



## Hematology Analyzer

## Output Formats

Ref: RAA055CEN



## Foreword

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### Revisions

Table 1: Revision table

| Part number | Software version | Chapters                                            | Date          |
|-------------|------------------|-----------------------------------------------------|---------------|
| RAA055AEN   | V 1.0.x          | All                                                 | April 2015    |
| RAA055BEN   | V1.0.x           | Restrictions associated to version 1.0.x of Yumizen | June 2015     |
| RAA055CEN   | V2.0.X           | All                                                 | February 2016 |

### Modifications

This document applies for Yumizen H500 OT and Yumizen H500 CT instruments.

- The Yumizen H500 OT/CT can transmit to the LIS and receive from the LIS other characters than the basic ASCII table ones.
- Patient Name and Attending Physician ID fields have been updated: refer to [Patient record fields](#) on page 12.
- Order record fields specifications have been updated: refer to [«Order» record fields specifications](#) on page 15.
- Analysis alarms list and suspected pathologies list have been updated: refer to [Suspected pathologies list](#) on page 26.

## Introduction

The Yumizen H500 communicates with the LIS using ASTM-CI (ASTM Common Implementation) protocol.

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.

Table 2: Definitions

| 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 low-level 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)                                                                                                                                                                                                                             |

Table 2: Definitions

| Term    | Definition                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
|---------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 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), Q (request order), M (manufacturer). |
| 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.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |

## Connections

### Physical connection

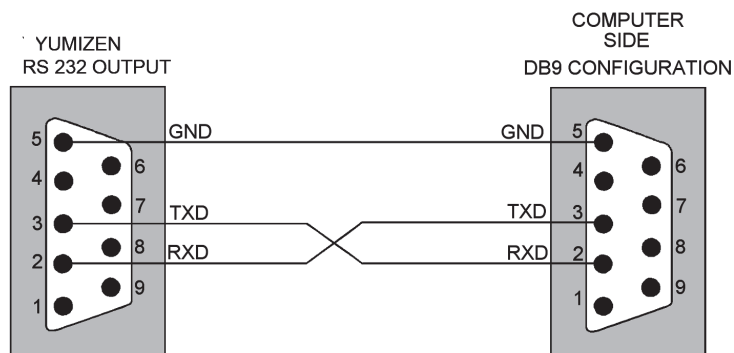
#### 1. RS232

All communications are expected to 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 Data Management System is configured as Data Terminal Equipment (DTE).

The Yumizen H500 System is connected to the LIS via a DB-9 connector.

Table 3: DB9 connection

| Pin (DB9) Yumizen Data Management | LIS Port Configuration | LIS Cable Must Provide |
|-----------------------------------|------------------------|------------------------|
| 3                                 | TXD                    | TXD                    |
| 2                                 | RXD                    | RXD                    |
| 5                                 | Ground                 | Ground                 |

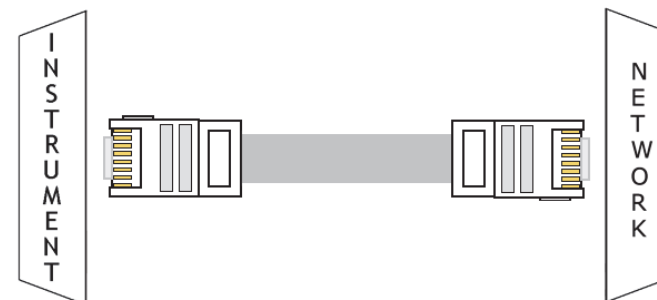


#### 2. Ethernet (RJ45)

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.

The control characters are the same as those used for the Serial Interface.



## General communication settings

Access (Super User access rights) **Settings > System > General communication**

- Select **Yes** in the **LIS Connection** area.
- Select **Network** or **RS232** in the **LIS Connection Mode** area.

- The Analyzer **IP address**
- The **Subnet Mask** IP address
- The **default Gateway** IP address



### 1. RS232

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

- The baud speed value (1200, 2400, 4800, 9600, 19200, 38400, 57600, 115200)
- The parity value (None, Odd, Even)
- The bit stop value (1 or 2)
- The protocol value (None by default, Xon, Xoff)

### 2. Ethernet connection

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: None, DHCP** (default) or **Static IP**
- The **Analyzer Name**

## ASTM-CI format

The HORIBA Medical analyzers format responds 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.

### 1. Connection specifications (ASTM LIS01-A2)

#### 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

#### 1.2. Output data characteristics

Characters: ASCII

Maximum message length: 247 characters (240 useful characters).

#### 1.3. Communication protocol

Table 4: Standard control characters

| Control String | Hexadecimal value |
|----------------|-------------------|
| <ENQ>          | \$05              |
| <ACK>          | \$06              |
| <NAK>          | \$15              |
| <STX>          | \$02              |
| <ETX>          | \$03              |
| <ETB>          | \$17              |

Table 4: Standard control characters

| Control String | Hexadecimal value |
|----------------|-------------------|
| <CR>           | \$0D              |
| <LF>           | \$0A              |
| <EOT>          | \$04              |

#### 1.3.1. Instrument/Host connection

Table 5: Typical discussion between the instrument and the host with 2 frames less than or equal to 247 bytes

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

Table 6: Typical dialogue between the instrument and the host with one frame of more than 247 bytes (240 usefull data bytes)

| Instrument                              | <> | Host  |
|-----------------------------------------|----|-------|
| <ENQ>                                   | >  |       |
|                                         | <  | <ACK> |
| <STX>1...Data(240) ...<ETB>xx<CR><LF>   | >  |       |
|                                         | <  | <ACK> |
| <STX>2...Data(10)...<CR><ETX>xx<CR><LF> | >  |       |
|                                         | <  | <ACK> |
| <EOT>                                   | >  |       |

### 1.3.2. 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

### 1.3.3. Defect packet during discussion between Instrument and Host

Table 7: Defect packet during discussion between Instrment 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>                               | >  |       |
| Instrument                          | <> | Host  |

### 1.4. ASTM Data frame format

A sequential number located after the <STX> character is inserted into each Data frame. The low-level 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 low-level frame number allows the receiver to distinguish new and retransmitted frames, in case of retransmitted frame (after a <NAK> response from the host), the low-level frame number is not incremented: <STX>1...Data...<CR><ETX>xx<CR><LF>

Table 8: 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, Comment messages, Query and Manufacturer                 |
| 3          | End of data message<br>ETX if end frame |                  | 1          |                                                                                          |
| 4          | Checksum                                |                  | 2          |                                                                                          |
| 5          | CRLF                                    | \$0D \$0A        | 2          |                                                                                          |

#### 1.4.1. Frame cheksum

According to ASTM LIS01-A2, the frame cheksum (<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>

## 2. Records general format specifications (ASTM LIS2-A2)

Data frames encapsulate records defined by the ASTM LIS2-A2 norm, records themselves encapsulate ASTM fields.

