Serial ATA International Organization:

Serial ATA Interoperability Program Revision 1.1 Policy Version 1.0

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Serial ATA International Organization: Serial ATA Interoperability Program Unified Test Document is available for download at www.sata-io.org.

For more information about Serial ATA, refer to the Serial ATA International Organization website at www.sata-io.org.

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1. Overview

This document describes the policies and procedures developed for the Serial ATA Interoperability Program revision 1.1 by the Serial ATA International Organization (SATA-IO). The detailed Serial ATA specification requirements and Integrators List (IL) requirements will not be outlined in this document.

1.1. References

The policies and procedures defined here are constructed in reference to the following other documentation:

- Serial ATA Revision 2.5
- Serial ATA Interoperability Program Unified Test Document revision 1.1

For information regarding future plans of test development and support for the Interoperability Program, please refer to the Serial ATA Interoperability Program Description Document revision 4.0.

1.2. Definitions, abbreviations, and conventions

1.2.1. Definitions and abbreviations

1.2.1.1. ATAPI device

A Serial ATA device (storage peripheral) supporting the PACKET Command feature set.

1.2.1.2. Product

General reference to any SATA product supportable by the Interop Program for testing.

1.2.1.3. Device

A product falling under the Device product class which is a storage peripheral. This includes both hard disk drives and ATAPI devices.

1.2.1.4. Frame Information Structure (FIS)

The user payload of a frame, does not include the SOF, CRC, and EOF delimiters.

1.2.1.5. Frame

A frame is an indivisible unit of information exchanged between a host and device. A frame consists of a SOF primitive, a Frame Information Structure, a CRC calculated over the contents of the FIS, and an EOF primitive.

1.2.1.6. Host

A Host or Host Bus Adapter (HBA) is a product that connects to the host system's expansion bus to provide connectivity for devices. Host Bus Adapters are also often referred to as controller cards or merely controllers

1.2.2. Keywords

Several keywords are used to differentiate between different levels of requirements and optionality.

1.2.2.1. mandatory

A keyword indicating items to be implemented as defined by this standard.

1.2.2.2. may

A keyword that indicates flexibility of choice with no implied preference.

1.2.2.3. optional

A keyword that describes features that is not required by this standard. However, if any optional feature defined by the standard is implemented, the feature shall be implemented in the way defined by the standard.

1.2.2.4. shall

A keyword indicating a mandatory requirement. Designers are required to implement all such mandatory requirements to ensure interoperability with other standard conformant products.

1.2.2.5. should

A keyword indicating flexibility of choice with a strongly preferred alternative. Equivalent to the phrase “it is recommended”.

2. Product Test Requirements

The Interoperability Program is not intended to define new specification requirements for Serial ATA, but is intended to develop and define the tests used to verify product adherence to the subset of requirements governed by the Interoperability Program requirements and test procedures.

Each Device or Host product submitted will be tested in two areas – specification requirements and system interoperability. Both areas of testing shall be completed for consideration to be included on the SATA-IO Integrators List, see section 3 for details. Each Cable product will be tested per the identified specification requirements.

It is required that all test results for a product are collected through an approved testing medium, including approved independent test labs or Interoperability Workshops. Results submitted for a review for a specific product which were gathered outside of an approved medium will not be considered for posting a product on the Integrators List.

Over time, the Interoperability Program documentation may be updated to modify existing test requirements or addition of new test requirements through the advancement of Serial ATA technology and development of the specification. With that in mind, it is expected that through this growth there will be revisioning of the Interop documentation on a major release level. Upon release of a new major release level, there will be a 60-day phase out period of any previous revisions of the testing requirements. As an example, after Revision 1.1 testing requirements are approved, results for products tested against Revision 1.0 will only be accepted for up to an additional 60 days.

2.1. Integrators List Details

The Integrators List is a database on the SATA-IO website which will hold the information of products that have passed the Serial ATA Interoperability Program testing. All products that have been approved based on test results will be listed on the Integrators List.

The Integrators List will contain both product information and vendor contact information. It will also contain information on approved test labs.

The listing of approved products from SATA-IO member companies on the Integrators List comes at no cost above the costs of testing itself. For non-members, there is a $1000.00 fee (per listing of product/family) to post an approved product listing on the Integrators List.

