HumaCount 30TS
HumaCount 80TS
| LIS Interface Manual

Version 5

Revision list

Revision	Date	Description	Editor
1	2015/04/02	First revision	Mathias Kamprath
2	2016/08/12	Changes in serial protocol 3.1	Mathias Kamprath
3	2016/12/12	Review of peer communication settings	Mathias Kamprath
4	2017/04/12	Review of HL7 example	Mathias Kamprath
5	2021/01/18	Added example of HL7 message sent to analyzer	Tony Petzold

Human
Diagnostics Worldwide

Contents

1. Setting up the communication link

Analyzers by default do not have communication enabled. You have to enable it by selecting communication port (serial), communication speed (baud) and protocol used. Upon selecting and confirming these parameters, analyzers will be ready to start communication.

Protocols that require handshake will start "introducing" themselves to the host PC by sending INIT packages. The host must reply to the INIT package. Each INIT package is sent once, and analyzer software is allowing 3 seconds for the host PC to reply. Upon the third unsuccessful attempt analyzer software will disable sending messages.

The host PC can wake up the analyzer by sending ENQ package. Analyzer will reply with an INIT package and will expect a reply as described in the protocol.

Protocols (3.1) that do not require handshake will also send the INIT package but do not expect a reply.

2. USB link

Before connecting the analyzer to a PC with a USB cable, a specific driver must be installed. The driver is available from **http://www.ftdichip.com/Drivers/VCP.htm**. Select the driver matching your operating system. Download and install. Now the analyzer can be connected.

The USB connection utilizes a standard USB A-B cable (not included with the analyzer). The cable must be connected to a free USB A socket on the PC and the USB B socket on the analyzer.

Upon connection, the pre-installed driver will recognize the analyzer's built-in USB device as a Virtual Serial Port.

Mind the USB cable category. USB CAT5 works, while USB CAT6 does not work.

3. Setting up the Windows driver

When the computer has recognized the analyzer, it will enroll the (virtual) serial port as one of the COM ports of the PC. Some applications require the serial port to be identified as a specific COM port. Please go to Hardware setup, and check the COM port ID. Modify if necessary. (Refer to Windows HW configuration procedures [My Computer, Properties, Hardware, Device Manager]).

4. Serial protocol 3.1

4.1. Introduction

The 3.1 protocol was introduced to simplify the receiving, parsing and storing of data records. The byte stream is a human readable ASCII character stream, with occasional control characters. Most programming environments are able to handle this stream as a simple ASCII string or text. The stream is line-oriented with special characters to separate fields. The protocol has a single format for transmitting a single measurement record. If more records are sent, they are simply chained together one after the other.

4.2. Characters and basic structure

The byte stream uses the ASCII characters in the range 1 to 255 (http://en.wikipedia.org/ASCII), or 01H to FFH in hexadecimal.

A record transmission consists of three parts: a small header, a big text body, and a small footer

A transmission always starts with the control character "Start of Header" (<SOH>, 1, 01H).

The second character is a counter. It will contain a single uppercase English letter in the range "A" to "Z", incrementing with every record. The first record will contain "A", the second will contain "B", etc. If the instrument sends many records without being turned off, the counter will overflow from "Z" to "A".

The third character is an identifier. It will be an uppercase "N".

The fourth character is the control character "Start of Text" (<STX>, 2, 02H).

The fifth and consecutive characters form the body of the transmission. The body may contain characters from the printable range ("Space", 32, 20H to "Tilda" 126, 7EH), and the control characters "Horizontal tab" (<HT>, 9, 09H), "Carriage return" (<CR>, 13, 0DH), and "Line feed" (<LF>, 10, 0AH). The body contains several lines separated by a two-byte sequence <CR><LF>. See below for the detailed description of the contents.

The body of the transmission is closed by the control character "End of Text" (<ETX>, 3, 03H).

The footer consists of a two-character checksum in a two-digit hexadecimal form. The checksum is calculated by summing up the values of all characters in the message header and body, including the beginning <STX> character and the last <ETX> character, adding 255 (FFH) to it, and keeping only the last two hexadecimal (!) digits.

The last character of a record is always the single control character "End of Transmission" (<EOT>, 4, 04H). There is no terminating "NULL" (<NUL>, 0, 00H) character at the end. The next record can start right after the <EOT> character.

