Test Suite for the CAx Implementor Forum Round 39J

September 2016 – March 2017

Release 1.2

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Document History

Release	Date	Change
1.0	2016-12-21	Initial Release
1.1	2017-01-30	Updated definition and test models for SM1
1.2	2017-02-24	Updated native model references for SP5 and TP4

1 Introduction

This document describes the suite of test cases to be used for the thirty-ninth round of testing of the CAx Implementor Forum (CAx-IF). The CAx-IF is a joint testing forum, organized and facilitated by AFNeT, PDES, Inc., and the ProSTEP iViP Association. The test rounds of the CAx-IF concentrate primarily on testing the interoperability and compliance of STEP processors based on AP242.

The test rounds in general combine testing of synthetic and production models. Production models will in most cases be provided by the member companies of the organizations ANFeT, PDES, Inc., and ProSTEP iViP Association. When production models are not available from the member companies, “production-like” models will be solicited from the various CAx-IF participants.

This test suite includes synthetic models for testing the following capabilities: Product Manufacturing Information (PMI), both as Graphic Presentation and as Semantic Representation, 3D Tessellated Geometry, Composite Materials, and Assembly Structure with External References in AP242 BO Model XML format.

1.1 Functionality tested in this round

Functionality tested in this round relates to:

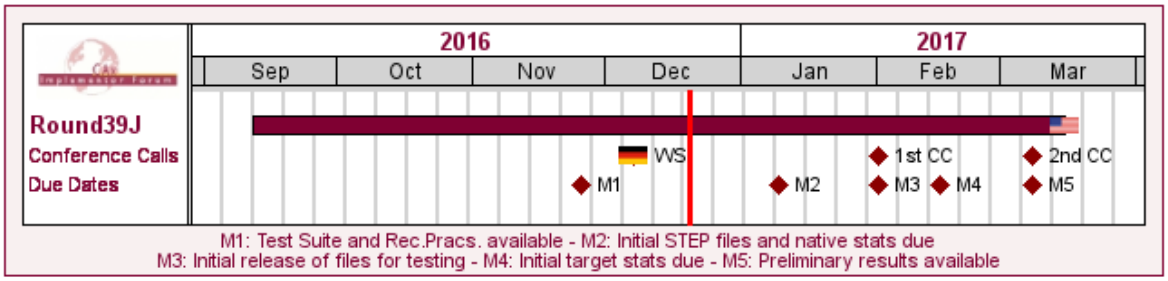
- **Product Manufacturing Information (PMI)** describes the capability to embed information about dimensions, tolerances and other parameters which are necessary input for the manufacturing and measuring of the part from the 3D model. In Round36J, the focus will be on the two approaches for the transfer of PMI in the 3D model:
    - “Tessellated Presentation” refers to breaking down each annotation into tessellated elements as supported by AP242, and exchanging them as geometry. This preserves the exact shape of the annotation, but is human readable only. The test will include section views as well.
    - “Semantic Representation” refers to the intelligent transfer of PMI data in an associative and re-usable way. This scenario aims towards driving downstream usage and later modifications of the model. The data is machine-readable, but not necessarily visible in the 3D model. However, the test also includes additional presentation data, which can be linked to the corresponding PMI representation.
- **Tessellated Geometry** is a simplified representation for the part shape, where the geometry is not given as an exact B-Rep model, but as a collection of simple planar faces (triangles) which can be easily and efficiently created and applied in specific use cases. The scope includes the watertight tessellation format (WTF) and compressed STEP files.
- **AP242 BO Model XML Assembly Structure** is a new implementation format introduced with AP242, and the designated process format for many applications in the aerospace and automotive industries. It will be used in combination with geometry formats matching the respective requirement. In the CAx-IF, the geometry files will be in STEP Part 21 format. The XML files will contain the assembly structure and part master information.

1.2 General testing instructions for this round

The general procedures for communication of models and statistics are outlined in a separate document, named ‘General Testing Instructions’. The document can be retrieved from the CAx Implementor Forum web sites. The latest version is v1.12, dated July 5, 2016.

1.3 Testing Schedule

The following schedule has been agreed on for Round 39J:



CAx-IF Round39J Schedule

Date	Action
25 Nov 2016 (Fri)	Test Suite and Rec.Pracs. available
7 Dec 2016 (Wed)	CAx-IF Technical Workshop in Darmstadt, Germany
9 Jan 2017 (Mon)	Initial STEP files and native stats due
1 Feb 2017 (Wed)	1st CAx-IF Round39J Conference Call / Initial release of files for testing
15 Feb 2017 (Wed)	Initial target stats due
8 Mar 2017 (Wed)	2nd CAx-IF Round39J Conference Call / Preliminary results available
13 Mar 2017 (Mon) - 15 Mar 2017 (Wed)	CAx-IF Round39J Review Meeting in Gaithersburg, MD, USA

Figure 1: CAx-IF Round39J Schedule

The CAx-IF Technical Workshop will be held in conjunction with a LOTAR meeting. Conference calls and web sessions will also be available.

