Introduction to ASTM Message Formats

DRAFT

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Definitions

TERM	DESCRIPTION
ASTM	Refers to ASTM E1394 and LIS02 standards.
ASTM Message	An ordered list of ASTM records, starting with a Header record and ending with a Terminator record.
ASTM Message Format	A specific implementation of the ASTM E1394 or LIS02 standards by a manufacturer.
Component	A single data element of a field's Data Type, i.e., of the patient name field in a Patient record.
Data Type	A defined format of one or more data values, such as a birthdate, patient's name, etc.
Field	An attribute (Data Type) of a record, i.e. a patient's name
LIS	Laboratory Information Systems
Record	An ordered list of fields, i.e., the fields in a Patient record containing a patient's name, date of birth, etc.

TERM	DESCRIPTION
Repeat field	A repeating field (Data Type), i.e., a list of two or more of a patient's attending physicians
Sequence Number	Used to distinguish records of the same type that may occur multiple times within ahierarchical level within a message.

TODO

- ◯ Add links to standards, LIS guides, and other resources.
- ◯ How do I find out what each field is? The instrument interface guide. The standard.
- ◯ Table of Data Types

Introduction

The ASTM E1394 standard was created over 30 years ago. However, messages based on the ASTM E1394 (now LIS02) standard are still being used by Laboratory Information Systems (LIS), middleware, and clinical laboratory instruments. Throughout this document, I will use ASTM to refer to ASTM E1394, LIS2, and LIS02 standards.

Below is one example of an ASTM message. I aim to help you understand its construction and identify each part. Don't worry; we won't jump into this all at once. We will start small and work our way up to more complex messages as we go along.

```
H|\^&|||OCD^VISION^5.13.1.46935^JNumber|||||||P|LIS2-A|20210309142633
P|1|PID123456||NID123456^MID123456^OID123456|Brown^Bobby^B|White|1965010203
0400|U|||||PHY1234^Kildare^James^P|Blaine
O|1|SID305||ABO|N|20210309142136||||||||CENTBLOOD|||||||20210309142229|||R
R|1|ABO|B|||||R||Automatic||20210309142229|JNumber
R|2|Rh|POS|||||R||Automatic||20210309142229|JNumber
L|1|N
```

An ASTM message is an ordered list of lines called records. A record is an ordered list of fields. A Field Separator separates fields; in this case, a pipe character is used (|). Each record starts with a Record Type ID, such as O, for the Order record. The Record Type ID identifies what data is contained in each record.

Let's begin with an ASTM Order record with only the essential parts and nothing else.

```
O|1|SID101||ABORH||||||||||CENTBLOOD
```

