Storage
Performance
Council

SPC Pricing Guide

Revision 1.0 – Effective 27 May 2020

OFFICIAL

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<h1 style="text-align:center">Clause 0 <u>Introduction</u></h1>

0.1   Goals

This specification provides a uniform approach to the composition and pricing of storage configurations that may be applied to all SPC benchmarks. It is intended to:

- Clarify the basis for pricing-related calculations and disclosures;

- Define the terms and constraints related to pricing within SPC benchmark disclosures;

- Provide a uniform framework that can be applied to all SPC benchmarks without constraining the development of novel benchmark methodologies;

- Simplify the process of benchmark and benchmark extension development.

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;

- Would be implemented by a significant percentage of the users in the target market segment (as defined by the benchmark specification) ;

- Are relevant to the market segment that the benchmark represents.

All SPC benchmark results have a distinctly identifiable TEST SPONSOR, who is responsible for the completeness, accuracy, and authenticity of those submitted results and materials. The pricing associated with a benchmark submission is an integral part of those materials.

While the use of new pricing models is encouraged, pricing whose primary purpose is the optimization of SPC benchmark results without any corresponding applicability to real-world applications and environments is strictly prohibited.   In other words, all "benchmark specials" pricing that improves benchmark results but not general, real-world configurations, are disallowed. The criteria used to assess whether a given storage implementation represents a violation of this guideline can be found in Clause 0.2 of any SPC benchmark specification. When evaluation a pricing model, the following criteria should be assessed:

- Is the packaging or pricing unusual or non-customary for the vendor, or unusual or non-customary to normal business practices? The following pricing practices are suspect:

  o Availability of a discount to a small subset of possible customers.

  o Discounts documented in an unusual or non-customary manner.

  o Pricing featured as a close-out or one-time special.

   o Unusual or non-customary restrictions on transferability of product, warranty or maintenance on discounted items.

In the same way that SPC benchmark results are expected to be accurate representations of subsystem performance, the pricing disclosures defined in this document are expected to accurately reflect the expected acquisition and maintenance costs of a benchmark configuration.

0.3 Related Documents

This document relies on:

- Version 1.0 of the *SPC Glossary (included as Appendix A)*

This document is included by reference in the following benchmark specifications:

- *SPC BENCHMARK 1™(versions 3.9 and later) and its associated benchmark extensions.*

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

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Clause 1 <u>Pricing Methodology</u>

1.1 Overview

This clause defines the components and methodology necessary to calculate pricing-related values required by SPC benchmarks. The fundamental premise of this clause is that what is tested is priced, and what is priced is tested.

The pricing methodology must reflect the cost of acquisition and operation of the <u>BENCHMARK CONFIGURATION</u> using packages and discounts commonly practiced and generally available products. This cost must be disclosed in a line item fashion using local pricing.

1.2 Packages and Discounts

1.2.1 Packaging and pricing that are generally available to customers are acceptable, including:

- Generally available discounts for the priced configuration are allowed.

- Generally available packaged pricing is allowed,

- Revenue discounts based on total price are permissible.

1.2.2 Packaging and pricing that depend on existing relationships, prior purchases, or other constraints that are not generally available to all customers are prohibited, including:

- Individually negotiated discounts are not permitted.

- Special customer discounts (e.g., GSA schedule, educational schedule) are not permitted.

- Promotional and/or limited availability offerings are explicitly excluded.

1.2.3 For all hardware components used in the priced system, the cost shall be the price of a new component (i.e., not reconditioned or previously owned).

1.2.4 For a <u>TEST SPONSOR</u> who only has indirect sales channels, pricing shall be actual, generally available pricing from indirect channels that meet all other requirements of this specification.

1.3 Maintenance Package Pricing

1.3.1 Maintenance may be bundled as a component of package pricing.

1.3.2 The maintenance component of the package must be clearly identified in the description of the bundle/package.

1.3.3 A <u>TEST SPONSOR</u> may also include a standard multi-year maintenance option as a separately priced component. In cases where there is not such a 'bundling' of maintenance, or where a standard multi-year maintenance options is not available, any required multi-year maintenance cost shall be computed as a simple multiple of the one-year maintenance cost. In this case, a discount based on pre-payment in excess of 12 months is prohibited.

1.4 Prior Purchase Dependencies

1.4.1   Any discount must be based solely on the configuration being priced and cannot be based on past or future purchases.

1.4.2   The reported pricing represents a one-time, stand-alone purchase. Assumptions of other purchases, other sites with similar systems, or any other assumption that relies on the principle that the customer has made any other purchase from the TEST SPONSOR are specifically prohibited.

1.5 Product Availability

1.5.1   All hardware and software used in the BENCHMARK CONFIGURATION must be commercially available and supported either as individual items or as a part of a larger package.

1.5.2   Hardware and software used in the BENCHMARK CONFIGURATION that is not included in the TESTED STORAGE CONFIGURATION is exempt from the preceding requirement if it is no longer commercially available and/or supported due to obsolescence.

> **Comment:**   *The intent is to allow the use of components in the BENCHMARK CONFIGURATION that were at one time commercially available and supported as long as the components are not a part of the TESTED STORAGE CONFIGURATION.*

1.5.3   The PRICED STORAGE CONFIGURATION is the actual configuration the customer would purchase.

1.5.4   All hardware and software used in the calculations must be announced and generally orderable by customers.

1.5.5   TEST SPONSORS may announce new products and disclose benchmark results before new products have actually shipped. Results based on products that have not yet shipped are still subject to the prohibition of benchmark-special implementations *(*Clause 0.2*)*.

