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STandard for the Exchange of Product model data (STEP): Procedures for NIST STEP Validation

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AND TECHNOLOGY
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ABSTRACT

The standard for Product Data Representation and Exchange, ISO 10303, defines a neutral, computer-interpretable representation for describing product data in a manner that is independent from any particular system. This standard is more commonly known as STEP, STandard for the Exchange of Product model data and it is designed to support a wide range of design, engineering, and product support applications. STEP was adopted verbatium as an American National Standard (ANS) titled Product Data Exchange using Step, ANSI USPRO 200. Support for specific applications is provided through an Application Protocol.

This document provides general procedures for the National Institute of Standards and Technology's (NIST) FIPS for STEP Validation Service. The Validation Service provides a way of determining the degree to which an implementation conforms to the proposed FIPS for STEP. The goal of the Validation Service is to maximize the probability of successful interchange among systems which implement the same STEP application protocol.

1 Introduction

1.1 Purpose

This document establishes operating procedures for administering the Computer Systems Laboratory's (CSL) validation program for proposed Federal Information Processing Standards (FIPS), Standard for the Exchange of Product Model Data (STEP). It addresses the requirements and policy for NIST certification of STEP implementations. The testing methodology is prescribed by ISO 10303, Product Data Representation and Exchange. The conformance testing process is documented in ISO 10303-31, *Conformance testing methodology and framework: General concepts* and NISTIR 5535, *Initial NIST Testing Policy for STEP - Beta Testing Program for AP 203 Implementations".* NISTIR 4743, *Issues, Requirements, and Recommendations for a STEP Conformance Testing Program* provides additional background information.

1.2 Background

The National Institute of Standards and Technology (NIST), Computer Systems Laboratory (CSL) is responsible for establishing conformance testing programs for Federal Information Processing Standards (FIPS). The authority for this responsibility is assigned under the Federal Property and Administrative Services Act of 1949, as amended by Public Law 100-235. The NIST National PDES Testbed within the Manufacturing Engineering Laboratory (MEL) and the Industrial Technology Institute's (ITI) Center for Electronic Commerce (CEC) have developed a conformance testing program for STEP Application Protocol (AP) 203: Configuration Controlled 3D Design for Mechanical Parts and Assemblies. Although working together, the conformance testing program is a NIST/MEL responsibility, whereas NIST/CSL is responsible for certification under the FIPS.

The testing of STEP implementations to determine the degree to which they conform to the federal standards may be required by government departments and agencies in accordance with with Federal Information Resources Management Regulation (FIRMR) 201-20.303, 201-20.304, 201-39.1002, the associated Federal ADP and Telecommunication Standards Index, and as specified by the proposed Federal Information Processing Standard Publication (FIPS PUB) for STEP. The testing information available from NIST aids Federal procurement authorities, as well as industry, in determining if the STEP implementations offered to the government comply with the Government's requirements for FIPS.

Conformance testing and certification is an essential step towards achieving interoperability. It maximizes the probability of successful exchange among systems which implement a standard. Moreover, conformance testing provides a functional and fiscal advantage to suppliers of commercial products and users of these products. Benefits include:

- Reducing costs by making it more predictable and less expensive to maintain software applications and transfer information among applications using different information systems;

- Providing users with increased confidence and expanded freedom in procuring commercial off-the-shelf products that meet the requirements in the standard;

- Assisting suppliers to detect deficiencies in their products and upon validation, stimulating sales to both government and industry.

1.3 Definitions

The following terms are used throughout this document.

Abstract test suite - a set of test cases necessary for conformance testing of an implementation of an application protocol.

Application Protocol (AP) - a part of ISO 10303 that specifies the data structures and semantics which satisfy the scope and information requirements of a specific application.

Certificate of Validation — a certificate that acknowledges compliance of an implementation to a FIPS PUB.

Client — anyone requesting conformance testing services.

Compliance — the state of the implementation for which correct test results were obtained using the applicable version of the test suite.

Conformance testing — the testing of a product for the existence of specific characteristics required by a standard in order to determine the extent to which that product is a conformant implementation.

Control board — the body of STEP and/or validation experts who resolve disputes concerning the correctness of the test suite with respect to the STEP standard.

Implementation under test — the product which is to be evaluated by testing and which implements the characteristics of the standard(s).

Registered Test Report - the document which presents the test results and other information relevant to the tests. Once all validation processing steps have been completed, the report is listed on the *Validated Products List (VPL).*

Test environment — the combination of computer hardware, software, network connections, etc., used during the testing process.

Test Laboratory — the organization that performs the validation. A testing laboratory can be a third-party testing laboratory, a user organization, or an independent unit of a supplier organization.

