



**SPC BENCHMARK 1™**  
**FULL DISCLOSURE REPORT**

**IBM CORPORATION**  
**IBM TOTALSTORAGE DS4300 WITH TURBO OPTION**  
*(NON-MIRRORED WRITE CACHE)*

**SPC-1 V1.7**

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**Notes**

The following terms, used in this document, are defined as:

- Kilobyte (KB) is equal to 1,000 ( $10^3$ ) bytes.
- Megabyte (MB) is equal to 1,000,000 ( $10^6$ ) bytes.
- Gigabyte (GB) is equal to 1,000,000,000 ( $10^9$ ) bytes.
- Terabyte (TB) is equal to 1,000,000,000,000 ( $10^{12}$ ) bytes.

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## AUDIT CERTIFICATION



IBM Corporation  
 Bruce McNutt  
 KBV/9062-2  
 9000 S. Rita Road  
 Tucson, AZ 85744

August 26, 2003

The SPC Benchmark 1™ results listed below for the IBM TotalStorage® FAStT600 with Turbo Option (*non-mirrored write cache*) were produced in compliance with the SPC Benchmark 1™ V1.7 Remote Audit requirements.

SPC Benchmark 1™ V1.7 Results	
Tested Storage Configuration (TSC) Name: IBM TotalStorage® FAStT600 with Turbo Option ( <i>non-mirrored write cache</i> )	
Metric	Reported Result
SPC-1 IOPS™	12,102.97
SPC-1 Price-Performance	\$9.28/SPC-1 IOPSTM
Total ASU Capacity	478.43 GB
Data Protection Level	Mirroring
SPC-1 LRT™	2.07 ms
Total TSC Price (including three-year maintenance)	\$112,360

The following SPC Benchmark 1™ Remote Audit requirements were reviewed and found compliant with V1.7 of the SPC Benchmark 1™ specification:

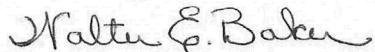
- A Letter of Good Faith, signed by a senior executive.
- The following Data Repository storage items were verified using information supplied by IBM Corporation:
  - ✓ Physical Storage Capacity and requirements.
  - ✓ Configured Storage Capacity and requirements.
  - ✓ Addressable Storage Capacity and requirements.
  - ✓ Capacity of each Logical Volume and requirements.
  - ✓ Capacity of each Application Storage Unit (ASU) and requirements.

- An appropriate diagram of the Benchmark Configuration (BC)/Tested Storage Configuration (TSC).
- Listings and commands to configure the Benchmark Configuration/Tested Storage Configuration, included customer tunable parameters.
- Commands and parameters used to configure the SPC-1 Workload Generator.
- The following Host System requirements were reviewed using documentation supplied by IBM Corporation:
  - ✓ The type of Host System including the number of processors and main memory.
  - ✓ The presence and version number of the Workload Generator on the Host System.
  - ✓ The TSC boundary within the Host System.
- The Test Results Files and resultant Summary Results Files received for each of following were authentic, accurate, and compliant with all of the requirements and constraints of Clauses 4 and 5 of the SPC-1 Benchmark Specification:
  - ✓ Data Persistence Test
  - ✓ Sustainability Test Phase
  - ✓ IOPS Test Phase
  - ✓ Response Time Ramp Test Phase
  - ✓ Repeatability Test
- The differences between the Tested Storage Configuration (TSC) used for the benchmark and Priced Storage Configuration are documented in the Executive Summary. The differences, if applied to the TSC, would not have a negative impact on the reported SPC-1 performance.
- The final version of the pricing spreadsheet met all of the requirements and constraints of Clause 8 of the SPC-1 Benchmark Specification.
- The Full Disclosure Report (FDR) met all of the requirements in Clause 9 of the SPC-1 Benchmark Specification.

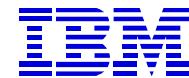
**Audit Notes:**

There were no additional audit notes or exceptions.

Respectfully,



Walter E. Baker  
SPC Auditor

**LETTER OF GOOD FAITH**


---

*P.O. Box 12195  
Research Triangle Park, NC 27709*

Date: *26 Aug 2003*

From: *IBM Corporation, Test Sponsor*

Submitted by:

*J.R. Hagan, Jr.  
VP, Storage Systems  
3039 Cornwallis  
RTP, NC 27709*

Contact Information:

*John Ponder / Bruce McNutt  
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To: *Walter E. Baker, SPC Auditor  
Gradient Systems, Inc.  
643 Bair Island Road, Suite 103  
Redwood City, CA 94063-2755*

Subject: Letter of good faith for the SPC Benchmark-1™ results on the IBM TotalStorage® FAStT600 with Turbo Option (with cache mirroring disabled).

IBM sponsored testing of the above listed product in compliance with the SPC-Benchmark-1 Specification. To the best of our knowledge and belief, the associated test results, including the SPC-1 Full Disclosure Report documenting the SPC Benchmark-1 results (per Clause 10 of the SPC Benchmark-1 Specification), are accurate.

Signed:

---

*J.R. Hagan, Jr.  
Vice President, Storage Systems  
26 Aug 2003*

## **EXECUTIVE SUMMARY**

### **Test Sponsor and Contact Information**

<b>Test Sponsor and Contact Information</b>	
<b>Test Sponsor Primary Contact</b>	IBM Corporation. – <a href="http://www.ibm.com">www.ibm.com</a> John Ponder <a href="mailto:ponder@us.ibm.com">ponder@us.ibm.com</a> KBV/9062-2 9000 South Rita Road Tucson, AZ 85744 Phone: (520) 799-4388 FAX: (520) 799-5530
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### **Revision Information and Key Dates**

<b>Revision Information and Key Dates</b>	
<b>SPC-1 Specification revision number</b>	V1.7
<b>SPC-1 Workload Generator revision number</b>	V2.00.03
<b>Date Results were first used publicly</b>	August 26, 2003
<b>Date FDR was submitted to the SPC</b>	August 26, 2003
<b>Date revised FDR was submitted to the SPC</b> Product name change from FASt600 to DS4300 Pricing was revised to include the price of the Turbo option.	September 5, 2006 April 15, 2004
<b>Date the TSC is/was available for shipment to customers</b>	September 12, 2003
<b>Date the TSC completed audit certification</b>	August 26, 2003

## Summary of Results

SPC-1 Results	
<b>Tested Storage Configuration (TSC) Name:</b> IBM TotalStorage DS4300 with Turbo Option <i>(non-mirrored write cache)</i>	
Metric	Reported Result
<b>SPC-1 IOPS™</b>	12,102.97
<b>SPC-1 Price-Performance</b>	\$11.07/SPC-1 IOPS™
<b>Total ASU Capacity</b>	478.43GB
<b>Data Protection Level</b>	Mirroring
<b>SPC-1 LRT™</b>	2.07ms
<b>Total TSC Price (including three-year maintenance)</b>	\$133,930

**SPC-1 IOPS™** represents the maximum I/O Request Throughput at the 100% load point.

**Total ASU (Application Storage Unit) Capacity** represents the total storage capacity read and written in the course of executing the SPC-1 benchmark. The Addressable Storage Capacity, which contains the Total ASU Capacity, was 478.43 GB. The Total ASU Capacity utilized 100% of the Addressable Storage Capacity. The actual Configured Storage Capacity was 956.87 GB, which included the multiple copies of user data required by a Data Protection Level of Mirroring. The Configured Storage Capacity utilized 48.65% of the priced Physical Storage Capacity of 1,966.68 GB.