1.5.6   Each product or collection of products that comprise the PRICED STORAGE CONFIGURATION must have an AVAILABILITY DATE.

1.5.7   When the PRICED STORAGE CONFIGURATION includes products or components with different AVAILABILITY DATES, the AVAILABILITY DATE for the PRICED STORAGE CONFIGURATION is the date at which all components are committed to be available

1.5.8   The essence of the AVAILABILITY DATE for the PRICED STORAGE CONFIGURATION is the ability to take physical delivery of an integrated configuration that is identical the PRICED STORAGE CONFIGURATION, achieves the reported SPC-1 performance, and demonstrates fulfillment of all the requirements of Clause 0.2.

1.5.9   The AVAILABILITY DATE for the PRICED STORAGE CONFIGURATION shall not be more than three months beyond the FULL DISCLOSURE REPORT submittal date.

1.6 "Target Country" Requirements

1.6.1   The TARGET COUNTRY is 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.

1.6.2   PRICED STORAGE CONFIGURATION pricing, as well as any included discounts, must be available to all customers in the TARGET COUNTRY.

1.7   Pricing Currency

1.7.1   Local Currency

SPC pricing may be in the currency of the TARGET COUNTRY where the PRICED STORAGE CONFIGURATION product availability, sales and support requirements would be met.

1.7.2   Non-Local Currency

1.7.2.1   SPC pricing may be in a currency other than the currency of the TARGET COUNTRY, if all of the following requirements are met:

- The TARGET COUNTRY requirements shall be met (see 1.6);

- The TEST SPONSOR shall disclose the country that is the source of the non-local currency used in the SPC pricing.

1.7.2.2   A public reference to a pricing element of an SPC RESULT that uses non-local currency pricing shall include a clear statement of the currency used and the TARGET COUNTRY. For example, "SPC-1 Pricing is in U.S. dollars for product availability, sales, and support in People's Republic of China".

1.8   Third-Party Pricing

1.8.1   In the event that any hardware, software, or maintenance is provided by a third party not involved as a TEST SPONSOR of the benchmark, the pricing must satisfy all requirements for general availability, standard volume discounts, and full disclosure.

1.8.2   The TEST SPONSOR is required to clearly identify all the items, components and services that are not acquired from the TEST SPONSOR. Any third-party supplier's items and prices, including discounts, are subject to the same disclosure requirements as those components supplied by the TEST SPONSOR. Discounts shall not be dependent on purchases from any other suppliers.

1.8.3   Any pricing that is not directly offered by the TEST SPONSOR and not derived from the third-party supplier's generally available pricing and discounts must be guaranteed by the third party in a written price quotation. The quotation must be valid for a period not less than 60 days from the date the results are submitted.

1.8.4   Third party's written quotations must be included in the FULL DISCLOSURE REPORT and must state:

- That the quoted prices are generally available;

- The time period for which the prices are valid;

- The basis of all discounts;

- Any terms and conditions that apply to the quoted prices.

Clause 2 <u>Priced Components</u>

2.1 Overview

Each benchmark specification shall identify the components that are to be priced ("priced components"). Unless stated otherwise in the benchmark specification, the priced components include:

- the hardware that comprises the <u>TESTED STORAGE CONFIGURATION</u> (see 2.2);

- software components present in the <u>TESTED STORAGE CONFIGURATION</u> (see 2.3);

- three-year maintenance on all components the <u>TESTED STORAGE CONFIGURATION</u> (see 2.5);

- any additional operational components required by <u>TESTED STORAGE CONFIGURATION</u> (see 2.6).

2.2 Hardware Pricing

The pricing for a benchmark submission shall include all hardware components in the <u>TSC</u>. The components that constitute the <u>TSC</u> typically include:

- A storage controller that plugs into a system I/O interconnect on the <u>HOST SYSTEM</u>;

- Batteries used to maintain power to cache/memory in the storage controller in the event of unexpected power failure;

- Cabling between the storage controller and the <u>STORAGE DEVICES</u> used to implement the <u>ASUS</u>;

- All cabinetry used to house components of the TSC (excluding the cabinetry, cooling, power, and monitoring systems required to house the storage controller embedded in the <u>HOST SYSTEM</u> cabinet);

- Environmental monitoring systems and related cabling used to monitor the health of components of the <u>TSC</u> ;

- Fans used to cool components of the <u>TSC</u> ;

- Power supplies and related cabling used to power components of the TSC;

- Power distribution systems and related cabling in cabinetry used to route power to the individual component power supplies in the TSC;

- All management software necessary to present the <u>ASUS</u> to the <u>WORKLOAD GENERATOR</u>;

- <u>STORAGE DEVICES</u> to provide the various levels of storage defined in the benchmark specification.

2.2.1 **Host System Inclusion**

2.2.1.1 Each HOST SYSTEM in the BENCHMARK CONFIGURATION must be included as a priced TESTED STORAGE CONFIGURATION component if any of the following conditions are true:

- The HOST SYSTEM contains an integral component that is a TSC hardware component, which cannot be unplugged and moved to a different HOST SYSTEM.

