SPC Benchmark 1™

Full disclosure Report

Inspur Electronic Information Industry Co. Ltd.

Inspur AS13000G5

SPC-1™ v3.10.0

Submission Identifier: A32022

Submitted For Review: June 25, 2021

First Edition – June 2021

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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

InfoSizing
The Right Metric For Sizing IT

Storage Performance Council
Certified Auditor

Carl Wei
Inspur Electronic Information Industry Co. Ltd.
NO.1036, Inspur Road, Jinan
People's Republic of China

June 14, 2021

I verified the SPC Benchmark 1™ (SPC-1™ v3.10.0) test execution and performance results of the following Tested Storage Product:

Inspur AS13000G5

The results were:

SPC-1 IOPS™	**6,300,529**
SPC-1 Price-Performance	**$229.00/SPC-1 KIOPS™**
SPC-1 Total System Price	1,442,799.14
SPC-1 IOPS Response Time	0.781 ms
SPC-1 Overall Response Time	0.506 ms
SPC-1 ASU Capacity	111,628 GB
SPC-1 ASU Price	$12.93/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.

Page **1** of 2

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

A32022   Inspur AS13000G5   Page **2** of **2**

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 A32022.

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

- The physical capacity of the data repository (288,000 GB).
- The total capacity of the Application Storage Unit (111,628 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
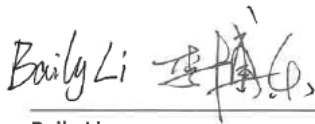
June 11, 2021

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 AS13000G5

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 3.10 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,

Baily Li

Baily Li
GM of Storage Product Department
Inspur Electronic Information Industry Co. Ltd.

2021.6.11
Date: June 11, 2021

Inspur AS13000G5

SPC-1 IOPS™	**6,300,529**	SPC-1 Price Performance	**$229.00/SPC-1 KIOPS™**
SPC-1 IOPS Response Time	**0.781 ms**	SPC-1 Total System Price	**$1,442,799.14**
SPC-1 Overall Response Time	0.506 ms	SPC-1 Overall Discount	67.47%
		Currency / Target Country	USD / China
		Availability Date	Currently Available

Extensions		*Storage Metrics*	
☆ SPC-1 Data Reduction	NA	SPC-1 Data Protection Level	Protected 2
☆ SPC-1 Encryption	NA	SPC-1 Physical Storage Capacity	288,000 GB
☆ SPC-1 NDU	NA	SPC-1 ASU Capacity	111,628 GB
☆ SPC-1 Synchronous Replication	NA	SPC-1 ASU Price	$12.93/GB
☆ SPC-1 Snapshot	NA		

Priced Storage Configuration Summary

50	Mellanox MCX516A-CCAT 100Gb 2-port
1	Inspur AS13000G5 Storage Cluster
30	AS13000G5 Storage Nodes
5,760	GB Total Cache
120	Total Front-End Ports
180	1.6 TB NVMe
2	Ruijie RG-S6920-4C Ethernet Switches
68	Total RUs

RAMPD Average Response Time (ms) vs. IOPS
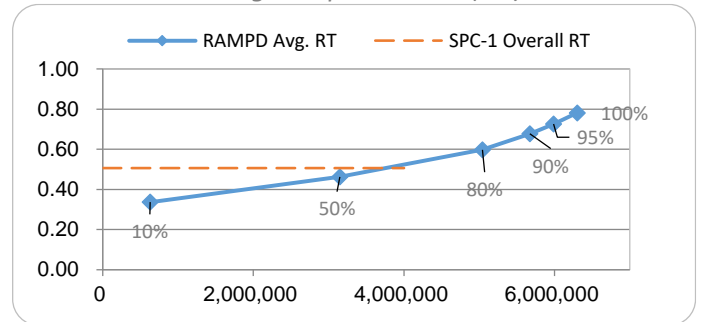
SUSTAIN Response Time (ms)
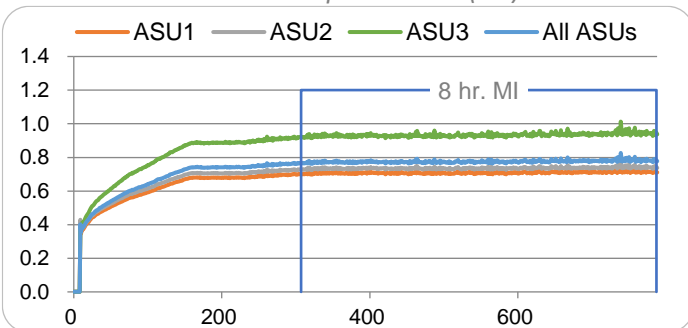
RAMPD_100 Response Time (ms)

PRICING DETAILS

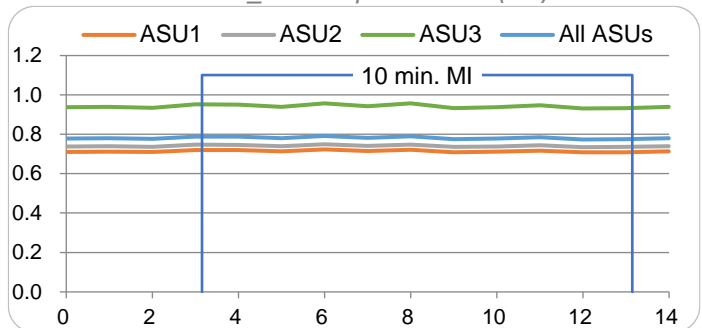| Part No.	Description	Source	Qty	Unit Price	Ext. Price	Disc.	Disc. Price
Hardware & Software							
EGW099014	Inspur AS13000G5 Storage Node (3.5 inch *12) Case (include PCIe Riser Card, Rear Hard Disk Backplane Module), Maximum expansion toto 5120 Nodes in One System	1	30	17,969.23	539,076.92	72%	150,941.54
EGW0010PJ	Intel Xeon 6248 (2.5GHZ/20 cores) Processor Unit	1	60	14,876.92	892,615.38	65%	312,415.39
EGW004058	Memory DDR4 RDIMM, 16G 2933 MT/s	1	360	1,169.23	420,923.08	65%	147,323.08
EGW070008	Network Card PCIEX16 100GbE Dual-port	1	110	6,155.38	677,092.31	75%	169,273.08
EGW02307R	Intel U.2 NVME SSD 1600GB PCIe 3.0*4	1	144	5,276.92	759,876.92	72%	212,765.54
EGW02508C	Inspur NVME SSD 1600GB PCIe3.0*4	1	36	5,123.08	184,430.77	72%	51,640.62
EGW0230S6	Enterprise HDD 300GB SAS 10K prm 2.5inch	1	60	1,000.00	60,000.00	65%	21,000.00
EGW09305P	Inspur AS13000G5 Basic Software, One License Matches One Node	1	30	20,723.08	621,692.31	60%	248,676.93
EGW045012	Ruijie Ethernet Network Switch Budle 4 units* 100G *32 ports	1	2	73,037.61	146,075.21	55%	65,733.85
EGW04302Q	Accelink 5M LC-LC MPO Optical Fiber Cable	1	170	63.08	10,723.08	55%	4,825.39
EGW0423B1	Mellanox Optical Module SFP 100G MM	1	340	173.50	58,991.45	55%	26,546.16
EGW03812A	Inspur Storage RACK 42U AC Cabinet	1	2	1,047.86	2,095.73	55%	943.08
					Hardware & Software Subtotal		**1,412,084.66**
Support & Maintenance							
F2HII17	AS13000 per node Bundle Installation Service Engineering	1	30	1,138.46	34,153.85	50%	17,076.93
F2HII00	Switch Bundle Installation Service Engineering	1	2	2,538.46	5,076.92	50%	2,538.47
F2HIIA02	UPgrade TO Onsite Premier 24x7x4H Engineer Onsite Service - 36Month(s)	1	32	693.69	22,198.15	50%	11,099.08
					Support & Maintenance Subtotal		**30,714.48**
SPC-1 Total System Price							**1,442,799.14**
SPC-1 IOPS™							6,300,529
SPC-1 Price-Performance™ ($/SPC-1 KIOPS™)							**229.00**
SPC-1 ASU Capacity (GB)							111,628
SPC-1 ASU Price ($/GB)							**12.93**

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. Carl Wei	http://en.inspur.com/ weilei01@inspur.com
SPC Auditor	InfoSizing Doug Johnson	www.sizing.com doug@sizing.com

Revision Information

Date	FDR Revision	Details
June 25, 2021	First Edition	Initial Publication

Anomalies, Exceptions, Waivers

There were no anomalies, exceptions or waivers associated with the audit of the Inspur AS13000G5.

CONFIGURATION INFORMATION

Tested Storage Product Description

Inspur AS13000G5 is a fully symmetrical distributed enterprise-level storage platform for massive data processing applications. The industry-leading "all-in-one" minimalist architecture can provide four kinds of storage service for file, block, object, and big data on one platform at the same time. AS13000G5 supports the maximum horizontal expansion of 5120 nodes, meanwhile a single namespace can support EB-level capacity, and the performance and capacity of the system vary with the number of nodes linearly. Due to the higher performance, higher expansion, higher reliability, easier management and maintenance, etc. AS13000G5 fully meets the storage and disaster recovery requirements of massive data in cloud computing, virtualization, database, file sharing, bill imaging, HPC, video surveillance, archive backup, etc. and has been widely used in government, finance, enterprise, telecom, radio and television, education, medical, transportation, energy, and other industries.