4.3. Details of the 3.1 protocol

The body of a transmission is line-oriented, separated by the two-byte "Carriage Return" "Line Feed" (<CR> <LF>, 13 10, 0DH 0AH) sequence. A single line might contain one or more fields, separated by the "Horizontal tab" (<HT>, 9, 09H) character.

The following lines are usually composed of an identifier field and one or more value fields, all separated by the <HT> character. The characters in **bold** appear in the transmission exactly as written, without any variance between records. Control characters are marked with the < and > characters, for example <HT>. For a more detailed discussion on the meanings of the various parameters and histograms, please refer to the instrument's User Manual.

Identifier field and value field(s)	Comments
header 1, header 2, … header 8	Header1 to header8 are the lab header lines. These lines are defined by the user in the instrument settings. Any or all of these lines can be empty.
Serial No.:<HT>serial	Serial is the 6 digit serial number of the instrument.
RecNo:<HT>recno	Recno is the internal record number, at most 6 digits.
Sample ID:<HT>sampleid	Sampleid is at most 8 characters long.
Patient ID:<HT>patientid	Patient id is at most 20 characters long.

Identifier field and value field(s)	Comments
Patient Name:<HT>patientname	Patient name is at most 32 characters long.
Mode:<HT>mode	Mode is the species name like "Dog", max 20 characters long.
Doctor:<HT>doctor	Doctor is at most 16characters long.
Age:<HT>value**<HT>**unit	Value is a number of at most 3 digits, unit is either "years" or "months".
Birth(ymd):<HT>birthdate	Birthdate is an 8 digit number, formatted yyyymmdd.
Sex:<HT>gender	Gender is "Male", "Female", "Neutered", "Spayed" or a single "-" character.
Test date(ymd):<HT>date	Date is an 8 digit number, formatted yyyymmdd.
Test time(hm):<HT>time	Time is a 6 digit number, formatted hhmmss.
Param<HT>Flags<HT>Value<HT>Unit<HT>[min-max] param**<HT>**flag**<HT>**value**<HT>**unit**<HT>[**min-max**]**	This is a header line, always the same. There are 24 similar lines param is the parameter name, at most four characters long, possible values are (in sequence): WBC, RBC, HGB, HCT, MCV, MCH, MCHC, PLT, PCT, MPV, PDWs, PDWc, RDWs, RDWc, LYM, MON, NEU, LY%, MO%, NE%, EOS, EO%, BAS, BA% Flag is a single character indicator, can be " " (space), "+", "-", "E" and "*"(asterisk). Value is the measured parameter value, exactly 4 characters: number with a possible decimal dot, padded with spaces on the left side, or 4 minus signs "----", or 4 spaces " ". Unit is at most 4 characters long, possible values are "10^9/l", "10^3/ul", "10^12/l", "10^6/ul", "fl", "%", "g/l", "g/dl", "mmol/l", "pg", "fmol", depending on the parameter. Min and max are the lower and upper bounds of the normal range, exactly 4 characters, including a possible decimal dot, padded with spaces on the left side.
Flags:<HT>flags	Flags is a series of characters indicating errors, at most 32 characters long, upper or lowercase letters "a" to "z".
WBC graph	Always the same, indicates the beginning of the WBC histogram.
Scale(fl):<HT>wbcscale	Wbcscale is maximum 3 digit number, indicating the fl value of the last channel, value is usually 400.
Channels:<HT>wbcchannels	Wbcchannels is the number of channels (columns) in the histogram, always 256.
WMarker1:<HT>wm1	Wm1 is the first WBC discriminator channel (RBC/WBC).
WMarker2:<HT>wm2	Wm2 is the second WBC discriminator channel (LYM/MON).

