Test Suite for the CAx Implementor Forum Round 5J

August - December 2000

Release 2.0

October 4th, 2000.

Contacts:

Jochen Boy
ProSTEP GmbH
Dolivostraße 11
64293 Darmstadt/Germany
jboy@prostep.de

Mark Lobo
ATI/PDES, Inc.
5300 International Blvd.
North Charleston, SC 29418 USA
lobo@aticorp.org

Contents:

1.0 Introduction

This document describes the suite of test cases to be used for the fifth round of testing of the CAx Implementor Forum (CAx-IF). The CAx-IF is a joint group of the organisations and vendors previously engaged in the ProSTEP CAD Round Table and the PDES, Inc. STEPnet.

The test rounds of the CAx Implementor Forum continue the tradition of the Test Rallies and STEPnet in testing the interoperability and conformance of STEP processors.

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 organisations PDES, Inc. and ProSTEP.

This test suite includes synthetic models for testing the following capabilities: surface geometry, model viewing, drawing organisation, 3D Text annotation, validation properties, and external references.

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

1.1 Functionality tested in this round

Functionality tested in this round relates to surface geometry, 3D text annotation/associative text, validation properties, model viewing, and external references.

Surface models are again tested because of previous findings that indicate that this exchange capability might still need some enhancement. It has been agreed that only topologically bounded models will be exchanges.

Associative text is the capability to associate text notes in 3D model space with portions of the model.

Validation properties (in AP214 named shape_dependent_properties) is a mechanism to allow the exchange of geometric properties and their assignment to geometric representations for the purposes of data exchange validation. Considered properties are volume, surface area and centroid.

The model viewing and drawing organization capability including the presentation of dimensions has already been tested in Rounds 2J and 4J. For Round5J, the scope of the test case is extended to test angular dimensions.

External references is 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. In respect to the CAx IF, external references will be used to split a single STEP file into a file containing the part identification and assembly structure and several STEP files containing the component geometry. In Round 5J of testing, CAx vendors will be processing files from the PDM Implementor Forum

(PDM-IF), for a joint CAx/PDM testcase (see Section 2.4). In addition to the joint testcase, the CAx vendors will also be pre/post processing a testcase for external references with document format properties.

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.

1.3 Schedule

Date	**Action**
August 16th, 2000	Task Force Meeting, Darmstadt (finalization of CAx-IF/PDM-IF test case definition)
August 30th, 2000	CAx Implementor Conference Call
October 4th, 2000	Production Models released
October 10th, 2000	Initial STEP files and native stats due
October 24th, 2000	STEP files and native stats frozen
November 3rd, 2000	Target stats due/ 2nd Conference Call
November 15th, 2000	Target stats frozen
November 22nd, 2000	Pre-release of final stats
December 5th, 2000	Review meeting for test round in Darmstadt
December 6th and 7th, 2000	CAx Implementor Forum meeting in Darmstadt

1.4 Copyrights on test cases

Not all of the production test cases which were provided by the PDES, Inc. and ProSTEP member companies are fully released for any purpose. The least common denominator is that the test cases can be freely distributed among the ProSTEP/PDES, Inc. Round Table participants and can be used for any purposes that are related to CAx Implementor Forum 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 Implementor Forum testing or outside of PDES, Inc. and ProSTEP.

2.0 Synthetic test case specifications

2.1 Model d3 : Draughting of block with (angular) Dimensions

2.1.1 Motivation

This synthetic model represents basic draughting capability. It involves the projection of a simple 3D solid onto a view which is then placed on a sheet. The sheet is organised in a drawing. In the test of this model the test case is extended by adding linear and angular dimension information to the views.

2.1.2 Approach

See the approach described in the CAx Implementor Forum Recommended Practices for *Model Viewing, Drawing structure and Dimensions* (see http://www.cax-if.org/public/ and http://www.cax-if.de/public/).

2.1.3 Testing Instructions

Please note that system vendors that do not support this basic draughting capability should not submit STEP files for this test case.

2.1.3.1 Model construction

The figures below indicate the construction of the draughting test case. The basic steps are:

1. Construct the solid geometry. The dimensions for the solid are given in the figure 1 below.
2. Define views of the solid and place it onto a sheet. The projection related to the views can be extracted from the figure 2.
3. Add the dimensions to the views as shown in figure 2.

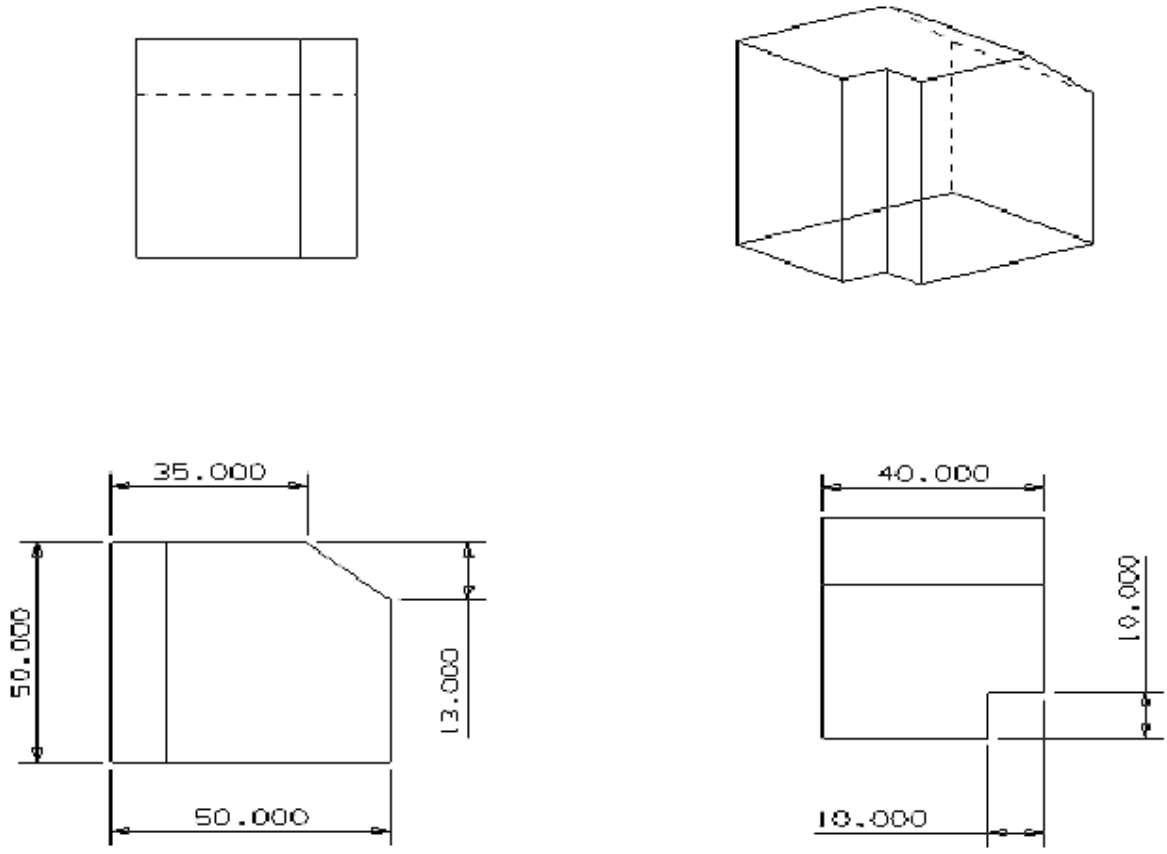


Figure 1: dimensions for solid for d3 (dimensions in mm)

