Routing ASTM Documents in Productions

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InterSystems IRIS Data Platform   Version 2024.1   2024-05-02
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Introduction to ASTM

This topic introduces ASTM and InterSystems support for ASTM.

1.1 Introduction to ASTM

The American Society for Testing and Materials (ASTM) established standards for transferring information between clinical instruments and computer systems. Specification ASTM E1394–97 covers the two-way digital transmission of remote requests and results between clinical instruments and computer systems. It specifies the conventions for structuring the content of the document and for representing the data elements contained within those structures. It does not specify conventions for low-level communications protocols and data transfer requirements. A separate specification, ASTM E1381–02 details a standard for low-level data transfer communications. The InterSystems ASTM package supports both of these standards. For further details, see the web site `http://www.astm.org/`.

ASTM has since transferred the responsibility for maintaining these standards to the Clinical and Laboratory Standards Institute (CLSI). You can find more information on these standards at the web site `http://www.clsi.org`. InterSystems healthcare products support the following listed standards from both organizations.

The originating standards from ASTM:

- *ASTM E1381-02 Standard Specification for Low-Level Protocol to Transfer Messages Between Clinical Laboratory Instruments and Computer Systems (Withdrawn 2002)*

- *ASTM E1394-97 Standard Specification for Transferring Information Between Clinical Instruments and Computer Systems (Withdrawn 2002)*

The successor standards from CLSI:

- *LIS01-A2 Specification for Low-Level Protocol to Transfer Messages Between Clinical Laboratory Instruments and Computer Systems;Approved Standard - Second Edition*

- *LIS02-A2 Specification for Transferring Information Between Clinical Instruments and Computer Systems; Approved Standard- Second Edition*

Note: For simplicity, in this documentation, *ASTM* refers to all forms of the supported standards.

1.2 InterSystems Support for ASTM Documents

InterSystems healthcare products support ASTM documents as virtual documents. A *virtual document* is a kind of message that InterSystems products parse only partially. This kind of message has the standard production message header and the standard message properties such as ID, Priority, and SessionId. The data in the message, however, is not available as message properties; instead it is stored directly in an internal-use global, for greater processing speed.

InterSystems provides tools so that you can access values in virtual documents, for use in data transformations, business rules, and searching and filtering messages. For background information, see Using Virtual Documents in Productions.

1.3 ASTM Communication Details

ASTM uses half-duplex, asynchronous communication, similar to a citizen's band radio. Only one party can communicate over the line at a time, but either party can initiate communication over that line. As an exchange begins, if there is contention, the parties negotiate to decide which should send data first. Generally the laboratory device goes first. A device that uses ASTM uses a single TCP socket to communicate with a business service. This single TCP socket is used for communication in both directions between InterSystems products and the device.

For all of these reasons, an ASTM business service must be able to do both of the following:

- Receive transmissions (and send their associated replies) over TCP

- Initiate transmissions (and receive their associated replies) over TCP

This is a departure from the architectural role of a business service, which is *only* to receive documents and return the associated replies. The typical production architecture prohibits a business service from initiating transmissions outside InterSystems products. Replies to received documents are fine, but there is no provision for a business service to initiate an exchange with an entity outside InterSystems products.

To adapt this restriction to ASTM conventions, InterSystems products provide a special-purpose business operation for use with ASTM business services. This business operation identifies the incoming ASTM business service as its *partner service*. Whenever any member of the production needs to initiate communication to the external device, it invokes this business operation, which sends the transmission out via its partner service. This preserves the production conventions for internal messaging (a business service may send messages to a business process or business operation only) while leaving room for ASTM conventions (there is only one TCP socket available on the device, and at the other end of this TCP connection is a business service).

The following sections describe how these conventions for business services and business operations work in two situations. Both are useful as you work with ASTM and InterSystems products:

- Connecting to a Device Using ASTM Over TCP

- Testing an ASTM Interface Without a Device

1.4 Connecting to a Device Using ASTM Over TCP

InterSystems products can communicate via TCP with a device that uses the ASTM protocol in scenarios like the following (all of which can occur in the same production):

- Scenario 1: Receiving and replying to an incoming transmission. This scenario requires a business service and a business process.

