column name	description
seq_ply_number	The total number of Plies defined within the Sequence as listed in the "Composite Ply Sequence" column of the data sheet.
seq_ply_material	The name of the Material of the specific Ply and Sequence as listed in the "Composite Ply Sequence" column of the data sheet.
seq_ply_mat_type	The type of Material of the specific Ply and Sequence as listed in the "Composite Ply Sequence" column of the data sheet.
seq_ply_orient	pass/fail - whether the orientation of the specific Ply and Sequence as listed in the "Composite Ply Sequence" column of the data sheet was correct
seq_ply_rosette	The name of the Rosette of the specific Ply and Sequence as listed in the "Composite Ply Sequence" column of the data sheet.
ply_rosette_type	The type of the Rosette of the specific Ply and Sequence as listed in the "Composite Ply Sequence" column of the data sheet.
ply_contour_area	The surface area of the ply contour of the specific Ply and Sequence as listed in the "Composite Ply Sequence" column of the data sheet.
facets	The number of facets in the Tessellated model
ply_explicit_area	The surface area of the 3D explicit representation (tessellated geometry) of the specific Ply and Sequence as listed in the "Composite Ply Sequence" column of the data sheet.
date	The date when the statistics were last updated (will be filled in automatically)
issues	A short statement on issues with the file

2.7 Test Case PID: Permanent Entity IDs

All information about this test case can also be viewed in CAESAR on its Information page.

2.7.1 Motivation

The ability to track a product's model information during design iteration, and from design iteration through to manufacturing and quality analysis has been limited by the lack of support for permanent IDs in STEP.

With the inclusion of permanent IDs in STEP, collaborating systems should now be able to exchange model data and track that data during design iteration. This suggests the ability to retain IDs contained in external data from a sender and reference those entities by the receiver. When a change to that model data occurs on the sender's side, the receiver should be able to update the receiver's copy of that external data and have any dependent data in their own models that refer to that external change, and update to respond to the change.

Like in the case of design iteration, the ability to track model entities via permanent IDs, will also allow downstream systems to update their representations of the design model and update their manufacturing and metrology planning to reflect changes in the design.

An additional benefit of the establishment of permanent IDs in STEP is the ability to retain a permanent audit trail of custody and connection between design and downstream systems for potential forensic analysis of critical product systems after in-service failure.

Finally, although not covered in this first test case, the introduction of permanent IDs provides the ability of any contributor to the information stream associated with a product's lifecycle to

add information to the model that can be connected to existing model content and that additional information can be retrieved by subsequent users and used as feedback from the contributor.

2.7.2 Approach

The approach to be used is described in the "Recommended Practices for Permanent Entity IDs for Design Iteration and Downstream Exchange" (Version 0.4; January 14, 2020), which can be found in the CAx-IF member area under "Information on Round 45J of Testing".

Within the domain of Permanent IDs, the following functionalities are in scope of Round 45J:

- Permanent IDs on Model (Product) for
  - testing the retention of model ID after changes in the underlying content
- Permanent IDs on Geometry for
  - testing the effect of a change in geometry and topology on dependent manufacturing planning that references that geometry and topology
  - testing the effect of a change in geometry and topology on dependent metrology planning that references that geometry and topology
  - this concept includes the introduction of Permanent IDs on Shape Aspect as they are used to collect individual geometry elements into logical groups for some downstream purposes
- Permanent IDs on Semantic PMI Representation for
  - testing the effect of changes in semantic PMI on dependent manufacturing planning that reference that semantic PMI
  - testing the effect of changes in semantic PMI on dependent metrology planning that reference that semantic PMI
- Permanent IDs on UDAs for
  - testing the effect of changes in UDAs attached to model, semantic PMI, or geometry on dependent manufacturing or metrology planning that reference that those UDAs

The following are out of scope for Round 45J and are moved to the Future Considerations section:

- Permanent IDs on Geometry and Permanent IDs on Semantic PMI Representation for
  - testing assembly constraints referencing those geometries
  - testing the effect of change in geometry and topology on dependent shape that references that geometry and topology for design iteration

The preferred AP242 schema to be used is the AP242 Edition 2 IS schema, which can be found on the public CAx-IF web sites under "Public Testing Information". As a fallback, the AP242 Edition 1 IS version can be used.

2.7.3 Testing Instructions

The tests will be performed based on an existing NIST test model, well known to the CAx-IF community, namely the NIST PMI test case FTC-09.

2.7.3.1 Test Model Overview

The specific test model to be used in this test case is a modified version of the NIST FTC-09 test case for testing permanent IDs and the effect of model change on downstream manufacturing and metrology planning.

