



## JT Implementor Forum

### Implementation Guidelines

Version 3.0; December 20, 2018

Status: Released

#### **Contacts:**

**Jochen Boy**  
PROSTEP AG  
Dolivostraße 11  
64293 Darmstadt / Germany  
[jochen.boy@prostep.com](mailto:jochen.boy@prostep.com)

**Stefan Just**  
PROSTEP AG  
Dolivostraße 11  
64293 Darmstadt / Germany  
[stefan.just@prostep.com](mailto:stefan.just@prostep.com)

## Contents

### Table of Contents

1 Introduction .....	7
1.1 About the JT Implementor Forum .....	7
1.2 Document History .....	7
1.3 About this Document .....	8
1.4 Implementing ISO 14306 – Patents and Licenses .....	8
1.5 JT Version Guide .....	9
2 JT Property Guidelines .....	9
2.1 Hidden Properties .....	9
2.2 State Flags .....	9
2.3 Property Naming and Value Restrictions .....	10
2.4 Recommended Alphabet for Attribute Keys and Values .....	11
2.5 Guidelines for Specific Properties .....	12
2.6 General Overview of JT properties .....	14
2.7 Identification of ISO JT Version in JT File Header and Applications .....	18
3 Data Organization / Tree Structure .....	19
3.1 Mapping of JT ISO elements to Step elements .....	19
3.2 Multi Body Handling .....	19
3.3 Handling of different states / variants in a JT file .....	21
3.4 Layers .....	23
4 PMI Elements .....	26
4.1 PMI Font .....	26
4.2 Semantic PMI Usage Guide .....	27
5 Geometry Handling .....	28
5.1 General .....	28
5.2 Non-Manifold Bodies .....	29
5.3 Multi-Domain Faces .....	29
5.4 Wireframe Geometry and Independent Points .....	29
5.5 Procedural Geometry .....	30
5.6 Foreign Geometry Definition .....	30
5.7 Supplemental Geometry .....	30
5.8 Tessellation .....	32
5.9 Chordal Deviation Parameter Units and Simplification Factor .....	34
5.10 Usage of Dimensions .....	35
6 Links between Geometrical Elements of Different Documents .....	35
6.1 External Links to JT Elements .....	35

6.2 Moniker ID.....	36
7 General Topics.....	37
7.1 Watermarks.....	37
7.2 Kinematics .....	37
7.3 Animations .....	37
7.4 Markup Elements .....	38
7.5 Thread Definition.....	38
7.6 Material Definition .....	39
7.7 Textures.....	41
7.8 Compression Algorithm .....	42
7.9 Definition of Views.....	43
7.10 Use of Properties for Validation.....	45
Annex A List of reported JT issues and Bugzilla IDs.....	48
Annex B Glossary.....	49
Annex C Mapping table JT ISO to STEP .....	50
C.1 Wireframe Geometry .....	50
C.2 Surfaces without topology.....	50
C.3 Shapes represented by wireframe models with topology .....	51
C.4 Manifold Surfaces with Topology .....	51
C.5 Advanced boundary representation solids .....	52
C.5.1 Color.....	53
C.5.2 Name.....	54
C.5.3 Wireframe style.....	54
C.5.4 Visibility .....	54
Annex D Procedural Geometry – Evaluation and Approximation.....	55
D.1 Introduction & Scope .....	55
D.1.1 Notation.....	55
D.1.2 Pseudocode.....	55
D.2 Intersection Curve.....	55
D.2.1 Intersection Curve Basics .....	55
D.2.2 Populating Chart Points .....	57
D.2.2.1 Getting Surface Parameter Values.....	57
D.2.2.2 Special Case: the First Point .....	59
D.2.2.3 Getting the Tangent Vector .....	60
D.2.2.4 Getting Chart Point Parameters .....	60
D.2.3 Computing a Point & Tangent on an Intersection Curve.....	63
D.2.3.1 Equations for the Point on the Intersection Curve.....	63