  An incoming document arrives from the device and enters a production via a **TCPServiceTwoWay** business service. The business service forwards the document to its configured business process, **WorkAndRouteProcess**. As in other business productions, the business process may invoke routing rules, data transformations, business operations, or other business processes. Eventually, as a result of this work a response comes to the business process. **WorkAndRouteProcess** relays this response to the **TCPServiceTwoWay** business service, which in turn relays it to the device.

  It is possible to set up the production so that the business service does not wait for the response to return from the business process as shown in this scenario. Instead, the request from **TCPServiceTwoWay** to **WorkAndRouteProcess** could be asynchronous and both configuration items could be free to do other work while the activities triggered by **WorkAndRouteProcess** take place. When a reply is finally ready as a result of these activities, **WorkAndRouteProcess** could initiate communication as described in scenario 3 to return the response document to the device.

- Scenario 2: Archiving the received documents as external files. This scenario requires a business service and a business operation.

  InterSystems products automatically archive all incoming and outgoing message data, but sometimes, especially for testing purposes, it can useful to capture the documents as external files, outside InterSystems products. A **TCPServiceTwoWay** business service could send incoming documents to the **FileOperationArchive** business operation over a simple pass-through interface. The **FileOperationArchive** would then store the documents as files in its configured directory on the local system. This scenario could easily coexist with either or both of the other scenarios described in this list.

- Scenario 3: Sending an outgoing transmission to the device and receiving a reply. This scenario requires a business service, a business process, and a business operation.

  Depending on the conventions expected by the device, it might be important for the InterSystems product, rather than the device, to initiate a connection and send the device data before the device can formulate a transmission. Suppose the logic for initiating the message begins at a business process, **WorkAndRouteProcess**. This configuration item sends an internal production message to the TCP business operation, **TCPOperationInitiate**, which uses its partner service, **TCPServiceTwoWay**, to send the payload document from this message to the device. If there is a reply from the device, it arrives via **TCPServiceTwoWay**, which directs the reply appropriately. One possibility is that the reply might trigger further activities by the **WorkAndRouteProcess**, but the details are up to the developer.

1.5 Testing an ASTM Interface Without a Device

You can test ASTM interfaces without having a device connected. You would need to save some of the ASTM documents that you expect to flow to and from your device as text files. Then you can use them to test throughput as follows:

- To simulate a document arriving from the device (and to test a TCP business service), you can use a file business service and a TCP business operation.

  This business service should look for a text file in its configured inbound directory and forward that to the TCP business operation. Then the TCP business operation can send the message to the TCP business service.

- To simulate processing the document, you can use a business service (**TCPServiceListen**) to receive the incoming ASTM document. This configuration item should send the document to a business process (**GenerateReplyProcess**). Because this test is a simulation, the business process can be an ordinary BPL business process that uses simple statements to generate a generic ASTM reply document. The business process then returns that response to the business service.

- To simulate a reply to the device, you can use a business service (**TCPServiceListen**) to send replies to a business operation (**TCPServiceConnect**, representing the device). Because this is a test and we want to see the results clearly,

TCPServiceConnect forwards the reply to a file business operation for output to a text file in its configured outbound directory.

2

Available Tools for ASTM

This topic provides an overview of the InterSystems tools that you can use to work with ASTM schemas and documents.

2.1 Using the ASTM Schema Structures Page

The **Interoperability** > **Interoperate** > **ASTM** > **ASTM Schema Structures** page enables you to import and view ASTM schema specifications.

For general information on using this page, see Using the Schema Structures Page.

For information on creating custom schema categories, see Creating Custom Schema Categories.

2.2 Using the ASTM Document Viewer Page

The **Interoperability** > **Interoperate** > **ASTM** > **ASTM Document Viewer** page enables you to display ASTM documents, parsing them in different ways, so that you can determine which DocType to use. You can also test transformations. The documents can be external files or documents from the production message archives.

For general information on using this page, see Using the Document Viewer Page.

2.3 ASTM Classes

For reference, this section lists the classes that InterSystems products provide to enable you to work with ASTM documents.

Item	Classes	Notes
Business services	• EnsLib.EDI.ASTM.Service.FileService • EnsLib.EDI.ASTM.Service.TCPService	Each of these ASTM business service classes uses a different adapter, as indicated by the class name.
Business processes		InterSystems provides a couple of sample business processes.

