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CE IVD

# AerC-3

## Auto 3-Diff Hematology Analyzer

## COMMUNICATION PROTOCOL


www.aehealthgroup.com

## 1. Overview

The LIS communication function between the analyzer and the PC in laboratory through Ethernet or RS-232, including sending analysis results to lab PC.

This communication protocol is defined based on the HL7 Standards. HL7 is a series of electronic data exchange standards for healthcare industry, which is originally defined by the US and is now adopted worldwide. This protocol is defined based on HL7 v2.3.1. For details of HL7 standards, see HL7 Interface Standards Version 2.3.1.

## 2. HL7 Protocol Grammar

### 2.1 Message Constructing Principles

Every HL7 message consists of several segments, each of which ends up with the <CR> (0x0D). Each segment consists of the segment name of three characters and a number of fields, and each field consists of some components and subcomponents. For each message, the delimiters of the fields, components and subcomponents are defined in the MSH segment.

E.g.

MSH|^~\&|||||20181231235941||ORU^R01|2|P|2.3.1||||||UNICODE

among which:

The five characters following MSH define the delimiters used between fields, components and subcomponents. Although they can be any non-text characters, HL7 standard recommends you use the characters in the table below:

**Table 1 HL7 Delimiters**

| Character | Meaning |
|---|---|
| \| | Field delimiter |
| ^ | Component delimiter |
| & | Subcomponent delimiter |
| ~ | Repetition delimiter |
| \ | ESC |

The first two fields of MSH contain all the delimiters. Some fields behind are null because they are optional and not used by AEHEALTH HL7 interface. Details about field definition and selection will be stated in the following sections.

For message of any type, the segments behind MSH appear in a fixed order. The order will be described in the following sections and the following grammar is used to organize the segments in proper order.

[ ] encloses optional segments.

{ } encloses segments which can repeat once or more.

### 2.2 Principles of Escape Character Conversion

For the field data of ST, TX, FT, and CF, etc. delimiters may be used in strings like remarks, clinical diagnosis and customized gender etc. When coding, the delimiters in the original strings shall be converted to escape sequence; which is restored in decoding. The principles for escape character conversion for HL7 interface are as follows:

| ESC Sequence | Original Character |
|---|---|
| \F\ | Field delimiter |
| \S\ | Component delimiter |
| \T\ | Subcomponent delimiter |
| \R\ | Repetition delimiter |
| \E\ | Escape delimiter |
| \.br\ | <CR>, segment end character |

Note: the "\" in the escape sequence represents the ESC delimiter, whose value is defined in the MSH segment.

## 3. HL7 Low-Level Message Protocol

HL7 of high-level protocol is based on messages. The function of terminating the message is not provided. In order to determine the message boundary, the MLLP low-level protocol is used (see *HL7 Interface Standards Version 2.3.1*.).

**Communication Level**

Messages are transmitted in the following format:

<SB> *ddddd* <EB><CR>

among which:

**<SB> = Start Block character (1 byte)**

ASCII <VT>, i.e. , <0x0B>. Do not confuse with the SOH or STX character in ASCII.

***ddddd* = Data (variable number of bytes)**

ddddd is the effective data of HL7 message and expressed in the form of string. For the strings used in the HL7 interface messages of the DMU, the UTF-8 code is used.

**<EB> = End Block character (1 byte)**

ASCII <FS>, i.e.<0x1C>. Do not confuse with the ETX or EOT character in ASCII.

**<CR> = Carriage Return (1 byte)**

ASCII carriage return character, i.e. <0x0D>.

**Note**

Each segment of HL7 message starts with ASCII<VT>（0x0B）and ends with ASCII<CR>（0x0D）. Each HL7 message ends with ASCII<FS>（0x1C）, the end of each HL7 message is followed one ASCII<CR>（0x0D）.

