu L$
Platelet Distribution Width	**PDW** *	μm^3	fL	fL	μm^3
Plateletcrit	**PCT** *	%	L/L	L/L	%
Platelets - Large Cell Count	**P-LCC** *	$10^3/\mu L$	$10^9/L$	$10^9/L$	$10^4/\mu L$
Platelets - Large Cell Ratio Calculation	**P-LCR** *	%	%	%	%
Mean Platelet Volume	**MPV**	μm^3	fL	fL	fL

Parameters	DIFF Code	Conventional	SI (international)	mmol/L	Japan
Lymphocytes #	**LYM#**	$10^3/\mu L$	$10^9/L$	$10^9/L$	$10^2/\mu L$
Lymphocytes %	**LYM%**	%	%	%	%
Monocytes #	**MON#**	$10^3/\mu L$	$10^9/L$	$10^9/L$	$10^2/\mu L$
Monocytes %	**MON%**	%	%	%	%
Neutrophils #	**NEU#**	$10^3/\mu L$	$10^9/L$	$10^9/L$	$10^2/\mu L$
Neutrophils %	**NEU%**	%	%	%	%
Eosinophils #	**EOS#**	$10^3/\mu L$	$10^9/L$	$10^9/L$	$10^2/\mu L$
Eosinophils %	**EOS%**	%	%	%	%
Basophils #	**BAS#**	$10^3/\mu L$	$10^9/L$	$10^9/L$	$10^2/\mu L$
Basophils %	**BAS%**	%	%	%	%
Large Immature Cells #	**LIC#** *	$10^3/\mu L$	$10^9/L$	$10^9/L$	$10^2/\mu L$
Large Immature Cells %	**LIC%** *	%	%	%	%

* USA only: PDW, PCT, P-LCC, P-LCR, RDW-SD, LIC# and LIC% have not been validated for a clinical diagnostic use in USA for this instrument.

3.4.2. Alarms and Pathologies

3.4.2.1. Suspicion and Reject

When a result is suspected of being abnormal or false, it is not reliable and the instrument returns a flag in field 10.1.9.

Refer to Description of Records.

3.4.2.2. Normal and Panic ranges

Flags when result exceeds normal or panic ranges are transmitted through field 10.1.7, they should be compared, to obtain a full result information, to the ranges set by the user.

Refer to Description of Records.

3.4.2.3. Analytical Alarms

Measurement type	Transmitted data	Description
HGB	BLK_OUT_OF_RANGE	Blank out of range
HGB	HGB_INSTABILITY	Ten consecutive HGB measurements are not enough consistent to provide a reliable result.
HGB	BLANK_INSTABILITY	The two consecutive HGB blank measurements results are out of a reliable range.
HGB	OUT_OF_LINEARITY_RA	HGB measurement out of linearity range
WBC	NOISE	Background noise
WBC	LL_OR_LL1_INTERFERE	LYM Interference
WBC	MON_INTERFERENCE	MON Interference
WBC	ABNORMAL_DIFFERENTIATI	Abnormal differentiation
WBC	ABNORMAL_DIFFERENTIATI	Low WBC correlation between optical ans resistive measurements
WBC	LMNE_OUT_OF_LINEARI	Out of linearity range
WBC	LIGHT_SHIFT	Optical bench light error
WBC	ZERO_COUNTING	No count
WBC	COUNTING_INSTABILITY	Unstable Count
WBC	HCT_OUT_OF_LINEARIT	HCT out of linearity range
RBC	ZERO_COUNTING	No count
RBC	BIG CELLS EXCESS	Nucleated cells interference
RBC	RBC_DBL	RBC double population
RBC	RBC_COUNT_TOO_LOW	Low Count
RBC	RBC_OUT_OF_LINEARIT	Out of linearity range
RBC	ABNORMAL_MCH	Abnormal MCH
RBC	ABNORMAL_MCHC	Abnormal MCHC
RBC	COUNTING_INSTABILITY	Unstable Count
PLT	SEP_RBC_PLT	RBC PLT Interference
PLT	PLT_COUNT_TOO_LOW	Low Count
PLT	ZERO_COUNTING	No count
PLT	PLT_OUT_OF_LINEARIT	Out of linearity range
PLT	COUNTING_INSTABILITY	Unstable Count
PLT	NOISE	Background noise
PLT	PC_MODE	PLT Concentrate Mode

Transmitted suspected pathologies list:

- Erythrocytosis
- Pancytopenia
- Anemia
- Dbl pop suspicion
- Microcytosis
- Macrocytosis
- Hypochromia
- Anisocytosis
- Poikilocytosis
- Cold Agglutinin
- Thrombocytosis
- Thrombocytopenia
- Macroplatelets
- Platelet Aggregates
- ERB

- Platelet Aggregates or ERB
- Leukocytosis
- Leukopenia
- Lymphocytosis
- Lymphopenia
- Neutrophilia
- Neutropenia
- Eosinophilia
- Monocytosis
- Basophilia
- Large Immature Cells
- Left Shift
- Extrem Neutropenia
- Atypic Lymphocytes

3.5. Curves and Matrix Transmission

3.5.1. Curves and Matrix

ASTM field	Definition	Transmitted data	Field max. length	Input type	Repeat delimiter	Mandatory
14.1	Record type	M	1	Fixed	No	Yes
14.2	Sequence number	1..99	2	Numeric	No	Yes
14.3	Message type	"HISTOGRAMS" "MATRIX"	10	Closed list	No	Yes
14.4	Measurement type	"RBC" "PLT" "WBC" "LMNE"	10	Open list	No	Yes
14.5	Name	Graphic name	20	Alphanumeric	No	Yes
14.6	Thresholds	Encode Type^Threshold data "FLOATLE-stream/ deflate:base64"		Alphanumeric^ Alphanumeric	Yes	No^Yes
14.7	Points	Encode Type^Graphic data		Alphanumeric^ Alphanumeric	Yes	No^Yes

3.5.2. General Decoding

The image data must be uncompressed using first the *base64* and secondly the *deflate* algorithms.

The data must be converted from binary to text format.

3.5.3. LMNE Matrix

Matrix manufacturer message record is as follows:

- The Message type field (14.3) is set to "MATRIX".
- The Measurement type field (14.4) is set to "LMNE".
- The Name field (14.5) is set to "LMNEResAbs".
- The Thresholds field (14.6) contains the "Encode Type" data. The Threshold data of Thresholds field (14.6) contains the FLOATLE-stream/deflate:base64 coded value of the LMNEB Matrix polygons.
- The Points field (14.7) contains the "Encode Type" data. The Graphic data of Points field (14.7) contains the FLOATLE-stream/deflate:base64 coded value of the LMNE Matrix.

Matrix thresholds

LMNEB Matrix polygons thresholds data shall be in accordance with the following framing:

Number of bytes	Data	Format	Meaning
4	X display min	FLOATLE FLOATLE : IEEE 754 floating point value transmitted in Little Endian byte order (Intel)	X min value for Matrix start
4	X display max	FLOATLE	X max value for Matrix end
4	Y display min	FLOATLE	Y min value for Matrix start
4	Y display max	FLOATLE	Y max value for Matrix end
4	NumberOfList = 3	FLOATLE	One list for X coordinates of polygons, one list for Y coordinates of polygons, one list for box identifiers
4	ListLength	FLOATLE	Always 0

As matrix thresholds are never displayed nor printed, matrix thresholds must not be sent too (ListLength = 0).