Validated Products List — the list published by NIST of computer products that have been validated for conformance to a specific FIPS PUB.

Validation — the process of testing for conformance to a specific standard.

2 General Concepts

2.1 Scope of validation

Validation is the process of testing an implementation for conformance to a specific standard. Certification is the administrative activity of recognizing an implementation has demonstrated conformance to a standard, and of publicly registering the test results.

In particular, current STEP validation is the testing of implementations for conformance to a specific STEP Application Protocol. If compliance is demonstrated, a Certificate of Validation is issued. Regardless of whether a certificate is issued, a Registered Test Report is produced for every validation performed. The Certificate of Validation and/or Registered Test Report verifies that the implementation has been tested using the NIST recognized STEP Conformance Test Suite for the proposed FIPS for STEP and that the test results obtained have been validated by NIST.

2.2 Application protocols and conformance classes

Support for specific application areas is provided through Application Protocols (AP). An AP specifies the information requirements for data exchange, the data representation, and the conformance requirements to support the applications. APs are defined in ISO 10303 200-series documents. A set of tests, specified in an abstract test suite, is defined for each AP.
Clients must indicate the AP for which testing is desired.

An AP uses at least one implementation method (ISO 10303-20 series document). An implementation method specifies the technique and data representation used by implementations to exchange or share product data. An AP may include implementation method specific information and requirements.

Within the AP, conformance classes are specified. A conformance class defines a subset of the AP for which conformance may be claimed. The client's implementation may be tested for conformance to one or several conformance classes. The scope of the conformance testing performed is based on the conformance class(es) claimed as supported by the client. A conforming implementation must support all the requirements within a conformance class. The

conformance classes for which a claim of conformance is sought, are listed in the test report and certificate.

2.3 Testing and validation services

A STEP testing program is designed to test for a specific AP and implementation method. It is expected that there will be distinct testing programs for the different APs and implementation methods, and that the testing programs may be developed and performed by different testing laboratories. A testing laboratory may be a third-party laboratory, government agency, user organization, or an independent unit of a supplier organization. For AP 203, the testing program will initially be performed by NIST, with the intent to transition to accredited testing laboratories. A list of FIPS for STEP testing laboratories is available from NIST[1]. The testing program will be available to government agencies and industry.

The STEP Validation Service for proposed FIPS for STEP will be conducted by NIST. As part of the validation service, the NIST/CSL and NIST/MEL will be responsible for managing and coordinating the testing and certification programs, including reviewing test reports and the issuance of certificates of conformity.

2.4 Validated Products List (VPL)

NIST/CSL publishes, on a quarterly basis, a Validated Products List that is a collection of registers describing implementations of Federal Information Processing Standards that have been validated for conformance to FIPS. The VPL contains information about the organizations, test methods, and procedures that support the validation programs for the FIPS identified in this document. The VPL is intended to serve as an index to more detailed information.

For STEP, the VPL will list those implementations that have completed conformance testing and received a Certificate of Validation and/or Registered Test Report. The VPL entries are a limited extract from the Registered Test Report. It is recommended that the Registered Test Report, available from NIST or the testing laboratories, be obtained for the complete test results.

The *Validated Products List* may be obtained by request from:

National Technical Information Service
United States Department of Commerce
5285 Port Royal Road
Springfield, VA 22151

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[1] A list of Testing Laboratories is available from NIST/CSL and NIST/MEL, in the VPL, or on the STEP ON-Line Information System (SOLIS).

Phone: (703) 487-4630
Order Number: PB93937303/AS

The *VPL* may be accessed electronically using MOSAIC or FTP on the World Wide Web. The MOSAIC address is http://speckle.ncsl.nist.gov/vpl/html/intro.vpl.

To access the *VPL* using FTP:

Type: ftp speckle.ncsl.nist.gov (internet address is 129.6.59.2)
Login as user ftp
Type your email address preceded by a dash (-) as the password
Type: cd vpl
Type: binary
Type: get and the name of the file you want (e.g., graphics)

2.5 Role of the procuring agency

The procuring agency has the responsilbity of reviewing the STEP validations listed in the VPL and determining the applicability of these validations to the hardware/software environment involved in a specific procurement. The criteria for applicability of a Certificate or Registered Test Report should be appropriate to the size and timing of the procurement.

2.6 Caveats

Validation testing does not warrant that the implementation tested will perform according to all the client's assertions. Validation only specifies that the implementation was tested and that the test results passed the requirements of the proposed FIPS for STEP.