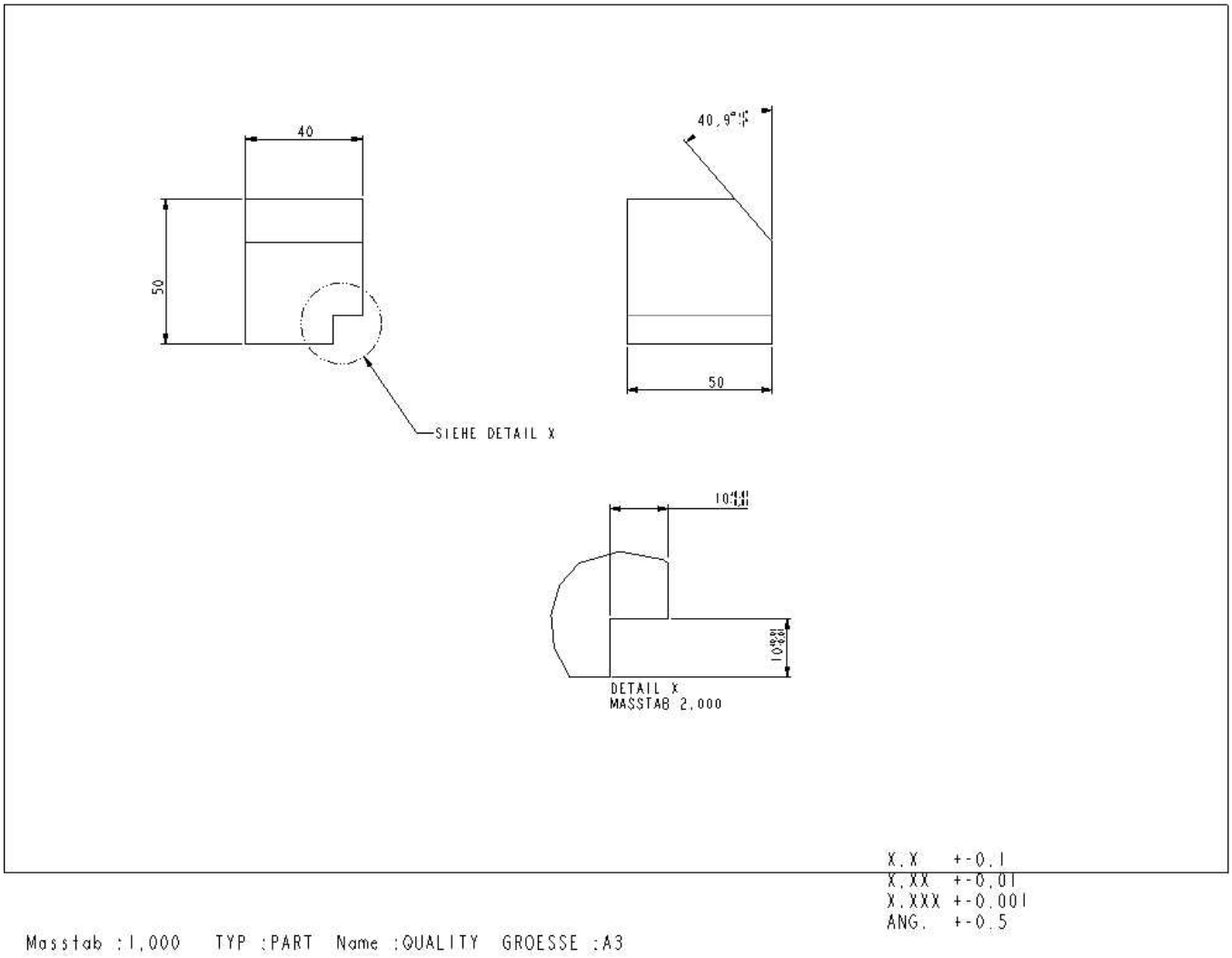


Figure 2: views on the drawing sheet with dimensions

The layout of the views on the sheet should be indicated as above, i.e.:

- TOP and LEFT are horizontally aligned
- TOP and LEFT are placed on the top of the sheet
- The DETAIL TOP is horizontally centred
- DETAIL TOP is placed on the bottom of the sheet

T he dimensions shall be added to the views as shown in figure 2.

2.1.3.2 Statistics

The statistics that must be associated which each STEP file submitted for the d2 test case are designed to represent the results for the following criteria and validations:

- Check the views: placement on the sheet and orientation

- Move the views on the sheet in order to test the association of the model to the view
- Check if the dimension text and symbology fits with the specification of the test case. Note: the dimensions are not supposed to be associative, i.e. linked with the geometrical dimensions of the solid. Tolerance information is only presented and not complemented by information in the 3D model.

model	d3
system_n	*native system code*
system_t	*target system code (for native statistics use 'stp' for system_t)*
views	*all/partial/none - whether the views appear on the sheet in the target system*
view_layout	*all/partial/none - whether the views appear with right placement and orientation in the target system*
pres_lin_dim	*all: if the presentation information of all linear dimensions received corresponds to the test case specifications* *partial: if the presentation of the linear dimensions is incomplete or not completely as specified in this test case* *none: if no linear dimensions are presented or all of them do not fit with the specifications*
pres_ang_dim	*all: if the presentation information of all angular dimensions received corresponds to the test case specifications* *partial: if the presentation of the angular dimensions is incomplete or not completely as specified in this test case* *none: if no angular dimensions are presented or all of them do not fit with the specifications*
valid_assoc	*pass/fail – whether modifications of the shape result in an appropriate update of the views (check with new dimension)*
date	*date submitted*
issues	*short description of issues*

Note: In case a vendor (native/target) is not testing a particular functionality (e.g. pres_dim) *'na'* must be used as code for that statistic.

2.2 Model s1 "space ship" : Validation Properties, Associative Text and External References

2.2.1 Motivation

This synthetic model (a slightly abstracted version of an "Überraschungsei"-toy) is a model already known from previous testing activities of the CAx-IF. The model is re-used to external references, test validation properties and 3D text annotation/text associativity. The model as used in Round4J can be re-used.

