



**Test Suite for the  
CAX Implementor Forum  
Round 13J**

October 2003 – March 2004

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## Contents:

1.0	Introduction .....	5
1.1	Functionality tested in this round.....	5
1.2	General test instructions for this round .....	6
1.3	Preliminary testing schedule .....	6
1.4	Copyrights on test cases .....	6
2.0	Synthetic test case specifications .....	7
2.1	Model B3 : Benchmark model 'torque converter housing' .....	7
2.1.1	Motivation .....	7
2.1.2	Approach.....	7
2.1.3	Testing Instructions .....	7
2.1.3.1	Construction of the benchmark model .....	8
2.1.3.2	Statistics .....	8
2.2	Model IS1: Assembly Instance Styling .....	9
2.2.1	Motivation .....	9
2.2.2	Approach.....	9
2.2.3	Testing Instructions .....	9
2.2.3.1	Model Construction .....	9
2.2.3.2	Statistics .....	10
2.3	Model GD1: Geometric Dimensioning and Tolerancing .....	11
2.3.1	Testing Instructions .....	11
2.3.1.1	Statistics .....	12
2.4	Model DM1: Density and Material name .....	13
2.4.1	Motivation .....	13
2.4.2	Approach.....	13
2.4.3	Testing Instructions .....	13
2.4.3.1	Statistics .....	14
2.5	Joint test case with PDM-IF .....	15
2.5.1	Motivation .....	15
2.5.2	AA.Tj0.12816.Tc.(hp.Tj0.Tc.(5pr.Tj0.12816 Tc (o) Tj0 Tc (iac) Tj0510 TD 0.12408 Tc (l) Tj0 Tc	

- 2.6.1 Motivation ..... 15
- 2.6.2 Approach and testing instructions ..... 15
  - 2.6.2.1 Statistics ..... 16
- 2.7 Tolerance Test Mouse ..... 16
  - 2.7.1 Motivation ..... 16
  - 2.7.2 Approach and testing instructions ..... 16
    - 2.7.2.1 Statistics ..... 17
- 3.0 Production models: PM11 ..... 18
  - 3.1 Motivation ..... 18
  - 3.2 Approach ..... 18
  - 3.3 Testing Instructions ..... 18

## 1.0 Introduction

This document describes the suite of test cases to be used for the thirteenth 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 on testing the interoperability and conformance of STEP processors based on AP 203 and AP 214.

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. When production models are not available from the member companies, "production-like" models will be solicited from the various CAX-IF participants.

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PDM-TDM/CAD integration uses external references, which are a mechanism for specifying external “documents” that are associated with objects defined within a STEP file. The external documents may be digital documents such as CAD native models, STEP files, WORD documents, or NC programs, OR non-digital documents such as technical drawings on paper, or hand-written documents. With respect to the CAx-IF, external references will be used to split a single STEP file into one file containing the part identification and assembly structure and several STEP files containing the component geometry. In Round 13J of testing, CAx vendors will be post-processing files from the PDM Implementor Forum (PDM-IF), for a joint CAx/PDM-IF testcase (see Section 2.3).

The Tolerance Test Mouse is a solid geometry test model, which includes problematic geometry identified in real production models during STEP data exchange.

In addition to synthetic models for the above capabilities, production models are included in this round of testing.

## 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 v1.2, dated November 2001.

## 1.3 Preliminary testing schedule

Date	Action
<b>December 10, 2003</b> (Wed)	<b>Test Suite available / 1<sup>st</sup> CAx Implementor Forum conference call</b>
<b>ASAP</b>	<b>TTMouse and Production Models released</b>
<b>January 7, 2004</b> (Wed)	<b>Initial STEP files and native stats due</b>
<b>January 30</b> (Fri)	<b>STEP files and native stats frozen</b>
<b>February 16</b> (Mon)	<b>Target stats due, 2<sup>nd</sup> conference call</b>
<b>March 1</b> (Mon)	<b>Target stats frozen</b>
<b>March 8</b> (Mon)	<b>Pre-release of final stats / 3<sup>rd</sup> conference call</b>
<b>March 16</b> (Tue)	<b>Review meeting for test round</b>
<b>March 17 – 18</b> (Wed – Thu)	<b>CAx Implementor Forum meeting, Myrtle Beach, SC</b>

## 1.4 Copyrights on test cases

Not all of the production test cases which were provided by the PDES, Inc. and ProSTEP-iViP member companies are fully released for any purpose. The least common denominator is

that the test cases can be freely distributed among the ProSTEP-iViP / PDES, Inc. Round Table participants 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.