The Integrators List will be posted in a public location on the SATA-IO website.

There will be a designation on the Integrators List for which revision of testing requirements each product has been tested against and approved for. It is not to be assumed that if a product is listed for a specific revision, that it is also certified against other newer or later revisions of testing requirements. As an example, if Product A is listed as certified against Revision 1.1 testing requirements, it shall not be assumed it would be certified against Revision 1.0 or 1.2 testing requirements.

Any product listed on the Integrators List which may be a result of Qualification by Similarity as defined in section 4.3 may be noted appropriately, without specifically identifying what products are similar.

2.2. Product Classes

Due to the difference in architecture and design of Serial ATA Products, the test requirements will distinguish among the following Product classes:

- Device : hard disk drive or ATAPI device
- Host controllers (e.g. chipsets, add-in HBA, embedded)
- Cable/Connector

Each test requirement associated with a specification requirement may have separately defined required behavior(s) for each of the above Product classes. In each case, there may be different methodology for both testing the requirement and determining the pass/fail criteria.

2.3. Specification Requirement Tests

Many of the tests consist of verifying a specific subset of SATA specification requirements that are critical for Product interoperability. These make up the foundation used to determine the expected behavior and intended functionality of Serial ATA technology. Each requirement includes an expected behavior, measurement requirements, and clear pass/fail criteria. The specification requirement testing will be directly tied to the defined test procedures in the Serial ATA Interoperability Program Unified Test Document revision 1.1.

There are three total test areas that a product shall be tested for specification requirement testing, including Phy, Digital, and CabCon specific requirements. A product under test shall be verified across all applicable test procedures as defined for the Interoperability Program. Please refer to Table 1 of the Unified Test Document for details on which tests are required for testing per product type (device, host, cable, etc…).

2.4. System Interoperability Tests

System interoperability testing is a separately defined test scenario designed to verify real-world behavior of a Serial ATA product in a system environment. The platforms used for the system testing are pre-defined with known behaviors. The product under test is inserted into the individual defined platform configurations to verify the defined required behavior at the system level.

The Interoperability testing will also be directly tied to the defined test procedures in the Serial ATA Interoperability Program Unified Test Document revision 1.1.

There is only a single test that a product shall be test against for system interoperability testing. A product under test shall be verified within all platform configurations as defined for the Interoperability Program. The System Interoperability Tests are required for the Device and Host product types. No System Interoperability testing is required for Cable products.

3. Product Test Methods

There are currently two mechanisms for testing products for Serial ATA Integrators List inclusion – approved independent test labs and Serial ATA Interoperability Workshops. Final consideration on a product's inclusion in the Integrators List is based on the results from one or more of the two mechanisms.

3.1. Test Areas

There are two major categories of Interoperability Testing – specification requirement tests and system interoperability tests. For the specification requirement testing, there are three total test areas that a product shall be tested for, including Phy, Digital, and CabCon specific requirements. When a submission for IL inclusion is made, the interested party shall supply test results for all four areas of testing (Phy, Digital, CabCon, and System Interoperability), where appropriate depending on the product being tested. Please refer to Table 1 of the Unified Test Document for details on which tests are required for testing per product type (device, host, cable, etc…).

3.2. Test Tools and Equipment

Within the Serial ATA Interoperability Program Unified Test Document, there are defined Methods of Implementation (MOI). These are specific details developed and documented for use of test equipment for the purpose of Interoperability Testing. All test labs interested in being approved for execution of Interoperability Tests shall use existing approved MOIs, or present new draft MOIs for approval by the SATA-IO. In either case, there shall be a complete set of MOIs defined for each test area in which a test lab is requesting to be approved for. Multiple MOIs may be used to gain complete test area coverage.

MOIs shall be in support of the specific MOI classes, as described in the Unified Test Document. The SATA-IO will keep a list of approved MOIs which are available for Interoperability testing. At times, the SATA-IO may revisit the existing list to understand if any procedures or equipment are out-of-date. Upon determination that an existing approved MOI is out-of-date or unusable for the current state of Interoperability Testing, the SATA-IO may elect to remove said MOI from the approved list. This will ensure that test labs are utilizing the most appropriate equipment and procedures for the defined testing.