The 'External references' test case described here includes the ability to assign document format properties to the external geometry files. Kindly refer to the example STEP file given in ext_ref_w_doc_form_prop.zip for more details. This ZIP file contains an example STEP file with comments and a slide showing the structure for the external references and the document format properties. The file is available on http://www.cax-if.org/ and http://www.cax-if.de/ under 'Joint testing information'.

Relating to the 'validation properties' functionality of the test case, the volume, surface area, and centroid for the entire assembly will be reported in the statistics, as has been done in prior rounds of testing of the validation properties functionality.

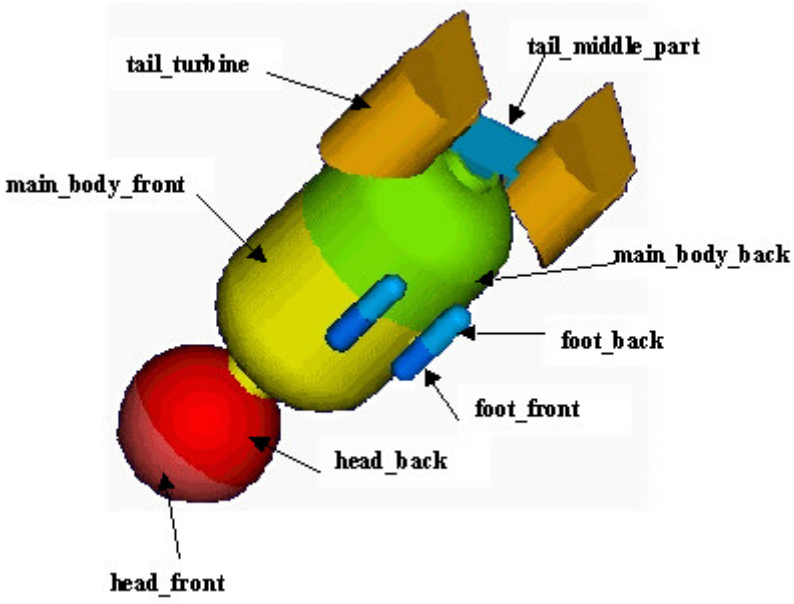


Figure 3: Annotated Shape of Space Ship s1.

2.2.2 Approach

See the approaches described in the CAx Implementor Forum Recommended Practices for *Geometric Validation Properties,* and *3D Associative Text* (see http://www.cax-if.org/public/ or http://www.cax-if.de/public/), and the *PDM Schema Usage Guide* (see http://www.pdm-if.org/).

2.2.3 Testing instructions

Please note that system vendors that do not support the validation property capability and external reference mechanism should not submit STEP files for this test case.

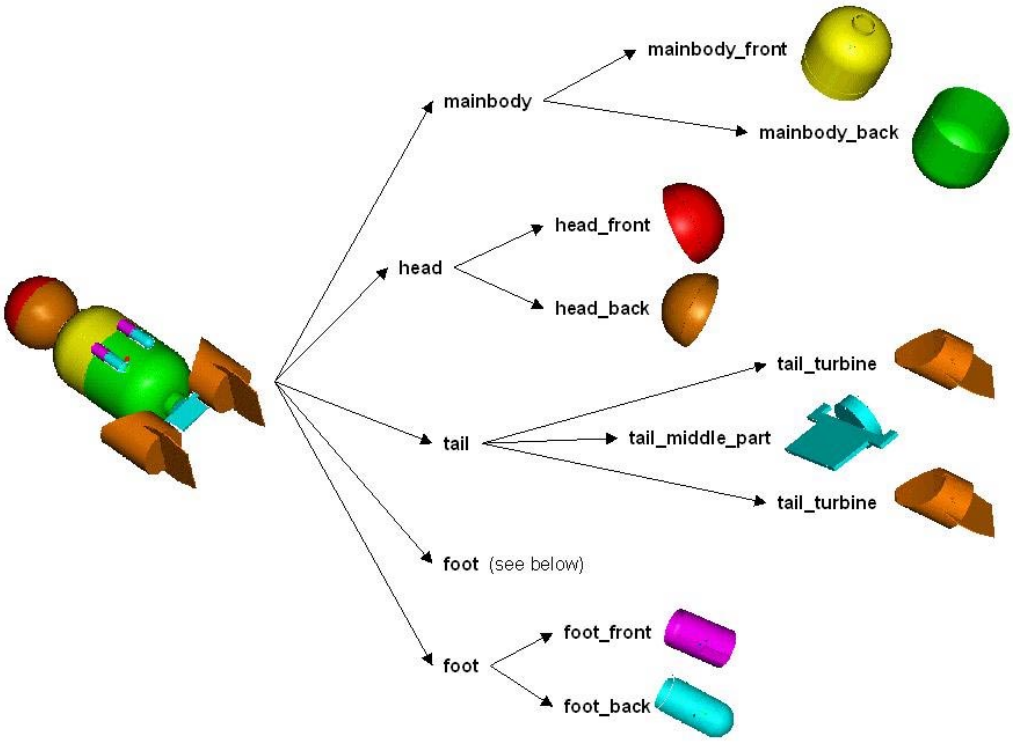
2.2.3.1 Construction of s1 "spaceship"

Dimensions

see Figures given in the annex

Assembly structure

The underlying assembly structure shall be (see figure above for part names):



The aim is to split the model into nine STEP files with the following contents:

Description	STEP file name
1.: The assembly structure	s1-(vendor code)-214.stp [e.g. s1-pe-214.stp]
2.1: Mainbody Front	s1-(vendor code)-(AP)-mfront.stp [e.g. s1-pe-214-mfront.stp]

2.2: Mainbody Back	s1-(vendor code)-(AP)-mback.stp [e.g. s1-pe-214-mback.stp]
2.3: Head Front	s1-(vendor code)-(AP)-hfront.stp [e.g. s1-pe-203-hfront.stp]
2.4: Head Back	s1-(vendor code)-(AP)-hback.stp [e.g. s1-pe-203-hback.stp]
2.5: Tail Turbine	s1-(vendor code)-(AP)-tturb.stp [e.g. s1-pe-214-tturb.stp]
2.6: Tail Middle Part	s1-(vendor code)-(AP)-tmiddle.stp [e.g. s1-pe-214-tmiddle.stp]
2.7: Foot Front	s1-(vendor code)-(AP)-ffront.stp [e.g. s1-pe-203-ffront.stp]
2.8: Foot Back	s1-(vendor code)-(AP)-fback.stp [e.g. s1-pe-203-fback.stp]

Note: The model shall be split in the same way as the XR1 test case in Round4J, i.e. one 'PDM master file', which contains the assembly structure, the validation properties, and the annotations, plus eight plain geometry files. These files may be either AP214 or AP203, which shall be stated in the document format property in the root file. A file example for a root file containing document format properties is available on the CAx-IF web sites.

