



SPC BENCHMARK 1™
FULL DISCLOSURE REPORT

**INSPUR ELECTRONIC INFORMATION INDUSTRY CO.
LTD.
INSPUR AS2200G2**

SPC-1 v3.9.1

SUBMISSION IDENTIFIER: A32019

SUBMITTED FOR REVIEW: OCTOBER 14, 2020

First Edition – October 2020

THE INFORMATION CONTAINED IN THIS DOCUMENT IS DISTRIBUTED ON AN AS IS BASIS WITHOUT ANY WARRANTY EITHER EXPRESS OR IMPLIED. The use of this information or the implementation of any of these techniques is the customer's responsibility and depends on the customer's ability to evaluate and integrate them into the customer's operational environment. While each item has been reviewed by Inspur Electronic Information Industry Co. Ltd. for accuracy in a specific situation, there is no guarantee that the same or similar results will be obtained elsewhere. Customers attempting to adapt these techniques to their own environment do so at their own risk.

This publication was produced in the United States. Inspur Electronic Information Industry Co. Ltd. may not offer the products, services, or features discussed in this document in other countries, and the information is subject to change with notice. Consult your local Inspur Electronic Information Industry Co. Ltd. representative for information on products and services available in your area.

© Copyright Inspur Electronic Information Industry Co. Ltd. 2020. All rights reserved.

Permission is hereby granted to publicly disclose and reproduce this document, in whole or in part, provided the copyright notice as printed above is set forth in full text on the title page of each item reproduced.

Trademarks

SPC Benchmark 1, SPC-1, SPC-1 IOPS, SPC-1 LRT and SPC-1 Price-Performance are trademarks of the Storage Performance Council.

Inspur, the Inspur logo and AS2200G2 are trademarks or registered trademarks of Inspur Electronic Information Industry Co. Ltd. in the United States and other countries. All other brands, trademarks, and product names are the property of their respective owners.

Benchmark Specification and Glossary

The official SPC Benchmark 1™ (SPC-1™) specification is available on the website of the Storage Performance Council (SPC) at www.spcresults.org.

The SPC-1™ specification contains a glossary of the SPC-1™ terms used in this publication.

Table of Contents

Audit Certification	4
Letter Of Good Faith	6
Executive Summary	7
Pricing Details	8
Publication Details	9
Contact Information	9
Revision Information	9
Exceptions and Waivers	9
Configuration Information	10
Tested Storage Product Description	10
Host System and Tested Storage Configuration Components	10
Configuration Diagrams	11
Benchmark Configuration Creation Process	12
Space Optimization Information	13
Benchmark Execution Results	14
Benchmark Execution Overview	14
ASU Pre-Fill	15
SUSTAIN Test Phase	16
RAMPD_100 Test Phase	19
Response Time Ramp Test	22
Repeatability Test	24
Data Persistence Test	27
Appendix A: Supporting Files	28
Appendix B: Third Party Quotation	29
Appendix C: Tuning Parameters and Options	30
Appendix D: Storage Configuration Creation	31
Appendix E: Configuration Inventory	32
Appendix F: Workload Generator	33

AUDIT CERTIFICATION



Hao Sun
 Inspur Electronic Information Co. Ltd.
 NO.1036, Inspur Road, Jinan
 People’s Republic of China

October 13, 2020

I verified the SPC Benchmark 1™ (SPC-1™ v3.9.1) test execution and performance results of the following Tested Storage Product:

Inspur AS2200G2

The results were:

SPC-1 IOPS™	369,997
SPC-1 Price-Performance	\$75.77/SPC-1 KIOPS™
SPC-1 Total System Price	28,032.86
SPC-1 IOPS Response Time	0.458 ms
SPC-1 Overall Response Time	0.282 ms
SPC-1 ASU Capacity	3,543 GB
SPC-1 ASU Price	\$7.92/GB

In my opinion, these performance results were produced in compliance with the SPC requirements for the benchmark.

The testing was executed using the SPC-1 Toolkit Version v3.0.2-1-g823a. The audit process was conducted in accordance with the SPC Policies and met the requirements for the benchmark.

A Letter of Good Faith was issued by Inspur Electronic Information Industry Co. Ltd., stating the accuracy and completeness of the documentation and testing data provided in support of the audit of this result.

A Full Disclosure Report for this result was prepared by InfoSizing, reviewed and approved by Inspur Electronic Information Industry Co. Ltd., and can be found at www.spcresults.org under the Submission Identifier A32019.

A32019

Inspur AS2200G2

Page 2 of 2

The independent audit process conducted by InfoSizing included the verifications of the following items:

- The physical capacity of the data repository (10,000 GB).
- The total capacity of the Application Storage Unit (3,543 GB).
- The accuracy of the Benchmark Configuration diagram.
- The tuning parameters used to configure the Benchmark Configuration.
- The Workload Generator commands used to execute the testing.
- The validity and integrity of the test result files.
- The compliance of the results from each performance test.
- The compliance of the results from each persistence test.
- The compliance of the submitted pricing model.
- The differences between the tested and the priced configuration, if any.

The Full Disclosure Report for this result was prepared in accordance with the disclosure requirements set forth in the specification for the benchmark.

The following benchmark requirements, if any, were waived in accordance with the SPC Policies:

None.

Respectfully Yours,



Doug Johnson, Certified SPC Auditor

63 Lourdes Dr. | Leominster, MA 01453 | 978-343-6562 | www.sizing.com

LETTER OF GOOD FAITH

October 13, 2020

To: Doug Johnson, SPC Auditor
PerfLabs, Inc. DBA InfoSizing
63 Lourdes Drive
Leominster, MA 01453-6709
USA

Subject: SPC-1 Letter of Good Faith for the AS2200G2

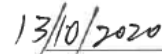
Inspur Electronic Information Industry Co. Ltd is the SPC-1 test sponsor for the above listed product. To the best of our knowledge and belief, the required SPC-1 results and materials we have submitted for that product are complete, accurate, and in full compliance with version 3.9 of the SPC-1 benchmark specification.

In addition, we have reported any items in the Benchmark Configuration and execution of the benchmark that affected the reported results even if the items are not explicitly required to be disclosed by the SPC-1 benchmark specification.

Sincerely,



Lay Sun
GM of Unified Storage Product Department
Inspur Electronic Information Industry Co. Ltd.



Date: October 13, 2020



SPC Benchmark 1™

Executive Summary



Inspur AS2200G2

SPC-1 IOPS™	369,997	SPC-1 Price Performance	\$75.77/SPC-1 KIOPS™
SPC-1 IOPS Response Time	0.458 ms	SPC-1 Total System Price	\$28,032.86
SPC-1 Overall Response Time	0.282 ms	SPC-1 Overall Discount	77.21%
		Currency / Target Country	USD / China
		Availability Date	August 30, 2020

Extensions

☆ SPC-1 Data Reduction	NA
☆ SPC-1 Encryption	NA
☆ SPC-1 NDU	NA
☆ SPC-1 Synchronous Replication	NA
☆ SPC-1 Snapshot	NA

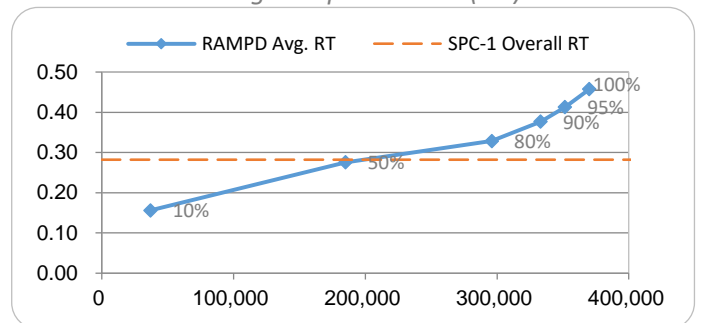
Storage Metrics

SPC-1 Data Protection Level	Protected 2
SPC-1 Physical Storage Capacity	10,000 GB
SPC-1 ASU Capacity	3,543 GB
SPC-1 ASU Price	\$7.92/GB

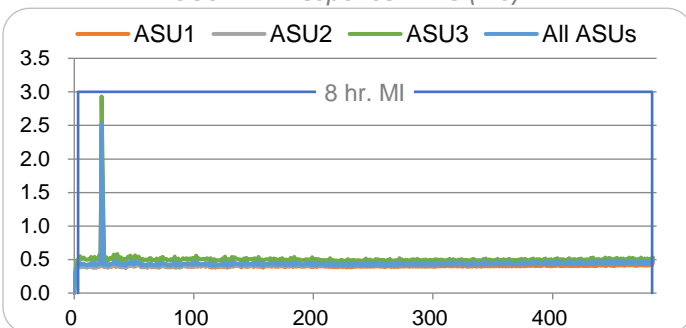
Priced Storage Configuration Summary

- 2 Emulex LPe16002 2-port FC HBA
- 1 Inspur AS2200G2 Enclosure
- 2 Controllers
- 64 GB Total Cache
- 4 16 Gb FC Ports
- 25 400 Gb SSDs
- 2 Total RUs

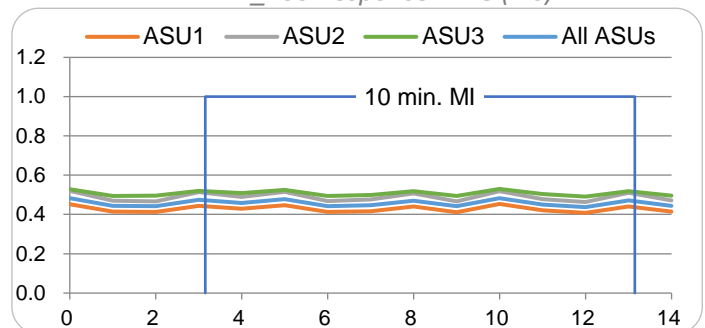
RAMPD Average Response Time (ms) vs. IOPS



SUSTAIN Response Time (ms)



RAMPD_100 Response Time (ms)



SPC Benchmark 1™ Specification Revision v3.9.1
 SPC Benchmark 1™ Workload Generator Revision v3.0.2-1-g823a

Submitted for Review October 14, 2020
 Submission Details www.storageperformance.org/r/A32019

PRICING DETAILS

Part No.	Description	Source	Qty	Unit Price	Ext. Price	Disc.	Disc. Price
Hardware & Software							
UAS2200G2002	2U Rack mounted SAN storage, 25HDD host chassis with BBU + Flash, Rack rail, Dual controller Unit	1	1	18,710.61	18,710.61	80%	3,742.13
TMO071	Inspur AS2200G2 Dual controller Cache Module-64GB	1	1	4,541.55	4,541.55	75%	1,135.39
THD088	Value SSD(2.5inch) 400GB x1	1	25	2,779.37	69,484.25	75%	17,371.07
TSJ160	Inspur AS2200G2 4*16Gbps FC Ports +SFP	1	2	5,114.62	10,229.24	85%	1,534.39
TWF003	Inspur 3M Lc-LC OM4 Fibre Channel Cable	1	4	28.66	114.64	75%	28.66
TSJ203	Inspur 2*Port 16Gbps Fibre Channel Adapter	1	2	9,247.86	18,495.72	85%	2,774.36
Hardware & Software Subtotal							26,586.00
Support & Maintenance							
F2HII04	Installation Service - Engineering	1	1	1,027.94	1,027.94	0%	1,027.94
F2GD0030AS55G525	Upgrade TO Onsite Premier 24x7x4H Engineer Onsite Service - 36Month(s)	1	1	418.92	418.92	0%	418.92
Support & Maintenance Subtotal							1,446.86
SPC-1 Total System Price							28,032.86
SPC-1 IOPS™							369,997
SPC-1 Price-Performance™ (\$/SPC-1 KIOPS™)							75.77
SPC-1 ASU Capacity (GB)							3,543
SPC-1 ASU Price (\$/GB)							7.92

Discount Details: The discounts shown are based on the storage capacity purchased and are generally available.

