



**Test Suite for the
CAX Implementor Forum
Round 9J**

December 2001 – March 2002

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Contacts:

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

Phil Rosché
ATI/PDES, Inc.
5300 International Blvd.
North Charleston, SC 29418 USA
rosche@aticorp.org

Contents:

1.0	Introduction	5
1.1	Functionality tested in this round.....	5
1.2	General test instructions for this round	6
1.3	Round 9J testing schedule.....	6
1.4	Copyrights on test cases.....	6
2.0	Synthetic test case specifications	7
2.1	Model C2 : Colors and 3D Annotation.....	7
2.1.1	Motivation.....	7
2.1.2	Approach.....	7
2.1.2.1	Presentation colors	7
2.1.2.2	Annotation	7
2.1.3	Testing Instructions.....	8
2.1.3.1	Model construction	8
2.1.3.2	Statistics & Screenshots	8
2.2	Model B2 : Benchmark model 'pump housing'	9
2.2.1	Motivation.....	9
2.2.2	Approach.....	9
2.2.3	Testing Instructions.....	10
2.2.3.1	Construction of the benchmark model	10
2.2.3.2	Statistics.....	10
2.3	Model IO1: AP214 IS migration.....	11
2.3.1	Motivation.....	11
2.3.2	Approach.....	11
2.3.3	Testing instructions	11
2.3.3.1	Model construction.....	11
2.3.3.2	Statistics.....	11
2.4	Joint Testcase with PDM-IF	12
2.4.1	Motivation.....	12
2.4.2	Approach.....	12
2.4.3	Testing Instructions.....	12
2.4.3.1	Model construction	12

2.4.3.2 Statistics.....	13
2.5 Joint Testcase with AP210 Group.....	13
2.5.1 Motivation.....	13
2.5.2 Approach and testing instructions	13
2.6 Solid Model Construction History	13
2.6.1 Motivation.....	13
2.6.2 Approach.....	13
2.6.3 Testing Instructions.....	14
3.0 Production models: PM7	14
3.1 Motivation.....	14
3.2 Approach.....	14
3.3 Testing Instructions.....	14
3.3.1 Models Being Tested	14
3.3.2 Statistics.....	15
4.0 Annex.....	16
4.1 Dimensions for io1 (flange) shape	16

1.0 Introduction

This document describes the suite of test cases to be used for the ninth round of testing of the CAx Implementor Forum (CAx-IF). The CAx-IF is a joint testing forum organized by PDES, Inc. and ProSTEP. 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. When production models are not available from the member companies, “production-like” models will be solicited from the various CAx-IF participants.

This test suite includes synthetic models for testing the following capabilities: surface and wireframe (curve) colors, 3D Text annotation, solid geometry exchange, AP210 interoperability, AP214 IS migration and PDM-TDM/CAD integration. If time allows, an AP 209 (Composite and Metallic Structural Analysis) file may be post processed for interoperability.

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 be imported/post-processed/read in by the rest of the participants

1.1 Functionality tested in this round

Functionality tested in this round relates to: surface and wireframe (curve) colors, 3D Text annotation, solid geometry exchange, AP210 interoperability, AP214 IS migration and PDM-TDM/CAD integration.

A simple model will be used to test the exchange of surface and curve colors, according to the updated Recommended Practices.

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

Solid geometry exchange aims for validation and improvement of the results of the 7th ProSTEP processor benchmark, using the same single piece part.

For AP210 interoperability, the goal is to import an AP210 in order to extract the included geometry, e.g. for collision testing when putting a circuit board into its casing.

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 9J of testing, CAx vendors will be processing files from the PDM Implementor Forum (PDM-IF), for a joint CAx/PDM-IF testcase (see Section 2.4) which has been defined in Round5J.

