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Abstract:
This document specifies mandatory and optional components of a test assertion model.

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1 Introduction

[All text is normative unless otherwise indicated.]

1.1 Terminology

Within this specification, the key words "shall", "shall not", "should", "should not" and "may" are to be interpreted as described in Annex H of [ISO/IEC Directives] if they appear in bold letters.

Data Model Formal Definition Terminology

The means of formally defining the model in this specification involves the use of terms "class", "attribute", "datatype" and "association". These are terms familiar in an object oriented paradigm but shall not be strictly interpreted as object oriented terms. The terms are used as a means of formally defining the data structures in the model and do not specify or imply how that data is to be accessed or used. The use of the object oriented terminology shall not be taken to mean that the implementation is to be object oriented.

Class

The term "class" is used when the structure so modeled is a complex grouping of more than one entity (either “attributes” or “associations” or both).

Datatype

The term "datatype" is primarily used of a simple, primitive type such as a string or integer. An implementation may implement a datatype with another datatype such as a more restricted datatype based on the datatype specified in the model. (For example an entity specified with datatype “string” may be implemented as a URI.)

Attribute

The term “attribute” is used to specify an entity based on a primitive or simple datatype such as a string or an integer.

Association

More complex entities based on the types specified as classes are here termed “associations”. These “associations” specify a combination of attributes or other associations or both. The type of an “association” is based on a class.

Domain terminology

Conformance

The fulfillment of specified requirements by a product, document, process, or service.

Conformance Clause

A statement in the Conformance section of a specification that provides a high-level description of what is required for an artifact to conform. The conformance clause may, in turn, refer to other parts of the
specification for details. A conformance clause must reference one or more normative statements, directly or indirectly, and may refer to another conformance clause.

**Implementation**

A product, document, process, or service that is the realization of a specification or part of a specification.

**Normative Statement, Normative Requirement**

A statement made in the body of a specification that defines prescriptive requirements on a conformance target.

**Test Case**

A set of a test tools, software or files (data, programs, scripts, or instructions for manual operations) that verifies the adherence of a test assertion target to one or more normative statements in the specification. Typically a test case is derived from one or more test assertions. Each test case includes: (1) a description of the test purpose (what is being tested - the conditions / requirements / capabilities which are to be addressed by a particular test), (2) the pass/fail criteria, (3) traceability information to the verified normative statements, either as a reference to a test assertion, or as a direct reference to the normative statement.

**Test Metadata**

Metadata that is included in test cases to facilitate automation and other processing.

1.2 **Normative References**


1.3 **Non-Normative References**


2 Definitions and Rationale

2.1 Test Assertion

A test assertion is a testable or measurable expression for evaluating the adherence of part of an implementation to a normative statement in a specification. It describes the expected output or behavior for the test assertion target within specific operation conditions, in a way that can be measured or tested.

A Test Assertion should not be confused with a Conformance Clause, nor with a Test Case. The specification will often have one or more conformance clauses which define (one or more) conformance profiles or levels. A set of test assertions may be associated with a conformance clause in order to define more precisely what conformance entails. Test assertions lie between the specification and any suite of tests to be conducted to determine conformance. Such a test suite is typically comprised of a set of test cases. These test cases may be derived from test assertions which address the normative statements of the specification.

2.2 Test Assertion Set and Test Assertion Document

A container may be produced for a complete set of test assertions; often those related to all or part of a specification or conformance profile. In some cases the container is the specification itself with test
assertions included within it. Test assertions can be added to the document, removed or changed using a change and version management procedure.

2.3 Benefits of Test Assertions

Improving the Specification

Test assertions may help provide a tighter specification: Any ambiguities, contradictions and statements which require excessive resources for testing can be noted as they become apparent during test assertion creation. If there is still an opportunity to correct or improve the specification, these notes can be the basis of comments to the specification authors. If not developed by the specification authors, test assertions should be reviewed and approved by them which will improve both the quality and time-to-deployment of the specification. Therefore, best results are achieved when assertions are developed in parallel with the specification. An alternative is to have the leader of the team that is writing test suites write the test assertions as well and to provide feedback to the specification authors.

Facilitating Testing

Test assertions provide a starting point for writing a conformance test suite or an interoperability test suite for a specification that can be used during implementation. They simplify the distribution of the test development effort between different organizations while maintaining consistent test quality. By tying test output to specification statements, test assertions improve confidence in the resulting test and provide a basis for coverage analysis (estimating the extent to which the specification is tested).
3 Test Assertion

3.1 Overview of a Test Assertion Model

Core Test Assertion Parts

A test assertion shall include, implicitly or explicitly:

Test Assertion Identifier

This unique identifier facilitates tools development and the mapping of assertions to specification statements. It is recommended that the identifier be made universally unique.¹

Normative Source(s)

These refer to the precise specification requirements or normative statements that the test assertion addresses.

Test Assertion Target

A test assertion target is the implementation or part of an implementation that is the object of a test assertion or test case. It categorizes an implementation or a part of an implementation of the referred specification.