- The HOST SYSTEM contains STORAGE DEVICES that are connected internally as integral HOST SYSTEM components.

- The HOST SYSTEM implements TSC data protection required by the benchmark.

Examples of TSC that includes the HOST SYSTEM as a priced TSC component are included in each benchmark specification.

2.2.1.2 HOST SYSTEMs may provide one or more of the following functionalities and not be included as a priced TSC component:

- Organize and manage the underlying LOGICAL VOLUMEs that comprise the APPLICATION STORAGE UNITS.

- Provide RAID 0 (striping)

2.2.1.3 TEST SPONSORS should request a recommendation from the SPC Compliance Review Committee, if the above wording does not clarify the TSC component status of a HOST SYSTEM in their BENCHMARK CONFIGURATION.

2.3 Software Pricing

The pricing for a benchmark submission shall include all software components in the TSC. This will typically include any licensing and usage fees associated with the TSC EXECUTIVE.

2.4 Pricing for Benchmark Extensions

2.4.1 Any hardware or software components added to the TSC in order to execute a benchmark extension shall be priced, and are subject to the other requirements in this guide, including discounting, availability and disclosure.

2.4.2 Hardware or software components used solely in the execution of a benchmark extension shall not be included in the calculation of any price-related metrics for the underlying BENCHMARK (e.g., SPC-1 price-performance).

Components that are used in both during the execution of one or more benchmark extensions and the underlying benchmark shall be included in the calculation of any price-related metrics for the underlying BENCHMARK.

2.4.3 Components used solely in the execution of a benchmark extension shall be not be included in the pricing spreadsheet for the underlying BENCHMARK (see 5.3.1). Instead, the disclosure for each benchmark extension included in a MEASUREMENT shall include a similar pricing summary that includes all components required for that extension that are not accounted for in the pricing spreadsheet for the underlying BENCHMARK, and their associated maintenance costs.

2.5   Maintenance Pricing

2.5.1   Hardware maintenance and software support shall provide the following:

- Acknowledgement of new and existing problems within four (4) hours.

- On-site presence of a qualified maintenance engineer or provision of a customer replaceable part within four (4) hours of the above acknowledgement for any hardware failure that results in an inoperative PRICED STORAGE CONFIGURATION that can be remedied by the repair or replacement of a PRICED STORAGE CONFIGURATION component. In either case, the remedy will result in resumption of operation.

- Resumption of operation means the PRICED STORAGE CONFIGURATION must be returned to the same state/configuration that was present before the failure.

- Commitment to fix software defects within a reasonable time.

2.5.2   The maintenance pricing must be independent of actual failure rates over the three-year period, no matter how many failures occur during that period. The use of Mean Time Between Failure (MTBF) data to directly compute the maintenance cost for this BENCHMARK is precluded. The hardware maintenance pricing requirements cannot be met by pricing based on the cost to fix specific failures, even if the failure rate is calculated from MTBF data.

2.5.3   Hardware maintenance and software support must be configured using standard pricing which covers 7 days per week, 24 hours per day coverage, either on-site, or if available as standard offering, via a central support facility.

2.5.4   Unless otherwise specified in the BENCHMARK specification, maintenance pricing shall be for a duration of at least three years (36 months).

2.6   Additional Component Pricing

2.6.1   Additional products explicitly required for the operation, administration, or maintenance of the PRICED STORAGE CONFIGURATION must be included. This includes all required third-party software and hardware products.

2.6.2   Copies of the software used by the PRICED STORAGE CONFIGURATION , on appropriate media, and a software load device, if required for initial load or maintenance updates, must be included.

2.6.3   The price of all cables used to connect components of the PRICED STORAGE CONFIGURATION must be included.

2.6.4   If the PRICED STORAGE CONFIGURATION is greater than 20U, the configuration must include the appropriate racking/cabinetry and power distribution.

Clause 3 TSC/PSC Pricing

3.1   Overview

The TSC represents the equipment configuration that is physically present during the benchmark measurement. The configuration used in pricing must be customer orderable. To allow the use of a valid measurement configuration that may not represent a customer orderable configuration, this clause will distinguish between the TSC and PRICED STORAGE CONFIGURATION (PSC).

3.2   Priced Storage Configuration

3.2.1   The PRICED STORAGE CONFIGURATION represents a customer orderable configuration. If the TSC, without modification, is customer orderable, it is also the PSC.

3.2.2   In cases where the TSC is a valid measurement configuration but not a customer orderable configuration, the TSC and PRICED STORAGE CONFIGURATION will differ. The PRICED STORAGE CONFIGURATION will be comprised of the TSC with appropriate components added or deleted to create a customer orderable configuration.

For example, consider a configuration in which a portion of the PHYSICAL STORAGE CAPACITY is not physically connected to the TSC , and the TSC can be ordered without that unused storage. In this case, the PRICED STORAGE CONFIGURATION would not include the unused storage.

A second example would be a configuration in which all of the PHYSICAL STORAGE CAPACITY is used in the benchmark, but that specific storage capacity is not orderable. The amount of storage included in the pricing would be adjusted to create an orderable configuration, again resulting in a PRICED STORAGE CONFIGURATION that differs from the TSC .

3.2.3   In those cases where there is deletion or addition of components to create a customer orderable configuration, the PRICED STORAGE CONFIGURATION must be capable of providing at least the same level of reported performance as the TSC . Any component change between the TSC and the PSC shall be performance-neutral.