Warranty: Provides 7x24x4H arrival service within designated city and distance. The service includes 7x24 contact to the Inspur call center with 4-hours on-site hardware replacement or troubleshooting, and online software support with access to all new software updates or troubleshooting.

Differences Between Tested and Priced Storage Configurations

There were no differences between the TSC and the Priced Storage Configuration.

PUBLICATION DETAILS

This section provides contact information for the test sponsor and auditor, a revision history of this document, and a description of any exceptions or waivers associated with this publication.

Contact Information

Role	Name	Details
Test Sponsor Primary Contact	Inspur Electronic Information Industry Co. Ltd. Hao Sun	http://en.inspur.com/ sunhaobj@inspur.com
SPC Auditor	InfoSizing Doug Johnson	www.sizing.com doug@sizing.com

Revision Information

Date	FDR Revision	Details
October 14, 2020	First Edition	Initial Publication

Exceptions and Waivers

None.

CONFIGURATION INFORMATION

Tested Storage Product Description

Inspur AS2200G2 is an entry-level hybrid flash storage system for small/medium-sized enterprises. AS2200G2 can provide maximum 3PB storage space and support 16Gb FC & 1/10Gb iSCSI host interface. With rich software features, and industry-leading hardware platform, AS2200G2 satisfies the data storage and disaster recovery requirement of various applications, such as OLTP/OLAP databases and virtualization.

Host System and Tested Storage Configuration Components

The following table lists the components of the Host System(s) and the TSC.

Host Systems
1 x Inspur NF5280M5 with: 2 x Intel® Xeon® Gold 6132 CPU (2.6 GHz, 14-Core, 19.25 MB L3) 128 GB Main Memory Red Hat Enterprise Linux 7.4
Tested Storage Configuration
2 x Emulex LPe16002 2-port FC HBAs
1 x AS2200G2 Enclosure with: 2 x Storage Controller, each with: 32 GB cache (64 GB total) 1 x 2-port 16 Gbps FC I/O module 25 x 400 GB SSDs (internal)

Component Changes in Revised Full Disclosure Report

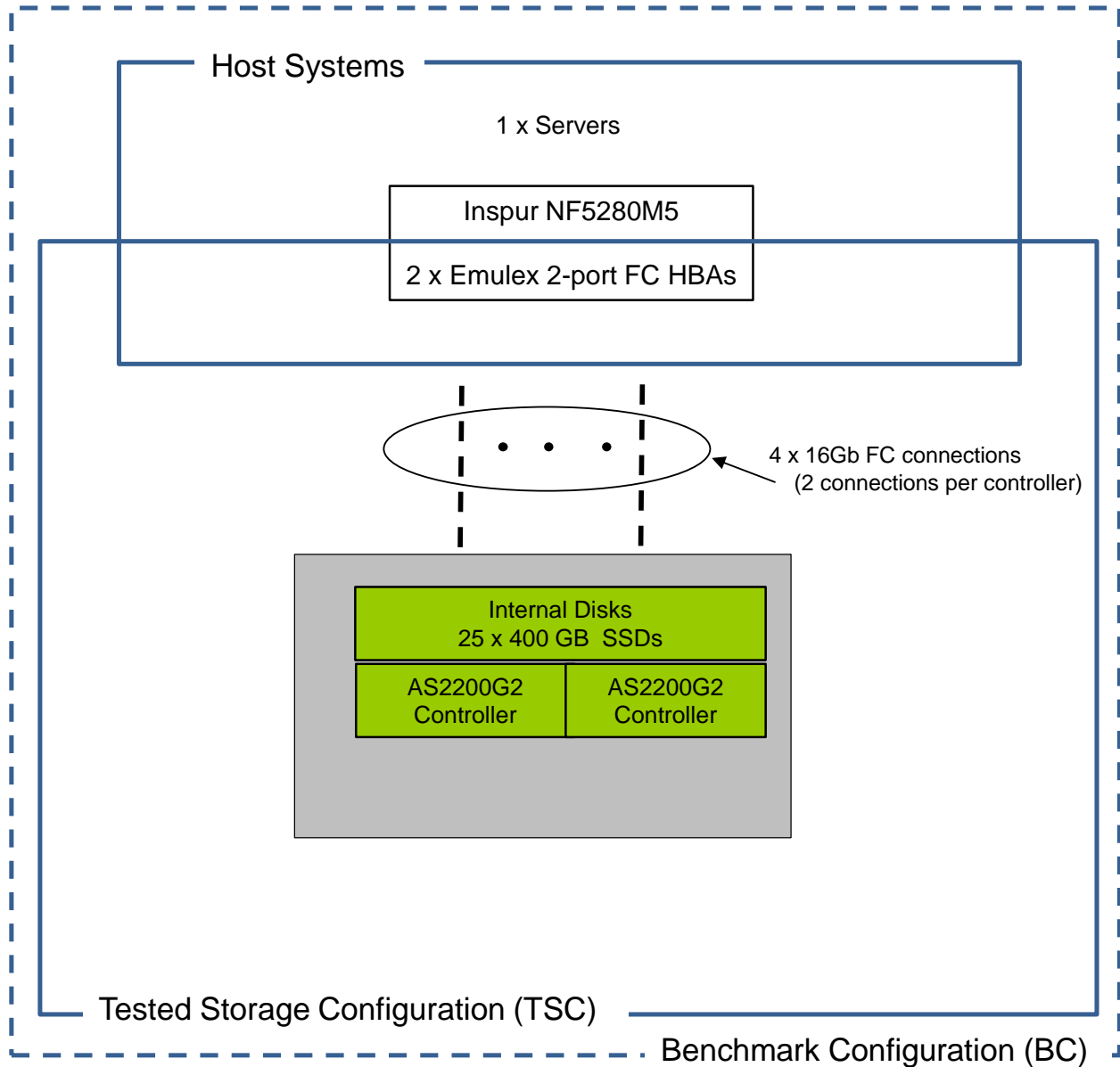
The following table outlines component changes that were made in revisions to this Full Disclosure Report.

Original Component	Revised Component	Description of Change
n/a	n/a	Initial submission

Configuration Diagrams

BC/TSC Configuration Diagram

The following diagram illustrates the Benchmark Configuration (BC), including the Tested Storage Configuration (TSC) and the Host System(s).



Storage Network Configuration

The Benchmark Configuration utilized direct-attached storage.

Benchmark Configuration Creation Process

Customer Tuning Parameters and Options

All the customer tuning parameters and options that have been altered from their default values for this benchmark are included in Appendix C and in the Supporting Files (see Appendix A).

Tested Storage Configuration Creation

A detailed description of how the logical representation of the TSC was created is included in Appendix D and in the Supporting Files (see Appendix A).

Tested Storage Configuration Inventory

An inventory of the components in the TSC, as seen by the Benchmark Configuration, is included in Appendix E and in the Supporting Files (see Appendix A).

Workload Generator Storage Configuration

The SPC-1 Workload Generator storage configuration commands and parameters used to invoke the execution of the tests are included in Appendix F and in the Supporting Files (see Appendix A).

Logical Volume Capacity and Application Storage Unit Mapping

The following table details the capacity of the Application Storage Units (ASUs) and how they are mapped to logical volumes (LVs). All capacities are reported in GB.

	LV per ASU	LV Capacity	Used per LV	Total per ASU	% ASU Capacity	Optimized*
ASU-1	9	177.1	177.1	1,594.5	45.0%	No
ASU-2	9	177.1	177.1	1,594.5	45.0%	No
ASU-3	2	177.1	177.1	354.3	10.0%	No
SPC-1 ASU Capacity				3,543	*See Space Optimization Techniques	

Physical Storage Capacity and Utilization

The following table details the Physical Capacity of the storage devices and the Physical Capacity Utilization (percentage of Total Physical Capacity used) in support of hosting the ASUs. All capacities are reported in GB.

Devices	Count	Physical Capacity	Total Capacity
400 GB SSD	25	400.0	10,000.0
Total Physical Capacity			10,000
Physical Capacity Utilization			35.43%

Data Protection

The data protection level used for all LVs was **Protected 2 (RAID-10)**, which was accomplished by configuring 20 LUNs over 1 storage pool comprising 4 RAID-10 arrays.

Space Optimization Information

Description of Utilized Techniques

The TSC did not use any space optimization techniques.

Physical Free Space Metrics

The following table lists the Physical Free Space as measured at each of the required points during test execution. If space optimization techniques were not used, "NA" is reported.

Physical Free Space Measurement	Free Space (GB)
After Logical Volume Creation	NA
After ASU Pre-Fill	NA
After Repeatability Test Phase	NA

Space Optimization Metrics

The following table lists the required space optimization metrics. If space optimization techniques were not used, "NA" is reported.

Metric	Value
SPC-1 Space Optimization Ratio	NA
SPC-1 Space Effectiveness Ratio	NA

BENCHMARK EXECUTION RESULTS

This portion of the Full Disclosure Report documents the results of the various SPC-1 Tests, Test Phases, and Test Runs.