Validation testing does not warrant that the implementation tested is free of nonconformities, even if all tests are passed. The practical goal of STEP validation is to identify STEP implementations which may be procured and used to develop applications which meet the FIPS goals of portability and interoperabilty. The test method, known as falsification testing, is not an exhaustive testing of permutations of features. Rather the test suite contains a carefully-chosen set of test cases which cover the required syntax and demonstrate the correct implementation of each of the applicable rules of the standard.

The STEP Test Suite is not designed to replace the client's quality assurance testing. The primary technical goal of the STEP validation testing is to verify that the STEP implementation correctly supports all required features of the proposed FIPS for STEP.

Validation is not intended as a means of performance benchmarking. The results of testing do not contain information about the speed, cost, or efficiency of executing the test cases.

3 Validation by Testing

3.1 Overview

The process of validation by testing consists of a test laboratory conducting the conformance tests on a Client's implementation and reporting the results of that testing in a test report. If the testing and validation procedures are followed and the test report and supporting documentation shows that the tested implementation demonstrated conformance to the standard, a Certificate of Validation and Registered Test Report is issued for the implementation on the computer environment tested.

A certificate is only issued if there are no errors detected by the validation process. For implementations that have been tested and contain errors, a Registered Test Report without a certificate will be issued. A Certificate of Validation is valid for two years; a Registered Test Report, without a certificate, is valid for one year. Generally, a Client must receive a Certificate of Validation or Registered Report in order for the Client's implementation to be procured by federal agencies.

For details of the testing process see ISO 10303-31, *Conformance testing methodology and framework: General concepts*, ISO 10303-32, *Conformance testing methodology and framework: Client and testing laboratory requirements*, and NISTIR 5535, *Initial NIST Testing Policy for STEP - Beta Testing Program for AP 203 Implementations.*

3.2 Test environment identification

All products are tested as part of a specific system environment. The environment includes the hardware, software, and communication network required to support the implementation to be tested. The client will identify the product as well as the test environment on a form provided by the testing laboratory. This information will be included on the Certificate of Validation and Registered Test Report.

3.3 Test Report

The results of the validation testing are documented in the test report. In addition to documenting the implementation under test and the test environment, the report contains:

- information on the testing program and test suite version;
- record of what tests were performed, the status of each test, and the verdict (pass/fail results) assigned to each test result;
- information related to test preparation and execution (e.g., changes made to the test suite in order to install implementation-dependent code);

- any additional information gathered during the validation process (e.g., product description form).

The information for the test report is based primarily on test results obtained by a NIST recognized testing laboratory, witnessing the execution of the STEP AP test suite on the client's implementation. A draft test report and Notification of Conformance form is sent to the Client. (An example of the notification form is provided in Appendix A). The Client should review the report and return the signed notification form to NIST. Once the signed notification form is received, the test report becomes final, is designated as a Registered Test Report, and is entered on the *Validated Products List.*

A test report will be issued for all completed validations. Until the report is finalized, all information concerning the validation is kept confidential. If the Client does not wish to release the Registered Test Report information, the client should indicate the desire for extended confidentiality. If the notification form is not signed or returned to NIST, then no further action regarding the validation will be taken. For more information on confidentiality and publication of results, see section 5.6.

3.4 Certificate of Validation

A Certificate of Validation is issued and listed in the VPL if the following criteria are met:

- The validation was performed by a NIST recognized testing laboratory;
- The implementation has been tested with the latest official release of the appropriate test suite;
- A final test report has been prepared reporting the results of validation testing;
- The implementation has successfully passed all test cases with a verdict of 'pass';
- All validation processing steps have been completed.

A Certificate of Validation is issued for a STEP implementation if the implementation passed all required test suite tests for the applicable AP and conformance class(es). A Certificate of Validation is valid for two years.

3.5 Renewal of a Certificate of Validation

A Certificate of Validation may be renewed annually, if the following conditions are met:

1. The Client certifies no changes have been made to any component of the implementation.
2. The Client certifies any changes made in the supporting operating system do not alter the function or operation of the implementation.

3. The testing program (including the standard and executable test suite) has not changed substantially since the last validation was performed.

4 Registration

4.1 Overview

The rationale for validation by registration is that an implementation may function identically on multiple computer system environments. As an alternative to formally validating each and every environment, validation by registration allows the Client to self-test additional computer system environments. Validation by registration provides the Client a low cost method for testing these additional environments and registering them in the *VPL*.

Validation by registration is only available for clients whose implementation has been formally validated by NIST. The self-tested environment is validated against the formally validated implementation. Compliance is demonstrated if the output from the self-tested environment is identical to the output from the formally validated implementation.