Identifier field and value field(s)	Comments
WMarker3:<HT>wm3	Wm3 is the third WBC discriminator channel (MON/NEU).
Points:<HT>ch0**<HT>** ……**<HT>**ch255	Chxx is the histogram height at a given channel (range 0 to 255), there are always wbcchannels values here (usually 256).
RBC graph	Always the same, indicates the beginning of the RBC histogram.
Scale(fl):<HT>rbcscale	Rbcscale is maximum 3 digit number, indicating the fl value of the last channel, value is usually 200.
Channels:<HT>rbcchannels	Rbcchannels is the number of channels (columns) in the histogram, always 256.
RMarker1:<HT>rm1	Rm1 is the RBC discriminator channel (PLT/RBC).
Points:<HT>ch0**<HT>** ……**<HT>**ch255	Chxx is the histogram height at a given channel (range 0 to 255), there are always rbcchannels values here (usually 256).
EOS graph	Always the same, indicates the beginning of the EOS histogram.
Scale(fl):<HT>eosscale	Eosscale is maximum 3 digit number, indicating the fl value of the last channel, value is usually 400.
Channels:<HT>eoschannels	Eoschannels is the number of channels (columns) in the histogram, always 256.
EMarker1:<HT>em1	Em1 is the EOS discriminator channel (WBC/EOS).
Points:<HT>ch0**<HT>** … **<HT>**ch255	Chxx is the histogram height at a given channel (range 0 to 255), there are always eoschannels values here (usually 256).
PLT graph	Always the same, indicates the beginning of the PLT histogram.
Scale(fl):<HT>pltscale	Pltscale is maximum 3 digit number, indicating the fl value of the last channel, value is usually 50.
Channels:<HT>pltchannels	Pltchannels is the number of channels (columns) in the histogram, always 256.
PMarker1:<HT>pm1	Pm1 is the first PLT discriminator channel (PLT start).
PMarker2:<HT>pm2	Pm2 is the second PLT discriminator channel (PLT/RBC).
Points:<HT>ch0**<HT>**ch1**<HT>** … **<HT>**ch255	Chxx is the histogram height at a given channel (range 0 to 255), there are always pltchannels values here (usually 256).

As mentioned above, after the last channel value in the PLT histogram the body of the record is closed with the control character "End of Text" (<ETX>, 3, 03H).

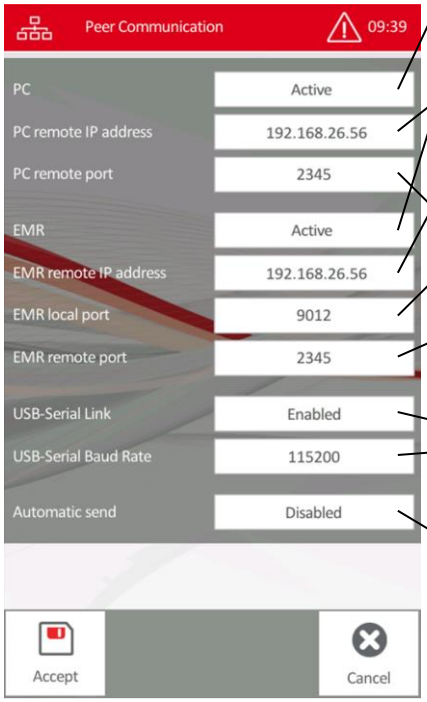
5. HL7 protocol (HL7V2.5)

The analyzer is able to send measurement results to and receive so-called work lists from a remote computer.

To activate and use this feature, the instrument needs to be connected to a HL7 capable server directly or through a computer network.

5.1. Peer communication with the server

Log in as Service user.
Go to Settings / Communication / Peer Communication.



Set the PC and/or EMR settings to Active to enable the communication.
The PC communication is only one-way (sending the results to the computer) and the EMR communication is bidirectional (sending and receiving).

Enter the remote PC IP address which is directly connected to the instrument.
If the EMR remote PC is the same computer you should enter the same IP address.
Note: If both peer communications are activated and using the same PC IP address you will receive the HL7 message twice.

If you want to receive sample requests from the remote PC you have to set in your application this port for the sender.

If you want to send results from the analyzer to your PC via TCP/IP you should set the PC remote port and the EMR remote port settings. These ports are the receiver side ports.

If you want to send results from the analyzer to your PC via serial communication you should set the USB-Serial Link to Enabled and the dedicated USB-Serial Baud Rate. No additional configuration is required.

If you want to send results automatically from the analyzer to your PC via TCP/IP or serial communication you should change the Automatic send option from Disabled to:

- PC only
  The remote PC connection will receive the results automatically.
- EMR (LIS) only
  The remote EMR (LIS) connection will receive the results automatically.
- PC and EMR (LIS)
  Both receivers will get the results.
- USB serial
  The serial communication will be used for autosend.