3.3   Additional Operational Components

3.3.1   Additional products explicitly required for the operation, administration, or maintenance of the PRICED STORAGE CONFIGURATION must be included. This includes all required third-party software and hardware products.

3.3.2   Copies of the software used by the PRICED STORAGE CONFIGURATION , on appropriate media, and a software load device, if required for initial load or maintenance updates, must be included.

3.3.3   The price of all cables used to connect components of the PRICED STORAGE CONFIGURATION must be included.

3.3.4   The rack capacity (stated in rack units or RU) required of the PRICED STORAGE CONFIGURATION shall be disclosed. If the PRICED STORAGE CONFIGURATION requires rack capacity of more than 20 RU, the configuration shall include the appropriate racking/cabinetry and power distribution.

Clause 4 <u>Configuration Changes and Pricing</u>

4.1   In addition to providing an accurate pricing model at the time of publication, test sponsors are responsible for maintaining the accuracy the pricing for a given measurement for as long as it active on the SPC results list.

4.2   Changes to the underlying PSC may be required over time, as components are changed, retired or replace. This is permitted, provided those changes have no impact PSC's ability to achieve the published performance

4.3   Each benchmark specification identifies those portions of its TSC that impact the performance of the configuration, and those that do not.

4.4   Benchmark specifications may also identify TSC components that may not be substituted after benchmark publication. No substitutions will be allowed for any components in this class.

4.5   Components that do not impact performance may be substituted at any time after benchmark publication. If such a substitution is made, the price-related information for the result shall be updated appropriately.

4.6   Components that are identified as impacting performance may be substituted after benchmark publication, provided that the performance neutral-nature of the substation can be demonstrated.

4.7   A demonstration of performance neutrality shall be designed in conjunction with a certified Auditor, and the results shall be reviewed by a certified Auditor, but are not subject to a new peer review.

4.8   The demonstration need not involve an entire system configuration, but may be based on a component-level comparison between the original PSC and the proposed configuration update.

Clause 5 **Disclosure Requirements**

5.1 **Component Availability and Support**

5.1.1   The TEST SPONSOR shall disclose all effective dates of the reported prices.

5.1.2   The TEST SPONSOR shall disclose the target country and priced currency.

5.2 **Calculation of Total System Price**

5.2.1   Calculation of TOTAL SYSTEM PRICE, includes:

- The cost of the PRICED STORAGE CONFIGURATION.

- The cost of additional hardware and/or software products.

- Maintenance as defined in the appropriate benchmark

- HOST SYSTEM(S) that are considered priced TSC components

- All applicable tariffs, duties, and import fees, when appropriate, if those costs are not included in the listed product prices.

5.2.2   Specifically excluded from the pricing calculation are the following:

- Components necessary for the execution of the benchmark that do not provide any storage functionality and do not enhance the measured performance of the TESTED STORAGE CONFIGURATION.

- Software, which is not a third-party product, that meets the exclusions listed in 2.3.

- The cost of maintenance for HBA(s) included in the PRICED STORAGE CONFIGURATION.

- Any associated shipping costs.

5.3 **Required Reporting**

5.3.1   **Pricing Spreadsheet**

5.3.1.1   The PRICING SPREADSHEET details how the cost of ownership is computed. It contains the prices, discounts, warranty information, and maintenance cost for all the hardware and software components in the PRICED STORAGE CONFIGURATION. Price disclosure shall be presented in a structured fashion to enhance clarity and comparability between test results.

5.3.1.2   The REFERENCE PRICE of a component or subsystem is defined as the price at which it could be ordered individually from the vendor or designated third-party suppler.

5.3.1.3   The PRICING SPREADSHEET must be included in the FULL DISCLOSURE REPORT and must include the following items for each component in the PSC:

- Part name or brief description

- Part number

- Source of the component, whether from a TEST SPONSOR or a third party (note: this can be an index into a list of component sources provided that list is included in the PRICING SPREADSHEET)

- REFERENCE PRICE of the component

- Quantity of the component used in the priced configuration

- The extended price of the component, based on the REFERENCE PRICE of the component, the quantity included in the priced configuration and any component-level discounting

- The maintenance cost (including any discount for pre-payment), or a notation that maintenance for the part is included in another maintenance charge.

- If the component is a bundle/package of parts, the above items apply to the bundle but each item in the bundle/package shall be clearly identified in the description of bundle/package.

- Components required to configure the PRICED STORAGE CONFIGURATION that have an aggregate price less than 0.1% of the PRICED STORAGE CONFIGURATION may be listed as a single line item with a description of the collection of components, e.g., "Miscellaneous Cables."

5.3.1.4 The TOTAL SYSTEM PRICE of the PRICED STORAGE CONFIGURATION and its associated three-year maintenance cost must be included in the PRICING SPREADSHEET . The TOTAL SYSTEM PRICE shall be stated in the minimum level of negotiable detail for the pricing currency, e.g. U.S. dollars and cents.

5.3.1.5 The percentage, amount, and basis (including type and justification) of all discounts listed shall be disclosed. A tabular summary may be employed to simplify the presentation.