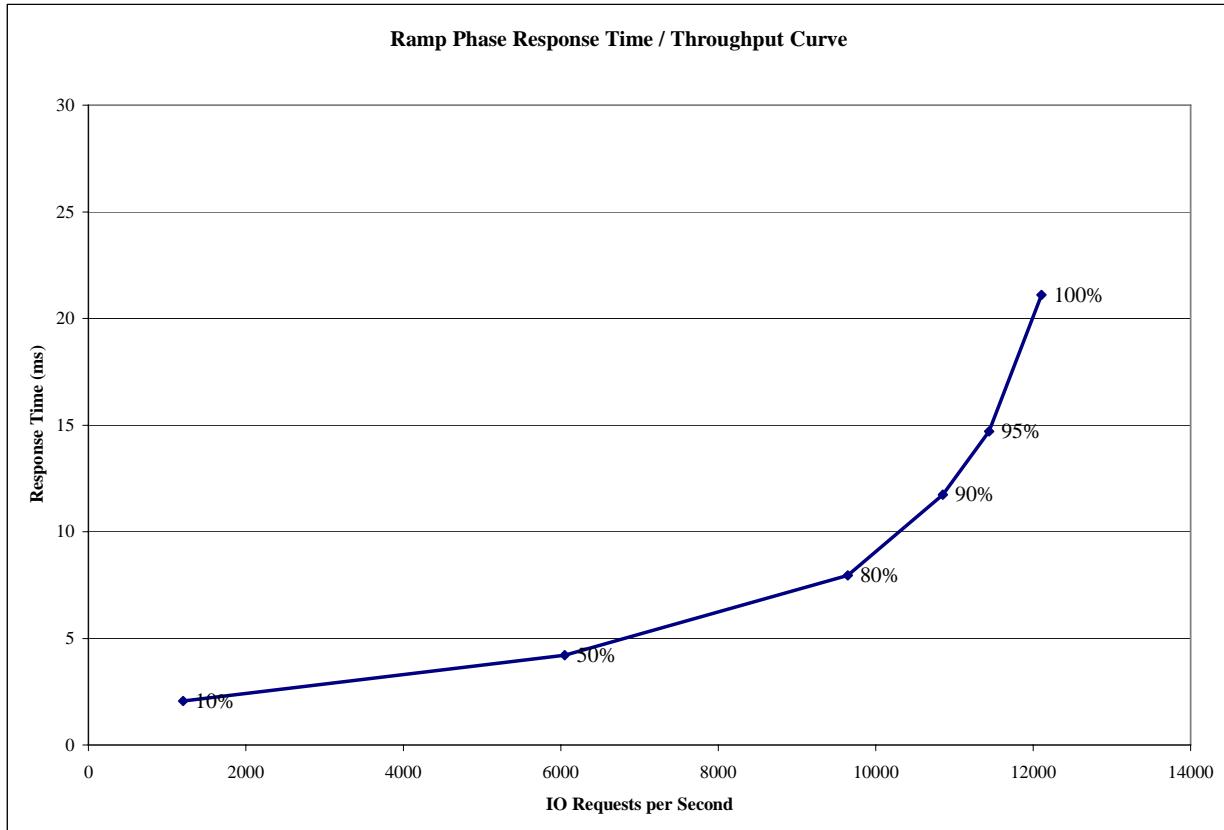
A **Data Protection Level** of Mirroring configures two or more identical copies of user data, maintained on separate disks.

The **SPC-1 LRT™** metric is the Average Response Time measured at the 10% load point, as illustrated on the next page. SPC-1 LRT™ represents the Average Response Time measured on a lightly loaded Tested Storage Configuration (TSC).

## Response Time – Throughput Curve

The Response Time-Throughput Curve illustrates the Average Response Time (milliseconds) and I/O Request Throughput at 100%, 95%, 90%, 80%, 50%, and 10% of the workload level used to generate the SPC-1 IOPS™ metric.

The Average Response Time measured at the 100% load point cannot exceed 30 milliseconds or the benchmark measurement is invalid.



## Response Time – Throughput Data

	10% Load	50% Load	80% Load	90% Load	95% Load	100% Load
I/O Request Throughput	1201.04	6049.86	9643.46	10852.05	11440.44	12102.97
Average Response Time (ms):						
All ASUs	2.07	4.21	7.96	11.74	14.70	21.09
ASU-1	2.77	5.54	10.67	16.39	20.78	30.49
ASU-2	2.25	4.63	7.12	8.22	9.19	10.82
ASU-3	0.53	1.21	2.59	3.39	4.25	5.65
Reads	4.48	8.82	15.10	21.04	25.46	35.20
Writes	0.51	1.21	3.32	5.68	7.70	11.90

## Tested Storage Configuration Pricing (*Priced Storage Configuration*)

M/T/M	fc#	description	Qty	US List Prices		
				Unit Price	Aggregate Price	Total
1722-60U		IBM TotalStorage FAStT600 Storage Server	1	14,999	14,999	
		2000 FAStT600 Turbo feature	1	21,570	21,570	
		2104 FAStT FC-2/133 host bus adapter	4	1,485	5,940	
		2210 Shortwave SFP	6	499	2,994	
		5625 25 meter fiber optic cable	4	189	756	
		7109 FAStT Storage Manager v8.4 upgrade	1	2,999	2,999	
1740-1RU		IBM TotalStorage FAStT EXP700 Storage Expansion Unit	3	6,000	18,000	
		2210 Shortwave SFP	12	499	5,988	
		5211 FAStT 36.4GB/15K rpm 2Gb FC Disk Drive Module	54	1,115	60,210	
		5601 1 meter fiber optic cable	6	79	474	
		9006 Attach to FAStT600	8	0	0	
				\$ 133,930		

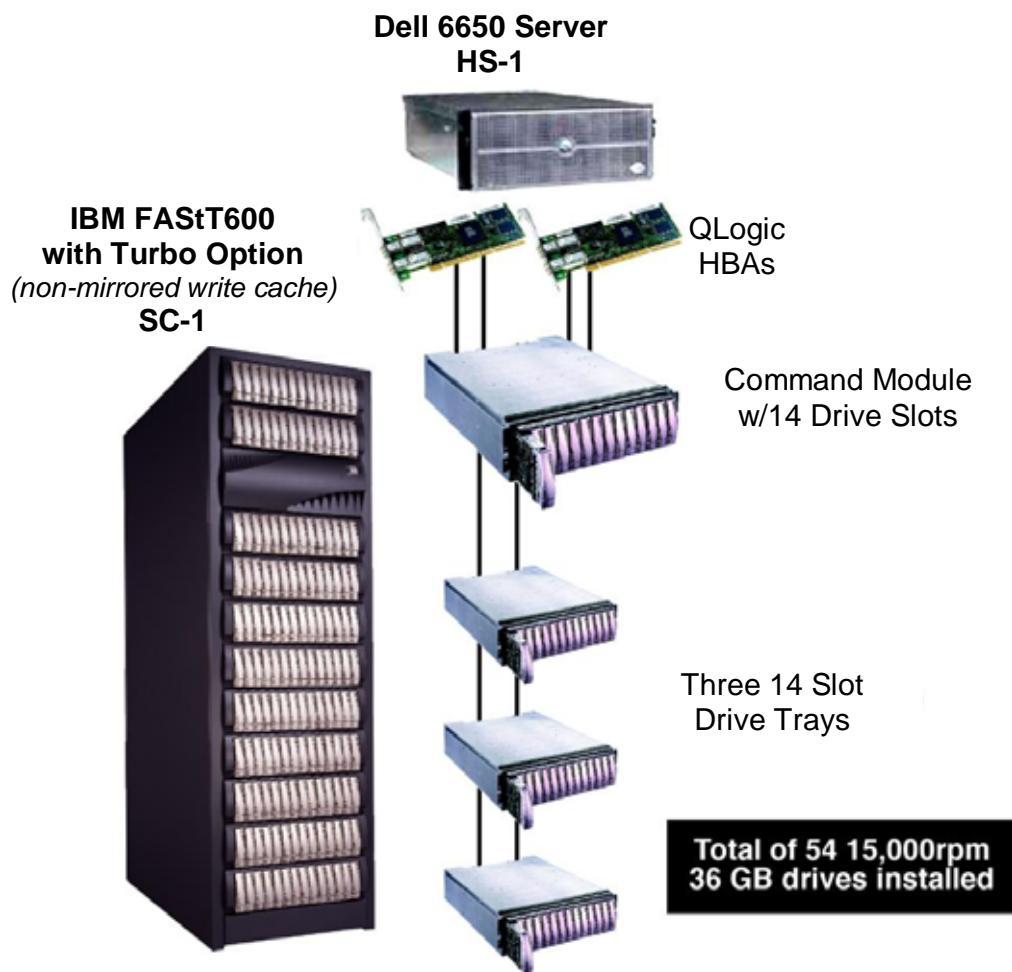
## Differences between the Tested Storage Configuration (TSC) and Priced Storage Configuration