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 Round 9J testing schedule

Date	Action
December 17 th , 2001	Test Suite available / 1 st CAx Implementor Forum conference call
January 14 th , 2002	Initial STEP files and native stats due
January 28 th	STEP files and native stats frozen
February 11 th	Target stats due
February 15 th	Production Models released
February 20 th	2 nd conference call
February 25 th	Target stats frozen
March 4 th	Pre-release of final stats / 3 rd conference call
March 19 th	Review meeting for test round
March 20 th – 22 nd	CAx Implementor Forum meeting, Asheville, NC

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-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.

2.0 Synthetic test case specifications

2.1 Model C2 : Colors and 3D Annotation

2.1.1 Motivation

The objective of this test case is to formally test the exchange of surface and curve color as done in Rounds 7J and 8J, plus 3D annotation.

In order to eliminate any unwanted side effects, a very simple model is used. It will contain a colored surface and a colored curve.

This model – for the systems having implemented the annotation capability – is also used to transfer associative text. The associative text capability is fully harmonized between AP 214 and the corresponding AP 203 application extension and thus should also be interoperable.

2.1.2 Approach

2.1.2.1 Presentation colors

The assignment of the surface and curve colors shall be based on the updated Recommended Practices for Colors and Layers, which is available from the CAx-IF web sites, <http://www.cax-if.org/> and <http://www.cax-if.de/>, under 'Joint Testing Information'.

2.1.2.2 Annotation

The systems' support for associative text varies greatly. The approach recently studied with the Implementor Forum allows for:

- unstyled text in the model
- styled notes in the model
- associative notes to the model
- associativity of notes visually depicted by leader curves

The support for this functionality inside the systems varies considerably. Further variations are introduced by the target elements to which the notes can be associated in a system.

For the test of 3D annotation, a scenario with a styled text associated to a face and a visual depiction of this associativity by a leader curve will be studied. Since the underlying STEP approach is modular, those systems that cannot exactly represent such a scenario are encouraged to use closest-fits, e.g. neglect the associativity when necessary.

The recommended practices for associative text are available on the CAx-IF web sites, <http://www.cax-if.org/> and <http://www.cax-if.de/>.

2.1.3 Testing Instructions

2.1.3.1 Model construction

In order to test color and text exchange without any unwanted side effects, a very simple geometry is used. The model should contain:

- A single surface with surface color.
- A separate curve with curve color.

This model is also used to test the exchange of 3D annotations, for systems supporting this functionality. Recommendations to set up the text in the model:

- Include two annotations in the model, one single-line text and one multi-line text.
- Style the two texts with an arbitrary color.
- The two annotations should be associated to portions of the model, e.g. the surface or an edge.
- Select an arbitrary placement of the text

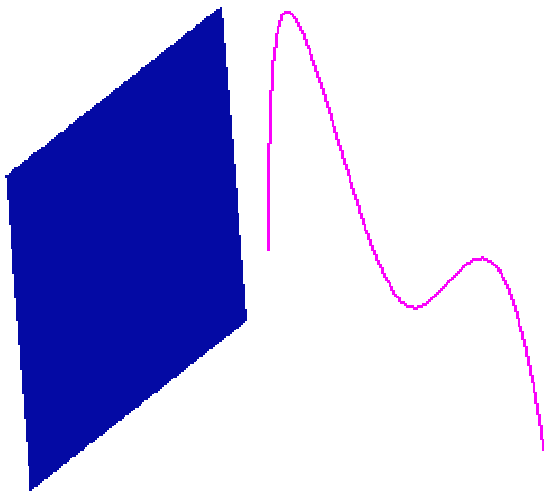


Figure 1: Example for a simple surface and a curve with different colors..

