HORIBA Medical

Yumizen H500

Hematology Analyzer

Output Format for Host Connection

Ref: RAA055DEN

Output Format for Host Connection

CE IVD

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Contents

1. Foreword

1.1. Revisions

Internal Reference	Software Version	Document Date Issued
RAA055AEN	1.0.x (OT only)	April 2015
RAA055BEN	1.0.x (OT only)	April 2015
RAA055CEN	2.0.x	January 2016
RAA055DEN	2.1.x	November 2016

1.2. What's New?

Here is the list of major updates in this document release:

- Curves and matrix sending in ASTM format: Curves and Matrix Transmission.

2. Introduction

The ASTM format is recommended by HORIBA Medical for every new connection development.

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).
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. Connection

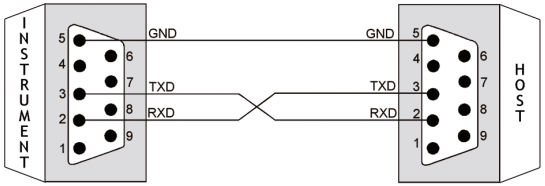
3.1. Serial Connection (RS232)

3.1.1. RS232 Connection Overview

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 H500 OT/CT Data Management System is configured as Data Terminal Equipment (DTE).

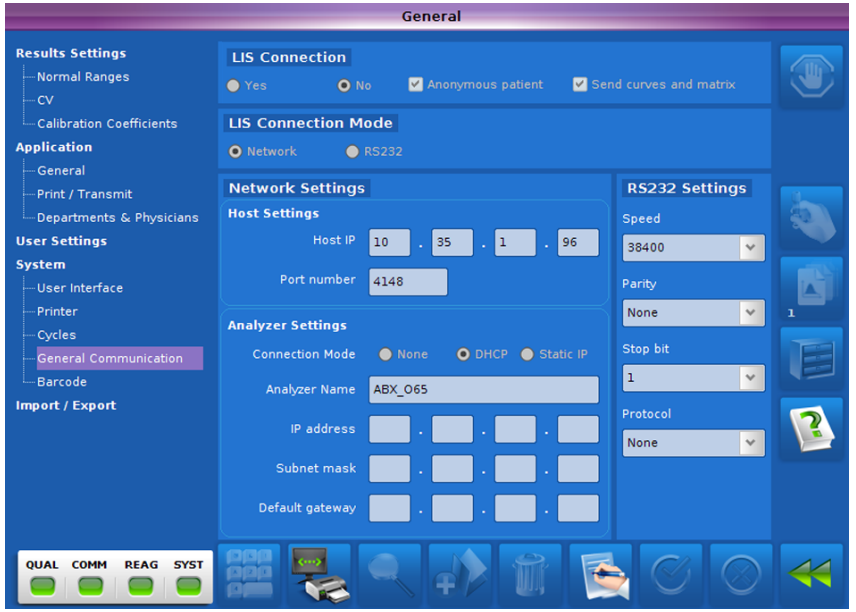
The Yumizen H500 OT/CT should be connected to the LIS via the DB-9 connector of the instrument computer connection.

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



3.1.2. Instrument Connection

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



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

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

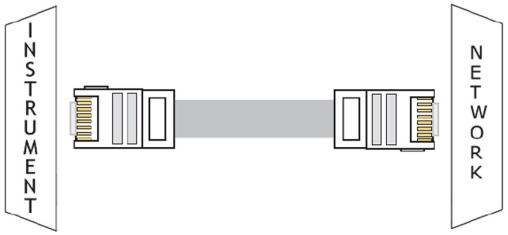
3.2. Ethernet Connection

3.2.1. Ethernet Connection Overview

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

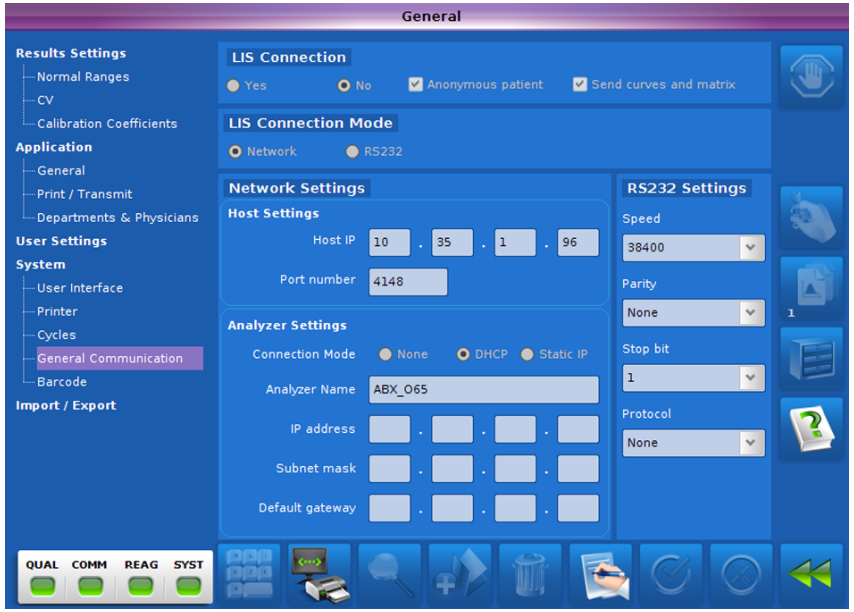
The data transmitted between the client and the server takes the form of ASTM high level packets.