The following are the differences between the TSC and Priced Storage Configuration:

- Four FAStT FC-2/133 HBAs (single port) were priced rather than the two QLogic 2342 dual channel HBAs used in the TSC.
- The priced disk drives have been configured to self-identify as a FAStT brand.
- The mounting of each drive is in an IBM drive carrier.
- The ‘data scrubbing’ option has a default setting of “off” in the TSC, but would need to be explicitly set to “off” in the Priced Storage Configuration.
- Twenty-five meter fiber optic cables were priced rather than the 30 meter cables used in the TSC.

The differences listed above, if applied to the TSC, would not have a negative performance impact on the reported SPC-1 performance.

## Benchmark Configuration/Tested Storage Configuration Diagram



Host System:	Tested Storage Configuration (TSC):
UID=HS-	UID=SC-1
1Dell 6650	Command Module
4 – Pentium 4 Xeon 2GHz with Hyperthreading Enabled	2 – Qlogic 2342 dual-port fibre channel host bus adapters
3GB Main Memory	2 – Disk Array Controllers, 1GB RAM Each
Windows 2003, Service Pack 3	4 – 2gb Fibre Channel host connections
WG	2 – 2gb Fibre Channel drive connections
	3 – Drive Modules
	54 – 36GB 15K RPM Disk Drives

## **CONFIGURATION INFORMATION**

### **Benchmark Configuration (BC)/Tested Storage Configuration (TSC) Diagram**

#### **Clause 9.2.4.4.1**

*A one page Benchmark Configuration (BC)/Tested Storage Configuration (TSC) diagram shall be included in the Executive Summary...*

A diagram of the benchmark configuration and tested storage configuration is included on the preceding page. The configuration consists of a single host system, with two Qlogic 2342 PCI to dual-channel 2gb fibre channel host adapters. The four host system, fibre channel connections are directly connected to the LSI command module. The host system is running Windows 2000, with Service Pack 3 applied.

### **Storage Network Configuration**

#### **Clause 9.2.4.4.2**

*If a storage network is employed in the BC/TSC, the FDR shall contain a topology diagram... . This diagram should include, but is not limited to the following components:*

1. *Storage Controller and Domain Controllers (see Clause 9.2.4.4.1)*
2. *Host Systems (see Clause 9.2.4.4.1)*
3. *Routers and Bridges*
4. *Hubs and Switches*
5. *HBAs to Host Systems and Front End Port to Storage Controllers*

*Additionally the diagram shall:*

- *Illustrate the physical connection between components.*
- *Describe the type of each physical connection.*
- *Describe the network protocol used over each physical connection.*
- *The maximum theoretical transfer rate of each class of interconnect used in the configuration.*
- *Correlate with the BC Configuration Diagram in Clause 9.2.4.4.1.*

*The Test Sponsor shall additionally supply (referenced in an appendix) a wiring diagram of the physical connections and physical port assignments used in the storage network. The diagram should allow anyone to exactly replicate the physical configuration of the storage network.*

A storage area network was not used for this test.

## Host System Configuration

### Clause 9.2.4.4.3

The FDR shall minimally contain, for each Host System running the Workload Generator, a listing of the following:

1. Number and type of CPUs.
2. Main memory capacity.
3. Cache memory capacity.
4. Number and type of disk controllers or Host Bus Adapters.

The details of the Host System configuration may be found on 14 (Benchmark Configuration/Tested Storage Configuration Diagram).

## Customer Tuning Parameters and Options

### Clause 9.2.4.5.1

All Benchmark Configuration (BC) components with customer tunable parameter and options that have been altered from their default values must be listed in the FDR. The FDR entry for each of those components must include both the name of the component and the altered value of the parameter or option.

## Windows 2000 Registry Changes

```
HKEY_LOCAL_MACHINE\SYSTEM\CurrentControlSet\Services\  
ql2300\Device\MaximumSGList=0xff  
  
HKEY_LOCAL_MACHINE\SYSTEM\CurrentControlSet\Services\  
ql2300\Device\NumberOfRequests=0xe0  
  
HKEY_LOCAL_MACHINE\SYSTEM\CurrentControlSet\Services\  
Disk\TimeOutValue=0x78  
  
HKEY_LOCAL_MACHINE\SYSTEM\CurrentControlSet\Services\  
ql2300\Device\DriverParameters=UseSameNN=1;BusChange=0;
```

## Array Controller Options

All array controller configuration options were set by the configuration script list in "Appendix A: TSC Configuration Script" on page 65.

## Host Bus Adapter Options

The table below lists the Host Bus Adapter options that were changed from their default values.

Host Bus Adapter Settings		
Item	Default	New Value
<b>Host Adapter Settings</b>		
Loop Reset Delay	5	8
Adapter Hard Loop ID	Disabled	Enabled
Hard Loop ID (unique for each)	0	Eg. 22
<b>Advanced Adapter Settings</b>		
Execution Throttle	16	255
Fast Command Posting	Disabled	Enabled
LUNs per Target	8	0
Enable Target Reset	No	Yes
Login Retry Count	8	30
Port Down Retry Count	8	70
<b>Extended Firmware Settings</b>		
Data Rate	0	2

## Tested Storage Configuration (TSC) Description

### Clause 9.2.4.5.2

The FDR must include sufficient information to recreate the logical representation of the TSC. In addition to customer tunable parameters and options (Clause 4.2.4.5.3), that information must include, at a minimum, a diagram and/or description of the following:

- All physical components that comprise the TSC. Those components are also illustrated in the Benchmark Configuration (BC) diagram in Clause 9.2.4.4.1 and, if applicable, the Storage Network Configuration Diagram in Clause 9.2.4.4.2.
- The logical representation of the TSC, configured from the above components that will be presented to the Workload Generator.

In addition the FDR may include listings of scripts and/or commands used to configure the physical components that comprise the TSC.

The TSC was configured as detailed in the “Benchmark Configuration/Tested Storage Configuration Diagram” on page 14 of this document. Each one of the host adapters was directly connected to a host port on the storage array command module. The disk drives were equally divided among the drive-side fibre channel connections of the storage array command module.

The configuration of the TSC was performed using a script, which is located in “Appendix A: TSC Configuration Script” on page 65. The LUNs created by the script comprise the reported Configured Storage Capacity, which contains both the Addressable Storage Capacity and a mirror of the Addressable Storage Capacity.

## SPC-1 Workload Generator Storage Configuration

### Clause 9.2.4.5.3

The FDR must include all SPC-1 Workload Generator storage configuration commands and parameters.

The following SPC-1 Workload Generator storage configuration commands and parameters were used:

```
javaparms="-Xmx64m -Xms64m"  
sd=asu1_1,lun=\PhysicalDrive1,size=215296770048  
sd=asu2_1,lun=\PhysicalDrive2,size=215296770048  
sd=asu3_1,lun=\PhysicalDrive3,size=47843726677
```

## **DATA REPOSITORY**

### **Definitions**

**Total ASU Capacity:** The total storage capacity read and written in the course of executing the SPC-1 benchmark.

**Application Storage Unit (ASU):** The logical interface between the storage and SPC-1 Workload Generator. The three ASUs (Data, User, and Log) are typically implemented on one or more Logical Volume.