D.2.3.2	Estimating a Starting Point .....	64
D.2.4	Approximating an Intersection Curve .....	66
D.2.4.1	Fitting Hermite Cubics .....	67
D.2.4.2	Estimating Approximation Error .....	67
D.2.4.3	Constructing a Cubic B-spline .....	68
D.2.4.4	Approximation Code .....	69
D.3	Rolling-Ball Blend Surface .....	75
D.3.1	Computing a Point on a Blend Surface .....	75
D.3.1.1	Stored Data .....	75
D.3.1.2	Surface Equation .....	76
D.3.1.3	Calculating a Point on a Blend Surface .....	77
D.3.1.4	Blend Surface Pseudocode .....	78
D.3.2	Approximating a Blend Surface .....	79
D.3.2.1	The Basic Bézier Patch .....	80
D.3.2.2	Approximation Code .....	81
D.3.2.3	Example .....	82
D.3.2.4	Derivatives of Projected Curves .....	83
D.3.2.5	Blend Surface Derivatives .....	83
D.3.2.6	Approximating Blend Surface Edges .....	84
D.3.3	Blend Surface Questions and Answers .....	85
Annex E	Bibliography .....	88

## List of Figures

Figure 1: Interaction of the VDA / prostep ivip JT initiatives .....	7
Figure 2: Merging the guidelines .....	8
Figure 3: Displaying Nodes that have SUBNODE properties .....	12
Figure 4: Example - Specification tree in CATIA V5 for a multi-body part .....	19
Figure 5: Layer Filter use in JT .....	24
Figure 6: A reference plane for a Datum as typical example for Supplemental Geometry.....	31
Figure 7: Example for Thread Information (4X M12) in a PMI Annotation .....	39
Figure 8: JT Part file with material settings .....	40

## List of Tables

Table 1: JT versions .....	9
Table 2: Maximum Property Key Length per Application .....	11
Table 3: Maximum Property Value Length per Application .....	11
Table 4: Recommended Translator Information Properties.....	14
Table 5: JT Properties Overview .....	18
Table 6: PMI "Reference" Types in JT .....	32
Table 7: General Overview on Views and major CAD systems.....	44

# 1 Introduction

## 1.1 About the JT Implementor Forum

The JT Implementor Forum was set up in 2010 and is a joint project organized by the prostep ivip Association and the German Association of the Automotive Industry (VDA). The aim of the project group is to provide the participating vendors with a platform where they can test the translators that they are developing “behind closed doors”. The JT Implementor Forum is a neutral forum for software vendors, where they can perform testing in an atmosphere of mutual trust and exchange information on experience already gained.

The work performed in the JT Implementor Forum is carried out in cooperation with the JT Workflow Forum and is enriched by the experience gained from the JT Translator Benchmarks.

New functionality is tested and optimized until it is declared “ready for market”. This also gives rise to requirements relating to implementation guidelines and pre-release testing.