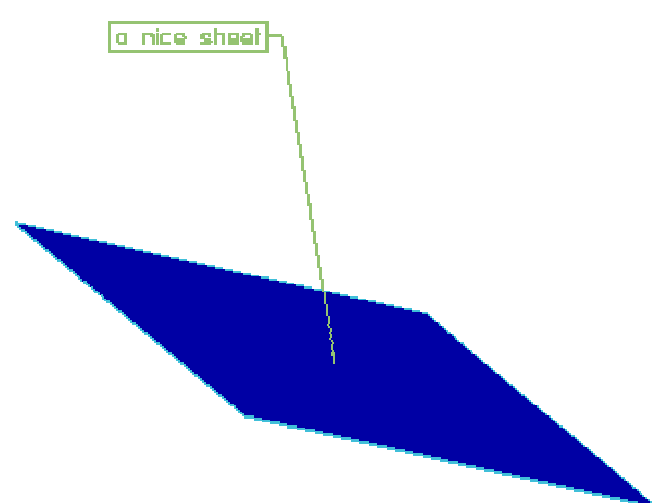


Figure 2: For system supporting this, 3D annotations may included in and associated to the model.

Note: The colors and shapes of the curve and surface don't necessarily need to be as shown on the figures above.

2.1.3.2 Statistics & Screenshots

With each STEP file submitted for c2, vendors must include a text file with the stats in comma-delimited form (.csv):

model	<i>c2</i>
system_n	<i>Native system code</i>
system_t	<i>Target system code (for native stats use 'stp' for system_t)</i>
unit	<i>Units</i>
area	<i>Total area of the surface.</i>
color_surf	<i>all/partial/none – if the color of the surface in the model is totally correct, partially correct , or lost completely.</i>
color_curve	<i>all/partial/none – if the color of the curve in the model is totally correct, partially correct , or lost completely.</i>
color_t1	<i>Text color used for the single-line text.</i>
color_t2	<i>Text color used for the multi-line text.</i>
valid_txt	<i>all/partial/none – whether the specified texts appear in the model Note: na indicates vendor is not testing associative text</i>
valid_txt - assoc	<i>all/partial/none – whether the association of the text to the elements of the geometric model as described above is correct Note: 'na' indicates vendor is not testing associative text</i>
date	<i>Date submitted</i>
issues	<i>Short description of issues</i>

In order to validate the color exchange on a visual basis, vendors are asked to send in a screenshot for their native model and one for each imported C2 to jboy@prostep.de. These pictures will then be published in the secure area of the CAX-IF web sites (<http://www.cax-if.de/secure/> and <http://www.cax-if.org/secure/>).

Please use the naming convention suggested in v1.2 of the General Testing Guidelines.

2.2 Model B2 : Benchmark model 'pump housing'

2.2.1 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 7th 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.

2.2.2 Approach

No new capability involved.

2.2.3 Testing Instructions

2.2.3.1 Construction of the benchmark model

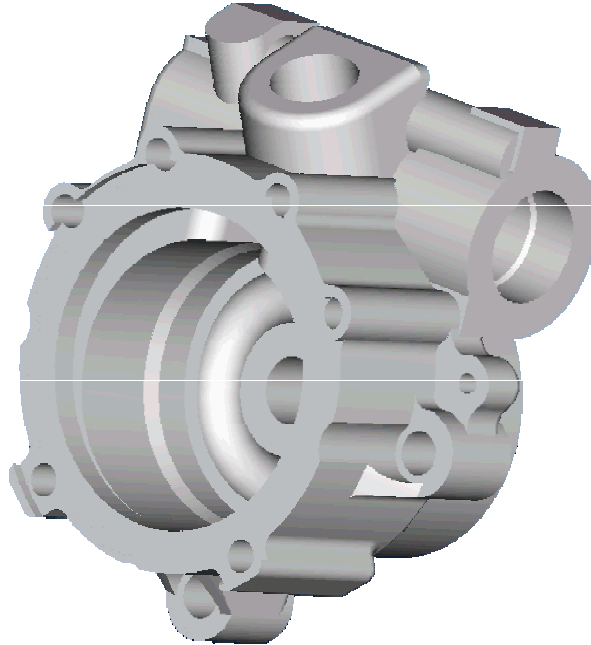


Figure 3: Shape of the B2 model (pump housing)

Those vendors who participated in the ProSTEP benchmark should re-use the pump 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 Round9J of Testing'.