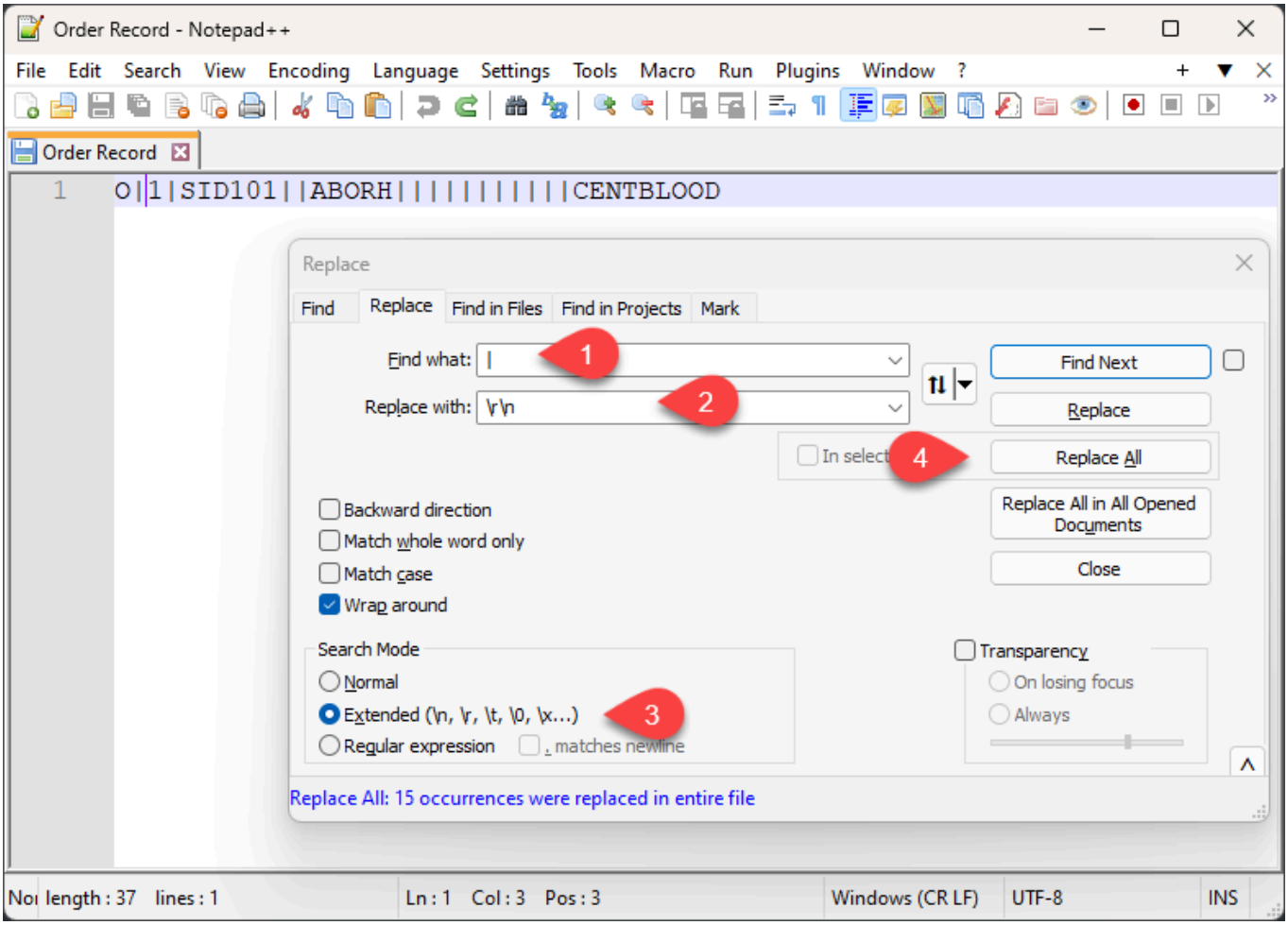
The table below shows the fields in the above Order record and their field position number, Data Type, and values. The field position in the record identifies its Data Type.

Field Number	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Description	Record Type	Sequence Number	Sample ID	Instrument Sample ID	Test ID	Priority	Ordered Timestamp	Collection Timestamp	Collection End Timestamp	Volume	Collector ID	Action Code	Danger Code	Clinical Information	Received Timestamp	Sample Type
Value	O	1	SID101		ABORH											CENTBLOOD

ASTM messages use field separators, making it easy for computers to create and parse these messages.

Let me show you how to manually disassemble this Order record and identify each field and the type of information it contains.

You can use any text editor that shows line numbers and allows you to replace each field separator (|) with a line break. I'll demonstrate with Notepad++.