The process of validation by registration consists of a client conducting the conformance tests, evaluating the results, and sending the results to NIST for inspection. In order to perform the self-testing, the client must have a copy of the latest version of the appropriate test suite and test software. If the registration criteria are met, the additional environments are added to the *Validated Products List* as a registered environment.

All self-tested environments are subject to challenge by NIST and other interested parties (such as procuring Federal agencies). If the NIST inspection reveals that a self-tested environment does not behave in accordance with the submitted validation material, all entries in the VPL for self-tested environments dependent on the formally validated implementation are stricken.

4.2 Registration criteria

1. The client's certificate of validation or registered report has not expired.

2. The client submits a request for registration.

3. The client conducts the conformance testing.

4. The client submits a signed statement along with all testing outputs, affirming that the results were obtained from the self-tested environment and are identical to the results obtained from the formally validated implementation.

5 Administrative Procedures

5.1 Submitting implementations for validation

The FIRMR refers to the Index that provides terminology for agencies to use when incorporating FIPS in Government procurement. This terminology requires that STEP implementations entering the Federal Government inventory be validated. This requirement may be satisfied by supplying a current Certificate of Validation for the STEP Implementation, or, at the option of the procuring agency, temporarily satisfy this requirement by submitting the STEP implementation for validation.

The phrase "submission for validation" used in the Index means that a letter has been received by the test laboratory requesting that the STEP implementation be validated for the purposes of offering the implementation to the Government. When such a request is received, the test laboratory will send the requestor a letter acknowledging receipt of the request and indicate the month in which validation testing is scheduled to take place. This letter may be offered to Government departments and agencies as proof of submission for validation.

5.2 Requests for Validation

A request for validation services shall be in the form of a letter or Request for Validation form (Appendix B) to any of the approved test laboratories. NIST may be contacted at the following address to receive a list of the approved test laboratories:

National Institute of Standards and Technology (NIST)

NVLAP Office
Building TFR Room A162,
Gaithersburg, MD 28099
(301) 975-4017

A list of approved test laboratories is also available electronically on the STEP On-line Information System (SOLIS). SOLIS access information is contained in NISTIR 5511, *The IGES/PDES Organization STEP On-Line Information Service (SOLIS).*

5.3 Disputed and Withdrawn Tests

Questions regarding the interpretation of the standard and the validity of the tests should be forwarded in writing to NIST, along with associated rationale and detailed documentation. NIST, testing laboratory, and the Client will attempt to resolve these issues informally. If no resolution is reached, NIST will refer the question to the Control Board for a ruling.

A Test Method Control Board will be employed to arbitrate any disputes arising from the performance of testing in accordance with the FIPS and the approved test method.

The test results are not issued by NIST until all outstanding disputes have been resolved by the Control Board. If the test is judged to be invalid, the offending test will be corrected or withdrawn, and the Registered Test Report altered to reflect the ruling.

5.4 Pricing

The STEP Validation Test Service validations are to be performed on a cost-reimbursable basis. No work will be performed until funding authorization has been received. The testing laboratory will determine the fee for the testing service. A NIST administrative fee of $1000 per validation will be submitted by the testing laboratory to NIST for the evaluation of the test results. This fee will be included within the fee the testing laboratory charges for the testing service.

5.5 Cancellation

Once the validation process has begun, the client agrees to reimburse NIST for any expenses incurred in preparation or performance of the validation. In the event that NIST cancels the validation due to nonsupport by the client or failure of the client to perform in a reasonable manner, the client agrees to pay NIST for all validation expenses.

5.6 Release of validation information

Until a Registered Test Report is finalized and a Notification of Conformance form is receive, NIST will treat all information concerning the validation to be confidential.

5.6.1 Publication and proprietary data

In general, NIST shall have the right to use all information gathered in the course of developing and administering a validation for any governmental purpose but shall not release such information publicly except: (1) When reporting on the results of testing, NIST may provide information, subject to the provisions of the subparagraphs below; and (2) as required pursuant to a request under the Freedom of Information Act (5 U.S.C. Section 552).

5.6.2 Proprietary data

The client shall place a Proprietary notice on all information delivered to NIST that the client asserts is proprietary. Any information designated as proprietary that is furnished to NIST, shall be used by NIST only for the purpose of carrying out validations. Information designated as proprietary shall not be disclosed, copied, reproduced or otherwise made available in any form to any other person, firm, corporation, partnership, association, or other entity without the consent of the client except as such information may be subject to disclosure under the Freedom of Information Act (5 U.S.C.522). NIST will use its best efforts to protect information designated as proprietary from unauthorized disclosure.