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



3.2.2. Instrument Connection

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



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

4. 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.

4.1. Connection Specifications (LIS01-A2)

4.1.1. 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

4.1.2. Output Data Characteristics

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

4.1.3. 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>	>	

4.1.4. 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>.

4.2. 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

4.2.1. 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 H500 OT/CT.

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
- .. C (Run Alarms) 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)

4.2.2. 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 "\" .

4.2.2.1. 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&

4.2.2.2. 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.

4.2.2.3. 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)

Message	Definition
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 CONNEXION ERROR

4.2.2.4. 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					

ASTM field	Definition	Transmitted data	Field max. length	Input type	Repeat delimiter	Mandatory
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	YYYYMMDDH HMMSS	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.

4.2.2.5. 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
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					

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

4.2.2.6. 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

ASTM field	Definition	Transmitted data	Field max. length	Input type	Repeat delimiter	Mandatory
8.9	Collection End Time	YYYYMMDDHHMMSS	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	YYYYMMDDHHMMSS	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 H500 OT/CT will send back the order with the record type field set to "X" and the received order will be ignored.

4.2.2.7. 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
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					

ASTM field	Definition	Transmitted data	Field max. length	Input type	Repeat delimiter	Mandatory
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	YYYYMMDDHHMMSS	14	Date	No	Yes
9.13	Date/Time Test Completed	YYYYMMDDHHMMSS	14	Date	No	No
9.14	Device Identification	From instrument to host: 9380BDED579C From host to instrument: not used	15	Alphanumeric	No	No

4.2.2.8. 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 asLeukocytosis or Large Immature Cells.
- **CONTROL_FAILED** for alarms due to bad control result.

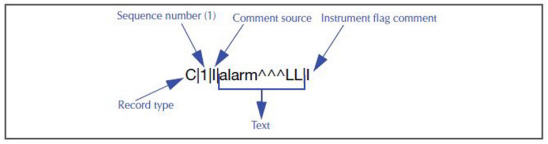
The Comment Text (10.4) field can contain a measurement type data as follows:

- **HGB** if the alarm is linked to the hemoglobin measurement.
- **LMNEB** 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 one of the analysis alarms values specified in Alarms and Pathologies.

- 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:



4.2.2.9. 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

4.2.2.10. 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

ASTM field	Definition	Transmitted data	Field max. length	Input type	Repeat delimiter	Mandatory
14.4	Traceability name	Reagent name: CLEANER, DILUENT, LYSE	20	Open list	Yes	Yes
14.5	Traceability Information	120130H1*^20120327151737^20120727	33 (9^14^8)	Alpha-numeric^Date and Time^Date Open list Alphanumeric	Yes Yes Yes	Yes^No^Yes Yes Yes

4.2.2.11. 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

4.3. Special characteristics for HORIBA Medical data

4.3.1. 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** *	$10^3/\mu L$	$10^9/L$	$10^9/L$	$10^4/\mu L$

Parameters	CBC Code	Conventional	SI (international)	mmol/L	Japan
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% ***	%	%	%	%

* PDW, PCT, P-LCC, P-LCR, RDW-SD, LIC# and LIC% have not been established as indications for use in United States for this instrument. Their use should be restricted to Research Use Only (RUO). Not for use in diagnostic procedure.

4.3.2. Alarms and Pathologies

4.3.2.1. 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.

4.3.2.2. 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.

4.3.2.3. Analytical Alarms

Parameters	Transmitted data		Description
	1.0.x (OT only)	2.0.x and 2.1.x	
HGB	BLK_OUT_OF_RANGE	BLK_OUT_OF_RANGE	Blank out of range
HGB	HGB_INSTABILITY	HGB_INSTABILITY	Ten consecutive HGB measurements are not enough consistent to provide a reliable result.
HGB	BLANK_INSTABILITY	BLANK_INSTABILITY	The two consecutive HGB blank measurements results are out of a reliable range.
HGB	OUT_OF_LINEARITY_RAN	OUT_OF_LINEARITY_RANGE	HGB measurement out of linearity range