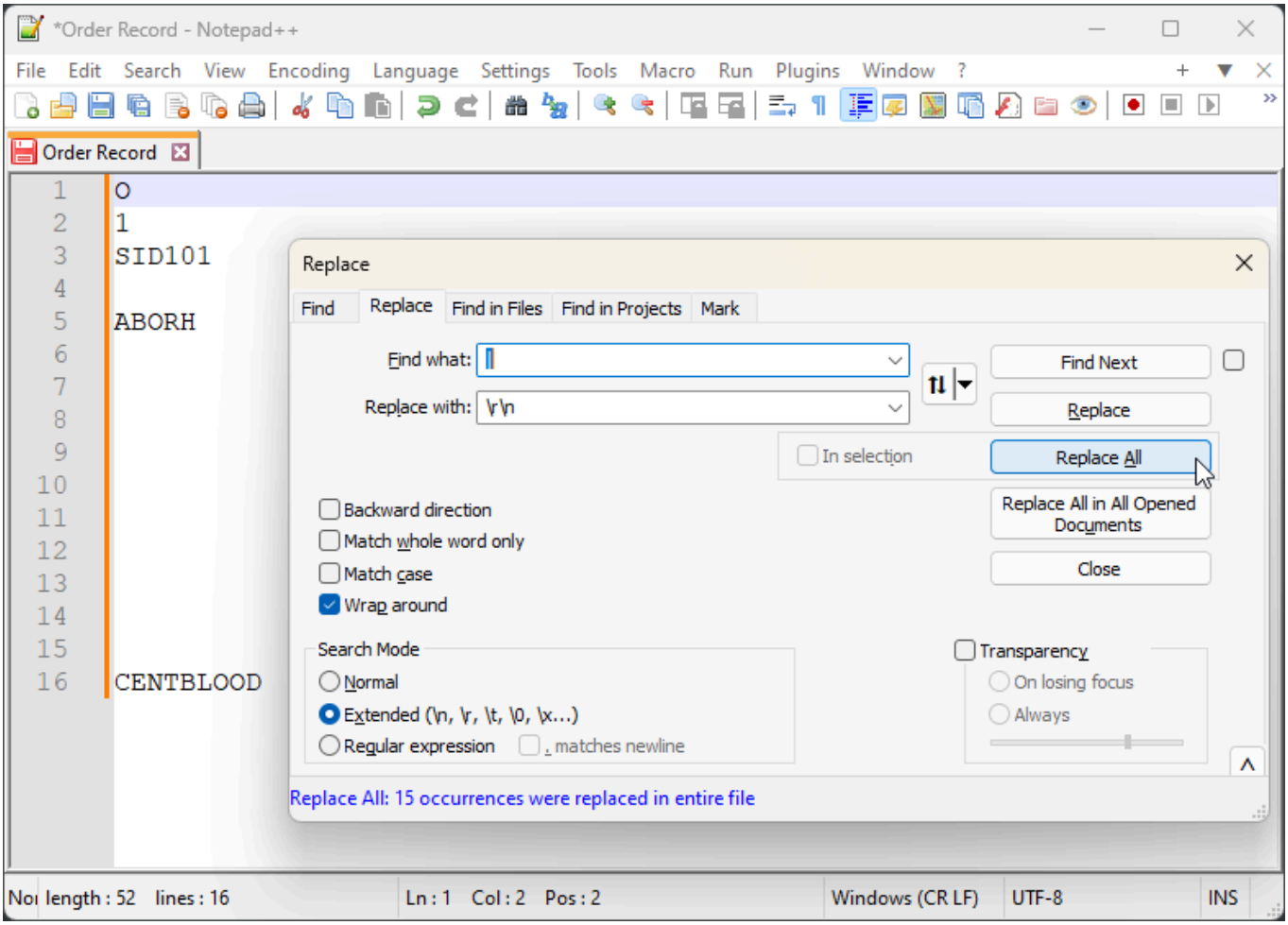


The first step is to split the fields into separate lines:

1. In the Replace dialog, enter the field separator.
2. Enter the new line characters: \r\n

3. Enable the Extended search
4. Click Replace All

You now have a list of fields where each line number is also its field position.



Field names and their position are defined in the ASTM standard. The specification for the Order record is in section 8 of the ASTM E1394-97 standard. The field definitions start with section 8.4.1 (Record Type ID). The field position is the last number of the section number that defines it, 1 for the Record Type ID.

The Specimen ID is in section 8.4.3 and is referred to as O.3 for Order record field 3.

Below, I list the fields, their position notation, Data Type, and value.