**Logical Volume:** The division of Addressable Storage Capacity into individually addressable logical units of storage used in the SPC-1 benchmark. Each Logical Volume is implemented as a single, contiguous address space.

**Addressable Storage Capacity:** The total storage (sum of Logical Volumes) that can be read and written by application programs such as the SPC-1 Workload Generator.

**Configured Storage Capacity:** This capacity includes the Addressable Storage Capacity and any other storage (parity disks, hot spares, etc.) necessary to implement the Addressable Storage Capacity.

**Physical Storage Capacity:** The formatted capacity of all storage devices physically present in the Tested Storage Configuration (TSC).

**User Data Copy:** An identical copy of user data maintained on separate disks.

**Required Storage:** The amount of Configured Storage Capacity required to implement the Addressable Storage Configuration, excluding the storage required for the three ASUs.

**Global Storage Overhead:** The amount of Physical Storage Capacity that is required for storage subsystem use and unavailable for use by application programs.

**Total Unused Storage:** The amount of storage capacity available for use by application programs but not included in the Total ASU Capacity.

## Storage Capacities and Relationships

*Two tables and an illustration documenting the storage capacities and relationships of the SPC-1 Storage Hierarchy (Clause 2.1) shall be included in the FDR.*

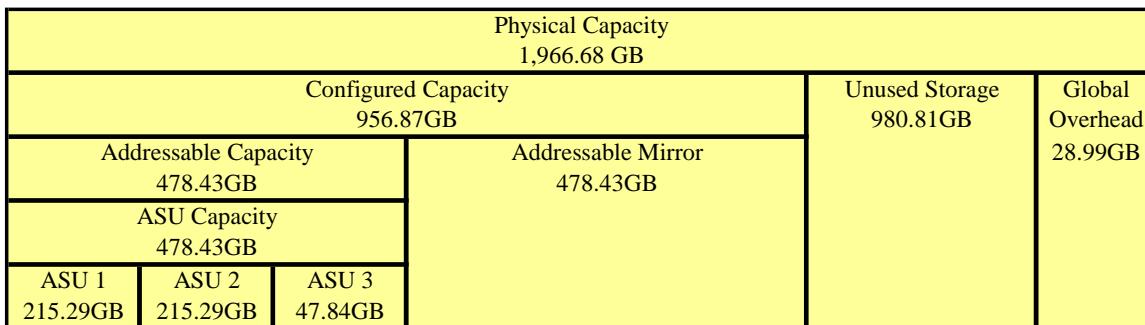
### SPC-1 Storage Capacities

SPC-1 Storage Capacities		
Storage Hierarchy Component	Units	Capacity
Total ASU Capacity	Gigabytes (GB)	478.43
Addressable Storage Capacity	Gigabytes (GB)	478.43
Configured Storage Capacity	Gigabytes (GB)	956.87
Physical Storage Capacity	Gigabytes (GB)	1,966.68
User Data Copy (Mirroring)	Gigabytes (GB)	478.43
Required Storage (metadata) & Hot Spares	Gigabytes (GB)	0.00
Global Storage Overhead	Gigabytes (GB)	28.99
Total Unused Storage	Gigabytes (GB)	980.81

The Physical Storage Capacity consisted of 54 disk drives with a formatted capacity of 36.420GB each. Each disk drive had 0.536GB reserved by the disk array management firmware, for a total of 28.99GB of Global Storage Overhead. The Total Unused Storage capacity was 980.81GB.

### SPC-1 Storage Capacities and Relationships Illustration

The various storage capacities configured in the benchmark result are illustrated below (not to scale).



## SPC-1 Storage Hierarchy Ratios

SPC-1 Storage Hierarchy Ratios			
	Addressable Storage Capacity	Configured Storage Capacity	Physical Storage Capacity
<b>Total ASU Capacity</b>	100.00%	50.00%	24.32%
<b>User Data Copy (Mirror)</b>		50.00%	24.32%
<b>Addressable Storage Capacity</b>		50.00%	24.32%
<b>Required Storage (metadata) &amp; Hot Spares</b>		0%	0%
<b>Configured Storage Capacity</b>			48.65%
<b>Global Storage Overhead</b>			1.47%
<b>Unused Storage</b>	0.00%	0.00%	49.87%

The Addressable Storage Capacity and Configured Storage Capacity contained no Unused Storage. The Physical Storage Capacity contained 49.87% (980.81 GB) of Unused Storage.

## Logical Volume Capacity and ASU Mapping

### Clause 9.2.4.6.2

A table illustrating the capacity of each ASU and the mapping of Logical Volumes to ASUs shall be provided in the FDR. Logical Volumes shall be sequenced in the table from top to bottom per its position in the contiguous address space of each ASU. The capacity of each Logical Volume shall be stated. ... In conjunction with this table, the Test Sponsor shall provide a complete description of the type of data protection (see Clause 2.4.5) used on each Logical Volume.

Logical Volume Capacity and Mapping		
ASU-1 (215.29 GB)	ASU-2 (215.29 GB)	ASU-3 (47.84 GB)
1 Logical Volume 215.29 GB per Logical Volume (215.29 GB used/Logical Volume)	1 Logical Volume 215.29 GB per Logical Volume (215.29 GB used/Logical Volume)	1 Logical Volume 47.84 GB per Logical Volume (47.84 GB used/Logical Volume)

The Data Protection Level used for all Logical Volumes was Mirroring as described on page 11. See “ASU Configuration” in the [IOPS Test Results File](#) for more detailed configuration information.

## **SPC-1 BENCHMARK EXECUTION RESULTS**

### **Definitions**

**Average Response Time:** The sum of the Response Times for all Measured I/O Requests divided by the total number of Measured I/O Requests.

**I/O Request Throughput:** The total number of Measured I/O requests in an SPC-1 Test Run divided by the duration of the Measurement Interval in seconds.

**Measurement Interval:** The finite and contiguous time period, after the Tested Storage Configuration (TSC) has reached Steady State, when data is collected by a Test Sponsor to generate an SPC-1 test result or support an SPC-1 test result.

**Steady State:** The consistent and sustainable throughput of the TSC. During this period the load presented to the TSC by the Workload Generator is constant. Comment: Steady State is achieved only after caches in the TSC have filled and as a result the I/O Request throughput of the TSC has stabilized.

**Test:** A collection of Test Phases or Test Runs sharing a common objective.

**Test Phase:** A collection of one or more SPC-1 Test Runs sharing a common objective and intended to be run in a specific sequence.

**Test Run:** The execution of SPC-1 for the purpose of producing or supporting an SPC-1 test result. SPC-1 Test Runs may have a finite and measured Ramp-Up period, Start-Up period, Shut-Down period, and Ramp-Down period as illustrated in the Figure 5-1 below. All SPC-1 Test Runs shall have a Steady State period and a Measurement Interval.

### **Sustainability Test Phase**

#### Clause 5.4.2.1

The Sustainability Test Phase consists of one Test Run at the 100% load point with a Measurement Interval of three (3) hours. The intent is to demonstrate a sustained maximum I/O Request Throughput as well as insuring the Tested Storage Configuration (TSC) has reached steady state prior to measuring the maximum I/O Request Throughput (SPC-1™ IOPS).

The reported I/O Request Throughput of the Sustainability Test Run must be within 5% of the reported SPC-1™ IOPS primary metric. The Average Response Time measured in Sustainability Test Run cannot exceed thirty (30) milliseconds.

#### Clause 9.2.4.7.1

For the Sustainability Test Phase the FDR shall contain:

1. A Data Rate Distribution (data table and graph).
2. I/O Request Throughput Distribution (data table and graph).
3. The human readable Test Run Results File produced by the Workload Generator.
4. A listing or screen image of all input parameters supplied to the Workload Generator.
5. The Measured Intensity Multiplier for each I/O stream.
6. The variability of the Measured Intensity Multiplier, as defined in Clause 5.3.13.3.