3.2.1. MOI Approval Process

In the event that an MOI is being introduced and approved through an Interop Workshop, a 1.0 Release Candidate draft shall be available prior to the Interop Workshop. It is requested that MOIs are submitted to the SATA-IO for review 30 days prior to the next Interop Workshop in this case. The final approval of an MOI in this scenario would complete following the Interop Workshop. Although this is one method for approving an MOI, it is not required that an MOI be test run through an Interop Workshop to be approved.

Either a test tool vendor (i.e. manufacturer of a specific test tool) or a test lab may submit a drafted MOI for approval in use for Interoperability Testing. Contents of the MOI shall follow the requirements as outlined in the Unified Test Document. The SATA-IO will review the MOI for completeness and clarity, along with ensuring appropriate coverage and applicability to the appropriate tests. Once an MOI has been approved, the latest revision will be available on the SATA-IO website.

3.3. Serial ATA Interoperability Workshops

The Interoperability Program testing at an Interoperability Workshop will be hosted by SATA-IO representatives or independent test labs. It is not a requirement that all independent test labs participate in a Workshop, but it will be required that all approved independent test labs to host the SATA-IO test suite(s) on occasion. Selection of staffing for a SATA-IO test suite(s) at a workshop is done by the SATA-IO.

It is recommended that test labs do participate in the Interoperability Workshops for the following reasons:

1) Demonstrate procedures are correct (i.e. re-approval).
2) Be positioned to serve as a back-up site to the SATA-IO test suite(s)

Test labs which are selected to support the SATA-IO test suite(s) will not be required to supply the test equipment needed for the event. The test lab shall supply the SATA-IO with an appropriate list of test equipment needed. The SATA-IO will then work to ensure that equipment is made available at the event in support of the test suite.

Results gathered in the SATA-IO test suite shall be supplied to the vendor with the product under test at the Interoperability Workshop.

Testing at an Interoperability Workshop is open only to SATA-IO member companies.

3.4. Test Lab Enabling

Independent test labs may be approved to execute Serial ATA Interoperability testing. This section outlines the process for how a test lab is approved to execute the testing for the Interoperability Program.

Vendors who are not members of SATA-IO may submit their products to independent test labs for verification in the Serial ATA Interoperability Program. There is no difference in the submission process of a non-member product from a member product through an independent test lab.

3.4.1. Requirements for Test Lab Approval

Test Labs shall be general members in good standing of the SATA-IO organization. Contributor level membership is highly suggested, to gain access and have input to future changes, but not required.

There are two methods for approving a test lab to execute the testing for the Interoperability Program. The first method involves participation in an Interoperability Workshop. The second method involves obtaining results to be compared to existing approved test labs not necessarily taken at an Interoperability Workshop.

It is feasible that a test lab be approved for one or more specification requirement test areas (Phy, Digital, CabCon, System Interoperability) in addition to one or more products (device, host, cable/connector). There are no requirements that a lab shall be approved to execute more than one test area, but submissions for product certification shall only be based on results for tests which are approved for certification from a particular lab or set of labs.

It is required that the test lab supply the necessary MOI references which they intend to use for the appropriate test areas. This can be done by utilizing already approved MOIs or by creating or using approved release candidate (RC) MOIs.

Test labs are required to incorporate in to their test process any updates or errata that are made to the MOIs or errata to the Unified Test Requirements document they use with in 30-days of final approval (minimum of 60-days from approval of RC).

3.4.1.1. Approval through Interoperability Workshop

For each product class which a test lab is interested in being approved for a minimum of 3 different products for each product class shall be tested. In the case of devices, this shall be 3 hard drives and 3 ATAPI devices – 6 total devices. The products that are selected by the SATA-IO are among products that are to be tested in the SATA-IO test suite during the Interoperability Workshop. This assures that the results gathered by the test lab under question may be

compared to the test results of the same product as tested in the SATA-IO test suite(s) gathered at the same event.

It is possible that a SATA-IO representative is present in the test suite under question while testing is being executed, only as an observer.