Position	Data Type	Value
O.1	Record Type ID	O
O.2	Sequence Number	1
O.3	Specimen ID	SID101

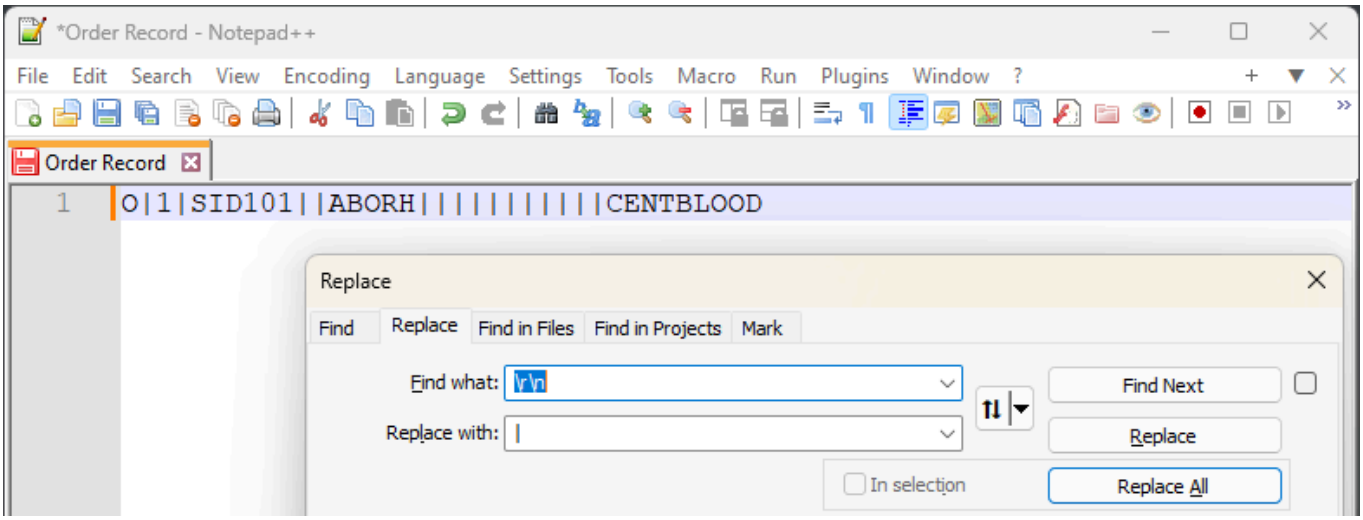
Position	Data Type	Value
O.5	Test ID	ABORH
O.16	Specimen Descriptor	CENTBLOOD

You can use the same process in reverse to create an Order record manually.

To hand code an Order record:

1. Enter each field attribute on the line number corresponding to its field position as defined by the ASTM standard or the manufacturer's LIS interface guide. For example, the sample ID goes in field 3 for an Order record, so write it on line 3.
2. Enter the new line characters: \r\n
3. Enter the field separator.
4. Enable the Extended search
5. Click *Replace all*

Now, we have manually created an Order record. Computers are programmed to do something similar.



Repeat Fields

A Repeat field contains multiple unique field values. For example, an order record with multiple Specimen IDs, such as a pair of blood samples from the same draw, one containing packed red blood cells and the other plasma.

```
O|1|SID102\SID103||ABO FWD/RVS||||||||||PACKEDCELLS\PLASMA
```