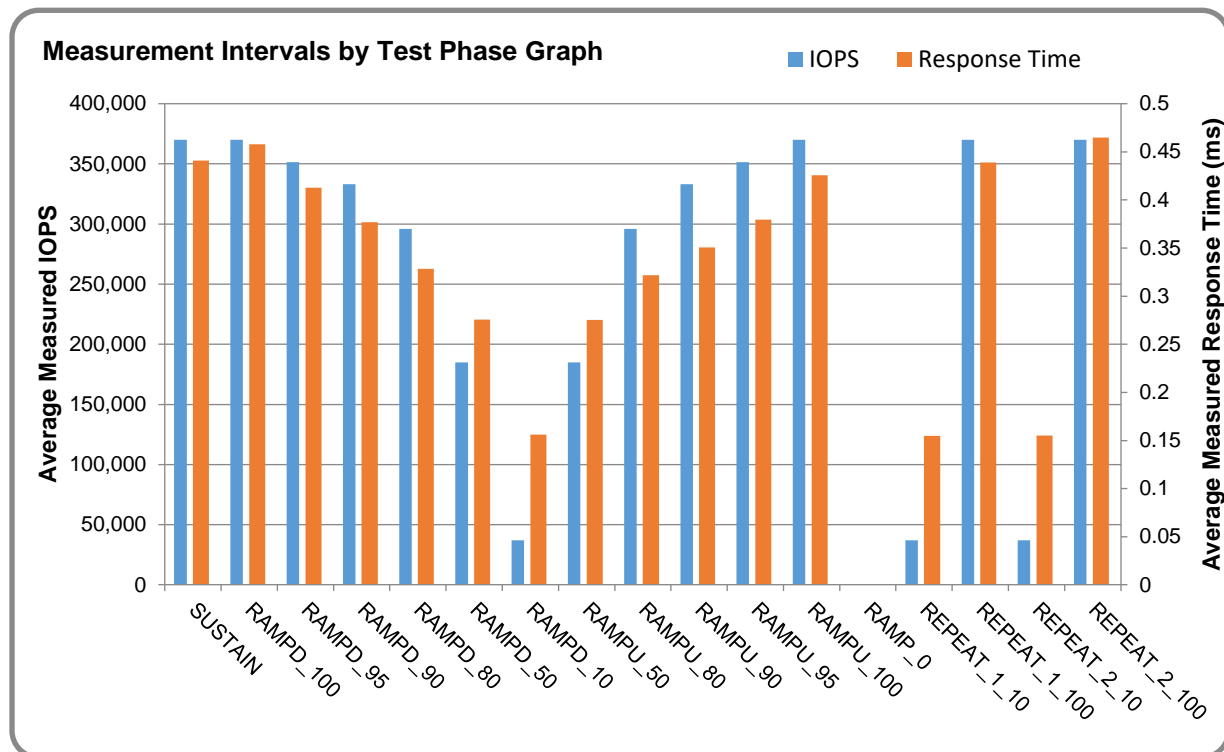
Benchmark Execution Overview

Workload Generator Input Parameters

The SPC-1 Workload Generator commands and input parameters for the Test Phases are presented in the Supporting Files (see Appendix A).

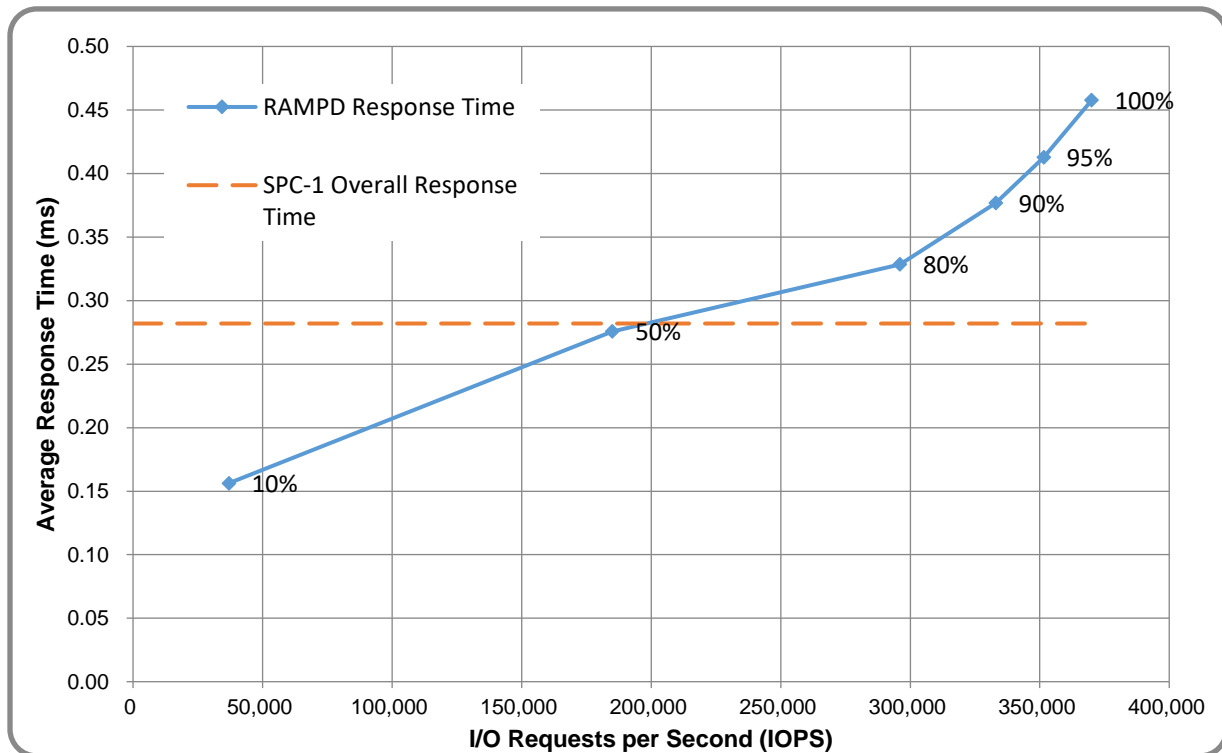
Measurement Intervals by Test Phase Graph

The following graph presents the average IOPS and the average Response Times measured over the MI of each Test Phase.



Response Time vs. Throughput Graph

The following graph presents the average Response Times versus the average IOPS for RAMPD_100 to RAMPD_10.



ASU Pre-Fill

The following table provides a summary of the Pre-Fill performed on the ASU prior to testing.

ASU Pre-Fill Summary			
Start Time	22-Sep-20 23:35:55	Requested IOP Level	1,000 MB/sec
End Time	23-Sep-20 00:33:06	Observed IOP Level	1,033 MB/sec
Duration	0:57:11	For additional details see the Supporting Files.	

SUSTAIN Test Phase

SUSTAIN – Results File

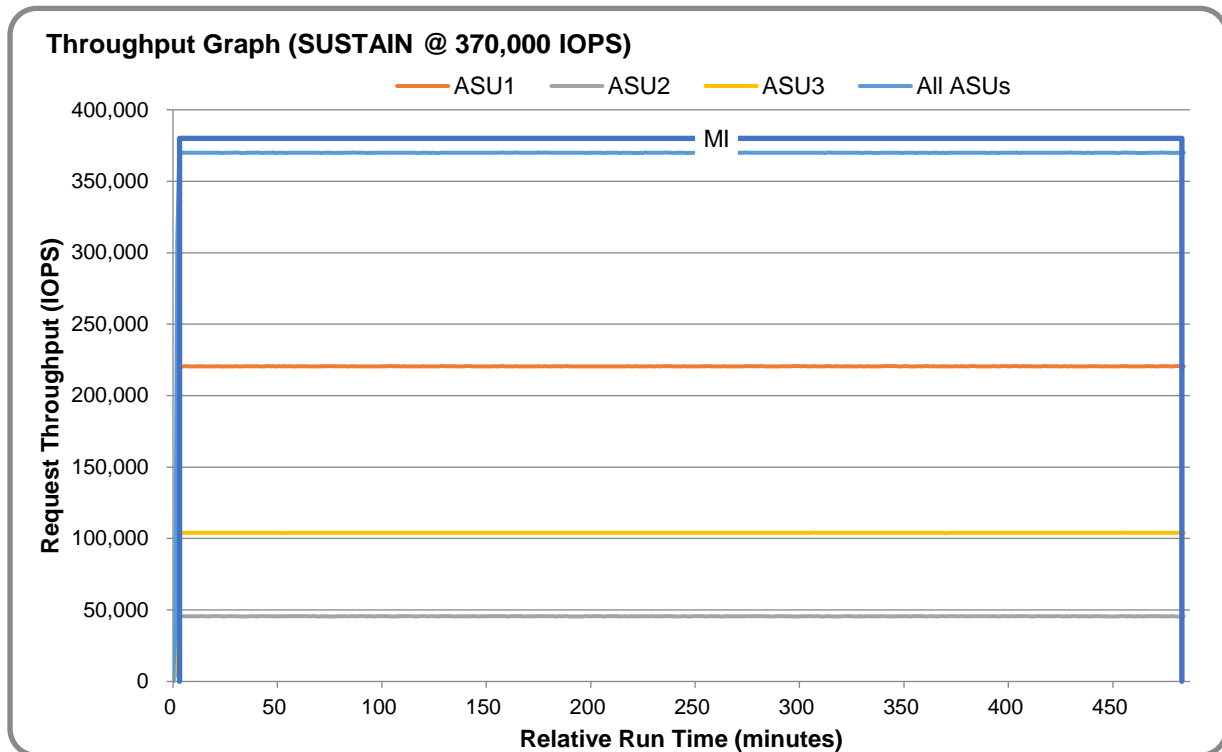
The results file generated during the execution of the SUSTAIN Test Phase is included in the Supporting Files (see Appendix A) as follows:

- SPC1_METRICS_0_Raw_Results.xlsx

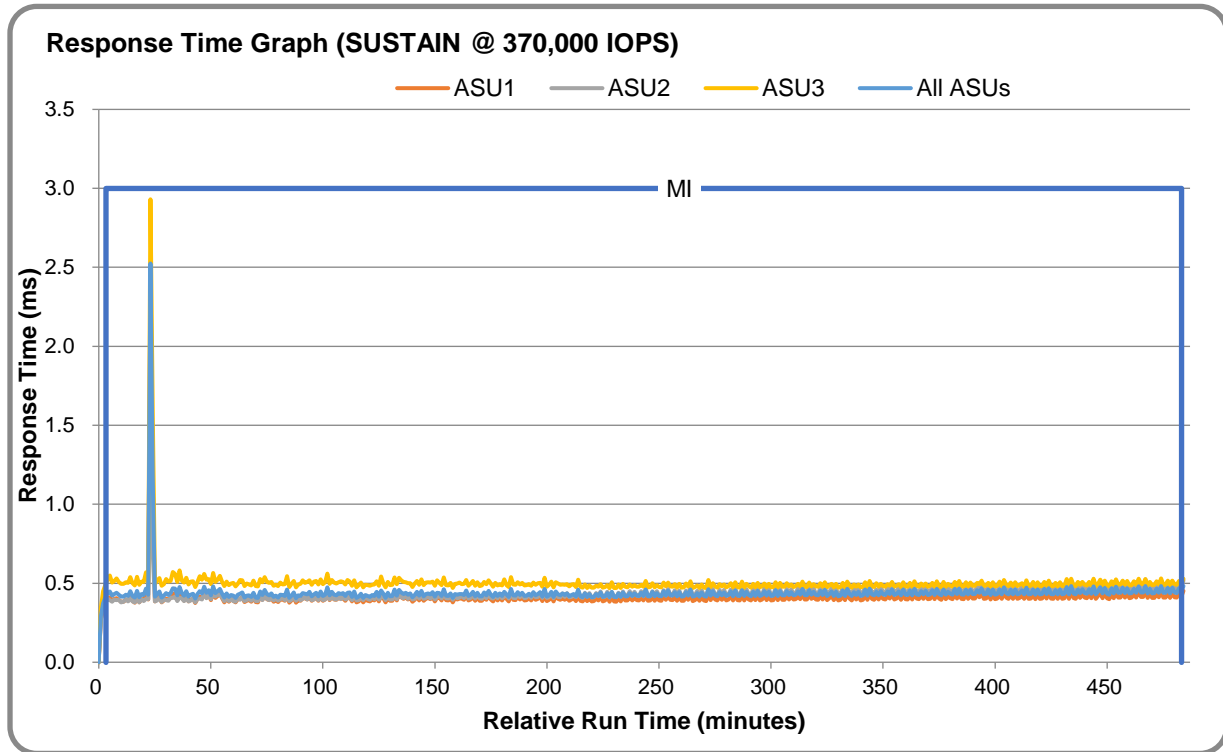
SUSTAIN – Execution Times

Interval	Start Date & Time	End Date & Time	Duration
Transition Period	23-Sep-20 00:38:38	23-Sep-20 00:41:38	0:03:00
Measurement Interval	23-Sep-20 00:41:38	23-Sep-20 08:41:39	8:00:01

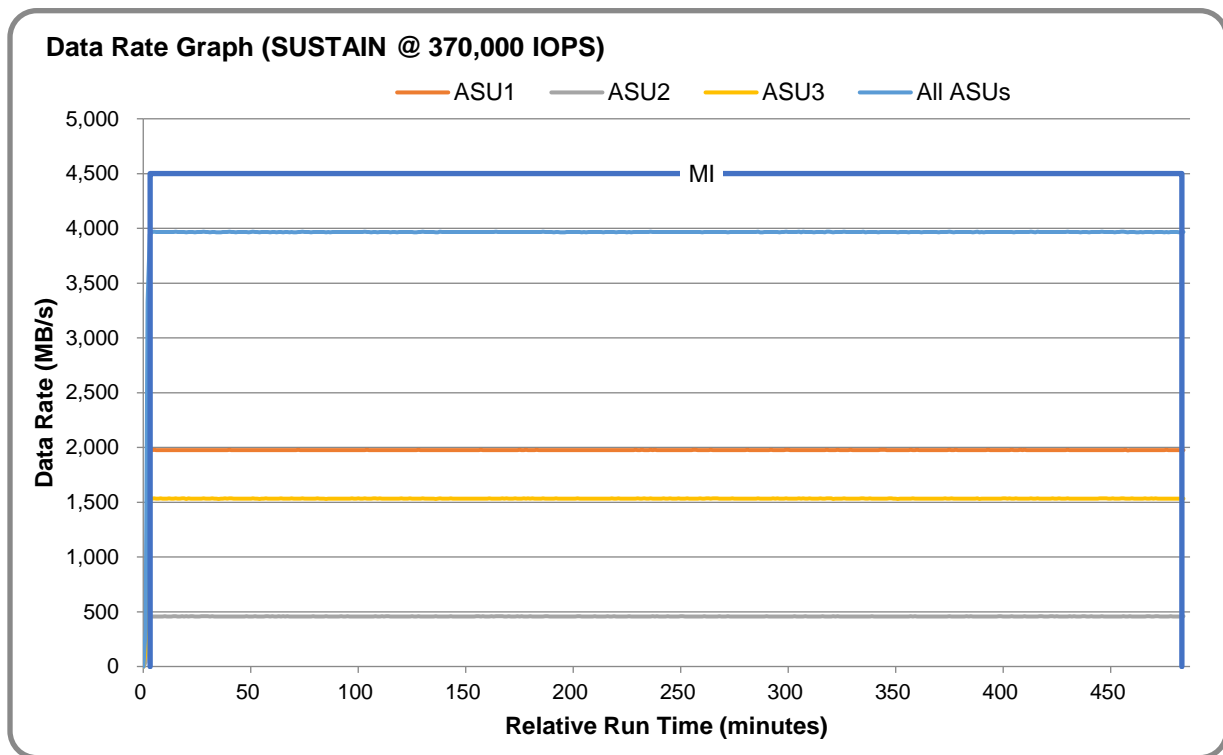
SUSTAIN – Throughput Graph



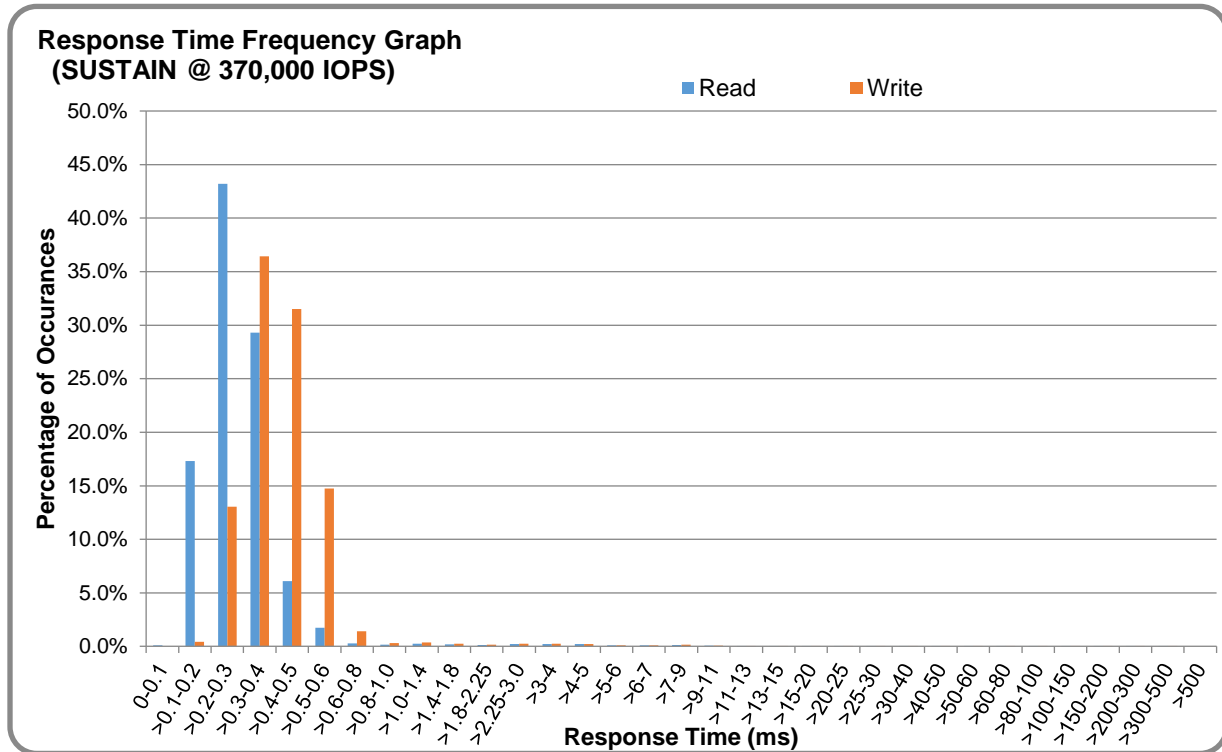
SUSTAIN – Response Time Graph



SUSTAIN – Data Rate Graph



SUSTAIN – Response Time Frequency Graph



SUSTAIN – Intensity Multiplier

The following table lists the targeted intensity multiplier (Defined), the measured intensity multiplier (Measured) for each I/O stream, its coefficient of variation (Variation), and the percentage of difference (Difference) between Defined and Measured.

	ASU1-1	ASU1-2	ASU1-3	ASU1-4	ASU2-1	ASU2-2	ASU2-3	ASU3-1
Defined	0.0350	0.2810	0.0700	0.2100	0.0180	0.0700	0.0350	0.2810
Measured	0.0350	0.2810	0.0700	0.2100	0.0180	0.0700	0.0350	0.2810
Variation	0.0011	0.0003	0.0008	0.0004	0.0016	0.0008	0.0011	0.0003
Difference	0.0111%	0.000%	0.002%	0.000%	0.004%	0.007%	0.002%	0.002%

RAMPD_100 Test Phase

RAMPD 100 – Results File

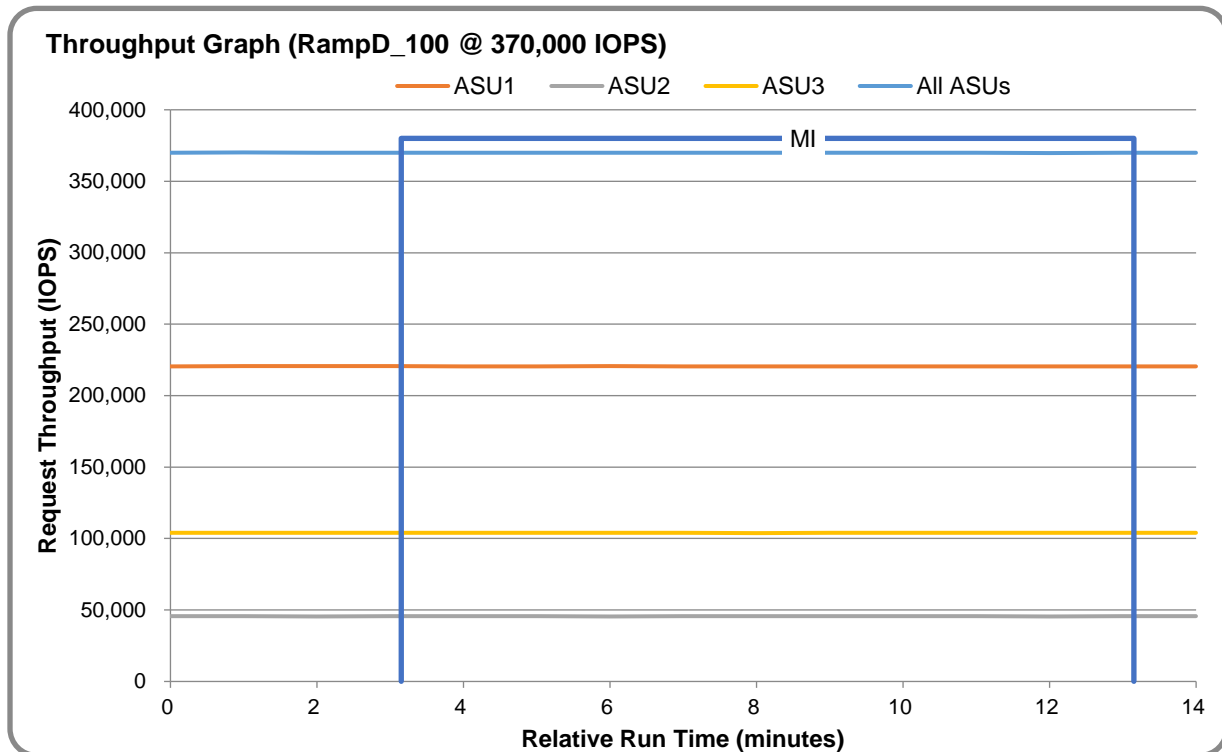
The results file generated during the execution of the RAMPD_100 Test Phase is included in the Supporting Files (see Appendix A) as follows:

- SPC1_METRICS_0_Raw_Results.xlsx

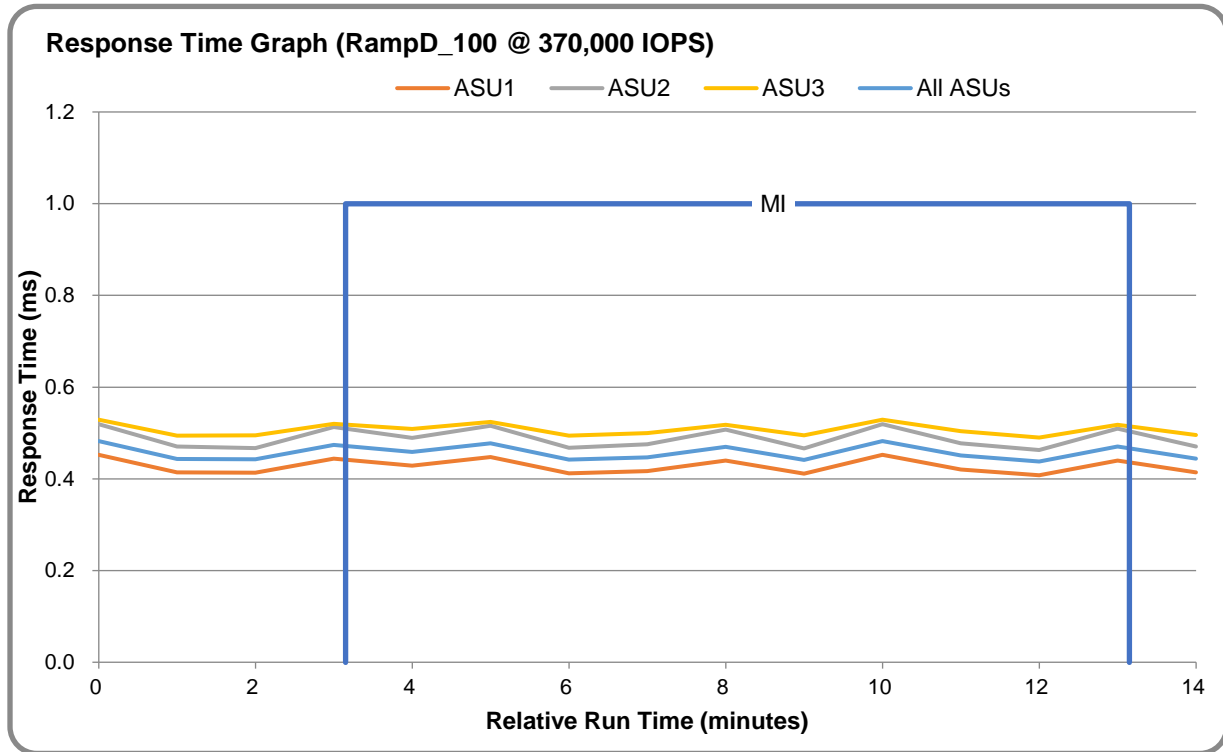
RAMPD 100 – Execution Times

Interval	Start Date & Time	End Date & Time	Duration
Transition Period	23-Sep-20 08:42:38	23-Sep-20 08:45:38	0:03:00
Measurement Interval	23-Sep-20 08:45:38	23-Sep-20 08:55:39	0:10:01

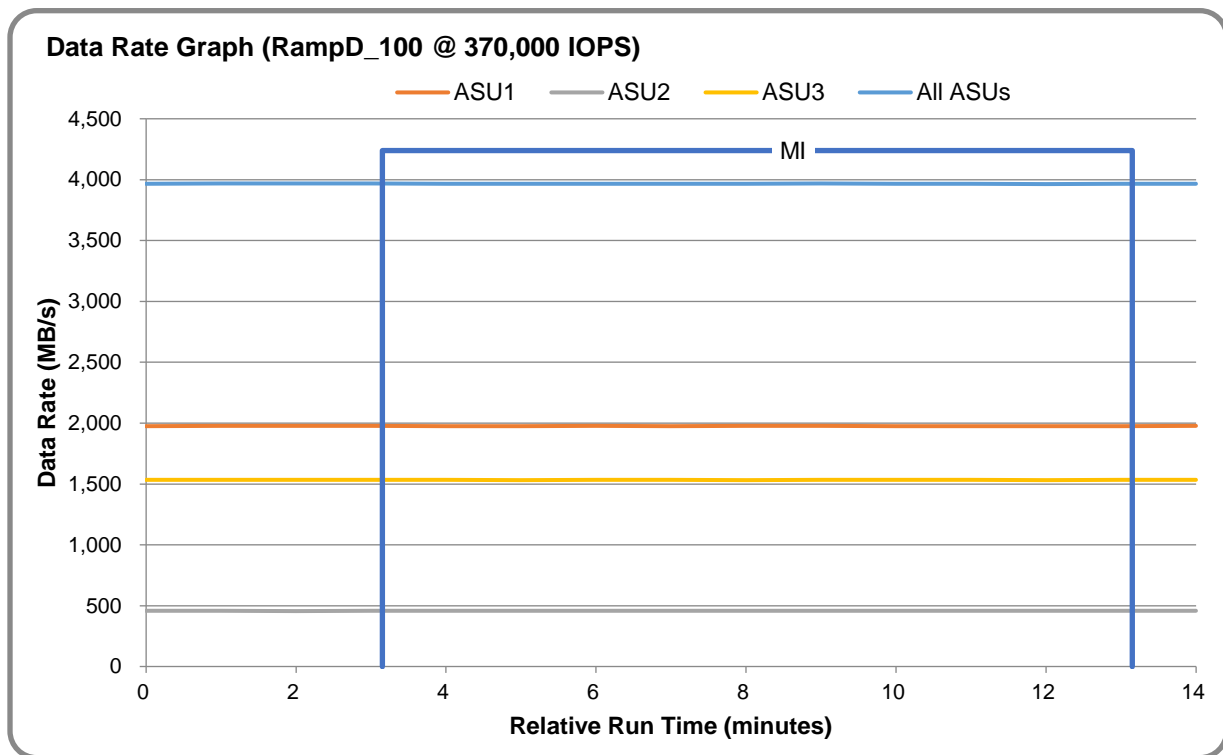
RAMPD 100 – Throughput Graph



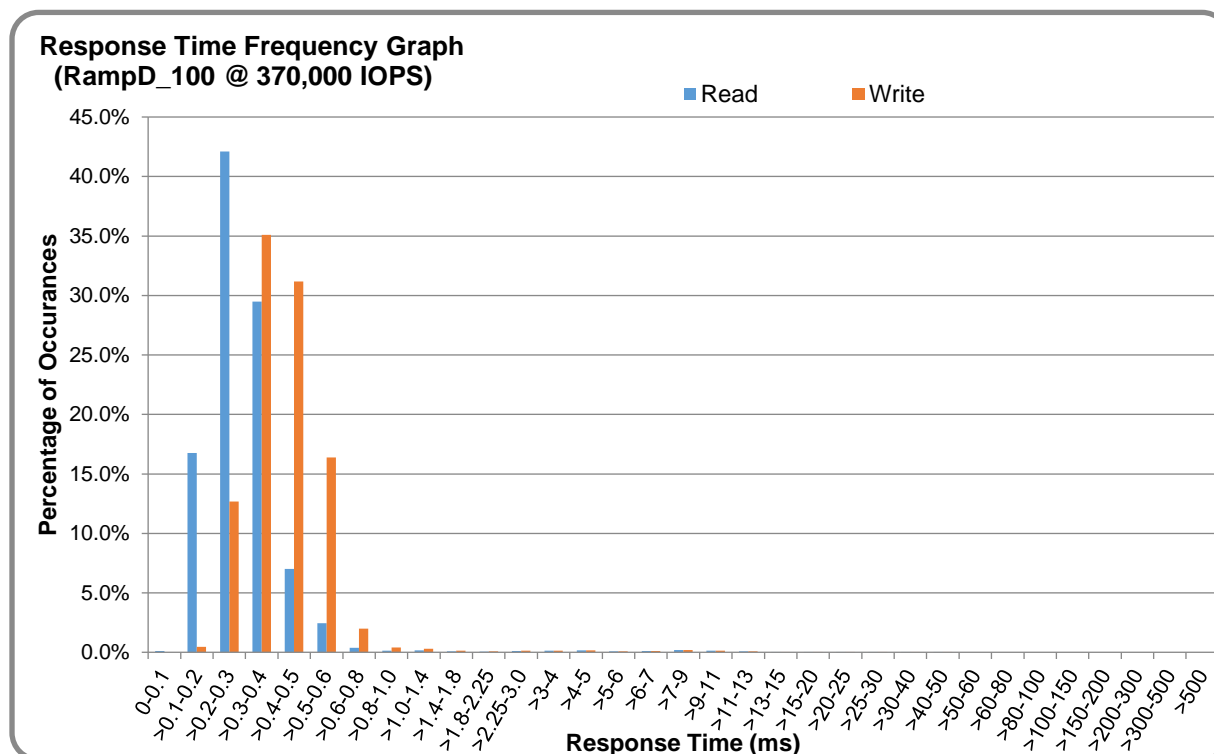
RAMPD 100 – Response Time Graph



RAMPD 100 – Data Rate Graph



RAMPD 100 – Response Time Frequency Graph



RAMPD 100 – Intensity Multiplier

The following table lists the targeted intensity multiplier (Defined), the measured intensity multiplier (Measured) for each I/O stream, its coefficient of variation (Variation), and the percentage of difference (Difference) between Defined and Measured.

