

# ProSTEP iViP/VDA

## 2. JT Translator Benchmark

## 2. JT TRANSLATOR BENCHMARK

SHORT REPORT



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## 1 Introduction

Publication of the JT specification 8.1c as an ISO Publicly Available Specification (PAS 14306) has laid the foundation for establishing JT as a mandatory process format. The ProSTEP iViP Association and the German Association of the Automotive Industry (VDA) have launched three JT-related projects in succession which are being coordinated with each other: the ProSTEP iViP/VDA JT Workflow Forum, the ProSTEP iViP/VDA JT Translator Benchmark and the ProSTEP iViP/VDA JT Implementor Forum. Furthermore, the ProSTEP iViP Association and Siemens PLM are working hand in hand toward standardizing JT with the ISO. In August, the ProSTEP iViP Association submitted the latest JT specification (version 9.5) to the ISO for standardization. On 26.11.10, the ISO announced that the specification had been accepted for standardization. This means that the first and most important hurdle on the way to establishing JT as an ISO standard has been taken. The objective is to bring the specification of JT as an ISO standard to a successful close by the end of 2011.

The second JT translator benchmark was carried out in 2010 to achieve an independent evaluation of the progress being made with regard to the development of JT translators. The object of the testing was JT 8.1c (ISO PAS). The benchmark was managed by the JT Workflow Forum and JT Implementor Forum. Because the benchmark involved an independent activity, it was financed directly by the two organizations the ProSTEP iViP Association and the VDA and not by the participating companies whose products were being tested. The aim was to create a neutral comparison of currently available JT translators with regard to selected test criteria. This means that the results of the benchmark can not only be used to evaluate the application of JT in PLM environments but also improvement to the interoperability of the translators.

## 2 ProSTEP iViP / VDA JT Translator Benchmark 2010

The second benchmark explicitly tested the quality of JT export and import. The respective conversion steps were also evaluated separately. The benchmarking methodology applied, the CAD systems and translators involved, the test criteria and test models used, and a summary of the results are described below.

### 2.1 Procedure

The quality of JT export and import were tested. Different combinations of translators and CAD systems were used by way of example. The information to be transferred and the requirements were defined by users in the ProSTEP iViP/VDA JT Workflow Forum. The vendors participating in the benchmark verified the test cases proposed by the users. They were also responsible for making available the translator settings to be used for their respective tools.

### 2.2 CAD systems and translators

Translators from four vendors and three CAD systems were involved in the benchmark. Only versions available on the market at the time the benchmark was started were used. The versions of the CAD systems used were determined by the participants in the ProSTEP iViP/VDA JT Workflow Forum. The translators and CAD systems involved in the benchmark are listed in Table 1 and Table 2.

These translators result in the test case matrix shown in Figure 1. The sending systems are listed in the column on the left and the receiving systems in the top row. The translators used to export the JT files are listed to the right of the sending systems, and the translators used to import the JT files are listed under the receiving systems. The abbreviations listed in Table 1 and Table 2 were used to make the matrix and result tables easier to read.

### 2.3 Test criteria

The following criteria were used to evaluate the results. The test criteria were defined for the ProSTEP iViP/VDA JT Translator Benchmark 2010 by users on the basis of user requirements and technical constraints. The criteria used for testing do not claim to represent the entire application spectrum, but they have been selected in such a way that they are a good indication of the trend in the various areas of application.

Only test criteria that can be satisfied in accordance with ISO PAS 14306 (JT, version 8.1c) were considered:

- Completeness of the geometry data
  - XT-BREP has to be used in the JT file for transferring exact geometry. In the case of the geometry, it was specified that a deviation of no more than 1% of the

Vendor	Translator/Version	Supported CAD Systems	Abbreviation in Tables
CT CoreTechnologie	3D Evolution 2010.224	CATIA V5; NX 6; Pro/ENGINEER	CoreTech
Siemens PLM	JT Bi-directional Translator for CATIA V5 6.3	CATIA V5	Siemens
	NX 6.0.5 (onboard JT translator)	NX 6	
	JT translator for Pro/ENGINEER 8.1	Pro/Engineer	
Theorem Solutions	CADverter Version 11	CATIA V5	Theorem
	CADverter Version 11.0.002	Pro/ENGINEER	
T-Systems	COM/FOX V4.3.6	CATIA V5	T-Systems