## SPC-1 Workload Generator Input Parameters

The SPC-1 Workload Generator input parameters for the Sustainability, IOPS, and Response Time Ramp Test Runs are listed below.

```
java -Xmx64m -Xms64m metrics -b 242 -s 1200
```

## Sustainability Test Results File

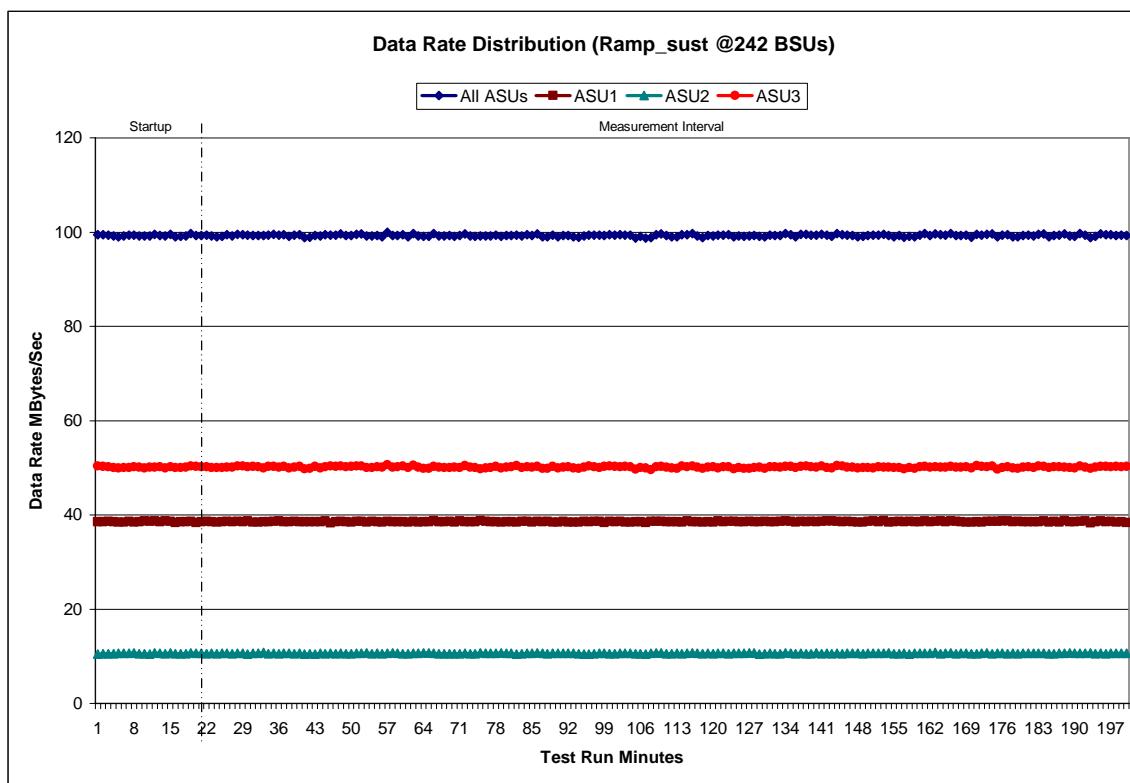
A link to the test results file generated from the Sustainability Test Run is listed below.

[Sustainability Test Results File](#)