Presentation

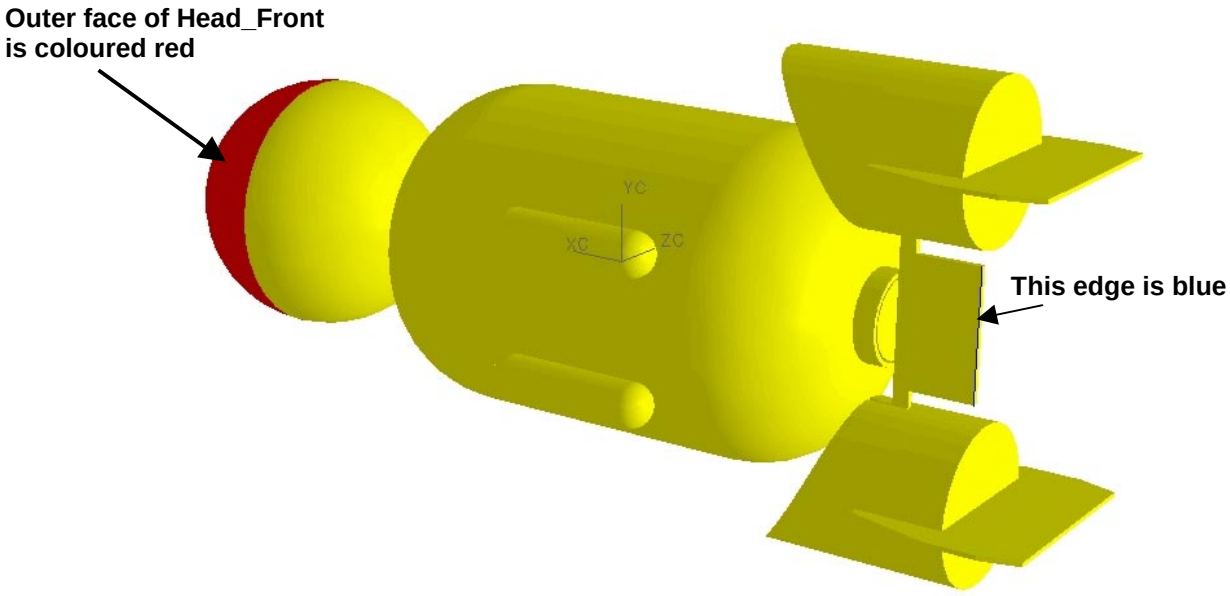


Figure 4: s1 Text Annotation Assignment

REMARK: the annotation is part of test case.

Annotations

Text is as shown in Figure 4. The following basic regulations are defined:

- style the two texts with an arbitrary colour
- associate the text "Outer face ..." to the outer face of the 'head_front'.

- associate the text "This edge ..." to the edge of the 'tail_middle_part'
- define the text "Outer face ..." as a multi-line text
- select an arbitrary placement of the text

2.2.3.2 Statistics

With each STEP file submitted for model s1 vendors must include a text file with the stats in comma-delimited form (.csv):

model	*s1*
system_n	*native system code*
system_t	*target system code (for native statistics use 'stp' for system_t)*
unit	*units*
solids	*number of solids*
volume	*total volume of all solids*
validation_ volume	*total volume of all solids as received via the validation property capability.*
valid_vol	*pass/fail, is the instantiation of the validation property 'volume' in the STEP file as per the recommended practices for validation properties?*
area	*total surface area of all solids*
validation_area	*total surface area of all solids (entire assembly) as received via the validation property capability.*
valid_area	*pass/fail, is the instantiation of the validation property 'area' in the STEP file as per the recommended practices for validation properties?*
cx cy cz	*Centroid of all solids*
validation_cx validation_cy validation_cz	*Centroid of all solids (entire assembly) as received via the validation property capability.*
valid_cent	*pass/fail, is the instantiation of the validation property 'centroid' in the STEP file as per the recommended practices for validation properties?*
color_t1	*Text color used for the annotation text "Outer face…"*
color_t2	*Text color used for the annotation text "This edge…"*
valid_txt	*all/partial/none – whether the specified texts appear in the*

	model
valid_txt_assoc	*all/partial/none – whether the association of the text to the elements of the geometric model as described above is correct*
fref_found	*All – all file references for the external geometry can be found and the file node associations to model parts can be established* *Partial – some of the file references for the external geometry can be found and some of the file node association to model parts can be established* *None – no references found or associations can not be established*
fref_processed	*All – all referenced files can be processed to construct the overal model* *Partial - all referenced files can be processed to construct the overal model* *None – referenced files can not be processed*
doc_props	*Pass/fail – is the instantiation of the document format properties as per Usage Guide / file example?*
doc_format	*All – all documents are according to the format stated in the document format properties.* *Partial – only some documents are of the stated format.* *None – no documents are of the stated format.*
date	*date submitted*
issues	*short description of issues*

Note: In case a vendor (native/target) is not testing a particular functionality, *'na'* must be used as code for that statistic.

2.3 Model k1 : Surface Model

2.3.1 Motivation

Previous findings indicated that the exchange of surface models may need some enhancement. Possible side effects with newly implemented functionality caused a regression in surface model exchange capability. To study this phenomena the capability tested with the model is limited to surface model exchange written as topologically bounded only.

2.3.2 Approach

No new capability involved.

2.3.3 Testing Instructions

2.3.3.1 Model construction

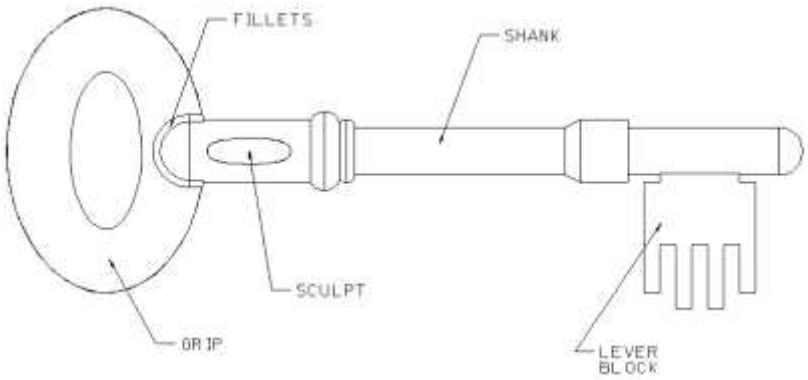


Figure 7 : Annotated shape of the k1 model.

The detailed modelling instructions are available as PDF document from the member areas of the CAx-IF web sites, http://www.cax.if.de/secure/ and http://www.cax-if.org/secure/ .