For details, please see:
https://en.inspur.com/en/storage/distributed_storage/2511242/index.html

Host System and Tested Storage Configuration Components

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

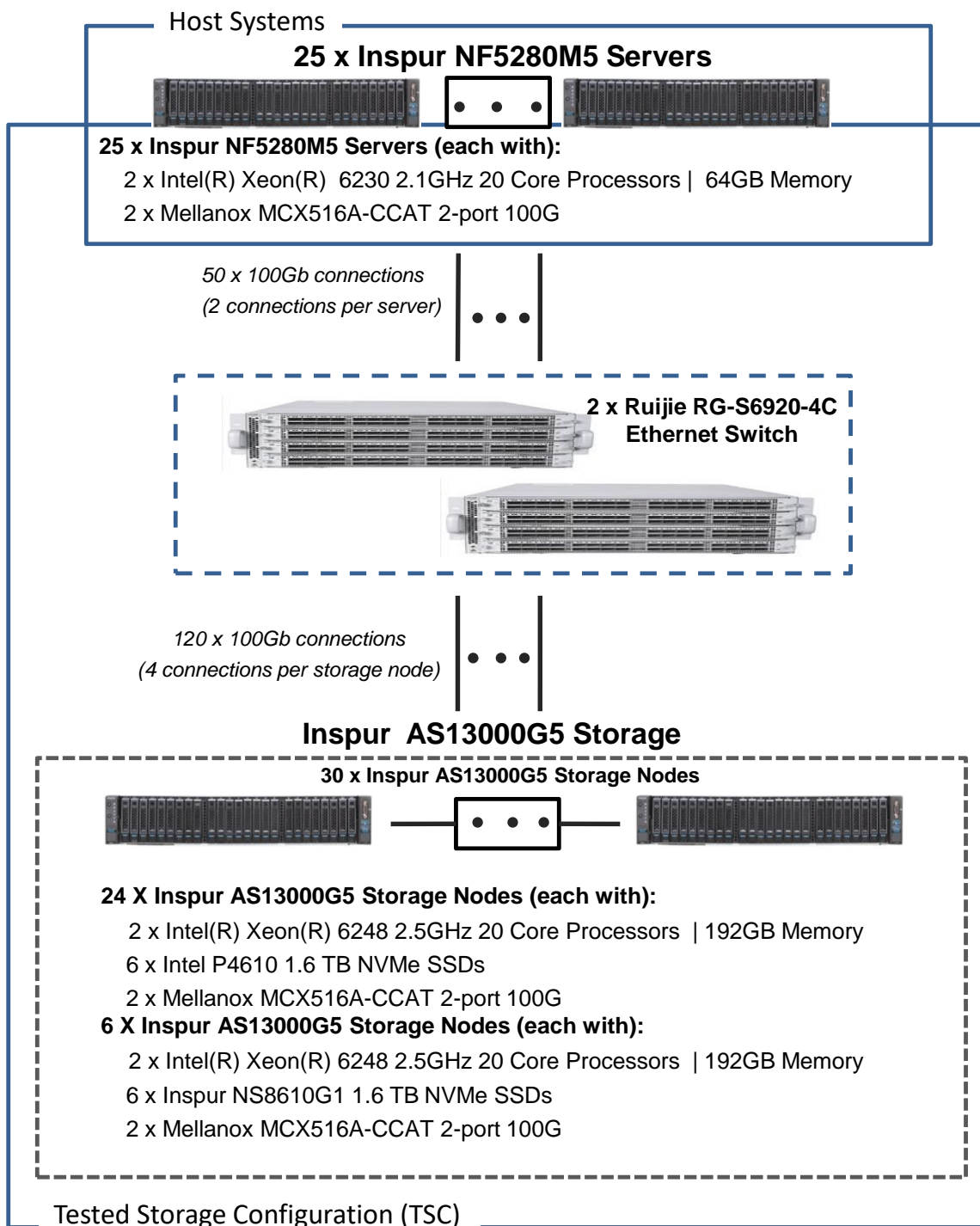| Host Systems |
|---|
| 25 x Inspur NF5280M5 Servers, each with: |
| 2 x Intel® Xeon® 6230 2.1 GHz 20-Core Processors |
| 192 GB Main Memory |
| CentOS Linux release 8.2.2004 |
| **Tested Storage Configuration** |
| 50 x Mellanox MCX516A-CCAT 100 Gb 2-port |
| 30 x Inspur AS13000G, each with: |
| 2 x Intel® Xeon® 6248 2.5 GHz 20-Core |
| 192 GB cache (5,760 GB total) |
| 4 x 100 Gbps Front End Ports |
| 6 x Intel P4610 1.6 TB NVMe (24 nodes) |
| 6 x Inspur NS8610G1 1.6 TB NVMe (6 nodes) |
| 180 x NVMe (Total) |
| 2 x Ruijie RG-S6920-4C Ethernet Switch (128 active ports) |

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).

Host Systems

25 x Inspur NF5280M5 Servers

25 x Inspur NF5280M5 Servers (each with):

2 x Intel(R) Xeon(R) 6230 2.1GHz 20 Core Processors | 64GB Memory

2 x Mellanox MCX516A-CCAT 2-port 100G

50 x 100Gb connections
(2 connections per server)

2 x Ruijie RG-S6920-4C Ethernet Switch

120 x 100Gb connections
(4 connections per storage node)

Inspur AS13000G5 Storage

30 x Inspur AS13000G5 Storage Nodes

24 X Inspur AS13000G5 Storage Nodes (each with):

 2 x Intel(R) Xeon(R) 6248 2.5GHz 20 Core Processors | 192GB Memory

 6 x Intel P4610 1.6 TB NVMe SSDs

 2 x Mellanox MCX516A-CCAT 2-port 100G

6 X Inspur AS13000G5 Storage Nodes (each with):

 2 x Intel(R) Xeon(R) 6248 2.5GHz 20 Core Processors | 192GB Memory

 6 x Inspur NS8610G1 1.6 TB NVMe SSDs

 2 x Mellanox MCX516A-CCAT 2-port 100G

Tested Storage Configuration (TSC)

Storage Network Configuration

The Tested Storage Configuration (TSC) involved 30 AS13000G5 Storage Nodes, driven by 25 Host Systems (Inspur NF5280M5). Each NF5280M5 host was connected to each Ruijie RG-S6920-4C switch using 1 port of each Mellanox MCX516A-CCAT. This is a total of 50 100 Gb connections between the hosts and the switches. Each AS13000G5 storage node had two connections to each Ruijie RG-S6920-4C switch using one port on each of the two Mellanox MCX516A-CCAT. This is a total of 120 100 Gb connections between the switches and the storage nodes.

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	18	2,790.7	2,790.7	50,232.9	45.0%	No
ASU-2	18	2,790.7	2,790.7	50,232.9	45.0%	No
ASU-3	4	2,790.7	2,790.7	11,162.8	10.0%	No
SPC-1 ASU Capacity				111,628	*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
Intel NVMe	144	1,600.0	230,400.0
Inspur NVMe	36	1,600.0	57,600
Total Physical Capacity			**288,000**
Physical Capacity Utilization			**38.76%**

Data Protection

The data protection level used for all LVs was **Protected 2 (Replication)**, which was accomplished by replicating all data on two separate storage nodes and providing fully redundant pathways from each host to the storage cluster.

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).
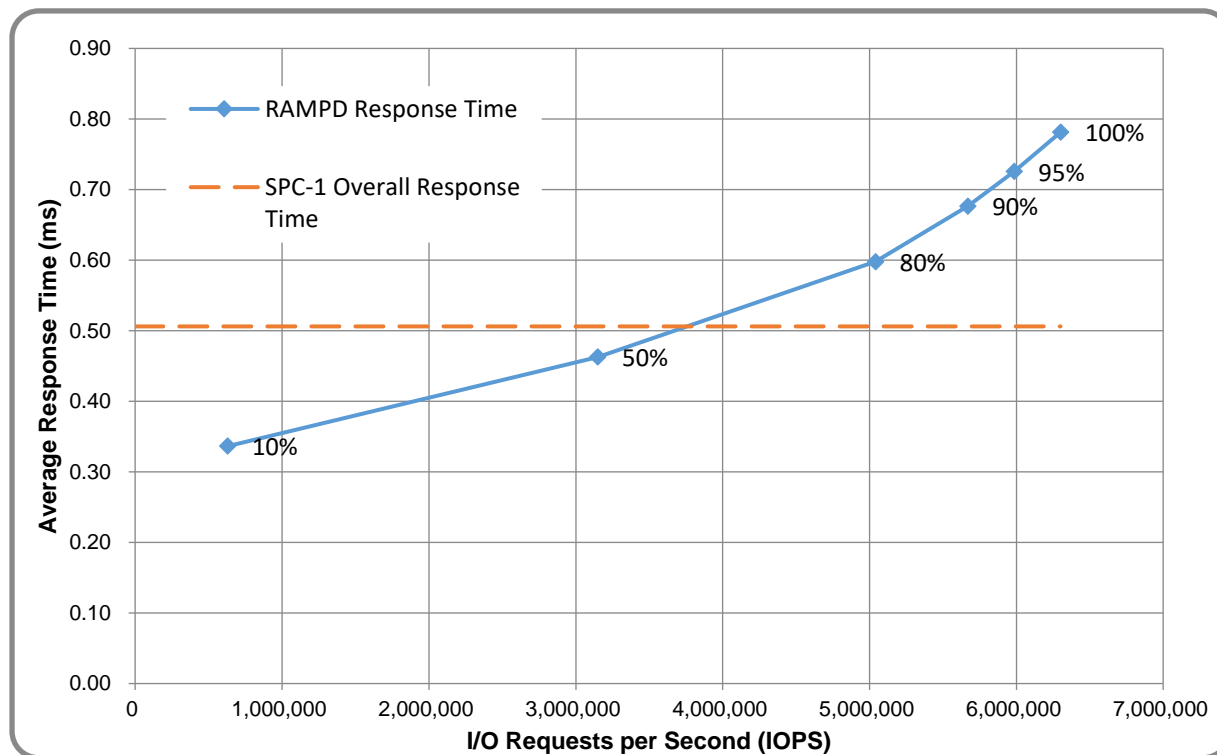
Measurement Intervals by Test Phase Graph