## **2.0 Synthetic test case specifications**

### **2.1 Model B3 : Benchmark model 'torque converter housing'**

#### **2.1.1 Motivation**

As a result of the presentation of the results from the ProSTEP Processor Benchmarks, it has been agreed to re-test the latest test model used there in the CAx-IF with the latest processor versions. This is the first round of testing the model from the 8<sup>th</sup> Benchmark.

**Note:** Those vendors who like to re-test the 'classic' validation properties functionality as tested in the previous rounds may do this informally (i.e. no stats reported) with this model.

#### **2.1.2 Approach**

No new capability involved.

#### **2.1.3 Testing Instructions**

All vendors testing this model are encouraged to export the file in **AP214-IS** format. AP214-DIS should only be used if the IS version is not yet supported.

### 2.1.3.1 Construction of the benchmark model

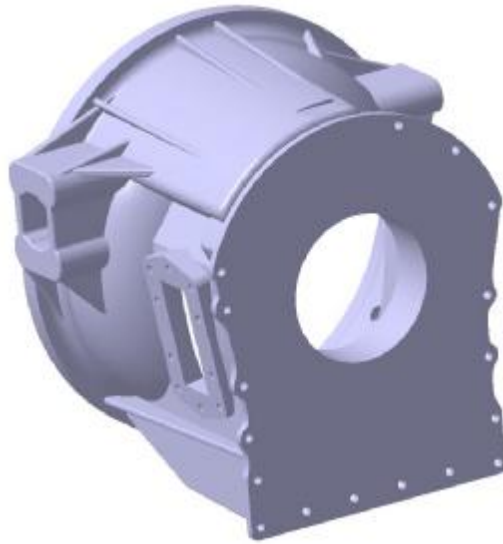


Figure 1: Shape of the B3 model (torque converter housing)

Those vendors who participated in the ProSTEP benchmark should re-use the torque converter housing model which has been constructed for that purpose. The modeling instructions may be found in the secure area of the CAx-IF web sites, <http://www.cax-if.org/secure/> and <http://www.cax-if.de/secure/>, under 'Information on Round12J of Testing'.

### 2.1.3.2 Statistics

With each STEP file submitted for the b3 model, vendors must include a text file with the stats in comma-delimited form (.CSV):

<b>model</b>	<i>b3</i>
<b>system_n</b>	<i>Native system code</i>
<b>system_t</b>	<i>Target system code (for native stats use 'stp' for system_t)</i>
<b>unit</b>	<i>Units</i>
<b>volume</b>	<i>Tartal vlume</i>

## 2.2 Model IS1: Assembly Instance Styling

### 2.2.1 Motivation

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

### 2.2.2 Approach

See the approach described in the 'Recommended Practices for Assembly Instance Styling', which is available from the CAX-IF web sites under 'Joint Testing Information' ([http://www.cax-if.org/joint\\_testing\\_info.html](http://www.cax-if.org/joint_testing_info.html) and [http://www.cax-if.de/joint\\_testing\\_info.html](http://www.cax-if.de/joint_testing_info.html)).

This document contains a STEP file example for the given test case.

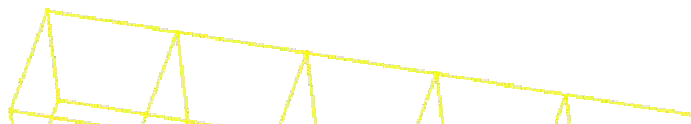
Because of the complex structure in bigger assemblies, the first test of this functionality only uses the 'NAUO approach' described in the document mentioned above.