Table 9: ASTM Records

| Record ID | ASTM Definition |
|-----------|-----------------|
| H         | Header          |
| P         | Patient         |
| O         | Order           |
| R         | Result          |
| C         | Comment         |

Table 9: ASTM Records

| Record ID | ASTM Definition                   |
|-----------|-----------------------------------|
| Q         | Query (Request information order) |
| M         | Manufacturer information          |
| L         | Terminator record                 |

## 2.1. Structure of Records

### 2.1.1. Structure of records for Order transmission

- H (Header)
- .. P (Patient)
- .....C (Patient Comments) Optional
- .....O (Order)
- .....

The transmission of an order without patient record is not allowed.

### 2.1.2. Structure of records for Result transmission

- H (Header)
- P (Patient)
- C (Patient Comments) Optional
- .. O (Order)
- ..... C (Order Comments) Optional
- ..... M (Traceability) Optional
- ..... R (Result)
- ..... R (Result)
- .....Q (Request information)
- L (Terminator)

### 2.1.3. Discussion with conflict between the instrument and the host

Sended data: No answer from Host for frame data

- Timeout: 15 seconds

- In case of negative answer (NAK): No time before a new transmission, up to 6 transmissions

Received data: Instrument waiting for frame data

- Timeout: 30 seconds

### 3. 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 delimiter inside records is “|”.
- Repeat delimiter inside a field is '\|’.
- Component delimiter inside a field is '^’.

#### 3.1. 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:

&Xhhhh&

«hhhh» is the Hexadecimal value of ASCII character completed with zero on 4 digits.

**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 sent or received, all the delimiter characters use the following format:

Table 10: Delimiter Character for Alphanumeric data

| Delimiter       | Escape sequence |
|-----------------|-----------------|
| Field delimiter | &F&             |

Table 10: Delimiter Character for Alphanumeric data

| Delimiter           | Escape sequence |
|---------------------|-----------------|
| Component delimiter | &S&             |
| Repeat delimiter    | &R&             |
| Escape delimiter    | &E&             |

#### 3.2. Records to send

The ASTM-CI controls all record's fields before sending a message.  
 The ASTM-CI sends a record with all mandatory fields filled with valid values.  
 Fields that are not used fields 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. Received records

If a field value, length, delimiter of a received record does not correspond to the required input type, the ASTM-CI generates an error log, and ignores the corresponding record, with all following records of upper level, until a new record of same level is received.

Table 11: Received Records High Level Errors

| Messages                      | 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                          |

Table 11: Received Records High Level Errors

| Messages                           | Definition                                              |
|------------------------------------|---------------------------------------------------------|
| 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  |

Table 12: 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 |

Table 13: Other ASTM errors managed by the instrument

| Message | Definition                  |
|---------|-----------------------------|
| H01     | ASTM PROTOCOL ERROR ORDER   |
| H02     | ASTM CONTEXTUAL ERROR ORDER |
| H03     | ASTM CONNEXION ERROR        |

### 3.4. Header record

Table 14: Header record fields

| ASTM field | Definition                                   | Transmitted data                                                                                               | Field max. length | Input Type                             | Repeat Delimiter | Mandatory |
|------------|----------------------------------------------|----------------------------------------------------------------------------------------------------------------|-------------------|----------------------------------------|------------------|-----------|
| 6.1        | Record Type ID                               | H                                                                                                              | 1                 | Fixed                                  | No               | Yes       |
| 6.2        | Delimiter Definition                         | \^&<br>Description :<br>  Field Delimiter<br>\ Repeat Delimiter<br>^ Component Delimiter<br>& Escape Delimiter | 4                 | Fixed                                  | No               | Yes       |
| 6.3        | Message Control ID                           | Not used                                                                                                       |                   |                                        |                  |           |
| 6.4        | Access Password                              | Not used                                                                                                       |                   |                                        |                  |           |
| 6.5        | Sender Name or ID<br>(From device to host)   | H500^SerialNumber^Software version<br>eg. : H500^9380BDED579C^v2.0.0.x                                         | 32 (5^15^10)      | Fixed^Alphanumeric^Fixed               | No               | Yes       |
| 6.5        | Sender Name or ID<br>(From Host to device)   | Host name                                                                                                      | 32                | Alphanumeric                           | No               | No        |
| 6.6        | Sender Address                               | Not used                                                                                                       |                   |                                        |                  |           |
| 6.7        | Reserved Field                               | Not used                                                                                                       |                   |                                        |                  |           |
| 6.8        | Sender Telephone Nb                          | Not used                                                                                                       |                   |                                        |                  |           |
| 6.9        | Characteristic of Sender                     | Not used                                                                                                       |                   |                                        |                  |           |
| 6.10       | Receiver Name or ID<br>(From device to host) | Host name                                                                                                      | 32                | Alphanumeric                           | No               | No        |
| 6.10       | Receiver Name or ID<br>(From Host to device) | InstrumentCode^SerialNumber^Software version<br>H500^9380BDED579C^v2.0.0.x                                     | 32 (5^15^10)      | Alphanumeric^Alphanumeric^Alphanumeric | No               | No        |
| 6.11       | Comment or Special Instruction               | Not used                                                                                                       |                   |                                        |                  |           |
| 6.12       | Processing ID                                | « P » for a Patient analysis,<br>« Q » for a QC,<br>« D » for technician                                       | 1                 | Fixed list                             | No               | Yes       |
| 6.13       | Version Number                               | « LIS2-A2 »                                                                                                    | 10                | Fixed                                  | No               | Yes       |
| 6.14       | Date and Time of Message                     | YYYYMMDDHHMMSS                                                                                                 | 14                | Date and time                          | No               | No        |

#### From device to Host

In case of remote command response, the field 6.5 should be an exact copy from the 6.10 field sent in the request by the host.  
Do not insert separator between 6.1 and 6.2 fields.

From Host to device

In case of request information response, the field 6.5 should be an exact copy from the 6.10 field sent in the request by the instrument.  
Do not insert separator between 6.1 and 6.2 fields.