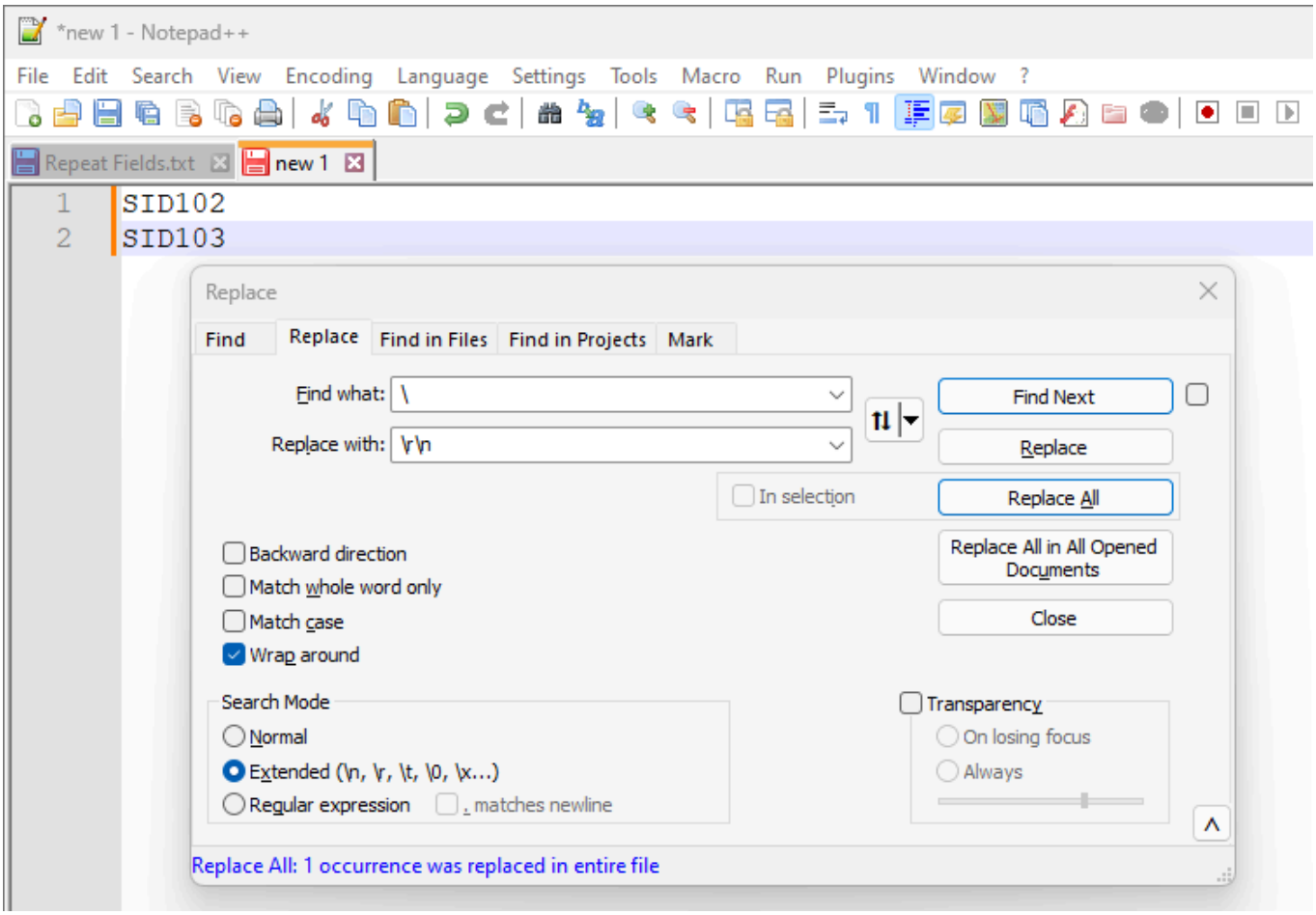
If we break the above Order record into fields, we get the following fields and values:

Position	Data Type	Value
O.1	Record Type ID	O
O.2	Sequence Number	1
O.3	Specimen ID	SID102\SID103
O.5	Test ID	ABO FWD/RVS
O.16	Specimen Descriptor	PACKEDCELLS\PLASMA

Field O.3, Specimen ID is a Repeat field. We can split the O.3 field into the repeated fields by replacing the Repeat field separator (^) with new lines. This is identical to what we did with fields.

```
SID102\SID103
```

And we end up with the following:



The notation for repeat fields is their filed notation plus their repeat field position. For sample ID SID103, the notation is O.3.2.

Below, I list the complete order record field position notations, Data Types, and values.