There are several degrees of freedom when implementing this test case:

- The first point is how two construct the model according to Theorem's test suite. There are two approaches (sweeping/revolving vs. union/intersection). Vendors may choose the approach which fits best with their system capabilities, the model should be constructed only once.
- The next step is to downgrade the model. It has been agreed that any number of shells is allowed. The information how many shells are used will be collected with the native stats, but will not be an exchange success criteria.

2.3.3.2 Statistics

It has been agreed, that for Round5J and future testing, only topologically bounded models shall be exchanged. Thus the model name is simply 'k1'.

With each STEP file submitted for k1, vendors must include a text file with the stats in comma-delimited form (.csv):

model	*k1*
system_t	*native system code*
system_n	*target system code*
unit	*Units*
shells	*Number of shells in the model (not a success criteria).*

area	*total surface area*
date	*date submitted*
issues	*short description of issues*

2.4 Model xr2 : External references / Joint Testcase with PDM-IF

2.4.1 Motivation

This test case is an extension of the well-known as1 model, which has been tested several times before, and it aims for CAD-PDM 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 Round5J, the PDM Implementor Forum will submit the files which will then be **imported only** by all CAx vendors testing this functionality.

2.4.2 Approach

See the approach described in the PDM Schema Usage Guide, available on the PDM-IF web-site (http://www.pdm-if.org/pdm_schema/). A Recommended Practices for External References with annotated, relevant sections of the Usage Guide and an example file for this test case is available on the CAx-IF site (http://www.cax-if.org/public/ and http://www.cax-if.de/public/).

2.4.3 Testing Instructions

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

2.4.3.1 Model construction

For Round5J, the files will be provided by the PDM vendors, based on the XR1 testcase from Round4J. All CAx vendors supporting external reference capability should import those files and submit target stats for the results they receive.

2.4.3.2 Statistics

The statistics that must be associated which the ‘root’ STEP file xr2-(vendor code)-214.stp

submitted for the xr1 test case are designed to represent the results for the following criteria and validations:

model	*xr2*
system_n	*native system code*
system_t	*target system code*
fref_found	*All – all file references for the external geometry can be found and the file node associations to model parts can be established* *Partial – some of the file references for the external geometry can be found and some of the file node association to model parts can be established* *None – no references found or associations can not be established*
Issue_description	*Please describe the problems you came across with the different test files. This feedback will be forwarded to the PDM-IF as a measure of success.*

3.0 Production models: pm3

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 of 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 model quality issues (if any) have been documented in a README file which accompanies the STEP files. In this round of testing production models, simple comparison of mass property data (volume, surface area, centroid) will be used as a basis for validating success/failure of the exchange.

3.3 Testing Instructions

3.3.1 Models Being Tested

In this round of testing, the following production models are being tested. The table below contains information on the models. A ZIP file <prodmod_r5j.ZIP> containing a README file and the STEP files (with files names as in the table) is available from the CAx IF sites in the secure area.

Model	Originating System	New / Retest (Round)	Schema	STEP File Name (in ZIP file)
Torsion Protector	CATIAV5 (Dassault)	New	203	pm3-ct-203.stp
Gasket Rings	CATIA V4 (Debis)	New	214 DIS	pm3-db-214.stp
Fixture Assembly	AutoCAD 2000i	New	214 DIS	pm3-ac-214.stp
Differential	Inventor 4.0	New	214 DIS	pm3-in-214.stp
Receiver	I-DEAS 8.0	New	214 DIS	pm3-id-214.stp
Transmission Control Unit Housing	Pro/ENGINEER 2000i^2	New	214 DIS	pm3-pe-214.stp
Rear Engine Mount Beam	Unigraphics	New	203	pm3-ug-203.stp

3.3.2 Statistics

As discussed briefly in the previous section (Section 3.2 Approach), the statistics that will be associated with each production model are aimed at determining if the production models are exchanged "successfully". As in past testing, change in volume, surface area, and centroid will be used as a basis for determining "pass/fail". For each production model, a set of native statistics have been collected from the respective system vendors.

For each STEP file (production model) being tested, vendors must send in target statistics in comma-delimited form (.csv): The naming convention for target stats is explained in the 'General Testing Instructions' document available on the CAx-IF sites, under the 'Joint Testing Information' link off the CAx-IF home page.

model	*pm3*
system_n	*native system code (use the native system code for each model listed in the table in Section 3.3.1)*
system_t	*target system*
unit	*Units*
volume	*total volume*
area	*total surface area*
cx cy cz	*Centroid*
date	*date submitted*
issues	*short description of issues*

Annex

Dimensions for s1 (space ship) shape

The following figures show the dimensions of the space ship design. Measures are given in centimetres.