Item	Classes	Notes
Business operations	• EnsLib.EDI.ASTM.Operation.FileOperation • EnsLib.EDI.ASTM.Operation.FTPOperation • EnsLib.EDI.ASTM.Operation.TCPOperation	Each of these ASTM business operation classes uses a different adapter, as indicated by the class name.
Message class	EnsLib.EDI.ASTM.Document	This is a specialized message class to carry ASTM documents as virtual documents.
Search tables	EnsLib.EDI.ASTM.SearchTable	This is a specialized search table class for ASTM documents.

You can also create and use subclasses of these classes.

The business host classes include configurable targets. The following diagram shows some of these configurable targets:
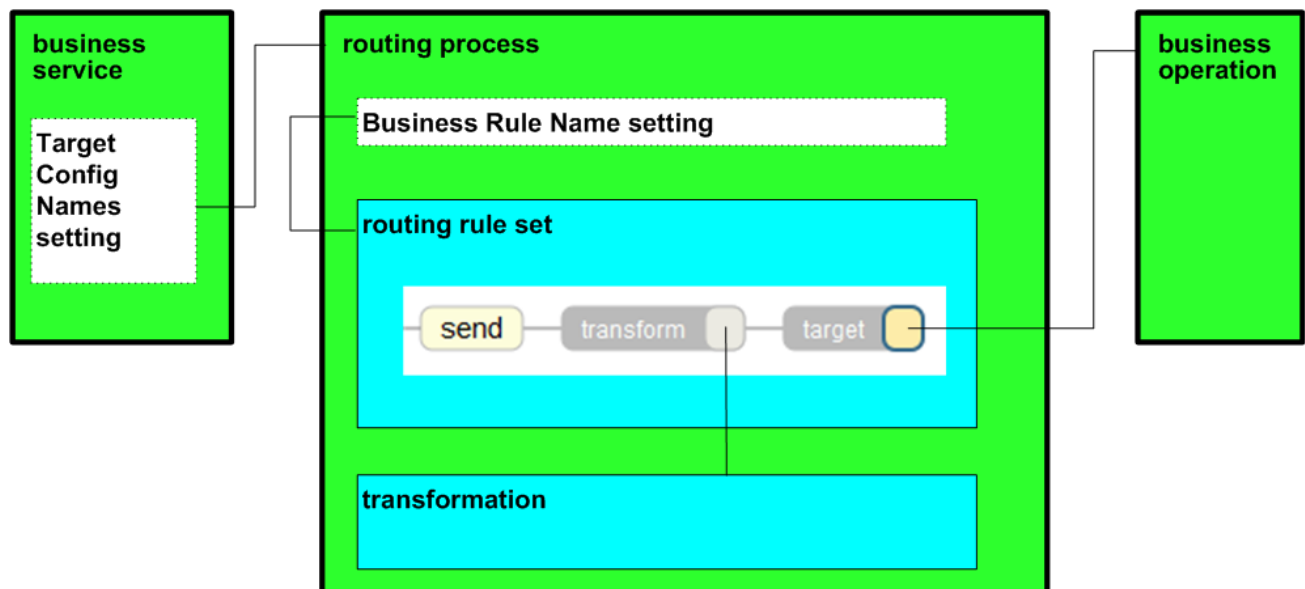
For information on other configurable targets, see Reference for Settings.

3

Configuring the Production for ASTM

This topic describes how to configure a production to include an ASTM routing interface using the **Interoperability** > **Configure** > **Production** page.

3.1 Adding ASTM Business Services

Add one ASTM business service for each document type that the production will receive. If this document type arrives via multiple communication modes (for example, via FTP in addition to files), you will need a business service for each communication mode.

To add an ASTM business service to a production, use the Business Service Wizard as usual; see Configuring Productions. Select one of the following classes from the **Service Class** list:

- EnsLib.EDI.ASTM.Service.FileService

- EnsLib.EDI.ASTM.Service.TCPService

3.1.1 Business Service Variation (EOTOPTIONAL)

InterSystems products also support a mode in which they receive consecutive ASTM E1394 messages not separated by ENQ/EOT control characters but just run together on the wire over a TCP connection. To enable this mode, create a subclass of one of the preceding business service classes, and add the following to your subclass:

Class Member

```
Parameter EOTOPTIONAL = 1;
```

Then use this subclass in your production.

3.2 Adding ASTM Business Processes

The example ASTM device interface uses a business process called **WorkAndRouteProcess**. A business process like this one inherits from EnsLib.MsgRouter.VDocRoutingEngine, just like the business processes that you would use for documents in the X12 format. For instructions to create one, see Adding an X12 Business Process. Instructions for the routing rules and data transformations that might be required to support such a business process are also available in the same topic.

