Test Suite for the CAx Interoperability Forum Round 53J

September 2023 – March 2024

Version 1.0

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Contacts	
Jochen Boy PROSTEP AG jochen.boy@prostep.com	Phil Rosché ACCR, LLC. phil.rosche@accr-llc.com
Rosemary Astheimer NIST rosemary.astheimer@nist.gov	Robert Lipman NIST robert.lipman@nist.gov

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Document History

Version	Date	Change
1.0	2024-01-16	Initial Release

1 Introduction

The CAx Interoperability Forum (CAx-IF) is part of the Model-Based Interoperability Forum (MBx-IF), which is a joint effort between AFNeT, PDES, Inc. and prostep ivip. An interoperability forum is a logical collection of a user group and an implementer group, focused on specific capabilities of a named standard, in this case ISO 10303 STEP.

- The **User Group** is comprised of industry representatives, all members of at least one of the Interoperability Forum hosting organizations. The group will define and prioritize use cases, derive requirements and related validation properties as well as document user best practices.
- The **Implementor Group** is a group of software vendors, 3rd party integrators, and independent implementors, all members of at least one of the Interoperability Forum hosting organizations, that define recommended practices based on the prioritized use cases provided by the user group and validate them in test rounds.

The objectives of the CAx-IF concentrate primarily on testing the interoperability and compliance of STEP processors based on all Editions of AP242, and include documenting and prioritizing use cases, requirements and best practices to ensure completeness and consistency of the STEP standard and it implementations, implementing new functionalities based on users' requirements while ensuring these do not adversely affect existing implementations, avoiding roadblocks by establishing agreed-upon approaches, and increasing user confidence in STEP by providing interoperable commercial software products.

The CAx-IF's Implementor Group performs two test rounds per year for each domain and presents summary results to the user community. Furthermore, Recommended Practices are developed, and issues are reported to the standards development community.

The test rounds in general combine testing of synthetic and production models. Production models will in most cases be provided by the user companies of the organizations AFNeT, PDES, Inc., and prostep ivip Association. When production models are not available from the user 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, Kinematics, Composite Materials, Assembly Structure with External References as well as Kinematic Mechanism definitions in AP242 Domain Model XML format, and Persistent Entity IDs.

1.1 Functionality tested in this Test Round

Functionality tested in this round relates to:

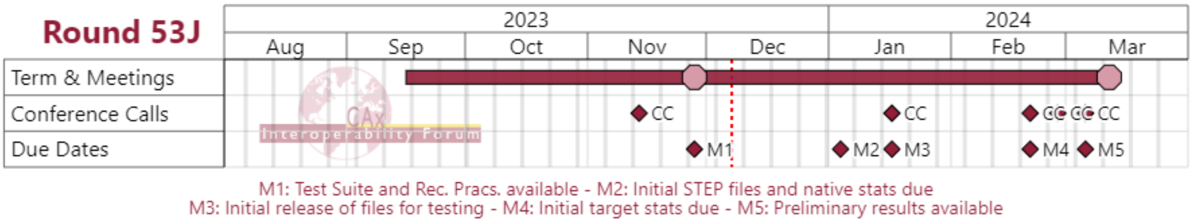
- **Product Manufacturing Information (PMI)** describes the capability to embed information about dimensions, tolerances and other parameters which are necessary input for the manufacturing and measuring of the part from the 3D model. In this round, the focus will be on the two approaches for the transfer 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.
    - "Semantic Representation" refers to the intelligent transfer of PMI data in an associative and reusable 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. The test also includes additional presentation data, which can be linked to the corresponding PMI representation.
    - "Assembly-level PMI" applies the concept above to assemblies, where PMI elements are defined between different parts, or part instances. Concepts such as Saved Views and Cross-Highlighting shall work in the same way.
- **AP242 Domain Model XML** is an 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 contain the assembly structure and part master information. The tests, which are conducted jointly with the PDM-IF, primarily aim at improving CAx-PDM interoperability by ensuring that the different types of systems correctly cope with the different levels of information.
- **Composite Materials** are made by layering various plies of material on top of each other. They can be defined in an implicit-precise way, by giving the laminate tables, ply boundaries, orientation, materials, and laminated cores; or in an explicit-tessellated way by calculating the resulting 3D Tessellated Solid. Both representations can be linked to each other.
- **Kinematics** is a capability in AP242 that allows describing the motion of parts over time and in relation to each other. This includes the definition of mechanisms with joints and constraints, defining the kinematic relationships between the parts, as well as motions, which are defined by capturing the positions of the moving parts at discrete points in time. To cover Aerospace as well as Automotive use cases, and to increase the range of participating systems, this capability is being tested jointly with the JT-IF.
- **Persistent Entity IDs** enable the ability to track a product's model information, specifically topological elements, during design iteration. This will allow consuming applications to update their designs based on the original model when changes are submitted.
- **User Defined Parameters** at the part level as well as at the geometry level are used to convey data that drives certain aspects of a model, e.g., geometric features, or engineering notes and requirements that manufacturing must comply with. This may also include custom-defined properties. A target application shall be able to pick up on these and make appropriate decisions for downstream processes.

1.2 General testing instructions for this round

The general procedures for communication of models and statistics are outlined in a separate document, entitled ‘General Testing Instructions’. The document can be retrieved from the CAx Interoperability Forum web sites. The latest version is v2.0, dated 23 June 2023.

1.3 Testing Schedule

The following schedule has been agreed upon for Round 53J:



Date	Action
15 Nov 2023 (Wed)	Round 52J Follow-up / Round 53J Preparation Call
29 Nov 2023 (Wed)	CAx-IF Round 53J Kick-Off Meeting / Test Suite and Rec. Pracs. available
5 Jan 2024 (Fri)	Initial STEP files and native stats due
18 Jan 2024 (Thu)	1st CAx-IF Round 53J Conference Call / Initial release of files for testing
22 Feb 2024 (Thu)	2nd CAx-IF Round 53J Conference Call / Initial target stats due
29 Feb 2024 (Thu)	3rd CAx-IF Round 53J Conference Call
7 Mar 2024 (Thu)	Preliminary results available / 4th CAx-IF Round 53J Conference Call
12 Mar 2024 (Tue) - 14 Mar 2024 (Thu)	CAx-IF Round 53J Review Meeting in Darmstadt, Germany

Figure 1: CAx-IF Round 53J Schedule

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 publicly 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.), if 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 AFNeT, 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 https://go.usa.gov/xuh9n

2 Synthetic Test Case Specifications

2.1 Test Case CO2: Composite Materials (Ply Contour, EEOP & MEOP)

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

2.1.1 Motivation

For several years, some STEP composite interfaces have been available in several CAD tools such as CATIA V5, FiberSIM and in CT CoreTechnologie tools, with a certain level of maturity proven by LOTAR pilot projects.

The goal of including Composite Materials in a CAx-IF test round is to align these implementations and provide an official framework for composite materials implementation tests as STEP AP 242 Ed.2 since it includes this capability.

2.1.2 User Stories

This test case supports the following User Stories provided by the CAx-IF UG on Redmine:

ID	Title
#41	Composite Validation property at part level
#42	Composite Validation property for each Laminate table, Sequence, Ply, core, ply piece, rosette
#44	Composite EEOP & MEOP
#46	Composite Core Samples
#77	Composite ply shape explicit contour
#78	Ply Material identifier

2.1.3 Approach

The scope of this test case is the “exact implicit” representation of composites where the ply geometry is based on surfaces and contours. “Basic” composite validation properties at the part level are also in scope of this test case. The approximate explicit representation of composite plies, where there is a 3D tessellated solid for each ply, is out of scope for this test case.

In addition, the tests in Round 53J consider the Engineering Edge of Part (EEOP) and Manufacturing Edge Of Part (MEOP) definitions given in the test model. The EEOP denotes the dimensions of the finished part, while the MEOP denotes the boundary to be used for manufacturing the laminate.

The approach is to export and to import composite information in STEP AP242 based on the:

- Recommended Practices for Composite Materials; Version 4.2; 17 August 2022; available on the MBx-IF homepage under “CAx Interoperability Forum > Implementor Group > CAx Recommended Practices”.

- Draft Recommended Practices for Composite Structure Validation Properties; Release 0.19; 11 February 2022; available on Nextcloud, folder

  🏠 〉 **MBX-IF** 〉 **CAX-IF** 〉 **Draft Recommended Practices**

- AP242 Edition 2 or Edition 3 IS Longform Express Schema, available on the MBx-IF homepage under “CAx > Schemas”.

Note: As the validation properties recommended practices have not been completely agreed upon, some tests will be done by end user checks.