**Note:** Files provided in R12J should be according to the updated Release 1.1 of the Recommended Practices document.

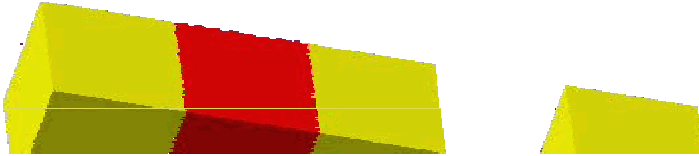
### 2.2.3 Testing Instructions

#### 2.2.3.1 Model Construction

For assembly instance styling we are using a very simple assembly which puts five instances of a solid yellow cube next to each other, as shown below in the wire frame view:







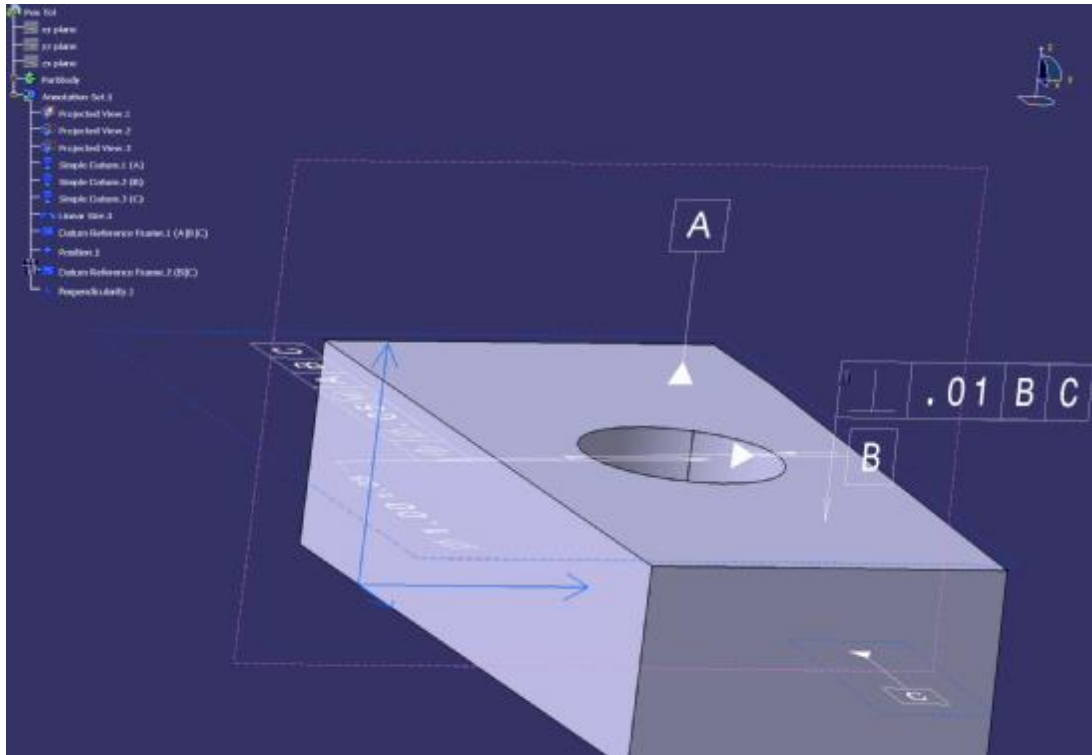
<b>issues</b>	<i>Short description of issues</i>
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## **2.3 Model GD1: Geometric Dimensioning and Tolerancing**

### **2.3.1 Testing Instructions**

1. Use UDCs for units. Tj106.23 0 TD ( ) Tj7-23284 018.984TD 0.12816 Tc (2)

This should create a part with a solid model, one dimensional tolerance, one position tolerance, one perpendicularity tolerance and three datums as shown below.



### 2.3.1.1 Statistics

With each STEP file processed for the GD&T model, vendors must include a text file with the stats in comma-delimited form (.CSV):

<b>model</b>	<i>gd1</i>
<b>unit</b>	<i>Units</i>
<b>volume</b>	<i>Total volume of all solids</i>
<b>area</b>	<i>Total surface area of all solids</i>
<b>cx, cy, cz</b>	<i>Centroid of all solids</i>
<b>dim_found</b>	<i>The number of dimensions processed.</i>
<b>datum_found</b>	<i>The number of datums processed.</i>
<b>tol_processed</b>	<i>The number of tolerances processed.</i>
<b>date</b>	<i>Date submitted</i>
<b>issues</b>	<i>Short description of issues</i>

## 2.4 Model DM1: Density and Material name

### 2.4.1 Motivation

Up to now, it has not been possible to transfer different materials via STEP. On export, a consistent density for all parts is assumed.