Parameters	Transmitted data		Description
	1.0.x (OT only)	2.0.x and 2.1.x	
LMNEB	NOISE	NOISE	Background noise
LMNEB	LL_OR_LL1_INTERFERENCE	LL_OR_LL1_INTERFERENCE	LYM Interference
LMNEB	MON_INTERFERENCE	MON_INTERFERENCE	MON Interference
LMNEB	SMALL_NEU	ABNORMAL_DIFFERENTIATION	Abnormal differentiation
LMNEB	SEP_MON_NEU	ABNORMAL_DIFFERENTIATION	Abnormal differentiation
LMNEB	SEP_NEU_EOS	ABNORMAL_DIFFERENTIATION	Abnormal differentiation
LMNEB	SEP_LYM_MON	ABNORMAL_DIFFERENTIATION	Abnormal differentiation
LMNEB	SEP_LYM_NEU	ABNORMAL_DIFFERENTIATION	Abnormal differentiation
LMNEB	CORRELATION_TOO_LOW	ABNORMAL_DIFFERENTIATION	Low WBC correlation between optical ans resistive measurements
LMNEB	ALY	(removed)	Atypic Lymphocytes
LMNEB	LMNE_OUT_OF_LINEARIT	LMNE_OUT_OF_LINEARITY_RANGE	Out of linearity range
LMNEB	LIGHT_SHIFT	LIGHT_SHIFT	Optical bench light error
LMNEB	ZERO_COUNTING	ZERO_COUNTING	No count
LMNEB	COUNTING_INSTABILITY	COUNTING_INSTABILITY	Unstable Count
RBC	HCT_OUT_OF_LINEARITY	HCT_OUT_OF_LINEARITY_RANGE	HCT out of linearity range
RBC	ZERO_COUNTING	ZERO_COUNTING	No count
RBC	BIG CELLS EXCESS	BIG CELLS EXCESS	Nucleated cells interference
RBC	RBC_DBL	RBC_DBL	RBC double population
RBC	RBC_COUNT_TOO_LOW	RBC_COUNT_TOO_LOW	Low Count
RBC	RBC_OUT_OF_LINEARITY	RBC_OUT_OF_LINEARITY_RANGE	Out of linearity range
RBC	(none)	ABNORMAL_MCH	Abnormal MCH
RBC	(none)	ABNORMAL_MCHC	Abnormal MCHC
RBC	(none)	COUNTING_INSTABILITY	Unstable Count
PLT	SEP_RBC_PLT	SEP_RBC_PLT	RBC PLT Interference
PLT	SCH	SCH (2.0.x) SEP_RBC_PLT (2.1.x)	Schizocytes presence
PLT	SCL	SCL (2.0.x) NOISE (2.1.x)	Background noise
PLT	PLT_COUNT_TOO_LOW	PLT_COUNT_TOO_LOW	Low Count
PLT	ZERO_COUNTING	ZERO_COUNTING	No count
PLT	PLT_OUT_OF_LINEARITY	PLT_OUT_OF_LINEARITY_RANGE	Out of linearity range
PLT	COUNTING_INSTABILITY	COUNTING_INSTABILITY	Unstable Count
PLT	NOISE	NOISE	Background noise
PLT	PC_MODE	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

4.4. Curves and Matrix Transmission

4.4.1. 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

4.4.2. 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.

4.4.3. 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

4.4.4. 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)

4.5. Example of Data Frame

4.5.1. 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>

4.5.2. 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>

4.5.3. 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|
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<- <STX>2R|12|^^^HGB^718-7|142|g/L|133 - 143|N||F||technician^^TECHNICIAN|20150323160321||<CR><ETX>9E<CR><LF>

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<- <STX>6R|16|^^^MCH^785-6|31.5|pg|27.6 - 31.6|N||F||technician^^TECHNICIAN|20150323160321||<CR><ETX>3B<CR><LF>

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<- <STX>7R|17|^^^MCHC^786-4|426|g/L|339 - 399|N||F||technician^^TECHNICIAN|20150323160321||<CR><ETX>0E<CR><LF>

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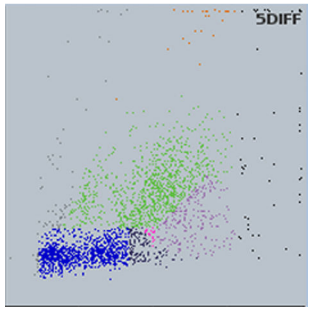
<- <EOT>

4.5.4. Example of Data Frame for LMNEB Matrix



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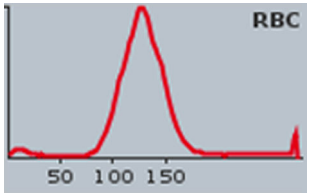
4.5.5. Example of Data Frame for Histograms



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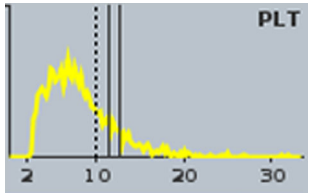

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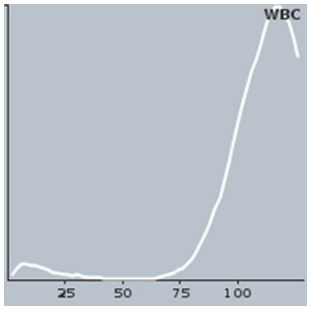

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