Table 1: Translators used

Vendor	CAD System	Abbreviations in Tables
Dassault Systèmes	CATIA V5 R19 SP3	CATIA V5
PTC	Pro/ENGINEER Wildfire 4.0 M080	Pro/E
Siemens PLM	NX 6.0.5	NX

Table 2: CAD systems used

		CATIA V5				Pro/E		NX	
		CoreTech	Siemens	Theorem	T-Systems	CoreTech	Theorem	CoreTech	Siemens
JT Export	CATIA V5	CoreTech	✓	✓	✓	✓	✓	✓	✓
		Siemens	✓	✓	✓	✓	✓	✓	✓
		Theorem	✓	✓	✓	✓	✓	✓	✓
		T-Systems	✓	✓	✓	✓	✓	✓	✓
JT Import	Pro/E	CoreTech	✓	✓	✓	✓	✓	✓	✓
		Siemens	✓	✓	✓	✓	✓	✓	✓
		Theorem	✓	✓	✓	✓	✓	✓	✓
JT Import	NX	CoreTech	✓	✓	✓	✓	✓	✓	✓
		Siemens	✓	✓	✓	✓	✓	✓	✓

Figure 1: Test case matrix

original values should be allowed for volumes and surfaces and a deviation of no more than 0.1% of the diagonal of the bounding box of the model should be allowed for the position of the center of gravity.

- Product structure
  - The product structure of the test assembly should not be changed by the conversion.
- Positioning
  - The positioning of the components should not be changed by the conversion.
- PMI
  - The PMI annotations “dimension”, “text” and “symbol (placement, correctness)” should be displayed graphically in the target system just as they were in the source system.
- Material data (material feature of the CAD systems)
  - Selected material information (material name, density, Young’s modulus, yield strength) should be transferred from the CAD material feature to the target system
- Tessellation
  - Three tessellations (LOD) should be generated with predefined settings:

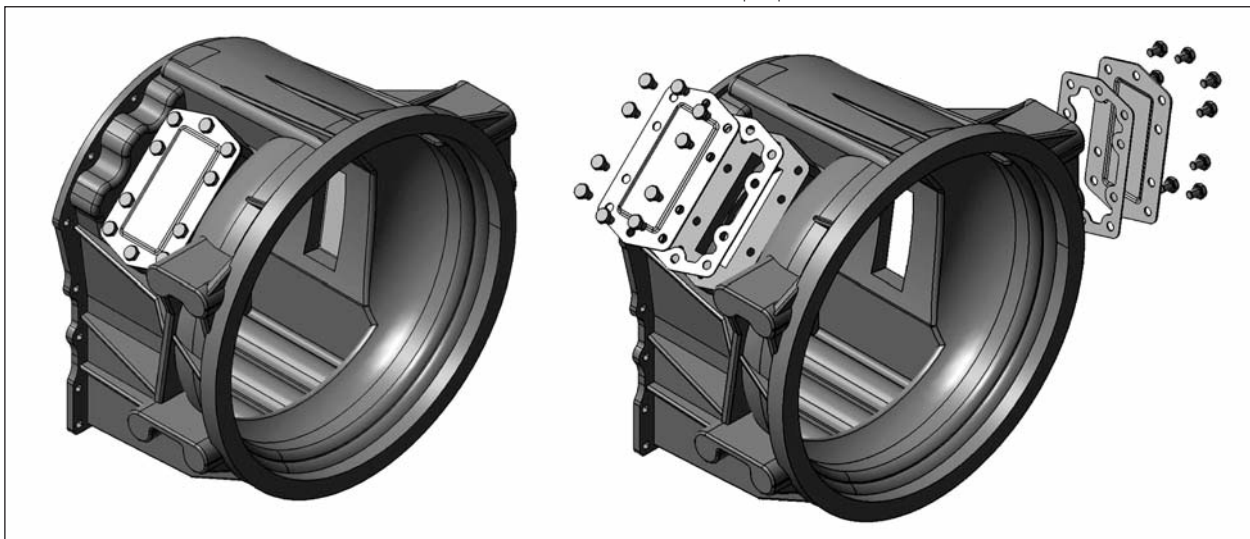
Parameter	LOD 1	LOD 2	LOD 3
Chordal (absolute)	0.2	0.8	1.8
Angular	45	45	45
Feature Suppression	0	0	0
Simplify	1	1	0.35

