SPC BENCHMARK 1™ (SPC-1™)
NDU Extension

Official Specification

Revision 1.0 – Effective TBD

Storage Performance Council (SPC)

Document History

Effective Date	Version	Description
TBD	1.0	Creation of stand-alone extension document.

Table of Contents

Clause 0   **Introduction**

0.1   **Preamble**

Benchmark extensions are optional additions to an existing benchmark ("the underlying benchmark specification") that are designed to showcase a feature or set of features, and to provide vendors with a means to differentiate their products across dimensions other than the existing performance or price-performance metrics of the benchmark

The SPC benchmark extensions are intended to be vendor and platform independent. Any vendor should be able to sponsor and publish an SPC result, with or without extensions, provided their tested configuration satisfies the performance, integrity, and availability requirements of the specification.

Rather than requiring or favoring a particular implementation, it is the goal of SPC benchmarks and extensions to provide a robust, verifiable, reproducible environment within which the relative strengths of differing design and configuration approaches can be evaluated.

0.2   **General Guidelines**

The purpose of SPC benchmarks is to provide objective, relevant, and verifiable data to purchasers of I/O subsystems. To that end, SPC specifications require that benchmark tests be implemented with system platforms and products that:

- Are generally available to users.
- A significant percentage of the users in the target market segment (server class systems) would implement.
- Are relevant to the market segment that the benchmark represents.

More detailed requirements can be found in the body of the SPC Benchmark-1 specification.

0.3   **Measurement Guidelines**

SPC benchmark results are expected to be accurate representations of subsystem performance. Therefore, stringent measurement, auditing, and reporting guidelines are mandated by this specification. In general, fidelity and candor must be maintained in reporting any anomalies in the results, even if not specified in the benchmark requirements.

More detailed measurement, evaluation and disclosure requirements can be found in the body of the specification.

0.4   **Document Conventions**

This document follows the standard typographical conventions for SPC publications.

Generally, words and expressions will adhere to their common English usage. Where a particular term is being defined or assumed to have a benchmark-specific meaning, it appears in SMALLCAPS, and its formal definition can be found in the *SPC Glossary,* which is included here as Appendix A.

This document also follows the standard SPC practice for document versioning and references. (see *SPC Policies and Guidelines* for more information).

0.5   Related Documents

This benchmark extension relies on:

- Version 3 of SPC Benchmark-1
- Version 1 of the *SPC Pricing Guide*
- Version 1 of the *SPC Glossary (included as Appendix A)*

0.6   Disclaimer

While this workload models a rich multi-user environment that emulates a broad range of server applications, it neither represents the entire range of I/O requirements for server systems nor precisely mimics any particular application. In addition, the extent to which anyone is capable of achieving the results reported by a vendor is highly dependent upon how closely the customer's application maps to the SPC-1 workload. The extrapolation of SPC-1 results to other environments is therefore not recommended.

Actual system performance is highly dependent upon specific workload characteristics, platform configuration, and application-specific tuning. Relative system performance will vary as a result of these and other factors. Thus, SPC-1 should not be used as a substitute for customer application benchmarking when critical performance requirements are called for.

SPC-1 uses terminology and metrics that are similar to other benchmarks. This similarity does not imply that results from this benchmark are comparable with other benchmarks.

Clause 1   **Workload Environment**

1.1   Overview

Enterprise grade storage arrays have long worked to minimize downtime, both planned an unplanned. A key feature of any array that truly seeks to minimize downtime is the ability to upgrade the operating software on the array while continuing to serve data.

This extension requires a successful, non-disruptive upgrade under moderate load.

.

Clause 2   **Storage Capacity and Content**

This extension has no impact on the storage capacity and content requirements defined in SPC-1.

Clause 3   **Workload and I/O Operation Profile**

This extension has no impact on the workload and I/O operation profile as defined in SPC-1.