The CAx-IF R39J Review meeting will take place in conjunction with the PDES, Inc. Spring Offsite meeting and a LOTAR workshop. In addition, conference calls and web sessions will be available for those not attending the meeting to dial in.

1.4 Copyrights on Test Cases

1.4.1 CAx-IF

None of the production test cases which were provided by the AFNeT, PDES, Inc. and ProSTEP iViP member companies may be publically released for any purpose. The test cases can be freely distributed among the CAx-IF members, and can be used for any purposes that are related to CAx-IF testing (i.e. testing, documentation of testing efforts, etc.), as long as a reference to the originating company is made.

The test cases must not be used for any purposes other than CAx-IF testing or outside of ANFeT, PDES, Inc. and ProSTEP iViP. Test cases provided by the LOTAR project for testing of specific capabilities are applicable to the same restrictions and may not be used outside LOTAR or the CAx-IF.

1.4.2 NIST

The test cases developed at the National Institute of Standards and Technology (NIST) are not subject to copyright protection and are in the public domain. NIST assumes no responsibility for the components of the test system for use by other parties and makes no guarantees, expressed or implied, about their quality, reliability, or any other characteristic. The use of the CAD systems to create the Test Models does not imply a recommendation or endorsement by NIST.

For more details, read the disclaimer at http://go.usa.gov/mGVm

2 Synthetic Test Case Specifications

2.1 Test Case SP5: Semantic PMI Representation, including STEP File Library

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

2.1.1 Motivation

Product Manufacturing Information (PMI) is required for a number of business use cases in the context of STEP data exchange. Among others, it is a prerequisite for long-term data archiving. In addition, PMI can be used to drive downstream applications such as coordinate measuring and manufacturing.

Semantic PMI Representation relates to the capability to store PMI data in the STEP file in a computer-interpretable way, so that it can be used for model redesign or downstream applications. Though the definition of the data is complete, it is by itself not visible in the 3D model.

Additional presentation capabilities are needed to display the data in a way that it is visible to the user in the 3D model. Addition of presentation data is optional in the SP5 test case.

2.1.2 Approach

The approach to be used is described in the latest version (at least v4.0.4, dated September 1, 2016) of the “Recommended Practices for Representation and Presentation of PMI (AP242)”, which can be found in the CAx-IF member area under “Information on Round38J of Testing”.

Within the PMI domain, the following functionalities are in scope of Round 39J:

- Semantic PMI Representation
- Graphic PMI Presentation (Polyline or Tessellated)
- Linking of PMI Representation to Presentation

Optional extensions:

- Transfer of editable PMI text as User Defined Attributes
- Semantic PMI Representation Validation Properties

The AP242 schema to be used is the IS version (v1.36), which can be found on the public CAx-IF web sites under “Joint Testing Information”.

2.1.3 Testing Instructions

The tests will be performed based on a verified set of test models, each with set of well-defined PMI elements. These models have been developed in the course of the “MBE PMI Validation and Conformance Testing” project, which has been supported by the CAx-IF in recent test rounds.

2.1.3.1 Test Model Overview

There are two data sets available:

1. Dataset 1 contains the so-called “Complex Test Cases” (CTC), with index numbers 1 through 5. They have been modelled in Dassault Systemes CATIA V5 R21, PTC Creo 2.0, Siemens NX 8.0, and Dassault Systemes SolidWorks 2012.
2. Dataset 2 contains the so-called “Fully-toleranced Test Cases” (FTC), which index numbers 6, 8, and 9. They have been modelled in Dassault Systemes CATIA V5-6R2014, PTC Creo 3.0, Siemens NX 9.0, and Dassault Systemes SolidWorks 2015.

In general, the CTC models are conceived to cover more basic PMI elements, while the FTC models also contain some more advanced constructs.

During Round 39J, the participants may choose individual models from these two datasets, depending on their current development focus.

Test Model Update

The NIST models – in particular the CTCs – are becoming outdated. Since their creation, new releases of the respective CAD systems have become available that overcome many of the limitations noted in the original design of the models. The vendors of all involved CAD systems are encouraged to upgrade the native models to their latest release, and work on the issues listed in the validation reports which are available on the NIST homepage (see below). Also available are updated test case descriptions for all CTC and FTC models:

- Updated CTC definitions - https://www.nist.gov/file/342726 (Update)
- Updated FTC definitions - https://www.nist.gov/file/342731 (Update)
- Deadline for submitting new native models is January 27, 2017.

In the course of Round 39J, validation services for the SP5 test case will be provided by International TechneGroup under contract from LOTAR.

