Test Suite for the
CAx Implementor Forum
Round 27J

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1.0 <u>Introduction</u>

This document describes the suite of test cases to be used for the twenty-seventh round of testing of the CAx Implementor Forum (CAx-IF). The CAx-IF is a joint testing forum organized by PDES, Inc. and the ProSTEP iViP Association. The test rounds of the CAx-IF concentrate primarily on testing the interoperability and conformance of STEP processors based on AP203 and AP214. Starting in Round 27J, they will also support prototyping of 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 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: Presentation of Product Manufacturing Information (PMI), both as Polylines and semantically based on Representation, and User Defined Attributes.

Production models are provided for assemblies and piece parts. The basis for the production test cases is native CAD models. Each test case therefore originates from a single CAD system, and the set of test cases to be pre-processed (converted to STEP files) is unique for each CAD system. After pre-processing, the resulting STEP files are then to be imported/post-processed/read in by the rest of the participants.

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 of the part from the 3D model. In Round27J, the focus will be on the two main approaches for the transfer of PMI in the 3D model:

  o "Polyline Presentation" refers to breaking down each annotation into polylines and arcs, and exchanging them as wireframe geometry. This preserves the exact shape of the annotation, but is human readable only.

  o "Representation and Semantic Presentation" relies on the "Representation" capability to render the information contents to be displayed. These are supplemented with basic styling and positioning information, to enable the importing CAD system to re-create the annotation elements using its internal PMI capability, and may be supplemented with additional textual information.

  o In Round27J, both capabilities will be extended by using an advanced approach for the implementation of Saved Views, and adding section views as well.

- **User Defined Attributes** are descriptions or values that can be added by the user in the CAD system and associated with a part or geometric elements in the model. Material or production costs are an example for this. This has been tested for some rounds, and the scope is being extended further in Round27J.

- • **Production Models** are included in this round of testing in addition to the synthetic models for the above capabilities.

1.2 General test instructions for this round

The general procedures for communication of models and statistics are outlined in a separate document 'General Testing Instructions'. The general instructions can be retrieved from CAx Implementor Forum web sites. The latest version is v1.8, dated June 2010.

1.3 Preliminary testing schedule

The following schedule has been agreed on for Round 27J:
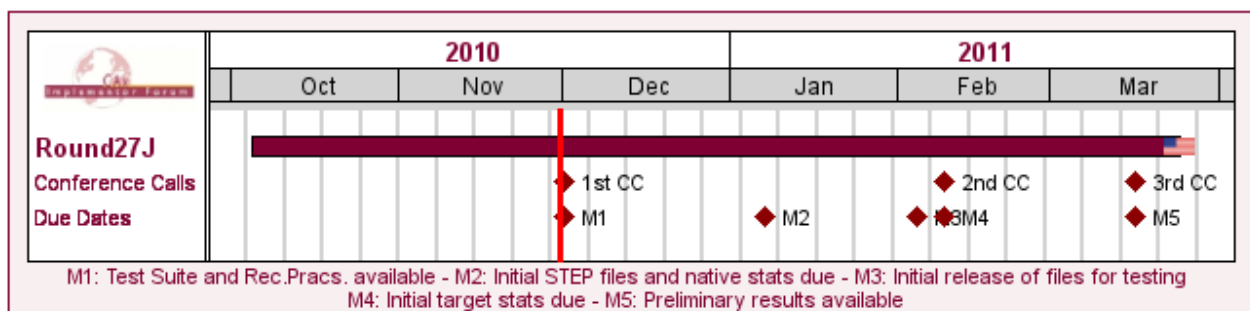
CAx-IF Round27J Schedule

Date	Action
1 Dec 2010 (Wed)	1st CAx-IF Round27J Conference Calle / Test Suite and Rec.Pracs. available
7 Jan 2011 (Fri)	Initial STEP files and native stats due
4 Feb 2011 (Fri)	Initial release of files for testing
9 Feb 2011 (Wed)	2nd CAx-IF Round27J Conference Call / Initial target stats due
16 Mar 2011 (Wed)	3rd CAx-IF Round27J Conference Call / Preliminary results available
22 Mar 2011 (Tue) – 24 Mar 2011 (Thu)	CAx-IF Round27J Review Meeting in tbd, USA

The CAx-IF meeting will take place in conjunction with a 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

None of the production test cases which were provided by the PDES, Inc. and ProSTEP iViP member companies are 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), as long as a reference to the originating company is made.