The ASTM testing interface uses a BPL business process called **GenerateReplyProcess** as its business process. The purpose of this business process is to generate an appropriate ASTM reply document, without actually connecting with a device. The source code for the sample BPL business process is as follows:

Class Definition

```
Class Test.ASTM.GenerateReplyProcess Extends Ens.BusinessProcessBPL
{

/// BPL Definition
XData BPL [ XMLNamespace = "http://www.intersystems.com/bpl" ]
{
<process language='objectscript'
        request='Ens.Request' response='Ens.Response'
        height='2000' width='2000' >
  <sequence xend='550' yend='300' >
    <assign name='CreateResponse' property='response'
            value='..%Process.NewResponse(request)' action='set'
            xpos='550' ypos='200' />
  </sequence>
</process>
}

Method NewResponse(pDocIn As EnsLib.EDI.ASTM.Document)
      As EnsLib.EDI.ASTM.Document
{
 Do {
  Set tDocOut=pDocIn.NewReplyDocument(,,.tSC)  Quit:$$$ISERR(tSC)
  #; Create correct number of blank segment objects in the output document
  For i=1:1:4 {
   Set tSC=tDocOut.SetSegmentAt(##class(EnsLib.EDI.ASTM.Segment).%New(),i)
   Quit:$$$ISERR(tSC)
  } Quit:$$$ISERR(tSC)
 Set tSC=tDocOut.SetValueAt("H|\^&|||",1)
 Set tSC=tDocOut.SetValueAt("P|1|315186|SH3F040230||ARNOUTS^A||19261201|W|",2)
 Set tSC=tDocOut.SetValueAt("O|1|0058224303||^^^BH05|R||||||A||||||||||||||Q",3)
 Set tSC=tDocOut.SetValueAt("L|1|F",4)
 } While 0
 If $$$ISERR(tSC) $$$LOGSTATUS(tSC)  Quit $$$NULLOREF
 Quit tDocOut
}

}
```

3.3 Adding ASTM Business Operations

Add an ASTM business operation for each output destination. You might also want to add a business operation to handle bad messages.

To add an ASTM business operation to a production, use the Business Operation Wizard as usual; see Configuring Productions. Select one of the following classes from the **Operation Class** list:

- EnsLib.EDI.ASTM.Operation.FileOperation

- EnsLib.EDI.ASTM.Operation.FTPOperation

- EnsLib.EDI.ASTM.Operation.TCPOperation

3.4 Connecting the ASTM Business Hosts

After you add the ASTM business hosts, connect these items as follows:

- For each ASTM business service, specify the Target Config Names setting as the name of the ASTM business process.

- Create a routing rule set that contains the desired logic. See Additional Steps.

For the routing rule set, make sure that the **Target** field is the ASTM business operation.

- For the ASTM business process, specify the **Business Rule Name** setting. Use the full name of the new routing rule set.

3.5 Configuring the Business Hosts

You should examine all the settings listed in Reference for Settings and set them as needed.

A couple of key settings for an ASTM business service are as follows:

- Doc Schema Category — Specifies the schema category to assign to the inbound documents. InterSystems products require this information for validation and for search table indexing.

- Search Table Class — Specifies the class to use to index virtual properties in the inbound documents.

- For a File business service, also consider whether you need to configure the Reply Target Config Names setting.

- (Optional) For a TCP business service, prepare the business service to initiate outgoing transmissions:

  Configure Out Separators and Response Timeout.

When ASTM is the protocol, a business operation needs a partner business service before it can initiate an outbound transmission to the device. The basic integration tasks are as follows:

- (For the TCP business operation) Configure the Separators settings.

- (For a partner TCP business service) Configure the **Partner Service** setting. Specify this is as the configuration name of the TCP business operation that sends documents to the device.

4

Additional Steps for ASTM

This topic discusses the additional steps needed to add ASTM routing interfaces to a production.

Be sure to perform these tasks in the same namespace that contains your production. When you create rule sets, transformations, and search tables, do not use reserved package names; see Reserved Package Names.

4.1 Loading ASTM Schemas into InterSystems Products

To load an ASTM schema into InterSystems products, use the ASTM Schema Structures page.

For information on creating custom schema categories, see Creating Custom Schema Categories.