- User-defined attributes
  - The following user-defined attributes stored in the CAD models should be transferred:
    - JT\_PROP\_MEASUREMENT\_UNITS
    - CAD\_MASS\_UNITS
    - CAD\_PROP\_MATERIAL\_THICKNESS
    - CAD\_SURFACE\_AREA
    - CAD\_VOLUME
    - CAD\_CENTER\_OF\_GRAVITY\_X
    - CAD\_CENTER\_OF\_GRAVITY\_Y
    - CAD\_CENTER\_OF\_GRAVITY\_Z
    - CAD\_MOMENT\_OF\_INERTIA\_XX
    - CAD\_MOMENT\_OF\_INERTIA\_XY
    - CAD\_MOMENT\_OF\_INERTIA\_XZ
    - CAD\_MOMENT\_OF\_INERTIA\_YY
    - CAD\_MOMENT\_OF\_INERTIA\_YZ
    - CAD\_MOMENT\_OF\_INERTIA\_ZZ
    - CAD\_MATERIAL

**2.4 Test models**

An assembly – selected parts of a torque converter – was used for the testing. The torque converter model was derived from the productive model of a truck transmission and was used in the 8th STEP benchmark and in part for the first JT translator benchmark 2009. It is a complex solid model that was available in CATIA V5, NX and Pro/ENGINEER. Figure 2 shows the individual parts of the assembly. The screws, covers and seals are assembled as an instance.

For the purpose of the benchmark, material data, PMI



**Figure 2: Test model housing assembly**

annotations and attributes were added to the models so that the required tests could be carried out.

**2.5 Test execution**

The software required to perform the testing was made available by the participating vendors and was installed under consideration of the defined releases and software versions. All testing was performed on PCs with Microsoft Windows XP Professional (2002 SP3, 32 bit) installed as the operating system.

First of all, the test models were converted to JT using the various translators in accordance with the test cases. These JT files were then converted to all the CAD formats for the systems involved with the translators. The settings used for the conversion were specified by the respective vendor.

The quality of the source data was checked to minimize the danger of conversion errors due to a low level of data quality.

The test results are the product of a comparison of the original (source) data and the converted (target) data. This included an automatic comparison of the values read, as well as manual checks. Siemens PLM Visualization Mockup 8.1 (VisMockup) was used for the visualization and analysis of JT. Within VisMockup, the JT models were checked using the JT inspector and 3D measurements.

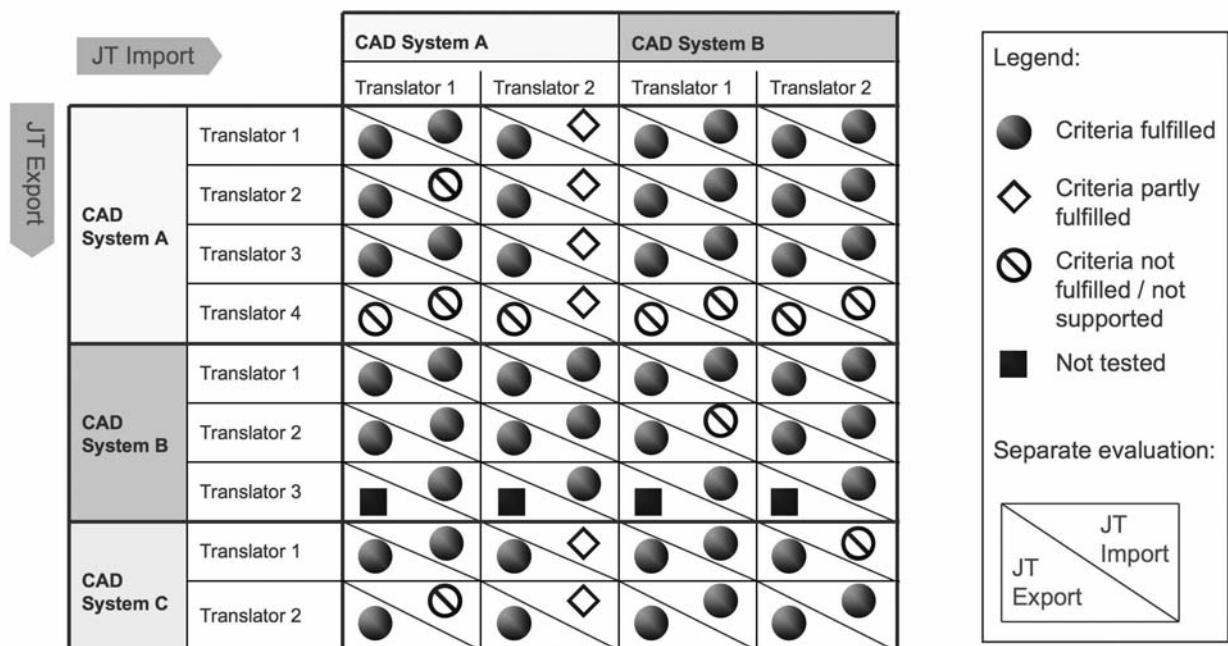
In order to check the geometry, the volume, surface and center of gravity in the source and target systems and in the JT file were measured and compared.