2.1.4 Testing Instructions

The native model is the file "CPD_PUBLIC_LOTAR.CATPart" which is available as *co2_native.zip* on Nextcloud, folder:

🏠 〉 **MBX-IF** 〉 **CAX-IF** 〉 **CAX-IG** 〉 **Round 52J** 〉 **CO2_CO5**

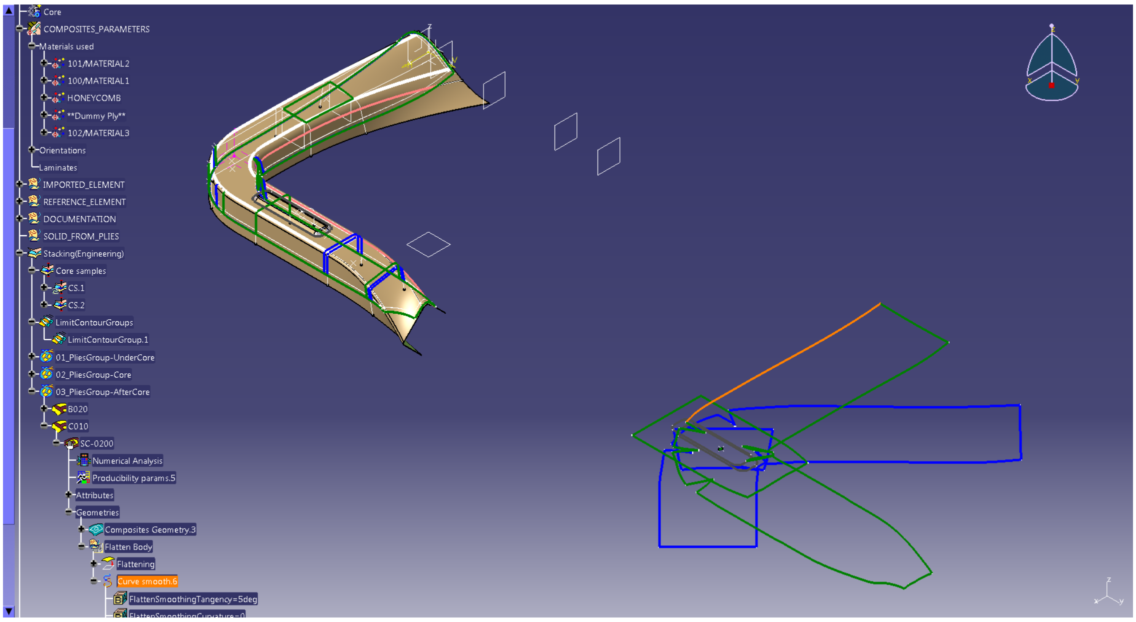


Figure 2: Illustration of the CO2 Test Case

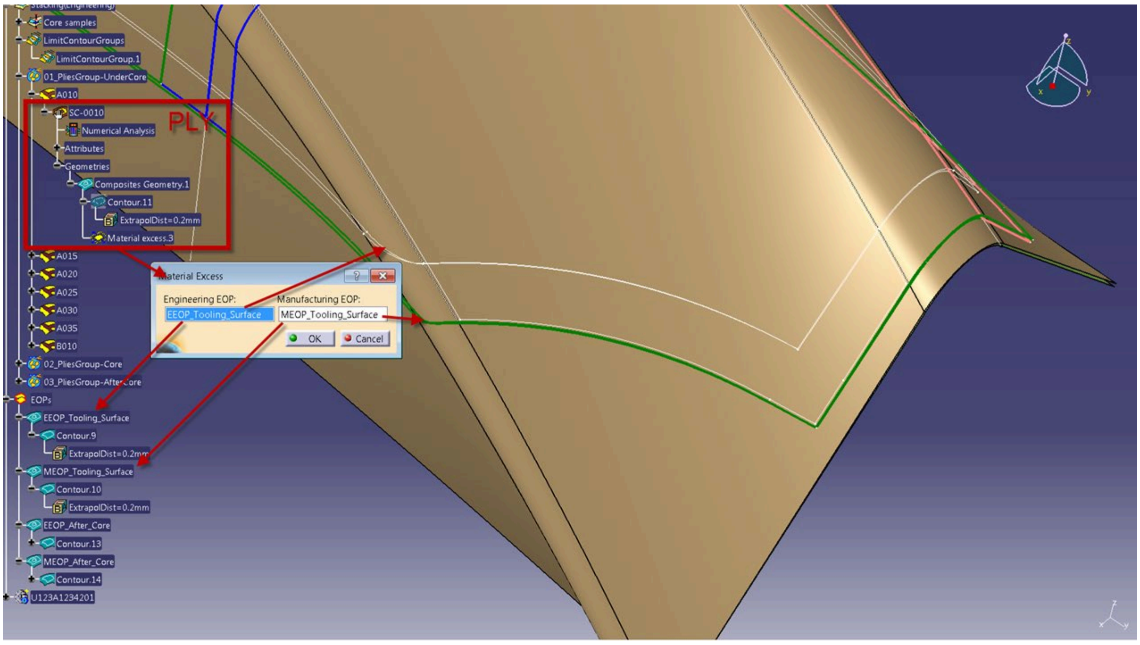


Figure 3: CO2 Details for EEOP & MEOP

2.1.5 Statistics

For each STEP file exported or imported for the CO2 test case, vendors must submit the corresponding statistics. To do so, go to the [CO2 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 file, report the results found after processing the file as described below:

Ply-related Statistics

Several of the Statistics for this test case are related to a specific ply within a specific sequence (e.g., material, orientation, rosette). The statistics cannot evaluate this for all plies in the model. Hence, the idea is to select one specific (interesting) sequence and ply on export, and to publish its name in the "Composite Ply Sequence" field of the statistics. Then, fill in the other ply-related statistics with the values as valid for this particular sequence and ply. After import, select the sequence and ply with the name given in the native statistics, and again provide the values valid for this particular sequence and ply.

The sequence and ply to be used for evaluating the CO2 test case in Round 46J is:

`PLY SC-0035 of SEQUENCE A035`

Statistics for Core Sample Point

The position of the point for the Core Sample shall be given for:

`CORE SAMPLE CS1`

Statistics for Flatten Pattern

The length of the curve contour of the flatten pattern shall be given for:

`PLY SC0200 of SEQUENCE C010`

Data Sheet Columns

These statistics will be enhanced in future test rounds, especially with the release of newer versions of the Recommended Practices for Composite Structure Validation Properties.

column name	description
model	The name of the test model, here 'CO2'
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'
unit	The unit the model is designed in
compos_tables	The number of Composite Tables in the Model
sequences	The number of Sequences in the model
plies	The total number of plies in the file
num_materials	Total number of Materials defined
compos_table_name	The name of the Composite Table of the model

column name	description
ply_sequence	The ID of the Sequence and the ID of the Ply within that Sequence for all ply-related statistics; e.g., "Ply.P4 of Sequence.S4".
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_surface_area	The value of the area of the specific Ply and Sequence as listed in the "Composite Ply Sequence" column of the data sheet.
cores	The total number of cores in the file
fp_length	The length of the curve contour of the Flatten pattern of the ply and sequence indicated in the Test Suite document.
validation_c_tables	Total number of Composite Tables in the model, as received via the validation properties capability
validation_se-quences	Total number of Sequences as received via the validation proper-ties capability
validation_plies	Total number of Plies (entire assembly) as received via the valida-tion properties capability
validation_c_materi-als	Total number of Materials as received via the validation properties capability
validation_c_orient	pass/fail, indicates whether the Number of Orientations per part in the model matches the Composite validation property value given in the STEP file
validation_ply_area	pass/fail, indicates whether the sum of all ply surface areas in the part matches the Composite validation property value given in the STEP file
validation_ply_cen-troid	pass/fail, indicates whether the sum of all ply geometric centroids in the part matches the Composite Validation Property value given in the STEP file
valid_cvp	pass/fail, is the instantiation of the validation properties for Tessel-lated Geomtry in the STEP file as per the recommended practices?
date	The date when the statistics were last updated (will be filled in au-tomatically)
issues	A short statement on issues with the file

2.2 Test Case CO5: Composite Part with Rosette Guided by a Curve 90°

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

2.2.1 Motivation

For several years STEP composite interfaces have been available in several CAD tools such as CATIA V5, FiberSIM and in CT CoreTechnologie tools, with a certain level of maturity proven by LOTAR pilot projects.

The goal of including Composite Materials in a CAx-IF test round is to align these implementations and provide an official framework for composite materials implementation tests as STEP AP242 Edition 2 and above include this capability.

The CAx-IF User group provided a user story including a composite part with Rosette Guided by a curve, where the primary direction is set to non-zero (i.e., 90°). The goal is to archive the data for certification, as well as exchanging it with a manufacturing supplier.

2.2.2 User Stories

This test case supports the following User Stories provided by the CAx-IF UG on Redmine:

ID	Title
#141	Rosette Guided by a curve 90°

2.2.3 Approach

The aim of this test is to transfer the rosettes defined in the part, the relationship to the respective guide curve, as well as the respective orientation as defined in the native model.

The table in section 2.2.5 provides the details for the given test model.

The basis for implementation of the CO5 test case is the following:

- AP242 Edition 2 or Edition 3 IS Longform Express Schema, available on the MBx-IF homepage under "CAx > Schemas".
- Recommended Practices for Composite Materials; Version 4.2; 17 August 2022; available on the MBx-IF homepage under "CAx > Rec. Practices".

2.2.4 Testing Instructions

The native model is the file "ASME_Y14.37_RosetteType2_90GuidedByCurve_A.CATPart" which is available as *co5_native.zip* on Nextcloud, folder:

〉 MBX-IF 〉 CAX-IF 〉 CAX-IG 〉 Round 52J 〉 CO2_CO5

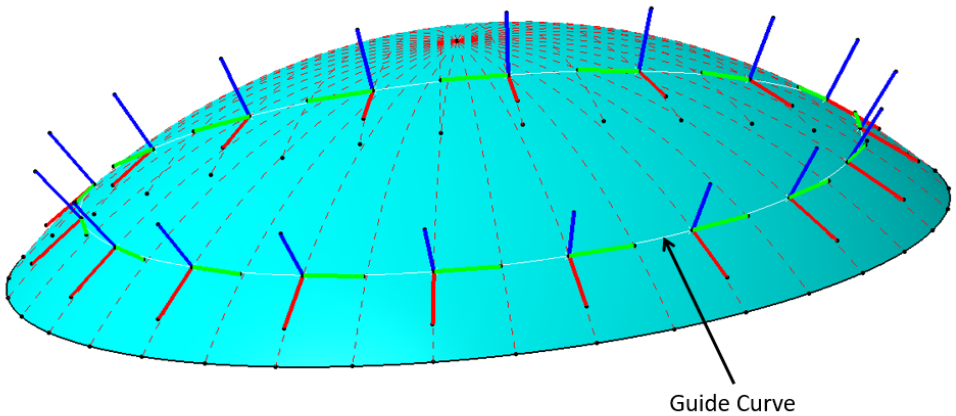


Figure 4: Illustration of the CO5 Test Case

2.2.5 Statistics

For each STEP file exported or imported for the CO5 test case, vendors must submit the corresponding statistics. To do so, go to the [CO5 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

.