Predicate

A predicate asserts, in the form of an expression, the feature (a behavior or a property) described in the referred specification statement(s). If the predicate is an expression which evaluates to “true” over the test assertion target, this means that the target exhibits this feature. “False” means the target does not exhibit this feature.

Optional Test Assertion Parts

In addition, a test assertion may optionally include:

Prescription Level

The prescription level is a keyword that indicates how imperative it is that the Normative Statement referred to in the Normative Source, be met. The test assertion defines a normative statement which may be mandatory (MUST / REQUIRED / SHALL), permitted (MAY / CAN) or preferred (SHOULD / RECOMMENDED). This property can be termed the test assertion’s prescription level. NOTE: in the case of the normative source including keywords ‘MUST NOT’ the prescription level ‘mandatory’ is used and the ‘NOT’ included in the predicate. There are differences between various conventions of normative language [ISO/IEC Directives] [RFC 2119] and the above terms may be extended with more specialized terms for a particular convention and its distinct shades of meaning.

Prerequisite(s)

A test assertion Prerequisite is a logical expression (similar to a Predicate) which further qualifies the Target for undergoing the core test (expressed by the Predicate) that addresses the Normative Statement. It may include references to the outcome of other test assertions. If the Prerequisite evaluates to “false”

¹ One way to do this is to designate a universally unique name for a set of test assertions and to include this name along with the identifier when referencing the test assertion from outside of this set.
then the Target instance is not qualified for evaluation by the Predicate. A prerequisite may include references to other test assertions.

**Tag(s)**

Test assertions may be assigned 'tags' or 'keywords', which may in turn be given values. These tags provide you with an opportunity to categorize the test assertions. They enable you to group the test assertions, for example based on the type of test they assume or based on their target properties.

**Variables**

Test assertions *may* also include variables for convenience in storing values for reuse and shared use. Another use of a variable is as parameter or attribute employed by the writer of a test assertion to refer to a value that is not known at the time the test assertion is written, but which will be determined at some later stage, possibly as late as the middle of running a set of tests.

**Implicit Test Assertion Parts**

In an actual test assertion definition, the previously mentioned properties are often explicitly represented as elements of the test assertion.

A concrete representation of a test assertion *may* omit elements provided they are implicit. A common case of implicit test assertion components is the implicit target: When several test assertions relate to the same target, the latter may be described just once as part of the context where the test assertions are defined, so that it does not need to be repeated. This calls for further structural components than those described so far. The more complex structure *may* include a test assertion set whose model caters for sharing of test assertion parts among a group of test assertions.

### 3.2 Test Assertion Model

Table 1. Mapping Section 3.1 test assertion overview to the formal Test Assertions Model

<table>
<thead>
<tr>
<th>Test Assertion Structures</th>
<th>Corresponding Entities in Test Assertions Model</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Core Parts</strong></td>
<td></td>
</tr>
<tr>
<td>Test Assertion</td>
<td>Class: testAssertion</td>
</tr>
<tr>
<td>Test Assertion Identifier</td>
<td>attribute: testAssertion.id</td>
</tr>
<tr>
<td></td>
<td>('id' attribute of testAssertion class)</td>
</tr>
<tr>
<td>Normative Source</td>
<td>Class: normativeSource</td>
</tr>
<tr>
<td>Test Assertion Target</td>
<td>Class: target</td>
</tr>
<tr>
<td>Predicate</td>
<td>Class: predicate</td>
</tr>
<tr>
<td><strong>Optional Parts</strong></td>
<td></td>
</tr>
<tr>
<td>Prescription Level</td>
<td>attribute: prescription.level</td>
</tr>
<tr>
<td></td>
<td>('level' attribute of prescription class)</td>
</tr>
<tr>
<td>Prerequisite</td>
<td>Class: prerequisite</td>
</tr>
<tr>
<td>Tag</td>
<td>Class: tag</td>
</tr>
<tr>
<td>Variable</td>
<td>Class: var</td>
</tr>
</tbody>
</table>
Convention Used for Formally Defining the Model

The means of formally defining the model in this specification involves the use of terms “class”, “attribute”, “datatype” and “association”. These are terms familiar in an object oriented paradigm but shall not be strictly interpreted as object oriented terms. The terms are used as a means of formally defining the data structures in the model and do not specify or imply how that data is to be accessed or used. The use of the object oriented terminology shall not be taken to mean that the implementation is to be object oriented. See section 1.2 for meanings of these terms.

Example Formal Definition:

```
example {
    content : string (0..1)
    id : string (1..1)
    Child : child (1..*)
    Sibling : sibling (0..*)
}
```

With the exception of the example above, all of the textual representations in this specification shall be taken as normative and authoritative. However, some classes in this specification may be extended either by adding further attributes or by adding further associations or both. This is indicated in the prose immediately following the representation of the class.