**3.5. Patient record**

Table 15: Patient record fields

| ASTM Field | ASTM definition                                                                                                                             | Instrument Definition      | Transmitted data                                                   | Field max. length | Input Type                  | Repeat Delimiter | Mandatory |
|------------|---------------------------------------------------------------------------------------------------------------------------------------------|----------------------------|--------------------------------------------------------------------|-------------------|-----------------------------|------------------|-----------|
| 7.1        | Record Type                                                                                                                                 |                            | P                                                                  | 1                 | Fixed                       | No               | Yes       |
| 7.2        | Sequence Number                                                                                                                             | Sequence of Patient record | 1..99                                                              | 2                 | Numeric                     | No               | Yes       |
| 7.3        | Practice Assigned Patient ID                                                                                                                | Not used                   | Not used                                                           |                   |                             |                  |           |
| 7.4        | Laboratory Assigned Patient ID                                                                                                              | PatientID                  | Patient Id                                                         | 25                | Alphanumeric                | No               | No        |
| 7.5        | Patient ID N°3                                                                                                                              | Not used                   | Not used                                                           |                   |                             |                  |           |
| 7.6        | Patient Name<br>(This field is not transmitted if the «Anonymous patient» check box is selected in the <i>General Communication</i> screen) | Last Name^First Name       | Last Name^First Name                                               | 41 (20^20)        | Alphanumeric                | No               | No        |
| 7.7        | Mother's Maiden Name                                                                                                                        | Not used                   | Not used                                                           |                   |                             |                  |           |
| 7.8        | Birthdate                                                                                                                                   | Birth Date^Age^Age unit    | YYYYMMDD^AGE^U<br>U : « Y » - year, « M » - month ,<br>« D » - day | 14 (8^3^1)        | Date^ numeric^Fixed List    | No               | No        |
| 7.9        | Patient Sex                                                                                                                                 | Gender                     | « M » - male<br>« F » - female<br>« U » - unknown                  | 1                 | Fixed list                  | No               | No        |
| 7.10       | Patient Race-Ethnic Origin                                                                                                                  | Patient Race               | Not used                                                           |                   |                             |                  |           |
| 7.11       | Patient Address                                                                                                                             | Not used                   | Not used                                                           |                   |                             |                  |           |
| 7.12       | Reserved Field                                                                                                                              | Not used                   | Not used                                                           |                   |                             |                  |           |
| 7.13       | Patient Telephone Nb                                                                                                                        | Not used                   | Not used                                                           |                   |                             |                  |           |
| 7.14       | Attending Physician ID                                                                                                                      | PhysicianID^PhysicianName  | PhysicianID^PhysicianName                                          | 51 (20^30)        | Alpha-numeric^Alpha-numeric | No               | No^No     |
| 7.15       | Special Field 1                                                                                                                             | Not used                   | Not used                                                           |                   |                             |                  |           |
| 7.16       | Special Field 2                                                                                                                             | Not used                   | Not used                                                           |                   |                             |                  |           |
| 7.17       | Patient Height                                                                                                                              | Not used                   | Not used                                                           |                   |                             |                  |           |
| 7.18       | Patient Weight                                                                                                                              | Not used                   | Not used                                                           |                   |                             |                  |           |
| 7.19       | Patient's known or suspect diag                                                                                                             | Not used                   | Not used                                                           |                   |                             |                  |           |
| 7.20       | Patient's active medication                                                                                                                 | Not used                   | Not used                                                           |                   |                             |                  |           |

Table 15: Patient record fields

| ASTM Field | ASTM definition                  | Instrument Definition | Transmitted data                   | Field max. length | Input Type   | Repeat Delimiter | Mandatory |
|------------|----------------------------------|-----------------------|------------------------------------|-------------------|--------------|------------------|-----------|
| 7.21       | Patient's diet                   | Not used              | Not used                           |                   |              |                  |           |
| 7.22       | Practice Field 1                 | Not used              | Not used                           |                   |              |                  |           |
| 7.23       | Practice Field 2                 | Not used              | Not used                           |                   |              |                  |           |
| 7.24       | Admission and discharge          | Not used              | Not used                           |                   |              |                  |           |
| 7.25       | Admission status                 | Not used              | Not used                           |                   |              |                  |           |
| 7.26       | Location                         | Department            | eg. : Emergency                    | 20                | Alphanumeric | No               | No        |
| 7.27       | Nature of Alter. Diag. Code      | Not used              | Not used                           |                   |              |                  |           |
| 7.28       | Alternative diag. code and class | Not used              | Not used                           |                   |              |                  |           |
| 7.29       | Patient Religion                 | Not used              | Not used                           |                   |              |                  |           |
| 7.30       | Marital Status                   | Not used              | Not used                           |                   |              |                  |           |
| 7.31       | Isolation Status                 | Not used              | Not used                           |                   |              |                  |           |
| 7.32       | Language                         | Not used              | Not used                           |                   |              |                  |           |
| 7.33       | Hospital Service                 | Not used              | Not used                           |                   |              |                  |           |
| 7.34       | Hospital Institution             | Not used              | Not used                           |                   |              |                  |           |
| 7.35       | Dosage Category                  | Patient Type          | eg. : Child 1, Child 2, Adult, etc | 20                | Alphanumeric | No               | No        |

### 3.6. Order record

#### 3.6.1. Description

Table 16: Order record fields

| ASTM Field | ASTM definition    | Instrument Definition    | Transmitted data                       | Field max. length | Input Type    | Repeat Delimiter | Mandatory                                                       |
|------------|--------------------|--------------------------|----------------------------------------|-------------------|---------------|------------------|-----------------------------------------------------------------|
| 8.1        | Record Type ID     |                          | O                                      | 1                 | Fixed         | No               | Yes                                                             |
| 8.2        | Sequence Number    | Sequence of Order record | 1..99                                  | 2                 | Numeric       | No               | Yes                                                             |
| 8.3        | Specimen ID        | SampleID^^^              | For open tube :<br>eg. : 0123456789^^^ | 19(16)            | Alphanumeric  | No               | No^^^                                                           |
| 8.4        | Device Specimen Id | Not used                 | Not used                               |                   |               |                  |                                                                 |
| 8.5        | Universal Test ID  | Tests                    | ^^^Testname (CBC or DIF)               | 6 (^^^3)          | ^^^Fixed list | Yes              | From device to host:<br>^^^Yes<br>From Host to device:<br>^^^No |