2.2.3.2 Statistics

With each STEP file submitted for the b2 model, vendors must include a text file with the stats in comma-delimited form (.CSV):

model	<i>b2</i>
system_n	<i>Native system code</i>
system_t	<i>Target system code (for native stats use 'stp' for system_t)</i>
unit	<i>Units</i>
volume	<i>Total volume of all solids</i>
area	<i>Total surface area</i>
cx, cy, cz	<i>Centroid of all solids</i>
date	<i>Date submitted</i>
issues	<i>Short description of issues</i>

2.3 Model IO1: AP214 IS migration

2.3.1 Motivation

The intention of this testcase is give implementers the opportunity to test their AP214 IS-based processors, and as well offer the chance for AP214 DIS vs. IS interoperability testing.

2.3.2 Approach

Part21 files sent in for this model shall be based on the AP214 IS EXPRESS schema which is available from the CAX-IF web sites, <http://www.cax-if.org/> and <http://www.cax-if.de/>, under 'Joint Testing Information'.

2.3.3 Testing instructions

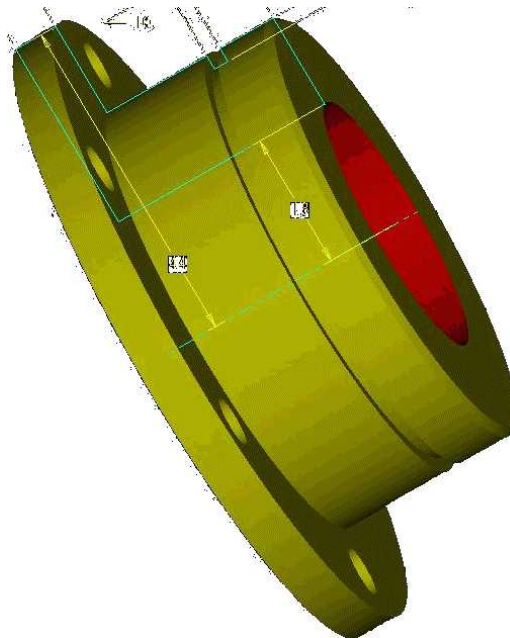


Figure 4: Shape of the io1 model (flange)

2.3.3.1 Model construction

Construct the flange as one solid. For dimensions see figures in the annex.

2.3.3.2 Statistics

With each STEP file submitted for the io1 model, vendors must include a text file with the stats in comma-delimited form (.CSV):

model	<i>io1</i>
system_n	<i>Native system code</i>

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

2.4 Joint Testcase with PDM-IF

2.4.1 Motivation

This test case is an extension of the well-known AS1 or S1 model, which has been tested several times before, and it 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 Round9J, the PDM Implementor Forum will submit the files which will then be **imported only** by all CAx vendors testing this functionality. The geometry (leaf node) files may not be included. The CAx vendors should then report which references could be found.

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/). Recommended Practices for External References with annotated, relevant sections of the Usage is available on the CAx-IF site (http://www.cax-if.org/joint_testing_info.html and http://www.cax-if.de/joint_testing_info.html).

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 Round8J, the files will be provided by the PDM vendors, based on the test cases 'dman1', 'dman2', 'er3' and 'er4', defined in Round5J. All CAx vendors supporting external reference capability should import those files and submit the results they receive.

2.4.3.2 Statistics

There are no formal stats like in the other test cases for the joint testing. Instead, there is a catalogue of questions to be answered. The results shall be fed back directly to the PDM-IF at peter.tabbert@prostep.de. A template document containing the questions to be answered will be available from the secure areas of the CAx-IF web sites (<http://www.cax-if.org/secure/> and <http://www.cax-if.de/secure/>), under 'Information on Round6J of Testing'.

2.5 Joint Testcase with AP210 Group

2.5.1 Motivation

Basis for this common testcase is the illustration of a business case, where the shape information of a circuit board should be extracted from an AP210 file and then be converted to an AP203 or AP214 detail/part or assembly, in order to use it for a build-in-test, i.e. checking for collisions when putting the circuit board into its casing, of which the geometry information is available as a STEP solid.