A standard test report containing the necessary results shall be completed for each product that is tested in the suite. The same format test report will be completed by the SATA-IO test suite(s) during to the Interoperability Workshop. It is a requirement that the exact samples used in testing the products are used in both test labs. A comparison of results between the two test suites will be done using the recorded results. Results are reviewed for completeness and consistency as compared to existing approved SATA-IO test suite(s).

It is feasible that a test lab is approved for executing Interoperability Program testing after attendance to a single Interoperability Workshop.

The test lab under question is only responsible for supplying the test results which were found in its test suite. The SATA-IO test suite(s) will be responsible for delivering comparison test results.

3.4.1.2. Approval through Comparison

For each product class which a test lab is interested in being approved for, a minimum of 3 products for each product class shall be tested. In the case of devices, this shall be 3 hard drives and 3 ATAPI devices – 6 total devices. The 3 products are selected by the SATA-IO.

It is possible that a SATA-IO representative is present in the test lab under question while testing is being executed, only as an observer.

The same results reporting and comparison from the Interop Workshop approval process are also used here.

The test lab under question is responsible for supplying the gathered test results which were found in its test lab. It is the responsibility of the SATA-IO to have additional results gathered on the same products for comparison of consistency and correctness.

3.4.2. Request for Approval

Test labs should contact the SATA-IO in regards to getting approved for Interoperability Program testing. Specific information from the test lab may be required at the beginning of the process, such as contact information and areas of testing which the lab is interested in being approved for.

The SATA-IO will assist the test lab in determining with approval process is used for the appropriate testing. Once the testing has been completed, the test lab will submit the results in the standard templates to the SATA-IO for review.

3.4.3. Approval Decision Process

Upon receipt of completed test results, the SATA-IO will determine whether a test lab is approved for execution of the appropriate Interoperability Program tests. The test lab in question will receive confirmation (by email) to the supplied main contact within 3 days of request receipt. Final disposition on approval for a test lab will happen within 30 day target of request receipt.

To be considered for approval, the number of tests proven consistent shall be at least 100%. There is an appeal process available for contention of consistency and approval decisions, see section 3.4.5.

Additionally, the test lab under question shall also execute the appropriate contract agreement(s) for executing the Interoperability Testing on behalf of SATA-IO.

At the time that a test lab is approved for testing, their approval will be valid for 15 months.

3.4.4. Audit Process

The purpose of the audit process is showing the continued capability of a test lab to execute the current approved testing.

Audit of test lab execution for the Interoperability Program may happen approximately every 12 months. The test lab under question will be notified by the SATA-IO when an audit is necessary, this shall happen at least 3 months prior to the next Interoperability Workshop. There are two methods in which a test lab may choose to support an audit of its testing procedures.

The first method consists of the following:

- Upon receipt of the audit notice, the test lab will be required to bring an already tested product (randomly chosen by SATA-IO from last 6 months of certified products from that test lab) to the next Interoperability Workshop. The previously gathered test results will already be available to the SATA-IO. The SATA-IO will test the same product at the Interop Workshop for comparison. .
    - Note : if the test lab has not submitted certification for any products for at least 6 months, then the most recent certified product from that lab will be used for audit.
- In this case, the test labs are responsible for ensuring product availability in the event of an audit request. It is not the responsibility of the product vendor to ensure a specific product is available for re-testing.

The second method consists of the following:

- Upon receipt of the audit notice, the test lab will host at test suite at the next Interoperability Workshop with representation of their own test lab equipment. Several products running through SATA-IO test suite will also be scheduled into the test suite under question for comparison of results. The results from both test suites, (test suite under question and SATA-IO test suite) are compared. This method is very similar to the initial approval process.

In the case that a test lab has not been audited within 12 months of its approval date, it is the responsibility of the test lab to work with the SATA-IO to ensure it obtains re-approval before the 15 month deadline occurs. If a test lab has not been re-approved when the 15 month deadline occurs, it may not submit any new product certifications until re-approval occurs. All product certifications submitted by the lab prior to the 15 month deadline will be valid for review by the SATA-IO.

If an audit results in a test lab not being re-approved for test support, the test lab may not submit any new product certifications until re-approval occurs. If the test lab is interested in future support of SATA Interoperability Testing, it may work with the SATA-IO to resolve any remaining issues identified resulting from the audit and eventually be re-approved through the appropriate processes outlined in previous sections.