2.7.3.2 Test Model Access

The native CAD files can be downloaded from the NIST homepage. See section 2.1.3.2 for details and direct download links.

2.7.3.3 Test Model Configuration

Unlike any previous CAx-IF test round, the PID test case requires iteration to confirm retention of permanent entity IDs. This iteration process implies a minimum of two exchanges – an initial exchange and a subsequent exchange. Test cases for downstream uses variants of the NIST Test Case FTC-09 (see Annex B). The two iterations will be identified by model suffixes in CAESAR (PID_1 – Initial Exchange; PID_2 – Subsequent Exchange).

Note also that there are two mechanisms for supporting the introduction of permanent IDs to STEP. The first is via the creation of new permanent `id_attribute` entities attached to certain entities within the Data Section of the Part 21 file. The second is via the creation of permanent ID relationships between STEP entity IDs and permanent entity IDs within an Anchor Section of a Part 21 Edition 3 file. Please refer to the recommended practice document for further details about the valid entity types to be used with `id_attribute` entities in the Data Section. Based on agreement, the scope of Round 45J will include only the first type of ID, i.e. `id_attribute` in the Data Section. This is reflected in the current version of the Recommended Practices. The testing of the Anchor Section approach will be considered in a future test round.

Test Case PID – Permanent Identifiers, via Data Section

The FTC09 NIST model will be used however we need to supplement the test case with additional information as follows.

Please add the following User Defined Attributes (UDAs):

- Attributes (UDAs) at the Product level in your native CAD model (taken from ASME 14.47, DRAFT, Feb 2018, Table 6-3 Metadata Elements (partial))

Element Name	Data Type	Description
CREATE_DATE	ISO 8601 extended form date/time	Date the data set was initially created.
MODEL_UNITS	String	System of units of measure (SI or U.S. Customary) of the model.
NOMENCLATURE	String	"NIST FTC09 Modified"
MODEL_PRECISION	Integer	Value that indicates numeric accuracy (number of significant digits) of model required in production of part in order for it to fulfill the design intent (ASME Y14.41).
REV	String	Current revision of the design per ASME Y14.35.

- Attributes (UDAs) on PMI (some PMI, not all):
  - UDA Name – "Severity Description"
  - UDA Type – String
  - UDA Value – "Critical"
  - UDA Name – "Severity Value"
  - UDA Type – Integer
  - UDA Value – 2

Please add the following Features (Shape Aspects):

- Collection of Geometries (surfaces) for the slotted hole (see Figure 6 below)

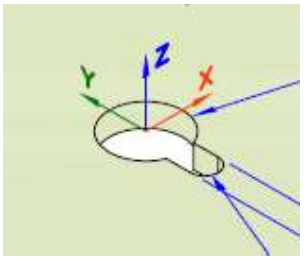

Figure 6: NIST FTC09, View C, slotted hole

Preprocessor (CAD)

Initial Iteration (PID_1)

- Export FTC09 as modified above (including IDs on Product, Geometry, Shape Aspect, PMI, and UDA)

Second Iteration (PID_2)

Modify UDAs as follows:

- UDA Name – "REV"
- UDA Type – Real or Integer (see below)
- UDA Value – if the model contains a PLM version attribute, use that type and value; if not, use the integer type with value 2

Modify the hole geometry and tolerance info for the 3 instances of the hole shown in Figure 7:

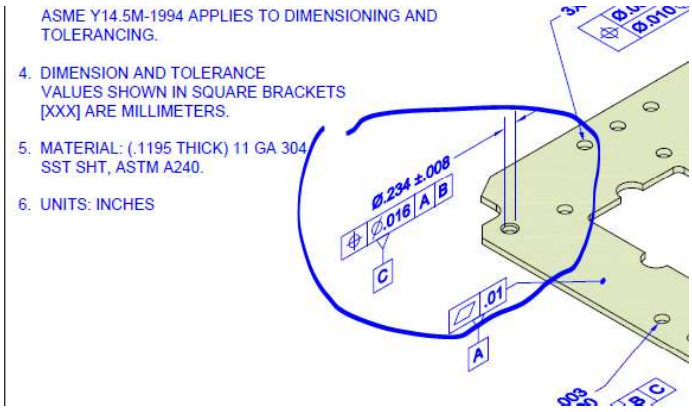

Figure 7: NIST Test Case FTC09, View A, Detail of Hole

- Change the three instances of 0.016 location tolerances to 0.014; add Criticality UDA on these two tolerances.
- Change the three nominal hole diameters from 0.234 to 0.236 and hole diameter tolerance values from 0.008 to 0.010