**2.6 Documentation**

All the testing performed, including the translator settings, were documented to ensure that the tests could be reproduced.

The results of the conversions were checked for errors, problems and any irregularities. The results of the conversions were examined for errors, problems and any irregularities. If errors or irregularities occurred, these were analyzed in order to localize the cause. This also included talking to the vendors. If errors that occurred could be remedied by changing the translator settings, this fact was also documented.

You will find the test results for all the criteria summarized below. The results are presented in matrix form for several of the criteria. There are separate fields for export to JT and import from JT. The structure of the matrices is explained in Figure 3. If the results for export were errored, the corresponding import fields have been left empty since, in this case, it is impossible to make any statement about possible results. If the settings had to be changed in order to achieve correct results, this is indicated by a footnote.



**Figure 3: Example of a result matrix**



### 3 Results

The results of the benchmark cannot be applied directly to the whole range of practical applications (neither positive nor negative aspects). The JT translator benchmark indicates the current status of implementation with regard to specific focal points defined by the users and thus gives an impression of the current quality of the translators with regard to the test criteria.

Errors that occur when importing JT can also be caused by defects in the JT files. This type of error can also exist even if the test criterion for the export was evaluated as being correct.

### 3.1 Geometry

All the tested translators are able to generate JT files with exact geometry in XT-BREP format. The deviations in the values for volume, surface and center of gravity measured for evaluation purposes in the JT files as compared with the values measured in the CAD systems lie well below the tolerances used.

All the tested translators were also able to re-generate exact CAD models using the BREP information stored in the JT files. In some cases, however, it was necessary to deviate from the translator settings originally provided by the vendors in order for conversion to be successful. Problems arose in particular with the complex geometry of the housing, which was often initially only transferred as a surface. According to the vendors, at least two of the JT files generated in the benchmark contain degenerated elements which do not result in closed surfaces during conversion even though they are not apparent during analysis in VisMockup. The result matrix for exact geometry is shown in Figure 4

JT Import		CATIA V5				Pro/E		NX		
		CoreTech	Siemens	Theorem	T-Systems	CoreTech	Theorem	CoreTech	Siemens	
JT Export	CATIA V5	CoreTech	●	●	●	●	●	●	●	●
		Siemens	●	1	●	●	●	●	●	●
		Theorem	●	●	●	●	●	●	●	1
		T-Systems	●	●	●	●	●	●	●	●
Pro/E	CoreTech	●	●	●	●	●	1	●	●	●
	Siemens	●	●	●	●	●	●	●	●	●
	Theorem	●	1	●	●	●	2	●	2	●
NX	CoreTech	●	●	●	●	●	●	●	1	●
	Siemens	●	●	●	●	●	2	●	2	●

- 1) With Heal- and Stitch-Functionalities and higher tolerances
- 2) Manual deletion of isolated 3D curves within converter
- 3) Option "Sew Faces" activated

- correctly converted
- ⊘ not correctly converted / not supported

Figure 4: Results for exact geometry

### 3.2 Product structure

All the JT files were generated using the structure option "per part". This means that one JT file contains the product structure and references to other JT files which, in turn, contain the geometry data and metadata for the individual parts.

All the translators were able to reproduce the instantiation of the individual parts correctly. Nevertheless, several small errors occur in the product structures. When the JT files were converted into the CAD formats, the product structure was transferred just as it was in the JT files, with just a few exceptions. The result matrix for the product structure is shown in Figure 5.

### 3.3 Positioning

All the translators transferred the positioning of the individual parts without error. This applies to both CAD to JT conversion and JT to CAD conversion.

### 3.4 PMI

In most cases, the export of PMI annotations to JT was correctly with regard to placement and representation. The import of PMI annotations from JT into the CAD systems was supported by a significantly smaller number of translators. Only when importing the JT files into NX 6 were the PMI annotations transferred during the conversion of the JT file into the CAD format. According to the vendor, Theorem also supports PMI import. This was, however, not tested within the framework of the benchmark with the translator settings used. The result matrix for PMI annotations can be seen in Figure 6.