2.1.3.2 Test Model Access

The updated native CAD files can be downloaded from the member area of the CAx-IF homepages under “Information on Round39J of testing”:

- CATIA V5R2016 (FTC models 6, 8, 9)
- NX 11 (all CTC models; FTC models 6, 8, 9)
- SolidWorks 2017 (all CTC and all FTC models)

2.1.3.3 Test Model Configuration

The following functionality shall be included in the test files provided for this round of testing, as far as it has been implemented by the CAx-IF participants and is described in the Recommended Practices:

- PMI Representation – the re-usable representation of PMI data should be included in all SP5 models to the extent supported by the native system.
- PMI Graphic Presentation – Many CAD systems require some minimal presentation information to be able to handle the PMI data in a model. Usually, both PMI representation and presentation data are included in the same file. Thus, some form of presentation information shall be included in the SP5 test case as well.
- Linking PMI Representation to Presentation – If a model contains PMI Representation information as well as Presentation data, the corresponding elements shall be linked together, so that a Representation element “knows” which annotation it is being presented in the model. The approach to create this link is described in section 7.3 of the PMI Rec. Pracs. (v4.0.4).

- Editable PMI Text – Some information relevant for PMI is not encoded in semantic entities, but given as plain text, such as the title block information or additional text on feature control frames for instance. In the context of semantic data exchange, this content needs to be editable in the target system. The approach to be used for this is based on the transfer of User Defined Attributes, and its application in the context of PMI is described in section 7.4 of the PMI Recommended Practices v4.0.4.
- Validation Properties – All participants providing STEP files for this test case are encouraged to include validation properties as far as supported. In particular, for vendors already working on the topic, validation properties for Semantic PMI Representation should be included in the test files, based on section 10.1 in the PMI Recommended Practices v4.0.4.

Also refer to 0 for test model translation configuration considerations.

2.1.3.4 Statistics

For each STEP file exported or imported for the SP5 test case, vendors must submit the corresponding statistics. To do so, go to the [SP5 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.

Screenshots

If presentation information is contained in the test files, it shall be accompanied by corresponding screenshots. Note that CASEAR allows the addition of multiple screenshots per dataset.

Note that in order to count the GD&T elements for the statistics, per agreement during the R22J Review Meeting, the actual STEP entity types (`datum`, `datum_target`…) shall be considered.

Note that based on the Round 35J results, a new count has been added for Composite Tolerances as defined in section 6.9.9. of the PMI Rec. Pracs. (v4.0.4).

Note that all statistics – native and target – shall be based on the Semantic PMI Representation data only, and not take any presentation into account.

Data Sheet Columns

column name	description
model	The name of the test model, here: ‘SP5’ followed by the model index; i.e. ‘SP5-06’, ‘SP5-08’, or ‘SP5-09’.
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, enter 'stp'

scope	A short designation of the scope tested in the model. In the case of SP5, recommended values are: ○ Representation ○ Representation + [char.-based / graphic] Presentation ○ Representation + Linked [… / …] Presentation
dimension	The number of dimensions processed
datums	The number of datums processed
datum_targets	The number of datum targets processed
tolerances	The number of tolerances (all types combined) processed, regardless of composition
compos_tols	The number of composite tolerances processed (number of instances of geometric_tolerance_relationship per section 6.9.9. in the PMI Rec. Pracs. v4.0)
labels	The number of labels processed
pmi_graphic_pres	all/partial/none – whether the graphic PMI annotations included in the file could be processed correctly
pmi_linked_pres_rep	all/partial/none – whether the Semantic PMI Representation elements and (Graphic) PMI Presentation elements were linked correctly together.
date	The date when the statistics were last updated (will be filled in automatically)
issues	A short statement on issues with the file

2.2 Test Case TP4: Tessellated PMI Presentation, incl. STEP File Library

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

2.2.1 Motivation

In addition to use cases that require a fully defined, precise, semantic definition of the part geometry and associated PMI as is the focus of the SP5 test case described above, there are also scenarios where the presentation of the data – geometry and annotations – for visual consumption are the primary goal. In such cases, a simplified and optimized version of the model is sufficient.

For this purpose, AP242 introduced a data model for tessellated geometry, which can be used for graphic presentation of PMI in a much more efficient way than was the case with Polylines – especially in the case of filled characters. The combination of precise B-Rep geometry with tessellated PMI presentation is a common use case and will be tested again in Round 39J.

2.2.2 Approach

The approach to be used is described in the latest version (at least v4.0.4, dated September 1, 2016) of the “Recommended Practices for Representation and Presentation of PMI (AP242)”, which can be found in the CAx-IF member area under “Information on Round38J of Testing”.

The AP242 schema to be used is the IS version (v1.36), which can be found on the public CAx-IF web sites under “Joint Testing Information”.

2.2.3 Testing Instructions

The tests will be performed based on the same set of NIST CTC and FTC models as for the SP5 test case described above.

2.2.3.1 Test Model Overview

- See section 2.1.3.1 above.

2.2.3.2 Test Model Access.

- See section 2.1.3.2 above.

2.2.3.3 Test Model Configuration

The following functionality shall be included in the test file provided for this round of testing, as far as it has been implemented by the CAx-IF participants and is described in the Recommended Practices:

- Tessellated Presentation – include the PMI elements as tessellated annotations. Stroked, outline and filled fonts (and combinations) are allowed, as well as styling of the annotations (colors).
- Definition of "Saved Views" – as far as supported, include the saved views defined in the models, which contain a subset of annotations in the file, and provide a predefined position of the model in the design space.
    - Several of the models have multiple Saved Views defined: CTC-02 (3), CTC-05 (2), FTC-06 (3), FTC-08 (4), and FTC-09 (4). In the test case definition documents, each page of the PDF document represents one Saved View.
    - For each view, a screenshot showing the model layout (displayed elements, orientation, zoom) shall be provided.