Example:

0x0B *message segment 1* 0x0D

0x0B *message segment 2* 0x0D

0x0B *message segment 3* 0x0D

……

0x0B *message segment n* 0x0D

0x1C

0x0D

**……**

**Note (Very important):**

The time interval when analyzer continuously is sending HL7 message is 500ms.

## 4. Mostly Used Messages:

### 4.1 MSH

MSH (Message Header) segment contains basic information of HL7 messages, including delimiter value, message type and coding method etc. It is the first field of every HL7 message.

Message example:

MSH|^~\&|||||***20181231235941***||ORU^R01|***2***|P|2.3.1|||||UNICODE

**Note**

Segment 10 (2) : it is used to identify one message, AEHEALTH analyzer identify every HL7 message continuously, incrementally from 0, such as 0,1, 2…

### 4.2 MSA

MSA(Message Acknowledgement) includes confirmation information for message.

MSA example:

MSA|AA|2

Used segment definition as below:

Segment 1 : AA - Accept, AE - Error, AR - Reject

Segment 2 : Message Control ID, it is the same as Segment 10 of MSH.

**Note**

Receiving end (Computer) should send MSA once it receives MSH from Sending end (AEHEALTH analyzer) according to rules above.

## 5. Mostly Used Definitions of HL7 Segment

### 5.1 PID

PID（Patient Identification）segment contains the patient demographic information.

Message example:

PID|*1*||*NK123*^^^^MR||^*Zhangsan*|||*M*

**Note**

- Segment 1 (1) : it is used to identify different PID segment of each HL7 message, AEHEALTH analyzer codes different PID segment of each HL7 message continuously, incrementally from 1, such as 1, 2, 3…
- Segment 3 (NK123^^^^MR) : It is used to be case ID in sample testing results. AEHEALTH analyzer sends Case ID of testing result using this segment, it is empty if user do not enter the information.
- Segment 5 (^Zhangsan) : It is used to be patient name in sample testing results. AEHEALTH analyzer sends patient name of testing result using this segment, it is empty if user do not enter the information.
- Segment 8 (M) : It is used to be patient gender in sample testing results. AEHEALTH analyzer sends patient name gender of testing result using this segment, sending M means Male, sending F means Female, sending empty character if the gender is unknown.

### 5.2 PV1

PV1（Patient Visit）segment contains the patient visit information.

Message example:

PV1|*1*|*Neike*|^^*BEDN123*

**Note**

- Segment 1 (1) : it is used to identify different PV1 segment of each HL7 message, AEHEALTH analyzer codes different PV1 segment of each HL7 message continuously, incrementally from 1, such as 1, 2, 3…
- Segment 2 (Neike) : It is used to be patient type in sample testing results. AEHEALTH analyzer sends Department information of testing result using this segment, it is empty if user do not enter the information.
- Segment 3 (^^BEDN123) : It is used to be position information of patient in sample testing results. AEHEALTH analyzer sends Bed No. information of testing result using this segment, it is empty if user do not enter the information.

### 5.3 OBR

OBR（Observation Request）segment contains the test report information.

Message example:

OBR|*1*||*WK001*|00001^Automated

Count^99MRC|||*20180408103851*|||*Zhangsan*|||||||||||||HM||||*Lisi*||||*Wangwu*

**Note**

- Segment 1 (1) : it is used to identify different OBR segment of each HL7 message, AEHEALTH analyzer codes different OBR segment of each HL7 message continuously, incrementally from 1, such as 1, 2, 3…
- Segment 3 (WK001) : It is used to be sample number in sample testing results. AEHEALTH analyzer sends Code information of testing result using this segment, it is empty if user do not enter the information.
- Segment 7 (20180408103851) : It is used to be testing time in sample testing results. AEHEALTH analyzer sends testing time of testing result using this segment.
- Segment 10 (Zhangsan) : It is used to be consigner information in sample testing results. AEHEALTH analyzer sends Consigner information of testing result using this segment, it is empty if user do not enter the information.
- Segment 28 (Lisi) : It is used to be inspector information in sample testing results. AEHEALTH analyzer sends Inspector information of testing result using this segment, it is empty if user do not enter the information.
- Segment 32 (Wangwu) : It is used to be operator information in sample testing results. AEHEALTH analyzer sends Operator information of testing result using this segment, it is empty if user do not enter the information.