Position	Data Type	Value
O.1	Record Type ID	O
O.2	Sequence Number	1
O.3.1	Specimen ID	SID102
O.3.2	Specimen ID	SID103
O.5	Test ID	ABO FWD/RVS
O.16.1	Specimen Descriptor	PACKEDCELLS
O.16.2	Specimen Descriptor	PLASMA

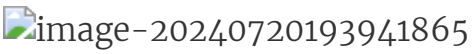
Components

One data type that occurs in ASTM is a person's full name. ASTM specifies that full names follow this format: last name, first name, middle name or initial, suffix, and title. Full names have several components, and the component separator separates each part. Naming conventions vary considerably around the world. Full names can be in any format agreed upon between the sender and the receiver. This means the parts of a full name do not have to be separated by the component separator. When more than one full name is required, they are separated by a repeat separator.

Let's add a couple of ordering physicians to our order record. Physicians can be identified by their identities, names, or both. I will use both in our example.

```
O|1|SID101||ABORH|||||||||||CENTBLOOD|PHY1001^Brewster^Katherine\PHY1002^McCoy^Leonard^H
```

As we know, the first step is to break the order record into fields.



We can see that O.17 is the ordering physician field and contains two repeat fields separated by the repeat field separator ().

```
PHY1001^Brewster^Katherine\PHY1002^McCoy^Leonard^H
```

We copy this field into another tab and break the repeat fields into separate lines.

We'll copy the first repeat field, O.17.1, into another tab and break the components into separate lines.

```
PHY1001^Brewster^Katherine
```

We will do the same with the component separator (^) as we did with the field separator.

O.17.1.1 is the physician ID, O.17.1.2 is the last name, and O.17.1.3 is the first name.

Below is a list of the fields, their position notation, Data Type, and value.

Position	Data Type	Value
O.1	Record Type ID	O
O.2	Sequence Number	1
O.3	Specimen ID	SID101
O.5	Test ID	ABORH
O.17.1.1	Physician [1] - Identifier	PHY1001
O.17.1.2	Physician [1] - Last Name	Brewster
O.17.1.3	Physician [1]- First Name	Katherine
O.17.2.1	Physician [1] - Identifier	PHY1002
O.17.2.2	Physician [1] - Last Name	McCoy
O.17.2.3	Physician [1]- First Name	Leonard
O.17.2.4	Physician [1]- Middle Initial	H
O.16	Specimen Descriptor	CENTBLOOD

ASTM Record Notation

The ASTM record notation I use allows us to identify the parts of a record. It consists of a record ID followed by indexes, one for Field, Repeat Field, and Component.

Record-ID.Field.Repeat.Component

Breaking down the introductory Message

As promised, we will break down the example ASTM message in the introduction into its parts.

```
H|\^&|||OCD^VISION^5.13.1.46935^JNumber|||||||P|LIS2-A|20210309142633
P|1|PID123456||NID123456^MID123456^OID123456|Brown^Bobby^B|White|1965010203
0400|U|||||PHY1234^Kildare^James^P|Blaine
O|1|SID305||ABO|N|20210309142136||||||||CENTBLOOD|||||||20210309142229|||R
R|1|ABO|B|||||R||Automatic||20210309142229|JNumber
R|2|Rh|POS|||||R||Automatic||20210309142229|JNumber
L|1|N
```

Record Type IDs

Type ID	Record Description	Level
H	Message Header - contains information about the sender and defines separators and the escape character	0
P	Patient - includes information on an individual patient	1
O	Order - when sent from an LIS, this record contains information about a test order. When sent by the instrument, it shall provide information about the test request.	2
R	Result - contains the results of a single analytic determination.	3

Type ID	Record Description	Level
M	Manufacturer Information - the fields in this record are defined by the manufacturer.	
Q	Request for information - used to request information, e.g., outstanding orders for a sample.	1
L	Message Terminator - the last record in the message. A header record may be transmitted after this record, which signifies the start of a second message.	0

Header Record

The Header record defines the separators and escape character, and contains information about the sender and receiver. It is the first record in an ASTM message.