Table 16: Order record fields

| ASTM Field | ASTM definition                 | Instrument Definition                         | Transmitted data                                                                                                                                     | Field max. length | Input Type               | Repeat Delimiter | Mandatory                                                               |
|------------|---------------------------------|-----------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------|--------------------------|------------------|-------------------------------------------------------------------------|
| 8.6        | Priority                        | Emergency                                     | « R » - for routine<br>« S » - for STAT                                                                                                              | 1                 | Fixed list               | No               | No                                                                      |
| 8.7        | Requested / Ordered date/time   | Order Date                                    | YYYYMMDDHHMMSS                                                                                                                                       | 14                | Date and time            | No               | No                                                                      |
| 8.8        | Specimen Collection Date/ time  | Collection Date                               | YYYYMMDDHHMMSS                                                                                                                                       | 14                | Date and time            | No               | No                                                                      |
| 8.9        | Collection End Time             | Not used                                      | Not used                                                                                                                                             |                   |                          |                  |                                                                         |
| 8.10       | Collection Volume               | Not used                                      | Not used                                                                                                                                             |                   |                          |                  |                                                                         |
| 8.11       | Collector Id                    | Not used                                      | Not used                                                                                                                                             |                   |                          |                  |                                                                         |
| 8.12       | Action Code                     | Action code                                   | <u>From device to host:</u><br>Not used<br><u>From host to device:</u><br>« A » - Add on existing order<br>« N » - New order<br>« C » - Cancel order | 1                 | Fixed list               | No               | <u>From device to host:</u><br>No<br><u>From Host to device:</u><br>Yes |
| 8.13       | Danger Code                     | Not used                                      | Not used                                                                                                                                             |                   |                          |                  |                                                                         |
| 8.14       | Relevant Clinical Information   | Not used                                      | Not used                                                                                                                                             |                   |                          |                  |                                                                         |
| 8.15       | Date and time Specimen received | Received Date                                 | YYYYMMDDHHMMSS                                                                                                                                       | 14                | Date and time            | No               | No                                                                      |
| 8.16       | Specimen Descriptor             | Specimen Type and Specimen Liquid description | SpecimenType^^SpecimenLiquid<br>SpecimenType :<br>«BLOOD»<br>«CTRL LOW»,<br>«CTRL MEDIUM»,<br>«CTRL HIGH»                                            | 26(12^^12)        | Fixed list^^Alphanumeric | No               | No^^No                                                                  |
| 8.17       | Ordering Physician              | Not used                                      | Not used                                                                                                                                             |                   |                          |                  |                                                                         |
| 8.18       | Physician Phone NB              | Not used                                      | Not used                                                                                                                                             |                   |                          |                  |                                                                         |
| 8.19       | User Field 1                    | Not used                                      | Not used                                                                                                                                             |                   |                          |                  |                                                                         |
| 8.20       | User Field 2                    | Not used                                      | Not used                                                                                                                                             |                   |                          |                  |                                                                         |
| 8.21       | Laboratory Field 1              | Not used                                      | Not used                                                                                                                                             |                   |                          |                  |                                                                         |
| 8.22       | Laboratory Field 2              | Not used                                      | Not used                                                                                                                                             |                   |                          |                  |                                                                         |

Table 16: Order record fields

| ASTM Field | ASTM definition                      | Instrument Definition | Transmitted data                                                                                                                                                                                                             | Field max. length | Input Type | Repeat Delimiter | Mandatory |
|------------|--------------------------------------|-----------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------|------------|------------------|-----------|
| 8.23       | Date and time result reported        | Not used              | Not used                                                                                                                                                                                                                     |                   |            |                  |           |
| 8.24       | Instrument charge to computer system | Not used              | Not used                                                                                                                                                                                                                     |                   |            |                  |           |
| 8.25       | Device Section Id                    | Not used              | Not used                                                                                                                                                                                                                     |                   |            |                  |           |
| 8.26       | Report Types                         |                       | <u>From device to host:</u><br>« F » - Final<br>«X» - Order cannot be done<br><u>From host to device:</u><br>« Q » - response to request information<br>« Z » - no record of this patient<br>« Y » - no test for this record | 1                 | Fixed list | No               | Yes       |
| 8.27       | Reserved Field                       | Not used              | Not used                                                                                                                                                                                                                     |                   |            |                  |           |
| 8.28       | Location or Ward                     | Not used              | Not used                                                                                                                                                                                                                     |                   |            |                  |           |
| 8.29       | Nosocomial Service                   | Not used              | Not used                                                                                                                                                                                                                     |                   |            |                  |           |
| 8.30       | Specimen Service                     | Not used              | Not used                                                                                                                                                                                                                     |                   |            |                  |           |
| 8.31       | Specimen Institution                 | Not used              | Not used                                                                                                                                                                                                                     |                   |            |                  |           |

### 3.6.2. «Order» record fields specifications

The order must follow the following:

- «SampleID» data of «Specimen ID» field (8.3) match the «SampleID» 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» (response to request information)
  - «Z» (no record for this patient)
  - «Y» (no test for this record)

Otherwise, the received order is ignored.

"If a received «Order» contains a «Universal Test ID» (field 8.5) with a TestName different from CBC or DIF, the YH500 will send back the Order with the "Record Type" field set to "X" and the received order will be ignored.