5.3.1.6 Thresholds for such discounts need not be disclosed.

5.3.1.7 The overall discount in defined as

$$D = \frac{\sum_C Q * R - T}{\sum_C Q * R}$$

Where:

D is overall discount
T is total system price
C is the set of components, services and maintenance in T
Q is the quantity of a given element in C used in the PSC
R is the reference price for that element in C

5.3.1.8 The overall discount shall be disclosed.

5.3.1.9   While package pricing is allowed, the level of discount obtained through such packages shall be disclosed by reporting the individual REFERENCE PRICE for each component in the PRICING SPREADSHEET.

> **Comment:**   *This requirement does not apply to components that are not sold separately, other than as repair parts.*

5.3.1.10   The PRICING SPREADSHEET shall contain the following text:

> Prices used in SPC benchmarks reflect the actual prices a customer would pay for a one-time purchase of the stated components. Individually negotiated discounts are not permitted. Special prices based on assumptions about past or future purchases are not permitted. All discounts reflect standard pricing policies for the listed components. For complete details, see the pricing sections of the SPC benchmark specifications. If you find that the stated prices or maintenance levels are not available according to these terms, please inform the SPC at SPCADMIN@STORAGEPERFORMANCE.ORG.

> **Comment:**   *This wording is intended to assure that SPC pricing is viewed in an appropriate context, and to encourage the participation of consumers of SPC data is ensuring that the pricing methodologies are properly adhered to.*

5.4   Disclosure Requirements

5.4.1   Each SPC Benchmark defines its own set of PRICE-RELATED DATA.

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5.4.2   Any information identified in a benchmark specification as PRICE-RELATED DATA shall be subject to the requirements defined in this document, unless explicitly exempted in the applicable benchmark specification.

5.4.3   All price-related data shall be reported to a resolution of the smallest negotiable whole unit of the pricing currency used in the pricing. For example, configurations priced in US dollars would report TOTAL SYSTEM PRICE as $12,345.67.

5.4.4   SPC-1 Pricing Revisions

PRICED STORAGE CONFIGURATION pricing of an existing RESULT may be revised based on fully documented price changes *(decreases and increases)*. If the cumulative price changes result in an increase of 5% or more from the reported TOTAL SYSTEM PRICE , the TEST SPONSOR must submit a revised FDR with the new pricing information to the SPC within 30 days of the effective date of the price changes for the SPC-1 RESULT to remain compliant. Pricing changes below the 5% increase threshold are submitted at the discretion of the TEST SPONSOR . In either case, the SPC-1 measurement need not be re-executed to remain compliant if there are no changes in the PRICED STORAGE CONFIGURATION components resulting from the revised pricing.

> **Comment:**   *The intent of this clause is that published the SPC-1 TOTAL SYSTEM PRICE- reflects the actual, current SPC-1 TOTAL SYSTEM PRICE.*

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5.4.5 Priced Storage Configuration Availability Date Revisions

The original AVAILABILITY DATE for the PRICED STORAGE CONFIGURATION may be revised consistent with the Availability requirement. The SPC-1 measurement need not be re-executed to remain compliant if there are no changes in the PRICED STORAGE CONFIGURATION resulting from the revised AVAILABILITY DATE.

5.4.6 Component Substitution in a revised SPC-1 Result

If a revision to an existing SPC-1 RESULT would result in a change to the PRICED STORAGE CONFIGURATION documented in the corresponding SPC-1 FULL DISCLOSURE REPORT (FDR), the TEST SPONSOR must submit, for review by an AUDITOR, a list of components that would be changed. The AUDITOR may require additional information and/or specific tests to be executed to ensure the revised PRICED STORAGE CONFIGURATION is capable of successfully completing the PERSISTENCE TEST, as well as, providing at least the same level of reported performance as stated in the current FDR.

Examples of component substitutions include:

- Replacement of a now obsolete component that was included in the existing PRICED STORAGE CONFIGURATION.

- Replacement of a component when a change in the component's availability would extend the SPC-1 AVAILABILITY DATE beyond the period allowed by the specification.

If the PRICED STORAGE CONFIGURATION component changes are approved by the AUDITOR, an amended SPC-1 Audit Certification letter will be issued to the TEST SPONSOR for inclusion in a revised FDR, which will contain a list of all changes *(.* If the AUDITOR does not approve the component changes, the TEST SPONSOR may appeal that decision to the SPC Compliance Review Committee.

5.4.7 Pricing Spreadsheet

5.4.7.1 The PRICING SPREADSHEET details how the three-year cost of ownership is computed. It contains the prices, discounts, warranty information, and maintenance cost for all the hardware and software components in the PRICED STORAGE CONFIGURATION. Price disclosure shall be presented in a structured fashion to enhance clarity and comparability between test results.

5.4.7.2 The REFERENCE PRICE of a component or subsystem is defined as the price at which it could be ordered individually from the vendor or designated third-party suppler.

5.4.7.3 The PRICING SPREADSHEET must be included in the FULL DISCLOSURE REPORT and must include the following items for each component in the PSC:

- Part name or brief description

- Part number

- Source of the component, whether from a TEST SPONSOR or a third party (note: this can be an index into a list of component sources provided that list is included in the PRICING SPREADSHEET)

- REFERENCE PRICE of the component

- Quantity of the component used in the priced configuration

- The extended price of the component, based on the REFERENCE PRICE of the component, the quantity included in the priced configuration and any component-level discounting

- The maintenance cost (including any discount for pre-payment), or a notation that maintenance for the part is included in another maintenance charge.