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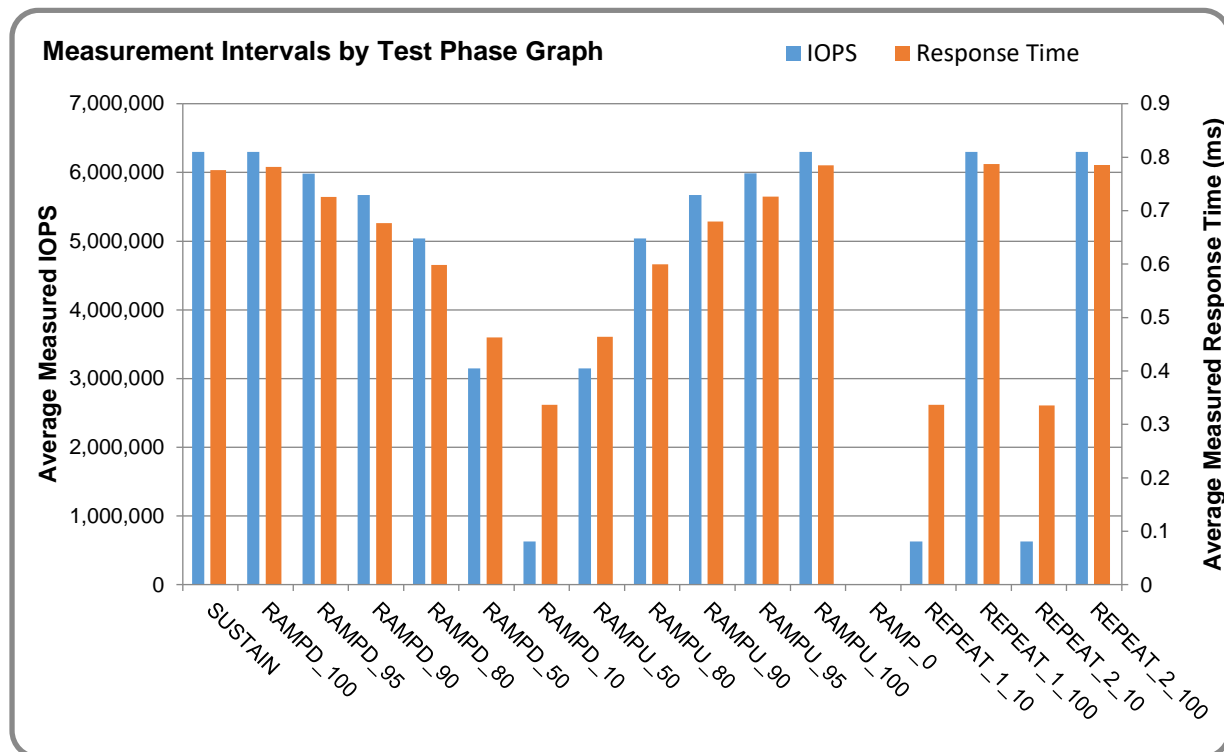
Response Time vs. Throughput Graph

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	07-Jun-21 12:24:15	Requested IOP Level	25,000 MB/sec
End Time	07-Jun-21 13:38:58	Observed IOP Level	24,898 MB/sec
Duration	1:14:44	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

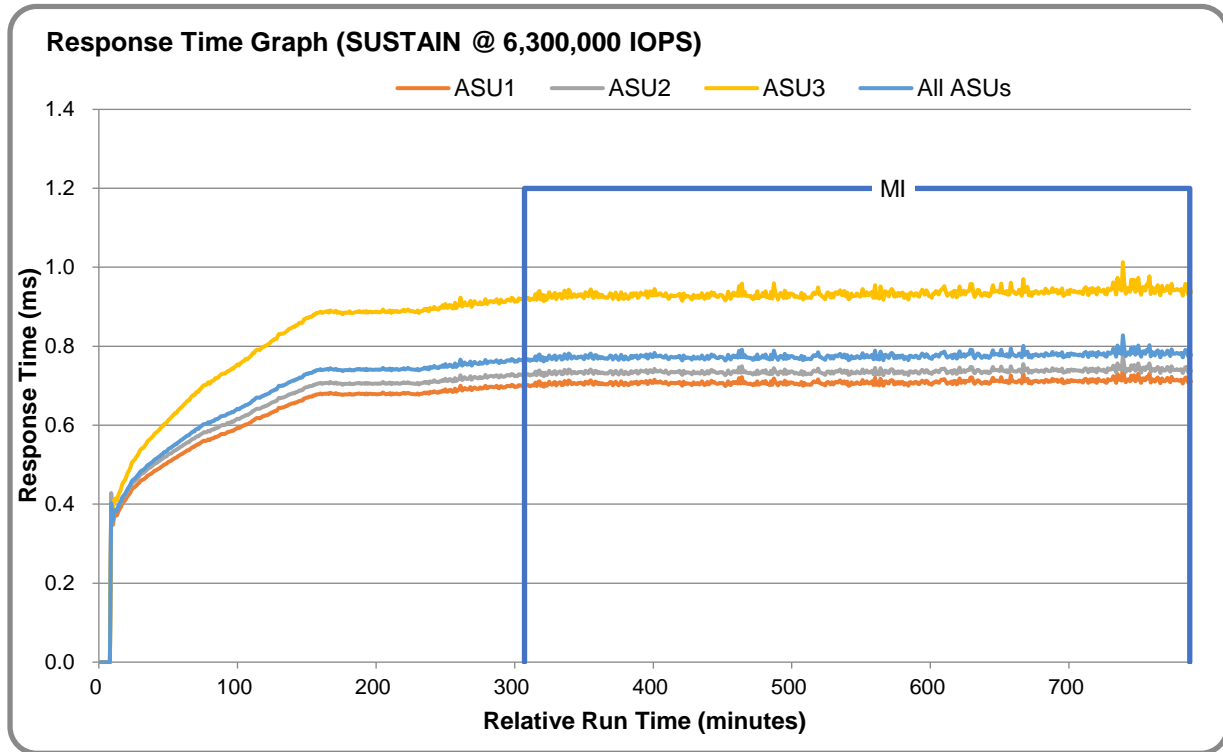| Interval	Start Date & Time	End Date & Time	Duration
Transition Period	07-Jun-21 13:53:57	07-Jun-21 18:53:54	4:59:57
Measurement Interval	07-Jun-21 18:53:54	08-Jun-21 02:53:55	8:00:01

SUSTAIN – Throughput Graph

Throughput Graph (SUSTAIN @ 6,300,000 IOPS)
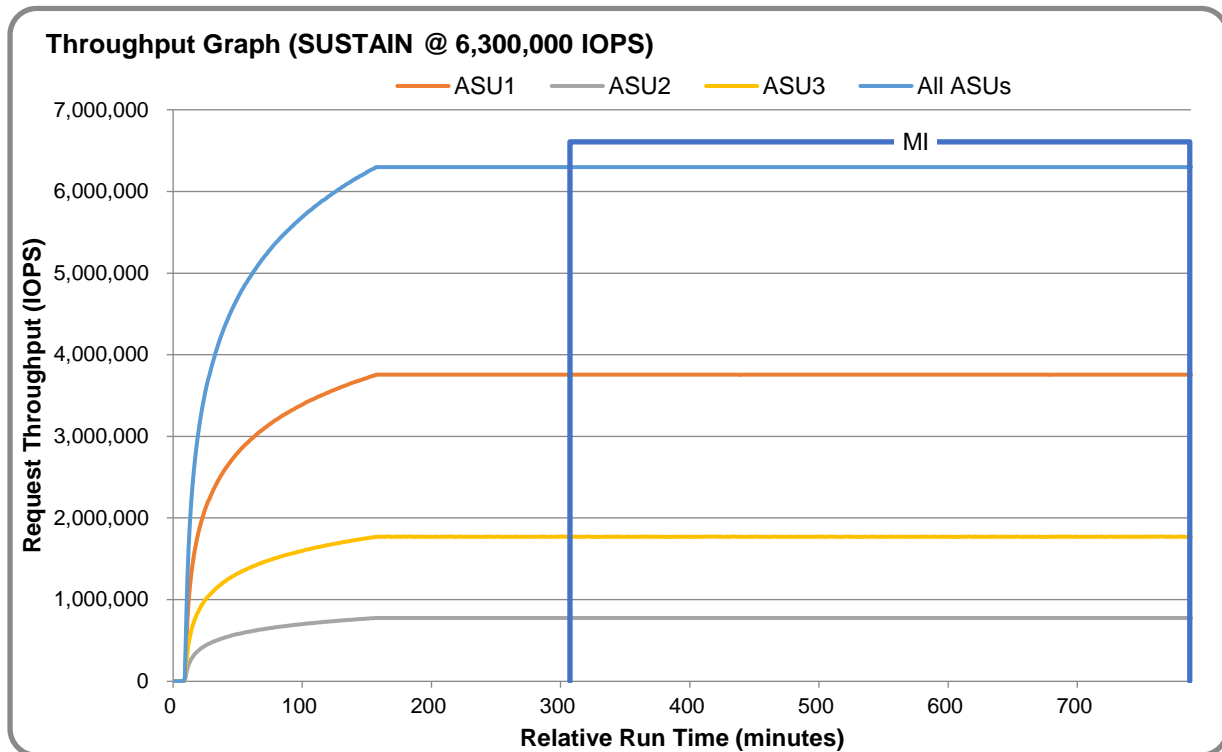
SUSTAIN – Response Time Graph