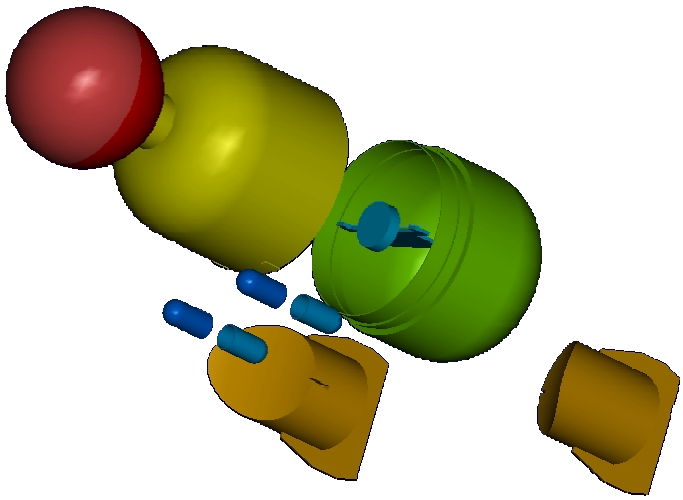


Figure 8: s1 - overview of parts of s1

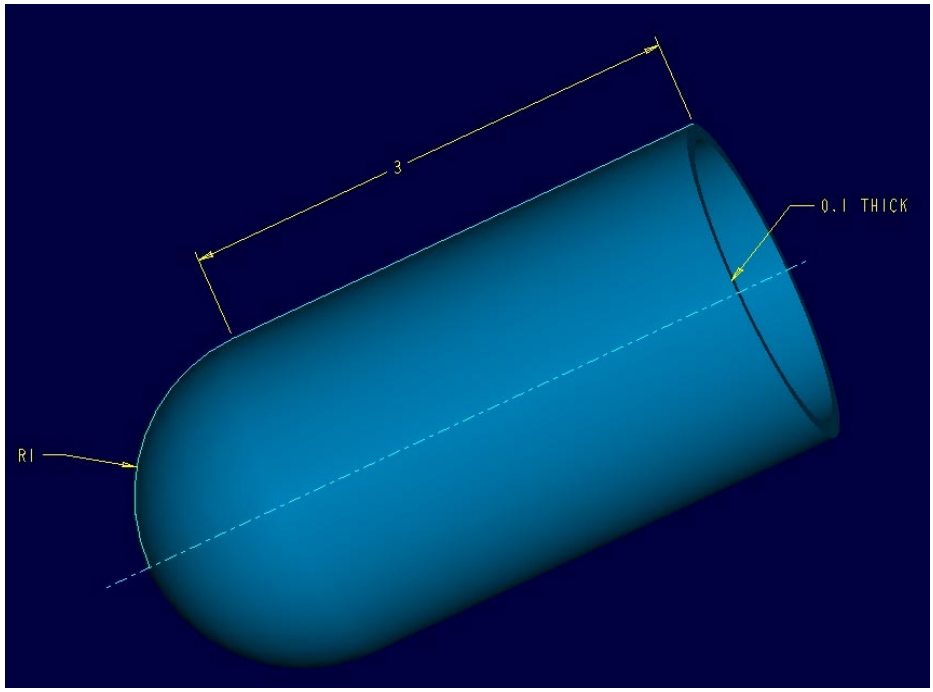


Figure 9: s1 - foot back

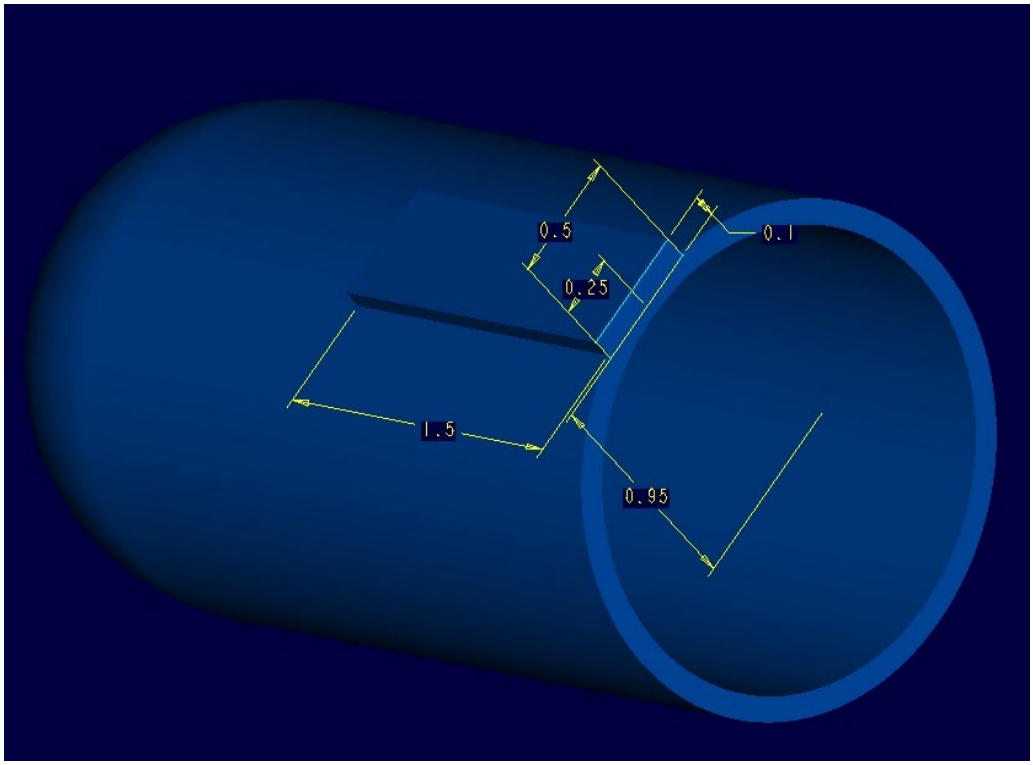


Figure 10: foot_front

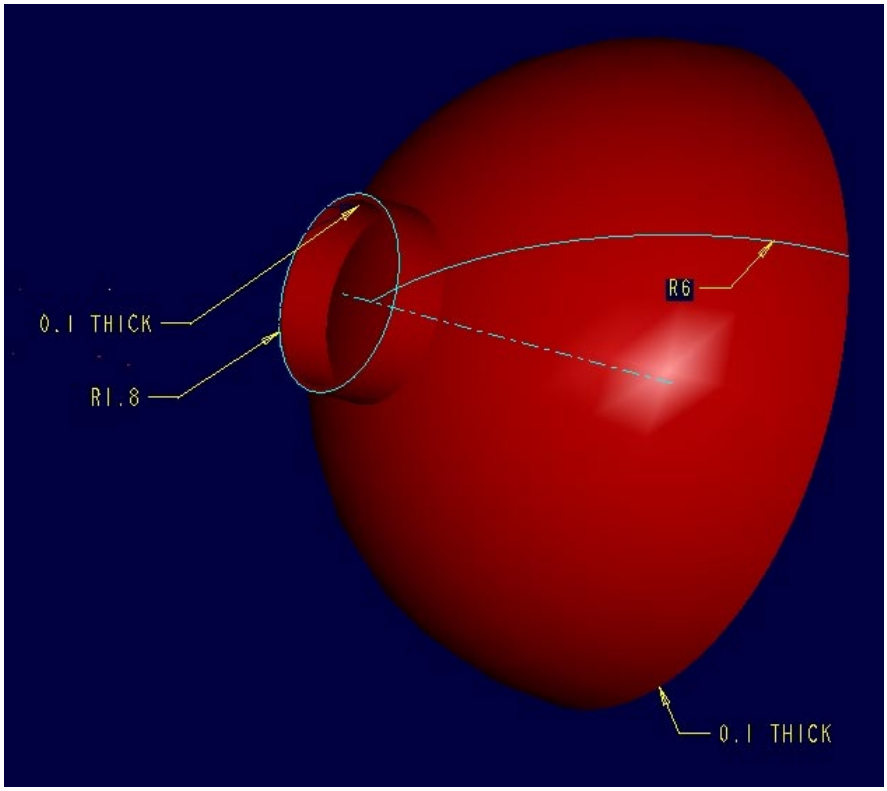