      Note that it is possible to attach several screenshots to one set of statistics in CAESAR. The name of the view shall be given as description for the screenshot.
    - Both "basic" and "advanced" view implementations are allowed.
    - The Saved Views also shall correctly show (or hide) the non-solid Supplemental Geometry contained in some of the models.
- Cross-highlighting of annotations and annotated shape – if supported, include in the STEP file the information necessary to maintain the association between annotations and the annotated shape elements in a way, that after import, when highlighting an annotation, the shape elements annotated by it are highlighted too, and vice versa.
- PMI Validation Properties for Tessellated Presentation – as far as supported, include the validation properties in the files, and evaluate these after import:
    - "Number of Segments"
    - "Tessellated Curve Length"
    - "Tessellated Curve Centre Point"
    - "Number of Facets"
    - "Tessellated Surface Area"
    - "Tessellated Surface Centre Point"
    - "Equivalent Unicode String"
    - "Affected Geometry"

Also refer to 0 for test model translation configuration considerations.

Note that for the creation of the Equivalent Unicode String, the mapping as defined by the "Unicode String Project" report (Revision J) shall be used. This document is available on the public CAx-IF homepages, under "Joint Testing Information".

Note that for the PMI validation properties, the new optimized implementation structure for validation properties can be used. This is currently defined in section 4.11 of the “Recommended Practices for Geometric and Assembly Validation Properties” (Release 4.4, dated August 17, 2016), which can be found on the CAx-IF homepages, under “Joint Testing Information”.

2.2.3.4 Statistics

For each STEP file exported or imported for the TP4 test case, vendors must submit the corresponding statistics to CAESAR. To do so, go to the [TP4 Data Sheet], and either fill in the web form, or upload a comma-delimited file (.csv) with the data as listed below.

View-related Statistics

Several of the Statistics for this test case are view-related (e.g. number of annotations, positioning/scaling). The statistics cannot evaluate this for all views in the model. Hence, the idea is to select one specific (interesting) view on export and publish its name in the “Saved View” field of the statistics. It is recommended to use the first view (by name, alphabetized) in the model. Then, fill in the other view-related statistics with the values as valid for this particular view. After import, select the view with the name given in the native statistics and again provide the values valid for this view.

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 in the table below.

Screenshots

For each Saved View in the model, provide one screenshot, which illustrates the layout (displayed geometry and annotation, model orientation, and zoom factor). Give the name of the view as the description of the screenshot.

Note that in order to count the PMI elements for the statistics, per agreement during the Round 22J Review Meeting, the names of the `tessellated_geometric_set` shall be considered.

See section “Indicating the Presented PMI Type” in the PMI Recommended Practices for details.

Data Sheet Columns

column name	description
model	The name of the test model, here: ‘TP4’ followed by the model index; e.g. ‘TP4-02’, ‘TP4-05’, or ‘TP4-09’.
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, enter 'stp'
dimension	The number of dimensions processed
datums	The number of datums processed
datum_targets	The number of datum targets processed
tolerances	The number of tolerances processed
labels	The number of labels processed

saved_view	The name of the Saved View which is the basis for the view-related statistics
view_annot	The number of annotations included in the specified saved view.
view_pos	pass/fail, whether the model orientation and zoom factor stored for the Saved View could be restored successfully.
highlight	all/partial/none – whether the cross-highlighting for annotations and annotated shape elements works correctly
tess_pmi_area	all/partial/none – whether the surface area of the Tessellated PMI annotations was validated successfully for all, some or none of the given annotations.
tess_pmi_clength	all/partial/none – whether the total length of segments per Tessellated PMI annotation was validated successfully for all, some or none of the given annotations.
tess_pmi_c	all/partial/none – whether the centroids of the Tessellated PMI annotations were validated successfully for all, some or none of the given annotations.
eq_unicode	all/partial/none - if the encoding of the equivalent Unicode string was correct for all, some or none of the given annotations.
valid_tess_vp	pass/fail, is the instantiation of the validation properties for Tessellated Geometry in the STEP file per the recommended practices?
affected_geo	all/partial/none – whether the affected geometry could be validated correctly for all, some or none of the PMI statements in the model.
date	The date when the statistics were last updated (will be filled in automatically)
issues	A short statement on issues with the file

2.3 Test Case S2: AP242 BO Model XML Assembly with Tessellated Geometry

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

2.3.1 Motivation

The exchange of assembly structures with external references to geometry files is a long-used concept in the STEP multiverse, which has proven its value and stability in many business use cases. In addition to the long-used Part 21 representation, AP242 provides a Business Object (BO) Model with a comprehensive data model in an XML representation.