4.2 Defining Routing Rule Sets for ASTM

Depending on the business process that you create, you may need to create a routing rule set.

For general information on defining business rules, see Developing Business Rules.

When you create a routing rule set for an ASTM routing interface:

- On the **general** tab, **Rule Type** should be **Virtual Document Message Routing Rule**. This choice sets the following options:

    - **Rule Assist Class** should be EnsLib.MsgRouter.VDocRuleAssist

    - **Context Class** should be EnsLib.MsgRouter.VDocRouting Engine

- In the **constraint** for a rule, specify **Message Class** as EnsLib.EDI.ASTM.Document.

4.3 Defining DTL Data Transformations for ASTM

Your routing rules might need one or more data transformations.

For general information on defining DTL data transformations, see Developing DTL Transformations.

When you create a DTL data transformation for ASTM documents:

- On the **Transform** tab, **Source Class** and **Target Class** should both be EnsLib.EDI.ASTM.Document.

- **Source Doc Type** should match the schema category name assigned by the business service.

- **Target Doc Type** should be the name of the target schema category. This must match a schema category name that you have loaded into the InterSystems product.

Use the ASTM Document Viewer Page to test your transformations, as described in Available Tools.

To integrate the DTL data transformation in the production, enter its full package and class name in the **Transform** field of a routing rule set.

4.4 Defining ASTM Search Tables

The ASTM search table class, EnsLib.EDI.ASTM.SearchTable, automatically indexes the ASTM document ID, which it gives the name Identifier.

If you need more items to search, you can create a subclass. The subclass inherits the Identifier property, plus the infrastructure that makes search tables work. For details, see Defining a Search Table Class.

For ASTM, InterSystems products support an additional value for PropType. You can use DateTime:HL7 in addition to the types listed in *Using Virtual Documents in Productions*.

Reference for ASTM Settings

Settings for ASTM Business Services

Provides reference information for settings for ASTM business services.

Summary

ASTM business services provide the following settings:

Group	Settings	See
Basic Settings	Target Config Names, Doc Schema Category	Settings for Business Services
Additional Settings	Search Table Class	Settings for Business Services
Additional Settings	Reply Target Config Names, Response Timeout, Out Separators, Local Application ID, Reply Mode, Get Reply	*sections in this topic*

The remaining settings are either common to all business services or are determined by the type of adapter. For information, see:

- Settings for All Business Services

- Settings for the File Inbound Adapter

- Settings for the FTP Inbound Adapter

  The EnsLib.EDI.ASTM.Adapter.TCPAdapter adapter also provides the Out Separators and Response Timeout settings that an InterSystems product needs when it sends outgoing messages. EnsLib.EDI.ASTM.Adapter.TCPAdapter also has the following adapter properties configured appropriately for ASTM by default:

  – **Port** has a default of 10001.

  – **Terminators** is set to the line feed character (ASCII 10). This property is not configurable in the Management Portal.

Get Reply

(TCP Only) Typically the external ASTM system provides an ACK reply to the ASTM TCP service and operation. If the external ASTM system does not provide an ACK reply, clear the **Get Reply** check box on the ASTM TCP business service. The ASTM TCP business operation uses the setting of its **Partner Service** business service.

The default value is true.

Local Application ID

Colon-separated *LocalID:Qualifier* code that represents the facility and application that receive ASTM documents via this business service. These are used to create reply document headers. The @ (at sign) character represents using the corresponding field from the incoming document. If your ID must contain a literal @ symbol, escape it with backslash: \@

The default value is:

```
ASTMService:ENS
```

Out Separators

(TCP only) When configuring an ASTM business service, you have the option of specifying **Out Separators** for outgoing ASTM documents. The fact that an ASTM business *service* can initiate communication from within an InterSystems product is an architectural variation that is necessary to support ASTM communication conventions.

For details, see Separator in Settings for ASTM Business Operations, which discusses a similar setting called **Separators**.

If you do not specify a value for **Out Separators**, the business service uses a default that consists of the four-character string `Flex`. InterSystems products do not use the `Flex` characters as separators but interprets this value as follows:

- If the outgoing document is a reply to a previously received inbound document, copy the separators from the inbound document.

- If the outgoing document initiates communication from within an InterSystems product, use the native separators of the outbound message (do not change separators to transmit the message).