Scope-specific Statistics:

The following table lists the key parameters define in the test model. For the test to be considered a success, the following information must be preserved during the exchange:

- Name of the Rosette
- Name of the associated Guide Curve
- Orientation Angle

The statistics gathered in CAESAR will record whether all, some, or none of there were transferred successfully.

Sequence	Ply	Core Material ID	Orientation	Rosette	Guide Curve
Sequence.1	Ply 1	10745	0°	Rosette A	Guide_Curve_90_Rosette A
Sequence.2	Ply 2	10745	45°	Rosette A	Guide_Curve_90_Rosette A
Sequence.3	Ply 3	10745	-45°	Rosette A	Guide_Curve_90_Rosette A
Sequence.4	Ply 4	10745	90°	Rosette A	Guide_Curve_90_Rosette A
Sequence.5	Ply 5	10745	0° or 90°	Rosette A	Guide_Curve_90_Rosette A
Sequence.6	Ply 6	10745	+45° or -45°	Rosette A	Guide_Curve_90_Rosette A

Data Sheet Columns

column name	description
model	The name of the test model, here 'CO5'
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'
rosette_names	all/partial/none - whether all, some, or none of the Rosette names for Ply X of Sequence Y have been transferred correctly per the test case definition.
rosette_curve_names	all/partial/none - whether all, some, or none of the names of the curves related to the Rosettes have been transferred correctly per the test case definition.
orientation_values	all/partial/none - whether all, some, or none of the orientation values for Ply X of Sequence Y have been transferred correctly per the test case definition.
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 KM3: Kinematics

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

2.3.1 Motivation

CAD methods have been used for many years now to design individual parts and assemblies of all sizes across all industries, from a single rivet to an entire airplane. Classically, the main focus is to ensure that the part can be manufactured correctly.

Products such as cars or planes are not static, however, contain many moving components as well: engine, power windows, foldable roof, windshield wipers, cargo doors, etc. thus, Kinematics are used to ensure they move correctly, and also to illustrate the behavior of the finished product. The use cases range from the definition of the Kinematic Mechanism, providing all relationships and constraints between the elements so that their definition can be changed in the receiving application, to Kinematic Motion, which works like a movie by providing discrete positions of the components over time.

The goal is to use a neutral standard format – AP242 Ed.3 Domain Model XML – for the definition of the Kinematic mechanisms and motion, with external references to the applicable geometry format for the respective use case.

2.3.2 Approach

The approaches for “Kinematic Mechanism” as well as for “Kinematic Motion” are described in the draft “Recommended Practices for STEP AP242 Ed.3 Domain Model XML Kinematics”, Version “1.2”, which is available on Nextcloud, folder

> 🏠 〉 **MBX-IF** 〉 **CAX-IF** 〉 **Draft Recommended Practices**

The tests in Round 53J shall be based on AP242 Edition 3, which was published end of 2022. The XML schema and name space definition to be used during this test are called out in the aforementioned Recommended Practices, section 1.1.2.

Collaboration with JT-IF

The Kinematics capabilities are being developed and tested in close collaboration with the JT Implementor Forum. While the file format for the part geometry is different, the AP242 XML files and the Kinematics definitions therein are identical. Test files for this capability will be exchanged between the two groups, in order to increase the number of participating systems. Testing feedback will be exchanged as well between the actively participating vendors, and any resulting improvements will be documented in the joint Recommended Practices. These collaborative efforts are coordinated by Jochen Boy (jochen.boy@prostep.com).

2.3.3 Testing Instructions

In Round 53J, the test model “eRod Suspension/Front Axle Assembly” will be used again. The model was developed by Siemens PLM and Audi, via the prostep ivip / VDA JT Workflow Forum. The NX model originates from Siemens PLM; the CATIA model has been set up by Audi.

It represents a front axle assembly. The CATIA and NX models are harmonized as far as possible, given the differences between the two systems. The Kinematic Pairs and Actuations have been set up in NX in the same way as in CATIA (same names, same limits, and same types, as far as possible). Compared to the gripper model, the scope has been extended with new joint types: universal joint, and rack & pinion pair. The model contains two actuations (commands): steering and suspension.

The native CAD files for the KM3 test model can be found on Nextcloud, folder

> **〉MBX-IF 〉 CAX-IF 〉 CAX-IG 〉 Round 53J 〉 KM3**

The latest versions of the native models are:

- CATIA V5-6: 7 June 2023
- NX 2206: 11 May 2023

In addition, the “KM3” folder also contains a video showcasing the two actuations defined in the model.

Note: Experiences from evaluating the first STEP files provided for KM3 (as part of the model development):

- Take care of the correct parametrization. For instance, in CATIA, for the rack & pinion pair, use "Radius1", do not use the "GearRatio": Radius1 * 2π = GearRatio.
- Explicitly include the unit for the angles in GeometricCoordinateSpace.Units. The ExchangeContext typically contains only the length unit.

Regarding the testing scope, the following has been agreed:

- **Kinematic Mechanism** is the primary use case, and the corresponding definitions shall be included in all provided files.
- **Kinematic Motion** can be added by anyone interested in supporting this extended scope.
- **Assembly & Kinematic Data** shall be provided in a single AP242 Ed.3 Domain Model XML file, using the schema indicated above.
- **Geometry** shall be included as AP242 Part 21 files.

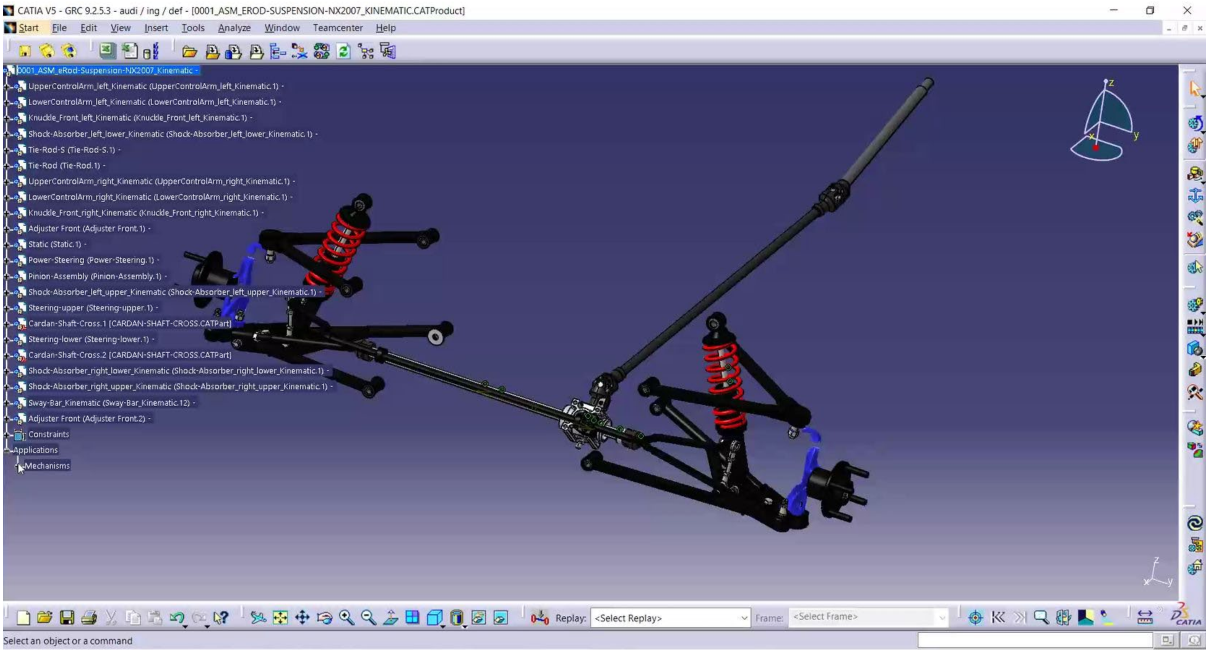


Figure 5: Illustration of the KM3 model in CATIA V5

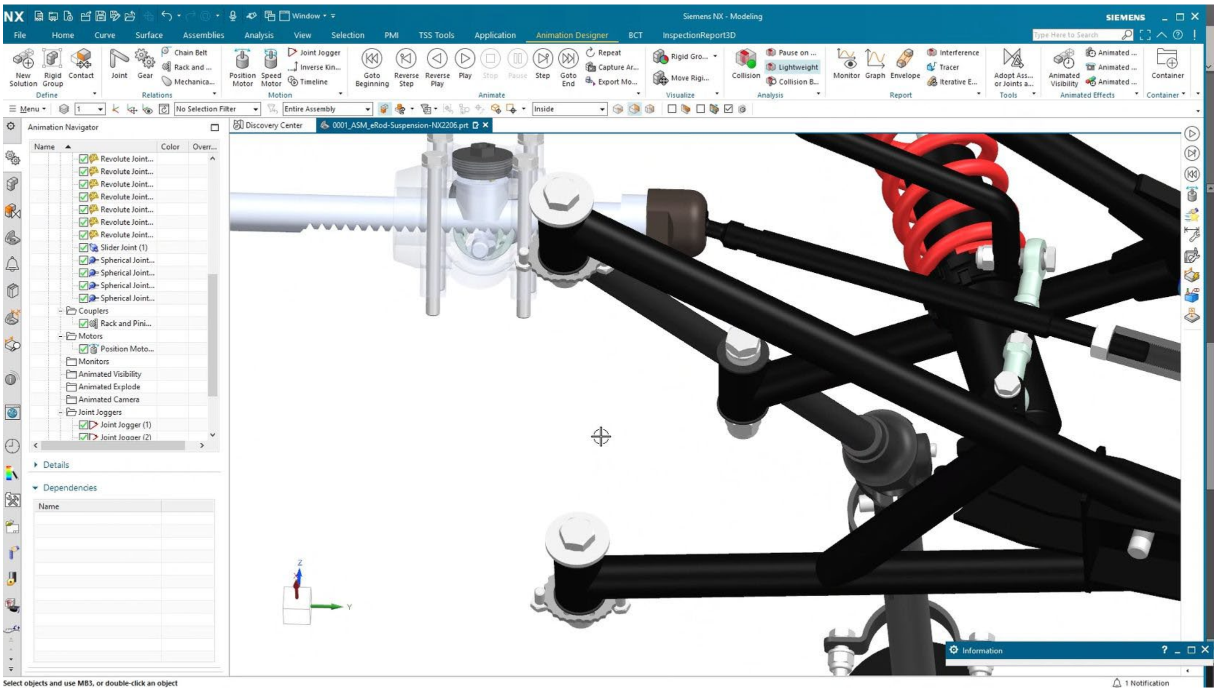


Figure 6: Close-up of the KM3 model in NX

2.3.4 Statistics

For each STEP file exported or imported for the KM3 test case, vendors must submit the corresponding statistics. To do so, go to the [KM3 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.