Clause 4 **<u>Benchmark Configuration and Tested Storage Configuration</u>**

This extension has no impact on the <u>BENCHMARK CONFIGURATION</u> or the <u>TESTED STORAGE CONFIGURATION</u> as defined in SPC-1.

Clause 5   **Test Methodology**

This extension has no impact on the SPC test methodology as defined in SPC-1.

Clause 6   <u>**Measurement Requirements (Execution Rules)**</u>

6.1   General Requirements

6.1.1   The NDU Extension defines two execution models:

- integrated execution: The upgrade occurs during the SUSTAIN TEST PHASE of an audited SPC-1 execution, or
- stand-alone execution: The upgrade occurs during an additional TEST PHASE, that is executed prior to those defined in the SPC-1 specification. While this additional TEST PHASE is subject to audit, it is distinct from the TEST PHASEs defined in the SPC-1 specification, and introduces its own set of requirements.

The TEST SPONSOR shall select one of the two execution models for the NDU Extension.

6.1.2   The execution sequence for NDU extension is detailed in 6.2. It must be completed regardless of the execution model selected by the test sponsor.

If the TEST SPONSOR opts for a stand-alone test, the benchmark execution shall also satisfy the requirements of clause 6.3.

6.1.3   The software upgrade shall occur during the MEASUREMENT INTERVAL of the TEST PHASE for the selected execution model.

6.1.4   The IOP level during the test phase shall be at least 10% of that used in the RAMPD_100 TEST PHASE of the baseline SPC-1 performance tests.

6.1.5   The TSC EXECUTIVE shall be upgraded from the version present at the start of the NDU extension ('initial version") to the upgraded version, which shall be operational on the TSC at the end of the extension execution.

Typically, the TSC EXECUTIVE is the software whose version information is displayed by the array GUI. This upgrade may or may not include upgrades to component firmware, such as that on drives, drive enclosures, and other TSC components.

Comment: *It is the intent of the upgrade process that the bulk of the operating software of the TSC will be updated and/or replaced.*

6.1.6   The upgraded version of the TSC EXECUTIVE in place at the completion of this extension shall be the version used in the execution of any subsequent TEST PHASES, and shall be the only version active within the TSC.

6.1.7   All components that could be called upon to execute the TSC EXECUTIVE shall be upgraded to the same version of the TSC EXECUTIVE, whether or not they are active during the execution of the baseline SPC-1 performance tests. For example, if the TSC includes both an active storage controller and a passive, normally idle storage controller, both must be upgraded as part of the execution of this benchmark extension.

6.2 Execution Sequence

The software upgrade shall be non-disruptive. For this benchmark extension a non-disruptive upgrade must satisfy all of the following criteria:

1. The upgrade shall move the TSC EXECUTIVE from the initial revision to to the upgraded version.

   > **Comment:** *If there is no newer revision of the TSC EXECUTIVE, it may be possible to satisfy this requirement. See 6.4.*

2. The upgrade shall be accomplished without operator intervention, other than whatever command or action is required to initiate the upgrade.
3. The upgrade shall not prevent the operation of the TSC, or its ability to satisfy IO requests. While there may be brief interruptions in the processing of IOs (and related increases in observed response time), all IO operations initiated during the execution of this benchmark extension shall be completed successfully.
4. The upgrade process may impact the observed performance of the TSC. IOs issued during this benchmark extension are not subject to an upper bound on their response time.
5. At the conclusion of the upgrade, the TSC shall be executing the updated version of its TSC EXECUTIVE.
6. The upgrade shall successfully complete within the test phase, and the test phase shall complete without error.
7. In the case of the integrated execution, the TSC shall complete the remainder of the SPC-1 baseline performance tests without any configuration change or operator intervention.

If the upgrade fails to satisfy one or more of the stated requirements, it is deemed to have failed.