The scope of this test is to provide a first approach to transfer density values (as real values) and material names (as strings). Using the density information, the center of geometry of a model can be distinguished from the center of gravity. The material name can be used to receive further information about that material from a database.

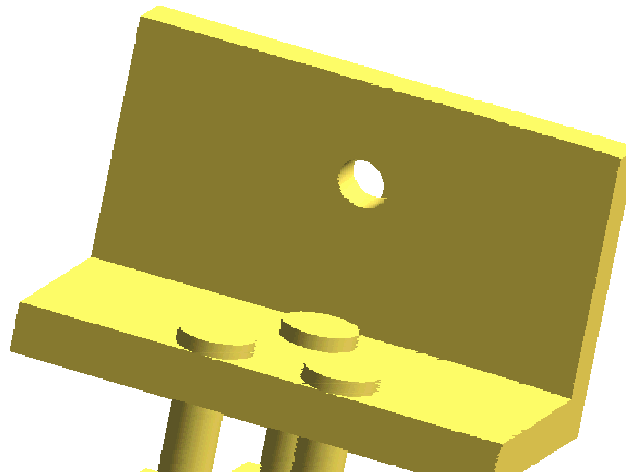
On a long-term perspective, the goal is to implement the “full” material properties as they are defined in AP214 and AP209.

### 2.4.2 Approach

The exchange of density and material name information is tested using the ‘general property’ approach (“valprops-like”), described in the “Recommended Practices for Density and Material Name”, which will be available from the CAx-IF web sites.

### 2.4.3 Testing Instructions

The test model is based on a sub-assembly of the well-known AS1 model, i.e. one of the “L-bracket assemblies”:



<b>Part</b>	<b>Density</b>	<b>Material name</b>
L-bracket	.160 lb/cu in	AMS 4928; Titanium 6-4
Bolt	.285 lb/cu in	AMS 5613; Greek Ascoloy
Nut	.297 lb/cu in	AMS 5662; Inconel 718

Due to the different densities, the center of gravity will differ from the center of geometry. These coordinates, besides the transferred values for density and material, will be the focus of this test.

#### 2.4.3.1 Statistics

With each STEP file submitted for the b3 model, vendors must include a text file with the stats in comma-delimited form (.CSV):

<b>model</b>	<i>dm1</i>
<b>system_n</b>	<i>Native system code</i>
<b>system_t</b>	<i>Target system code (for native stats use 'stp' for system_t)</i>
<b>unit</b>	<i>Units</i>
<b>volume</b>	<i>Total volume of all solids</i>
<b>area</b>	<i>Total surface area</i>
<b>geoX, geoY, geoZ</b>	<i>Geometric centroid of all solids</i>
<b>gravX, gravY, gravZ</b>	<i>Center of gravity for all solids</i>
<b>densityLB, densityNut, densityBolt</b>	<i>Density values for the three parts</i>
<b>materialLB, materialNut, materialBolt</b>	<i>Material names for the three parts</i>
<b>date</b>	<i>Date submitted</i>
<b>issues</b>	<i>Short description of issues</i>

## 2.5 Joint test case with PDM-IF

### 2.5.1 Motivation

This test case aims for CAD/PDM-TDM interaction. A major usage of external references is the splitting of product data describing assemblies into multiple files representing individual parts. The focus of the actual implementation is to deal with external representations. In the scope of this round of testing, the external representation shall be defined via STEP files.

The test case models a situation where the assembly structures are contained in one file, and the individual parts in a single file each. The file containing the assembly references the model contained in the part file.

In Round13J, the PDM Implementor Forum will submit files which include managed documents. The CAX-IF vendors are asked **to import** these files, **then export** them again (**'roundtrip'**) and send them back to the PDM-IF in order to see which information was maintained and which was lost. The geometry (leaf node) files may not be included.