Kinematics-specific Statistics

For more detailed information about and discussion of in the Kinematics-specific statistics, please refer to section 4.12 of the Kinematics Recommended Practices mentioned above.

Data Sheet Columns

column name	description
model	The name of the test model, here ‘km2’
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’
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.
kin_mechanisms	The number of Kinematic Mechanisms defined in the model
kin_moving_parts	Number of moving parts in a Kinematic Mechanism
kin_mech_pairs	The number of low/high order Kinematic Pairs defined for a Kinematic Mechanism
kin_fix_joints	The number of fully constrained Kinematic Pairs (fixed joints) defined for a Kinematic Mechanism
kin_revolute_pairs	The number of Revolute Pairs defined for Kinematic Mechanisms
kin_sphere_pairs	The number of spherical Kinematic Pairs defined for a Kinematic Mechanism
kin_cylindrical_pairs	The number of Cylindrical Pairs defined for Kinematic Mechanisms
kin_prism_pairs	The number of prismatic Kinematic Pairs defined for a Kinematic Mechanism
kin_rack_pinion	The number of Rack & Pinion Kinematic Pairs defined for a Kinematic Mechanism
kin_placements	The number of AxisPlacements used by KinematicPairs
kin_limits	pass/fail, if the lower and upper limits defined for kinematic pairs were transferred correctly.
kin_mech_acts	The number of Kinematic Pairs that have a non-zero value in the attribute ‘actuation’, i.e., where an initial movement can occur
valid_mechanism	pass/fail, whether the Kinematic Mechanism was successfully recognized by the target system and is moving as expected.
kin_mech_valprops	all/partial/none - whether the validation properties for Kinematic Mechanism matched for all, some or none of the Kinematic definitions.
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 PID: Persistent IDs*

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

2.4.1 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 persistent IDs in STEP.

With the inclusion of persistent 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.

As in the case of design iteration, the ability to track model entities via persistent 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 persistent 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.

As stated earlier, vendors may choose to support either preprocessing native models to generate STEP data or postprocessing such STEP models. Iterative postprocessing can be performed to exercise the design iteration use case. Post-processing may also be performed to exercise the downstream consumption use case.

Finally, although not covered in this test case, the introduction of persistent 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.

2.4.2 Approach

The approach to be used is described in the "Recommended Practices for Permanent Entity IDs for Design Iteration and Downstream Exchange" (Version 1.0; 28 November 2023), which can be found on Nextcloud, folder

> 🏠 〉 **MBX-IF** 〉 **CAX-IF** 〉 **Draft Recommended Practices**

Within the domain of Persistent IDs, the following functionalities are in scope of Round 53J:

- Persistent IDs on Model (Product) for
  - testing the retention of model ID after changes in the underlying content
- Persistent IDs on Geometry and Topology for
  - testing the effect of a change in geometry and topology on design iteration between CAD systems that reference that geometry and topology during bidirectional exchange
  - this concept includes the introduction of Persistent IDs on Shape Aspect, when needed, to collect individual geometry elements into logical groups when sending and receiving systems have differing geometry or topological structures, e.g. periodic or aperiodic cylindrical holes.

- Persistent IDs on Geometry and Topology and Persistent IDs on Semantic PMI Representation for
    - testing the effect of change in geometry and topology on dependent shape and semantic PMI that references that geometry and topology for design iteration or for downstream consumption.
- Persistent 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

The following are out of scope for Round 53J and are moved to the Future Considerations section:

- Persistent IDs on Geometry and Persistent IDs on Semantic PMI Representation for
    - testing assembly constraints referencing those geometries

The preferred AP242 schema to be used is an extension to AP242 Edition 3 schema that will be introduced formally in AP242 Edition 4. The schema for this test case can be found on Nextcloud, folder

〉MBX-IF 〉 CAX-IF 〉 CAX-IG 〉 Round 53J 〉 PID

2.4.3 Testing Instructions

The test will be performed based on a simple test model, developed by Rosemary Astheimer of NIST. The test case is a series of multiple exchanges between two exchanging systems with each system either making changes to existing native model features or adding new model features before exchanging with their exchange partner system.

2.4.3.1 Test Model Overview

The specific test model to be used in this test case is a simplified test case for testing the first exchange of persistent IDs and the effect of model change during iterative design exchange or downstream consumption exchange.

2.4.3.2 Test Model Access

Native CAD files are available in CATIA V5-6R2022, NX 2207, and Creo 9.03 formats for the test case can be downloaded from Nextcloud, folder

〉MBX-IF 〉 CAX-IF 〉 CAX-IG 〉 Round 53J 〉 PID

2.4.3.3 Test Model Configuration

Unlike any previous CAx-IF test round, the PID test case requires iteration to confirm retention of persistent entity IDs. This test case is multi-model, uni-directional iterative exchange process in which a minimum of three exchanges will take place – an initial exchange, a subsequent exchange in the same direction after a model design change is made by the original sender, , an alternate subsequent exchange in the same direction after a model design change is made by the original sender, and a third exchange, also in the same direction, where an additional model feature is added by the sending system.

The three iterations will be identified by model suffixes in CAESAR (PID_0 – Initial Exchange; PID_1 – Update Exchange, PID_2 – alternate method for the Update Exchange, PID_3 – Second Update Exchange). PID_3 is an optional case to further test model exchange with changes resulting in new entities (and thus new UUIDs) added and entities removed (with their UUIDs discarded).

as an optional exercise.

Note also that there are two mechanisms for supporting the introduction of persistent IDs to STEP. The first is via the creation of new persistent `uuid_attribute` entities attached to certain entities within the Data Section of the Part 21 file. The second is via the creation of persistent ID relationships between STEP entity IDs and persistent 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 subtypes to be used in place of the abstract `uuid_attribute` entity type in the Data Section. Based on agreement, the scope of Round 53J will include only the first type of ID, i.e. subtypes of `uuid_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 – Persistent Identifiers, via Data Section

The test case for design and/or downstream exchange is an iterative sequence of simple exchanges that represent an exchange between two designers, designated A and B respectively, or alternatively between a designer and a downstream consumer, designated A and B respectively. This sequence of exchanges, each considered a sub-case of the PID test case are described and illustrated on the following pages -

PID Test Cases and Iterative Exchange Sequence (3 exchanges required, last exchange optional)

- PID_0 (initial exchange),
- PID_1 (first change, hole moves),
- PID_2 (alternate first change, hole replaced), and
- PID_3 (second change, chamfer added).

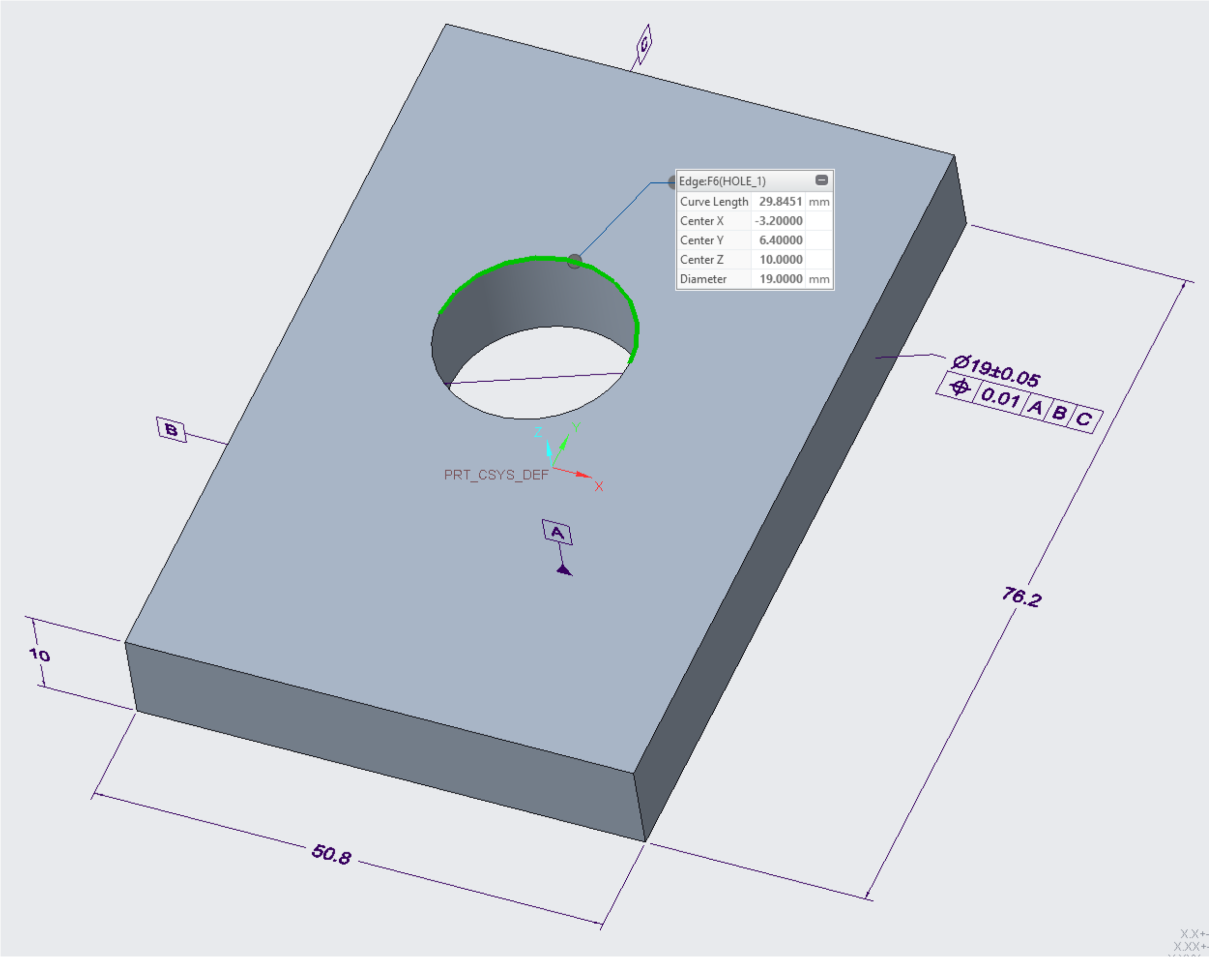


Figure 7: Illustration of PID_0 Test Case

PID_0 –

Preprocessor (CAD System) A's initial design is exchanged to B (model version is 0.0).