5.2. Example of an HL7 message

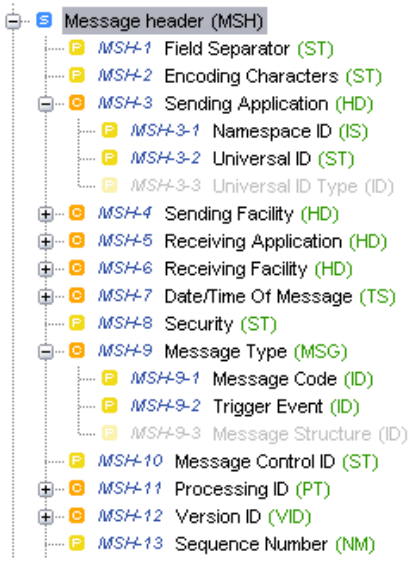
5.2.1. Message

```
MSH|$~\&|Humacount 80TS||||20150121110514||ORU_R01|AUTO_00000|P|2.5.1||||||UNICODE UTF-8|||
PID|||||||00000000|U
NTE|1
NTE|2||32
NTE|3
OBR||||Humacount 80TS
SPM|1|||WB|||||||P
OBX|1|TX|WBC||2.39|$10^9/l|4.00-11.70|L|||P
OBX|2|TX|LYM||1.46|$10^9/l|0.80-3.30||||P
OBX|3|TX|MID||0.16|$10^9/l|0.30-1.70|L|||P
OBX|4|TX|GRA||0.77|$10^9/l|2.30-8.80|L|||P
OBX|5|TX|LYM%||61.1|$%|10.8-45.4|H|||P
OBX|6|TX|MID%||6.6|$%|1.8-17.0||||P
OBX|7|TX|GRA%||32.3|$%|44.0-80.9|L|||P
OBX|8|TX|RBC||2.88|$10^12/l|2.76-5.74||||P
OBX|9|TX|HGB||7.3|$g/dl|8.8-16.5|L|||P
OBX|10|TX|HCT||26.05|$%|26.10-49.60|L|||P
OBX|11|TX|MCV||90.4|$fl|76.4-102.0||||P
OBX|12|TX|MCH||25.4|$pg|23.3-36.1||||P
OBX|13|TX|MCHC||28.2|$g/dl|29.7-36.8|L|||P
OBX|14|TX|RDWc||19.9|$%|11.3-16.7|H|||P
OBX|15|TX|RDWs||64.1|$fl|20.0-42.0|H|||P
OBX|16|TX|PLT||89|$10^9/l|97-390|L|||P
OBX|17|TX|PCT||0.09|$%|0.00-0.00||||P
OBX|18|TX|MPV||10.5|$fl|7.5-13.1||||P
OBX|19|TX|PDWc||41.0|$%|0.0-0.0||||P
OBX|20|TX|PDWs||15.7|$fl|9.0-17.0||||P
OBX|21|TX|P-LCC||27|$10^9/l|0-0||||P
OBX|22|TX|P-LCR||30.78|$%|13.00-43.00||||P
OBX|23|TX|WBC SCALE||400|$fl|||||P
OBX|24|TX|WMarker1||19||||||P
OBX|25|TX|WMarker2||66||||||P
OBX|26|TX|WMarker3||106||||||P
OBX|27|TX|WBC
HISTO||00000000000000000000006D6B665F564C443D3835333539404B59697A8DA0B3C6D9E9F5FCFFFCF6ECE0D1C1B2A39
6897E746B635B554F4B46413C38332E2B272422201E1C1B1A191919181817171616161616161717161614131110 0F0F0F0F0
F0F0F0E0E0D0D0D0D0C0C0A0A090909090A0A0A0A0B0C0C0C0B0A0A0A0A0A0B0B0B0B0A0A09090808090A0B0C0C0C0B0A090
70707070707080909090909090A0A0C0E0F0F0F0D0C0A0A0A0B0C0D0E0F10101111111213141415161616171819191919 1A1
A1B1B1B1B1A19191A1C1D1E2022232323211E1C1A19191A1C1C1C1C1D1E1F212223242626252321201E1E202123262728282
8282625221F1A140E08||||||P
OBX|28|TX|RBC SCALE||200|$fl|||||P
OBX|29|TX|RMarker1||33||||||P
OBX|30|TX|RBC
HISTO||0104080D11171C1F222222201F1D1A171413100D0B0A0A080707050505040402020101010101000001010101010 1
0101010101010202020202040405050708 0B0D101114191C2025292F353B434C535C636C747D848D959CA5ACB4BBC4CCD3D
9E1E5EBF1F6F9FCFEFEFEFDFDFAF9F6F3F0EDEAE8E5E4E1DED9D5CFC9C3BBB5AEA7A19B95908C87837E7A746C665F59534F4
C4A474644413E3A37342F2C2B282625232220201F1D1C1C1A1A191716141311100E0D0D0B0B0B0A0A0A0808070705050 50
4040404020202020202020201010101010101010101010101010101000000000000000000000000000000000000000000000
000000000000000000||||||P
OBX|31|TX|PLT SCALE||50|$fl|||||P
OBX|32|TX|PMarker1||10||||||P
OBX|33|TX|PMarker2||130||||||P
OBX|34|TX|PLT
HISTO||0000000000000000000000001020505080C111519191C1D1E1E1E1E1E1E1F1F1F1F1F1F1E1D1C1C1B1B1B1C1D1D1
F20201F1E1E1C1A191716161515141312121110100F0E0E0E0E0D0D0C0C0C0B0B0A0A0A0909090909090909090909080807060
5040404040405060606070706060505050404040404040404040404040403020201010100000101010202030303030302020 20
1010101010000000001010101010202020202020202020201010101010101010101010202020202020303030304040404040
4030302010101000000000000000101010101020202020202030303030304040505050505040403030303020202030303030
4040505050606060707||||||P
```