Figure 11: s1 - head_back

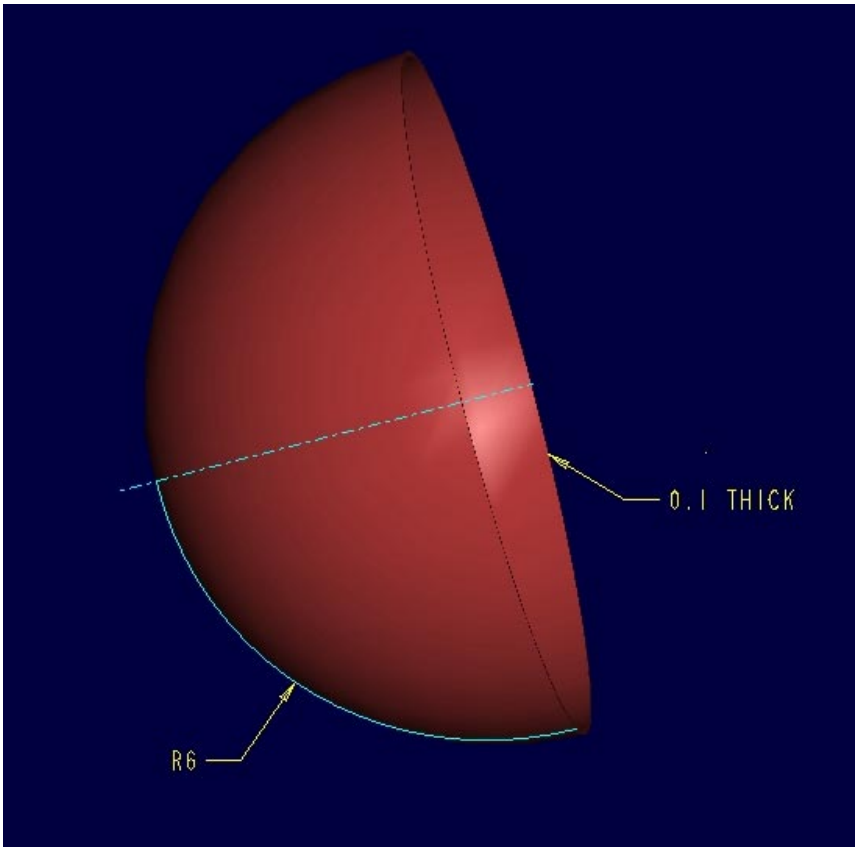


Figure 12: s1 - head_front

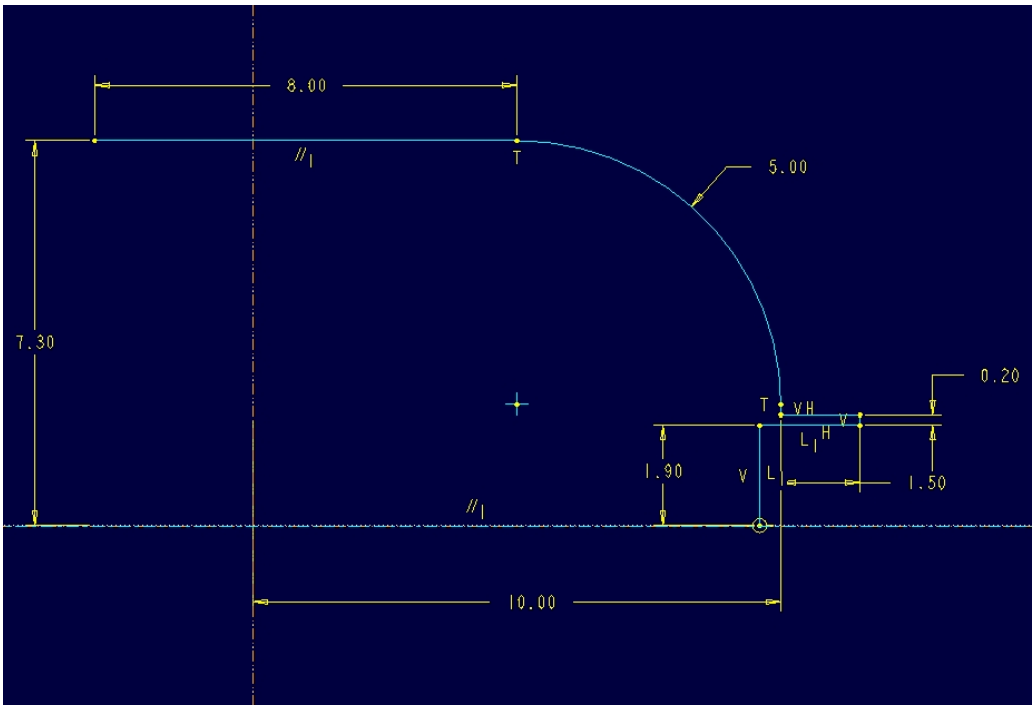


Figure 13: s1 - main_body_back

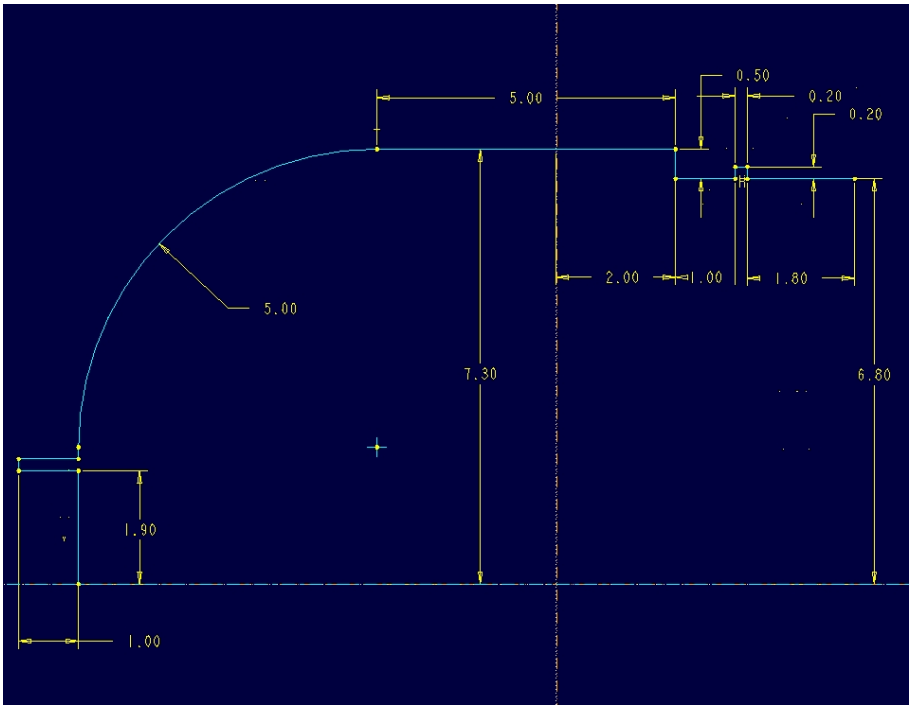


Figure 14: s1 - main_body_front