Response Time Graph (SUSTAIN @ 6,300,000 IOPS)

SUSTAIN – Data Rate Graph

Data Rate Graph (SUSTAIN @ 6,300,000 IOPS)
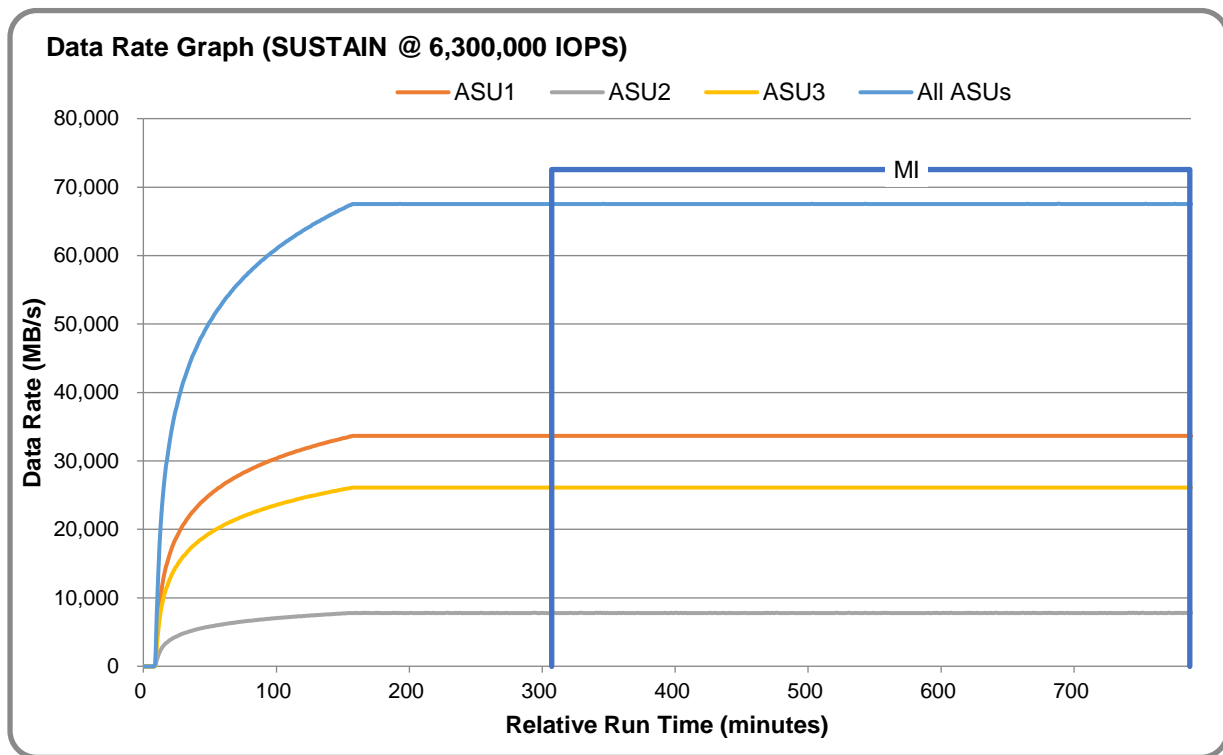
SUSTAIN – Response Time Frequency Graph
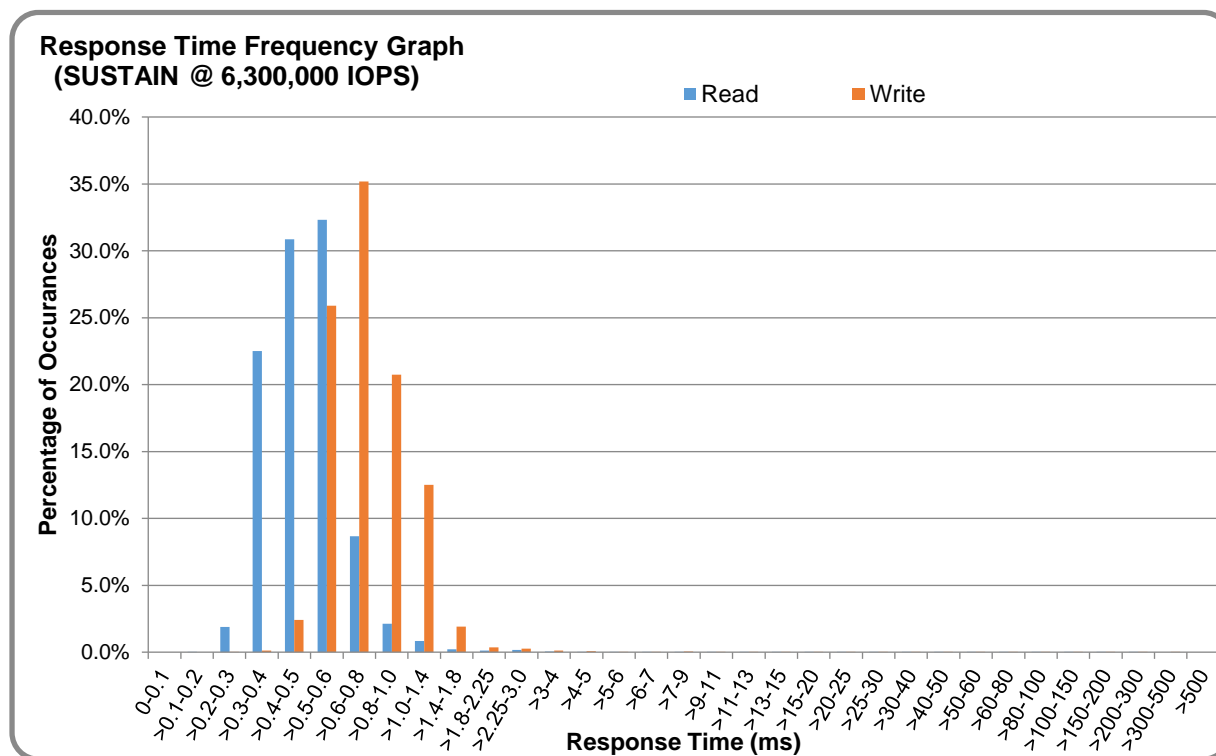
SUSTAIN – Intensity Multiplier

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.