Slotted Hole (see Figure 8):

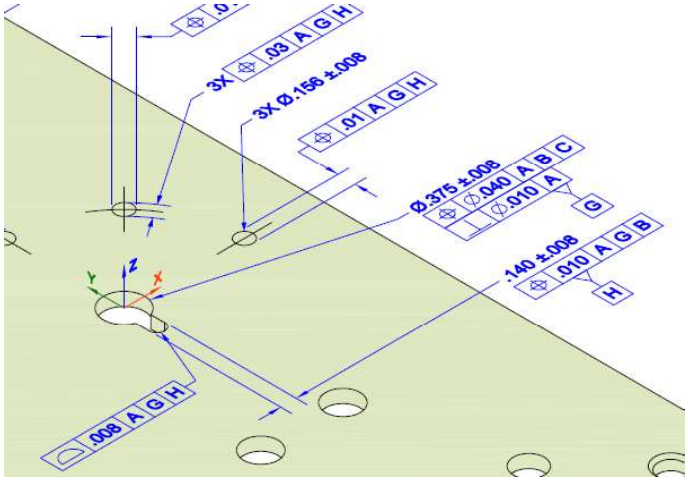

Figure 8: NIST Test Case FTC09, View C, Detail of Slotted Hole

- Change the hole diameter from 0.375 to 0.385, and
- Change the slot width from 0.140 to 0.150.

Postprocessor (CAD System or Manufacturing and/or Metrology Planning System)

Initial Iteration (PID_1)

- Import FTC09 and confirm receipt of Permanent IDs on Product, on Geometry, on Shape Aspect, on PMI, and on UDAs

Second Iteration (PID_2)

Import revised FTC09 and confirm receipt of the same Permanent IDs on Product, on Geometry, on Shape Aspect, on PMI, and on UDAs as were received in PID1:

- Confirm change to location tolerance values
- Confirm retention of Criticality UDA on these tolerances
- Confirm change to hole diameters (geometry and nominal value) and hole diameter tolerance values; confirm aggregate and individual IDs on hole cylinders and their shape aspect
- Confirm change to slot geometry; Confirm aggregate and individual IDs on reference surfaces and their shape aspect

2.7.4 Statistics

For each STEP file exported or imported for during one of the iterations of the PID test case, vendors must submit the corresponding statistics. To do so, go to the [PID Data Sheet], and either fill in the web form, or upload a comma-delimited file (.csv) with the data as listed below.

Native Statistics

When exporting a STEP file, report what data importing systems should expect to find. For numeric statistics, enter the respective value or 'na' if not supported. For other statistics, select either 'full support' (i.e. test case and Rec. Pracs. definitions are fulfilled), 'limited support'

(meaning the implementation does not meet all criteria and issues may be expected on import), or 'na' if not supported.

Target Statistics

When importing a STEP file, report the results found after processing the file as described below.

Data Sheet Columns

column name	description
model	The name of the test model, here 'PID'. **Important:** Add the iteration as suffix to the model, i.e.: • PID_1 for the initial exchange • PID_2 for the subsequent exchange
system_n	The system code of the CAD system creating the STEP file
system_t	The system code of the CAD system importing the STEP file. For native stats, select 'stp'
pid_product	pass/fail – whether the permanent ID at the product level was transferred correctly
num_pid_pmi	The number of semantic PMI elements processed with permanent IDs
num_pid_topol	The number of topological elements (e.g., `advanced_face`) processed with permanent IDs
num_pid_shape	The number of `shape_aspects` processed with permanent IDs
num_pid_uda	The number of user defined attributes processed with permanent IDs
downstream_update	all/partial/none - indicates whether the receiving system was able to successfully update the references on subsequent iterations
date	The date when the statistics were last updated (will be filled in automatically)
issues	A short statement on issues with the file

2.8 Test Case IS1: Assembly Instance Styling

All information about this test case can also be viewed in CAESAR on its Information page.

2.8.1 Motivation

Assembly Instance Styling allows the assignment of different styles to different instances of the same part in order to emphasize this instance in a given context. For example, one might want to color one instance of a bolt in a different color to point out it serves a special purpose, or one might define a certain part as being invisible because that part is of no interest in the given context but its geometry should be maintained in the model.

This capability was originally tested in 2003 and 2004 (Rounds 11J – 14J) and was requested to be tested again using current schemas and Recommended Practices.

2.8.2 Approach

The current approach for assembly instance styling is described in section 5 of the “Recommended Practices for Model Styling & Organization”, version 1.6, which is available on the CAx-IF homepages under “CAx-IF > Implementor Group > Recommended Practices”.