3.4.5. Appeal Process

A written appeal of a SATA-IO decision shall be delivered within 30 days of the disposition. The SATA-IO shall respond with its disposition of the appeal within 30 days. Appeals shall include relevant information or data to support their position. This information could have been obtained at a prior Interop Workshop or other testing.

3.4.6. Listing of Approved Test Labs

Upon approval of a test lab to execute Interoperability Program testing, the test lab company will be listed on the SATA-IO website. The website will include information on what items the lab was approved to test (i.e. test areas, product classes, etc…), in addition to relevant contact information.

4. Product Certification Process

This section outlines the process for acceptance or rejection of product submissions to be listed on the Integrators List.

4.1. Request for Certification

Vendors who are interested in having their products Interoperability Program certified, shall only use a certified test source.

Possible Certified test sources are:

1. Participating in a SATA-IO Interoperability Workshop
2. Contracting with an approved test lab.

In all cases, a unique test ID shall be assigned to a product prior to testing being started. In the case that testing is done by an approved test lab, the test lab shall request a unique test ID be assigned to the product in question. Included in the request will be specific information related to the product to be tested to ensure proper tracking of the correct product through testing will occur.

The unique test ID assists in anonymity of vendors and specific products when results are being reviewed and discussed. The unique test ID will be assigned by the SATA-IO.

Test results and information shall be treated confidentially by SATA-IO. Information in the standard submission form is handled as non-confidential. Only at the time that a product has been approved for Integrators List testing will product details actually be visible.

4.2. Submission Acceptance Process

All product submissions shall use current and approved result templates for the revision being submitted against. Upon receipt of a product test results, the SATA-IO will determine whether the submission is accepted. This determination will be based on results completeness, clarity, and other factors. Upon submission receipt, the vendor with the product in question, and the test lab when applicable, will receive confirmation (by email) to the supplied main contact within 3 days of request receipt. Final disposition on approval for a product will happen within 30 day target of request receipt.

To be considered for certification, the number of tests passed shall be at least 100%. There is a waiver and appeal process available for contention of results and certification decisions, see sections 4.2.1 and 4.2.2.

Any submission that has been approved by the SATA-IO (i.e. product certification) will be added to the Integrators List. The results and any SATA-IO final resolution comments will be delivered to the vendor of the product submitted. The product sample which was used in the testing of an accepted product to be listed on the Integrators List shall be kept by the test lab which executed the tests for at least 6 months.

A product may also be removed from the IL per request by the manufacturer of that product.

As the Interoperability Program evolves, there will be differentiation among products on the Integrators List outlining which scope of testing (by revision or other denotation) of what it has been approved for.

If a submission is rejected, the results report and SATA-IO final resolution comments will be delivered to the vendor. The vendor has the opportunity to appeal the resolution from the SATA-IO within 30 days after the results report is issued. Upon final determination of submission rejection, including waiver considerations, the product test samples will be returned to the vendor.

In the case that testing was completed at a test lab, the lab will also receive the appropriate confirmations and status of certification. In addition, the test lab shall keep all results for tested products on record for at least 12 months.

4.2.1. Appeal Process

A written appeal to a SATA-IO decision delivered within 30 days of disposition. The SATA-IO has 30 days to respond to the appeal. Appeals shall include relevant information or data to support their position. This information could have been obtained at a prior Interop Workshop or other testing.

4.2.2. Waiver Request

Waiver Requests are only applicable to test failures for specification requirement testing. There will be no consideration for waivers regarding failures of products in the system interoperability testing. Any request submitted shall contain waiver justification, which may consist of additional test support data from a certified test source or other details associated with relevant impact of the failed tests with regards to interoperability.

All Waiver Requests will be reviewed by the SATA-IO for validity and judgment on the affect of the product's potential incompatibilities with other Serial ATA products.

Any test failures that are not accompanied by a Waiver Request are grounds for finalizing submission rejection.

4.2.3. Re-submissions of Products

If a product submission is rejected due to test failures and sufficient Waiver details are not resolved, it is possible that the same product family or modified product would be re-submitted a future date assuming the past issues leading to failures are resolved. In these cases, a completely new submission process is required including a new unique test ID being allocated to the product and tests re-executed. For tracking purposes, it may be helpful to ensure the old unique test ID is available.