Postprocessor (CAD System or Downstream System) B checks for

1. UUID on Product.
2. Version – UUIDs on Product Version to be tested in a future test round.
3. UUIDs on all Advanced_Faces (either 7 or 8 depending on system)
4. UUIDs on all topological Edges (either 14 or 18 depending on system)
5. UUIDs on all topological Vertices (either 10 or 12 depending on system)
6. UUID on Closed Shell
7. UUID on MSBR
8. UUIDs on PMI (diameter and location tolerance; linear dimensions for the overall size of the plate have been removed in the released version of the test model)

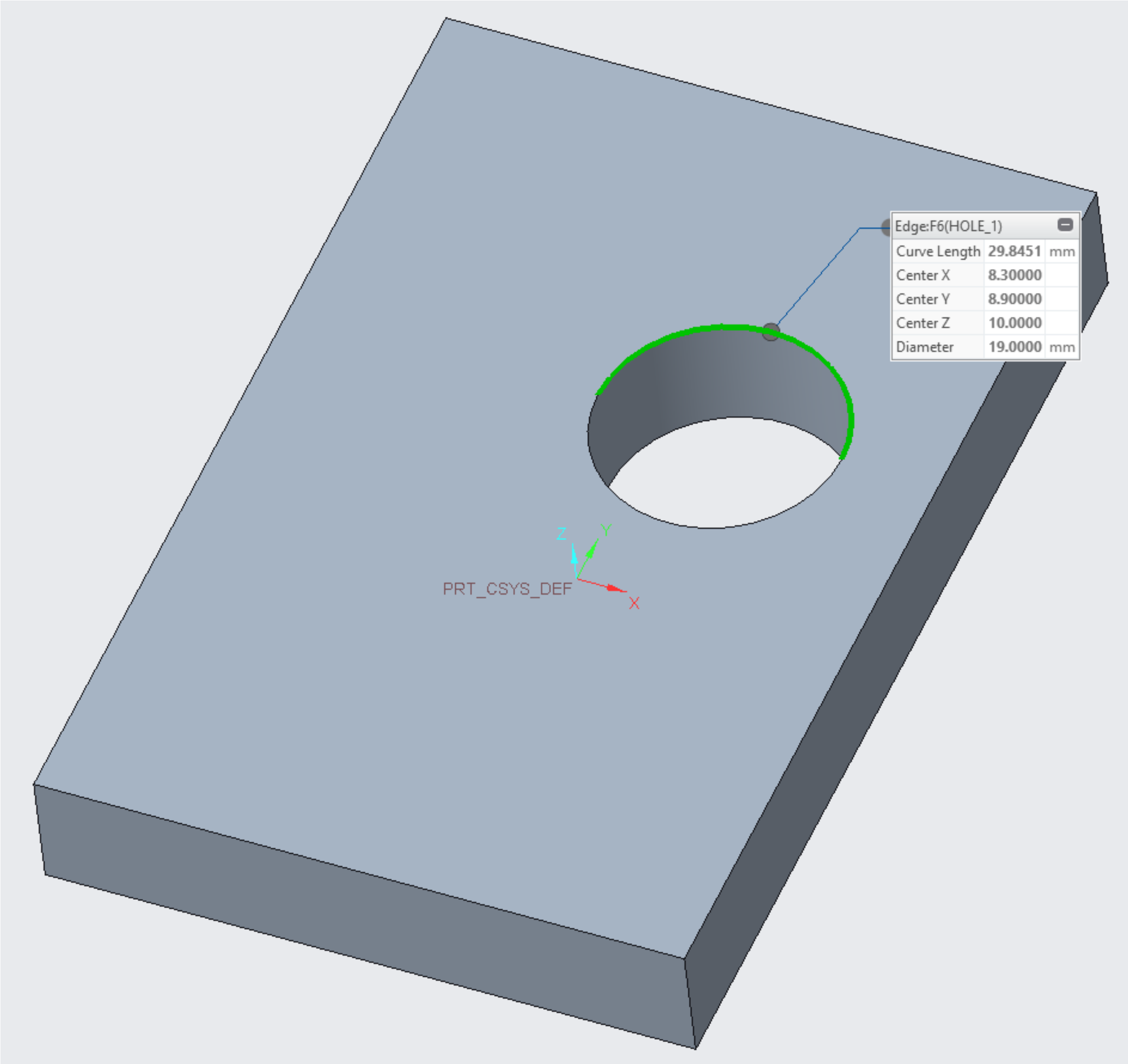


Figure 8: Illustration of PID_1 Test Case

PID_1 -

Preprocessor (CAD System) A modifies the location of the hole (moved, not replaced), versions model, and resends revised model to B

Postprocessor (CAD or Downstream System) B checks for

1. Version – UUIDs on Product Version to be tested in a future test round.
2. Model hole surface (or surfaces) move and PMI dimensions remain associated with geometry
3. All above UUIDS (Product, Advanced_Faces, Edge_Curves, Vertex_Points, Closed_Shell, MSBR, and PMI [if exchanged, optional]) should be the same as previously imported
    a. 1 Product
    b. 7 or 8 Faces
    c. 14 or 18 Edges
    d. 10 or 12 Vertices
    e. 1 Closed Shell
    f. 1 MSBR
    g. 2 PMI (Diameter and Location Tolerance)

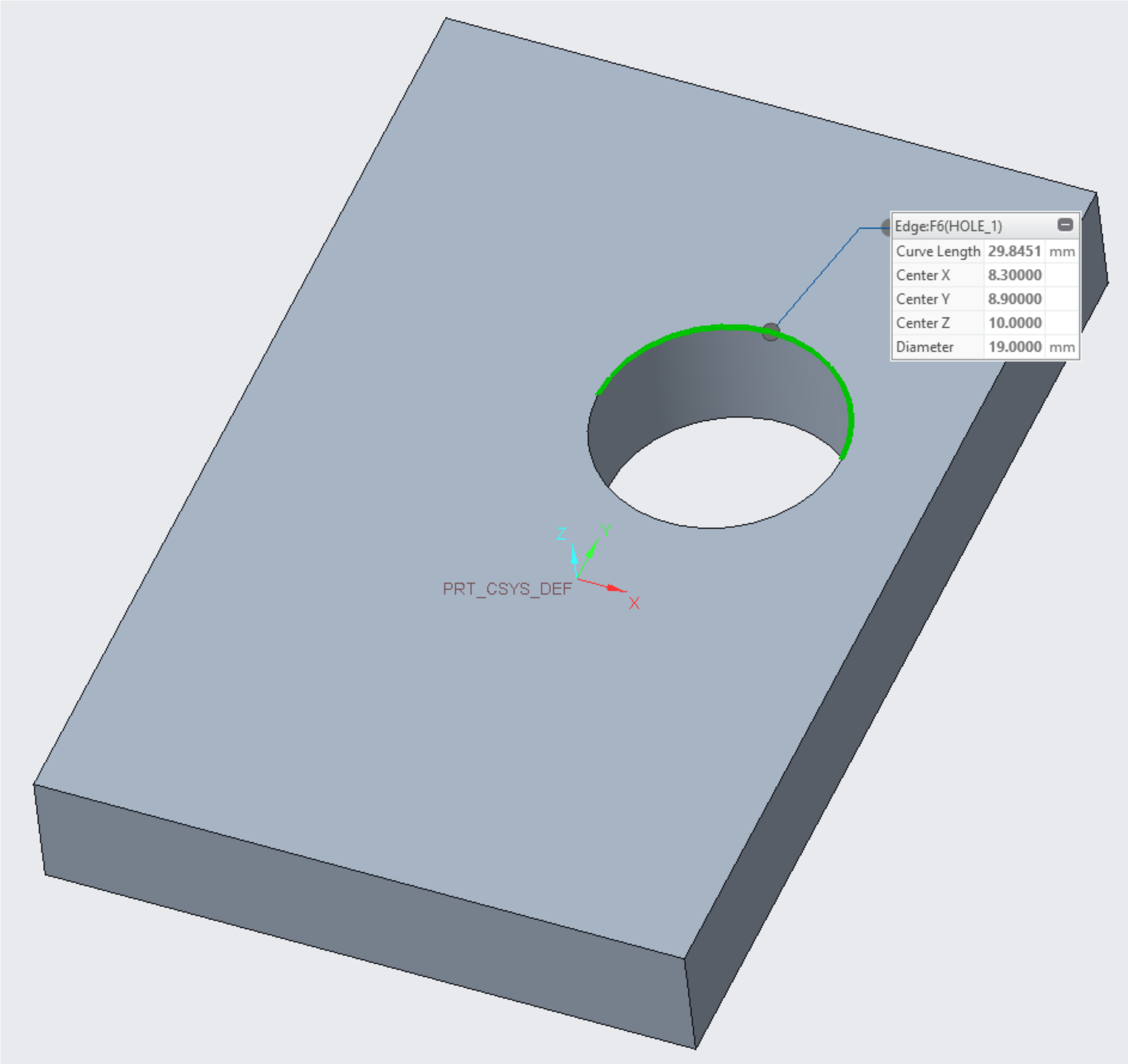


Figure 9: Illustration of PID_2 Test Case

PID_2 –

Preprocessor (CAD System) In case 2, A modifies the location of the hole as in case 1 but the hole is removed from its old location and replaced in the new location (i.e. recreated, not moved), versions model, and resends revised model to B