5.6.3 Publication

Registered Test Reports completed by NIST shall be made available to the public. In no event, however, shall the name of the client or any of its trademarks and trade names be used in NIST

publications without the client's prior written consent. With respect to publication in the VPL, the Notification of Conformance shall contain the client's written consent.

NIST and the client shall agree to confer and consult prior to the publication of data to assure that no Proprietary Data is released and that patent rights are not jeopardized. Prior to publishing a Registered Test Report, the client shall be offered an opportunity to review such proposed publication.

Appendix A

Example of NOTIFICATION OF CONFORMANCE

The information below and test will be part of the Registered Test Report and listed on the NIST register (VPL) of tested STEP implementations.

The STEP implementation identified in this notification has been tested for comformance the proposed FIPS for STEP. This notification and associated Test Report should be reviewed for identification of the implementation, test environment, implmentation-defined specifications, and test case verdicts.

Registered Report Number:	**NIST-96/000**
Month of Issue:	**April 1996**
Client:	**Name of Corporation** **Address**
Client Representative:	**Name of representative**
STEP Implementation:	**Name of product**
Test Environment:	
Hardware Platform	**Computer**
Software Platform	**Operating system, and other software**
Other Components	
Testing Interfaces	**Networks, etc**
Federal Information Processing Standard Publication	**proposed FIPS PUB for STEP**
STEP Application Profile	**AP 203**
Conformance Class	**1, 3**
Testing Completed on:	**Date**
Testing Laboratory:	**NIST** **Gaithersburg, MD 20899**
Validation System:	**STEP AP 203 Test Suite, version X**
Test Results:	**No errors detected**

The client declares that the STEP implementation specified above was tested in the described environments for conformance to the given FIPS for STEP and application protocol.

The client's signature acknowledging acceptance of this Notification is required before the Certificate of Validation and Registered Test Report can be issued.

Signed: Date

Type Name Title

Appendix B
Example of a Request for Validation Form

STEP Validation Request

Company Name _____
Address _____

_____

_____

1. Product to be validated:
   Name/Version # _____

   _____

2. Test Environment:
   Hardware Platform _____
   Software Platform _____
   File exchange (e.g., network, dos floppy, tar tape) _____

3. Validation Location: _____
   (if different from above) _____

4. Validation month: Desired month _____ Alternate month _____
   Deadline (if any) for completion of validation _____
   Validation is requested for a specific RFP (yes/no) _____

5. Points of Contact:
   Contractual _____ Telephone _____
   Technical _____ Telephone _____

This is not a commitment for a validation. The undersigned will be contacted by the test laboratory to discuss procedures, scheduling, and cost.

Signature _____ Date _____
(printed name) _____ Telephone _____

Appendix C

Source of Documents

US PRO, care of National Computer Graphics Association, P.O. Box #S, 2722 Merrilee Drive, Suite 200, Merrifield VA, Telephone: (703)698-9600, ext. 325, Fax: (703)560-2752.

ISO 10303-1:1994, *Industrial automation systems and integration - Product data representation and exchange* - Part 1: Overview and fundamental principles.

ISO 10303-21:1994, *Industrial automation systems and integration - Product data representation and exchange* - Part 21: Implementation methods: Clear text encoding of the exchange structure.

ISO 10303-31:1994, *Industrial automation systems and integration - Product data representation and exchange* - Part 31: Conformance testing methodology and framework: General concepts.

ISO 10303-32:1994, *Industrial automation systems and integration - Product data representation and exchange* - Part 32: Conformance testing methodology and framework: Client and testing laboratory requirements.

ISO 10303-203:1994, *Industrial automation systems and integration - Product data representation and exchange* - Part 203: Application Protocol: Configuration Controlled 3D Design for Mechanical Parts and Assemblies.

National Institute of Standards and Technology (NIST), Manufacturing Engineering laboratory, Building 220 Room A127, Gaithersburg, MD 20899, telephone: (301)975-3983, fax: (301)258-9749.

Issues, Requirements, and Recommendations for a STEP Conformance testing Program, NISTIR 4743, January 1993.

STEP On-line Information System (SOLIS), NISTIR 5511, October 1994.

Initial NIST Testing Policy for STEP - Requirements for Conformance Assessment of AP 203 Implementations, NISTIR 5535, November 1994.

National Institute of Standards and Technology (NIST), Computer Systems Laboratory, Building 225 Room B64, Gaithersburg, MD 20899, telephone: (301)975-2816.

proposed *FIPS PUB for STEP*

National Technical Information Service (NTIS), U.S. Department of Commerce, 5285 Port Royal Road, Springfield, VA 22151, telephone (703)487-4650.

Validated Products List, order number PB94-937304/AS.