**Sustainability - Data Rate Distribution Data (MB/second)**

Ramp-Up/Start-Up				Start	Stop	Interval	Duration	Measurement Interval							
				23:18:22	23:38:22	0-19	0:20:00					23:38:22	2:38:22	20-199	3:00:00
Interval	All ASUs	ASU1	ASU2	ASU3	Interval	All ASUs	ASU1	ASU2	ASU3	Interval	All ASUs	ASU1	ASU2	ASU3	
0	99.4	38.54	10.45	50.41	67	99.16	38.55	10.55	50.06	134	99.44	38.58	10.58	50.27	
1	99.4	38.53	10.58	50.31	68	99.25	38.64	10.57	50.04	135	99.01	38.48	10.53	49.99	
2	99.3	38.63	10.53	50.18	69	99.10	38.48	10.52	50.09	136	99.54	38.65	10.62	50.27	
3	99.2	38.56	10.58	50.03	70	99.23	38.67	10.54	50.02	137	99.49	38.56	10.53	50.40	
4	99.0	38.46	10.61	49.95	71	99.64	38.54	10.62	50.48	138	99.33	38.60	10.58	50.16	
5	99.2	38.48	10.67	50.01	72	99.21	38.54	10.55	50.12	139	99.35	38.57	10.70	50.08	
6	99.4	38.66	10.66	50.06	73	99.11	38.52	10.55	50.04	140	99.51	38.60	10.58	50.33	
7	99.3	38.47	10.67	50.18	74	99.18	38.78	10.68	49.72	141	99.31	38.69	10.64	49.98	
8	99.2	38.53	10.51	50.14	75	99.16	38.62	10.64	49.90	142	99.12	38.72	10.50	49.89	
9	99.2	38.70	10.54	49.95	76	99.18	38.53	10.58	50.06	143	99.70	38.62	10.65	50.43	
10	99.2	38.66	10.50	50.07	77	99.36	38.51	10.60	50.26	144	99.46	38.52	10.58	50.37	
11	99.6	38.74	10.67	50.14	78	99.12	38.48	10.67	49.97	145	99.35	38.64	10.58	50.12	
12	99.3	38.52	10.61	50.17	79	99.22	38.50	10.65	50.08	146	99.24	38.54	10.63	50.08	
13	99.2	38.70	10.51	49.95	80	99.31	38.49	10.66	50.16	147	99.03	38.48	10.59	49.96	
14	99.6	38.65	10.71	50.21	81	99.39	38.44	10.50	50.45	148	99.06	38.49	10.54	50.04	
15	99.0	38.38	10.58	50.03	82	99.21	38.60	10.57	50.04	149	99.27	38.63	10.60	50.03	
16	99.1	38.51	10.55	50.00	83	99.45	38.64	10.59	50.22	150	99.31	38.72	10.61	49.97	
17	99.2	38.57	10.56	50.07	84	99.23	38.44	10.64	50.15	151	99.33	38.51	10.67	50.15	
18	99.7	38.65	10.70	50.38	85	99.59	38.59	10.71	50.29	152	99.52	38.76	10.62	50.14	
19	99.2	38.39	10.59	50.27	86	99.04	38.53	10.67	49.84	153	99.26	38.44	10.72	50.10	
20	99.3	38.52	10.60	50.15	87	99.01	38.61	10.52	49.89	154	99.05	38.51	10.51	50.03	
21	99.3	38.58	10.53	50.20	88	99.32	38.41	10.65	50.26	155	99.25	38.66	10.55	50.04	
22	99.2	38.52	10.65	50.04	89	98.98	38.42	10.64	49.92	156	98.91	38.54	10.61	49.76	
23	99.0	38.45	10.54	49.99	90	99.28	38.60	10.61	50.07	157	99.12	38.63	10.49	50.00	
24	99.1	38.51	10.59	50.02	91	99.30	38.48	10.60	50.22	158	99.04	38.50	10.64	49.89	
25	99.4	38.64	10.63	50.14	92	98.99	38.49	10.59	49.92	159	99.33	38.51	10.59	50.23	
26	99.2	38.51	10.57	50.13	93	98.91	38.48	10.54	49.89	160	99.67	38.75	10.63	50.30	
27	99.5	38.59	10.60	50.33	94	99.18	38.60	10.47	50.11	161	99.29	38.55	10.65	50.09	
28	99.4	38.49	10.61	50.35	95	99.34	38.55	10.45	50.34	162	99.59	38.61	10.78	50.20	
29	99.4	38.70	10.49	50.18	96	99.34	38.62	10.55	50.16	163	99.40	38.73	10.52	50.15	
30	99.3	38.41	10.63	50.25	97	99.31	38.66	10.60	50.06	164	99.33	38.57	10.62	50.14	
31	99.3	38.44	10.65	50.17	98	99.29	38.34	10.64	50.31	165	99.71	38.72	10.69	50.29	
32	99.3	38.54	10.77	49.96	99	99.47	38.60	10.52	50.35	166	99.27	38.63	10.57	50.07	
33	99.4	38.53	10.57	50.27	100	99.34	38.49	10.57	50.28	167	99.22	38.54	10.60	50.08	
34	99.5	38.64	10.63	50.24	101	99.44	38.61	10.61	50.22	168	99.32	38.48	10.60	50.24	
35	99.4	38.67	10.56	50.12	102	99.34	38.43	10.64	50.28	169	98.89	38.41	10.54	49.93	
36	99.4	38.54	10.59	50.32	103	99.31	38.47	10.62	50.22	170	99.56	38.55	10.52	50.50	
37	99.1	38.56	10.61	49.93	104	98.77	38.53	10.58	49.65	171	99.35	38.45	10.64	50.25	
38	99.3	38.63	10.55	50.13	105	99.13	38.55	10.53	50.05	172	99.54	38.63	10.69	50.22	
39	99.4	38.54	10.59	50.28	106	98.78	38.37	10.48	49.94	173	99.57	38.64	10.53	50.40	
40	98.8	38.57	10.45	49.80	107	98.82	38.61	10.62	49.59	174	98.99	38.66	10.61	49.72	
41	98.9	38.54	10.53	49.84	108	99.46	38.57	10.69	50.19	175	99.34	38.68	10.66	50.00	
42	99.3	38.54	10.45	50.27	109	99.57	38.62	10.68	50.27	176	99.41	38.67	10.57	50.17	
43	99.1	38.56	10.61	49.97	110	99.25	38.57	10.54	50.14	177	99.04	38.49	10.64	49.91	
44	99.4	38.69	10.51	50.23	111	98.97	38.52	10.50	49.95	178	99.03	38.64	10.57	49.81	
45	99.3	38.30	10.65	50.40	112	99.05	38.56	10.65	49.84	179	99.26	38.50	10.63	50.13	
46	99.3	38.52	10.57	50.25	113	99.40	38.44	10.56	50.40	180	99.32	38.50	10.60	50.22	
47	99.6	38.65	10.63	50.34	114	99.47	38.66	10.61	50.20	181	99.21	38.57	10.64	50.00	
48	99.3	38.56	10.57	50.15	115	99.69	38.54	10.74	50.41	182	99.55	38.53	10.64	50.38	
49	99.3	38.44	10.56	50.26	116	99.22	38.50	10.60	50.12	183	99.60	38.70	10.60	50.30	
50	99.5	38.59	10.59	50.34	117	98.85	38.46	10.52	49.88	184	99.01	38.47	10.55	49.99	
51	99.6	38.58	10.61	50.39	118	99.27	38.55	10.59	50.14	185	99.29	38.58	10.54	50.17	
52	99.2	38.42	10.71	50.05	119	99.19	38.47	10.53	50.19	186	99.31	38.44	10.64	50.23	
53	99.1	38.62	10.54	49.98	120	99.31	38.74	10.63	49.94	187	99.57	38.80	10.64	50.13	
54	99.3	38.49	10.59	50.20	121	99.37	38.51	10.64	50.22	188	99.20	38.53	10.68	50.00	
55	99.0	38.43	10.50	50.12	122	99.41	38.66	10.53	50.22	189	99.08	38.50	10.65	49.94	
56	99.9	38.66	10.63	50.66	123	99.04	38.64	10.64	49.76	190	99.67	38.63	10.66	50.38	
57	99.3	38.49	10.71	50.09	124	99.16	38.56	10.59	50.01	191	99.33	38.66	10.60	50.07	
58	99.3	38.54	10.59	50.15	125	99.06	38.57	10.65	49.84	192	98.83	38.29	10.68	49.86	
59	99.4	38.52	10.56	50.34	126	99.19	38.65	10.68	49.86	193	99.12	38.53	10.50	50.09	
60	99.0	38.45	10.55	50.00	127	99.26	38.52	10.68	50.06	194	99.63	38.68	10.63	50.32	
61	99.7	38.61	10.62	50.50	128	99.09	38.51	10.49	50.08	195	99.43	38.55	10.57	50.31	
62	99.2	38.46	10.62	50.08	129	98.98	38.60	10.57	49.81	196	99.44	38.59	10.67	50.19	
63	99.1	38.57	10.70	49.84	130	99.33	38.50	10.66	50.17	197	99.30	38.44	10.61	50.25	
64	99.1	38.50	10.70	49.88	131	99.28	38.54	10.54	50.21	198	99.35	38.50	10.67	50.18	
65	99.7	38.80	10.59	50.30	132	99.29	38.66	10.55	50.08	199	99.31	38.38	10.66	50.26	
66	99.2	38.57	10.54	50.10	133	99.69	38.68	10.69	50.32						

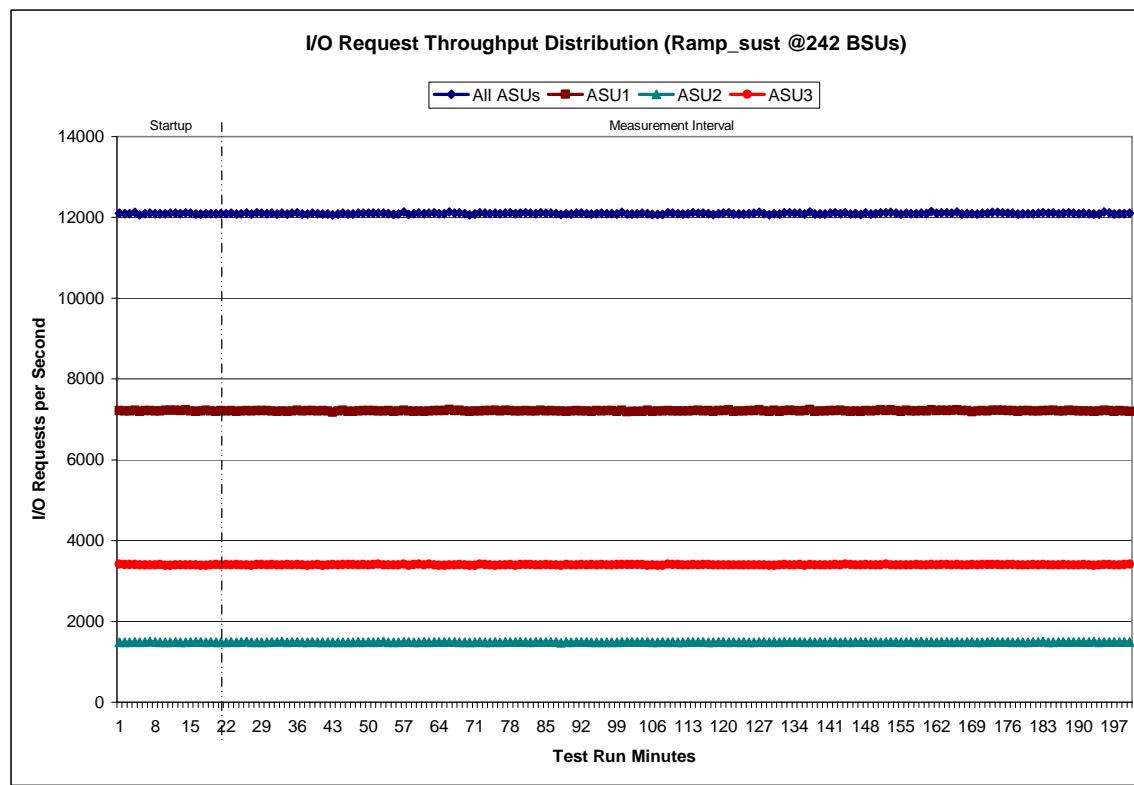
## Sustainability - Data Rate Distribution Graph