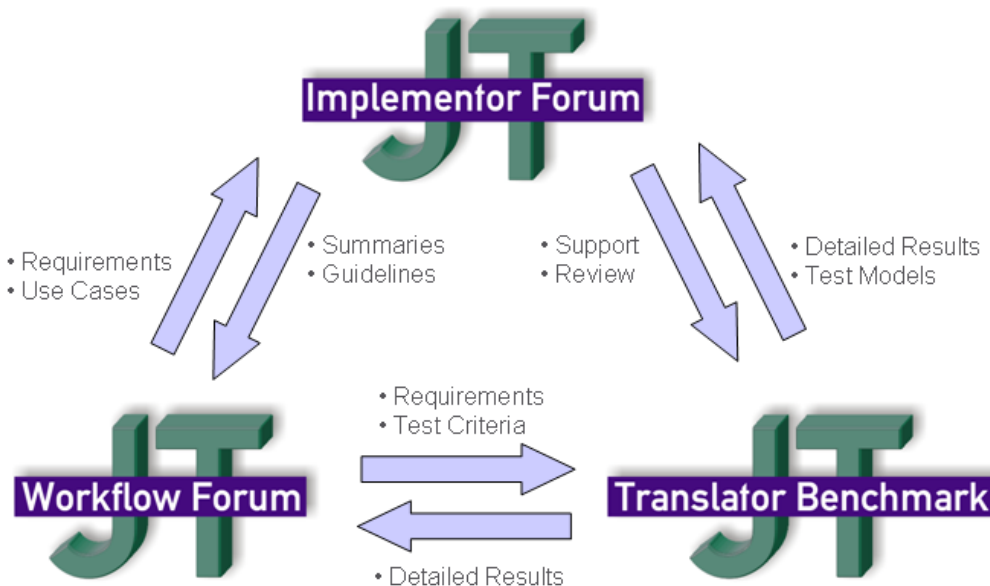


Figure 1: Interaction of the VDA / prostep ivip JT initiatives

## 1.2 Document History

Since the year 2010 the JT Implementor Forum is working on Implementation Guidelines where findings from conducted test rounds were documented. Latest release of the Guideline is version 10. From late 2014 to early 2015, an additional Implementation Guideline was created in the context of the "JT industrialization" approach, with the aim to close documentation gaps in the ISO JT File Specification. Latest version of this document was 1.4. In May 2015, both Guidelines have been merged the new JT Implementation Guideline v2.0. From now on, this new Guideline is the single source of documentation and basis for upcoming updates.

According to the publications of the DIN SPEC 91383 – JT Industrial Application Package (2018) and the JT ISO V2, the duplicate information was removed from the Implementation Guideline to avoid redundant data storage. In addition, a version guide has been added, see chapter 1.5.

The current version 3.0 includes improvements based on testing experiences as well as user feedback.

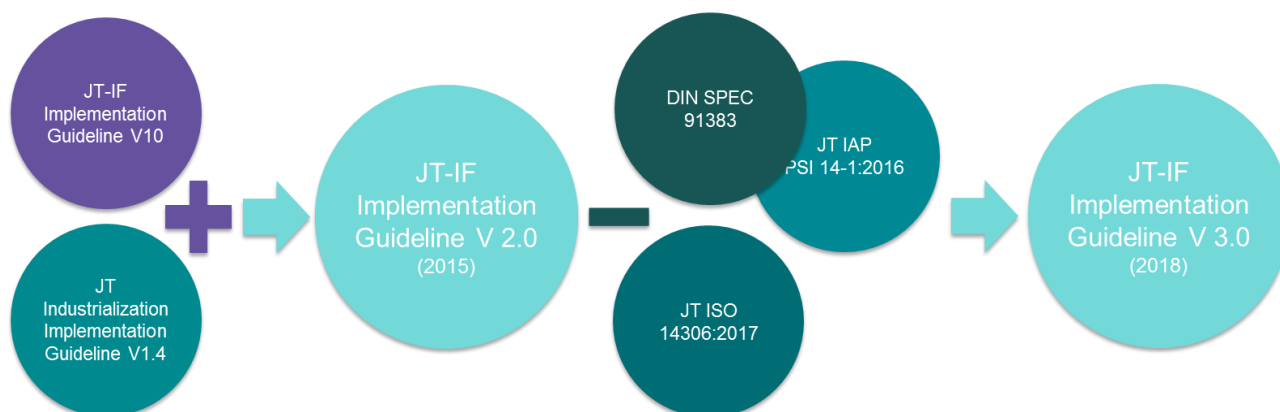


Figure 2: Merging the guidelines

### 1.3 About this Document

The implementation guidelines and recommendations provided in this document are aimed to close the gap between the JT specification (JT DIN SPEC and ISO 14306) and “real world” implementation tasks. They are also aimed towards vendors with the objective to provide recommendations how to best implement certain aspects of the JT standards, by itself or in combination with accompanying formats such as STEP AP242 XML. The recommendations given in this document have been discussed intensively, and agreed on, by the JT Implementor Forum members and will be implemented by them as a means of enhancing interoperability of application using the JT format.

This document understands itself as a complement to the following documents:

- The JT File Format specification (currently: ISO 14306:2017; 2017-11), which defines the data model and file format itself.
- The JT DIN SPEC 91383:2018-09, JT Industrial Application Package (JTIAP), which defines the syntax and semantics of the JT file format and is compatible to the JT file format specification in ISO 14306 (in its version from 2012 and successors) as well as to the essential implementations currently available to the market.
- The JT Content Harmonization guideline (currently: version 2.1; 2012-12-07), which gives recommendations about property names (keys), property values, and configuration settings to be applied by users.

Consequently, the JT Implementation Guideline stands between the two documents listed above, as it gives additional information on the implementation of the JT File Format specification where the group feels the given information is not sufficient, or ambiguous. It is aimed towards the implementers of JT translators and documents agreements on a technical level.

The JT Content Harmonization guideline, on the other hand, is aimed towards users and documents agreements on the levels of process and content.