Matrix points

LMNEB Matrix shall be in accordance with the following framing:

Number of bytes	Data	Format	Meaning
4	X display min	FLOATLE	X min value for Matrix start
4	X display max	FLOATLE	X max value for Matrix end
4	Y display min	FLOATLE	Y min value for Matrix start
4	Y display max	FLOATLE	Y max value for Matrix start
4	X scale NB	FLOATLE	Number of X ticks in the list to display
4 x X scale NB	X scale	FLOATLE	X tick values
4 x X scale NB	Y scale	FLOATLE	Y tick values
4	NumberOfList = 4	FLOATLE	One list for X points, one list for Y points, one list for the number of points for this coordinate, one list for the population to which the point belongs (X, Y coordinates)
4	ListLength	FLOATLE	Number of elements in the list
4 x ListLength	X	FLOATLE	X (Coordinate)
4 x ListLength	Y	FLOATLE	Y (Coordinate)
4 x ListLength	Qty	FLOATLE	Quantity (number of points for the (X, Y) coordinate)
4 x ListLength	Pop	FLOATLE	Population to witch the point (X, Y coordinates) belongs

PopulationID shall be set to:

- 0 for LYM box
- 1 for MON box
- 2 for NEU box
- 3 for EOS box
- 4 for LIC box
- 5 for ALY box
- 6 for LL box
- 7 for RN box
- 8 for RM box
- 11 for BNL box
- 12 for BNH box
- 13 for LN box
- 14 for BASO box

3.5.4. Histograms

Histogram manufacturer message record shall be in accordance with the following specifications:

- The Message type field (14.3) is set to "HISTOGRAM".
- The "Measurement type" field (14.4) is set to one of the following values: RBC/PLT or WBC.
- The Name field (14.5) is set to one of the following values: RbcAlongRes, PltAlongRes, WbcAlongRes.
- The Thresholds field (14.6) contains the "Encode Type" data. The Threshold data of Thresholds field (14.6) contains one of the following FLOATLE-stream/deflate:base64 coded value of: RbcAlongRes thresholds, PltAlongRes thresholds or WbcAlongRes thresholds.
- The Points field (14.7) contains the "Encode Type" data. The Graphic data of Points field (14.7) contains one of the following FLOATLE-stream/deflate:base64 coded value of: RbcAlongRes data, PltAlongRes data or WbcAlongRes data.

Histogram points

PLT histogram, RBC histogram and WBC histogram data shall be in accordance with the following framing:

Number of bytes	Data	Format	Meaning
4	X display min	FLOATLE	X min value for Histogram start
4	X display max	FLOATLE	X max value for Histogram end
4	Y display min	FLOATLE	Y min value for Histogram start
4	Y display max	FLOATLE	Y max value for Histogram end
4	X scale NB	FLOATLE	Number of X ticks in the list to display
4 x X scale NB	X scale	FLOATLE	X tick values
4	Y scale NB	FLOATLE	Number of Y ticks in the list to display
4 x X scale NB	Y scale	FLOATLE	Y tick values
4	NumberOfList = 2	FLOATLE	Number of list of data. One list for X positions and one list for the Y positions (quantity on each X position)
4	ListLength	FLOATLE	Number of elements in the list
4 x ListLength	X	FLOATLE	X (Coordinate)
4 x ListLength	Y	FLOATLE	Y (Coordinate)

Histogram thresholds

PLT histogram, RBC histogram and WBC histogram data shall be in accordance with the following framing:

Number of bytes	Data	Format	Meaning
4	X display min	FLOATLE	X min value for Histogram start
4	X display max	FLOATLE	X max value for Histogram end
4	Y display min	FLOATLE	Y min value for Histogram start
4	Y display max	FLOATLE	Y max value for Histogram end
4	NumberOfList = 2	FLOATLE	Number of list of thresholds. One list for X threshold positions and one list of threshold Identifiers.
4	ListLength	FLOATLE	Number of thresholds in the list
4 x ListLength	X	FLOATLE	X value of the threshold for each threshold
4 x ListLength	ThrsID	FLOATLE	ID of each threshold (listed below)

ThrsID for RbcAlongRes: None (so ListLength = 0)

ThrsID for PltAlongRes: (ListLength = 3)

Threshold name	ThrsId	Value
Pec	0	3
PltL	1	11
PltRbc	2	Mobile

ThrsID for WbcAlongRes: None (so ListLength = 0)

3.6. Example of Data Frame

3.6.1. Example of a Query With the Response

<- Instrument

-> Host

<- <ENQ>

-> <ACK>

<- <STX>1H|\^&|||H500^001YOXH00031^1.0.0.6||||||P|LIS2-A2|
20150323160052<CR><ETX>34<CR><LF>

-> <ACK>

<- <STX>2Q|1|^289645146||ALL||||||O<CR><ETX>F7<CR><LF>

-> <ACK>

<- <STX>3L|1|N<CR><ETX>06<CR><LF>

-> <ACK>

<- <EOT>

-> <ENQ>

<- <ACK>

-> <STX>1H|\^&|||HCM||||||P|LIS2-A2|20150323160111<CR><ETX>51<CR><LF>

<- <ACK>

-> <STX>2P|1||2||BOND^JAMES||19770526|M|||||<CR><ETX>24<CR><LF>

<- <ACK>

-> <STX>3O|1|289645146||^^^DIF|R|20150323160111|||||N|||||||||||Q|||||<CR><ETX>C0<CR><LF>

<- <ACK>

-> <STX>4L|1|<CR><ETX>B9<CR><LF>

<- <ACK>

-> <EOT>

3.6.2. Example of Result Sent by the Instrument

<- Instrument

-> Host

<- <ENQ>

-> <ACK>

<- <STX>1H|\^&|||H500^001YOXH00031^1.0.0.6||||||D|LIS2-A2|
20150323160731<CR><ETX>2C<CR><LF>

-> <ACK>

<- <STX>2P|1||123||Dylan^Bob||19900302|M|||||||||||||||||||||||MAN||<CR><ETX>F3<CR><LF>

-> <ACK>

<- <STX>3O|1|145654||^^^DIF|R|20150323160230|||||||BLOOD|||||||||F|||||<CR><ETX>8D<CR><LF>

-> <ACK>

<- <STX>4C|1|I|CONDITIONS^^CONTROL_FAILED
\NON_COMPLIANT_DATA^LMNE^SEP_MON_NEU\NON_COMPLIANT_DATA^LMNE^NOISE
\NON_COMPLIANT_DATA^LMNE^LG_OR_LG1_INTERFERE
\NON_COMPLIANT_DATA^LMNE^LG_OR_LG1_INTERFERE
\SUSPECTED_PATHOLOGY^^MICROCYTOSIS\SUSPECTED_PATHOLOGY<ETB>1F<CR><LF>

-> <ACK>

<- <STX>5^^ANISOCYTOSIS\SUSPECTED_PATHOLOGY^^COLD_AGGLUTININS
\SUSPECTED_PATHOLOGY^^ERB\SUSPECTED_PATHOLOGY^^LARGE_IMMATURE_CELLS|
I<CR><ETX>A7<CR><LF>

-> <ACK>

<- <STX>6M|1|REAGENT|CLEANER\DILUENT\LYSE|
150106I1^20150306000000^20150606\141215H1*^20150317110528^20150917\141215M11^20
150314163050^20150514<CR><ETX>F2<CR><LF>

-> <ACK>

<- <STX>7R|1|^^^PCT^51637-7|0.002|10E-2L/L|0.002 - 0.005|N||F||technician^^TECHNICIAN|20150323160230||<CR><ETX>E3<CR><LF>

-> <ACK>

<- <STX>0R|2|^^^NEU#^751-8|4.12|10E9/L|2.00 - 7.50|N||W||technician^^TECHNICIAN|20150323160230||<CR><ETX>B4<CR><LF>

-> <ACK>

<- <STX>1R|3|^^^MCV^787-2|73.9|fL|80.0 - 100.0|L||F||technician^^TECHNICIAN|20150323160230||<CR><ETX>10<CR><LF>

-> <ACK>

<- <STX>2R|4|^^^P-LCR^48386-7|33.9|%|0.0 - 0.3|HH||F||technician^^TECHNICIAN|20150323160230||<CR><ETX>13<CR><LF>

-> <ACK>

<- <STX>3R|5|^^^NEU%^770-8|64.0|%|0.0 - 100.0|N||W||technician^^TECHNICIAN|20150323160230||<CR><ETX>7E<CR><LF>