2.5.2 Approach and testing instructions

The AP210 file(s) should be imported and the geometry information should then be excerpted. A testcase description will be given by the AP210 group, to which all results should be fed back.

2.6 Solid Model Construction History

2.6.1 Motivation

Solid Model Construction History has been identified as a major field of interest in future test activities of the CAx-IF. Several aerospace, computer, and automotive companies have identified requirements to exchange solid model construction history using STEP to enable design modification in the receiving system while maintaining parametric relationships. That capability is discussed in this Implementor's Guide for Solid Model Construction History. This version includes procedural or history-based modelling constructs and operations, which can be used to extend capabilities of existing APs.

Since implementations in that field still are on a pilot level with only few vendors participating and a limited scope, it has been agreed the Construction History is not yet to be run as a full-blown CAx-IF test case. However, any vendor interested in that field is greatly welcome and encouraged to join the activities in that direction.

2.6.2 Approach

See the approach described in the 'Implementor's Guide for Solid Model Construction History', available on the CAx-IF sites (http://www.cax-if.org/joint_testing_info.html and http://www.cax-if.de/joint_testing_info.html), as well as the EXPRESS schema and the Part21

file example, also available from the above mentioned location. Any questions about testing this functionality should be directed to Dr. Bill Anderson (anderson@aticorp.org).

2.6.3 Testing Instructions

All information on construction of the model and implementation of the construction history functionality may be found in the Implementor's Guide mentioned above.

3.0 Production models: PM7

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 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 <9j_pm7.zip> containing the STEP files (with files names as in the table) is available from the CAx-IF sites in the secure area.

Model	Originating System	Schema	STEP File Name (in ZIP file)
Electric Motor	CATIA V5	214	pm7-ct-214.stp
Ed's Activity Tray	I-DEAS	214	pm7-id-214.stp
Oil Pan	Inventor	214	pm7-in-214.stp
Drive Actuator	Theorem (I-DEAS)	203	pm7-ts-203.stp
Turbine Blade	Unigraphics	214	pm7-ug-214.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	<i>pm7</i>
system_n	<i>Native system code (use the native system code for each model listed in the table in Section 3.3.1)</i>
system_t	<i>Target system</i>
unit	<i>Units</i>
volume	<i>Total volume</i>
area	<i>Total surface area</i>
cx cy cz	<i>Centroid</i>
date	<i>Date submitted</i>
issues	<i>Short description of issues</i>