The class name, here called 'example', is shown before the opening curly bracket. The attributes combine the name of the attribute in lower camel case separated by a colon from the name of the datatype on which the type of the attribute is based. The associations combine the name of the association in upper camel case separated by a colon from the name of the class which is associated and which represents the type of the association. The cardinalities are specified using the notation "(x..y)" where "x" represents the lower bound and "y" the upper bound of the cardinality. The symbol "*" represents a limitless upper bound. There are four cardinalities in the model:

- (0..1) specifies an optional, singular entity (lower bound 0, upper bound 1)
- (0..*) specifies an optional, multiple entity (lower bound 0, upper bound unlimited)
- (1..1) specifies a mandatory, singular entity (lower bound 1, upper bound 1)
- (1..*) specifies a mandatory, multiple entity (lower bound 1, upper unlimited)

In the example representation above there is a class called “example” (not a real class, just an example to illustrate the representation convention used in this specification). The class has a mandatory attribute, shown with "(1..1)" to signify that it is mandatory, called “id” whose content is type “string”. The class called “example” has another attribute named “content” which is shown to be optional by the notation (0..1). The “example” class has associations to other classes called “child” and “sibling”. These are similar to attributes whose types are complex and represented in this model as classes. The (0..*) notation signifies that the entity named “sibling” has multiple cardinality and is optional. The (1..*) after the association called “child” signifies that this association is mandatory and multiple.

Any graphic images such as class diagrams included in this specification are non-normative. It is the text which shall be taken as normative. Any diagrams are to be interpreted loosely as illustrative material and in the case of any discrepancy with the text it is the text which is to be taken as authoritative.
**testAssertion**

Formal Definition:

testAssertion {

  id : string (1..1)
  language : string (0..1)
  NormativeSource : normativeSource (1..1)
  Target : target (1..1)
  Prerequisite : prerequisite (0..1)
  Predicate : predicate (1..1)
  Prescription : prescription (0..1)
  Description : description (0..1)
  Tag : tag (0..*)
  Variable : variable (0..*)
  Report : report (0..*)
}

Other attributes and associations may be added to the testAssertion class.

An implementation instance may have the testAssertion as the top level class.

Each test assertion has an identifier and for this reason the testAssertion class has an 'id' attribute. A test assertion shall have a test assertion identifier unless the identifier is implicit. So the 'id' attribute may be implicit (by some special provision in a particular profile or implementation, perhaps using an expression to derive the identifiers, for example). For this reason the attribute is optional. If no provision is made for an implicit identifier to be assigned to a test assertion, a test assertion identifier shall be provided for every test assertion using the 'id' attribute of the testAssertion class.

The test assertion and most other classes in the Test Assertions Model have an optional attribute named 'language' which is used to specify the language used in the test assertion. The string datatype for this attribute may be further constrained using a language codelist.

Each test assertion declares a normative source, a target and a predicate and for this reason the testAssertion class has associations with the classes named normativeSource, target and predicate. A test assertion shall have a normative source, a target and a predicate unless either or all of these are implicit. The normativeSource, target and predicate associations may be implicit and also may be declared in a test assertion set (specified later). For this reason these associations are optional in the Test Assertion Model testAssertion class. Each conforming implementation of the Test Assertion Model should ensure that a normative source, a target and a predicate are implicitly or explicitly provided for each test assertion.

A test assertion may also declare a prerequisite (either as a single entity comprising all prerequisites together or multiple prerequisites), a prescription level and any number of tags. For this the testAssertion class has optional associations to classes named prerequisite, prescription and tag. The tag association has optional, multiple occurrence. A test assertion may have prerequisite(s), a prescription level and tags, either implicitly or explicitly. The model provides a 'variable' component as an association to a class which it calls variable. Besides these associations to other classes, this model provides other associations for convenience to the usability of tool support. These additional, optional associations are to classes description and report.

In a concrete test assertion representation, mandatory parts could be absent provided that they are implicitly defined somewhere else (i.e. that their actual representation can be inferred, either from a container structure like a “test assertion set” or from other rules).
**normativeSource**

Formal Definition:

```plaintext
normativeSource {

  content : string (0..1)
  Comment : comment (0..1)
  Interpretation : interpretation (0..1)
  RefSourceItem : refSourceItem (0..*)
  TextSourceItem : textSourceItem (0..*)
  DerivedSourceItem : derivedSourceItem (0..*)
}
```

Other attributes may be added to the `normativeSource` class.

The normative source of a test assertion may be provided as a reference using the `refSourceItem` class.
Formal Definition:

refSourceItem {
    content : string (0..1)
    name : string (0..1)
    language : string (0..1)
    uri : string (0..1)
    documentId : string (0..1)
    versionId : string (0..1)
    revisionId : string (0..1)
    dateString : string (0..1)
    resourceProvenanceId : string (0..1)
    resourceType : string (0..1)
    resourceTypeVersionId : string (0..1)
    resourceTypeSchemaId : string (0..1)
    resourceTypeSchemaVersionId : string (0..1)
    resourceTypeProvenanceId : string (0..1)
}

Other attributes may be added to the refSourceItem class.