- If the component is a bundle/package of parts, the above items apply to the bundle but each item in the bundle/package must be clearly identified in the description of bundle/package.

- Components required to configure the PRICED STORAGE CONFIGURATION that have an aggregate price less than 0.1% of the PRICED STORAGE CONFIGURATION may be listed as a single line item with a description of the collection of components, e.g., "Miscellaneous Cables."
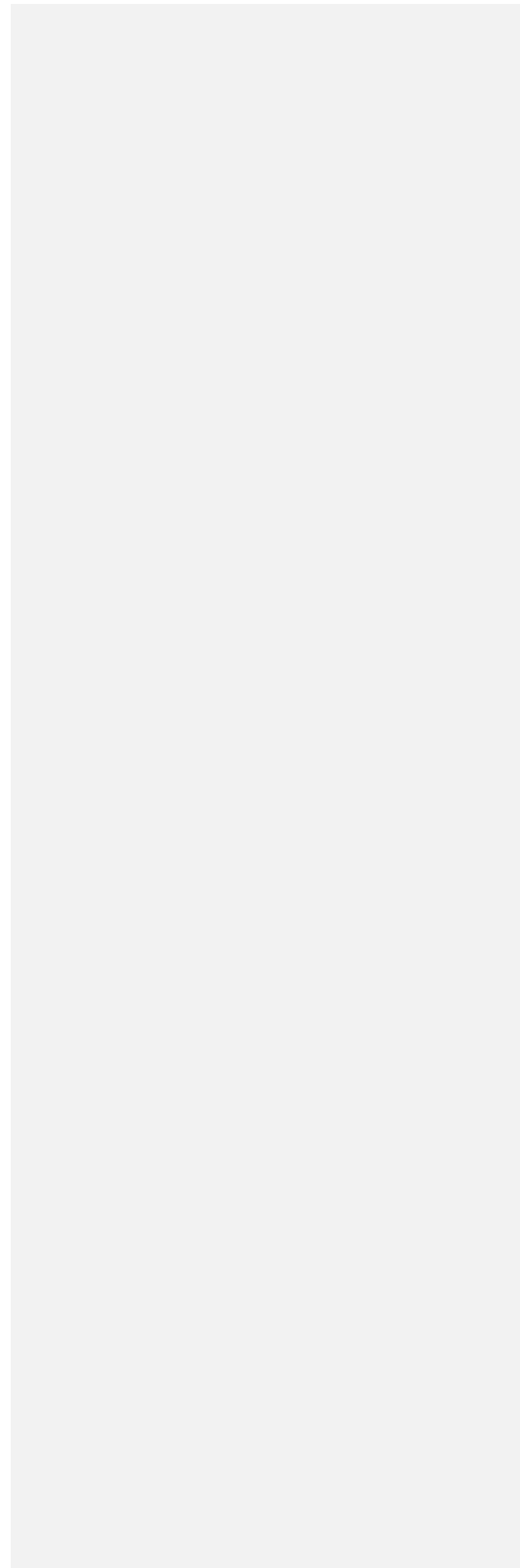
5.4.7.4   The TOTAL SYSTEM PRICE of the PRICED STORAGE CONFIGURATION and its associated three-year maintenance cost must be included in the PRICING SPREADSHEET. The TOTAL SYSTEM PRICE must be stated in the minimum level of negotiable detail for the pricing currency, e.g. U.S. dollars and cents.

5.4.7.5   The percentage, amount, and basis (including type and justification) of all discounts listed must be disclosed. A tabular summary may be employed to simplify the presentation.

5.4.7.6   Thresholds for such discounts need not be disclosed.

5.4.7.7   While package pricing is allowed, the level of discount obtained through such packages shall be disclosed by reporting the individual REFERENCE PRICE for each component in the PRICING SPREADSHEET (see Clause 5.4.7.2).

> **Comment:**   *This requirement does not apply to components that are not sold separately, other than as repair parts.*

5.4.7.8   The PRICING SPREADSHEET shall contain the following text:

> Prices used in SPC benchmarks reflect the actual prices a customer would pay for a one-time purchase of the stated components. Individually negotiated discounts are not permitted. Special prices based on assumptions about past or future purchases are not permitted. All discounts reflect standard pricing policies for the listed components. For complete details, see the pricing sections of the SPC benchmark specifications. If you find that the stated prices or maintenance levels are not available according to these terms, please inform the SPC at SPCADMIN@STORAGEPERFORMANCE.ORG.

> **Comment:**   *This wording is intended to assure that SPC pricing is viewed in an appropriate context, and to encourage the participation of consumers of SPC data is ensuring that the pricing methodologies are properly adhered to.*

Clause 6 <u>Audit Requirements</u>

6.1   The AUDITOR shall review a preliminary copy of the PRICING SPREADSHEET, and verify that it meets all the requirements and constraints of this document.

6.2   The AUDITOR is not required to review the final pricing prior to issuing the Audit Certification letter.

Clause 7 <u>Usage of Pricing Information</u>

7.1   Comparison of Results

7.1.1   A comparison of two or more SPC benchmark results that includes price-related data is prohibited unless the referenced results:

- Are both compliant with all other requirements in the appropriate benchmark specifications;

- Are run against comparable revisions of the same benchmark specification;

- Use an identical currency for pricing;

- Identify the same target country.