4.0 Annex

4.1 Dimensions for io1 (flange) shape

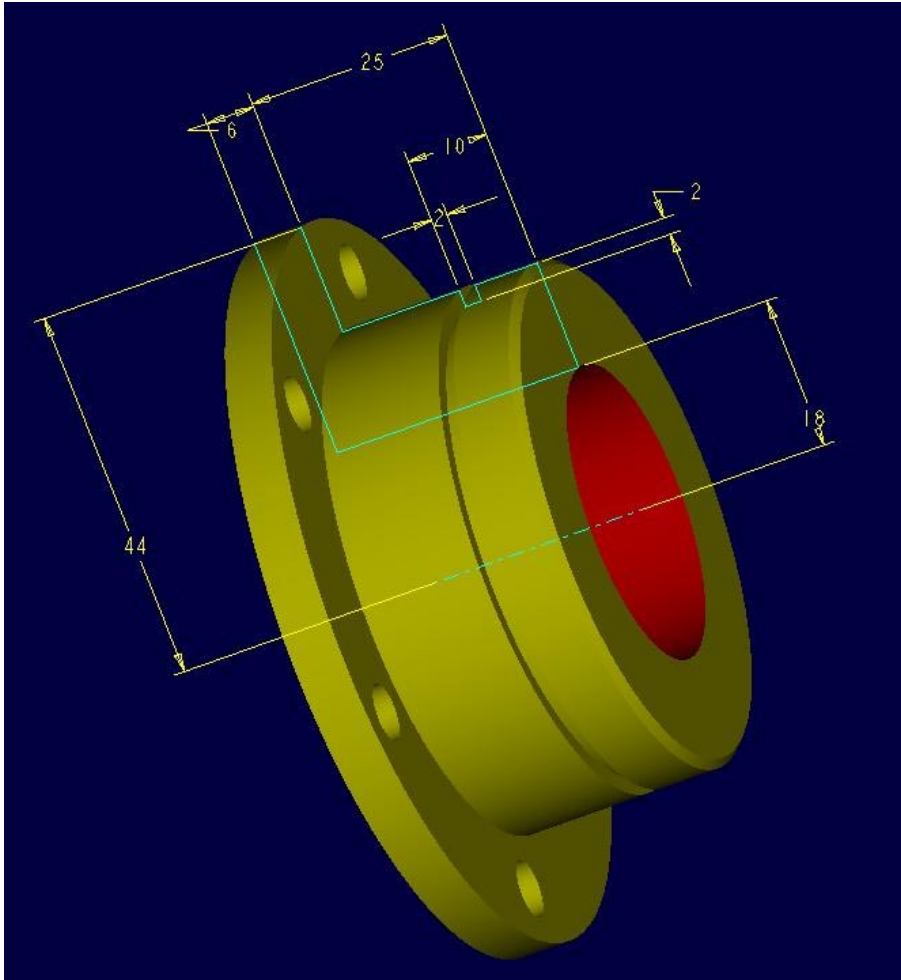


Figure 5: io1 shape

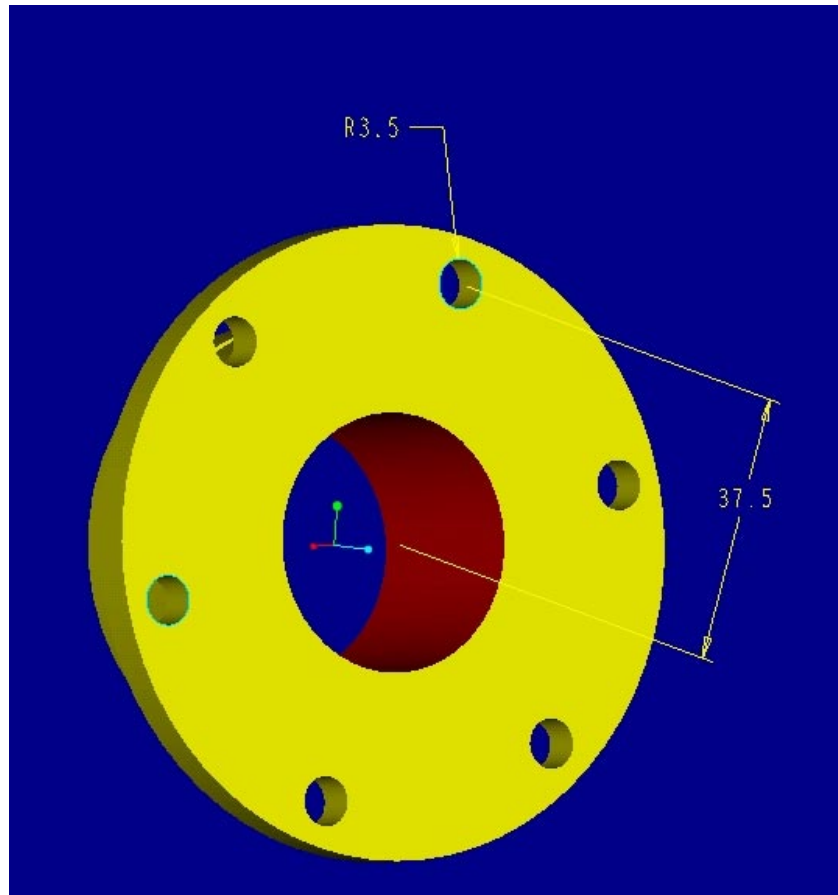


Figure 6: io1 – profile