Here there is metadata which may be used to specify the identification of a resource containing the normative source items. The uri attribute may contain data to help locate the resource but the expected implementation is one where an identifier or URI is used to point to a repository of some kind which is a more appropriate container for the specific information needed to make the normative source items available. The other metadata attributes includes information about the kind of resource involved and most appropriately its provenance (such as authorship identifiers to certify its authenticity) and version, etc.

An alternative to using a reference to point to the normative source in a specification is to actually quote verbatim the source item so the normative source includes an association with a class named textSourceItem which allows a direct, verbatim quote of the specification text.

Formal Definition:

textSourceItem {
    content : string (0..1)
    name : string (0..1)
    language : string (0..1)
}

Other attributes may be added to the textSourceItem class.

An alternative again to quoting verbatim the source item is to derive a form of words equivalent in meaning to the source item and for this the normative source includes an association to a class named derivedSourceItem. This is particularly useful when the source consists of tables, diagrams, graphs or text spread over several parts of the specification.

Formal Definition:

derivedSourceItem {
    content : string (0..1)
    name : string (0..1)
    language : string (0..1)
    uri : string (0..1)
    documentId : string (0..1)
    versionId : string (0..1)
    revisionId : string (0..1)
    dateString : string (0..1)
}
resourceProvenanceId : string (0..1)
resourceType : string (0..1)
resourceTypeVersionId : string (0..1)
resourceTypeSchemaId : string (0..1)
resourceTypeSchemaVersionId : string (0..1)
resourceTypeProvenanceId : string (0..1)

Other attributes may be added to the derivedSourceItem class.

Here there is metadata which may be used to specify the identification of a resource containing the normative source items. The uri attribute may contain data to help locate the resource but the expected implementation is one where an identifier or URI is used to point to a repository of some kind which is a more appropriate container for the specific information needed to make the normative source items available. The other metadata attributes includes information about the kind of resource involved and most appropriately its provenance (such as authorship identifiers to certify its authenticity) and version, etc.

Formal Definition:
comment {
    content : string (0..1)
    language : string (0..1)
}

Other attributes may be added to the comment class.

The comment class may be used to simply add comments of any kind (or as further specified in a conformance profile for this markup or a customization thereof) to a normative source test assertion part.

Formal Definition:
interpretation {
    language : string (0..1)
    content : string (0..1)
}

Other attributes may be added to the interpretation class.

The interpretation class may be used to simply add an alternative description in prose of any kind (or as further specified in a conformance profile for this markup or a customization thereof) to a normative source test assertion part. This allows a prose expression to be added to improve human understanding of its logic.

target

Formal Definition:
target {
    content : string (0..1)
    type : string (0..1)
    schemeRef : string (0..1)
    language : string (0..1)
}

Other attributes may be added to the target class.
A target can either be a specific item or a category of items. The target class has a 'type' attribute which should be used to specify the target category, and this may be implemented using a controlled vocabulary, ontology or other classification or taxonomy system. Where the scheme for listing or categorizing these types is defined in a document, the identifier, URL or URI for this document may be associated with the target using the attribute named 'schemeRef'. A target 'schemeRef' attribute or, for a set of test assertions, a shared target 'schemeRef' attribute may be used in cases where the target type scheme is defined using an expression or prose definition within the test assertion or set of test assertions.

The target content is a string. This may be an expression in a specialized formal expression language which may be specified using the 'language' attribute or using a complete conformance profile for that particular use of the markup. The target shall be the subject of the test assertion predicate and, during implementation of the test assertion, it should be the subject (target) of the corresponding test(s).

**prerequisite**

Formal Definition:

```plaintext
prerequisite {
    content : string (0..1)
    language : string (0..1)
}
```

Other attributes may be added to the prerequisite class.

The prerequisite may be expressed using a specialized formal expression language which may be specified using the 'language' attribute or using a complete conformance profile for that particular use of an implementation of the model. The semantics of the test assertion depends on the value of the prerequisite (see Section 3.3). These semantics require that the prerequisite evaluates to a boolean logical true or false. The prerequisite class is an optional association of a test assertion (including where a test assertion prerequisite is inherited from an ancestor test assertion set), unless otherwise made mandatory using a conformance profile of a customization for an implementation of the test assertions model. The content of the prerequisite shall contain an expression which evaluates to true or false. The prerequisite expression shall be used to determine whether (true) or not (false) the target qualifies for the test assertion (in particular for the predicate of the test assertion). The evaluation of the test assertion shall conform to the semantics of the outcome of the test assertion specified in Section 3.3.

**predicate**

Formal Definition:

```plaintext
predicate {
    content : string (0..1)
    language : string (0..1)
}
```

Other attributes may be added to the predicate class.