AP242 BO Model XML is the designated standard process format for the automotive and aerospace industries and will be used together with various standardized and proprietary geometry file formats, depending on the actual use case. This also includes tessellated formats. External References and 3D Tessellated Geometry, which are capabilities that have been tested many times in the CAx-IF already, but always separately. In Round 35J, they were combined into a consolidated test case, which will be re-used this round.

The number of exchanges and the quality of results improved steadily from the past rounds of testing. Hence, the S2 test case extends the testing scope from the previous S1 by adding two new capabilities to AP242 BO Model XML implementations, which are well-known from the Part 21 side of things:

- Assembly Validation Properties
- User Defined Attributes.

These shall be included in the XML files as well.

2.3.2 Approach

The following schemas and documents shall be used for this test:

- *AP242 IS Business Object Model XML*, dated May 5, 2014 [R34J]
- *AP242 IS Longform Schema (v1.36)*, dated May 22, 2014 [JTI]
- *Recommended Practices for AP242 Business Object Model XML Assembly Structure*, version 1.1.06, dated November 28, 2016 [R39J]
    - Note that a set of example XML files is available as well, based on AS1 [R38J].
- *Recommended Practices for 3D Tessellated Geometry*, version 1.0, dated December 17, 2015 [JTI]
- *Recommended Practices for STEP File Compression*, version 1.2, dated August 15, 2016 [JTI]

The documents can be found in the following locations, as indicated:

- [JTI] – Public CAx-IF Homepage, “Joint Testing Information”
- [R34J] – CAx-IF Member Area, “Information on Round 34J of Testing”
- [R38J] – CAx-IF Member Area, “Information on Round 38J of Testing”
- [R39J] – CAx-IF Member Area, “Information on Round 39J of Testing”

2.3.3 Test Model

The test model for this test is based on the well-known “S2” model (“spaceship”).

For those vendors who do not have the S1 model at hand, modelling instructions can be found in the Round5J Test Suite document (v2.0), which can be found on the “Joint Testing Information” pages of the CAx-IF web sites, dated October 4th, 2000.

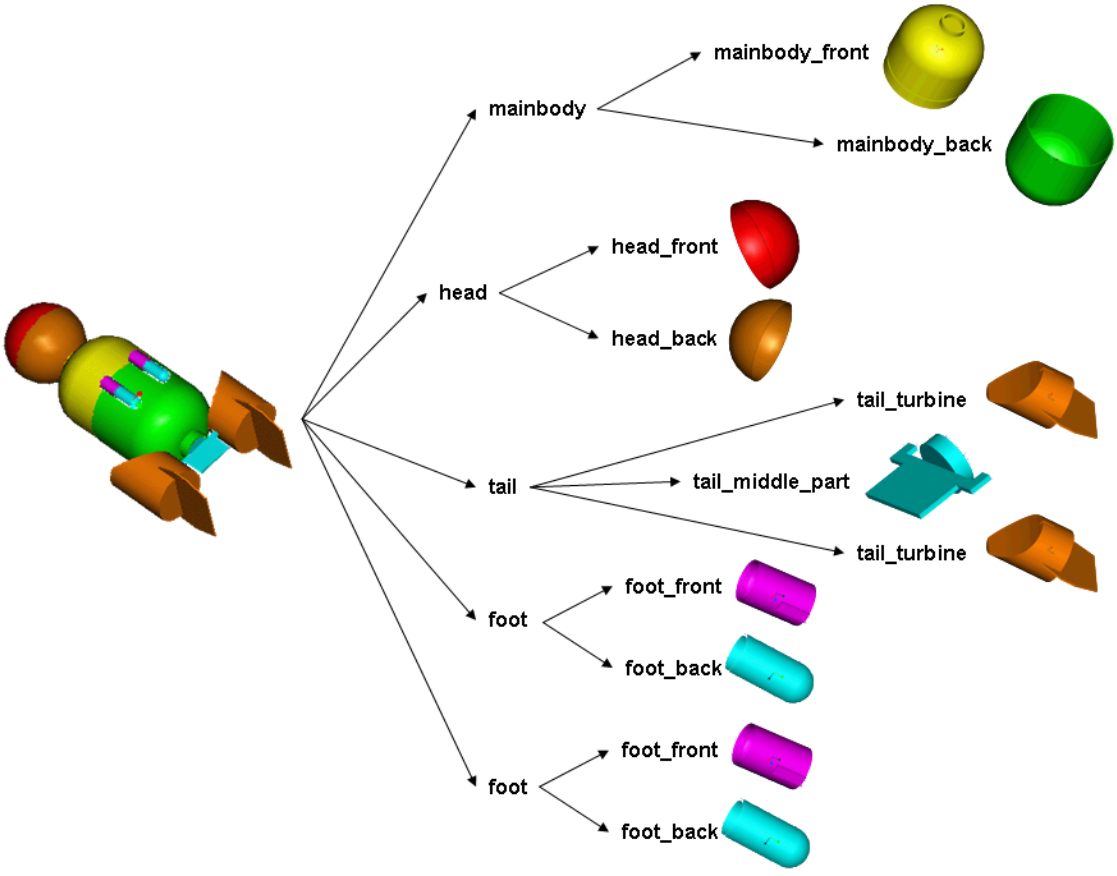


Figure 2: Shape and Structure of the S2 model (spaceship)

The aim of this test is to correctly transfer the assembly structure based on AP242 BO Model XML files, using either the “all-in-one” or the “nested” approach, and referencing tessellated parts.