5.2.2. Description

Message header (MSH)

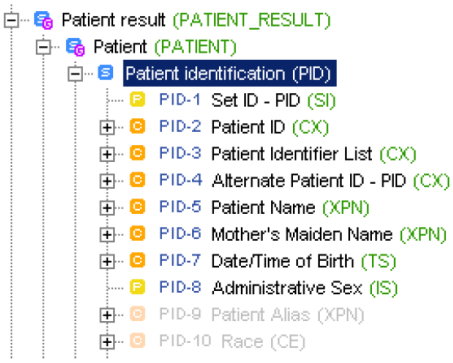
MSH|$~\&|A3CPC||||20130816154927||ORU_R01|SAMPLE001|P|2.5.1||||||UNICODE UTF-8|||



1. **|** is the field separator.
2. **$~\&** are the encoding characters.
3. **A3CPC** is the sending application.
4. **20130816154927** is the date/time of the message.
5. **ORU_R01** is the message type.
6. **SAMPLE001** is the message control ID, which contains the sample ID of the measurement.
7. **P** means preliminary, which is the processing ID.
8. **2.5.1** is the version ID.
9. **UNICODE UTF-8** is the character set.

Patient identification (PID)

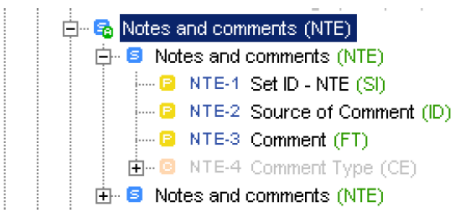
PID|||PATIENT_ID001||Thomas A.||19621119000000|F



1. **PATIENT_ID001** is the ID number of the patient identifier list.
2. **Thomas A.** is the patient name.
3. **19621119000000** is the date/time of birth.
4. **F** is the administrative sex.

Notes and comments (NTE)

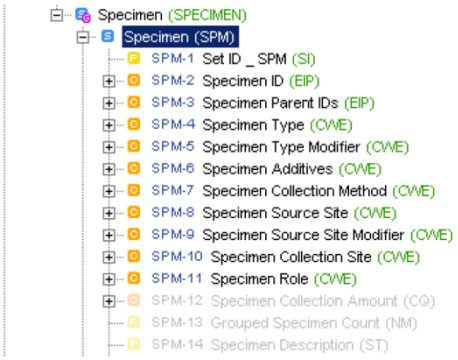
NTE|1||Dr. Smith
NTE|2||32



1. Set ID. The field determines the type of the NTE.
   1 = doctor name, 2 = type of sample.
2. Comment. The field describes the value of the ID.
   For type of sample:
   32 = human, 33 = male, 34 = female,
   35 = baby, 36 = toddler, 37 = child

Specimen (SPM)

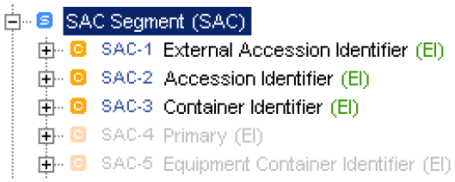
SPM|1|||WB|||||||P



1. **1** is the ID of the SPM field.
2. **WB** is the specimen type. Means whole blood.
3. **P** is the specimen role. Means preliminary.