-> <ACK>

<- <STX>4R|6|^^^RDW-CV^788-0|17.4|%|11.0 - 16.0|HH||F||technician^^TECHNICIAN|20150323160230||<CR><ETX>62<CR><LF>

-> <ACK>

<- <STX>5R|7|^^^RBC^789-8|4.51|10E12/L|3.80 - 6.50|N||F||technician^^TECHNICIAN|20150323160230||<CR><ETX>B9<CR><LF>

-> <ACK>

<- <STX>6R|8|^^^MPV^32623-1|9.9|fL|6.0 - 11.0|N||F||technician^^TECHNICIAN|20150323160230||<CR><ETX>F0<CR><LF>

-> <ACK>

<- <STX>7R|9|^^^P-LCC^N/A|78.8|10E9/L|0.0 - 0.3|HH||F||technician^^TECHNICIAN|20150323160230||<CR><ETX>98<CR><LF>

-> <ACK>

<- <STX>0R|10|^^^MON#^742-7|0.08|10E9/L|0.20 - 1.00|L||W||technician^^TECHNICIAN|20150323160230||<CR><ETX>D8<CR><LF>

-> <ACK>

<- <STX>1R|11|^^^WBC^6690-2|6.92|10E9/L|4.00 - 10.00|N||W||technician^^TECHNICIAN|20150323160230||<CR><ETX>19<CR><LF>

-> <ACK>

<- <STX>2R|12|^^^PLT^777-3|232.7|10E9/L|150.0 - 500.0|N||F||technician^^TECHNICIAN|20150323160230||<CR><ETX>52<CR><LF>

-> <ACK>

<- <STX>3R|13|^^^LIC%^55433-7|7.3|%|0.0 - 3.0|HH||W||technician^^TECHNICIAN|20150323160230||<CR><ETX>B6<CR><LF>

-> <ACK>

<- <STX>4R|14|^^^MON%^5905-5|1.2|%|0.0 - 100.0|N||W||technician^^TECHNICIAN|20150323160230||<CR><ETX>AC<CR><LF>

-> <ACK>

<- <STX>5R|15|^^^LIC#^55432-9|0.47|10E9/L|0.00 - 0.30|HH||W||technician^^TECHNICIAN|20150323160230||<CR><ETX>7F<CR><LF>

-> <ACK>

<- <STX>6R|16|^^^LYM#^731-0|1.94|10E9/L|1.00 - 4.00|N||W||technician^^TECHNICIAN|20150323160230||<CR><ETX>ED<CR><LF>

-> <ACK>

<- <STX>7R|17|^^^PDW^51631-0|14.1|fL|11.0 - 18.0|N||F||technician^^TECHNICIAN|20150323160230||<CR><ETX>6F<CR><LF>

-> <ACK>

<- <STX>0R|18|^^^HGB^718-7|142|g/L|130 - 170|N||F||technician^^TECHNICIAN|20150323160230||<CR><ETX>9E<CR><LF>

-> <ACK>

<- <STX>1R|19|^^^LYM%^736-9|30.0|%|0.0 - 100.0|N||W||technician^^TECHNICIAN|20150323160230||<CR><ETX>B7<CR><LF>

-> <ACK>

<- <STX>2R|20|^^^RDW-SD^21000-5|66.4|fL|0.0 - 0.3|HH||F||technician^^TECHNICIAN|20150323160230||<CR><ETX>06<CR><LF>

-> <ACK>

<- <STX>3R|21|^^^BAS%^706-2|0.4|%|0.0 - 100.0|N||W||technician^^TECHNICIAN|20150323160230||<CR><ETX>5D<CR><LF>

-> <ACK>

<- <STX>4R|22|^^^BAS#^704-7|0.03|10E9/L|0.00 - 0.20|N||W||technician^^TECHNICIAN|20150323160230||<CR><ETX>C5<CR><LF>

-> <ACK>

<- <STX>5R|23|^^^MCH^785-6|31.5|pg|27.0 - 32.0|N||F||technician^^TECHNICIAN|
20150323160230||<CR><ETX>2C<CR><LF>

-> <ACK>

<- <STX>6R|24|^^^MCHC^786-4|426|g/L|320 - 360|HH||F||technician^^TECHNICIAN|
20150323160230||<CR><ETX>36<CR><LF>

-> <ACK>

<- <STX>7R|25|^^^HCT^4544-3|0.333|L/L|0.370 - 0.540|LL||F||technician^^TECHNICIAN|
20150323160230||<CR><ETX>30<CR><LF>

-> <ACK>

<- <STX>0R|26|^^^EOS#^711-2|0.28|10E9/L|0.00 - 0.50|N||W||technician^^TECHNICIAN|
20150323160230||<CR><ETX>D9<CR><LF>

-> <ACK>

<- <STX>1R|27|^^^EOS%^713-8|4.3|%|0.0 - 100.0|N||W||technician^^TECHNICIAN|
20150323160230||<CR><ETX>79<CR><LF>

-> <ACK>

<- <STX>2L|1|N<CR><ETX>05<CR><LF>

-> <ACK>

<- <EOT>

3.6.3. Example of QC Result Sent by the Instrument

<- Instrument

-> Host

<- <ENQ>

-> <ACK>

<- <STX>1H|\^&|||H500^001YOXH00031^1.0.0.6||||||D|LIS2-A2|
20150323160731<CR><ETX>2C<CR><LF>

-> <ACK>

<- <STX>2P|1||||||||||||||||||||||||||||||||||||||||<CR><ETX>33<CR><LF>

-> <ACK>

<- <STX>3O|1|PX035N||^^^DIF|R|20150323160321||||||||CTRL^^CTRL MEDIUM|||||||||F|||||
<CR><ETX>7A<CR><LF>

-> <ACK>

<- <STX>4C|1|I|CONTROL_FAILED^^HCT_BELOW_TOLERANCE
\CONTROL_FAILED^^MCV_BELOW_TOLERANCE
\CONTROL_FAILED^^MCHC_ABOVE_TOLERANCE\CONTROL_FAILED^^EOS
%_ABOVE_TOLERANCE\CONTROL_FAILED^^EOS#_ABOVE_TOLERANCE|
I<CR><ETX>05<CR><LF>

-> <ACK>

<- <STX>5C|2|I|PX035N|G<CR><ETX>C8<CR><LF>

-> <ACK>

<- <STX>6M|1|REAGENT|CLEANER\DILUENT\LYSE|
150106I1^20150306000000^20150606\141215H1*^20150317110528^20150917\141215M11^20
150314163050^20150514<CR><ETX>F2<CR><LF>

-> <ACK>

<- <STX>7R|1|^^^NEU#^751-8|3.71|10E9/L|2.80 - 4.60|N||F||technician^^TECHNICIAN|
20150323160321||<CR><ETX>B4<CR><LF>

-> <ACK>

<- <STX>0R|2|^^^MCV^787-2|73.9|fL|75.0 - 85.0|N||F||technician^^TECHNICIAN|
20150323160321||<CR><ETX>F1<CR><LF>

-> <ACK>

<- <STX>1R|3|^^^NEU%^770-8|53.6|%|50.0 - 70.0|N||F||technician^^TECHNICIAN|
20150323160321||<CR><ETX>79<CR><LF>

-> <ACK>

<- <STX>2R|4|^^^RDW-CV^788-0|17.4|%|3.9 - 23.9|N||F||technician^^TECHNICIAN|
20150323160321||<CR><ETX>FE<CR><LF>

-> <ACK>

<- <STX>3R|5|^^^RBC^789-8|4.51|10E12/L|4.47 - 4.87|N||F||technician^^TECHNICIAN|
20150323160321||<CR><ETX>C2<CR><LF>

-> <ACK>

<- <STX>4R|6|^^^MPV^32623-1|9.9|fL|8.1 - 12.1|N||F||technician^^TECHNICIAN|
20150323160321||<CR><ETX>F2<CR><LF>