Position	Type	Value
H.1	Record Type ID	H
H.2	Delimiter Definition	\^&
H.5	Sender Name or ID	OCD^VISION^5.13.1.46935^JNumber
H.12	Processing ID (P, T, D, Q)	P
H.13	Version Number	LIS2-A
H.14	Date and Time of Message	20210309142633

Patient Record

The patient record contains patient demographics, such as patient IDs, names, sex, and dates of birth.

Position	Type	Value
P.1	Record Type ID	p

Position	Type	Value
P.2	Sequence Number	1
P.3	Practice-Assigned Patient ID	PID123456
P.5	Patient ID Number 3	NID123456^MID123456^OID123456
P.5.1.1	National ID	NID123456
P.5.1.2	Medical Record	MID123456
P.5.1.3	Other ID	OID123456
P.6	Patient Name	Brown^Bobby^B
P.6.1.1	Patient Last Name	Brown
P.6.1.2	Patient First Name	Bobby
P.6.1.3	Patient Middle Initial	B
P.7	Mother’s Maiden Name	White
P.8	Birthdate	19650102030400
P.9	Patient Sex	U
P.14	Attending Physician ID	PHY1234^Kildare^James^P
P.14.1.1	Physician ID	PHY1234
P.14.1.2	Last Name	Kildare
P.14.1.3	First Name	James
P.14.1.4	Middle Initial	P
P.15	Special Field 1	Blaine

Test Order Record

The Test Order record contains all required information to request tests to be performed on one or more specimens.

Position	Type	Value
O.1	Record Type ID	p
O.2	Sequence Number	1
O.3	Specimen ID	SID305
O.5	Universal Test ID	ABO
O.6	Priority	N
O.7	Requested/Order Date and Time	20210309142136
O.16	Specimen Descriptor	CENTBLOOD
O.23	Date/Time Results Reported or Last Modified	20210309142229
O.26	Report Types	R

Result Record (1)

The Result record

A Result record is returned for each separate analysis requested by the test.

Position	Type	Value
R.1	Record Type ID	p
R.2	Sequence Number	1
R.3	Test ID	ABO
R.4	Analysis	B

Position	Type	Value
R.9	Result Status	R
R.11	Operator Identification	Automatic
R.13	Date/Time Test Completed	20210309142229
R.14	Instrument Identification	JNumber

Result Record (2)

Position	Type	Value
R.1	Record Type ID	p
R.2	Sequence Number	1
R.3	Test ID	Rh
R.4	Analysis	POS
R.9	Result Status	R
R.11	Operator Identification	Automatic
R.13	Date/Time Test Completed	20210309142229
R.14	Instrument Identification	JNumber

Terminator Record (L)

Position	Type	Value
R.1	Record Type ID	p
R.2	Sequence Number	1

Position	Type	Value
R.3	Termination Code	N

ASTM Escape Sequences

Separators and escape characters can vary with each message; they are defined in the Header record and used throughout the message. The escape character is the last of the four defined characters in the header. Its primary purpose is to create a sequence of characters to replace message separator characters used in field data. There is also an escape sequence for the escape character.

ASTM messages use escape sequences to handle situations where the standard field separator character might appear within the data.

- **Standard Separators:** The structure of an ASTM message uses specific characters to separate different data elements. Depending on the specific implementation, these separators could be commas, pipes ("|"), or other characters.
- **Data with Separators:** Sometimes, the data might contain the same separator character used in the structure of the message.

Escape sequences avoid confusion when the receiver reads a message. The special character sequence tells the receiving system to interpret the escape sequence as a separator *character*, not part of the message's structure.

Take, for example, the name of a profile that contains the repeat field separator, as in "ABO\Rh\ABScr", named after the analyses returned by the profile. If this profile name were placed in the order profile field as is, the receiver would read it as three repeat fields and not one profile name. To prevent this, the repeat field separators in the text data are replaced by the sender with an escape sequence, which will be converted back to the repeat field separator character by the receiver of the message.

ESCAPE Sequence	
&F&	Embedded field separator
&S&	Embedded component separator

ESCAPE Sequence	
&R&	Embedded repeat field separator
&E&	Embedded escape character