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

2.0 <u>Synthetic Test Case Specifications</u>

2.1 Model PP2: PMI Polyline Presentation

The Test Case description, and Test Models, for Polyline Presentation in Round27J will be added at a later point in time. The following is planned:

- *use LOTAR test models (these are currently in work)*
- *scope will be close to what was tested before and is for the most part*
- *implementation of section views with one or several section planes (i.e. combination of planes) is encouraged*
- *there will be a slight change in the implementation of validation properties "per annotation". AP242 will then provide the fully legal implementation of this.*

2.2 Model SP2: PMI Representation & Semantic Presentation

The Test Case description, and Test Models, for PMI Representation & Semantic Presentation will be added at a later point in time. The following is planned:

- *use LOTAR test models (these are currently in work)*
- *some models will be dedicated to test exising scope (similar to R26J, based on AP203e2 / AP214e3)*
- *some models will be dedicated for AP242 prototype testing. A first longform schema and the accordingly updated practices will be available soon.*
- *implementation of section views with one or several section planes (i.e. combination of planes) is encouraged*

2.3 Model UD3: User Defined Attributes

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

2.3.1 Motivation

Most CAD systems allow the user to add user-defined attributes in the form of key-value pairs to a part or shape. These carry information which can not be derived from the geometry, such as material costs, but is of relevance to downstream processes or for archiving purposes. In Round 26J, this capability will be extended to include UDA validation properties.

2.3.2 Approach

The approach to be used to transfer the user-defined attributes is described in the Draft Recommended Practices for User Defined Attributes (v0.8, dated November 1, 2010), which are available in the member area of the CAx-IF homepages under "Information on Round 27J of Testing".

Note that the version 0.8 of the Recommended Practices introduces specific subtypes for integer, boolean and real attributes to be used with AP203e2.

User Defined Attributes can be attached to either a single part, an instance of a component in an assembly, or a geometric element of its shape. Each attribute can be descriptive (i.e. the value is a text string) or numeric (with and without unit). Attributes and attribute values can also be grouped together.

Validation Properties for User Defined Attributes can be given by creating a count of how many attributes are attached where in model structure – i.e. at the part/product level or various classes of geometric elements – and by creating a count of the major attribute type classes (string, integer, real, boolean). The two sums have to match in the end.

2.3.3 Testing Instructions

The User Defined Attributes shall be tested using the well-known as AS1 model.

Note that the LOTAR group has been queried for "real world" models containing a preferably large number of real (or at least realistic) user defined attributes. If they become available in time for R27J testing, they will be made available in the File Repository, and added here.

2.3.3.1 Construction of the model

The following attributes are suggested values for use in the UD3 test. **Note** that the locations where the attributes should be attached (solid/surface, instance, part/product) are proposals, not mandatory. All attribute types should be contained in the model and attached in the file structure where meaningful for the originating system.

- To one of the faces of the 'plate' part, add a descriptive attribute (see section 5.3 in the Recommended Practices):
    - Name: 'Surface Finish'
    - Description: 'Anodize per specification MIL-A-8625, Type I'
- To the two instances of the L-bracket assembly, add a value attribute each (see section 5.2 in the Recommended Practices):
    - Name: 'asm_step'
    - Values: 1 and 2 respectively

- o **Note:** according to version 0.8 of the Recommended Practices, use "`inte-ger_representation_item`" in AP203e2 to transfer this value. In AP214, use a "`count_measure`" (that requires the values to be real, i.e. 1.0 and 2.0)

- To the 'plate' part, add a measure attribute (see section 5.1 in the Recommended Practices):
  - o Name: 'weight'
  - o Unit: kilograms (kg) or pounds (lbs)
  - o Value: <calculated weight of component preferred but generic value can be provided if necessary>

It is allowable to add additional information to each of the attributes (see section 5.4 in the Recommended Practices).

In addition, Validation Properties for the UDA shall be included, giving the following values (see section 7 in the Rec.Pracs.):

- the number of UDAs per model element type
- the number of UDAs per attribute type class

2.3.3.2 Statistics

For each STEP file exported or imported for the UD3 test case, vendors must submit the corresponding statistics. To do so, go to the [UD3 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: 'UD3'
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'
face_attr	pass/fail, have the User Defined Attributes at the solid/surface level been processed correctly?
instance_attr	pass/fail, have the User Defined Attributes at the assembly component instance level been processed correctly?

part_attr	pass/fail, have the User Defined Attributes at the part/product level been processed correctly?
valid_attr	pass/fail, is the instantiation of the User Defined Attributes as per the Recommended Practices?
uda_part_vp	pass/fail, has the number of User Defined Attributes at the Part/Product level been processed correctly? This includes UDA VP at assembly component instances and for groups of UDA.
uda_geo_vp	pass/fail, has the number of User Defined Attributes at the Geometry level been processed correctly?
uda_type_vp	pass/fail, has the number of User Defined Attributes per attribute type class (booelan/integer/real/string) been processed correctly?
uda_group	pass/fail, have the groups of attributes and values been processed correctly?
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 Model CO1: Composite Materials

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

2.4.1 Motivation

With the growing usage of composite materials throughout the industry, the need arises to exchange (and archive) detailed information about their buildup. Not only the materials used, but also how they are combined to build a composite have significant impact on the properties of the resulting material.