Since transfer of the S2 geometry itself can safely be considered stable, there will be no geometry-related statistics. The evaluation will focus on completeness and correctness of the assembly structure and the external references.

2.3.4 Testing Instructions

Each set of files (structure + geometry files) shall be provided as a ZIP package containing:

- For the component part geometry files:
  - A compressed AP242 Part 21 file (*.stpZ) with a tessellated representation of the part geometry
  - Vendors who do not support 3D tessellated geometry in their implementations may provide the part geometry as “classic” STEP B-Rep data (*.stp).
- For the assembly structure:
  - One AP242 BO Model XML file (“all-in-one” approach), or
  - Multiple AP242 BO Model XML files (“nested” approach) – see section 9.2 in the Recommended Practices for AP242 BO Model XML Assembly Structure.

The assembly files shall contain Assembly Validation Properties for all nodes in the product structure. The two values – number of children, and notional solids centroid – and their representation are defined in section 13.1 of the AP242 BO Model XML Assembly Structure Recommended Practices.

In addition, all CAx-IF members supporting User Defined Attributes are encouraged to include these into the model as well. It is recommended to include attributes at the part level (section 12.4.1 of the Recommended Practices) and at the assembly instance level (section 12.4.2). Examples for attributes to be added can be found in earlier CAx-IF Test Rounds.

2.3.5 Statistics

For each STEP file exported or imported for the S2 test case, vendors must submit the corresponding statistics to CAESAR. To do so, go to the [S2 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 in the table below.

Data Sheet Columns

column name	description
model	The name of the test model, here: ‘S2’
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, enter 'stp'

fref_found	all/partial/none - indicates if all, some or none of the references to the external files can be found in the assembly structure file(s), and if they are correctly associated with the respective nodes in the assembly structure.
fref_processed	all/partial/none - indicates if all, some or none of the referenced files were be processed correctly to successfully construct the overall model.
assem_struct	pass/fail - if the model structure (assembly tree) was transferred correctly, i.e. no nodes have been added or removed, and all elements are on the correct hierarchical level.
assem_place	all/partial/none - whether the placement of assembly components is correct
children	pass/fail, indicates whether the number of children for each node in the assembly tree matches the AVP value given in the STEP file
valid_child	pass/fail, is the instantiation of the validation property 'number of children' in the STEP file as per the recommended practices for validation properties?
notional_solids	all/partial/none, whether the position of all, some or none of the assembly components in the model could be validated throug the 'notional solids' AVP.
valid_notion	pass/fail, is the instantiation of the validation property 'notional solids' in the STEP file as per the recommended practices for validation properties?
part_attr	pass/fail, have the User Defined Attributes at the part/product level been processed correctly?
instance_attr	pass/fail, have the User Defined Attributes at the assembly component instance level been processed correctly?
valid_attr	pass/fail, is the instantiation of the User Defined Attributes as per the Recommended Practices?
date	The date when the statistics were last updated (will be filled in automatically)
issues	A short statement on issues with the file

2.4 Test Case SM1: Alternative Part Shapes / Sheet Metal

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

2.4.1 Motivation

A number of scenarios have recently come up that require storing more than one shape for a particular part. After initial testing in Round 38J, the use case in focus for this round provides the folded and unfolded shape of a sheet metal part in the same file.

2.4.2 Approach

The approach to be used is described in the draft Recommended Practices for Alternative Shapes, version 0.1, dated May 31, 2016. It can be found in the member area of the CAx-IF homepages under “Information on Round 38J of Testing”.

In particular, this test case relates to section 6 of this document, “Alternative Part Shapes”.

2.4.3 Testing Instructions

The model used for this test is based on the NIST test case CTC-03. The part as available from the NIST homepage (see SP5 and TP4 test cases above) contains the folded shape of the part.

Based on this, ITI has created native CAD models that contain the folded as well as the unfolded shape. These files are available in the member area of the CAx-IF homepages under "Information on Round 39J of Testing". Currently included are:

- `nist_ctc_03_asme1_cr40b0_smtl.prt` (PTC Creo 4.0)
- `nist_ctc_03_asme1_nx110_rc.prt` (Siemens NX 11)
- `nist_ctc_03_asme1_rc_sw1702_ra.SLDPRT` (SolidWorks 2017)
- `nist_ctc_03_asme1_ct5_2016_flatpattern.CATPart` (CATIA V5-6R2016)

Each model contains both shapes – as-designed model with an additional flat pattern feature and a family table, aka part family table, aka design table to differentiate the two versions – generally naming the instances `<name>_DSGN` and `<name>_FLAT`.

Note that the NX model was not created as a sheet metal model to begin with, so it has been converted.

In SolidWorks, the two representations are stored in the model as "configurations". The "Default" configuration is for the as-designed model and the "FLAT" configuration is for the flattened part.