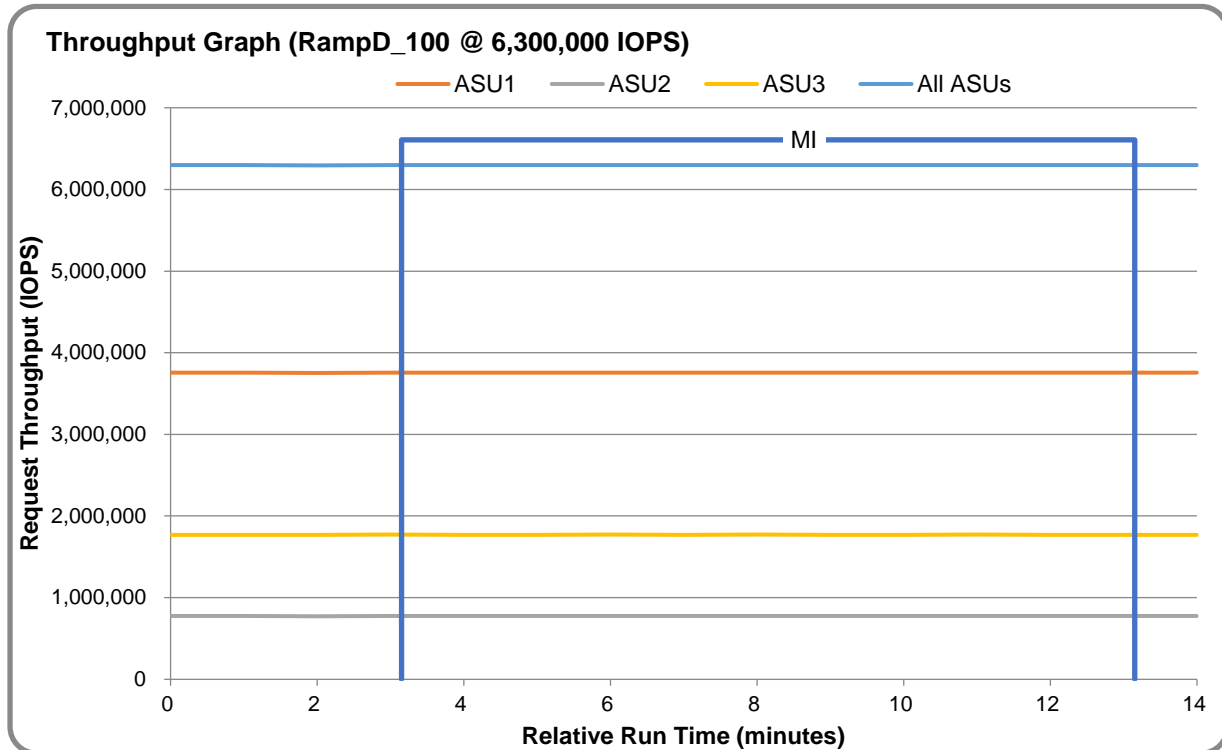|	ASU1-1	ASU1-2	ASU1-3	ASU1-4	ASU2-1	ASU2-2	ASU2-3	ASU3-1
Defined	0.0350	0.2810	0.0700	0.2100	0.0180	0.0700	0.0350	0.2810
Measured	0.0350	0.2810	0.0700	0.2100	0.0180	0.0700	0.0350	0.2810
Variation	0.0003	0.0001	0.0002	0.0001	0.0004	0.0002	0.0003	0.0001
Difference	0.007%	0.001%	0.004%	0.000%	0.009%	0.004%	0.003%	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:
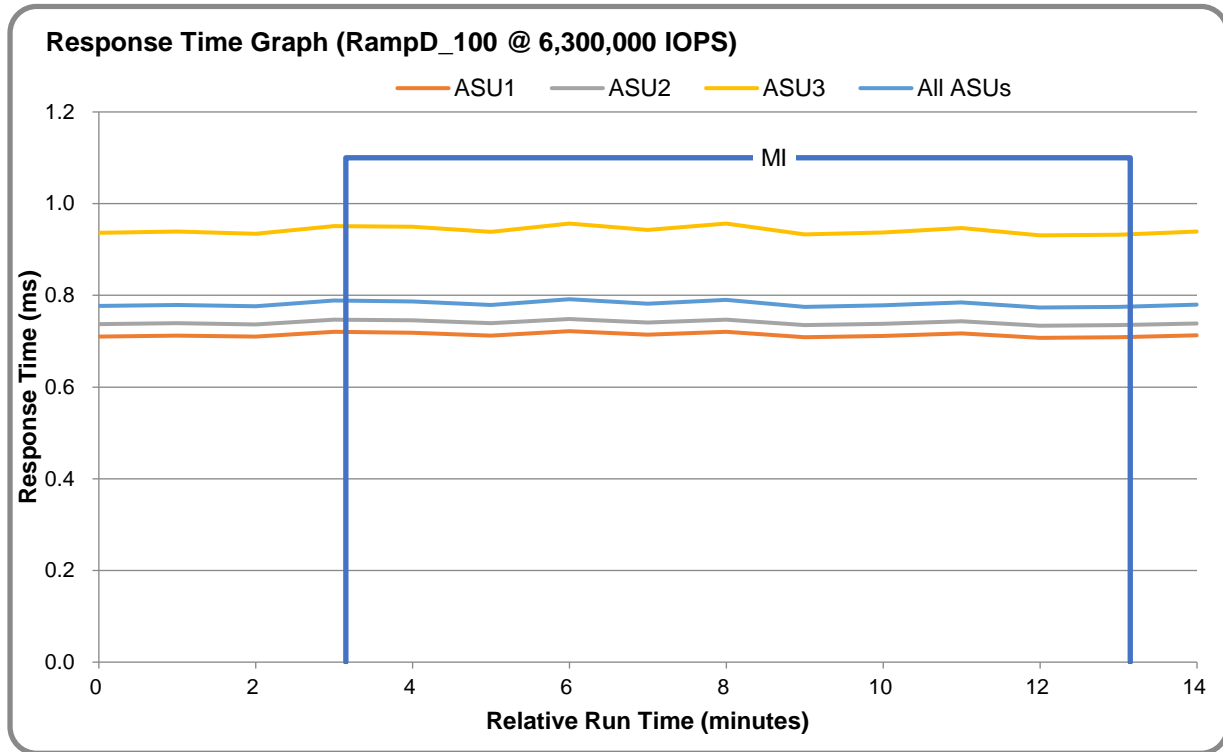
- **SPC1_METRICS_0_Raw_Results.xlsx**

RAMPD_100 – Execution Times

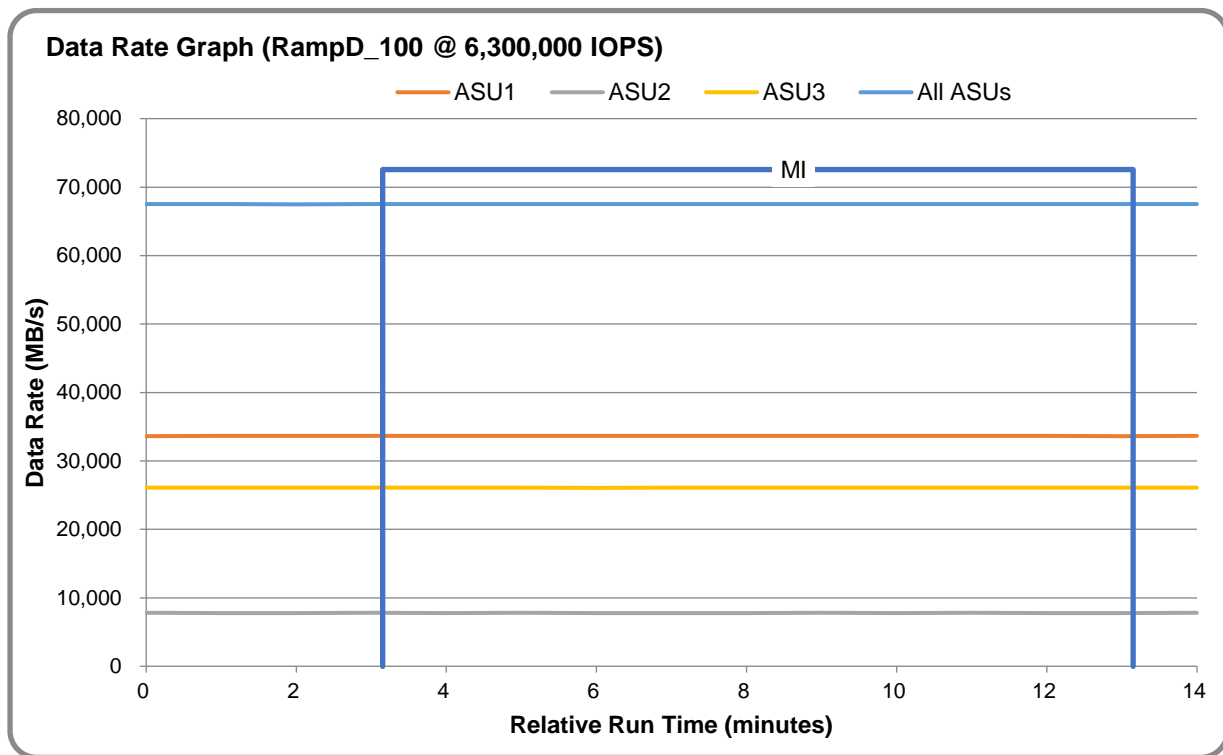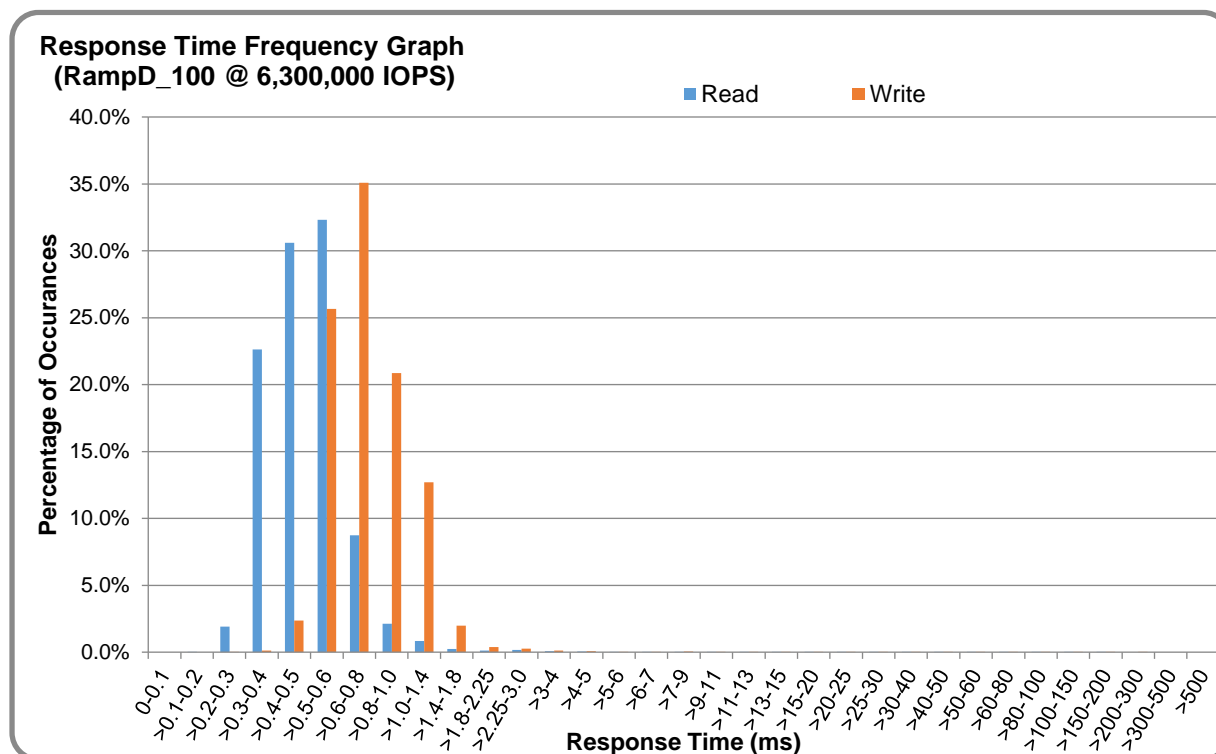| Interval	Start Date & Time	End Date & Time	Duration
Transition Period	08-Jun-21 02:54:54	08-Jun-21 02:57:55	0:03:01
Measurement Interval	08-Jun-21 02:57:55	08-Jun-21 03:07:55	0:10:00