### 5.4 OBX

OBX（Observation/Result）segment contains the parameter information of each test result.

Message example:

OBX|*1*|*NM*|*6690-2^WBC^LN*||*8.0*|*10*9/L*|*4.00-10.00*||||F

**Note**

- Segment 1 (1) : it is used to identify different OBX segment of each HL7 message, AEHEALTH analyzer codes different OBX segment of each HL7 message continuously, incrementally from 1, such as 1, 2, 3…
- Segment 2 (NM) : It is used to be data type of sample testing results.
- Segment 3 (6690-2^WBC^LN) : It is used to be identification of test item.
- Segment 5 (8.0) : It is used to be testing results.
- Segment 6 (10*9/L) : It is used to be unit of testing results, it can be empty.
- Segment 7 (4.00-10.00) : It is used to be reference range of testing results, it can be empty.
- Segment 8 : Identification of testing result.
- Segment 11 (F) : It is used to be status of testing results.

## 6. Complete Sample Message Examples

The message example below shows the communication process of sample data.

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MSH|^~\&|||||***20181231235941***||ORU^R01|***2***|P|2.3.1||||||UNICODE

PID|1||***NK123***^^^^MR||^***Zhangsan***|||***M***

PV1|1|***Neike***|^^***BEDN123***

OBR|1||***WK001***|00001^Automated Count^99MRC|||***20180408103851***|||***Zhangsan***||||||||||||||HM||||***Lisi***||||***Wangwu***

OBX|1|IS|08001^Take Mode^99MRC||O||||||F

OBX|2|IS|08002^Blood Mode^99MRC||***W***||||||F // Sampling mode：**W** - Whole blood；**P** – Pre-diluted

OBX|3|IS|08003^Test Mode^99MRC||CBC||||||F

OBX|4|IS|01002^Ref Group^99MRC||Common||||||F

OBX|5|NM|30525-0^Age^LN||***20***|***yr***|||||F // Age unit：**yr** – year, **mo** – month, **d** - day

OBX|6|ST|01001^Remark^99MRC||Remark||||||F

OBX|7|NM|6690-2^WBC^LN||****.****|***10*9/L***|****.*-*.****|***N***|||F // Testing result, unit、reference range and identification of testing result:

OBX|8|NM|731-0^Lymph#^LN||****.****|***10*9/L***|****.*-*.****|***N***|||F // **N** – Normal

OBX|9|NM|10027^Mid#^99MRC||****.****|***10*9/L***|****.*-*.****|***N***|||F // **H** – Higher than upper limit of reference range

OBX|10|NM|10028^Gran#^99MRC||****.****|***10*9/L***|****.*-*.****|***N***|||F // **L** – Less than lower limit of reference range

OBX|11|NM|736-9^Lymph%^LN||****.****|***%***|****.*-*.****|***N***|||F // **B** – WBC/RBC/HGB bubble

OBX|12|NM|10029^Mid%^99MRC||****.****|***%***|****.*-*.****|***N***|||F // **C** – WBC/RBC clog

OBX|13|NM|10030^Gran%^99MRC||****.****|***%***|****.*-*.****|***N***|||F // **F** – HGB fault