6.3 Stand-alone Execution Requirements

Table 6-1   NDU Test Phases

Test Phase Group	Test Phase	Load Percentage	Required Durations		
			Ramp Up (minimum)	Measurement Interval	RunOut
	NDU	10	3 min	30 Minutes (minimum)	1 minute

6.3.1 The required parameters for the extra TEST PHASE used to demonstrate the upgrade ("NDU test phase") are summarized in Table 6-1.

6.3.2 The MEASUREMENT INTERVAL shall begin at least 10 minutes prior to the beginning of the upgrade of the TSC EXECUTIVE, and shall continue for at least 10 minutes after the upgrade is complete. The duration of the MEASUREMENT INTERVAL shall be no less than 30 minutes.

6.3.3   All constraints on a TEST PHASE (see *"SPC-1 Benchmark Specification, version 3.9", clause* 5) must be satisfied during the NDU TEST PHASE.

6.3.4   Other than changes to the TSC EXECUTIVE, there shall be no changes to the configuration of the TSC between the NDU TEST PHASE and the SPC-1 benchmark test.

6.3.5   The IO access patterns presented to the TSC during the NDU test phase shall be identical to that used during the SUSTAIN test phase of the baseline SPC-1 performance tests.

6.3.6   The IO level shall be 10% of that used during the RAMPD_100 test phase of the baseline SPC-1 performance tests.

6.3.7   Since the extension execution must be run against a fully operation BENCHMARK CONFIGURATION, it requires an execution of the ASU Pre-fill and content verification steps defined in the SPC-1 specification prior to the execution of the NDU test phase. Similarly, the ASU Pre-fill and content verification steps must be executed after the completion of the NDU extension in order to satisfy the execution rules of the baseline SPC-1 benchmark execution. The resulting execution sequence will be:

        INIT → VERIFY → NDU → INIT → VERIFY → PERFORMANCE TEST

        The test information gathered during the first INIT and VERIFY tests phases shall be disclosed as part of the FDR annex used to document this extension.

        The test information gathered during the second INIT and VERIFY tests phases shall be disclosed as part of the FDR for the underlying SPC-1 measurement.

6.4   Single-Version Upgrades

6.4.1   A single version upgrade may be used when it is impossible to configure the TSC with an earlier, commercially-available release and upgrade it to the version used to execute the SPC-1 performance tests.

6.4.2   The single-version upgrade may only be used if there is no other commercially available software that will run on the TSC that can be used as the initial version of the TSC EXECUTIVE,. Whenever possible, a prior commercially-available release of the storage software shall be used, even it provides a substantially different feature set than the release used to execute the SPC-1 performance tests.

6.4.3   For the single-version upgrade, the TEST SPONSOR may employ a prior version of the software that is not commercially available. The prior version shall be substantially similar to the final software, but must differ by at least the displayed version identification. The version strings for the software running before and after upgrade must be distinct.

6.4.4   A configuration which employs the single-version upgrade shall satisfy all other requirements of this extension.

Clause 7 __Data Persistence Requirements and Test__

This extension has no impact on the Persistence test defined in SPC-1.

<h1 style="text-align:center">Clause 8   <u>Reported Data</u></h1>

8.1   Comparability and Permitted Use

8.1.1   Results that execute this extension are subject to all Permitted Use requirements.

8.1.2   Public reference that includes a comparison of one or more SPC-1 RESULTS may distinguish those results that included the execution of this extension from those that did not.

8.1.3   If the testing defined in this extension is completed successfully, the result may be referred to "SPC-1 NDU Capable".

Clause 9 **Full Disclosure Report**

9.1   For the NDU Extension, the FDR shall disclose:

     a) The steps taken to upgrade the TSC EXECUTIVE,
     b) The selected execution model,
     c) The version of the TSC EXECUTIVE in use before and after the NDU,
     d) The commercial-availability status of the TSC EXECUTIVE in use before the NDU.