Postprocessor (CAD System) A checks for

1. Version – UUIDs on Product Version to be tested in a future test round.
2. Product UUID is the same
3. Original UUIDs for the block are the same
4. However, since the hole has been replaced, the UUIDs for the hole (Faces and Topology) are changed
5. PMI UUIDs are the same [if exchanged, optional]

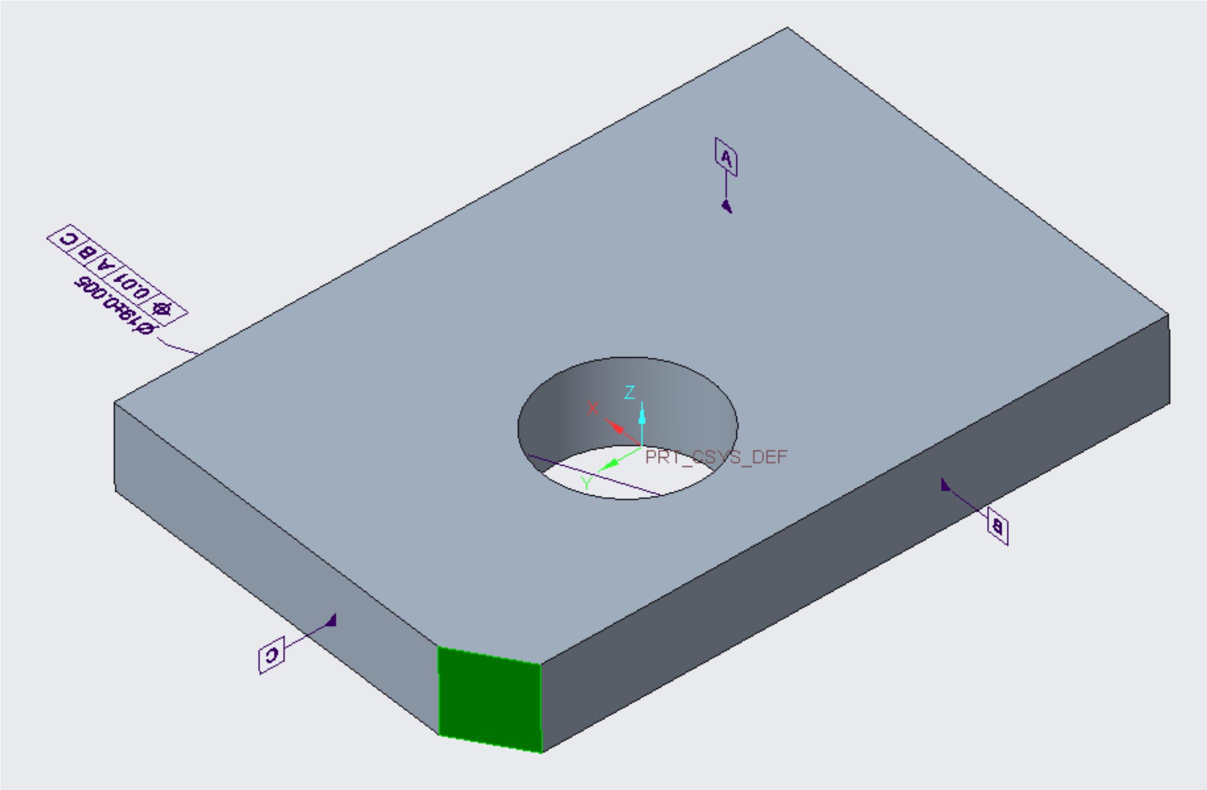


Figure 10: Illustration of PID_3 Test Case

PID_3 –

Preprocessor (CAD System) A adds a chamfer to the corner of the block, versions model, and sends model back to B

Postprocessor (CAD System or Downstream System) B checks for

1. Version – UUIDs on Product Version to be tested in a future test round.
2. Product UUID is the same
3. Original UUIDs for the block are the same (except for the changes noted in 5 below).
4. Original PMI UUIDs are the same [if exchanged, optional]
5. New UUIDs (generated by A on export) for the new chamfer face and its new topological edges and vertices

2.4.4 Statistics

For each STEP file exported or imported 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_0 for the initial exchange • PID_1 for the first design change (hole move) • PID_2 for the first alternate design change (hole replace) • PID_3 for the second design change (chamfer add)
system_n	The system code of the CAD system creating the STEP file
system_t	The system code of the CAD system or downstream system importing the STEP file. For native stats, select 'stp'
pid_product	pass/fail – whether the persistent ID at the product level was transferred correctly
pid_version	pass/fail – whether the model version at the product level was transferred correctly (in this round, n/a)
num_pid_pmi	The number of semantic PMI elements processed with persistent IDs
num_pid_sfcs	The number of surface elements (e.g., `advanced_face`) processed with persistent IDs
num_pid_topol	The number of topological elements (e.g., `edge_curve`, `vertex_point`) processed with persistent IDs
num_pid_shape	The number of `shape_aspects` processed with persistent IDs
design_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

2.5 Test Case STC: Graphic & Semantic PMI using NIST STC Models

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

2.5.1 Motivation

Product Manufacturing Information (PMI) is required for numerous 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.

In addition to use cases that require a fully defined, precise, semantic definition of the part geometry and associated PMI, there are also scenarios where the presentation of the data - geometric elements and annotations - for visual consumption are the primary goal. In such cases, a simplified and optimized version of the model is sufficient. The tessellated geometry model included in AP242 provides an efficient mechanism to support this.

A wide variety of test models is available from NIST as well as prostep ivip, each containing a different selection of PMI elements. Each model typically concentrated on particular subsets of PMI data.

The suite of NIST test models so far contained the Complex Test Cases (CTC) and the Fully-toleranced Test Cases (FTC). The latter contained some advanced PMI constructs which were difficult to fully represent not only in STEP, but also in the native CAD systems. Hence the suggestion was made to create a set of Simplified Test Cases (STC), based on the FTC models 6 through 10, which focus on more common-practice PMI elements.

2.5.2 User Stories

This test case supports the following User Stories provided by the CAx-IF UG on Redmine:

ID	Title
#49	Saved views Validation Properties
#124	Default saved view
#184	Annotation placeholder

2.5.3 Approach

The approach to be used is described in the latest version (at least v4.0.12, dated 10 March 2023) of the "Recommended Practices for Representation and Presentation of PMI (AP242)", which can be found on Nextcloud, folder:

〉MBX-IF 〉 CAX-IF 〉 Draft Recommended Practices

Within the PMI area, the following functionalities are in scope of Round 53J:

- Semantic PMI Representation
- Tessellated PMI Presentation
- Correct implementation and definition of the Saved Views (view layout and contents)
- Linking of PMI Representation to Presentation
- Transfer of editable PMI text as User Defined Attributes
- PMI Validation Properties (Representation & Presentation)
- Presentation Placeholder (including Placeholder Leader Lines if supported)

The AP242 schema to be used is the AP242 Edition 3 schema, which is available on the CAx-IF homepages under "Public Testing Information". This schema provides full support of the latest changes and additions in the Recommended Practices, in particular, the Presentation Placeholder. The AP242 Ed.2 schema can be used if Ed.3 is not yet supported, respecting the scope limitations.

Pre-checking of files with SFA: All vendors generating STEP files for the PMI test case shall run them through the latest version of NIST's STEP File Analyzer and Viewer (SFA; currently version 5.04). The tool provides feedback on basic syntax errors such as missing or malformed entity instances. Files with such errors will not be accepted for testing.

SFA can be downloaded for free at

https://www.nist.gov/services-resources/software/step-file-analyzer-and-viewer

2.5.4 Testing Instructions

2.5.4.1 NIST Test Model Overview

The Simplified Test Models are available in CATIA V5, Inventor, and NX native formats. The native models have been updated compared to Round 52J. They have been harmonized and validated, with support from ITI Global. A ZIP file containing updated native files is available here:

https://www.nist.gov/document/nist-stc-pmi-cad-models-version-3

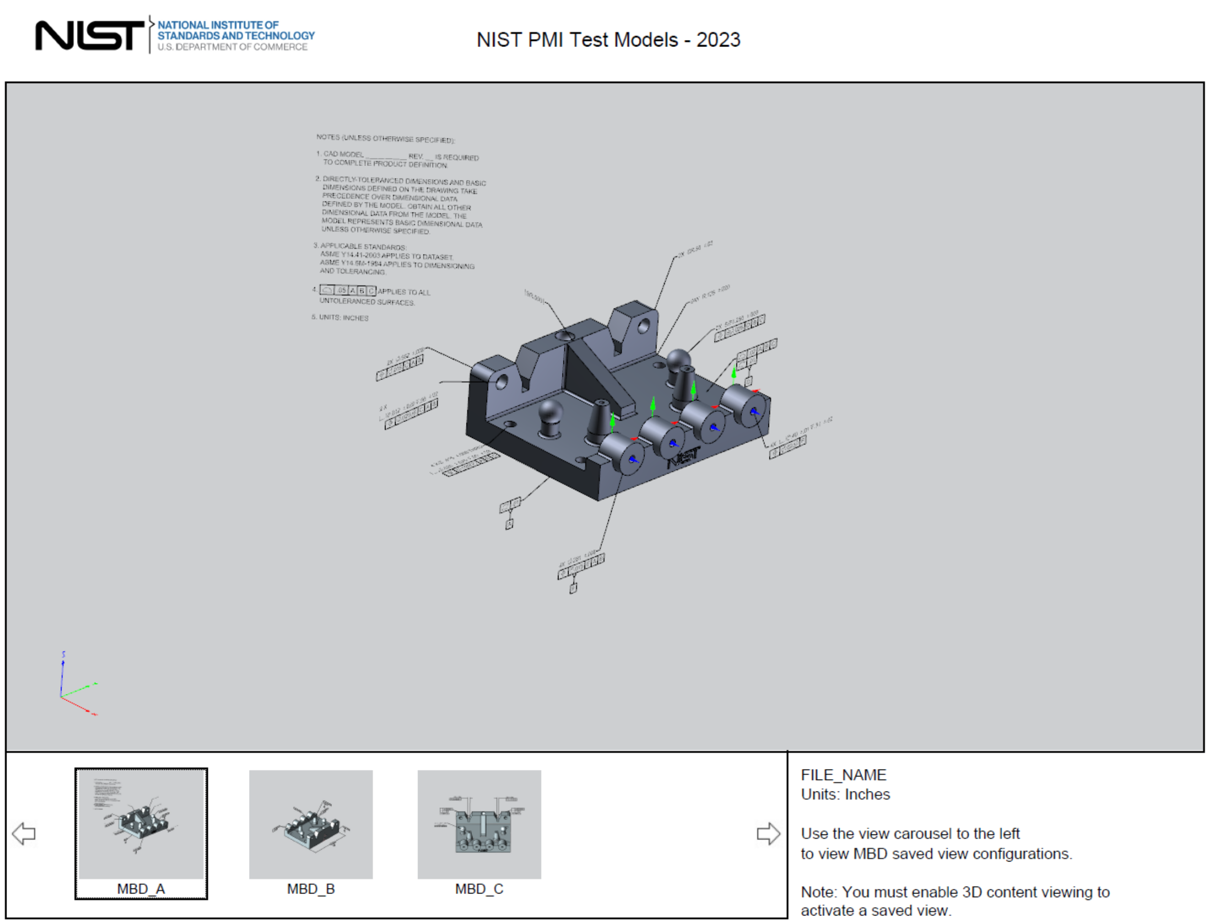


Figure 11: 3D PDF Test Case Specification for STC-6

2.5.4.2 NIST Test Model Selection

The following Simplified Test Cases are available for testing in Round 53J:

- **STC-6:** Datum targets (lines and curves), radius, more holes
- **STC-7:** PMI validation properties, dimensions, position tolerances and surface profile tolerances
- **STC-8:** Complex and stacked feature control frames, mix of tolerances and modifiers
- **STC-9:** Perpendicularity on hole diameter (every vendor had a different solution)
- **STC-10:** Datum features and Datum targets; mix of tolerances and modifiers

For each test model, a 3D PDF document is provided showing the individual Saved View configurations.

2.5.5 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:

- <u>PMI Representation</u> – the re-usable representation of PMI data should be included in all PMI models to the extent supported by the native system.
- <u>PMI Tessellated Presentation</u> – 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 PMI test case as well.
- <u>PMI Presentation Placeholder</u> – This information enables a target system with PMI authoring capability to recreate the presentation of a PMI element based on its Semantic Representation data. It intends to provide a minimal set of presentation information to CAD systems, which require information such as the leader line attachment point on the part geometry to create the corresponding Semantic PMI Representation elements.
  - Implementation of this capability requires the AP242 Ed.3 MIM Longform EXPRESS Schema, which is available on the public CAx-IF homepage, as well as the section 7.2 from version 4.0.12 of the PMI Recommended Practices, which is available on Nextcloud, folder *MBX-IF > CAX-IF > Draft Recommended Practices*.
- <u>Definition of “Saved Views”</u> – as far as supported, include the saved views defined in the models, which contain a subset of annotations in the file, and provide a pre-defined position of the model in the design space.
  - All models have multiple Saved Views defined. 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.
  - **<u>Note</u>** 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.
  - Saved Views shall correctly show (or hide) the part geometry, as well as the non-solid Supplemental Geometry contained in some of the models (see section 9.4.2 / Figure 95 in the PMI Rec. Practices v4.0.12). A document pointing out important supplemental geometry elements for the NIST test cases is available in the old CAx-IF member area, under “Information on Round 42J of testing”.

- 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. 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 v4.0.12.
- 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. (v4.0.12).
- Cross-highlighting of annotations and annotated shape – if supported, include in the STEP file the information necessary to maintain the association between graphic 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.
- Validation Properties – All participants providing STEP files for this test case are encouraged to include validation properties for PMI semantic representation and graphic presentation, as defined in the PMI Recommended Practices v4.0.12, sections 10.1 and 10.2 respectively.
- Presentation Placeholder – As extension of the scope in Round 50J, STEP files created for the PMI test case shall also include Presentation Placeholders per section 7.2 in the PMI Recommended Practices (v4.0.12), as far as supported by the translator.

  Vendors are encouraged to also include definitions of the placeholder leader lines (section 7.2.4), though these are not mandatory for an initial implementation of the placeholder. Note that AP242 Edition 3 is required to implement placeholder leader lines.

Also refer to Annex A for test model translation configuration considerations.

2.5.6 File Naming Convention and SFA Checking

In order for SFA to correctly identify the STC test cases, the STEP files must strictly follow the following naming convention:

- `nist-stc-nn-systemcode-242.stp`

For instance, nist-stc-06-c5-242.stp would be the STEP file exported by Dassault Systemes out of CATIA V5 for the CTC-6 model.

The expected PMI in SFA, which are the basis for the SFA scores, have been adjusted for the STC models, but further adjustments might be necessary. Please get in touch with Bob Lipman if you encounter any discrepancies.

2.5.7 Statistics

For each STEP file exported or imported for the STC test case, vendors must submit the corresponding statistics. To do so, go to the STC 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 after processing the file as described below.

Screenshots

For each Saved View in the model, provide one screenshot, which illustrates the layout (displayed geometry and annotations, model orientation, and zoom factor). Give the name of the view as the description of the screenshot. 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 all statistics – native and target – shall be based on the Semantic PMI Representation data only, and not take any presentation into account.

Note that for evaluation, the spreadsheets generated by the STEP File Analyzer and Viewer will be amended with corresponding aggregations of relevant counts and charts.

Data Sheet Columns

column name	description
model	The name of the test model, here 'stc', with one of the following suffixes: 06, 07, 08, 09, 10.
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'
scope	A short designation for the contents of the model as defined in the Test Suite. This is for information only; there will be no results for this field.
dimensions	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. v4.0.10).
labels	The number of labels processed
pmi_semantic_txt	all/partial/none – whether 'semantic' (editable) PMI text was transferred correctly (content and associativity)
pmi_semantic_val-prop	all/partial/none – whether the validation properties for Semantic PMI Representation matched for all, some or none of the semantic PMI elements.
saved_view	The name of the Saved View which is the basis for the view-related statistics
view_annot	The number of annotations (polyline or tessellated) included in the specified saved view. This does NOT include annotation placeholders.
view_placeholders	The number of annotation placeholders included in the specified saved view.

column name	description
view_pos	pass/fail, whether the model orientation and zoom factor stored for the Saved View could be restored successfully.
elem_visibility	all/partial/none – whether all, some, or none of the elements to be displayed in the indicated saved view were mapped correctly into the corresponding draughting_model.
pmi_savedview_valprop	all/partial/none - whether the validation properties for PMI Saved Views matched for all, some or none of the views defined in the model.
pmi_graphic_pres	all/partial/none – whether the graphic PMI annotations included in the file could be processed correctly
pmi_present_valprop	all/partial/none – whether the validation properties for Graphic PMI Presentation matched for all, some or none of the presentation elements.
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

2.6 Test Case UD4: User Defined Parameters

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

2.6.1 Motivation

CAD models often contain user-defined parameters which define additional properties on the part. These can be parameters which drive the geometry (parametric definition), or engineering notes, requirements and custom properties that are relevant for downstream processes such as manufacturing.

These properties are typically authored in the source CAD systems and need to be transferred in a way that target applications can identify and process them in such a way that they make the appropriate decisions and derive relevant information for downstream use.

The CAx-IF User Group has defined several user stories related to user-defined properties and user-defined parameters at the part level as well as at the geometry level. The UD4 test case in Round 53J serves as an acceptance test for these user stories.

While the exact naming, structuring and association of these parameters to model elements – at part level as well as geometry level – differs between the different CAD systems based on their respective internal data models, they can be mapped to common concepts in STEP.

2.6.2 User Stories

This test case supports the following User Stories provided by the CAx-IF UG on Redmine:

ID	Title
#34	User Defined Parameters at the part level
#35	User Defined Properties at the part level
#36	User Defined Parameters of a solid
#37	User Defined Parameters of a geometric set
#38	User Defined Parameters of surface, curves, point

2.6.3 Approach

The approach for transferring user-defined properties and parameters is described in the "Recommended Practices for User Defines Attributes", version 1.8 (18 February 2021), which is available on the public web site of the CAx-IF Implementor Group. Specifically, section 5.3 of this document, which was newly introduced with version 1.7, provides the necessary classification mechanism to properly identify user-defined parameters and properties.

The precise mapping recommendation for testing user defined properties and parameters in Round 53J is as follows (all based on section 5.3 of the Recommended Practices):

- `id_attribute.attribute_value` = 'general property'
- `property_definition.description` =
  - 'customized PDM property' (for properties managed by the PLM system)
  - 'user defined attribute' (for user defined properties)

The schema to be used is the AP242 Edition 2 IS schema, available in the public area of the CAx-IF Implementor Group web page.

2.6.4 Testing Instructions

Test Models

The CAx-IF User Group has provided a set of native CATIA V5 test models with pre-defined parameters and properties:

- The test model "ParameterTestPart_simplified.CATPart" contains the basic parameters described in the Illustration.
- In addition, the test model "Parameter Test Part.CATPart" contains the complete set of Parameters/Properties that can be used.