### 3.7. Result Record

Table 17: Result record fields

| ASTM Field | ASTM definition               | Instrument Definition                                                                            | Transmitted data                                                                                                                                                                                                                                                                                   | Field max. length | Input Type                                                              | Repeat Delimiter | Mandatory                 |
|------------|-------------------------------|--------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------|-------------------------------------------------------------------------|------------------|---------------------------|
| 9.1        | Record Type ID                |                                                                                                  | R                                                                                                                                                                                                                                                                                                  | 1                 | Fixed                                                                   | No               | Yes                       |
| 9.2        | Sequence Number               | Sequence of Result record                                                                        | 1..99                                                                                                                                                                                                                                                                                              | 2                 | Numeric                                                                 | No               | Yes                       |
| 9.3        | Universal Test ID             | Test information                                                                                 | ^^^English result name^LOINC^Dil<br>Description :<br>Result name : in English.<br>LOINC <u>from device to host</u> : Code associated with the result name, if available.<br>LOINC <u>from host to device</u> : Not used<br>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                                                                                      | eg. : 1.23, data observation                                                                                                                                                                                                                                                                       | 16                | AlphaNumeric                                                            | No               | No                        |
| 9.5        | Units                         | Test units                                                                                       | Unit text (ISO 2955 or specific)                                                                                                                                                                                                                                                                   | 10                | Open list (refer to <a href="#">Parameters presentation</a> on page 22) | No               | Yes but No if observation |
| 9.6        | Reference Ranges              | <u>From device to host</u> :<br>Reference Ranges<br><u>From Host to device</u> :<br>Not used     | <u>From device to host</u> :<br>Low ranges to high range<br><u>From Host to device</u> :<br>Not used                                                                                                                                                                                               |                   | Alphanumeric                                                            | Yes              | No                        |
| 9.7        | Result Abnormal Flag          | <u>From device to host</u> :<br>Result Abnormal Flag<br><u>From Host to device</u> :<br>Not used | <u>From device to host</u> :<br>« L » - below low normal<br>« H » - above high normal<br>« LL » - below panic normal<br>« HH » - above panic normal<br>« < » - below absolute low<br>« > » - above absolute high<br>« A » - abnormal<br>« N » - normal<br><u>From Host to device</u> :<br>Not used | 2                 | Fixed list                                                              | No               | Yes                       |
| 9.8        | Nature of abnormality Testing | Not used                                                                                         | Not used                                                                                                                                                                                                                                                                                           |                   |                                                                         |                  |                           |
| 9.9        | Result Status                 | <u>From device to host</u> :<br>Result Status<br><u>From Host to device</u> :<br>Not used        | <u>From device to host</u> :<br>« W » - Warning (suspicion on validity)<br>« X » - order cannot be done (result)<br>«F» - Final Result<br><u>From Host to device</u> :<br>Not used                                                                                                                 | 1                 | Fixed list                                                              | No               | Yes                       |



Table 17: Result record fields

| ASTM Field | ASTM definition                | Instrument Definition                                                                         | Transmitted data                                                                                                                                                                                | Field max. length | Input Type                   | Repeat Delimiter | Mandatory |
|------------|--------------------------------|-----------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------|------------------------------|------------------|-----------|
| 9.10       | Date of Change in Norm. Values | Not used                                                                                      | Not used                                                                                                                                                                                        |                   |                              |                  |           |
| 9.11       | Operator Identification        | <u>From device to host:</u><br>Login^^User profile<br><u>From Host to device:</u><br>Not used | <u>From device to host:</u><br>Login^^User profile or<br>LastName FirstName^^User profile<br><br>User profile: TECHNICIAN /<br>LABMANAGER / USER<br><br><u>From Host to device:</u><br>Not used | 63(41^^20)        | Alphanumeric ^^ Alphanumeric | No               | Yes       |
| 9.12       | Date/Time Test Starting        | Date/Time Test Starting                                                                       | YYYYMMDDHHMMSS                                                                                                                                                                                  | 14                | Date                         | No               | Yes       |
| 9.13       | Date/Time Test Completed       | Date/Time Test Completed                                                                      | YYYYMMDDHHMMSS                                                                                                                                                                                  | 14                | Date                         | No               | No        |
| 9.14       | Device Identification          | <u>From device to host:</u><br>Serial Number<br><u>From Host to device:</u><br>Not used       | <u>From device to host:</u><br>eg. : 9380BDED579C<br><u>From Host to device:</u><br>Not used                                                                                                    | 15                | Alphanumeric                 | No               | No        |

From Host to device: The result Frame is used for history purpose.

### 3.8. Comment record

#### 3.8.1. Description

Table 18: Comment record fields

| ASTM Field | ASTM definition | Instrument Definition      | Transmitted data                                                                                                        | Field max. length                  | Input Type                                  | Repeat Delimiter                  | Mandatory                          |
|------------|-----------------|----------------------------|-------------------------------------------------------------------------------------------------------------------------|------------------------------------|---------------------------------------------|-----------------------------------|------------------------------------|
| 10.1       | Record Type ID  |                            | C                                                                                                                       | 1                                  | Fixed                                       | No                                | Yes                                |
| 10.2       | Sequence Number | Sequence of Comment record | 1..99                                                                                                                   | 2                                  | Numeric                                     | No                                | Yes                                |
| 10.3       | Comment source  | Comment source             | « l » - Clinical device system                                                                                          | 1                                  | Fixed list                                  | No                                | Yes                                |
| 10.4       | Comment text    | Comment information        | <u>From device to host:</u><br>For result comment (after R frame) : Alarm                                               | <u>From device to host:</u><br>20  | <u>From device to host:</u><br>Open list    | Yes                               | Yes                                |
|            |                 |                            | For order comment (after O frame):<br>AlarmType^MeasurementType^Alarm<br><i>example:</i><br>"ANALYTICAL^RBC^FEW_EVENTS" | 52(20^10^20)                       | Open list^Open list^Open list               | Yes                               | Yes^No^Yes                         |
|            |                 |                            | For patient comment or sample comment (after P or O frame): Free text                                                   | 200                                | Alphanumeric                                | No                                | Yes                                |
|            |                 |                            | <u>From Host to device:</u><br>Comments                                                                                 | <u>From Host to device:</u><br>200 | <u>From Host to device:</u><br>Alphanumeric | <u>From Host to device:</u><br>No | <u>From Host to device:</u><br>Yes |
| 10.5       | Comment type    | Comment type               | « l » - Device flag comment                                                                                             | 1                                  | Fixed list                                  | No                                | Yes                                |

### 3.8.2. Alarm Specifications

The «Comment text» field (10.4) 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 Hgb instability, Noise, Counting instability, Abnormal NEU distribution ...
- «SUSPECTED\_PATHOLOGY» for suspected pathologies alarms such as Leukocytosis, Large Immature Cells, ...
- «CONTROL\_FAILED» for alarms due to bad control result.