9.2   If the TEST SPONSOR selected the stand-alone execution model, the FDR shall fully disclose the NDU TEST PHASE, including:

- The name of the file included in the SUPPORTING FILES and that contains the data resulting from the execution of the NDU TEST PHASE, as produced by a supported version of the SPC-1 data reduction tool.
- The timing of the execution of the TEST PHASE, including the TRANSITION period and the MEASUREMENT INTERVAL.
- The Throughput Graph, as produced by a supported version of the SPC-1 data reduction tool.
- The Response Time Graph, as produced by a supported version of the SPC-1 data reduction tool
- The Data Rate Graph, as produced by a supported version of the SPC-1 data reduction tool.
- The Response Time Frequency Graph, as produced by a supported version of the SPC-1 data reduction tool
- A summary of the I/O requests during the MEASUREMENT INTERVAL, including the total number of completed I/O REQUESTS, the number of I/O REQUESTS with a RESPONSE TIME less than or equal to 30.00 milliseconds and the number of I/O REQUESTS with a RESPONSE TIME greater than 30.00 milliseconds.
- Any and all changes to the TSC made between the audited run and the NDU TEST PHASE.

9.3   If the TEST SPONSOR selected the integrated execution model, the FDR shall disclose the following:

- The start and end times of the execution of the NDU,

9.4   If the TEST SPONSOR selected the stand-alone execution model, the FDR shall disclose the following:

- The measurement data of the first executions of the INIT and VERIFY TEST PHASES,
- The start and end time of each TEST PHASES that occurred prior to upgrading the TSC EXECUTIVE.

Clause 10   **<u>Measurement, Audit and Result Submission</u>**

10.1   NDU Related Verification Items

1. Confirm the version of the <u>TSC EXECUTIVE</u> prior to the NDU.
2. Verify that the upgrade was executed the version of the <u>TSC EXECUTIVE</u> changed.
3. Ensure that the selected <u>TSC EXECUTIVE</u> versions satisfy the requirements of Clause 6 (e.g., commercial availability and/or single-version).

Appendix A　　Glossary

The SPC Glossary is used in all SPC specifications, and is available as a stand-alone document. It is included here in its entirety for ease of reference.

SPC Glossary, version 1.0, which was current as of 24 March 2020

A.1　　A

ADDRESSABLE CAPACITY

the portion of the storage capacity of a LOGICAL VOLUME that is accessible to the WORKLOAD GENERATOR.

APPLICATION STORAGE UNIT (ASU)

the logical representation of the persistent, non-volatile storage read and or written in the course of executing a BENCHMARK.

An ASU represents is a logical interface between a BENCHMARK CONFIGURATION's data and a workload generator.

APPLICATION STORAGE UNIT CAPACITY

the total ADDRESSABLE CAPACITY of all the portions of LOGICAL VOLUMES to which an ASU is mapped.

APPLICATION STORAGE UNIT STREAM

a collection of one or more I/O STREAMs, that completely defines the I/O sent to a given ASU.

ASSOCIATED DATA

data and measurements defined by a given BENCHMARK that are used to calculate, clarify or reinforce the metrics reported as part of a RESULT.

ASU　　　　*see APPLICATION STORAGE UNIT.*

ASU CAPACITY　*see APPLICATION STORAGE UNIT CAPACITY.*

ASU PRICE　　*the ratio of TOTAL SYSTEM PRICE to ASU CAPACITY.*

ASU STREAM　　*see APPLICATION STORAGE UNIT STREAM.*

AUDIT　　　*the process that verifies that a MEASUREMENT is eligible for submission as a RESULT.*

AUDITOR　　*An individual who has been certified by the SPC to perform an AUDIT.*

AVAILABILITY DATE

a date by which a given product, component or configuration is released for general availability.

AVERAGE RESPONSE TIME

the sum of the RESPONSE TIMES for all MEASURED I/O REQUESTS within a given interval, divided by the total number of MEASURED I/O REQUESTS.