In CATIA, switching between the two shapes is done using a command in the sheet metal design workbench. The MultiViewer command can be used for that, which is similar to opening the same model twice in the same session.

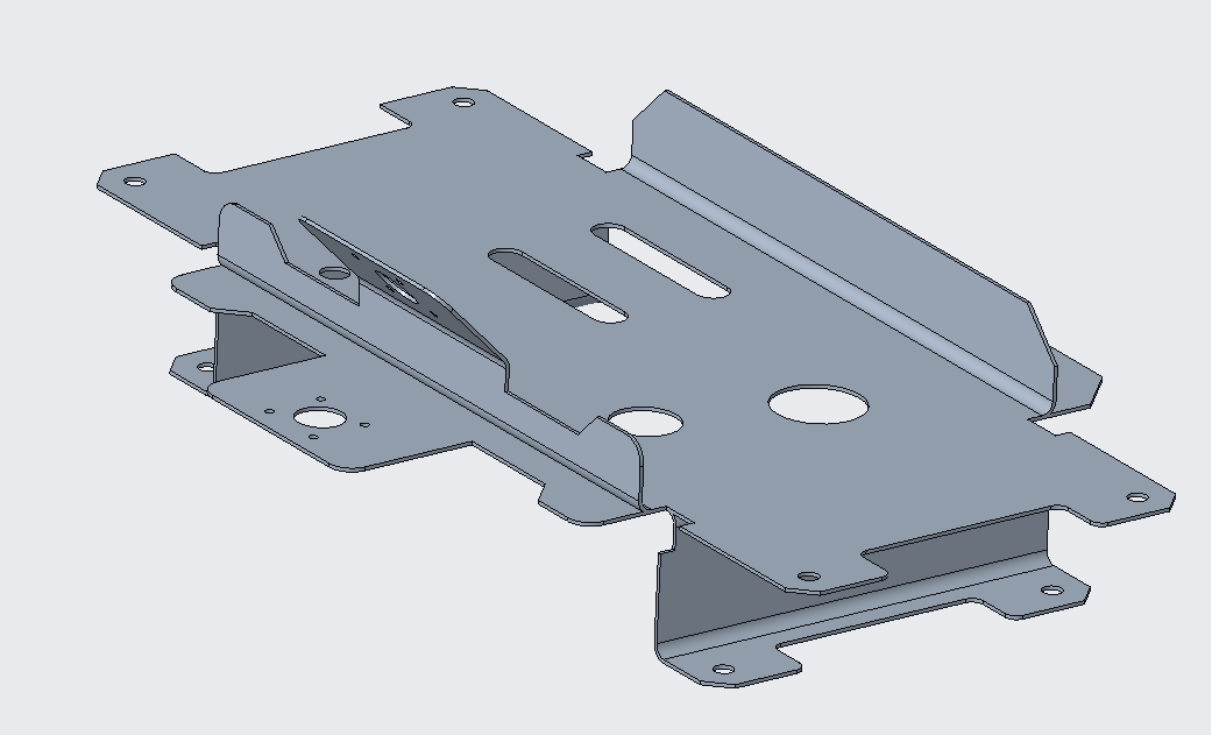


Figure 3: Illustration of SM1, showing folded and unfolded shape simultaneously

When manufacturing such a part, it is clear that the flat shape is the starting point, created by shearing and punching, which is then folded or "broken" in one or several subsequent steps. In CAD design however, the process usually works the other way around: the final folded part is designed, and then the flat shape is derived from that. So which of the two shapes shall be identified as the derived shape in the STEP file depends on the point of view (manufacturing or design) is a topic for discussion.

2.4.4 Statistics

For each STEP file exported or imported for the SM1 test case, vendors must submit the corresponding statistics. To do so, go to the [SM1 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 '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 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: ‘SM1’
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, enter 'stp'
unit	The unit the model is designed in
alt_shapes	all/partial/none - whether the alternative part shapes in the model were processed correctly
bbox_minx	The (min X, min Y, min Z) corner point of the Bounding Box (per GVP RP v3.3 or later)
bbox_miny	
bbox_minz	
bbox_maxx	The (max X, max Y, max Z) corner point of the Bounding Box (per GVP RP v3.3 or later)
bbox_maxy	
bbox_maxz	
bbox_min_unfoldx	The (min X, min Y, min Z) corner point of the Bounding Box of the Unfolded (Flat) Shape of a Sheet Metal Part (per GVP RP v3.3 or later)
bbox_min_unfoldy	
bbox_min_unfoldz	
bbox_max_unfoldx	The (max X, max Y, max Z) corner point of the Bounding Box of the Unfolded (Flat) Shape of a Sheet Metal Part (per GVP RP v3.3 or later)
bbox_max_unfoldy	
bbox_max_unfoldz	
date	The date when the statistics were last updated (will be filled in automatically)
issues	A short statement on issues with the file

Annex A NIST Model Translation Configuration Considerations

Based on data translation issues identified in the NIST Phase 2 project (requiring multiple dataset submission iterations to resolve), the following translator configuration considerations have been derived for the PMI-related test cases (SP5 and TP4) in Round 38J:

- Include annotations, coordinate systems, model properties, and PMI views
- Include supplemental geometry (non-solid surfaces, curves, points)
- Preserve annotation associations with both product and supplemental geometry
- Preserve annotation semantic PMI properties
    - Clearly point out if these are intentionally not translated
- Preserve annotation text
    - Creo should be configured to display dimension tolerances (tol_display on)
    - Do not drop leading zeros or add trailing zeros
- Preserve annotation units
    - NIST CTC 01, 02 and 04 models are defined in millimeters
    - NIST CTC 03 and 05 models are defined in inches
- Preserve display names of annotations and coordinate systems
    - Point out if you use NX 9 or newer since this will change some of the annotation names (see Figure 4 below)
- Preserve display colors of product geometry, supplemental geometry, and annotations
- Preserve view-specific visibility of annotations, coordinate systems, and supplemental geometry
- Preserve view frustum (orientation and zoom level) definition
- Do not export extraneous information
    - Only CATIA Captures (not Views) should be exported to STEP Saved Views
    - Creo sketch dimensions should only be included when visible in a Combined View

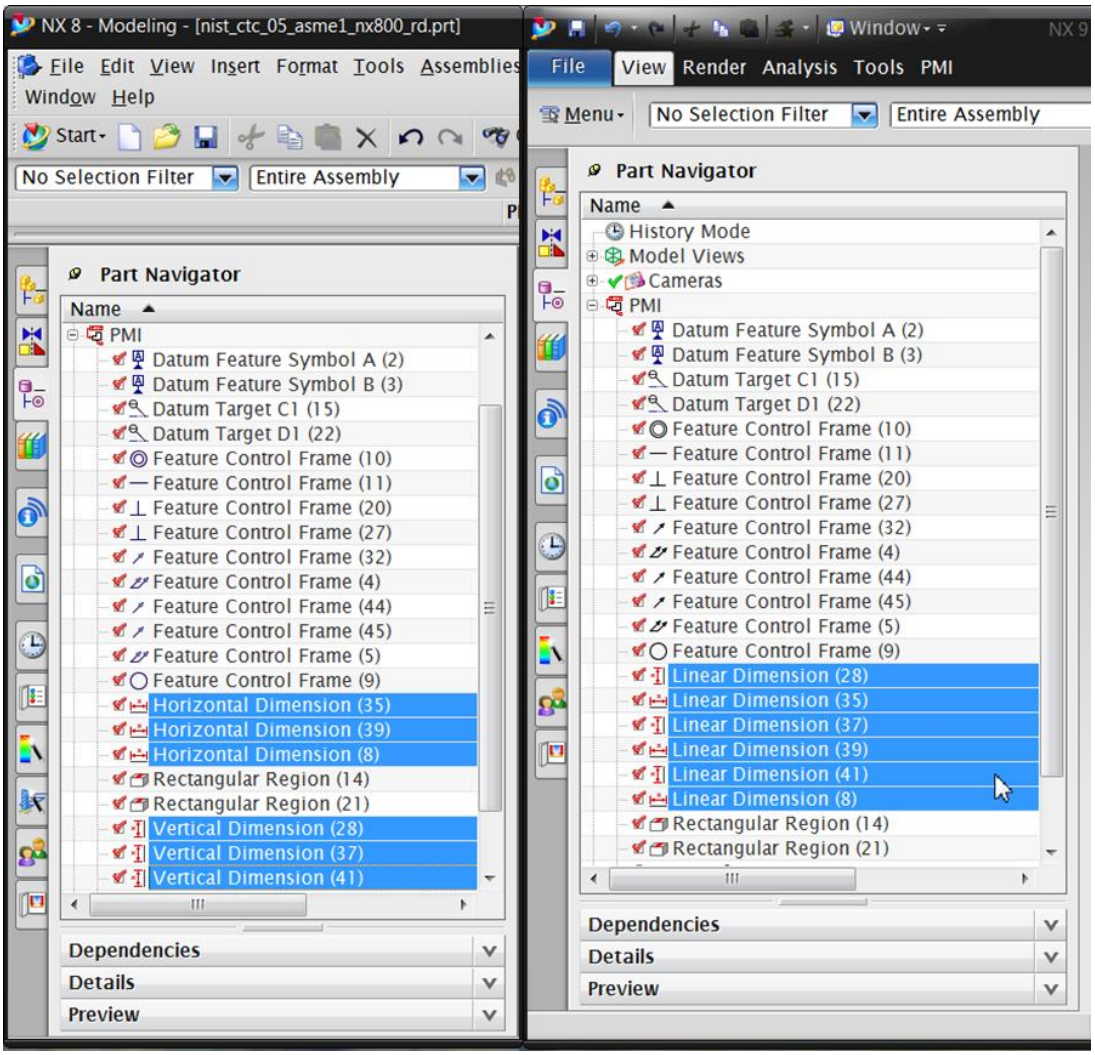


Figure 4: NX 8 vs. NX 9 Dimension Display Names