	ASU1-1	ASU1-2	ASU1-3	ASU1-4	ASU2-1	ASU2-2	ASU2-3	ASU3-1
Defined	0.0350	0.2810	0.0700	0.2100	0.0180	0.0700	0.0350	0.2810
Measured	0.0350	0.2810	0.0700	0.2099	0.0180	0.0700	0.0350	0.2810
Variation	0.0008	0.0003	0.0007	0.0005	0.0013	0.0007	0.0010	0.0004
Difference	0.039%	0.001%	0.009%	0.027%	0.074%	0.003%	0.002%	0.013%

RAMPD 100 – I/O Request Summary

I/O Requests Completed in the Measurement Interval	222,000,498
I/O Requests Completed with Response Time <= 30 ms	221,989,132
I/O Requests Completed with Response Time > 30 ms	11,366

Response Time Ramp Test

Response Time Ramp Test – Results File

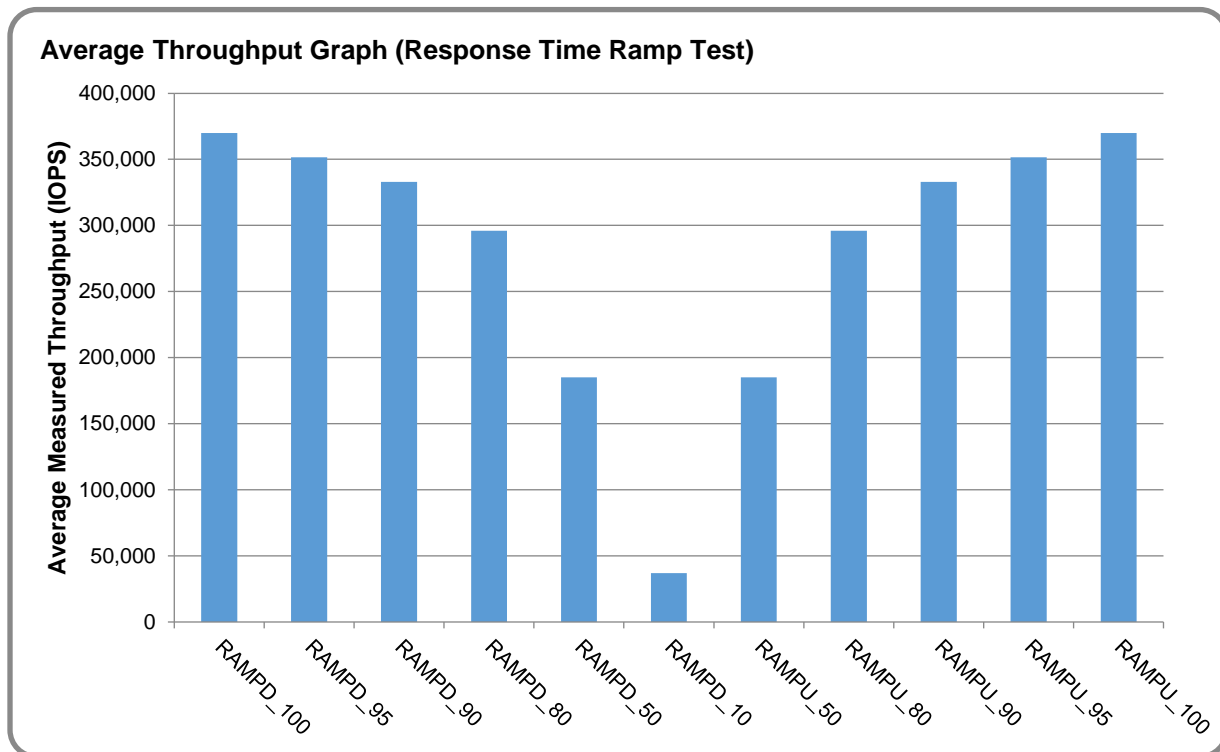
The results file generated during the execution of the Response Time Ramp Test is included in the Supporting Files (see Appendix A) as follows:

- **SPC1_METRICS_0_Raw_Results.xlsx**

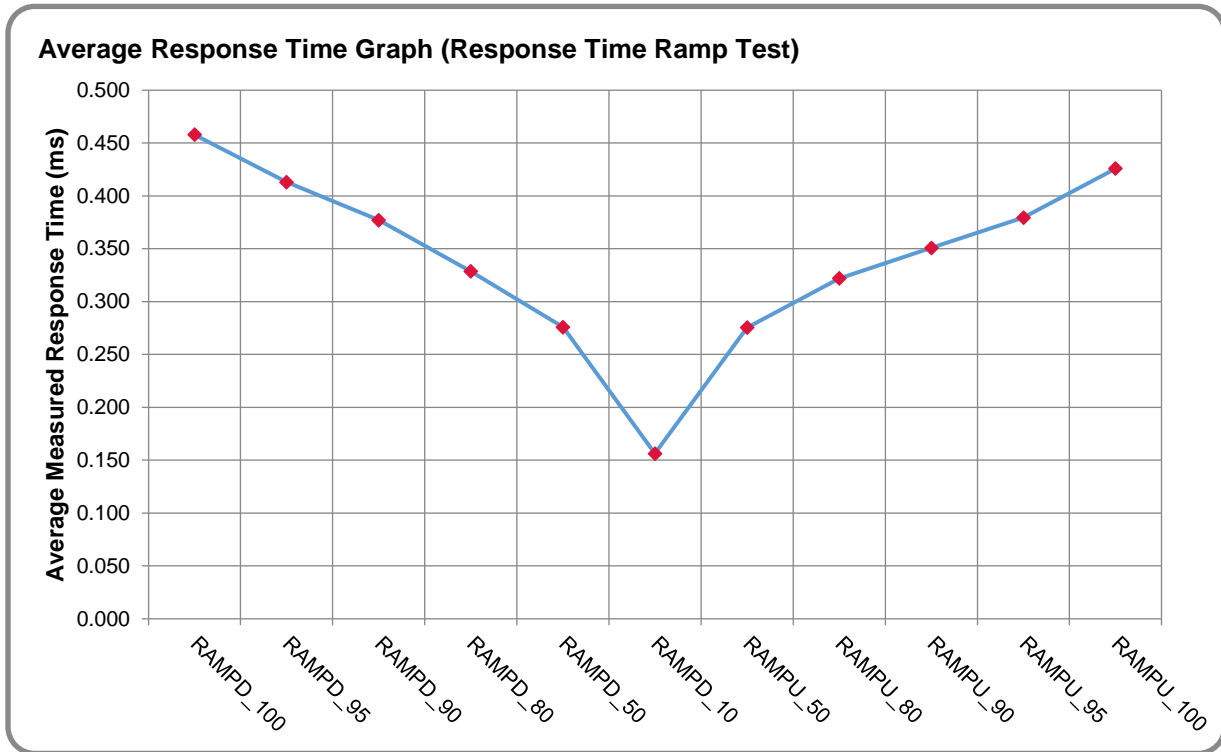
Response Time Ramp Test – Phases

The Response Time Ramp Test is comprised of 11 Test Phases, including six Ramp-Down Phases (executed at 100%, 95%, 90%, 80%, 50%, and 10% of the Business Scaling Unit) and five Ramp-Up Phases (executed at 50%, 80%, 90%, 95%, and 100% of the Business Scaling Unit).

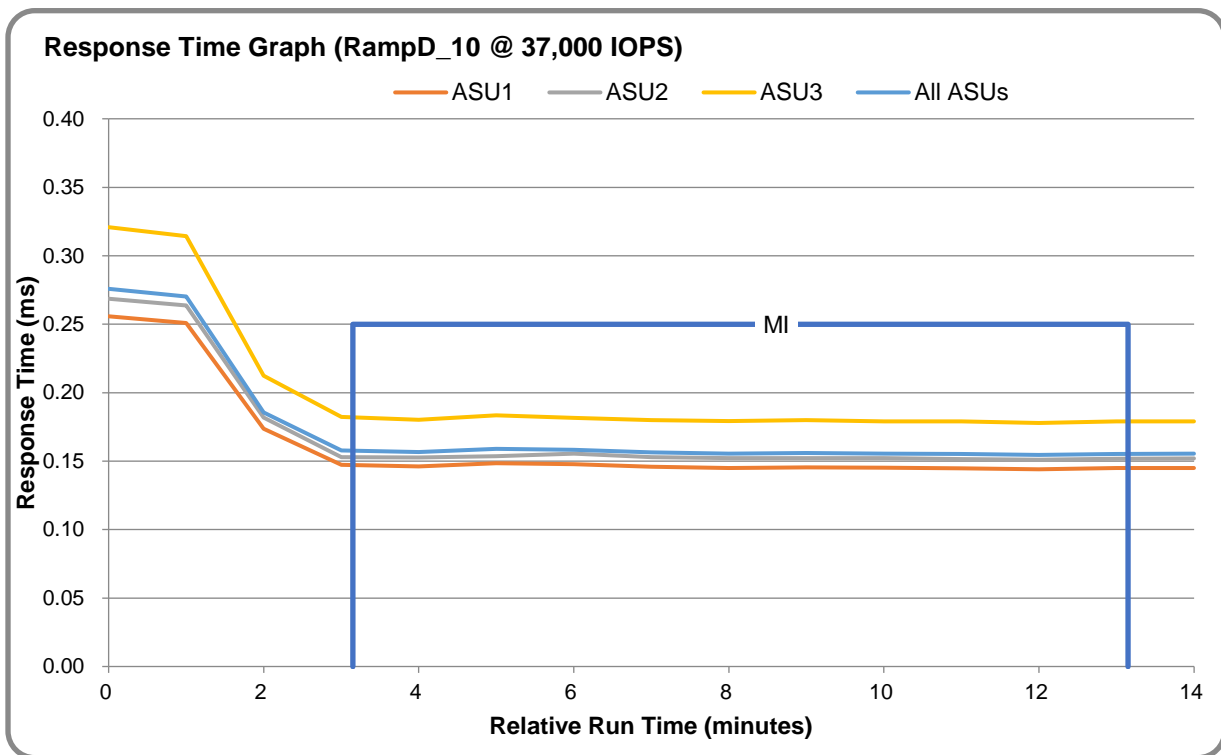
Response Time Ramp Test – Average Throughput Graph



Response Time Ramp Test – Average Response Time Graph



Response Time Ramp Test – RAMPD 10 Response Time Graph



Repeatability Test

Repeatability Test Results File

The results file generated during the execution of the Repeatability Test is included in the Supporting Files (see Appendix A) as follows:

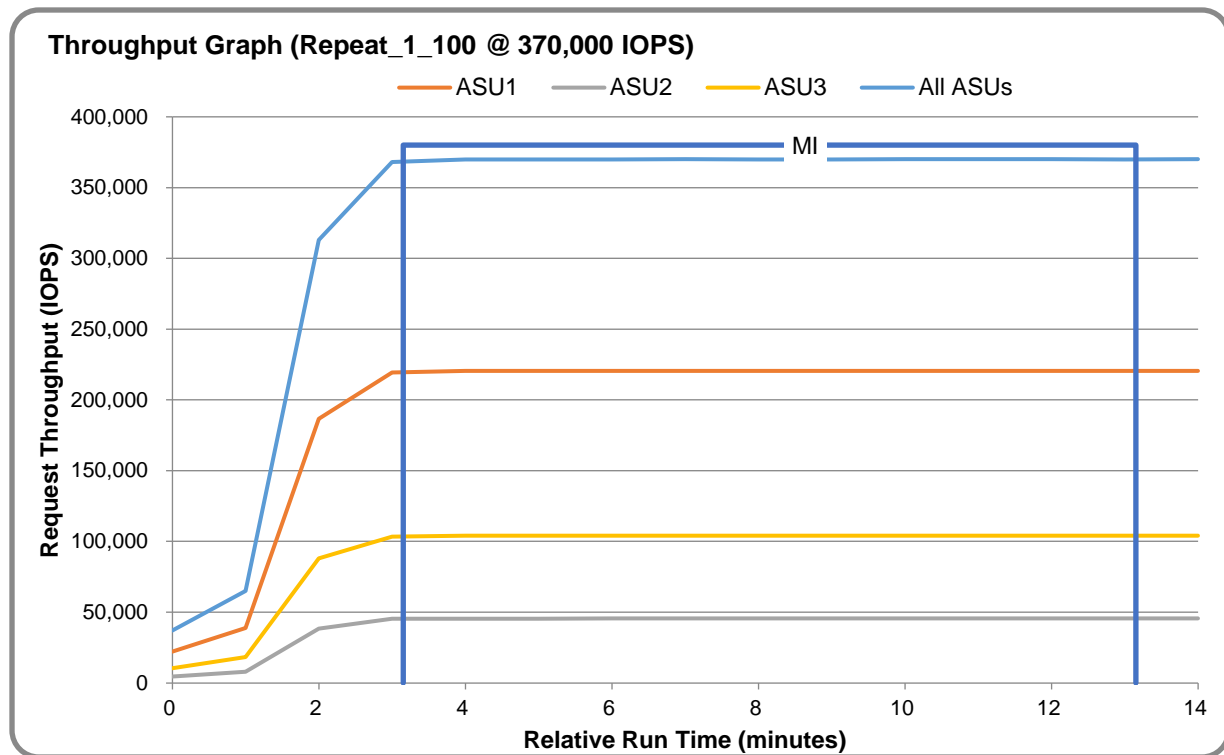
- **SPC1_METRICS_0_Raw_Results.xlsx**

Repeatability Test Results

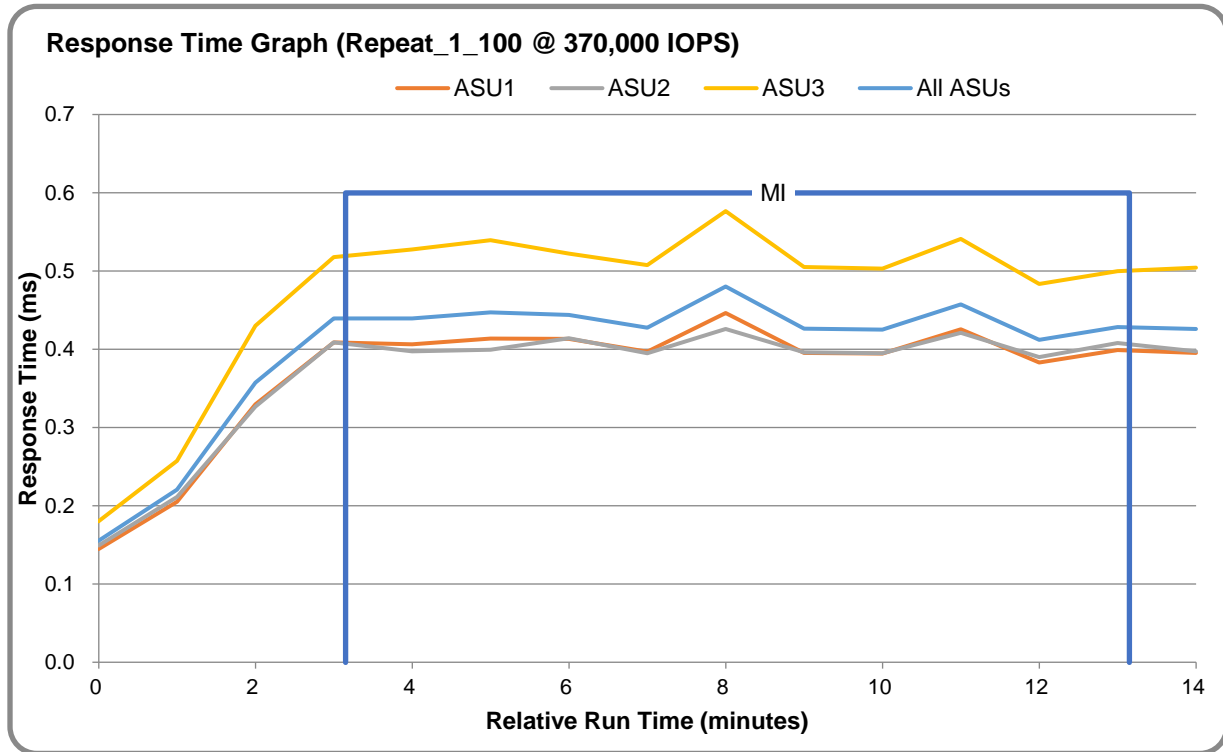
The throughput measurements for the Response Time Ramp Test (RAMPD) and the Repeatability Test Phases (REPEAT_1 and REPEAT_2) are listed in the table below.

Test Phase	100% IOPS	10% IOPS
RAMPD	369,997.5	36,992.2
REPEAT_1	370,011.6	37,015.0
REPEAT_2	370,034.3	36,989.9