A.2　　B

BC　　　　*see BENCHMARK CONFIGURATION.*

BENCHMARK   *a collection of <u>TESTS</u>, <u>TEST PHASES</u>, documentation requirements, and comparability constraints that fully define the process for taking a <u>MEASUREMENT</u> and creating a <u>RESULT</u>.*

BENCHMARK CONFIGURATION
> *all hardware and software components used in the creation of a <u>MEASUREMENT</u>.*

A.3   <u>C</u>

COMPLETED I/O REQUEST   *an <u>I/O REQUEST</u> with a <u>START TIME</u> and a <u>COMPLETION TIME</u>.*

COMPLETION TIME
> *the time recorded by the <u>WORKLOAD GENERATOR</u> when an <u>I/O REQUEST</u> is satisfied by the <u>TSC</u>.*

COMMITTED: *Of an IO operation, written to persistent, non-volatile storage, in such a manner that the data can be retrieved after recovery from a <u>TSC</u> failure.*

CRASH-CONSISTENT:
> *A data image (logical or physical) is considered crash consistent if there exists a point in time such that all write operations completed prior to that time are included in the image, and no write operation initiated after that time is included.*

A.4   <u>D</u>

DATA RATE   *the data volume transferred in a given interval divided by the duration of the interval, in seconds.*

A.5   <u>E</u>

EXTENSION   *optional addition(s) to an existing <u>BENCHMARK</u> that showcase a feature or set of features not captured by the <u>BENCHMARK'S</u> existing metrics.*

EXTENSION CONFIGURATION
> *all hardware and software components used in the execution of an <u>EXTENSION</u>.*

EXPECTED I/O COUNT
> *for any given <u>I/O STREAM</u> and <u>TEST PHASE</u>, the product of requested IO load in IOs per second, the duration of the <u>TEST PHASE</u> in seconds, and the <u>INTENSITY MULTIPLIER</u> parameter for that <u>I/O STREAM</u>.*

EXECUTIVE SUMMARY
> *a high-level report summarizing a <u>RESULT</u>, and the configuration used to produce it.*

A.6   <u>F</u>

FAILED I/O REQUEST
> *any <u>I/O REQUEST</u> issued by the <u>WORKLOAD GENERATOR</u> that could not be completed or was signaled as failed by the OS running on the <u>HOST SYSTEM</u> .*
>
> A FAILED I/O request has no <u>COMPLETION TIME</u>.

FDR   *see <u>FULL DISCLOSURE REPORT</u>.*

FULL DISCLOSURE REPORT
　　　　　　　a report detailing a <u>*RESULT*</u>*, along with the procedures, configuration, and equipment used to produce it.*

A.7   <u>G</u>

No terms defined.

A.8   <u>H</u>

HOST SYSTEM   *a computer system where the* <u>*WORKLOAD GENERATOR*</u> *executes.*

A.9   <u>I</u>

IN-FLIGHT I/O REQUEST
　　　　　　　an <u>*I/O REQUEST*</u> *issued by the* <u>*WORKLOAD GENERATOR*</u> *that does not complete within a given* <u>*MEASUREMENT INTERVAL*</u>*.*

INTEGRATED EXECUTION
　　　　　　　of a benchmark extension: completed during one of the test phases of a benchmark execution.

INTENSITY MULTIPLIER
　　　　　　　the ratio of the IO load produced by a given <u>*I/O STREAM*</u> *to the total IO load produced by all active* <u>*I/O STREAMS*</u>*.*

I/O COMMAND   *see* <u>*I/O REQUEST*</u>*.*

I/O STREAM   *a single, well-defined, sequence of* <u>*I/O REQUESTS*</u>*.*

I/O REQUEST   *a single, atomic I/O operation.*

I/O REQUEST THROUGHPUT
　　　　　　　the total number of <u>*MEASURED I/O REQUESTS*</u> *in a* <u>*TEST PHASE*</u>*, divided by the duration of that* <u>*TEST PHASE*</u>*'s* <u>*MEASUREMENT INTERVAL*</u>*, expressed in seconds.*

A.10   <u>J</u>

No terms defined.