## **Sustainability - I/O Request Throughput Distribution Data**

<b>Ramp-Up/Start-Up</b>		<b>Start</b>	<b>Stop</b>	<b>Interval</b>	<b>Duration</b>											
<b>Measurement Interval</b>		23:18:22	23:38:22	0-19	0:20:00											
		23:38:22	2:38:22	20-199	3:00:00											
Interval	All ASUs	ASU1	ASU2	ASU3		Interval	All ASUs	ASU1	ASU2	ASU3		Interval	All ASUs	ASU1	ASU2	ASU3
0	12109.78	7213.62	1482.55	3413.62		67	12119.35	7229.78	1483.32	3406.25		134	12104.47	7207.32	1492.43	3404.72
1	12098.52	7205.63	1484.87	3408.02		68	12097.17	7210.05	1485.70	3401.42		135	12084.38	7215.57	1481.13	3387.68
2	12098.10	7209.08	1483.03	3405.98		69	12069.15	7197.08	1484.23	3387.83		136	12133.57	7242.35	1488.68	3402.53
3	12126.58	7228.50	1492.30	3405.78		70	12084.28	7209.03	1484.33	3390.92		137	12084.28	7200.80	1485.68	3397.80
4	12067.37	7192.75	1482.58	3392.03		71	12117.02	7211.10	1489.85	3416.07		138	12088.33	7202.85	1492.62	3392.87
5	12098.13	7213.48	1491.32	3393.33		72	12109.10	7213.37	1484.75	3410.98		139	12089.83	7209.25	1485.28	3395.30
6	12108.47	7217.07	1497.05	3394.35		73	12097.78	7211.77	1486.58	3399.43		140	12108.50	7216.70	1491.32	3400.48
7	12096.32	7201.75	1495.25	3399.32		74	12107.95	7229.30	1489.37	3389.28		141	12115.83	7221.73	1487.53	3406.57
8	12094.80	7207.15	1482.07	3405.58		75	12095.60	7209.38	1486.42	3399.80		142	12096.50	7221.90	1482.80	3391.80
9	12096.32	7225.40	1481.98	3388.93		76	12107.65	7222.47	1492.20	3392.98		143	12119.92	7209.60	1490.75	3419.57
10	12101.48	7228.03	1482.85	3390.60		77	12112.53	7213.35	1490.32	3408.87		144	12086.35	7195.02	1486.52	3404.82
11	12104.00	7222.88	1488.05	3393.07		78	12092.72	7209.18	1492.78	3390.75		145	12094.12	7206.98	1487.08	3400.05
12	12098.90	7214.92	1484.23	3399.75		79	12106.88	7211.32	1492.42	3403.15		146	12079.55	7194.85	1490.85	3393.85
13	12114.90	7238.28	1484.17	3392.45		80	12116.38	7215.13	1491.07	3410.18		147	12110.82	7216.77	1488.92	3405.13
14	12101.67	7211.65	1488.72	3401.30		81	12102.98	7211.40	1486.35	3405.23		148	12086.55	7201.63	1486.62	3398.30
15	12083.85	7199.37	1491.20	3393.28		82	12091.65	7206.25	1487.08	3398.32		149	12096.75	7214.57	1489.58	3392.60
16	12082.00	7210.92	1488.95	3382.13		83	12118.65	7226.22	1492.67	3399.77		150	12118.63	7236.35	1485.58	3396.70
17	12095.13	7222.72	1483.12	3389.30		84	12101.18	7208.38	1486.70	3406.10		151	12116.82	7215.62	1487.73	3413.47
18	12097.30	7201.62	1494.50	3401.18		85	12101.55	7214.35	1491.77	3395.43		152	12124.32	7232.68	1494.28	3397.35
19	12090.60	7200.87	1481.85	3407.88		86	12091.43	7207.12	1486.88	3397.43		153	12105.38	7212.78	1491.15	3401.45
20	12098.72	7217.57	1485.22	3395.93		87	12073.27	7209.50	1476.15	3387.62		154	12080.27	7197.13	1482.23	3400.90
21	12096.98	7207.88	1484.82	3404.28		88	12095.25	7194.60	1492.48	3408.17		155	12108.53	7222.10	1488.10	3398.33
22	12105.37	7213.00	1494.72	3397.65		89	12087.98	7208.33	1482.97	3396.68		156	12095.83	7209.52	1487.03	3399.28
23	12082.58	7199.72	1480.18	3402.68		90	12104.37	7219.98	1490.73	3393.65		157	12097.70	7206.82	1485.23	3405.65
24	12094.30	7204.50	1488.63	3401.17		91	12101.20	7205.28	1487.17	3408.75		158	12106.25	7214.53	1498.20	3393.52
25	12112.90	7218.15	1498.70	3396.05		92	12091.83	7205.13	1490.53	3396.17		159	12094.18	7207.55	1485.68	3400.95
26	12086.33	7211.08	1484.33	3390.92		93	12080.03	7199.87	1477.92	3402.25		160	12141.97	7236.32	1495.03	3410.62
27	12110.30	7215.02	1485.67	3409.62		94	12096.02	7219.23	1481.42	3395.37		161	12103.80	7220.00	1485.50	3398.30
28	12106.62	7215.67	1483.40	3407.55		95	12101.40	7207.72	1483.77	3409.92		162	12116.80	7221.92	1489.30	3405.58
29	12098.53	7216.52	1483.52	3398.50		96	12098.97	7218.12	1486.30	3394.55		163	12116.03	7218.68	1486.98	3410.37
30	12102.75	7203.18	1491.97	3407.60		97	12094.38	7217.00	1484.75	3392.63		164	12106.47	7222.88	1482.72	3400.87
31	12086.17	7195.87	1494.68	3395.62		98	12085.77	7200.20	1480.88	3404.68		165	12137.15	7232.65	1493.72	3410.78
32	12100.77	7209.30	1499.48	3391.98		99	12127.62	7228.90	1491.22	3407.50		166	12088.92	7211.93	1484.87	3392.12
33	12088.82	7199.93	1481.18	3407.70		100	12084.38	7187.67	1488.43	3408.28		167	12095.32	7213.92	1488.72	3392.68
34	12104.83	7210.53	1494.77	3399.53		101	12085.12	7192.32	1487.78	3405.02		168	12090.48	7190.67	1491.35	3408.47
35	12119.47	7223.72	1493.30	3402.45		102	12097.15	7197.12	1489.38	3410.65		169	12086.85	7206.47	1485.32	3395.07
36	12085.78	7203.50	1480.65	3401.63		103	12101.70	7200.58	1494.28	3406.83		170	12103.25	7216.97	1483.72	3402.57
37	12089.30	7218.13	1484.55	3386.62		104	12096.15	7222.12	1488.85	3385.18		171	12100.73	7207.77	1486.82	3406.15
38	12104.85	7216.28	1488.68	3399.88		105	12077.90	7199.72	1481.17	3397.02		172	12126.00	7222.70	1493.55	3409.75
39	12092.40	7203.73	1483.07	3405.60		106	12075.50	7203.43	1482.08	3389.98		173	12123.53	7227.50	1486.77	3409.27
40	12085.32	7212.67	1482.92	3389.73		107	12077.80	7204.65	1490.70	3382.45		174	12114.35	7225.95	1494.50	3393.90
41	12080.18	7206.88	1479.63	3393.67		108	12116.83	7217.93	1482.50	3416.40		175	12108.32	7215.43	1490.92	3401.97
42	12066.10	7178.63	1483.73	3403.73		109	12102.35	7206.82	1493.30	3402.23		176	12105.72	7218.48	1484.40	3402.83
43	12084.92	7206.57	1486.50	3391.85		110	12094.98	7210.75	1479.73	3404.50		177	12082.33	7198.50	1490.18	3393.65
44	12109.77	7225.52	1477.92	3406.33		111	12083.37	7208.78	1479.02	3395.57		178	12095.62	7216.58	1482.42	3396.62
45	12088.63	7192.98	1484.87	3410.78		112	12097.37	7209.72	1495.38	3392.27		179	12095.18	7213.22	1486.55	3395.42
46	12088.70	7199.80	1483.13	3405.77		113	12113.02	7215.72	1487.58	3409.72		180	12099.68	7201.90	1491.40	3406.38
47	12103.63	7211.37	1491.48	3400.78		114	12108.97	7225.23	1489.32	3394.42		181	12105.45	7210.52	1493.45	3401.48
48	12106.12	7217.73	1484.40	3403.98		115	12109.50	7209.85	1493.97	3405.68		182	12119.32	7213.77	1496.82	3408.73
49	12100.90	7215.10	1488.05	3397.75		116	12098.78	7213.77	1482.98	3402.03		183	12104.52	7220.75	1486.15	3397.62
50	12108.90	7214.87	1484.22	3409.82		117	12079.48	7197.83	1483.18	3398.47		184	12111.20	7223.45	1486.23	3401.52
51	12107.38	7204.72	1488.40	3414.27		118	12099.17	7212.55	1492.02	3394.60		185	12095.57	7206.60	1491.82	3397.15
52	12105.23	7209.98	1499.07	3396.18		119	12101.65	7217.07	1486.77	3397.82		186	12104.10	7207.30	1493.57	3403.23
53	12099.90	7218.55	1482.52	3398.83		120	12114.07	7234.15	1481.02	3398.90		187	12110.35	7223.77	1493.85	3392.73
54	12074.83	7198.07	1483.07	3393.70		121	12086.58	7200.90	1486.83	3398						