The predicate may be expressed using a specialized formal expression language which may be specified using the 'language' attribute or using a complete conformance profile for that particular use of an implementation of the model. The semantics of the test assertion depends on the value of the predicate (see Section 3.3). These semantics require that the predicate evaluates to a boolean logical true or false.
A predicate shall be specified for every test assertion. The manner of its expression shall include where a test assertion predicate is inherited from an ancestor test assertion set. Therefore the actual predicate class shall be optional as association of a testAssertion class unless otherwise made mandatory using a conformance profile of a customization. The content of the predicate class shall contain an expression which evaluates to true or false. The predicate expression shall be used to determine whether (true) or not (false) the target passes the test assertion. As already stated (see ‘prerequisite’ above), the evaluation of the test assertion shall conform to the semantics of the outcome of the test assertion specified in Section 3.3.

**prescription**

Formal Definition:

```plaintext
prescription {
  content : string (0..1)
  level : string (0..1) {allowed values = mandatory|preferred|permitted}
}
```

Other attributes may be added to the prerequisite class.

The allowable values for the attribute 'level' of the class prescription may be extended beyond the built-in values of mandatory, preferred and permitted. Custom values may be ignored by an implementation.

The prescription values correspond to the terms used in a specification to denote conformance requirements. [RFC 2119] terms conveying mandatory nature of a statement such as 'MUST' and 'MUST NOT' and in Annex H of [ISO/IEC Directives] terms 'shall', etc shall correspond to the prescription level value 'mandatory'. RFC2119 terms conveying optionality with preference such as 'SHOULD' and 'SHOULD NOT', 'RECOMMENDED', etc and ISO/IEC Directive terms 'should', etc shall correspond to the prescription level value 'preferred'. RFC2119 terms conveying optionality without preference 'MAY' and ISO/IEC Directive terms 'may', etc shall correspond to the prescription level value 'permitted'.

The RFC2119 terms for preference do not permit non-conformance without a reason and usually the same 'preferred' prescription level is acceptable but in some cases implementers may wish to make a distinction by making use of the extension facility and specify further enumeration values.

The prescription shall not affect the outcome semantics of the test assertion but may determine how the outcome affects conformance or otherwise of the implementation to a conformance profile or to the conformance clause of the specification.

Besides the use of the 'level' attribute, the content (string) may be used to express further information regarding the prescription level using prose or as a logical expression.

**description**

Formal Definition:

```plaintext
description {
  content : string (0..1)
  language : string (0..1)
}
```

Other attributes may be added to the description class.
The description class may be used to add a description in prose of any kind (or as further specified in a conformance profile for this markup or a customization thereof) to a test assertion or set of test assertions. This may be especially useful when a test assertion is otherwise expressed purely in a specialized, formal, logical language which might not be intended for legibility to human readers; the description allows a prose expression to be added to such a test assertion to improve human understanding of its logic. It may also be used to explain the expressions used in a test assertion and to add comments.

**tag**

Formal Definition:

```plaintext
tag {
    content : string (0..1)
    name : string (0..1)
    language : string (0..1)
}
```

Other attributes may be added to the tag class.

The use of 'tags' assigned to a test assertion is a means to assign metadata and data of a similar nature to the test assertion. Special examples are to indicate to which versions of a specification the test assertion or set of test assertions applies and to specify that a test assertion or set of test assertions exist to define a particular normative property. The tag class may be used to attach such data to a test assertion or test assertion set.

**Reserved Tag Names**

**DefinesNormativeProperty** and **NormativeProperty**

A test assertion may be tagged to show that it is a property test assertion using two reserved word tag names DefinesNormativeProperty and NormativeProperty.

A test assertion having a reserved word property tag DefinesNormativeProperty or NormativeProperty may have an absence of the prescription element.

**VersionAdd and VersionDrop**

```plaintext
tag: VersionAdd: the lowest numerical version to which the test assertion applies.
tag: VersionDrop: the lowest numerical version number to which the test assertion does NOT apply.
```

Both VersionAdd and VersionDrop are optional tags. The absence of both tags shall mean that the test assertion is valid in all specification versions. If only a VersionAdd tag exists and its value is X, the test assertion will be valid in version X of the specification and all subsequent versions. If only a VersionDrop tag exists and its value is Y, the test assertion shall be valid in all versions of the specification prior to version Y. If both VersionAdd and VersionDrop tags exist, the test assertion shall be valid in version X and all subsequent versions up to but not including version Y. Based on these rules, you can easily generate the set of test assertions that apply to a specific version of the specification.
**variable**

Formal Definition:

```plaintext
variable {
    content : string (0..1)
    name : string (0..1)
    language : string (0..1)
}
```

Other attributes may be added to the `variable` class.

The use of variables allows several parts of a test assertion or indeed several test assertions within a set to share a value between them. Such variables may have their values supplied as parameters at a stage subsequent to the authoring of the test assertions. The variable class may be used to implement variables. Their values may be declared with scope across specific test assertions by declaring the variables in the shared part of a set of test assertions of which all the test assertions in scope are members (either by reference to the test assertions or by their inclusion explicitly as descendants of the set or as otherwise specified for test assertion sets (see Section 4 'Test Assertion Set'). The variable value may be used within a test assertion part expression using a notation such as `$variable1` where the corresponding variable is named 'variable1'. This is one method but others may be used instead.