4.3. Qualification by Similarity

A submission for inclusion on the IL may include reference to an already submitted test report or certified product, and offer its results in lieu of some or all of the results of the required tests. Such a submission shall be made using the standard "Re-testing form" and shall include the written permission of the original submitting company (if different). The submission shall state if it is claimed there are no material digital or electrical changes, or if there are some. Where there is no material SATA changes, as covered under the re-testing requirements section below, no further testing is required. If approved, this additional product, or set of products, would also be added on the Integrators List.

4.3.1. Family of Products qualification

Also, it is possible that a family of products are approved for IL listing in similar cases to the above, with the requirement that one of the products within the family is approved and that no SATA specific characteristics differences exist among the family of products. An example would be a family of hard disk drive products which only differ in their storage capacity but the SATA characteristics and capabilities match across the different product part numbers.

4.3.2. Single Family Listing

Some product vendors may offer a large number of products that are only different by model # or part #, or firmware # to support branding partners (OEMs, company partnerships, etc), multiple marketing brands and to identify the sales / support channel. In order to keep the usefulness of the Integrators List, if a vendor requests more than 10 products to be listed under a single family qualification they shall be required to support a single family listing on the Integrators list. The following are the requirements of a “Single Family Listing”:

1) No SATA-impacting material differences can exist between any of the products, except for the presents of SATA optional features.
2) All products covered by the Single Family Listing shall have no additional SATA optional features than the original tested product
3) Part number definition. The single family part number scheme definition shall be provided and defined in 40 text characters or less
4) Model number definition. The single family model number scheme definition shall be provided and defined in 40 text characters or less.
5) Firmware revision definition. The single family firmware revision scheme definition shall be provided and defined in 40 text characters or less.
6) The vendor agrees to not create any products that requires any “Re-testing” (as defined in a Re-Testing section) that would fall under the Single Family Listing definition.

The Integrators List shall appropriately indicate Single Family Listings, and also indicate that some products under the Single Family Listing may not have all optional SATA features enabled.

4.4. Requirements for Re-test

Any product that has non-SATA impacting material changes and has changed the vendor or model #, or firmware revision, shall perform one of the following actions: If the changed product meets all the requirements of an existing “Single Family Listing”, no further action is required, if not a Re-Testing form shall be submitted with all the updated information, indicating no material SATA changes have been made.

Any SATA impacting material changes to a product already on or about to be listed on the Integrators List shall submit a completed standard Re-testing form, with a MINIMUM of the following test data from a certified testing source:

Change Type:	Re-Test form and Action required
No material SATA change – different vendor or model #, bezel color, capacity.	No re-testing required.
Additional source of connector, PCB or support components (AC caps, etc)	No re-resting required IF additional source has the same characteristics and does not cause a PCB layout change. Shall declare same characteristics on Re-test form
Connector	Run PHY/TSG/OOB, RX/TX and applicable MDx or MHx tests
PCB SATA layout, stack up, geometry or material type	Run PHY/TSG/OOB, RX/TX tests
SATA interface silicon	Run PHY/TSG/OOB, RX/TX, Digital, System Interop tests
SATA interface non-silicon parts (AC caps, etc)	Run PHY/TSG/OOB, RX/TX tests
Firmware – SATA interface impact (SSC, signal level, edge rate, etc)	Run PHY/TSG/OOB, RX/TX tests
Firmware – Link layer (DIPM, etc)	Run Digital tests
Firmware – New or changed SATA Feature sets (NCQ, etc)	Run Digital tests
Firmware – Removal of optional SATA features	No re-testing required
Firmware – Non SATA impacting (additional removable media vendor support	No re-testing required
External material changes (change in size or shape of exterior contains the mounting or surrounds ? the SATA connector)	Run applicable MDx and MHx tests

The “Re-testing” form will request the following (minimum) information:

- Declaration of the change
- Justification of why test results from the previous product can be used
- Required test data, as listed above, from a certified test source
- Previous product identification (Vendor, Model, part number, firmware)
- Family Model, part number, firmware number if applicable
- Single family definitions, if applicable