In Round27J, this capability will be tested for the second time. The focus of the tests is to see what other CAD processors can read from the file, what side-effects there are, and as soon as processors for downstream applications are available, if they can retrieve the full set of information.

2.4.2 Approach

The approach as described in the "Recommended Practices for Composite Materials" (available on the CAx-IF Web Sites under "Joint Testing Information") shall be used. This includes the definition of cores, plies, laminate tables and materials, for which the required data structures have been taken over from AP209.

2.4.3 Testing Instructions

In Round27J, a prototype STEP file including documentation about implementation details will be provided in the member area of the CAx-IF web sites. Under "Information on Round26J of Testing", some additional background on the implementation taken by Dassault Systèmes is available. All vendors interested in testing transfer of Composite Material information are encouraged to import this file and report their findings..

2.4.3.1 Statistics

For each STEP file exported or imported for the CO1 test case, vendors must submit the corresponding statistics. To do so, go to the [CO1 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: 'CO1
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
laminate	The total number of laminate tables in the file
cores	The total number of cores in the file
plies	The total number of plies in the file
ply_bound	Total length of all ply boundaries
num_materials	Total number of materials defined
date	The date when the statistics were last updated (will be filled in automatically)
issues	A short statement on issues with the file

3.0 <u>Production Models</u>

3.1 PM24

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

3.1.1 Motivation

In an attempt to test the STEP processors on real world models, the CAx Implementor Forum will be testing production parts in this round and future rounds of CAx-IF testing. These production models are characteristic for components and assemblies that are encountered in the aerospace and automotive industries. PDES, Inc. and ProSTEP iViP member companies and vendors have supplied these models. As they may contain data about current products of

these companies, all native and STEP files related to these models have to be handled confidentially and their use is strictly limited to the CAx-IF activities.

3.1.2 Approach

Testing of Production Models focuses mainly on data quality, not on specific functionalities. Assemblies should therefore be exported as a single STEP file. The file format should be either AP214-IS, AP214e3 or AP203e2. In order to support quality validation of the Production Model exchange, all vendors shall include the maximum level of Validation Properties they support, and report them in the statistics.

All source system native models and STEP files may be analyzed for data quality by the "CADIQ" developers. STEP syntax and structure will be checked by the CAx-IF facilitators. In order to enable an end-to-end analysis of the data exchange, all vendors importing Production Model STEP files may submit the resulting target model from their system along with the target statistics.

3.1.3 Testing Instructions

The native models as provided by the user companies should be exported to STEP by all participants who maintain a STEP processor for the respective CAD system. The native models are available on the CAx-IF File Repository in the member area. Once there, browse to the sub-folder "Round 27J > Production Models".

3.1.4 List of available models

Model name	Stats code	Native System	Remarks
Combiner Assembly	pm24_asm	SolidWorks	Courtesy of Rockwell-Collins
Combiner Bracket	pm24_cast	SolidWorks	Courtesy of Rockwell-Collins
MFD Assembly	pm24	NX	Courtesy of Rockwell-Collins **Note:** The assembly is quite large. You need to download all six ZIP files.

3.1.5 Statistics

For each STEP file exported or imported for the PM24 test case, vendors must submit the corresponding statistics. To do so, go to the [PM24 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: 'PM24'
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
volume	Total volume of all solids
validation_volume	Total volume of all solids as received via the validation property capability
valid_vol	pass/fail, is the instantiation of the validation property 'volume' in the STEP file as per the recommended practices for validation properties?
area	Total surface area of all solids
validation_area	Total surface area of all solids (entire assembly), as received via the validation property capability
valid_area	pass/fail, is the instantiation of the validation property 'area' the STEP file as per the recommended practices for validation proper-ties?
cx	Centroid of all solids
cy	
cz	
validation_cx	Centroid of all solids (entire assembly) as received via the valida-tion property capability
validation_cy	
validation_cz	
valid_cent	pass/fail, is the instantiation of the validation property 'centroid' in the STEP file as per the recommended practices for validation properties?
model_size	model_size is the length of the space diagonal of the 3dimensional bounding box enclosing all entities in the model. The result is the Centroid deviation divided by the model_size
shoveit_ok	pass/fail, indicates whether the model passed comparison of the Extended GVP (i.e. no parts/subassemblies misplaced), or failed.
valid_shoveit	pass/fail, indicates whether the target system considers the im-plementation of the instance information valid as per the recom-mended practices
date	The date when the statistics were last updated (will be filled in automatically)
issues	A short statement on issues with the file