**report**

Formal Definition:

```plaintext
report {
    content : string (0..1)
    label : string (0..1)
    message : string (0..1)
    when : string (0..1)
}
```

Associations and other attributes may be added to the `report` class.

The `report` class may be used to specify what messages and labels are included in any reports generated from any test cases based on the test assertion. It may also be used to specify which outcomes of the test cases result in which reports, so the `report` association is optional and of multiple cardinality in the `testAssertion` class.

The attribute `label` shall allow values 'fail', 'pass' and 'notQualified' as content, corresponding to the standard possible outcomes defined in Section 3.3. Further values may be added which may be defined in a conformance profile.

The content of optional attribute `message` shall describe the assertion outcome stated in the attribute and this message may be used to provide a report with an error message. A more detailed diagnostic message may be provided in the content of the `report` element. Further attributes may be defined for the `report` class in a conformance profile.

The optional 'when' attribute may be used to restrict, beyond the value 'label' attribute, the circumstances which shall be true for the report to be generated. It shall contain an expression which evaluates to true or false.
3.3 Semantics

As a test assertion has parts that can be evaluated over a Target instance (i.e. the prerequisite and the predicate), the following semantics shall apply to a test assertion:

With regard to a Target instance

- "Target not qualified": if the Prerequisite (if any) evaluates to "false" over a Target instance.
- "Normative statement fulfilled [by the Target]": if the Prerequisite (if any) evaluates to "true" over a Target instance, and the Predicate evaluates to "true".
- "Normative statement not fulfilled [by the Target]": if the Prerequisite (if any) evaluates to "true" over a Target instance, and the Predicate evaluates to "false".

A test assertion predicate shall be worded as an assertion, not as a requirement. Any 'MUST' or 'shall' keyword shall be absent from the predicate but reflected in the prescription level. The predicate has a clear Boolean value: Either the statement is true, or it is false for a particular target.
4 Test Assertion Set

testAssertionSet

Formal Definition:
testAssertionSet {

    id : string (0..1)
    language : string (0..1)
    date : date (0..1)
    time : time (0..1)
    TestAssertionDocumentHeader : testAssertionDocumentHeader (0..1)
    Shared : shared (0..1)
    TestAssertion : testAssertion (0..*)
    TestAssertionRef : testAssertionRef (0..*)
    TestAssertionSet : testAssertionSet (0..*)
    TestAssertionSelector : testAssertionSelector (0..1)
}

Other attributes and associations may be added to the testAssertionSet class.
The `testAssertionSet` class may be used to group together test assertions either by inclusion of the test assertion within the test assertion set or by references to their Ids.

An implementation instance may have the `testAssertionSet` as the top level class.

An implementation conformance profile for the model may include the use of the feature where a `testAssertionSet` may include other test assertion sets. The default model defined in this specification allows a test assertion set to optionally include any number of other test assertion sets. Care shall be taken to avoid infinite recursion: A test assertion set shall not include itself as an ancestor. The `testAssertionSet` may be assigned an identifier using the 'id' attribute. This allows a drill down from the test assertion set through any ancestor test assertion sets to individual ancestor test assertions when referencing a test assertion or test assertion set.

A test assertion set may be used to wrap together all the test assertions in, say, a document. In this case the `testAssertionDocumentHeader` may be used once within a document either on its own or as a direct child of the outermost `testAssertionSet` element. See section later on `testAssertionDocumentHeader`.

Another purpose of the test assertion set is that it may be used to provide a set of shared test assertion parts and their values in the same way to more than one test assertion (either to limit repetition or to ensure that the values correspond or to provide scope for variables across such test assertions). (See the section on the 'shared' class below.)

The `testAssertionSelector` may be used when test assertions are contained within a document but outside of the test assertion set. One case where this may be used is where such test assertions are distributed throughout a physical or logical document written in some kind of markup where the `testAssertionSelector` may provide an expression which identifies all of the test assertions within that markup. The `language` attribute may be used to identify the expression language used.

**Formal Definition:**

```plaintext
testAssertionSelector {
    content : string (0..1)
    language : string (0..1)
}
```

Other attributes may be added to the `testAssertionSelector` class.

**shared**

**Formal Definition:**

```plaintext
shared {
    NormativeSource : normativeSourceShared (0..1)
    Target : targetShared (0..1)
    Prerequisite : prerequisiteShared (0..1)
    Predicate : predicateShared (0..1)
    Prescription : prescriptionShared (0..1)
    Description : descriptionShared (0..1)
    Tag : tagShared (0..*)
    Variable : variableShared (0..*)
    Report : reportShared (0..*)
}
```

Other associations may be added to the `shared` class.
The class 'shared', an association of the testAssertionSet class may be used to provide one or more test assertion parts either as overrides (either overridden by or overriding any corresponding parts of the same kind of test assertions within the set) or as composites (composing as either conjunctions or disjunctions with any corresponding parts of the same kind of test assertions within the set) to all the descendant test assertions of the test assertion set.