RAMPD_100 – Throughput Graph

RAMPD_100 – Response Time Graph

RAMPD_100 – Data Rate Graph

RAMPD_100 – Response Time Frequency Graph

Response Time Frequency Graph
(RampD_100 @ 6,300,000 IOPS)

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	0.2100	0.0180	0.0700	0.0350	0.2810
Variation	0.0003	0.0001	0.0003	0.0001	0.0004	0.0002	0.0002	0.0001
Difference	0.015%	0.000%	0.008%	0.002%	0.003%	0.004%	0.009%	0.002%

RAMPD_100 – I/O Request Summary

I/O Requests Completed in the Measurement Interval	3,780,324,474
I/O Requests Completed with Response Time <= 30 ms	3,778,701,364
I/O Requests Completed with Response Time > 30 ms	1,623,110

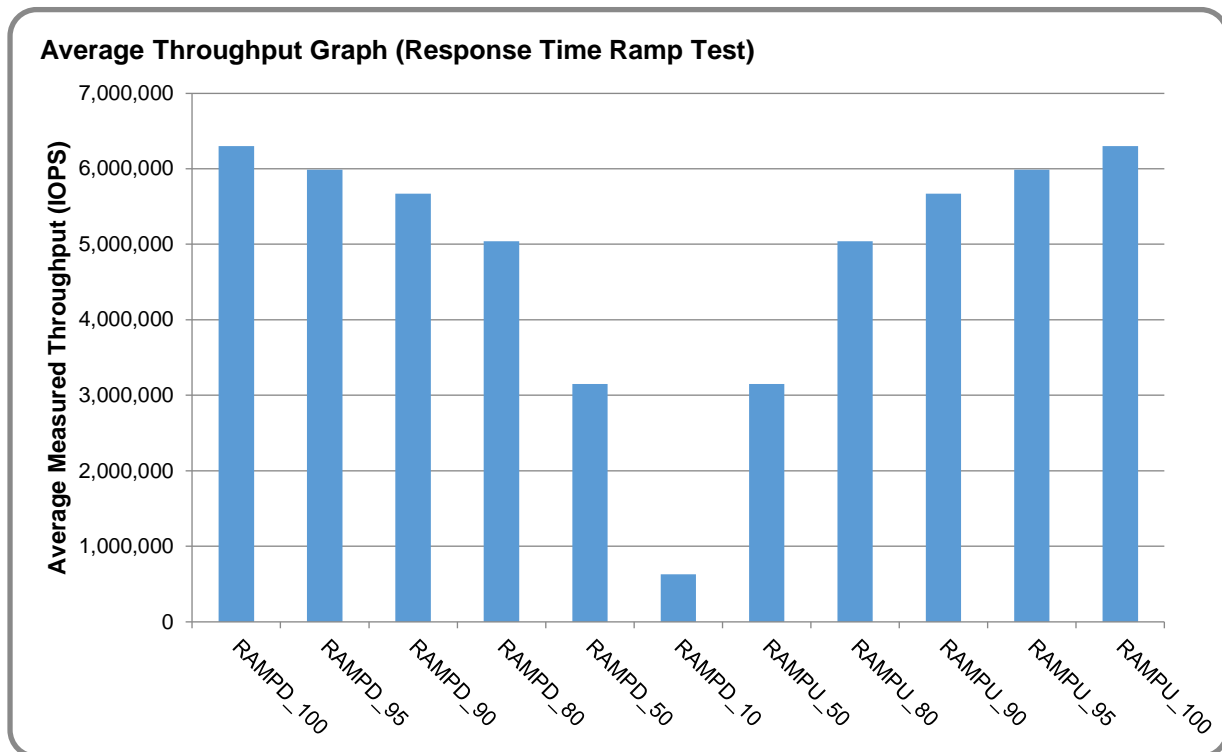# Response Time Ramp Test

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

Average Throughput Graph (Response Time Ramp Test)

Response Time Ramp Test – Average Response Time Graph

Average Response Time Graph (Response Time Ramp Test)
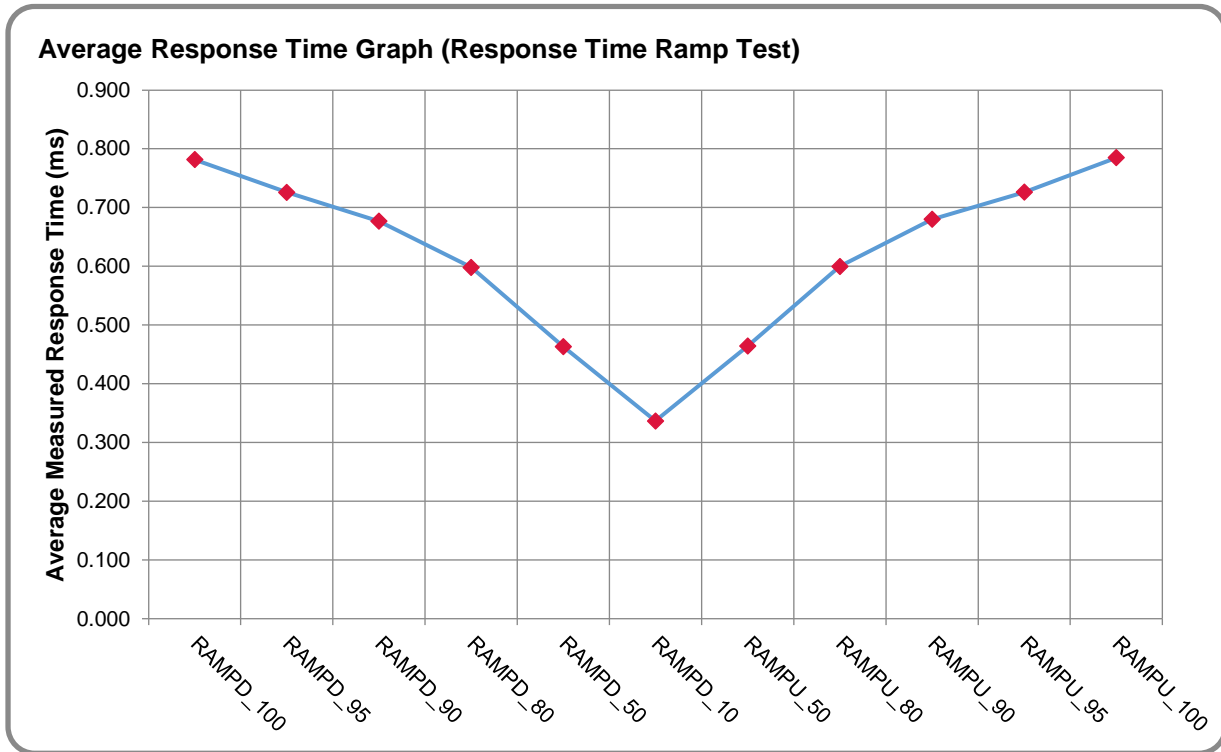
Response Time Ramp Test – RAMPD_10 Response Time Graph