A.11   <u>K</u>

No terms defined.

A.12   <u>L</u>

LOGICAL BLOCK *the smallest directly addressable unit of storage on the* <u>*ASU*</u>*.*

LOGICAL VOLUME *an individually addressable logical unit of storage presented to the* <u>*WORKLOAD GENERATOR*</u>*.*

A.13   __M__

MEASURED I/O REQUEST

an _I/O REQUEST_ with a _COMPLETION TIME_ occurring within the _MEASUREMENT INTERVAL_.

MEASURED INTENSITY MULTIPLIER

the percentage of all _MEASURED I/O REQUESTS_ that were issued by a given _I/O STREAM_.

MEASUREMENT: the data gathered during the execution of a _BENCHMARK_.

MEASUREMENT INTERVAL

of a _TEST PHASE_, the time from the end of the _TRANSITION_ to the start of the _RUNOUT_.

A.14   __N__

No terms defined.

A.15   __O__

ON-SITE AUDIT   an _AUDIT_ for which the _AUDITOR_ is physically present.

A.16   __P__

PHYSICAL CAPACITY UTILIZATION

ASU CAPACITY divided by the _PHYSICAL STORAGE CAPACITY_.

PHYSICAL FREE SPACE

the persistent storage capacity that could be used to hold application data and the metadata required to access, maintain and protect that data, but is not in use at the time of the measurement.

PHYSICAL STORAGE CAPACITY

the total storage capacity of all of the _STORAGE DEVICES_ in the _TESTED STORAGE CONFIGURATION_.

PRICED STORAGE CONFIGURATION ("PSC"):

the customer-orderable version of the _TSC_.

PRICE-PERFORMANCE

the ratio of the _TOTAL SYSTEM PRICE_ to the primary performance metric for a _BENCHMARK_"):.

PRICING SPREADSHEET

a detailed computation of the total cost of ownership for a _PRICED STORAGE CONFIGURATION_.

PRIMARY METRIC   a metric that provides a primary basis for comparison of _RESULTS_.

PROTECTED 1   a data protection level in which the failure of any single _STORAGE DEVICE_ in the _TSC_ will not require user intervention to restore access to the _BENCHMARK'S_"): data repository.

PROTECTED 2   a data protection level in which the failure of any single component in the _TSC_ will not require user intervention to restore access to the _BENCHMARK'S_ data repository.

PSC   see _PRICED STORAGE CONFIGURATION_.

A.17　**Q**

No terms defined.

A.18　**R**

REFERENCE PRICE
the price at which component or subsystem could be ordered individually from the _TEST SPONSOR_ or designated third-party suppler.

REMOTE AUDIT　an _AUDIT_ for which the _AUDITOR_ is not physically present. See _ON-SITE AUDIT_.

REPLICATION　the automatic execution of all I/O operations executed against a primary storage system on a one or more, independent storage systems.

RESPONSE TIME　for an _I/O REQUEST_, _COMPLETION TIME_ minus _START TIME_.

RESULT　an audited _MEASUREMENT_ which has been submitted to the SPC for publication

RESULTS FILES　the output of the _WORKLOAD GENERATOR_, created during a _MEASUREMENT_.

REPORTED DATA　The set of data, as defined by a given _BENCHMARK_, which fully characterizes a _MEASUREMENT_.

RUNOUT　of a _TEST PHASE_, the time period immediately following the _MEASUREMENT INTERVAL_ during which the IO load presented by the _WORKLOAD GENERATOR_ to the _TSC_ remains constant long enough for any IO issued during the _MEASUREMENT INTERVAL_ to complete.

A.19　**S**

SER　see _SPACE EFFECTIVENESS RATIO_.