Segment (SAC)

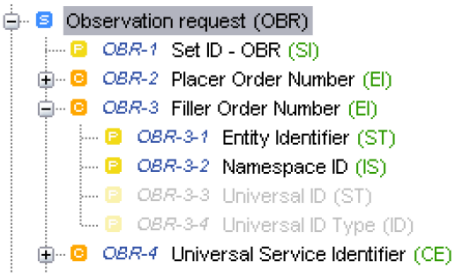
SAC|||SAMPLE001



1. **SAMPLE001** is the container identifier, which contains the sample ID.

Observation request (OBR)

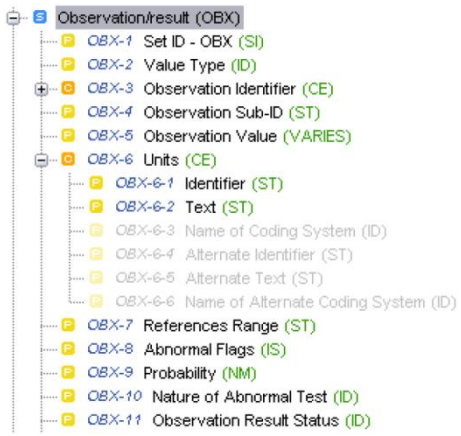
OBR||AWOS_ID001



1. **AWOS_ID001** is a unique ID, which refers to a record of the EMR.

Observation result (OBX)

OBX|1|TX|WBC||14.80|10^9/l|5.00-10.00|H



1. **1** is the ID of the OBX field. It is an increscent value.
2. **TX** is the value type. It means text data.
3. **WBC** is the observation identifier.
4. **14.80** is the observation value.
5. **10^9/l** is the unit.
6. **5.00-10.00** is the reference range (normal range).
7. **H** means high. It is the abnormal flag.

Available observation identifiers	Description
RBC, WBC, LYM, MID,GRA,LYM%,MID%,GRA%, Hb, HCT, MCV, MCH, MCHC, RDW, RDWS, PLT, MPV	Values of common parameters.
WBC HISTO	Contains the results of the WBC measurement, 256 x 1 bytes. Every byte represents a count of given volume of white blood cells.
WBC SCALE	It shows the volume at the 256th column of the WBC histogram.
WMarker1, WMarker2, WMarker3	Markers of the WBC histogram.
RBC HISTO	Contains the results of the RBC measurement, 256 x 1 bytes.
RBC SCALE	It shows the volume at the 256th column of the RBC histogram.
RMarker1	Marker of the RBC histogram.
PLT HISTO	Contains the results of the PLT measurement, 256 x 1 bytes.
PLT SCALE	It shows the volume at the 256th column of the PLT histogram.
PMarker1, PMarker2	Marker of the PLT histogram.

The last OBX lines are the histograms, scales and markers of the observation. The histogram contains 256 x 1 byte values. The scale parameter shows the corresponding volume of the 256th column. The scale of the X-axis (volume of the cells) can be calculated by dividing the scale parameter (i.e. WBC/PLT/RBC SCALE) by 256. The marker's value specifies the index of the histogram column (not directly the volume in femtoliter). The related observation identifiers can be found in the sample message.

General acknowledge message

After the LIS received the result, a general acknowledge must sent back.