-> <ACK>

<- <STX>5R|7|^^^MON#^742-7|0.63|10E9/L|0.03 - 1.23|N||F||technician^^TECHNICIAN|
20150323160321||<CR><ETX>AC<CR><LF>

-> <ACK>

<- <STX>6R|8|^^^WBC^6690-2|6.92|10E9/L|6.20 - 8.20|N||F||technician^^TECHNICIAN|
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<- <STX>0R|18|^^^HCT^4544-3|0.333|L/L|0.355 - 0.395|N||F||technician^^TECHNICIAN|
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<- <STX>3L|1|N<CR><ETX>06<CR><LF>

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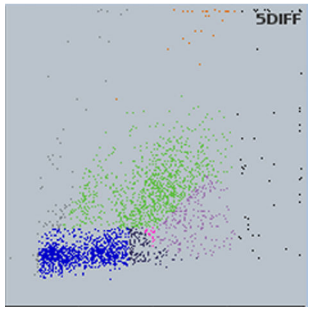
<- <EOT>

3.6.4. Example of Data Frame for LMNEB Matrix



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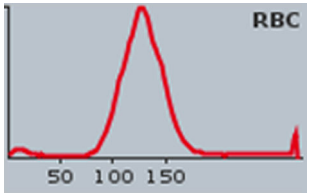
3.6.5. Example of Data Frame for Histograms



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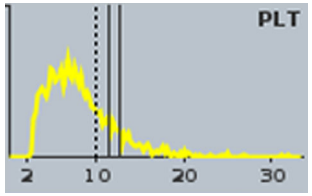

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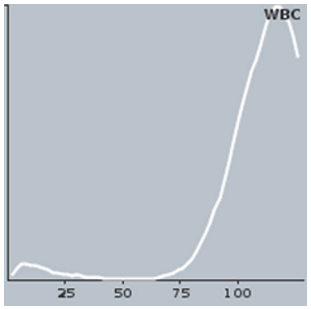

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4. HL7 Format

HL7 content is enclosed by special characters to form a block.

The block format is <SB> HL7 Message <EB> <CR>.

The characters below shall surround the HL7 TCP message:

Element	Description	Value	Comment
<SB>	Start Block character (1 byte)	<0x0B> / <VT>	Vertical Tab
HL7 Message	This is the HL7 data content of the block	The data can contain any single-byte values greater than 0x1F and the ASCII carriage return character <CR>	
<EB>	End Block character (1 byte)	<0x1C> / <FS>	File Separator
<CR>	Carriage Return (1 byte)	<0x0D> / <CR>	Carriage Return

4.1. Protocol Description

4.1.1. Overview

Messages

A message is the atomic unit of data transferred between systems. It consists of a group of segments in a defined sequence. Each message has a message type that defines its purpose.

Segments and segment groups

A segment is a logical grouping of data fields. Segments of a message may be required or optional. They may appear only once in a message or they may be allowed to repeat.

Each segment is identified by a unique three-character code known as the Segment ID. Two or more segments may be organized as a logical unit called a segment group. A segment group may be required or optional and might or might not repeat.

Each message is defined in special notation that lists the segment IDs in the order they would appear in the message.

- Braces { . . . }, indicate one or more repetitions of the enclosed group of segments. The group may contain only a single segment.
- Brackets [. . .], show that the enclosed group of segments is optional.

If a group of segments is optional and may repeat it should be enclosed in brackets and braces [{ . . . }].

Fields

A field is a string of characters.

HL7 does not take into account how systems store data within an application.

When fields are transmitted, they are sent as character strings.

Separators

The HL7 messages must be created by using the separators below:

Separator	Name
\	Escape character
|	Field separator
~	Repetition separator
^	Component separator
&	Sub-component separator

Escape sequences

If producing HL7 messages that contain the separators in the fields content, the application should properly escape the data using the escape sequences below:

Special character	Escape sequence
\	\E\
|	\F\
~	\R\
^	\S\
&	\T\

Date and time format

Date and time fields and components must contain a date and time formatted as follows: YYYYMMDDhhmmss

Date fields and components must contain a date formatted as follows: YYYYMMDD

Numerical values

The numerical values must use the character "." as decimal separator.

4.1.2. Message Structure

The following table lists the message types supported by Yumizen H550 for the laboratory testing workflow transactions:

Message	Description
OML^O33	Order information (related to a single patient and a single specimen) used to send a request from an external system to Yumizen H550 (request downloading).
ORL^O34	Acknowledgment / Rejection of a request message sent from Yumizen H550 to an external system.
OUL^R22	Result information (related to a single order) used to send a test result from Yumizen H550 to an external system (result uploading).
ACK^R22	Acknowledgment / Rejection of a test result message sent from an external system to Yumizen H550.

The application must respect the following attribute descriptions to create and process the HL7 messages:

- Segment: the segment ID
- Meaning: the contain of this segment
- Usage: whether the segment is required (R) or optional (O)
- Card: whether the segment may repeat

Card.	Description
[0..1]	Element may be omitted and it can have at most one occurrence
[1..1]	Element must have exactly one occurrence
[0..*]	Element may be omitted or repeat for an unlimited number of times
[1..*]	Element must appear at least once and may repeat for an unlimited number of times

4.1.2.1. OML^O33^OML_O33

The following table lists the detailed structure for message OML^O33 used to send a request from an external system to Yumizen H550:

Segment	Meaning	Usage	Card.
MSH	Message Header	R	[1..1]
	--- PATIENT begin		
PID	Patient Identification	R	[1..1]
[{NTE}]	Notes and comments	O	[0..1]
	--- PATIENT end		
	--- SPECIMEN begin		
SPM	Specimen	R	[1..1]

Segment	Meaning	Usage	Card.
[OBX]	Observation Result (for specimen)	O	[0..1]
[SAC]	Specimen Container	O	[0..1]
	--- ORDER begin		
ORC	Order Common	R	[1..1]
	--- Observation Request begin		
OBR	Observation Request	R	[1..1]
[{NTE}]	Notes and comments	O	[0..1]
	--- Observation Request end		
	--- ORDER end		
	--- SPECIMEN end		

4.1.2.2. ORL^O34^ORL_O34 / ACK^R22^ACK_R22

The following table lists the detailed structure for messages ORL^O34 and ACK^R22 used to acknowledge a message reception by both Yumizen H550 and an external system:

Segment	Meaning	Usage	Card.
MSH	Message Header	R	[1..1]
MSA	Message Acknowledgment	R	[1..1]
[ERR]	Error	O	[0..1]

4.1.2.3. OUL^R22^OUL_R22

The following table lists the detailed structure for message OUL^R22 used to send a test result from Yumizen H550 to an external system:

Segment	Meaning	Usage	Card.
MSH	Message Header	R	[1..1]
	--- PATIENT begin		
[PID]	Patient Identification	O	[0..1]
	--- PATIENT end		
	--- SPECIMEN begin		
SPM	Specimen	R	[1..1]
[OBX]	Observation Result (for specimen)	O	[0..1]
[SAC]	Specimen Container	O	[0..1]
	--- ORDER begin		
OBR	Observation Request	R	[1..1]
[ORC]	Order Common	O	[0..1]
[NTE]	Notes and comments	O	[0...2]
{	--- RESULT begin		
OBX	Observation Result	R	[1..1]
}	--- RESULT end		
	--- ORDER end		
	--- SPECIMEN end		

4.2. Message Segments

Messages consist of segments of various types that are listed in the table below:

Segment Type	Name
MSH	Message Header
PID	Patient Identification
NTE	Notes and comments
SPM	Specimen
SAC	Specimen Container
ORC	Order Common
OBR	Observation Request
OBX	Observation Result
MSA	Message Acknowledgment
ERR	Error

Fields and components must contain a value that complies with the specified input type. The input types are listed in the table below:

Input type	Name	Description
F	Fixed	The corresponding fields and components must contain only this fixed value.
CL	Closed list	The corresponding fields and components must contain only the predefined values.
OL	Open list	The corresponding fields and components must contain only the values specified in the Yumizen H550.
AN	Alphanumeric	The corresponding fields and components must contain a free text.
N	Numeric	The corresponding fields and components must contain a numerical positive data including 0 (zero).
DT	Date and time	The corresponding fields and components must contain a date and time formatted as follows: YYYYMMDDhhmmss
D	Date	The corresponding fields and components must contain a date formatted as follows: YYYYMMDD

4.2.1. MSH - Message Header Segment

The MSH segment defines the intent, source, destination, and some specifics of the syntax of a message.