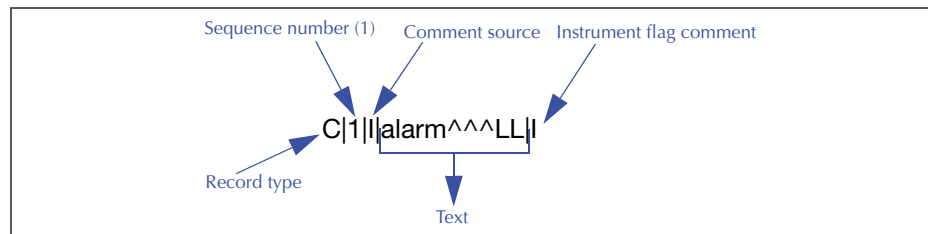
The «Comment text» field (10.4) can contain a Measurement Type data as follows:

- «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» field (10.4) can contain one of the analysis Alarms values specified in [Alarms and Pathologies](#), page 23

- The default condition in case of "CONDITIONS" alarm type, truncated to 20 characters (for exemple REAGENT\_EXPIRED)
- The reason of the controle failure in case of CONTROL\_FAILED alarm type, truncated to 20 characters (for exemple EOS%\_ABOVE\_TOLERANCE, RDW-CV\_DELOW\_TOLERAN )

An analysis alarms comment record is structured as follows:



### 3.9. Request information record

Table 19: Request information record fields

| ASTM Field | ASTM definition                  | Instrument 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                  | Sequence of Request record | 1..99                                 | 2                 | Numeric          | No               | Yes       |
| 11.3       | Starting Range ID Number         | ^SampleID^^^               | For open tube :<br>eg. : ^01234567^^^ | 20(^16^^^)        | ^Alphanumeric^^^ | No               | ^Yes^^^   |
| 11.4       | End Of identifier List           | Not used                   | Not used                              |                   |                  |                  |           |
| 11.5       | Universal Test ID                | ALL                        | ALL                                   | 3                 | Fixed            | No               | Yes       |
| 11.6       | Time limits                      | Not used                   | Not used                              |                   |                  |                  |           |
| 11.7       | Time Max limits                  | Not used                   | Not used                              |                   |                  |                  |           |
| 11.8       | Time Min limits                  | Not used                   | Not used                              |                   |                  |                  |           |
| 11.9       | Physician Name                   | Not used                   | Not used                              |                   |                  |                  |           |
| 11.10      | Telephone Number                 | Not used                   | Not used                              |                   |                  |                  |           |
| 11.11      | Reserved for User                | Not used                   | Not used                              |                   |                  |                  |           |
| 11.12      | Reserved for User                | Not used                   | Not used                              |                   |                  |                  |           |
| 11.13      | Request Information Status Codes | Request Information Status | « O » request for test information    | 1                 | Fixed            | No               | Yes       |

### 3.10. Traceability record

Table 20: «Manufacturer message» record fields

| ASTM Field | ASTM definition          | Instrument Definition                         | Transmitted data                              | Field max. length | Input Type   | Repeat Delimiter | Mandatory  |
|------------|--------------------------|-----------------------------------------------|-----------------------------------------------|-------------------|--------------|------------------|------------|
| 14.1       | Record Type ID           |                                               | M                                             | 1                 | Fixed        | No               | Yes        |
| 14.2       | Sequence Number          | Sequence of Manufacturer record               | 1..99                                         | 2                 | Numeric      | No               | Yes        |
| 14.3       | Message type             | Message type                                  | « REAGENT »                                   | 10                | Fixed list   | No               | Yes        |
| 14.4       | Traceability name        | Traceability name                             | Reagent name:<br>«CLEANER», «DILUENT», «LYSE» | 20                | Open list    | Yes              | Yes        |
| 14.5       | Traceability Information | ReagentID^Loaded date/<br>time^ExpirationDate | eg. : 120130H1*^20120327151737^20120727       | 33 (9^14^8)       | Alphanumeric | Yes              | Yes^No^Yes |

### 3.11. Terminator record

Table 21: Terminator record fields

| ASTM Field | ASTM definition  | Instrument 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..99                 | 1..99            | 2                 | Numeric    | No               | Yes       |
| 12.3       | Termination code | Not used              |                  |                   |            |                  |           |

#### 4. Special characteristics for HORIBA Medical data

##### 4.1. Yumizen Parameters Presentation

Table 22: Parameters presentation

| Parameter                                 | Universal Test ID field 9.3 | Units field 9.5                  |                     |                     |                                  |
|-------------------------------------------|-----------------------------|----------------------------------|---------------------|---------------------|----------------------------------|
|                                           |                             | conventional                     | International       | mmol                | Japanese                         |
| White Blood Cell                          | WBC                         | 10 <sup>3</sup> /mm <sup>3</sup> | 10 <sup>9</sup> /L  | 10 <sup>9</sup> /L  | 10 <sup>2</sup> /mm <sup>3</sup> |
| Lymphocytes #                             | LYM#                        | 10 <sup>3</sup> /mm <sup>3</sup> | 10 <sup>9</sup> /L  | 10 <sup>9</sup> /L  | 10 <sup>2</sup> /mm <sup>3</sup> |
| Lymphocytes %                             | LYM%                        | %                                | %                   | %                   | %                                |
| Monocytes #                               | MON#                        | 10 <sup>3</sup> /mm <sup>3</sup> | 10 <sup>9</sup> /L  | 10 <sup>9</sup> /L  | 10 <sup>2</sup> /mm <sup>3</sup> |
| Monocytes %                               | MON%                        | %                                | %                   | %                   | %                                |
| Neutrophils #                             | NEU#                        | 10 <sup>3</sup> /mm <sup>3</sup> | 10 <sup>9</sup> /L  | 10 <sup>9</sup> /L  | 10 <sup>2</sup> /mm <sup>3</sup> |
| Neutrophils %                             | NEU%                        | %                                | %                   | %                   | %                                |
| Eosinophils #                             | EOS#                        | 10 <sup>3</sup> /mm <sup>3</sup> | 10 <sup>9</sup> /L  | 10 <sup>9</sup> /L  | 10 <sup>2</sup> /mm <sup>3</sup> |
| Eosinophils %                             | EOS%                        | %                                | %                   | %                   | %                                |
| Basophils #                               | BAS#                        | 10 <sup>3</sup> /mm <sup>3</sup> | 10 <sup>9</sup> /L  | 10 <sup>9</sup> /L  | 10 <sup>2</sup> /mm <sup>3</sup> |
| Basophils %                               | BAS%                        | %                                | %                   | %                   | %                                |
| Large Immature cells #                    | LIC#                        | 10 <sup>3</sup> /mm <sup>3</sup> | 10 <sup>9</sup> /L  | 10 <sup>9</sup> /L  | 10 <sup>2</sup> /mm <sup>3</sup> |
| Large Immature cells %                    | LIC%                        | %                                | %                   | %                   | %                                |
| Red Blood Cell                            | RBC                         | 10 <sup>6</sup> /mm <sup>3</sup> | 10 <sup>12</sup> /L | 10 <sup>12</sup> /L | 10 <sup>4</sup> /mm <sup>3</sup> |
| Hemoglobin                                | HGB                         | g/dL                             | g/L                 | mmol/L              | g/dL                             |
| Hematocrit                                | HCT                         | %                                | L/L                 | L/L                 | %                                |
| Mean Corpuscular Volume                   | MCV                         | µm <sup>3</sup>                  | fL                  | fL                  | µm <sup>3</sup>                  |
| 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 <sup>3</sup>                  | fL                  | fL                  | µm <sup>3</sup>                  |
| Platelets                                 | PLT                         | 10 <sup>3</sup> /mm <sup>3</sup> | 10 <sup>9</sup> /L  | 10 <sup>9</sup> /L  | 10 <sup>4</sup> /mm <sup>3</sup> |