7.1.2   While a comparison of two or more SPC benchmark results may be based solely on price-related data, it must satisfy all requirements for the comparison of benchmark results, and the disclosure of reported data.

7.2   Creation of New Results from Existing Results

- The hardware and software components that comprise the PRICED STORAGE CONFIGURATION *(Clause 3.2)* in the new SPC-C Result are materially the same as those used in the existing SPC-1 RESULT.

7.3   Pricing Revisions

7.3.1   **SPC-1 Pricing Revisions**

PRICED STORAGE CONFIGURATION pricing of an existing SPC-1 RESULT may be revised based on fully documented price changes *(decreases and increases)*. If the cumulative price changes result in an increase of 5% or more from the reported SPC-1 TOTAL SYSTEM PRICE, the TEST SPONSOR must submit a revised FDR with the new pricing information to the SPC within 30 days of the effective date of the price changes for the SPC-1 RESULT to remain compliant. Pricing changes below the 5% increase threshold are submitted at the discretion of the TEST SPONSOR. In either case, the SPC-1 measurement need not be re-executed to remain compliant if there are no changes in the PRICED STORAGE CONFIGURATION components resulting from the revised pricing.

> **Comment:**   *The intent of this clause is that published the SPC-1 TOTAL SYSTEM PRICE- reflects the actual, current SPC-1 TOTAL SYSTEM PRICE.*

7.3.2   **Priced Storage Configuration Availability Date Revisions**

The original AVAILABILITY DATE for the PRICED STORAGE CONFIGURATION may be revised consistent with the Availability requirement. The SPC-1 measurement need not be re-executed to remain compliant if there are no changes in the PRICED STORAGE CONFIGURATION resulting from the revised AVAILABILITY DATE.

7.3.3   Price-related data shall be reported to a resolution of the smallest negotiable whole unit of the pricing currency. For example, configurations priced in US dollars would report price-related information to a resolution of $0.01, rounded up to the nearest cent.

7.3.4 A public reference, which includes price-related data for a RESULT that uses non-local currency pricing shall include a clear statement of the currency used and the TARGET COUNTRY. For example, "SPC-1 Pricing is in U.S. dollars for product availability, sales, and support in People's Republic of China".

Appendix A   SPC 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.

The following content is from *SPC Glossary, version 1.0, which* was current as of 24 March 2020

A.1   <u>A</u>

ADDRESSABLE CAPACITY
> the portion of the storage capacity of a <u>LOGICAL VOLUME</u> that is accessible to the <u>WORKLOAD GENERATOR</u>.

APPLICATION STORAGE UNIT (ASU)
> the logical representation of the persistent, non-volatile storage read and or written in the course of executing a <u>BENCHMARK</u>.
>
> An ASU represents is a logical interface between a <u>BENCHMARK CONFIGURATION</u>'s data and a workload generator.

APPLICATION STORAGE UNIT CAPACITY
> the total <u>ADDRESSABLE CAPACITY</u> of all the portions of <u>LOGICAL VOLUMES</u> to which an <u>ASU</u> is mapped.

APPLICATION STORAGE UNIT STREAM
> a collection of one or more <u>I/O STREAM</u>s, that completely defines the I/O sent to a given <u>ASU</u>.

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

ASU   see <u>APPLICATION STORAGE UNIT</u>.

ASU CAPACITY   see <u>APPLICATION STORAGE UNIT CAPACITY</u>.

ASU PRICE   the ratio of <u>TOTAL SYSTEM PRICE</u> to <u>ASU CAPACITY</u>.

ASU STREAM   see <u>APPLICATION STORAGE UNIT STREAM</u>.

AUDIT   the process that verifies that a <u>MEASUREMENT</u> is eligible for submission as a <u>RESULT</u>.

AUDITOR   An individual who has been certified by the SPC to perform an <u>AUDIT</u>.

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

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

A.2 **B**

BC see *BENCHMARK CONFIGURATION*.

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

BENCHMARK CONFIGURATION
all hardware and software components used in the creation of a MEASUREMENT.

A.3 **C**

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

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

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 TSC 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 **D**

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

A.5 **E**

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

EXTENSION CONFIGURATION
all hardware and software components used in the execution of an EXTENSION.

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

EXECUTIVE SUMMARY
a high-level report summarizing a RESULT, and the configuration used to produce it.

A.6 F

FAILED I/O REQUEST

any I/O REQUEST issued by the WORKLOAD GENERATOR that could not be completed or was signaled as failed by the OS running on the HOST SYSTEM .

A FAILED I/O request has no COMPLETION TIME.

FDR
see FULL DISCLOSURE REPORT.

FULL DISCLOSURE REPORT

a report detailing a RESULT, along with the procedures, configuration, and equipment used to produce it.

A.7 G

No terms defined.

A.8 H

HOST SYSTEM
a computer system where the WORKLOAD GENERATOR executes.

A.9 I

IN-FLIGHT I/O REQUEST

an I/O REQUEST issued by the WORKLOAD GENERATOR that does not complete within a given MEASUREMENT INTERVAL.

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 I/O STREAM to the total IO load produced by all active I/O STREAMS.

I/O COMMAND
see I/O REQUEST.

I/O STREAM
a single, well-defined, sequence of I/O REQUESTS.