The Message Header segment contains general information and identifies the sender. The Message Header segment is always the first record in a transmission.

4.2.1.1. From LIS to Yumizen H550

SEQ	LEN	OPT	Input type	Element name	Example
0	3	R	F	Segment ID	**MSH**
1	1	R	F	Field Separator	| (Pipe)
2	4	R	F	Encoding Characters	**^~\&**
					^: component separator
					~: repetition separator
					\: escape character
					&: sub-component separator
5	42	O	AN	Receiving Application	**YH550^123456A^1.0.0**
	15				YH550: instrument code
	15				123456A: serial number
	10				1.0.0: version
6	14	O	F	Receiving Facility	**HORIBA_MEDICAL**
7	14	R	DT	Date/Time of message	**20161012144125** YYYYMMDDhhmmss: date and time of the message
9	15	R	CL	Message Type	**OML^033^OML_033**
					OML: message code ID
					033: trigger event ID
					OML_033: message structure ID

SEQ	LEN	OPT	Input type	Element name	Example
10	20	R	DT	Message Control ID	**20161012145002000 02** YYYYMMDDhhmmss: current date and time CCCCC: counter from 00001 to 99999
11	1	R	CL	Processing ID	**P** P (Production) D (Debugging) Default setting depending on user profile: ■ Tech: D ■ Others: P
12	3	R	F	Version ID	**2.5**
18	16	O	CL	Character Set	**UNICODE UTF-8**

Example of a message sent by LIS:
MSH|^~\&|||YH550^123456A^1.0.0|HORIBA_MEDICAL|20161012144125||
OML^033^OML_033|20161012145002000 02|P|2.5|||||UNICODE UTF-8

4.2.1.2. From Yumizen H550 to LIS

SEQ	LEN	OPT	Input type	Element name	Example
0	3	R	F	Segment ID	**MSH**
1	1	R	F	Field Separator	**|** (Pipe)
2	4	R	F	Encoding Characters	**^~\&**
					^: component separator
					~: repetition separator
					\: escape character
					&: sub-component separator
3	42	R	AN	Sending Application	**YH550^123456A^1.0.0**
	15				YH550: instrument code
	15				123456A: serial number
	10				1.0.0: version
4	14	R	F	Sending Facility	**HORIBA_MEDICAL**
5		O	AN	Receiving Application	Application setting
6		O	AN	Receiving Facility	Application setting
7	14	R	DT	Date/Time of message	**20161012145002** YYYYMMDDhhmmss: date and time of the message
9	15	R	CL	Message Type	**OUL^R22^OUL_R22**: results
	3				OUL: message code ID
	3				R22: trigger event ID
	7				OUL_R22: message structure ID
10	19	R	DT	Message Control ID	**20161012145002000 02** YYYYMMDDhhmmss: current date and time CCCCC: counter from 00001 to 99999
11	1	R	CL	Processing ID	**P** P (Production) D (Debugging) Default setting depending on user profile: ■ Tech: D ■ Others: P
12	3	R	F	Version ID	**2.5**
18	16	R	F	Character Set	**UNICODE UTF-8**

Example of a message sent by Yumizen H550:
MSH|^~\&|YH550^123456A^1.0.0|HORIBA_MEDICAL|setting|setting|20161012183025||
OUL^R22^OUL_R22|20161012161702000 04|P|2.5|||||UNICODE UTF-8

4.2.2. PID - Patient Identification Segment

The PID segment is used by all applications as the primary means of communicating patient identification information. This segment contains permanent patient identifying and demographic information.

4.2.2.1. From LIS to Yumizen H550

SEQ	LEN	OPT	Input type	Element name	Example
0	3	R	F	Segment ID	**PID**
1	1	O	N	Set ID - PID	**1**
3	34	R		Patient Identifier List	**PID0002^^^^PI**
	25		AN		PID0002: ID number
	5		CL		PI: identifier type code
5	41	O	AN	Patient Name	**Doe^John**
	20				Doe: family name
	20				John: given name
7	8	O	D	Date/Time of Birth	**19800926** YYYYMMDD: date of birth
8	1	O	CL	Administrative Sex	**M** M (Male) F (Female) U (Unknown)

Example of a patient identification segment sent by LIS:
PID|1||PID0002^^^^PI||Doe^John||19800926|M

4.2.2.2. From Yumizen H550 to LIS

SEQ	LEN	OPT	Input type	Element name	Example
0	3	R	F	Segment ID	**PID**
1	1	R	F	Set ID - PID	**1**
3	34	R		Patient Identifier List	**PID0002^^^^PI**
	25		AN		PID0002: ID number
	5		F		PI: identifier type code
5	41	O	AN	Patient Name	**Doe^John**
	20				Doe: family name
	20				John: given name
7	8	O	D	Date/Time of Birth	**19800926** YYYYMMDD: date of birth
8	1	O	CL	Administrative Sex	**M** M (Male) F (Female) U (Unknown)

Example of a patient identification segment sent by Yumizen H550:
PID|1||PID0002^^^^PI||Doe^John||19800926|M

4.2.3. NTE - Notes and Comments Segment

The NTE segment is defined here for inclusion in messages defined in other chapters. It is commonly used for sending notes and comments. The NTE segment can be linked to a PID or an OBR segment.

4.2.3.1. From LIS to Yumizen H550

SEQ	LEN	OPT	Input type	Element name	Example
0	3	R	F	Segment ID	**NTE**
1	1	O	N	Set ID - NTE	**1**
3	200	O	AN	Comment	**Patient Comment** Depends on the associated segment: ■ PID: patient comment ■ OBR: order comment
4	1	R	CL	Comment Type	**G** G (General): patient comment, order comment

Example of a message sent by LIS:
NTE|1||the patient is afraid of needles|G

4.2.3.2. From Yumizen H550 to LIS

SEQ	LEN	OPT	Input type	Element name	Example
0	3	R	F	Segment ID	**NTE**
1	1	R	N	Set ID - NTE	**1**
2	1	R	F	Source of comment	**L** L (Filler)
3		R		Comment	Depends on the comment content (refer to the table below).
4	1	R	CL	Comment Type	**G** G (General): patient comment, order comment I (Device Flag): analyzer and analytical alarms

Comment content

What?	Associated Segment	LEN	OPT	Input type	Example
Patient comment	PID	200	R	AN	**Patient Comment**
Order comment	OBR	200	R	AN	**Order Comment**
Analyzer alarm	OBR	33			**AlarmType^MeasurementType^Alarm~**
		1	R	CL	Alarm type: P (processing alarm, analyzer alarm, suspected pathologies)
		10	O	OL	Measurement type: name of the alarm family
		20	R	OL	Alarm: name of the alarm
Analytical alarm	OBR	33			**AlarmType^MeasurementType^Alarm~**
		1	R	CL	Alarm type: A (analytical alarm)
		10	O	OL	Measurement type: name of the alarm family
		20	R	OL	Alarm: name of the alarm

Example of a message sent by Yumizen H550:
NTE|1||A^PLT^MIC~P^^BAD_SAMPLING|I

4.2.4. SPM - Specimen Segment

The intent of this segment is to describe the characteristics of a specimen.

It contains information about the sample.