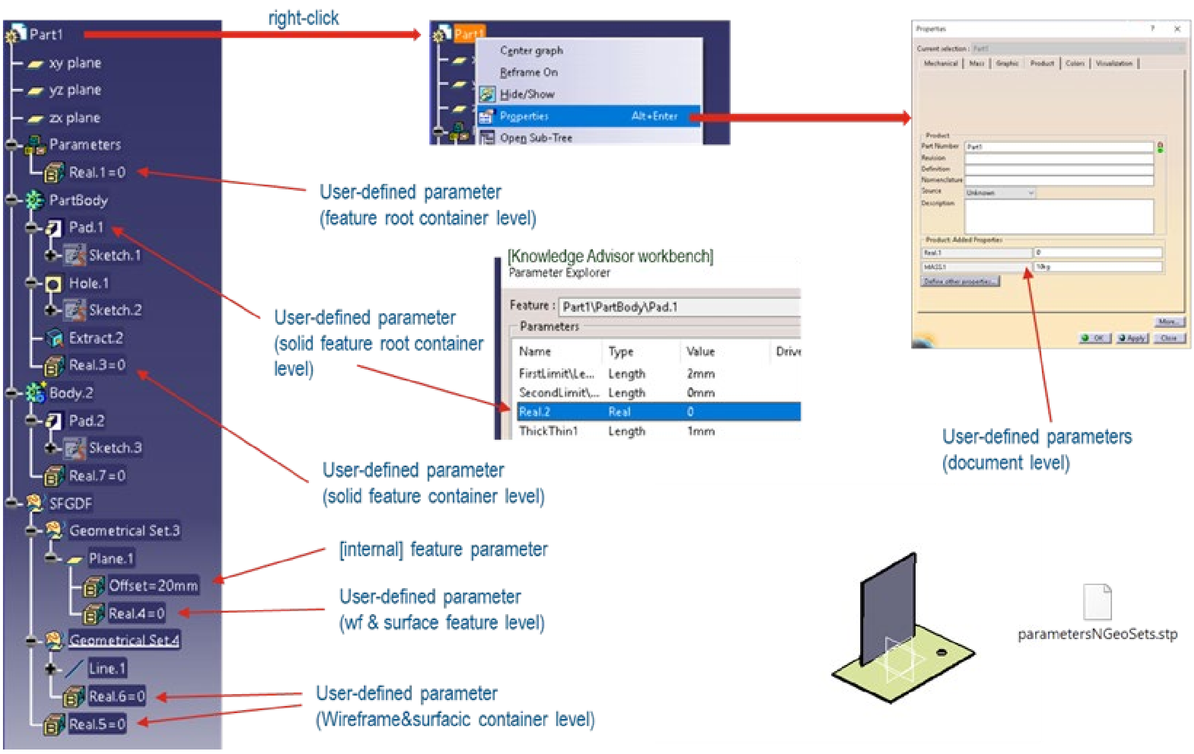


Figure 12: Overview on Parameters and Properties defined in the CATIA model

In addition, Siemens has provided an NX native model, which contains the following attributes:

Attribute	Type	On Entity
DB_PART_DESC	PDM Property	On Part
DB_PART_REV	PDM Property	On Part
DB_PART_NAME	PDM Property	On Part
DB_PART_NO	PDM Property	On Part
DB_PART_TYPE	PDM Property	On Part
DB_PART_MFKID	PDM Property	On Part
PART_Attribute	CAD Property	On Part
DB_SEED_PART_USED	CAD Property	On Part
NX_ComponentGroup	CAD Property	On Part
NX_ReferenceSet	CAD Property	On Part
NX_MaterialMissingAssignments	CAD Property	On Part
NX_MaterialMultipleAssigned	CAD Property	On Part
BODY_1_Title	CAD Property	On Body 1
BODY_2_Title	CAD Property	On Body 2

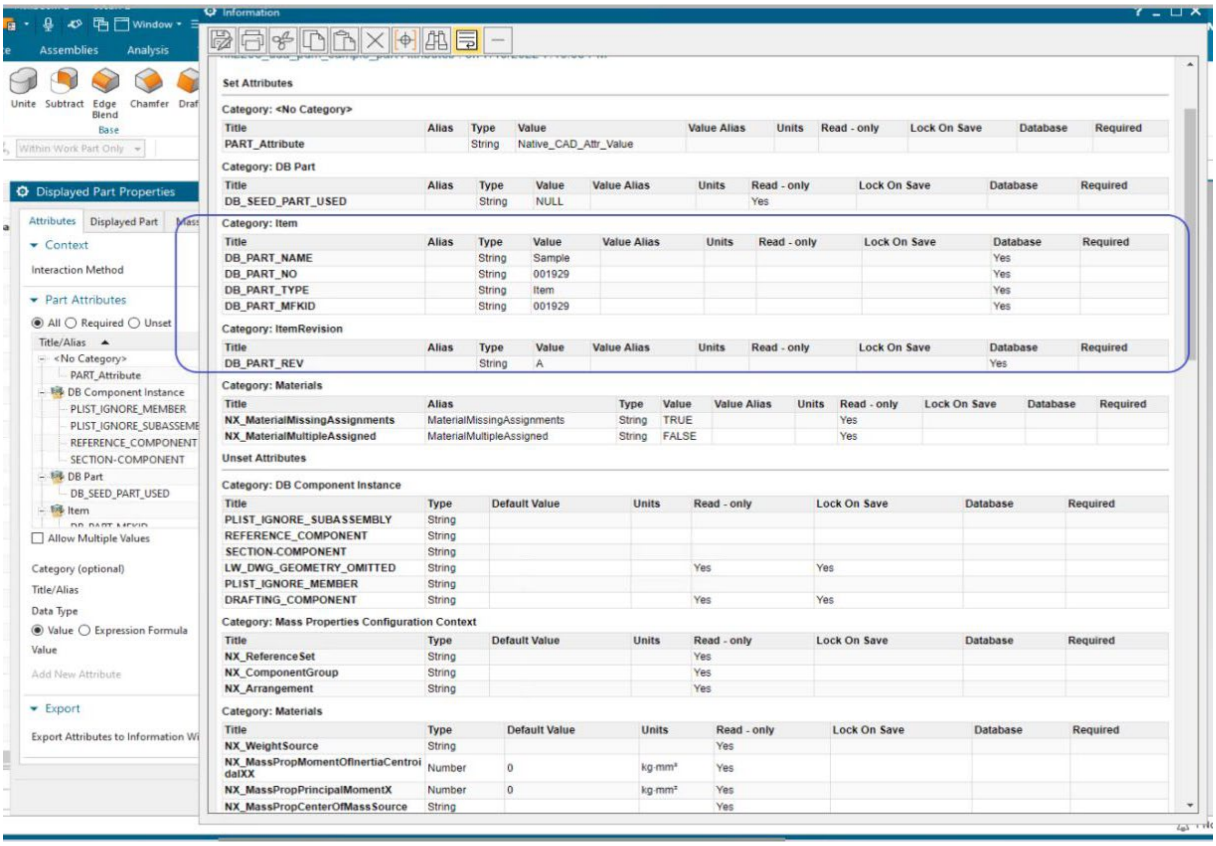


Figure 13: Overview on the Properties defined in the NX model for UD4.

All native models can be downloaded from Nextcloud, folder

🏠 〉 **MBX-IF** 〉 **CAX-IF** 〉 **CAX-IG** 〉 **Round 52J** 〉 **UD4**

Testing Instructions

- CATIA / 3DExperience as well as NX STEP interfaces shall map the user defined properties and parameters as defined above, maintain their semantics on export and import.
- STEP translators for other CAD systems shall import the generated files are report their experiences on how they map the data.

The main objective for Round 53J, in addition to any roundtrip testing, is exchanging the information between CATIA-based and NX-based STEP interfaces to see whether the desired distinction between user-defined and system-managed properties is maintained across system boundaries.

2.6.5 Statistics

For each STEP file exported or imported for the UD4 test case, vendors must submit the corresponding statistics. To do so, go to the [UD4 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 'ud4'
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'
ud_param_part	pass / fail, have the user defined parameters at part / product level been transferred correctly?
ud_prop_part	pass / fail, have the user defined properties at part / product level been transferred correctly?
ud_param_solid	pass / fail, have the user defined parameters for solids been transferred correctly?
ud_param_geoset	pass / fail, have the user defined parameters for CATIA geometric sets been transferred correctly?
ud_param_scp	pass / fail, have the user defined parameters for surfaces, curves and points been transferred correctly?
valid_attr	pass/fail, is the instantiation of the User Defined Attributes as per the Recommended Practices?

column name	description
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?
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 data set submission iterations to resolve), the following translator configuration considerations have been compiled for the STC test case in Round 53J:

- 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.
  - If the native CAD system supports entity association for annotation placement separate from entity association for annotation applicability, do not export the annotation placement associations to STEP.
- 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.
  - STC 06 through 09 models are defined in inches.
  - STC 10 and 11 models are defined in millimeters.
- Preserve display names of annotations and coordinate systems.
  - If the user has configured the native CAD system display of particular annotation names, for example adding the identifier to the end of datum names, preserve this in the STEP model.
- Preserve display colors of product geometry, supplemental geometry, and annotations.
- Preserve view-specific visibility of annotations, coordinate systems, and supplemental geometry:
  - A PDF named "*nist_[ctc/ftc]_suppl_elem_visibility.pdf*" giving a detailed definition of which elements shall be visible in which view, and which not, can be requested from the CAx-IF facilitators.
  - Note that for each test case, there is a second PDF document included in the ZIP files, named "*…_elem_ids.pdf*" which contains the element ids for unambiguous identification of all PMI.
- 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.
- Preserve the view plane and orientation of each annotation.
  - If this varies for the same annotation used in multiple saved views, export the correct plane and orientation for each view.
- Convert parametric annotation parameter values to explicit values.
  - For example, a diameter defined as 2 x 2.75 mm should be represented in the STEP model as a numerical 5.5 value with a mm unit rather than a "2 x 2.75 mm" string value.