OBX|14|NM|789-8^RBC^LN||****.*****|***10*12/L***|****.**-*.*****|***N***|||F

OBX|15|NM|718-7^HGB^LN||*********|***g/L***|******-******|***N***|||F

OBX|16|NM|4544-3^HCT^LN||****.****|***%***|****.*-*.****|***N***|||F

OBX|17|NM|787-2^MCV^LN||***.*|fL|***.*-***.*|N|||F

OBX|18|NM|785-6^MCH^LN||***.*|pg|***.*-***.*|N|||F

OBX|19|NM|786-4^MCHC^LN||****|g/L|****-****|N|||F

OBX|20|NM|788-0^RDW-CV^LN||**.*|%|**.*-**.*|N|||F

OBX|21|NM|21000-5^RDW-SD^LN||***.*|fL|***.*-***.*|N|||F

OBX|22|NM|777-3^PLT^LN||****|10*9/L|****-****|N|||F

OBX|23|NM|32623-1^MPV^LN||**.*|fL|**.*-**.*|N|||F

OBX|24|NM|32207-3^PDW^LN||**.*||**.*-**.*|N|||F // The unit of testing result can be **empty**.

OBX|25|NM|10002^PCT^99MRC||*.***|%|*.***-*.***|N|||F

OBX|26|NM|10013^P-LCC^99MRC||****|10*9/L|****-****|N|||F

OBX|27|NM|10014^P-LCR^99MRC||***.*|%|***.*-***.*|N|||F

OBX|28|IS|12045^Multiple alerts^99MRC||T|||||F // Alarm identification of **WBC histogram Rm**（there is more than 2 R alarms）: **T** – Ture, **F** – False

OBX|29|IS|12046^Lym left region alert^99MRC||T|||||F // Alarm identification of **WBC histogram R1**: **T** – Ture, **F** – False

OBX|30|IS|12047^Lym mid region alert^99MRC||T|||||F // Alarm identification of **WBC histogram R2**: **T** – Ture, **F** – False

OBX|31|IS|12048^Mid gran region alert^99MRC||T|||||F // Alarm identification of **WBC histogram R3**: **T** – Ture, **F** – False

OBX|32|IS|12049^Gran right region alert^99MRC||T|||||F // Alarm identification of **WBC histogram R4**: **T** – Ture, **F** – False

OBX|33|IS|12050^Plt rbc boundary blur^99MRC||T|||||F // Alarm identification of **PLT histogram Pm**: **T** – Ture, **F** – False

OBX|34|NM|15010^WBC Lym left line^99MRC||1|||||F // Abscissa of the first line（from left to right）**WBC histogram**

OBX|35|NM|15011^WBC Lym Mid line^99MRC||2|||||F // Abscissa of the second line（from left to right）**WBC histogram**

OBX|36|NM|15012^WBC Mid Gran line^99MRC||3|||||F // Abscissa of the third line（from left to right）**WBC histogram**

OBX|37|NM|15013^WBC Gran right line^99MRC||4|||||F // Abscissa of the fourth line（from left to right）**WBC histogram**

OBX|38|ED|15000^WBC Histogram Binary^99MRC||^Application^Octer-stream^000111022003|||||F

// **WBC histogram data**, length：**3x256 ASCII characters（0-9）**

OBX|39|NM|15051^RBC Histogram Left Line^99MRC||***5***|||||F // Abscissa of the first line（from left to right）**RBC histogram**

OBX|40|NM|15052^RBC Histogram Right Line^99MRC||***6***|||||F // Abscissa of the second line（from left to right）**RBC histogram**

OBX|41|ED|15050^RBC Histogram Binary^99MRC||^Application^Octer-stream^***000111022003***|||||F

// **RBC histogram data**, length：**3x256 ASCII characters（0-9）**

OBX|42|NM|15111^PLT Histogram Left Line^99MRC||***7***|||||F // Abscissa of the first line（from left to right）**PLT histogram**

OBX|43|NM|15112^PLT Histogram Right Line^99MRC||***8***|||||F // Abscissa of the second line（from left to right）**PLT histogram**

OBX|44|ED|15100^PLT Histogram Binary^99MRC||^Application^Octer-stream^***000111022003***|||||F

// **PLT histogram data**, length：**3x256 ASCII characters（0-9）**

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**The End**