SOR　see _SPACE OPTIMIZATION RATIO_.

SNAPSHOT　a logical, point-in-time, _CRASH-CONSISTENT_ image of one or more _LOGICAL VOLUMES_.

SNAPSHOT SET　a crash-consistent collection of _SNAPSHOTS_, taken and managed as a unit.

SPACE EFFECTIVENESS RATIO (_"SER"_)
the ratio of the total amount of data that the _TSC_ can hold to its _PHYSICAL CAPACITY_.

SPACE OPTIMIZATION RATIO (_"SOR"_)
the size of a data set as generated by the _WORKLOAD GENERATOR_ divided by the amount of incremental space consumed by that data set.

SPC RESULT　see _RESULT_.

SSU　see _STIMULUS SCALING UNIT_.

START TIME　for an _I/O REQUEST_, the time recorded by the _WORKLOAD GENERATOR_ when the request is submitted for execution on the _TSC_.

STEADY STATE *a state in which the behavior of the [TSC](#) is stable and sustainable while the load presented to the [TSC](#) by the [WORKLOAD GENERATOR](#) is constant.*

STIMULUS SCALING UNIT
a logical abstraction that captures the key elements in the IO demands of an application's user population.

STORAGE DEVICE *a discrete, physical hardware component, such as an HDD or an SSD, that provides permanent data storage.*

> A [STORAGE DEVICE](#) must be capable of storing data indefinitely without external power. The requirement excludes components that provide volatile data storage, such as a read and/or write cache.

SYNCHRONOUS REPLICATION
REPLICATION IN WHICH THE INITIAL I/O OPERATION IS NOT MARKED AS COMPLETE UNTIL THE RELATED OPERATION HAS COMPLETED ON THE OTHER, INDEPENDENT STORAGE SYSTEM(S).

SUBMISSION IDENTIFIER
a unique identifier, assigned by the SPC, for each new [RESULT](#).

SUPPORTING FILES
a collection of data, documentation, and illustrations used to demonstrate the validity of a [RESULT](#).

A.20   T

TARGET COUNTRY
the country in which the [PRICED STORAGE CONFIGURATION](#) is available for sale no later than the [AVAILABILITY DATE](#), and in which the required hardware maintenance and software support is provided either directly from the [TEST SPONSOR](#) or indirectly via a third-party supplier

TEST *a collection of one or more [TEST PHASES](#) sharing a common objective.*

TEST PHASE *the smallest logical component of a [TEST](#), during which a data is collected to satisfy the requirements of a [BENCHMARK](#).*

TEST SPONSOR *a distinctly identifiable entity that acts as the sponsor of an [RESULT](#).*

TESTED STORAGE CONFIGURATION
all software and hardware necessary to implement and support the storage configuration defined for a [MEASUREMENT](#).

TESTED STORAGE PRODUCT
a distinct, customer orderable product, which is the focal point of a [RESULT](#).

TOTAL SYSTEM PRICE
the total cost of ownership for the [PRICED STORAGE CONFIGURATION](#).

TRANSITION *of a [TEST PHASE](#), a time period during which the IO load presented by the [WORKLOAD GENERATOR](#) to the [TSC](#) is changing, either increasing or decreasing.*

TSC *see [TESTED STORAGE CONFIGURATION](#).*

TSC BOUNDARY *the boundary between the [HOST SYSTEM](#) and [TSC](#).*

TSC EXECUTIVE   the software component of the _TSC_.

TSP   _see TESTED STORAGE PRODUCT_.

A.21   U

No terms defined.

A.22   V

No terms defined.

A.23   W

WORKLOAD   _a collection of ASU STREAMS._

WORKLOAD GENERATOR
               a user-space application, provided by the SPC, that produces benchmark-specific IO STREAMS.

A.24   X

No terms defined.

A.25   Y

No terms defined.

A.26   Z

No terms defined

Index

W