### 2.5.2 Approach

See the approach described in the second version of the Recommended Practices for External References, which are available from the CAX-IF web sites under 'Joint testing information' (dated November 25, 2002).

This document also contains references to relevant sections of the PDM Schema Usage Guide, available on the PDM-IF web-site ([http://www.pdm-if.org/pdm\\_schema/](http://www.pdm-if.org/pdm_schema/)).

### 2.5.3 Testing Instructions

Please note that system vendors that do not support the external reference mechanism should not import STEP files from this test case.

## 2.6 Joint Test case with AP209 (EA) Group

### 2.6.1 Motivation

Since the number of APs used in every day data exchange is constantly increasing, the subject of AP interoperability is of growing interest. The focus of this test is on extracting the geometry (design shape) from a 209 file and converting it to an AP203 or AP214 detail/part or assembly.

### 2.6.2 Approach and testing instructions

AP209 file(s) should be imported, and the geometry information should then be extracted. Of special interest is the interpretation of the product structure (design shape vs. analysis shape) as discussed during the Round9J review meeting. Only the design shape should be extracted.

### 2.6.2.1 Statistics

With each STEP file processed for the AP209 model, vendors must include a text file with the stats in comma-delimited form (.CSV):

<b>model</b>	<i>ap209</i>
<b>system_n</b>	<i>Native system code</i>
<b>system_t</b>	<i>Target system code (for native stats use 'stp' for system_t)</i>
<b>unit</b>	<i>Units</i>
<b>volume</b>	<i>Total volume of all solids</i>
<b>area</b>	<i>Total surface area</i>
<b>cx, cy, cz</b>	<i>Centroid of all solids</i>
<b>date</b>	<i>Date submitted</i>
<b>issues</b>	<i>Short description of issues</i>

In order to help the discussion of the results with the EMT group, it may be helpful to prepare a more detailed (textual) description of the issues found, which may be sent to out via email before the meeting.

## 2.7 Tolerance Test Mouse

### 2.7.1 Motivation

The so-called Tolerance Test Mouse is designed to address certain issues which have been noticed in STEP data exchange by users. Although the model itself is an artificial model, the problems it includes are derived from real production models. Some of these problems might be caused by bad, but nevertheless legal, modeling practices. The intention of the test is to focus on these specific issues and, if possible, find ways to resolve them.

First tests at Volkswagen showed very different results for different STEP processors. In order to verify them on a neutral basis and get a broader range of results, this model is being tested again in the CAx-IF.

This model is also intended as a kind of preparation for the next PROSTEP-iViP Benchmark, which will probably include some similar geometric configurations build in the respective variants of the test model.

### 2.7.2 Approach and testing instructions

In Round12J, the complete model as STEP files exported from CATIA V4 and Pro/E was tested. This round, in order to focus on the individual points of interest, several sub-parts of the model are tested, which originate from CATIA V5. The sub-parts are:

- The scale body
- The pipes
- The spheres
- The voids and
- The retainer

STEP files for these parts will be provided by the participating V5 processors. All CAx members are asked to import these STEP files and provide input on the results (see below).

### 2.7.2.1 Statistics

With each STEP file submitted for the TTMouse model, vendors must include a text file with the stats in comma-delimited form (.CSV):

<b>model</b>	<i>ttm_pipes, ttm_retainer, ttm_scale, ttm_spheres_ ttm_voids</i>
<b>system_n</b>	<i>Native system code</i>
<b>system_t</b>	<i>Target system code (for native stats use 'stp' for system_t)</i>
<b>unit</b>	<i>Units</i>
<b>volume</b>	<i>Total volume of all solids</i>
<b>area</b>	<i>Total surface area</i>

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*Figure 4 : Screenshots of the ttm\_pipes model, native (left) and with issues after import(right)*

In addition, a textual description of the issues found (including face / curve ids) would be very useful.

## **3.0 Production models: PM11**

### **3.1 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 member companies and vendors have supplied these models.

### **3.2 Approach**

STEP files provided by member companies and vendors have been analysed for quality of (solid and/or surface) geometry as well as syntax and structure. The moTj2.04408 Tc ( ) Tj218 Tc ( ) T