Reply Mode

An ASTM routing interface is a two-way interface; the business service can send outbound documents on it using its partnered business operation. However if your target configuration item wishes to return an immediate response, you can enable this by configuring a **Reply Mode** value of `Application`. Specify one of the following values:

- `Never` — Do not send back any reply. This is the default.

- `Application` — Wait for a response from the target configuration item and relay the response back when it arrives.

Reply Target Config Names

(**File** only) Allows you to specify a comma-separated list of configuration items within the production to which the business service should relay any ASTM *reply* documents that it receives. Usually the list contains one item, but it can be longer. The list can include business processes or business operations, or a combination of both.

Compare to Target Config Names.

Response Timeout

(TCP only) Number of seconds to wait for a response to begin arriving back from the remote system after sending a request. Setting the timeout to `-1` means wait forever.

If the response does not arrive in the **Response Timeout** value for the request, the ASTM adapter generates and logs an `<Ens>ErrTCPReadTimeoutExpired` error, then returns to listening for new inbound messages and waiting for new outbound messages.

Settings for ASTM Business Operations

Provides reference information for settings for ASTM business operations.

Summary

ASTM business operations provide the following settings:

Group	Settings	See
Basic Settings	File Name	*section in this topic*
Additional Settings	Search Table Class	Settings for Business Operations
Additional Settings	Partner Service, Separators	*sections in this topic*

The remaining settings are common to all business operations. See Settings for All Business Operations.

File Name

(**File** only) The target file name. The **File Path** adapter setting determines the path for this file; **File Name** determines the name. **File Name** can include time stamp specifiers. If you leave this setting blank, the default uses the time stamp specifier %f_%Q where:

- %f is the name of the data source, in this case the input filename

- _ is the literal underscore character, which will appear in the output filename

- %Q indicates ODBC format date and time

In substituting a value for the format code %f, InterSystems strips out any of the characters |,?,\,/,:,[,],<,>,&,,,;,NUL,BEL,TAB,CR,LF, replacing spaces with underscores (_) and slashes (/) with hyphens (-). When the output file is being saved on an OpenVMS system, InterSystems replaces colons with hyphens (-). Otherwise, colons (:) become dots (.).

For details, see Time Stamp Specifications for Filenames.

Partner Service

(**TCP** only) The configured **Name** of the TCP business service that is paired with this business operation to send ASTM documents out over the TCP socket. For details, see the overview of ASTM interfaces in InterSystems Support for ASTM.

The **Production Configuration** page does not display the connection to this business operation.

Separators

A string of four characters which InterSystems assigns to ASTM separators in left to right order: FS, RS, CS, ESC.

An ASTM message uses special characters to organize its raw contents. These characters may vary from one clinical application to another. There are four characters, as follows:

1. Field separator (FS)

2. Repetition separator (RS)

3. Component separator (CS)

4. Escape character (ESC)

The specific character that plays each role may vary from one clinical application to another.

When configuring an ASTM business service, you have the option of specifying a set of **Out Separators** for outgoing ASTM documents. The fact that an ASTM business *service* can initiate communication from within an InterSystems product is an architectural variation that is necessary to support ASTM communication conventions. For details about these conventions, see Introduction

There is a similar setting called Out Separators for ASTM business services.

For either setting, you must supply a string of four characters which InterSystems assigns to ASTM separators in left to right order: FS, RS, CS, ESC, as described in the previous list.

If you do not specify a value for **Separators**, the default is:

|\^&

ASTM Escape Sequences

Provides reference information for ASTM escape sequences.

Details

When separator characters need to appear within the data contents of an ASTM message, ASTM provides escape sequences to replace the separator characters.

Thus, within the ASTM data stream you might see certain characters replaced by an escape sequence, such as `&E&` replacing `&` in the following samples:

```
Parker &E& Sons
XR CHEST PA&E&LAT
```

The following table lists the four standard ASTM escape sequences and their meanings. ASTM escape sequences begin and end with the defined escape character, as described in Separators. ASTM escape sequences are case-sensitive, and they use the specific characters F S R or E as shown in the table. In the examples shown, the `&` (ampersand) is the escape character.

This character sequence...	If found within ASTM data, indicates...	For example...
`&.br&`*	Carriage return	
`&F&`	Field separator character	|
`&S&`	Component separator character	\
`&R&`	Repetition separator character	^
`&E&`	Escape character	`&`
`&X0A&`	Line feed	
`&X0D&`	Carriage return	

* Only used for unescaping.