4.2.4.1. From LIS to Yumizen H550

SEQ	LEN	OPT	Input type	Element name	Example
0	3	R	F	Segment ID	**SPM**
1	1	O	N	Set ID - SPM	**1**
2	16	O	AN	Specimen ID	**0123456789**
4	20	R	CL	Specimen Type	**WB** WB (Whole Blood)
11	20	O	CL	Specimen Role	**P** P (Patient)
17	14	O	DT	Specimen Collection Date/Time	**20161012145110** YYYYMMDDhhmmss: date and time of the specimen collection
18	14	O	DT	Specimen Received Date/Time	**20161012181002** YYYYMMDDhhmmss: date and time of the specimen reception

Example of a specimen segment sent by LIS:
SPM|1|0123456789||WB||||||P||||||20161012145110|20161012181002

4.2.4.2. From Yumizen H550 to LIS

SEQ	LEN	OPT	Input type	Element name	Example
0	3	R	F	Segment ID	**SPM**
1	1	R	F	Set ID - SPM	**1**
2	16	O	AN	Specimen ID	**0123456789**
4	20	R	F	Specimen Type	**WB** WB (Whole Blood)
11	20	R	F	Specimen Role	**P** P (Patient)
17	14	O	DT	Specimen Collection Date/Time	**20161012145110** YYYYMMDDhhmmss: date and time of the specimen collection
18	14	O	DT	Specimen Received Date/Time	**20161012181002** YYYYMMDDhhmmss: date and time of the specimen reception

Example of a specimen segment sent by Yumizen H550:
SPM|1|0123456789||WB||||||P||||||20161012145110|20161012181002

4.2.5. SAC - Specimen Container Segment

The intent of this segment is to give information about the specimen position in the laboratory rack management.

4.2.5.1. From LIS to Yumizen H550

SEQ	LEN	OPT	Input type	Element name	Example
0	3	R	F	Segment ID	**SAC**
10	11	O		Carrier ID	**01234^2**
	8		AN		01234: rack ID
	2		N		2: rack loading number
11	2	O	N	Position in carrier	**1** 1: rack position

Example of a specimen container segment sent by LIS:
SAC|||||||||01234^2|1

4.2.5.2. From Yumizen H550 to LIS

SEQ	LEN	OPT	Input type	Element name	Example
0	3	R	F	Segment ID	**SAC**
10	11	O		Carrier ID	**01234^2**
	8		AN		01234: rack ID
	2		N		2: rack loading number
11	2	O	N	Position in carrier	**1** 1: rack position

Example of a specimen container segment sent by Yumizen H550:
SAC|||||||||01234^2|1

4.2.6. ORC - Common Order Segment

The Common Order segment (ORC) is used to transmit fields that are common to all orders.

However, the Yumizen H550 manages only one order at a time.

4.2.6.1. From LIS to Yumizen H550

SEQ	LEN	OPT	Input type	Element name	Example
0	3	R	F	Segment ID	**ORC**
1	2	R	CL	Order Control	**NW** NW (New order)
17	21	O	AN	Entering Organization	**^Hematology_Department**
	20				Hematology_Department: department name

Example of a common order segment sent by LIS:
ORC|NW|||||||||||||||^Hematology_Department

4.2.6.2. From Yumizen H550 to LIS

SEQ	LEN	OPT	Input type	Element name	Example
0	3	R	F	Segment ID	**ORC**
1	2	R	F	Order Control	**SC** SC (Status Change)
17	21	O	AN	Entering Organization	**^Hematology_Department**
	20				Hematology_Department: department name

Example of a common order segment sent by Yumizen H550:
ORC|SC|||||||||||||||^Hematology_Department

4.2.7. OBR - Observation Request Segment

In the reporting of clinical data, the OBR serves as the report header. It identifies the observation set represented by the following atomic observations. It includes the relevant ordering information when that applies. It contains many of the attributes that usually apply to all of the included observations.

The Universal Service Identifier field corresponds to any parameters or compatible panels:

CBC
DIF

4.2.7.1. From LIS to Yumizen H550

SEQ	LEN	OPT	Input type	Element name	Example
0	3	R	F	Segment ID	**OBR**
1	4	O	N	Set ID - OBR	**1**
4	10	R	OL	Universal Service Identifier	**CBC** Test panel: ■ CBC ■ DIF
16	51	O	AN	Ordering Provider	**789456^JOHN DOE**
	20				789456: physician ID
	30				JOHN DOE: physician name

Example of an observation request segment sent by LIS:
OBR|1|||CBC||||||||||789456^MISTER PHYSICIAN

4.2.7.2. From Yumizen H550 to LIS

SEQ	LEN	OPT	Input type	Element name	Example
0	3	R	F	Segment ID	**OBR**
1	4	R	F	Set ID - OBR	**1**
4	20	R	OL	Universal Service Identifier	**DIF** Test panel: ■ CBC ■ DIF
16	51	O	AN	Ordering Provider	**789456^JOHN DOE**
	20				789456: physician ID
	30				JOHN DOE: physician name
22	14	R	DT	Results Rpt / Status Chng Date	**20161012161021** YYYYMMDDhhmmss: date and time of the result delivery
25	1	R	F	Result Status	**F** F (Final)
34	41	R	AN	Technician	**LoginName** LoginName: user login name

Example of an observation request segment sent by Yumizen H550:
OBR|1|||CBC||||||||||789456^MISTER PHYSICIAN|||||20161012161552|||F|||||||||LoginName

4.2.8. OBX - Observation Result Segment

The OBX segment is used to transmit a single observation or observation fragment. It represents the smallest indivisible unit of a report. The OBX segment can be linked to a SPM or an OBR segment.

4.2.8.1. From LIS to Yumizen H550 with the SPM Segment

SEQ	LEN	OPT	Input type	Element name	Example
0	3	R	F	Segment ID	**OBX**
1	4	O	N	Set ID - OBX	**1**
2	2	O	CL	Value Type	**NM** NM (Numeric)
3	24	O	F	Observation Identifier	**35659-2^Age at specimen collection^LN**
	10				35659-2: LOINC code
	10				Age at specimen collection: name of the transmitted observation
	2				LN: Logical Observation Identifiers Names and Codes (LOINC)

SEQ	LEN	OPT	Input type	Element name	Example
5	3	O	N	Observation Value	**35** 35: patient age
6	13	O		Units	**d^Day^UCUM** Unit: ■ a^Year^UCUM or a (Year) ■ mo^Month^UCUM or mo (Month) ■ d^Day^UCUM or d (Day)
	2		CL		
	5		CL		
	4		F		
11	1	O	F	Observation Result Status	**F** F (Final)

Example of an observation result segment sent by LIS:
OBX|1|NM|35659-2^Age at specimen collection^LN||36|a^Year^UCUM|||||F

4.2.8.2. From Yumizen H550 to LIS with the SPM Segment

SEQ	LEN	OPT	Input type	Element name	Example
0	3	R	F	Segment ID	**OBX**
1	4	R	F	Set ID - OBX	**1**
2	2	R	F	Value Type	**NM** NM (Numeric)
3	40	R	F	Observation Identifier	**35659-2^Age at specimen collection^LN**
	10				35659-2: LOINC code
	26				Age at specimen collection: name of the transmitted observation
	2				LN: Logical Observation Identifiers Names and Codes (LOINC)
5	3	R	N	Observation Value	**35** 35: patient age
6	13	R	F	Units	**a** a (Year)
	2				
	5				
	4				
11	1	R	F	Observation Result Status	**F** F (Final)

Example of an observation result segment sent by Yumizen H550:
OBX|1|NM|35659-2^Age at specimen collection^LN||36|a|||||F

4.2.8.3. From Yumizen H550 to LIS with the OBR Segment

SEQ	LEN	OPT	Input type	Element name	Example
0	3	R	F	Segment ID	**OBX**
1	4	R	N	Set ID - OBX	**3** Incremented by one at each OBX segment in the OBR segment, starting with 1.
2	2	R	CL	Value Type	**ST** NM (Numeric) ST (String)
3	24			Observation Identifier	**742-7^MON#^LN**
	10	O	OL		742-7: LOINC code
	10	R	OL		MON#: parameter English name
	2	R	F		LN: Logical Observation Identifiers Names and Codes (LOINC)
5	16	R	AN	Observation Value	**2.4** 2.4: parameter value
6	10	R	OL	Units	**10/F/9/E/L** 10/F/9/E/L: parameter unit