The 'normativeSource', 'target', 'predicate', 'prerequisite', 'prescription', 'description', 'tag', 'variable' and the 'report' associated classes of this 'shared' element, are extended with a 'conflict' attribute. These extended classes are here given a suffix 'Shared' but other conventions may be used to distinguish the extended classes and associations to them.

**normativeSourceShared**

Formal Definition:

```plaintext	normativeSourceShared {
    content : string (0..1)
    conflict : string (0..1) (allowed values = conjunction|disjunction|overriding|overridden)
    Comment : comment (0..1)
    Interpretation : interpretation (0..1)
    RefSourceItem : refSourceItem (0..*)
    TextSourceItem : textSourceItem (0..*)
    DerivedSourceItem : derivedSourceItem (0..*)
}
```

Other attributes may be added to the normativeSourceShared class.

**targetShared**

Formal Definition:

```plaintext	targetShared {
    content : string (0..1)
    type : string (0..1)
    schemeRef : string (0..1)
    language : string (0..1)
    conflict : string (0..1) (allowed values = conjunction|disjunction|overriding|overridden)
}
```

Other attributes may be added to the targetShared class.

**prerequisiteShared**

Formal Definition:

```plaintext	n prerequisiteShared {
    content : string (0..1)
    language : string (0..1)
    conflict : string (0..1) (allowed values = conjunction|disjunction)
}
```

Other attributes may be added to the prerequisiteShared class.
**predicateShared**

Formal Definition:

```
predicateShared {
    content : string (0..1)
    language : string (0..1)
    conflict : string (0..1) (allowed values = conjunction|disjunction|
                        overriding|overridden)
}
```

Other attributes may be added to the predicateShared class.

**prescriptionShared**

Formal Definition:

```
prescription {
    content : string (0..1)
    level : string (0..1) (allowed values = mandatory|preferred|permitted)
    conflict : string (0..1) (allowed values = overriding|overridden)
}
```

Other attributes may be added to the prescriptionShared class.

**descriptionShared**

Formal Definition:

```
descriptionShared {
    content : string (0..1)
    language : string (0..1)
    conflict : string (0..1) (allowed values = conjunction|disjunction|
                        overriding|overridden)
}
```

Other attributes may be added to the descriptionShared class.

**tagShared**

Formal Definition:

```
tagShared {
    content : string (0..1)
    name : string (0..1)
    language : string (0..1)
    conflict : string (0..1) (allowed values = conjunction|disjunction|
                        overriding|overridden)
}
```

Other attributes may be added to the tagShared class.
**variableShared**

Formal Definition:

```plaintext
variableShared {
    content : string (0..1)
    name : string (0..1)
    language : string (0..1)
    conflict : string (0..1) (allowed values = conjunction|disjunction|
                                  overriding|overridden)
}
```

Other attributes **may** be added to the `variableShared` class.

**reportShared**

Formal Definition:

```plaintext
reportShared {
    content : string (0..1)
    label : string (0..1)
    message : string (0..1)
    when : string (0..1)
    conflict : string (0..1) (allowed values = conjunction|disjunction|
                                  overriding|overridden)
}
```

Associations and other attributes **may** be added to the `reportShared` class.

Whether these test assertion parts compose, with conjunction or disjunction (that is, combine using a logical 'AND' or 'OR' respectively), or override or are overridden by any corresponding test assertion parts of the same kind (and, in the case of 'tag' and 'variable', with the same 'name' attribute value) within the test assertion set **shall** depend on the corresponding values of the 'conflict' attribute.

Note that the part classes can each have different sets of allowed values for the 'conflict' attribute.

The values of the 'conflict' attribute **may** be extended. Custom values **may** be ignored by an implementation.

**Test Assertion Reference**

**testAssertionRef**

Formal Definition:

```plaintext
testAssertionRef {
    language : string (0..1)
    name : string (0..1)
    TestAssertionReference : testAssertionResource (0..1)
    TestAssertionSetId : testAssertionSetId (0..1)
    TestAssertionId : testAssertionId (0..1)
}
```

Other attributes and associations **may** be added to the `testAssertionRef` class.
A test assertion set may refer to one or more test assertions by their test assertion identifiers rather than include the test assertions literally within the set. A test assertion set in which references are made to other test assertions outside of the set (whether in the same document or other documents) shall use the testAssertionRef class to do so. The structure of this class allows for the possibility that test assertions may be contained in another document in another location by inclusion of an association to class testAssertionResource. Other associations testAssertionSetId and testAssertionId allow for the possibilities that the test assertion may be within one or more layers of test assertion sets and might only be uniquely identifiable by nesting the identifiers of these sets around the test assertion identifier itself: The testAssertionSetId associations can be nested and the testAssertionId nested within the innermost testAssertionSetId. At the same time they also allow for the possibility that the test assertion has an identifier sufficiently unique to only require that test assertion identifier itself: The testAssertionRef and the testAssertionResource can each include the testAssertionId as a direct child without the need for further identifiers when they are inappropriate. The testAssertionRef may be used to refer to a test assertion set as a whole, rather than a reference to each test assertion individually.