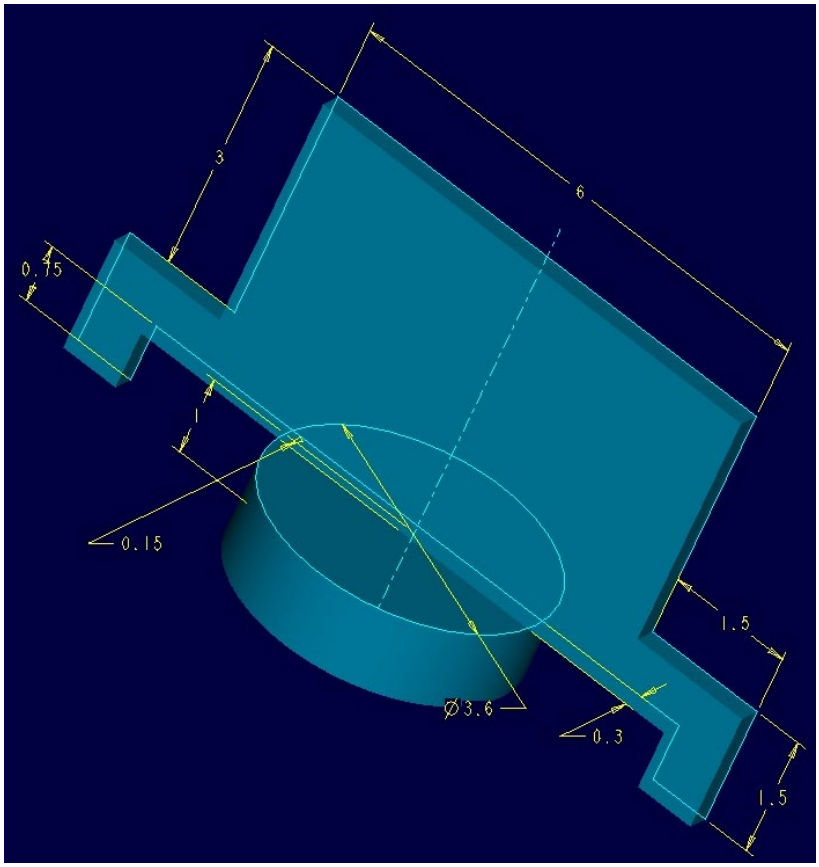


Figure 15: s1 - tail_middle_part

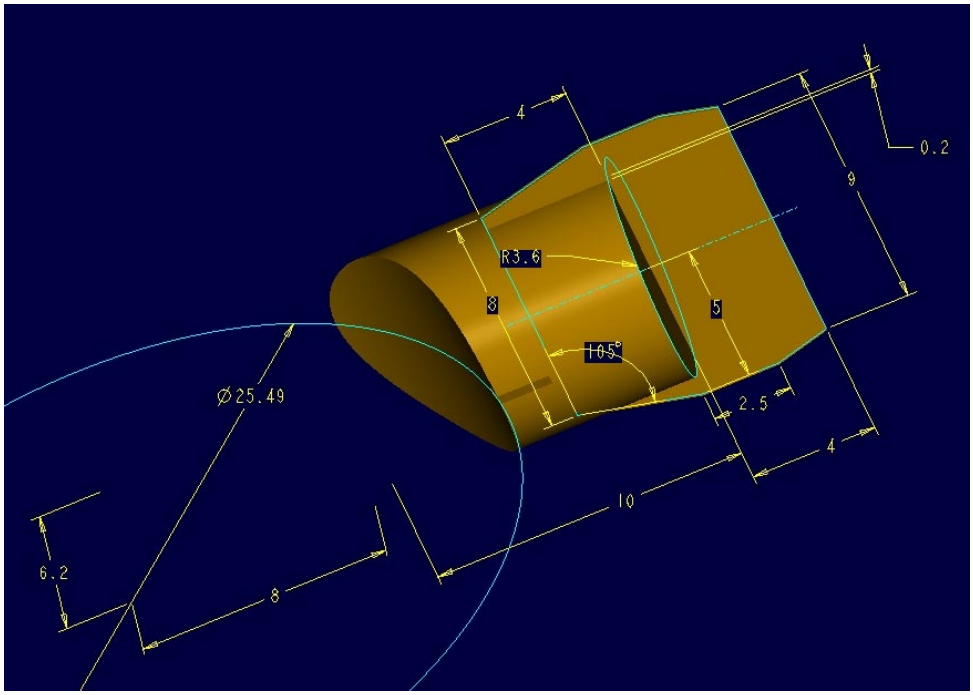


Figure 16: s1 - tail_turbine

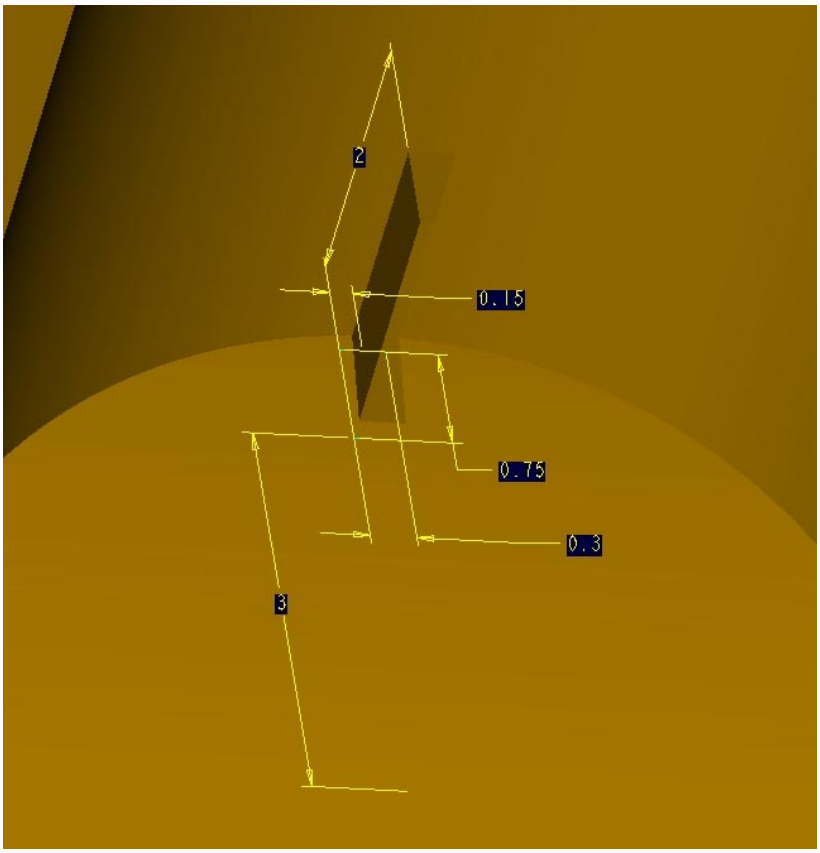


Figure 17: s1- detail nut of tail_turbine