SEQ	LEN	OPT	Input type	Element name	Example
7	110	O		References Range	**xx - yy^REFERENCE_RANGE&xx - yy^CRITICAL_RANGE&Child1^CHILD_CATEGORY** One or more ranges (used to evaluate the abnormal flags of the parameter) are sent as follows: range values1^range type1&range values2^range type2&...
	20		AN		xx - yy: range values
	15		CL		REFERENCE_RANGE: range type ■ REFERENCE_RANGE ■ CRITICAL_RANGE ■ CHILD_CATEGORY If the range type is "CHILD_CATEGORY", then the range values must contain the name of the child category.
8	2	O		Abnormal Flags	**L~F**
			CL		L: abnormal flag ■ L (Low) ■ H (High) ■ LL (Critically low) ■ HH (Critically high) ■ < (Off scale low) ■ > (Off scale high) ■ A (Abnormal) ■ N (Normal)
			OL		F: qualification flag ■ F (Other) ■ X (Rejected) ■ Z (Warning)
11	1	R	F	Observation Result Status	**F** F (Final)
16	41	R	AN	Responsible Observer	**LoginName** LoginName: user login name

Example of an observation result segment sent by Yumizen H550:
OBX|1|NM|789-8^RBC^LN||507|10/F/4/E/µL|404 - 604^REFERENCE_RANGE|~F|||F|||||
LoginName

4.2.9. MSA - Message Acknowledgment Segment

The MSA segment contains information sent while acknowledging another message.

4.2.9.1. From LIS to Yumizen H550

SEQ	LEN	OPT	Input type	Element name	Example
0	3	R	F	Segment ID	**MSA**
1	2	R	CL	Acknowledgment Code	**AA** AA (Accept) AE (Error) AR (Reject)
2	20	R	AN	Message Control ID	**20161012145002000002** Message Control ID of the corresponding message sent by the Yumizen H550.

Example of a message sent by LIS:
MSA|AA|20161012145002000002

4.2.9.2. From Yumizen H550 to LIS

SEQ	LEN	OPT	Input type	Element name	Example
0	3	R	F	Segment ID	**MSA**
1	2	R	CL	Acknowledgment Code	**AA** AA (Accept) AE (Error) AR (Reject)
2	20	R	AN	Message Control ID	**20161012145002000002** Message Control ID of the corresponding message sent by the LIS.

Example of a message sent by Yumizen H550:
MSA|AA|20161012145002000002

4.2.10. ERR - Error Segment

The ERR segment is used to add error comments to acknowledgment messages.

4.2.10.1. From LIS to Yumizen H550

SEQ	LEN	OPT	Input type	Element name	Example
0	3	R	F	Segment ID	**ERR**
3	20	R	CL	HL7 Error Code	**203** Error code
4	1	R	CL	Severity	**E** E (Error)
8	250	O	AN	User Message	**The Version ID is not supported** Error message

Example of a message sent by LIS:
ERR|||203|E||||The Version ID is not supported

4.2.10.2. From Yumizen H550 to LIS

SEQ	LEN	OPT	Input type	Element name	Example
0	3	R	F	Segment ID	**ERR**
3	20	R	CL	HL7 Error Code	**101** Error code
4	1	R	CL	Severity	**E** E (Error)
8	250	O	AN	User Message	**A required field is missing from a segment** Error message

Error code

When?	Error code	Name	Context	Concerned Segment / Field
Message rejected	200	Unsupported message type	The Message Type is not supported.	MSH-9
Message rejected	201	Unsupported event code	The Event Code is not supported.	MSH-9
Message rejected	202	Unsupported processing id	The Processing ID is not supported.	MSH-11
Message rejected	203	Unsupported version id	The Version ID is not supported.	MSH-12
Message rejected	204	Unknown key identifier	The order to delete does not exist.	SPM SAC
Message rejected	205	Duplicate key identifier	The ID of the patient, order, etc., already exists.	SPM
Message rejected	206	Application record locked	The analyzer is not be able to manage the message because of an error at the application storage.	Not applicable

When?	Error code	Name	Context	Concerned Segment / Field
Message rejected	207	Application internal error	A catch-all for internal errors not explicitly covered by other codes.	Not applicable
Message error	100	Segment sequence error	The message segments were not in the proper order, or required segments are missing.	Not applicable
Message error	101	Required field missing	A required field is missing from a segment or a required component is missing in the field.	Not applicable
Message error	102	Data type error	The field contains data of the wrong input type.	Not applicable
Message error	103	Table value not found	A field (that must contain only predefined value) was compared against the corresponding table, and no match was found.	Not applicable
Message error	104	Value too long	A value exceeded the normative length.	Not applicable

Example of a message sent by Yumizen H550:
ERR|||101|E||||A required field is missing from a segment

4.2.11. Special characteristics for HORIBA Medical data

4.2.11.1. Data Presentation

Parameters	CBC Code	Conventional	SI (international)	mmol/L	Japan
White Blood Cell	**WBC**	10^3/µL	10^9/L	10^9/L	10^2/µL
Red Blood Cell	**RBC**	10^6/µL	10^{12}/L	10^{12}/L	10^4/µL
Hemoglobin	**HGB**	g/dL	g/L	mmol/L	g/dL
Hematocrit	**HCT**	%	L/L	L/L	%
Mean Corpuscular Volume	**MCV**	µm^3	fL	fL	fL
Mean Corpuscular Hemoglobin	**MCH**	pg	pg	fmol	pg
Mean Corpuscular Hemoglobin Concentration	**MCHC**	g/dL	g/L	mmol/L	g/dL
Red Distribution Width	**RDW-CV**	%	%	%	%
Red Distribution Width Standard Deviation	**RDW-SD** *	µm^3	fL	fL	µm^3
Platelets	**PLT**	10^3/µL	10^9/L	10^9/L	10^4/µL
Platelet Distribution Width	**PDW** *	µm^3	fL	fL	µm^3
Plateletcrit	**PCT** *	%	L/L	L/L	%
Platelets - Large Cell Count	**P-LCC** *	10^3/µL	10^9/L	10^9/L	10^4/µL
Platelets - Large Cell Ratio Calculation	**P-LCR** *	%	%	%	%
Mean Platelet Volume	**MPV**	µm^3	fL	fL	fL

Parameters	DIFF Code	Conventional	SI (international)	mmol/L	Japan
Lymphocytes #	**LYM#**	10^3/µL	10^9/L	10^9/L	10^2/µL
Lymphocytes %	**LYM%**	%	%	%	%
Monocytes #	**MON#**	10^3/µL	10^9/L	10^9/L	10^2/µL
Monocytes %	**MON%**	%	%	%	%
Neutrophils #	**NEU#**	10^3/µL	10^9/L	10^9/L	10^2/µL
Neutrophils %	**NEU%**	%	%	%	%
Eosinophils #	**EOS#**	10^3/µL	10^9/L	10^9/L	10^2/µL
Eosinophils %	**EOS%**	%	%	%	%

Parameters	DIFF Code	Conventional	SI (international)	mmol/L	Japan
Basophils #	**BAS#**	10^3/µL	10^9/L	10^9/L	10^2/µL
Basophils %	**BAS%**	%	%	%	%
Large Immature Cells #	**LIC# ***	10^3/µL	10^9/L	10^9/L	10^2/µL
Large Immature Cells %	**LIC% ***	%	%	%	%

* USA only: PDW, PCT, P-LCC, P-LCR, RDW-SD, LIC# and LIC% have not been validated for a clinical diagnostic use in USA for this instrument.