Test Assertion Reference (Non-Normative UML-Style Class Diagram)

testAssertionResource

Formal Definition:
testAssertionResource {

    language : string (0..1)
    uri : string (0..1)
    documentId : string (0..1)
    versionId : string (0..1)
    revisionId : string (0..1)
    dateString : string (0..1)
    resourceProvenanceId : string (0..1)
}
resourceType : string (0..1)  
resourceTypeVersionId : string (0..1)  
resourceTypeSchemaId : string (0..1)  
resourceTypeSchemaVersionId : string (0..1)  
resourceTypeProvenanceId : string (0..1)  
TestId : testAssertionId (0..1)  
TestAssertionSetId : testAssertionSetId (0..1)

}  
Other attributes may be added to the testAssertionResource class.

Here is the metadata which may be used to specify the identification of a resource containing test assertions. The uri attribute may contain data to help locate the resource but the expected implementation is one where an identifier or URI is used to point to a repository of some kind which is a more appropriate container for the specific information needed to make the external test assertions available. The other metadata attributes includes information about the kind of resource involved and most appropriately its provenance (such as authorship identifiers to certify its authenticity) and version, etc.

testAssertionId

Formal Definition:
testAssertionId {
  ref : string (0..1)  
  language : string (0..1)
}

Other attributes may be added to the testAssertionId class.

This is a pointer to a test assertion identifier. It is used as part of a reference to a test assertion within a test assertion set. The ref attribute shall be used to contain the test assertion identifier itself.

testAssertionSetId

Formal Definition:
testAssertionSetId {
  ref : string (0..1)  
  language : string (0..1)  
  section : string (0..1)  
  TestAssertionId : testAssertionId (0..1)  
  TestAssertionSetId : testAssertionSetId (0..1)
}

Other attributes may be added to the testAssertionSetId class.

The testAssertionSetId is a pointer to a test assertion set identifier. It is used as part of a reference to a test assertion within a test assertion set or to a test assertion set within another test assertion set.

The ref attribute shall be used to contain the test assertion set identifier itself. A section within that test assertion set may also be specified where appropriate, bearing in mind that the test assertion set (perhaps called by another term) might not be written using an implementation of this model.
**testAssertionDocumentHeader**

Formal Definition:

```
testAssertionDocumentHeader {  
   Common : common (1..1)
}
```

*Other associations may be added to the testAssertionDocumentHeader class.*

The `testAssertionDocumentHeader` may be used to provide metadata (author, location, etc) about the specification to which test assertions are associated when such test assertions are interspersed within a document. The `testAssertionDocumentHeader` element may, alternatively, provide a container for metadata about the specification in the outermost `testAssertionSet` of a test assertion document or where an implementation only allows one test assertion set for each document.

An instance may have this as the top level class. There shall be no more than one `testAssertionDocumentHeader` used in any given document implementing this model.

![Test Assertion Document Header (Non-Normative UML-Style Class Diagram)](image)

**common**

Formal Definition:

```
common {
   SourceDocument : sourceDocument (0..1)  
   Authors : authors (0..1)  
   Location : location (0..1)  
   Namespaces : namespaces (0..1)
}
```

*Other associations may be added to the common class.*

Formal Definition:

```
sourceDocument
   content : string (0..1)  
   revision : string (0..1)  
   version : string (0..1)
```


Here some of the metadata about the source document to which the test assertions relate is assigned to the document containing those test assertions. The content **should** be the name or other identifier for the specification. The attributes specify its version information.

Formal Definition:

```plaintext
namespaces {
    content : string (0..1)
    Namespace : namespace (0..*)
}
```

Formal Definition:

```plaintext
namespace {
    content : string (0..1)
    Prefix : prefix (0..1)
    Uri : uri (0..1)
}
```

Formal Definition:

```plaintext
prefix {
    content : string (0..1)
}
```

Formal Definition:

```plaintext
uri {
    content : string (0..1)
}
```

The **namespaces** element caters for a special case of usage of the markup. Here the content **should** be the set of namespaces used when the target implementation is itself XML. The namespaces may be included as the content of the element or the prefixes and URIs of the namespaces may be split into separate elements within the child element called **namespace** (singular). Other kinds of implementation of the markup **may** omit implementation of this feature.
5 Conformance

Implementations subject to conformance are representations of the test assertion model described in Section 3 and Section 4.

In order to conform to these guidelines, a test assertion representation:

(1) **shall** contain all test assertion parts defined in Section 3  
(2) **may** contain any test assertion parts defined in Section 4  
(3) **shall** use names for these parts that are identical or can be unambiguously mapped to the definitions used in Section 3 and implemented parts of Section 4  
(4) **shall** implement the normative statements for the test assertion model and its semantics in this specification.

Mandatory statements are designated by the keyword `**shall**` and `**shall not**` in bold type, as described in Annex H of [ISO/IEC Directives].
Appendix A. Acknowledgments

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Participants:

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