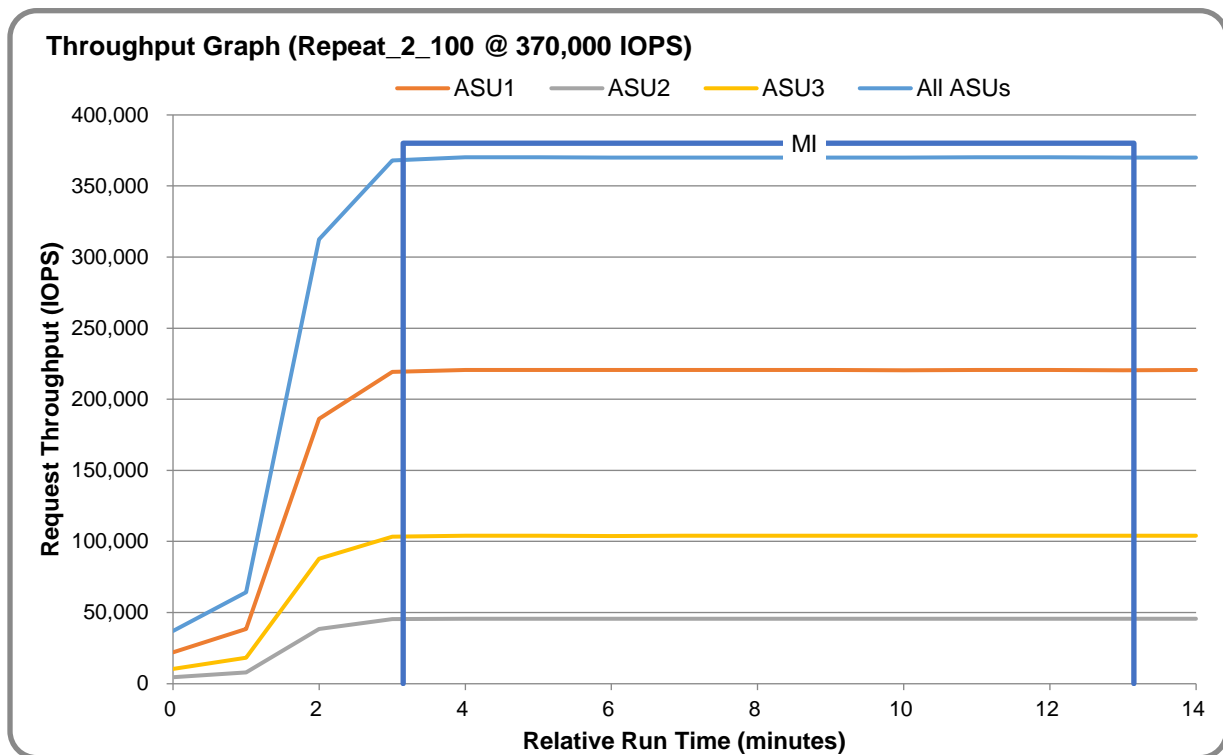
REPEAT 1 100 - Throughput Graph



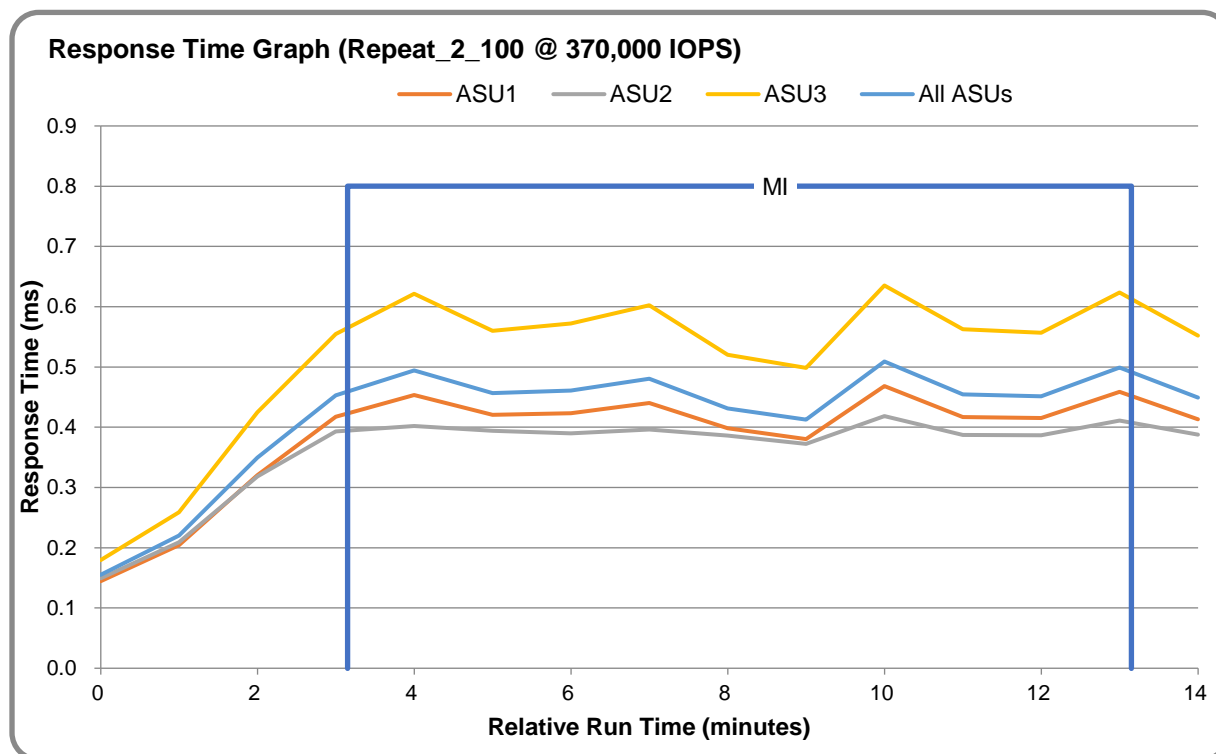
REPEAT 1 100 – Response Time Graph



REPEAT 2 100 – Throughput Graph



REPEAT 2 100 – Response Time Graph



Repeatability Test – Intensity Multiplier

The following tables lists the targeted intensity multiplier (Defined), the measured intensity multiplier (Measured) for each I/O stream, its coefficient of variation (Variation), and the percent of difference (Difference) between Defined and Measured.

REPEAT_1_100 Test Phase

	ASU1-1	ASU1-2	ASU1-3	ASU1-4	ASU2-1	ASU2-2	ASU2-3	ASU3-1
Defined	0.0350	0.2810	0.0700	0.2100	0.0180	0.0700	0.0350	0.2810
Measured	0.0350	0.2810	0.0700	0.2100	0.0180	0.0700	0.0350	0.2810
Variation	0.0015	0.0003	0.0008	0.0005	0.0017	0.0007	0.0017	0.0003
Difference	0.034%	0.016%	0.013%	0.023%	0.023%	0.029%	0.021%	0.012%

REPEAT_2_100 Test Phase

	ASU1-1	ASU1-2	ASU1-3	ASU1-4	ASU2-1	ASU2-2	ASU2-3	ASU3-1
Defined	0.0350	0.2810	0.0700	0.2100	0.0180	0.0700	0.0350	0.2810
Measured	0.0350	0.2810	0.0700	0.2100	0.0180	0.0700	0.0350	0.2810
Variation	0.0011	0.0004	0.0006	0.0004	0.0010	0.0006	0.0014	0.0004
Difference	0.050%	0.013%	0.009%	0.006%	0.040%	0.012%	0.028%	0.003%

Data Persistence Test

Data Persistence Test Results File

The results files generated during the execution of the Data Persistence Test is included in the Supporting Files (see Appendix A) as follows:

- **SPC1_PERSIST_1_0_Raw_Results.xlsx**
- **SPC1_PERSIST_2_0_Raw_Results.xlsx**

Data Persistence Test Execution

The Data Persistence Test was executed using the following sequence of steps:

- The PERSIST_1_0 Test Phase was executed to completion.
- The Benchmark Configuration was taken through an orderly shutdown process and powered off.
- The Benchmark Configuration was powered on and taken through an orderly startup process.
- The PERSIST_2_0 Test Phase was executed to completion.

Data Persistence Test Results

Data Persistence Test Phase: Persist1	
Total Number of Logical Blocks Written	87,599,902
Total Number of Logical Blocks Verified	45,205,213
Total Number of Logical Blocks Overwritten	42,394,689
Total Number of Logical Blocks that Failed Verification	0
Time Duration for Writing Test Logical Blocks (sec.)	601
Size in bytes of each Logical Block	8,192
Number of Failed I/O Requests in the process of the Test	0

Committed Data Persistence Implementation

The TSC uses a BBU power-down protection mechanism. Each controller has two batteries and an SSD as the system disk. When an unexpected power-down occurs, the controller continues to be powered by the battery and refreshes the cache data to the SSD for permanent storage. When the power supply is restored, the data in the system disk SSD is automatically restored.

APPENDIX A: SUPPORTING FILES

The following table details the content of the Supporting Files provided as part of this Full Disclosure Report.

File Name	Description	Location
/SPC1_RESULTS	Data reduction worksheets	root
SPC1_INIT_0_Raw_Results.xlsx	Raw results for INIT Test Phase	/SPC1_RESULTS
SPC1_METRICS_0_Quick_Look.xlsx	Quick Look Test Run Overview	/SPC1_RESULTS
SPC1_METRICS_0_Raw_Results.xlsx	Raw results for Primary Metrics Test	/SPC1_RESULTS
SPC1_METRICS_0_Summary_Results.xlsx	Primary Metrics Summary	/SPC1_RESULTS
SPC1_PERSIST_1_0_Raw_Results.xlsx	Raw results for PERSIST1 Test Phase	/SPC1_RESULTS
SPC1_PERSIST_2_0_Raw_Results.xlsx	Raw results for PERSIST2 Test Phase	/SPC1_RESULTS
SPC1_Run_Set_Overview.xlsx	Run Set Overview Worksheet	/SPC1_RESULTS
SPC1_VERIFY_0_Raw_Results.xlsx	Raw results for first VERIFY Test Phase	/SPC1_RESULTS
SPC1_VERIFY_1_Raw_Results.xlsx	Raw results for second VERIFY Test Phase	/SPC1_RESULTS
/C_Tuning	Tuning parameters and options	root
set_nr_requests.sh	Set queue depth, max AIO and scheduler	/C_Tuning
/D_Creation	Storage configuration creation	root
init_as2200G2.sh	Create Pools, RAIDs, LUNs, and Hosts	/D_Creation
lv_scan.sh	Scan and activate logical volumes	/D_Creation
lvm.sh	Create logical volumes	/D_Creation
vg.sh	Create volume groups	/D_Creation
/E_Inventory	Configuration inventory	root
profile.sh	Captures profile of storage environment	/E_Inventory
profile_end_as2200g2.txt	Storage configuration after restart	/E_Inventory
profile_start_as2200g2.txt	Storage configuration before INIT	/E_Inventory
volume_list.sh	Captures logical volume environment	/E_Inventory
volume_listing_end.txt	List of logical volumes after restart	/E_Inventory
volume_listing_start.txt	List of logical volumes before INIT	/E_Inventory
/F_Generator	Workload generator	root
full_test_before_persist.sh	Executes all test phases before PERSIST1	/F_Generator
HOST1.HST	Host configuration file	/F_Generator
SPC1.asu	Define LUNs hosting the ASUs	/F_Generator
test_persist1.sh	Executes PERSIST1	/F_Generator
test_persist2.sh	Executes PERSIST2	/F_Generator

APPENDIX B: THIRD PARTY QUOTATION

All components are available directly through the Test Sponsor (Inspur Electronic Information Industry Co. Ltd.).

APPENDIX C: TUNING PARAMETERS AND OPTIONS

Change the Scheduler on each Host System. Execute the `set_nr_requests.sh` script on each Host System to complete the following settings:

- Change the maximum number of AIO operations to 1048576.
- Change the `nr_requests` from 128 to 1024 on each Host System for each device.
- Change the I/O scheduler from `cfq` to `noop` on each Host System.

APPENDIX D: STORAGE CONFIGURATION CREATION

Step 1: Create Storage Pools, RAIDs, LUNs, Hosts, Mapping and deploy LUNs.

Execute the `init_as2200g2.sh` script on a remote server which can login on AS2200G2 storage system to complete the following:

1. Create 1 storage pools: Pool0
2. Create 4 RAID10
3. Create 20 LUNs(20 LUN per Pool, 170 GB per LUN)
4. Create 1 Host in storage cluster
5. Add the FC port's WWPN to the 1 host (4 WWPNs per Host)
6. Map LUNs to the 1 Host

Step 2: Create Volumes on the Master Host System

Execute the `vg.sh` script on the Master Host System to create 2 VGs ,and the excute the `lvm.sh` script to create 20 logical volumes as follows:

In addition, the script will make each logical volume available (activate).

1. Create Physical Volumes

Create 20 physical volumes using the `pvcreate` command.

2. Create Volumes Groups

Create 2 volume groups (`spc1vg1` `spc1vg2`) using the `vgcreate` command as follows:

Create `spc1vg1` using 10 of 20 physical volumes,and create `spc1vg2` using 10 of 20 physical volumes

3. Create Logical Volumes

- Create 5 logical volumes ,every volume capacity is 165 GB, on `spc1vg1` for ASU-1.
- Create 4 logical volumes ,every volume capacity is 165 GB, on `spc1vg2` for ASU-1
- Create 4 logical volumes ,every volume capacity is 165 GB, on `spc1vg1` for ASU-2.
- Create 5 logical volumes ,every volume capacity is 165 GB, on `spc1vg2` for ASU-2.
- Create 1 logical volumes ,every volume capacity is 165 GB, on `spc1vg1` for ASU-3.
- Create 1 logical volumes ,every volume capacity is 165 GB, on `spc1vg2` for ASU-3.

Step 3: Change the Scheduler on each Host System.

1. Execute the `set_nr_requests.sh` script on each Host System to complete the following settings:

- Change the maximum number of AIO operations to 1048576
- Change the from 128 to 1024 on each Host System for each device.
- Change the I/O scheduler from `cfq` to `noop` on each Host System.

APPENDIX E: CONFIGURATION INVENTORY

An inventory of the configuration was collected by running the following scripts.

- profile.sh
- volume_list.sh

The following log files were generated by running the above scripts.

- profile_start_as2200g2.txt
- profile_end_as2200g2.txt
- volume_listing_start.txt
- volume_listing_end.txt

These files are all available in the Supporting Files (see Appendix A).

APPENDIX F: WORKLOAD GENERATOR

The ASUs accessed by the SPC-1 workload generator were defined using the script SPC1.ASU.

The hosts used to drive the SPC-1 workload were defined using the script HOST1.HST. The scripts used to execute the benchmark sequence were:

- full_run_before_persist.sh
- test_persist1.sh
- test_persist2.sh

These files are all available in the Supporting Files (see Appendix A).