Response Time Graph (RampD_10 @ 630,000 IOPS)
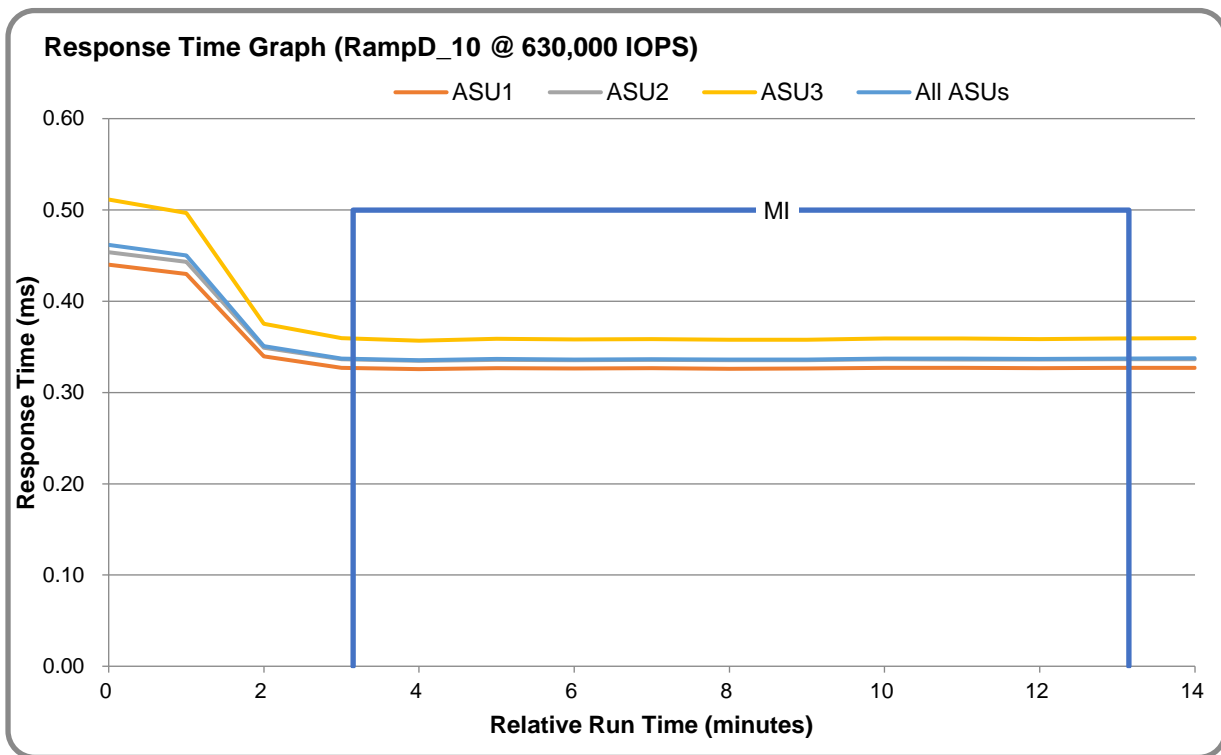
Repeatability Test

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**
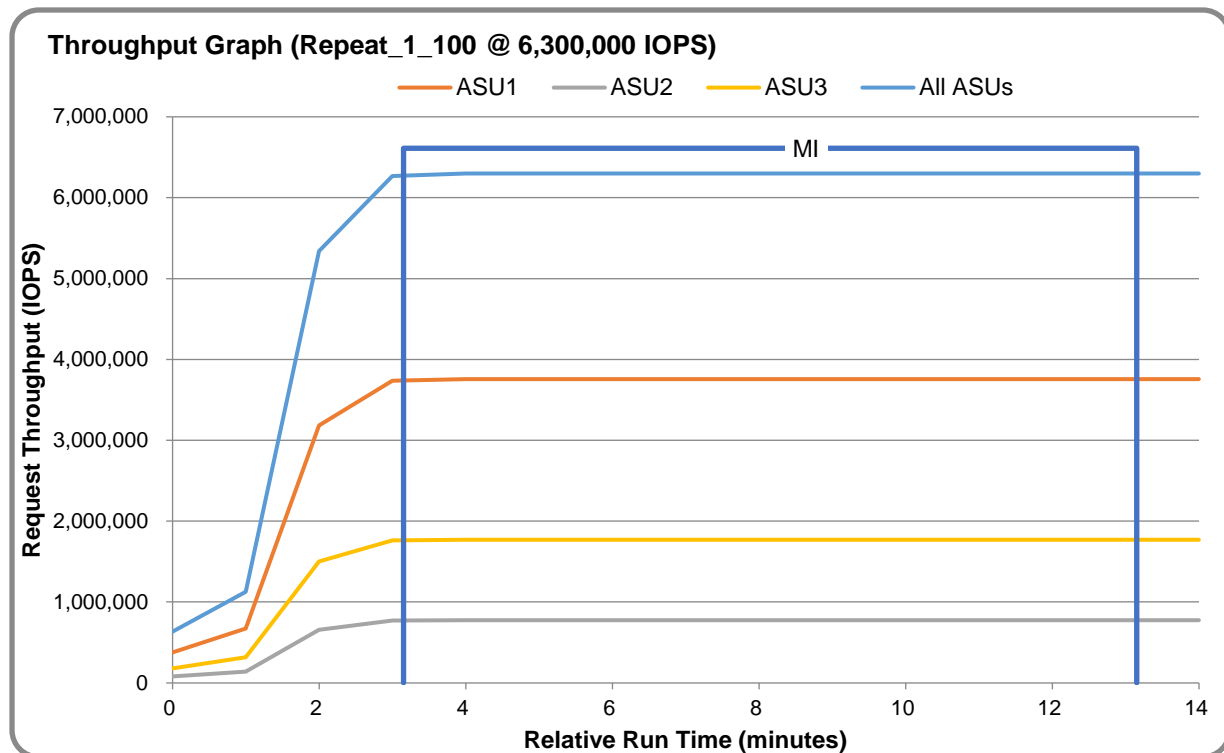
Repeatability Test Results

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	6,300,529.0	630,031.2
REPEAT_1	6,300,359.8	630,045.0
REPEAT_2	6,300,364.4	630,038.7

REPEAT_1_100 – Throughput Graph

REPEAT_1_100 – Response Time Graph

Response Time Graph (Repeat_1_100 @ 6,300,000 IOPS)
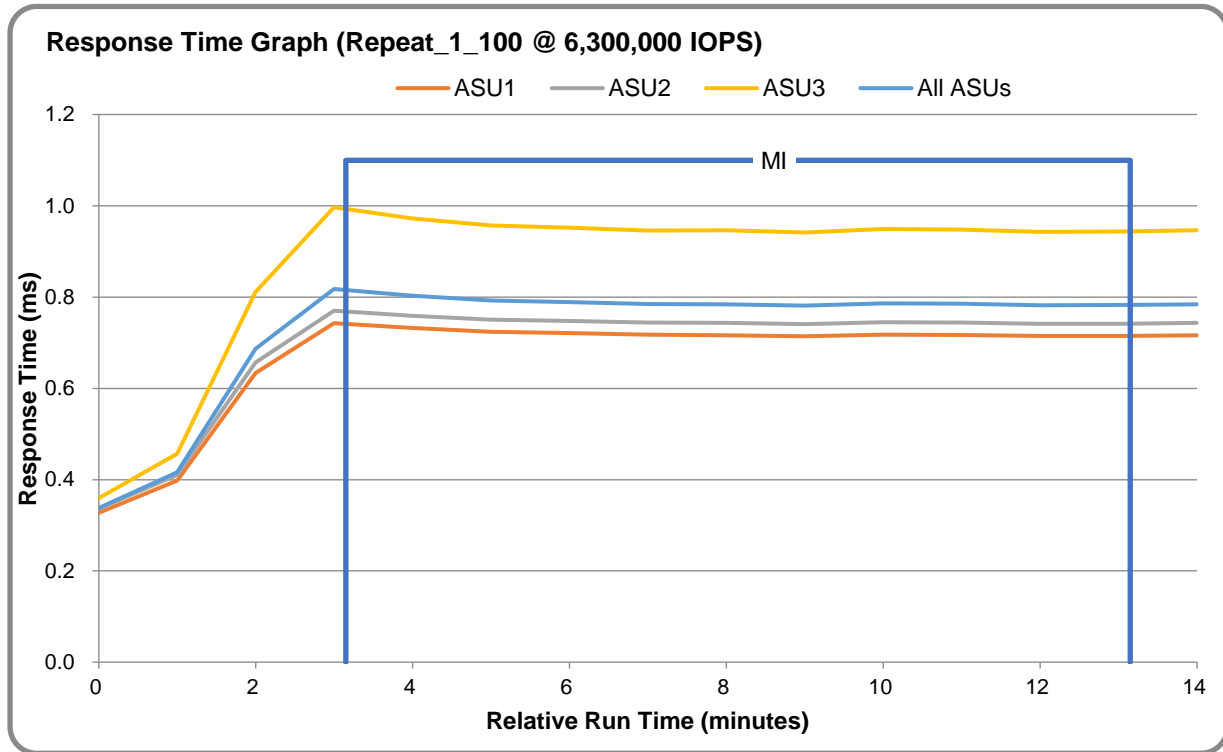
REPEAT_2_100 – Throughput Graph