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

I/O REQUEST THROUGHPUT

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

A.10 J

No terms defined.

A.11 **K**

No terms defined.

A.12 **L**

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 <u>I/O REQUEST</u> with a <u>COMPLETION TIME</u> occurring within the <u>MEASUREMENT INTERVAL</u>.

MEASURED INTENSITY MULTIPLIER
the percentage of all <u>MEASURED I/O REQUESTS</u> that were issued by a given <u>I/O STREAM</u>.

MEASUREMENT: *the data gathered during the execution of a <u>BENCHMARK</u>.*

measurement boundary
of the point within a benchmark configuration at which measurements are taken.

MEASUREMENT INTERVAL
of a <u>TEST PHASE</u>, the time from the end of the <u>TRANSITION</u> to the start of the <u>RUNOUT</u>.

A.14

N

No terms defined.

A.15 **O**

ON-SITE AUDIT   *an <u>AUDIT</u> for which the <u>AUDITOR</u> is physically present.*

A.16 **P**

PHYSICAL CAPACITY UTILIZATION
<u>ASU CAPACITY</u> divided by the <u>PHYSICAL STORAGE CAPACITY</u>.

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 <u>STORAGE DEVICES</u> in the <u>TESTED STORAGE CONFIGURATION</u>.

PRICED DISCLOSURE ITEM:

A PRICING-RELATED DATA *item that is included in the fdr,* AND *is subject to requirements defined in the SPC Pricing Guide.*

PRICED *storage configuration (*"PSC"*):*

the customer-orderable version of the <u>TSC</u>*.*

PRICE-PERFORMANCE

the ratio of the <u>TOTAL SYSTEM PRICE</u> *to the primary performance metric for a* <u>BENCHMARK</u>*")*:*.*

PRICING SPREADSHEET

a detailed computation of the total cost of ownership for a <u>PRICED STORAGE CONFIGURATION</u>*.*

PRIMARY METRIC *a metric that provides a primary basis for comparison of* <u>RESULTS</u>*.*

PROTECTED 1 *a data protection level in which the failure of any single* <u>STORAGE DEVICE</u> *in the* <u>TSC</u> *will not require user intervention to restore access to the* <u>BENCHMARK'S</u>*"): data repository.*

PROTECTED 2 *a data protection level in which the failure of any single component in the* <u>TSC</u> *will not require user intervention to restore access to the* <u>BENCHMARK'S</u> *data repository.*

PSC *see* <u>PRICED STORAGE CONFIGURATION</u>*.*

A.17 <u>Q</u>

No terms defined.

A.18 <u>R</u>

REFERENCE PRICE

the price at which component or subsystem could be ordered individually from the <u>TEST SPONSOR</u> *or designated third-party suppler.*

REMOTE AUDIT *an* <u>AUDIT</u> *for which the* <u>AUDITOR</u> *is not physically present. See* <u>ON-SITE AUDIT</u>*.*

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

REPORTED DATA *the set of data, as defined by a given benchmark, which fully characterizes a measurement.*

response time *for an* <u>I/O REQUEST</u>*,* <u>COMPLETION TIME</u> *minus* <u>START TIME</u>*.*

RESULT *an audited* <u>MEASUREMENT</u> *which has been submitted to the SPC for publication*

RESULTS FILES   *the output of the* <u>WORKLOAD GENERATOR</u>, *created during a* <u>MEASUREMENT</u>.

RUNOUT   *of A test phase, the time* <u>PERIOD</u> *immediately following the measurement interval during which the IO load presented by the* <u>WORKLOAD GENERATOR</u> *to the* <u>TSC</u> *remains constant long enough for any IO issued during the* <u>MEASUREMENT INTERVAL</u> *to complete.*

S

secondary metric a metric that is not a primary basis for comparison of results, but still provides important information.

ser   *see* <u>SPACE EFFECTIVENESS RATIO</u>.

SOR   *see space optimization ratio.*

snapshot   *a logical, point-in-time,* <u>CRASH-CONSISTENT</u> *image of one or more* <u>LOGICAL VOLUMES</u>.

SNAPSHOT set   *a crash-consistent collection of* <u>SNAPSHOTS</u>, *taken and managed as a unit.*

SPACE effectiveness ratio ("ser")
    THE ratio of the total amount of data that the <u>TSC</u> *can hold to its* <u>PHYSICAL CAPACITY</u>.

SPACE OPTIMIZATION ratio ("sor")
    the size of a data set as generated by <u>THE</u> *workload generator divided by the amount of incremental space consumed by that data set.*

<u>*SPC*</u> *result*   *see result.*

ssu   *see* <u>STIMULUS SCALING UNIT</u>.

START TIME   *for an i/o request, the* TIME *recorded by the workload generator WHEN THE REQUEST is submitted FOR EXECUTION on the* <u>TSC</u>.

steady state   *a state in which the behavior of the* <u>TSC</u> *is stable and sustainable while the load presented to the* <u>TSC</u> *by the* <u>WORKLOAD GENERATOR</u> *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 <u>STORAGE DEVICE</u> *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.19　　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.20　　U

No terms defined.

A.21　　V

No terms defined.

A.22 W

WORKLOAD *a collection of ASU STREAMS.*

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

A.23 X

No terms defined.

A.24 Y

No terms defined.

A.25 Z

No terms defined