The issues mentioned here were raised by one of the following bodies:

- During the ISO ballot
- prostep ivip / VDA JT Workflow Forum
- prostep ivip / VDA JT Implementor Forum

### 1.4 Implementing ISO 14306 – Patents and Licenses

JT became an International Standard when it was published as ISO 14306 in 2012. Concerns were raised whether Siemens, as developer of the format, still holds patents or requires licenses affecting implementation and commercial use of JT. This is not the case, as Siemens states answering those questions in the following ISO document:

<http://isotc.iso.org/livelink/livelink?func=ll&objId=17011200&objAction=browse&viewType=1>

## 1.5 JT Version Guide

Since the JT file specifications (ISO V1, V2 and JT IAP v2) don't explicitly state which Siemens JT version they are based on, this chapter should serve as a "version guide". The table below shows the differences between the standards and the JT versions and show which Siemens JT version belongs to which specification.

<b>JT Specification:</b>	ISO 14306:2012	JT IAP v2 (2016)	ISO 14306:2017
<b>Underlying JT File Format Specification</b>	JT 9.5 (Rev-E)	JT 10 (Rev-B)	JT 9.5 (Rev-E)
<b>Compression Algorithm:</b>	ZLIB	LZMA	ZLIB
<b>Types of exact geometry representation:</b>	JT BREP, XT BREP, ULP	JT BREP (deprecated), XT BREP, ULP, STEP BREP (deprecated)	XT BREP, STEP BREP, ULP, LWPA, JT BREP (deprecated)

*Table 1: JT versions*

Since the file format specification for JT v10.2 is not freely available at the moment, i.e. it can be written and read only with the Siemens toolkit, JT v10.2 is out of scope for the JT-IF.

For STEP AP242 BO Model XML, the decision is to use the TC version of AP242 (with the recommended practices v1.99 / v2.0). This is because the updated schema provides meaningful implementation enhancements, and it is also the minimum required level for AP242 for supporting kinematics. Thus, it can be used consistently.

## 2 JT Property Guidelines

The JT properties which are stored on hierarchy node level are used for different purposes:

- User specific metadata
- Data organization such as layer, layer filter, reference sets, subnode etc.
- JT internal definitions such as measurement unit
- CAD measurement properties

This section provides some useful information about the usage and appearance of properties within a JT file. The file specifications [1], [11] and [12] contain also a list of required and optional properties.

### 2.1 Hidden Properties

The recommendation for dealing with hidden properties is described in DIN SPEC (PSI 14-1:2016 chapter 14.8.1.1.1) and in JT ISO 14306:2017 (chapter 11.8.1.3).

### 2.2 State Flags

The recommendation for dealing with state flags is described in DIN SPEC (PSI 14-1:2016 chapter 14.14) and in JT ISO 14306:2017 (chapter 6.2.1).



- Note that these two surfaces intersect to give the cliff curve
- The range is [0,0]
- The spine is the cliff curve (formed by intersecting the two surfaces), and can be conceptually thought of as the curve of the cliff edge
- The blend\_type is R

## Annex E Bibliography

The following documents are referenced in this document:

- [1] ISO/IS 14306:2012 – JT file format specification for 3D Visualization (2012-12-14)
- [2] JT Content Harmonization (v3.0) – Progress Report and Proposal for JT and Accompanying Formats (2013-05-21)
- [3] Layer Filter Support in JT Files (v2.0; February, 2013) – provided by Siemens
- [4] JT-v10-file-format-reference-rev-A\_tcm1023-224370.pdf – JT File Format Reference Version 10.0 Rev-A – provided by Siemens
- [5] JT OPEN ADVANCED MATERIALS (March, 2012) – provided by Siemens
- [6] Numerical Recipes, by Press, Teukolsky, Vetterling, Flannery.
- [7] <http://www.gnu.org/software/gsl/>
- [8] <http://en.wikipedia.org/wiki/MINPACK>
- [9] [http://en.wikipedia.org/wiki/Loss\\_of\\_significance](http://en.wikipedia.org/wiki/Loss_of_significance)
- [10] CAx-IF Recommended Practices for Geometric and Assembly Validation Properties, Release 4.4, by Boy, Cheney, Rosché
- [11] ISO 14306:2017 – JT file format specification for 3D visualization (2017-11)
- [12] DIN SPEC 91383 – JT Industrial Application Package (JTIAP) (2018-09)