Throughput Graph (Repeat_2_100 @ 6,300,000 IOPS)
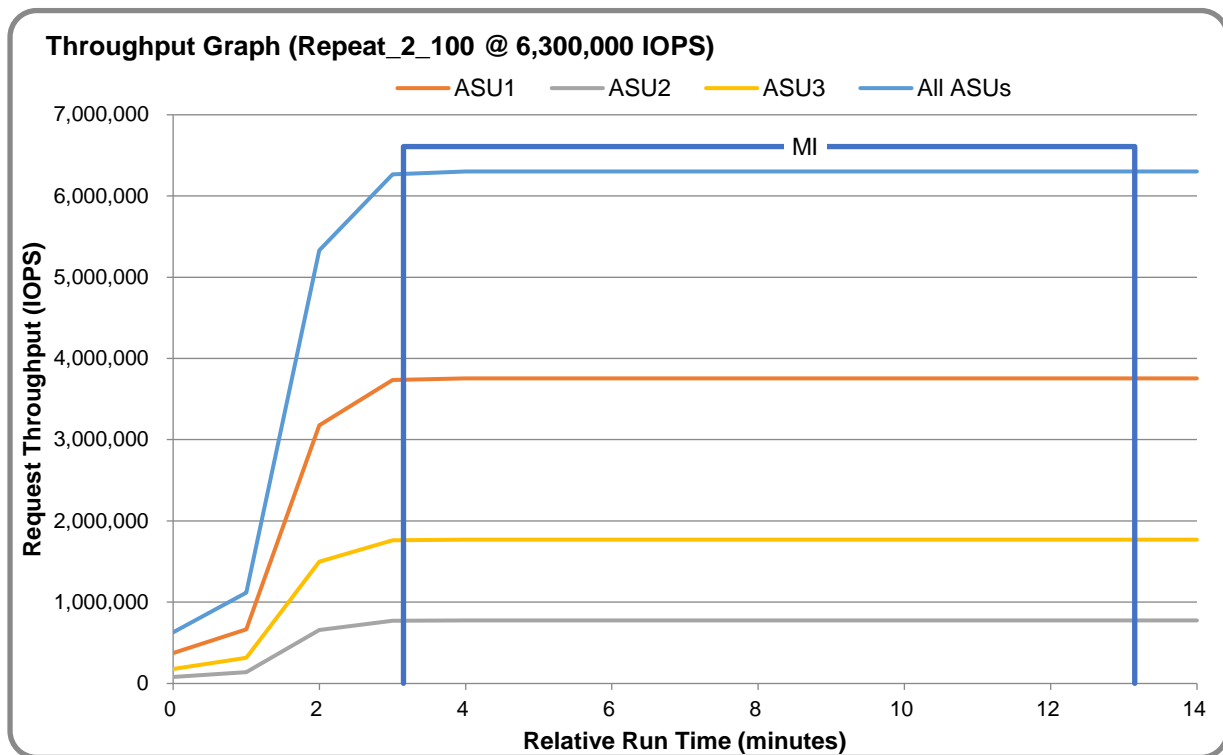
REPEAT_2_100 – Response Time Graph
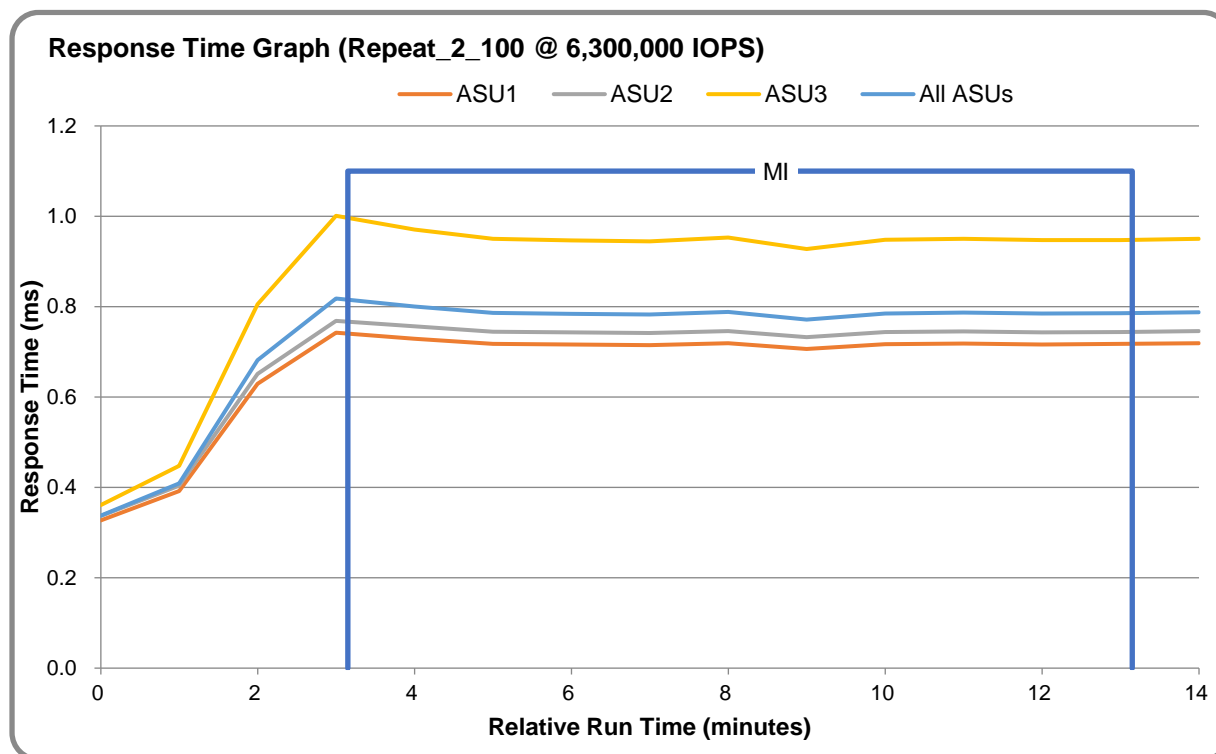
Repeatability Test – Intensity Multiplier

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	0.0002	0.0001	0.0002	0.0001	0.0004	0.0002	0.0002	0.0001
Difference	0.002%	0.002%	0.001%	0.002%	0.000%	0.002%	0.002%	0.003%

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	0.0002	0.0000	0.0002	0.0001	0.0004	0.0001	0.0002	0.0001
Difference	0.010%	0.002%	0.003%	0.003%	0.004%	0.004%	0.002%	0.006%

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	1,314,640,452
Total Number of Logical Blocks Verified	635,093,468
Total Number of Logical Blocks Overwritten	679,546,984
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 AS13000G5 storage cluster divides the data into small pieces of data (objects) of the same size. Each object is written to two storage nodes before responding to the client successfully. When the storage node is writing, write success is returned when the object is recorded in the journal file. The data will be written to the disk in the background. After the node restarts, it will read the journal file for data recovery.

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**
deploy-storage-cluster.sh	Deploys the storage cluster	/D_Creation
init_AS13000G5.sh	Create replicated pools and images	/D_Creation
lv_scan.sh	Scan and activate logical volumes	/D_Creation
lvm.sh	Create logical volumes	/D_Creation
rbdmap.sh	Map images on host system	/D_Creation
vg.sh	Create volume groups	/D_Creation
/E_Inventory	**Configuration inventory**	**root**
profile-AS13000G5.sh	Captures profile of storage environment	/E_Inventory
profile_info_AS13000G5_start.txt	Storage configuration before INIT	E_Inventory
profile_info_AS13000G5_end.txt	Storage configuration after restart	E_Inventory
volume_list.sh	Captures logical volume environment	E_Inventory
volume_listing_start.txt	List of logical volumes before INIT	E_Inventory
volume_listing_end.txt	List of logical volumes after restart	E_Inventory
/F_Generator	**Workload generator**	**root**
full_run_before_persist2-40lun-lvm.sh	Execute all test phases through PERSIST1	/F_generator
HOST25.HST	Host configuration file	/F_generator
SPC1.asu	Define LUNs hosting the ASUs	/F_generator
test_persist2.sh	Execute 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 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 Replicated Pools and create images.

Execute the init_AS13000G5.sh script on a remote server which can login on AS13000G5 storage system to complete the following:

1. Create 1 replicated storage pools: Pool1.
2. Create 80 images (1300 GB per image).

Step 2: Map images on the Host System

Execute the rbdmap.sh script on the Host System to map the images of the Storage cluster on the Host System; And execute vg.sh script on the Host System to create 2 VGs, and execute the lvm.sh script to create 40 logical volumes as follows:

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

1. Map images on the Host System

    Map the images of the Storage cluster on the Host System.

2. Map Physical Volumes

    Create 80 physical volumes using the pvcreate command.

3. Create Volumes Groups

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

    Create spc1vg1 using 40 of 80 physical volumes and create spc1vg2 using 40 of 80 physical volumes.

4. Create Logical Volumes

    - Create 9 logical volumes, every volume capacity is 2600 GB, on spc1vg1 for ASU-1.
    - Create 9 logical volumes, every volume capacity is 2600 GB, on spc1vg2 for ASU-1
    - Create 9 logical volumes, every volume capacity is 2600 GB, on spc1vg1 for ASU-2.
    - Create 9 logical volumes, every volume capacity is 2600 GB, on spc1vg2 for ASU-2.
    - Create 2 logical volumes, every volume capacity is 2600 GB, on spc1vg1 for ASU-3.
    - Create 2 logical volumes, every volume capacity is 2600 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_info_AS13000G5_start.txt
- profile_info_AS13000G5_end.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 HOST25.HST. The scripts used to execute the benchmark sequence were:

- full_run_before_persist2-40lun-lvm.sh

- test_persist2.sh

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