		JT Import				Pro/E		NX		
		CoreTech	Siemens	Theorem	T-Systems	CoreTech	Theorem	CoreTech	Siemens	
JT Export	CATIA V5	CoreTech	●	●	●	●	●	●	●	●
		Siemens	●	●	●	●	●	⊘	●	●
		Theorem	●	●	●	●	●	●	●	●
		T-Systems <sup>1)</sup>	◇	◇	◇	◇	◇	◇	◇	◇
Pro/E	CoreTech	●	●	●	●	●	●	●	●	
	Siemens <sup>2)</sup>	●	●	●	●	●	●	●	⊘	
	Theorem	●	●	●	●	◇	◇	●	●	
NX	CoreTech	●	●	●	◇	◇	◇	●	◇	
	Siemens <sup>3)</sup>	◇	◇	◇	◇	◇	◇	◇	◇	

- 1) T-Systems: "Works as designed and according to customer requirements to enable view control on multi-body parts"
- 2) Option "DatumPlaneFlag = false" to avoid datum planes as structure elements
- 3) Siemens PLM: "Works as designed according to JT schema and customer requirements"

- correctly converted
- ◇ partially correct converted
- ⊘ not correctly converted / not supported

Figure 5: Results for product structure



JT Import		CATIA V5				Pro/E		NX				
		CoreTech <sup>1)</sup>	Siemens <sup>1)</sup>	Theorem	T-Systems <sup>1)</sup>	CoreTech <sup>1)</sup>	Theorem <sup>1)</sup>	CoreTech <sup>1)</sup>	Siemens			
JT Export	CATIA V5	CoreTech	●	⊗	●	■	●	⊗	●	⊗	●	●
		Siemens	●	⊗	●	■	●	⊗	●	⊗	●	●
		Theorem	●	⊗	●	■	●	⊗	●	⊗	●	●
		T-Systems	●	⊗	●	■	●	⊗	●	⊗	●	●
Pro/E	CoreTech	●	⊗	●	■	●	⊗	●	⊗	●	●	
	Siemens <sup>2)</sup>	◇	⊗	◇	■	◇	⊗	◇	⊗	◇	●	
	Theorem <sup>1)</sup>	⊗	⊗	⊗	⊗	⊗	⊗	⊗	⊗	⊗	⊗	
NX	CoreTech	⊗	⊗	⊗	⊗	⊗	⊗	⊗	⊗	⊗	⊗	
	Siemens	●	⊗	●	■	●	⊗	●	⊗	●	●	

- 1) Not supported by the Translator for this CAD System and translation direction
- 2) Siemens PLM: "Siemens has the ability to process 3d drawing annotation through an extended capability to the translator and recommends that customers use it when this type of annotations are needed"
- correctly converted
- ◇ partially correct converted
- ⊗ not correctly converted / not supported
- PMI import from JT to CATIA V5 was not tested with the provided translator settings but is reported to be available by Theorem

Figure 6: Results for PMI annotations

### 3.5 Material data (CAD feature)

Material information from the CAD systems material feature is read out by several translators and stored in JT as attributes. Differences still exist with regard to whether just the material name or also other material attributes are transferred.

When transferring material information from JT back to CAD, it is transferred to the CAD model as an attribute. This means that the material feature from the original CAD model was never reconstructed.

### 3.6 Tessellation

The translators are able to generate several LODs on the basis of different tessellation parameters for visualization

purposes. However, it was not possible to test the accuracy of these tessellations using the available tools.

### 3.7 User-defined attributes

All the tested translators are able to transfer the user-defined attributes from the CAD models to the JT files. In some cases, a number was added to the names of the attributes. The transfer of the attributes from JT to CAD was only successful in certain test cases.

## 4 Publication

Detailed documentation on the 2nd ProSTEP iViP/VDA JT translator benchmark will be made available to members on the ProSTEP iViP Association website ([www.prostep.org](http://www.prostep.org)).

## 5 Outlook

Significant improvements can already be observed compared with the first JT translator benchmark. Nevertheless, one development task that the vendors still need to tackle is the reliable transfer of not only the geometry to the JT files but also other information that is stored in the CAD model. This also requires cooperation with the manufacturers of the CAD systems so that the relevant interfaces can be identified and improved. Another task is collaboration between the vendors to create a common understanding of the JT specification and its implementation.

Since, with JT Version 9.5, a new specification has been submitted to the ISO for standardization, all future testing will be performed on the basis of this version.

## 6 Acknowledgements

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