MSH|$~\&|||||20150831143101||ACK| SAMPLE001|P|2.5.1
MSA|AA| SAMPLE001

5.2.3. Example of a HL7 message to be sent to the analyzer as a LIS item

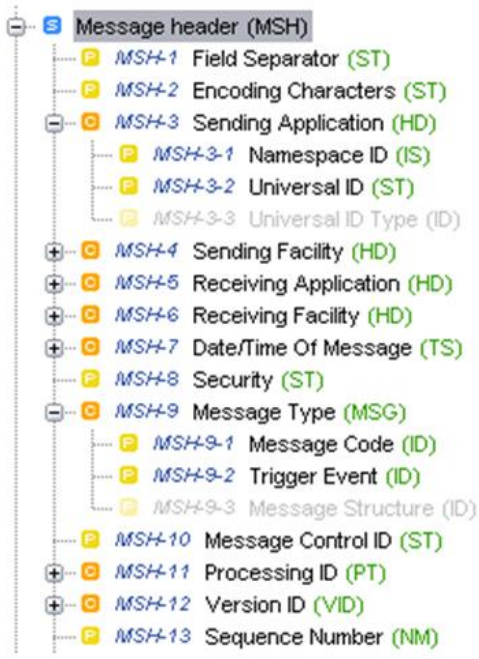
MSH|$~\&|PC_001||||20130816154927||ORM^O01|12345|P|2.5.1||||||UNICODE UTF-8|||
PID||80012345||| Thomas^A.||19621119000000|F||||||||||PATIENT_ID001
NTE|1||Dr. Smith
NTE|2||32
ORC|NW
OBR||AWOS_ID001||SAMPLE001||20130527164606

After the analyzer processed the request, a general acknowledge is sent back.
MSH|^~\&|A3CPC||PC||20130816154513||ACK|12345|P|2.5.1||||||WINDOWS-1250|||
MSA|AA|12345
The first field of MSA segment in the acknowledged message is used to define whether the analyzer accepted the Work List Item or not.
'AA' – Application Acknowledgment
'AR' – Application Reject
The analyzer will refuse the request (and send an AR message), if the number of samples in the Work List exceeds 255.

5.2.4. Description of the HL7 message to be sent to the analyzer as a LIS item

Message Header (MSH)

MSH|^~\&|PC_001||||20130816154927||ORM^O01|12345|P|2.5.1||||||UNICODE UTF-8|||



1. **|** is the field separator
2. **^~\&** is the encoding characters
3. **PC_001** is the sending application.
4. **20130816154927** is the date/time of message
5. **ORM^O01** is the message type
6. **12345** is the message control ID
7. **P** means preliminary which is the processing ID
8. **2.5.1** is the version ID
9. **UNICODE UTF8** is the character set

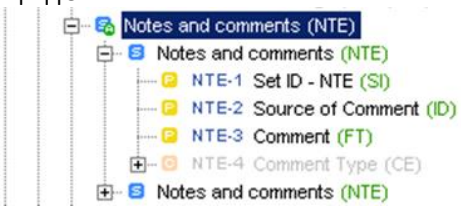
Patient Identification (PID)

PID||80012345|||Thomas^A.||19621119000000|F||||||||||PATIENT_ID001

1. **80012345** is the patient ID
2. **Thomas A.** is the patient name
3. **19621119000000** is the date/time of birth
4. **F** is the administrative sex
5. **PATIENT_ID001** is the SSN number of the patient

Notes and Comments (NTE)

NTE|1||Dr. Smith
NTE|2||32



1. **Set ID**. Determines the type of the NTE: 1 = doctor name, 2 = type of sample
2. **Comment field.** Describes the value of the ID. In case of type of sample, the valid values are: 32 for human, 33 for male, 34 for female, 35 for baby, 36 for toddler, 37 for child

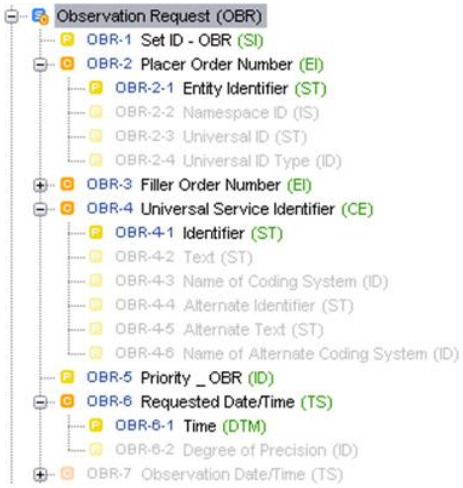
Order Control Segment (ORC)

ORC|NW

1. **NW** for new order or **CA** for cancel order request

Observation Request (OBR)

OBR||AWOS_ID001|| SAMPLE001||20100527164606



1. **AWOS_ID001** is the place order number. It is the unique identifier of the measurement
2. **SAMPLE001** is the identifier of universal service identifier. It must be used for sample ID
3. **20100527164606** is the requested date/time for the EMR entry.

6. Notes