4.3. Laboratory Testing Workflow Examples

4.3.1. LIS to Yumizen H550 standard test request

Message without optional segments

```
MSH|^~\&|||YH550^123456A^1.0.0|HORIBA_MEDICAL|20161012144125||OML^033^OML_033|
20161012145002000002|P|2.5|||||||UNICODE UTF-8
PID|1||PID0002^^^^PI||Doe^John||19800926|M
SPM|1|0123456789||WB||||||P||||||20161012145110|20161012181002
ORC|NW|||||||||||||||^Hematology_Department
OBR|1|||CBC||||||||||789456^MISTER PHYSICIAN
```

Message with optional segments

```
MSH|^~\&|||YH550^123456A^1.0.0|HORIBA_MEDICAL|20161012144125||OML^033^OML_033|
20161012145002000002|P|2.5|||||||UNICODE UTF-8
PID|1||PID0002^^^^PI||Doe^John||19800926|M
NTE|1||the patient is afraid of needles|G
SPM|1|0123456789||WB||||||P||||||20161009145110|20161009181002
OBX|1|NM|35659-2^Age at specimen collection^LN||36|a^Year^UCUM|||||F
SAC|||||||||01234^2|1
ORC|NW|||||||||||||||^Hematology_Department
OBR|1|||CBC||||||||||789456^MISTER PHYSICIAN
NTE|1||order comment|G
```

4.3.2. Yumizen H550 to LIS acknowledgment

Message accepted

```
MSH|^~\&|YH550^123456A^1.0.0|HORIBA_MEDICAL|setting|setting|20161012152010||
OML^034^OML_034|20161012152002000003|P|2.5|||||||UNICODE UTF-8
MSA|AA|20161012145002000002
```

Message rejected

```
MSH|^~\&|YH550^123456A^1.0.0|HORIBA_MEDICAL|setting|setting|20161012152010||
OML^034^OML_034|20161012152002000003|P|2.5|||||||UNICODE UTF-8
MSA|AR|20161012145002000002
ERR|||203|E|||| The Version ID is not supported
```

Message error

MSH|^~\&|YH550^123456A^1.0.0|HORIBA_MEDICAL|setting|setting|20161012152010||
OML^034^OML_034|20161012152002000003|P|2.5|||||UNICODE UTF-8

MSA|AE|20161012145002000002

ERR|||101|E|||| A required field is missing from a segment

4.3.3. Yumizen H550 to LIS standard result

MSH|^~\&|H550^112YAXH47741^1.0.0.4e|HORIBA_MEDICAL|ReceivingApplication|
ReceivingFacility|20170522122311||OUL^R22^OUL_R22|20170522122311000003|P|2.5|||||
UNICODE UTF-8

PID|1||^^^^PI

SPM|1|SID_12345||WB|||||P

OBX|1|NM|35659-2^Age at specimen collection^LN|||a|||||F

SAC|||||||||1000|1

OBR|1|||DIF|||||||||||||||20170522122236|||F|||||||Tech_111

ORC|SC

NTE|1|L|
P^^NOT_EFFECTIVE~P^^CONTROL_FAILED~P^^REAGENT_EXPIRED~P^^OPEN~P^^TECHNI
CIAN_ANALYSIS~P^^LARGE_IMMATURE_CELLS|I

OBX|1|NM|21000-5^RDW-SD^LN||41.6|um3|37.0 - 49.0^REFERENCE_RANGE|N~F|||F||||Tech_111

OBX|2|NM|55432-9^LIC#^LN||0.29|10E3/uL|0.00 - 0.10^REFERENCE_RANGE|H~F|||F||||Tech_111

OBX|3|NM|55433-7^LIC%^LN||3.7|%|0.0 - 1.0^REFERENCE_RANGE|HH~F|||F||||Tech_111

OBX|4|NM|704-7^BAS#^LN||0.05|10E3/uL|0.00 - 0.15^REFERENCE_RANGE|N~F|||F||||Tech_111

OBX|5|NM|48386-7^P-LCR^LN||0.1|%|18.0 - 50.0^REFERENCE_RANGE|L~F|||F||||Tech_111

OBX|6|NM|711-2^EOS#^LN||0.27|10E3/uL|0.00 - 0.50^REFERENCE_RANGE|N~F|||F||||Tech_111

OBX|7|NM|706-2^BAS%^LN||0.7|%|0.0 - 2.0^REFERENCE_RANGE|N~F|||F||||Tech_111

OBX|8|NM|5905-5^MON%^LN||2.4|%|4.0 - 12.0^REFERENCE_RANGE|L~F|||F||||Tech_111

OBX|9|NM|713-8^EOS%^LN||3.5|%|0.5 - 7.0^REFERENCE_RANGE|N~F|||F||||Tech_111

OBX|10|NM|51631-0^PDW^LN||15.2|um3|11.0 - 22.0^REFERENCE_RANGE|N~F|||F||||Tech_111

OBX|11|NM|787-2^MCV^LN||95.6|um3|76.0 - 100.0^REFERENCE_RANGE|N~Z|||F||||Tech_111

OBX|12|NM|742-7^MON#^LN||0.18|10E3/uL|0.20 - 0.80^REFERENCE_RANGE|L~F|||F||||Tech_111

OBX|13|NM|^P-LCC^LN||0|10E3/uL|44 - 140^REFERENCE_RANGE|L~F|||F||||Tech_111

OBX|14|NM|731-0^LYM#^LN||2.14|10E3/uL|1.00 - 3.00^REFERENCE_RANGE|N~F|||F||||Tech_111

OBX|15|NM|785-6^MCH^LN||30.9|pg|27.0 - 34.0^REFERENCE_RANGE|N~F|||F||||Tech_111

OBX|16|NM|736-9^LYM%^LN||27.2|%|15.0 - 45.0^REFERENCE_RANGE|N~F|||F||||Tech_111

OBX|17|NM|32623-1^MPV^LN||9.1|um3|8.0 - 11.0^REFERENCE_RANGE|N~F|||F||||Tech_111

OBX|18|NM|786-4^MCHC^LN||31.6|g/dL|32.0 - 35.0^REFERENCE_RANGE|LL~F|||F||||Tech_111

OBX|19|NM|751-8^NEU#^LN||6.70|10E3/uL|1.60 - 7.00^REFERENCE_RANGE|N~F|||F||||Tech_111

OBX|20|NM|770-8^NEU%^LN||66.2|%|40.0 - 73.0^REFERENCE_RANGE|N~F|||F||||Tech_111

OBX|21|NM|4544-3^HCT^LN||37.3|%|35.0 - 52.0^REFERENCE_RANGE|N~Z|||F||||Tech_111

OBX|22|NM|718-7^HGB^LN||12.3|g/dL|11.5 - 17.0^REFERENCE_RANGE|N~F|||F||||Tech_111

OBX|23|NM|51637-7^PCT^LN||0.45|%|0.15 - 0.40^REFERENCE_RANGE|H~F|||F||||Tech_111

OBX|24|NM|789-8^RBC^LN||4.47|10E6/uL|3.80 - 6.00^REFERENCE_RANGE|N~Z|||F||||Tech_111

OBX|25|NM|777-3^PLT^LN||206|10E3/uL|150 - 400^REFERENCE_RANGE|N~F|||F||||Tech_111

OBX|26|NM|788-0^RDW-CV^LN||14.5|%|11.0 - 17.0^REFERENCE_RANGE|N~F|||F||||Tech_111

OBX|27|NM|6690-2^WBC^LN||9.63|10E3/uL|3.50 - 10.00^REFERENCE_RANGE|N~F|||F||||
Tech_111

4.3.4. LIS to Yumizen H550 acknowledgment

MSH|^~\&|||YH550^123456A^1.0.0|HORIBA_MEDICAL|20161012152010||OML^034^OML_034|
20161012152002000003|P|2.5|||||UNICODE UTF-8

MSA|AA|20161012145002000002

4.4. References

Title	Version	Date	Author
HL7 Messaging Standard	2.5	2013	HL7 Int.
IHE Laboratory (LAB) Technical Framework	5.0	2013	IHE Int.