Table 22: Parameters presentation

| Parameter                    | Universal Test ID field 9.3 | Units field 9.5                  |                     |                     |                                  |
|------------------------------|-----------------------------|----------------------------------|---------------------|---------------------|----------------------------------|
|                              |                             | conventional                     | International       | mmol                | Japanese                         |
| Mean Platelet Volume         | MPV                         | µm <sup>3</sup>                  | fL                  | fL                  | µm <sup>3</sup>                  |
| Plateletcrit                 | PCT                         | %                                | 10 <sup>-2</sup> /L | 10 <sup>-2</sup> /L | %                                |
| Platelet Distribution Width  | PDW                         | %                                | %                   | %                   | %                                |
| Platelets - Large Cell Count | PL-LCC                      | 10 <sup>3</sup> /mm <sup>3</sup> | 10 <sup>9</sup> /L  | 10 <sup>9</sup> /L  | 10 <sup>4</sup> /mm <sup>3</sup> |
| Platelets - Large Cell Ratio | PL-LCR                      | %                                | %                   | %                   | %                                |

## **4.2. Alarms and Pathologies**

### **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 9.9 (Refer to [Table 17 - Result record fields](#), page 16.).

### **4.2.2. Normal and Panic ranges**

Flags when result exceeds Normal or Panic ranges are transmitted through field 9.7, they should be compared, to get a full result information, to the ranges set by the user (Refer to [Table 17 - Result record fields](#), page 16.).

### **4.2.3. Analysis alarms**

The analysis alarms (Refer to [Table 20 - Analysis alarms list](#), page 22.) are transmitted to a comment record.

It follows the order record.

Table 23: Analysis alarms list

| Parameter | Transmitted data     |                             | Description                                                                              |
|-----------|----------------------|-----------------------------|------------------------------------------------------------------------------------------|
|           | V1.0.X               | V2.0.X                      |                                                                                          |
| HGB       | BLK_OUT_OF_RANGE     | BLK_OUT_OF_RANGE            | HGB 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                                                   |
| LMNEB     | NOISE                | NOISE                       | Background noise                                                                         |
| LMNEB     | LL_OR_LL1_INTERFEREN | LL_OR_LL1_INTERFERENCE      | Lymphocyte interferences                                                                 |
| LMNEB     | MON_INTERFERENCE     | MON_INTERFERENCE            | Monocyte interferences                                                                   |
| LMNEB     | SMALL_NEU            | ABNORMAL_DIFFERENTIATION    | Abnormal Neutrophil distribution                                                         |
| LMNEB     | SEP_MON_NEU          | ABNORMAL_DIFFERENTIATION    | Abnormal Monocyte/Neutrophil distribution                                                |
| LMNEB     | SEP_NEU_EOS          | ABNORMAL_DIFFERENTIATION    | Abnormal Neutrophil/Eosinophil distribution                                              |
| LMNEB     | SEP_LYM_MON          | ABNORMAL_DIFFERENTIATION    | Abnormal Lymphocyte/Monocyte distribution                                                |
| LMNEB     | SEP_LYM_NEU          | ABNORMAL_DIFFERENTIATION    | Abnormal Lymphocyte/Neutrophil distribution                                              |
| LMNEB     | CORRELATION_TOO_LOW  | ABNORMAL_DIFFERENTIATION    | Low WBC correlation between optical and resistive measurements                           |
| LMNEB     | ALY                  | (removed)                   | Atypical Lymphocyte                                                                      |
| 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               | Incorrect sampling                                                                       |
| LMNEB     | COUNTING_INSTABILITY | COUNTING_INSTABILITY        | Counting instability                                                                     |
| RBC       | HCT_OUT_OF_LINEARITY | HCT_OUT_OF_LINEARITY_RANGE  | HCT out of linearity range                                                               |
| RBC       | ZERO_COUNTING        | ZERO_COUNTING               | Incorrect sampling                                                                       |
| RBC       | BIG_CELLS_EXCESS     | BIG_CELLS_EXCESS            | Nucleated cells interference                                                             |
| RBC       | PC_MODE              | PC_MODE                     | PLT Concentrate Mode                                                                     |
| RBC       | RBC_DBL              | RBC_DBL                     | RBC double population                                                                    |
| RBC       | RBC_COUNT_TOO_LOW    | RBC_COUNT_TOO_LOW           | Low RBC count                                                                            |
| RBC       | RBC_OUT_OF_LINEARITY | RBC_OUT_OF_LINEARITY_RANGE  | RBC out of linearity range                                                               |
| RBC       | (none)               | ABNORMAL_MCH                | Abnormal MCH                                                                             |
| RBC       | (none)               | ABNORMAL_MCHC               | Abnormal MCHC                                                                            |
| PLT       | SEP_RBC_PLT          | SEP_RBC_PLT                 | RBC/PLT interference                                                                     |
| PLT       | SCH                  | SCH                         | Schistocyte presence                                                                     |

Table 23: Analysis alarms list

| Parameter | Transmitted data     |                            | Description                |
|-----------|----------------------|----------------------------|----------------------------|
|           | V1.0.X               | V2.0.X                     |                            |
| PLT       | SCL                  | SCL                        | Small Cells presence       |
| PLT       | PLT_COUNT_TOO_LOW    | PLT_COUNT_TOO_LOW          | Low PLT count              |
| PLT       | ZERO_COUNTING        | ZERO_COUNTING              | Incorrect sampling         |
| PLT       | PLT_OUT_OF_LINEARITY | PLT_OUT_OF_LINEARITY_RANGE | PLT out of linearity range |
| PLT       | COUNTING_INSTABILITY | COUNTING_INSTABILITY       | Counting instability       |
| PLT       | NOISE                | NOISE                      | Background noise           |

Transmitted suspected pathologies list:

- ERYTHROCYTOSIS
- PANCYTOPENIA
- ANEMIA
- DBL\_POP\_SUSPICION
- MICROCYTOSIS
- MACROCYTOSIS
- HYPOCHROMIA
- ANISOCYTOSIS
- POIKILOCYTOSIS
- COLD\_AGGLUTININS
- THROMBOCYTOSIS
- THROMBOCYTOPENIA
- MACROPLATELETS
- PLT\_AGGREGATE
- ERB
- PLT\_AGGREGATES\_OR\_ERB
- LEUKOCYTOSIS
- LEUKOPENIA
- LYMPHOCYTOSIS
- LYMPHOPENIA
- NEUTROPHILIA
- NEUTROPENIA
- EOSINOPHILIA
- MONOCYTOSIS
- BASOPHILIA
- LARGE\_IMMATURE\_CELLS
- LEFT\_SHIFT
- EXTREM\_NEUTROPENIA

## 5. Example of data frame

### 5.1. Example of a query with the response

Table 24: Query and 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>
    
```

### 5.2. Example of result sent by instrument

Table 25: Example of result sent by 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||CONDITIONS^^CONTROL_FAILED\NON_COMPLIANT_DATA^LMNE^SEP_MON_NEU\NON_COMP
LIANT_DATA^LMNE^NOISE\NON_COMPLIANT_DATA^LMNE^LG_OR_LG1_INTERFERE\NON_COMPLIANT_DAT
A^LMNE^LG_OR_LG1_INTERFERE\SUSPECTED_PATHOLOGY^^MICROCYTOSIS\SUSPECTED_PATHOLOGY<
ETB>1F<CR><LF>
-> <ACK>
<-
<STX>5^^ANISOCYTOSIS\SUSPECTED_PATHOLOGY^^COLD_AGGLUTININS\SUSPECTED_PATHOLOGY^^ER
B\SUSPECTED_PATHOLOGY^^LARGE_IMMATURE_CELLS|I<CR><ETX>A7<CR><LF>
-> <ACK>
<-
<STX>6M|1|REAGENT\CLEANER\DILUENT\LYSE|1501061^20150306000000^20150606\141215H1^20150317
110528^20150917\141215M11^20150314163050^20150514<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|H|H||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>
    
```

Table 25: Example of result sent by instrument

```

<- <STX>4R|6|^^^RDW-CV^788-0|17.4|%|11.0 -
16.0|H|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|H|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|H|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|H|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>
    
```

Table 25: Example of result sent by instrument

```

<- <STX>2R|20|^^^RDW-SD^21000-5|66.4|fL|0.0 -
0.3|H|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|H|F|technician^^TECHNICIAN|20150323160230||<CR><ETX>36<CR><LF>
-> <ACK>
<- <STX>7R|25|^^^HCT^4544-3|0.333|L/L|0.370 -
0.540|L|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>
    
```

### 5.3. Example of QC Result sent by instrument

Table 26: Example of QC result

```

<- Instrument
-> Host
<- <ENQ>
-> <ACK>
<- <STX>1H|^&||H500^001YOXH00031^1.0.0.6||||D|LIS2-A2|20150323160731<CR><ETX>2C<CR><LF>
-> <ACK>
    
```

Table 26: Example of QC result

```

<- <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||CONTROL_FAILED^HCT_BELOW_TOLERANCE\CONTROL_FAILED^MCV_BELOW_TOLERANCE\
CONTROL_FAILED^MCHC_ABOVE_TOLERANCE\CONTROL_FAILED^EOS%_ABOVE_TOLERANCE\CONTRO
L_FAILED^EOS#_ABOVE_TOLERANCE|<CR><ETX>05<CR><LF>
-> <ACK>
<- <STX>5C|2||PX035N|G<CR><ETX>C8<CR><LF>
-> <ACK>
<-
<STX>6M|1|REAGENT\CLEANER\DILUENT\LYSE|1501061H^20150306000000^20150606\141215H1^20150317
110528^20150917\141215M11^20150314163050^20150514<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|20150323160321||<CR><ETX>C1<CR><LF>
-> <ACK>
<- <STX>7R|9|^PLT^777-3|232.7|10E9/L|230.0 -
330.0|N||F||technician^TECHNICIAN|20150323160321||<CR><ETX>2E<CR><LF>
-> <ACK>
    
```

Table 26: Example of QC result

```

<- <STX>0R|10|^MON%^5905-5|9.2|0.7 -
16.7|N||F||technician^TECHNICIAN|20150323160321||<CR><ETX>80<CR><LF>
-> <ACK>
<- <STX>1R|1|^LYM#^731-0|1.89|10E9/L|1.59 -
2.99|N||F||technician^TECHNICIAN|20150323160321||<CR><ETX>F5<CR><LF>
-> <ACK>
<- <STX>2R|12|^HGB^718-7|142|g/L|133 -
143|N||F||technician^TECHNICIAN|20150323160321||<CR><ETX>9E<CR><LF>
-> <ACK>
<- <STX>3R|13|^LYM%^736-9|27.3|23.7 -
39.7|N||F||technician^TECHNICIAN|20150323160321||<CR><ETX>CA<CR><LF>
-> <ACK>
<- <STX>4R|14|^BAS%^706-2|2.5|0.5 -
8.5|N||F||technician^TECHNICIAN|20150323160321||<CR><ETX>04<CR><LF>
-> <ACK>
<- <STX>5R|15|^BAS#^704-7|0.17|10E9/L|0.02 -
0.62|N||F||technician^TECHNICIAN|20150323160321||<CR><ETX>C5<CR><LF>
-> <ACK>
<- <STX>6R|16|^MCH^785-6|31.5|pg|27.6 -
31.6|N||F||technician^TECHNICIAN|20150323160321||<CR><ETX>3B<CR><LF>
-> <ACK>
<- <STX>7R|17|^MCHC^786-4|426|g/L|339 -
399|N||F||technician^TECHNICIAN|20150323160321||<CR><ETX>0E<CR><LF>
-> <ACK>
<- <STX>0R|18|^HCT^4544-3|0.333|L/L|0.355 -
0.395|N||F||technician^TECHNICIAN|20150323160321||<CR><ETX>ED<CR><LF>
-> <ACK>
<- <STX>1R|19|^EOS#^711-2|0.51|10E9/L|0.04 -
0.44|N||F||technician^TECHNICIAN|20150323160321||<CR><ETX>CF<CR><LF>
-> <ACK>
<- <STX>2R|20|^EOS%^713-8|7.4|0.1 -
6.7|N||F||technician^TECHNICIAN|20150323160321||<CR><ETX>14<CR><LF>
-> <ACK>
<- <STX>3L|1|N<CR><ETX>06<CR><LF>
-> <ACK>
<- <EOT>
    
```