## Sustainability - I/O Request Throughput Distribution Graph



## Sustainability - Measured Intensity Multiplier and Coefficient of Variation

	ASU1-1	ASU1-2	ASU1-3	ASU1-4	ASU2-1	ASU2-2	ASU2-3	ASU3-1
IM	0.0350	0.2810	0.0700	0.2100	0.0180	0.0700	0.0350	0.2810
MIM	.0350	.2810	.0700	.2100	.0180	.0700	.0350	.2810
COV	.0061	.0018	.0041	.0022	.0087	.0042	.0059	.0019

**IM - Intensity Multiplier:** The ratio of I/Os for each I/O stream relative to the total I/Os for all I/O streams (ASU1-1 – ASU3-1) as required by the benchmark specification.

**MIM - Measured Intensity Multiplier:** The Measured Intensity Multiplier represents the ratio of measured I/Os for each I/O stream relative to the total I/Os measured for all I/O streams (ASU1-1 – ASU3-1). This value may differ from the corresponding Expected Intensity Multiplier by no more than 5%.

**COV - Coefficient of Variation:** This measure of variation for the Measured Intensity Multiplier cannot exceed 0.2.

## IOPS Test Phase

### Clause 5.4.2.2

*The IOPS Test Phase consists of one Test Run at the 100% load point with a Measurement Interval of ten (10) minutes. The IOPS Test Phase immediately follows the Sustainability Test Phase without any interruption or manual intervention.*

*The IOPS Test Run generates the SPC-1 IOPS™ primary metric, which is computed as the I/O Request Throughput for the Measurement Interval of the IOPS Test Run.*

*The Average Response Time is computed for the IOPS Test Run and cannot exceed 30 milliseconds. If the Average Response Time exceeds the 30 millisecond constraint, the measurement is invalid.*

### Clause 9.2.4.7.2

*For the IOPS Test Phase the FDR shall contain:*

1. *I/O Request Throughput Distribution (data and graph).*
2. *A Response Time Frequency Distribution.*
3. *An Average Response Time Distribution.*
4. *The human readable Test Run Results File produced by the Workload Generator.*
5. *A listing or screen image of all input parameters supplied to the Workload Generator.*
6. *The total number of I/O Requests completed in the Measurement Interval as well as the number of I/O Requests with a Response Time less than or equal to 30 milliseconds and the number of I/O Requests with a Response Time greater than 30 milliseconds.*

## SPC-1 Workload Generator Input Parameters

The SPC-1 Workload Generator input parameters for the Sustainability, IOPS, and Response Time Ramp Test Runs are listed below.

```
java -Xmx64m -Xms64m metrics -b 242 -s 1200
```

## IOPS Test Results File

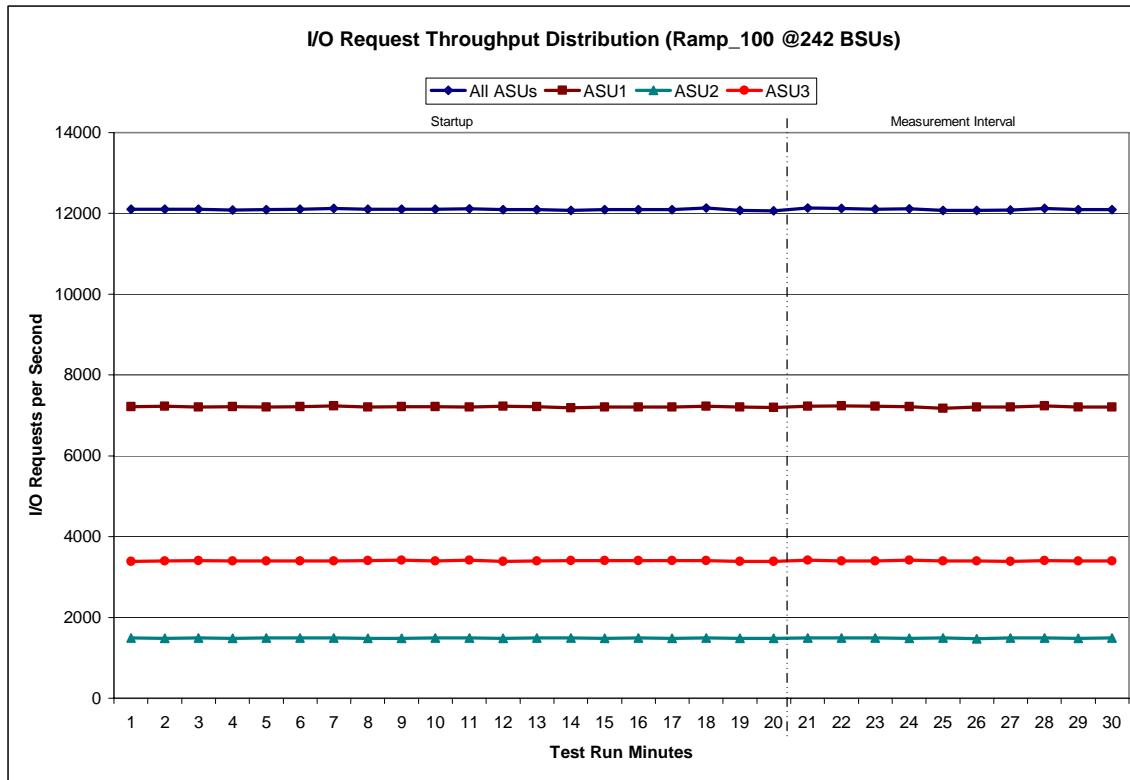
A link to the test results file generated from the IOPS Test Run is listed below.

[IOPS Test Results File](#)

### IOPS Test Run – I/O Request Throughput Distribution Data

<b>242 BSUs</b>	<b>Start</b>	<b>Stop</b>	<b>Interval</b>	<b>Duration</b>
<i>Start-Up/Ramp-Up</i>	2:38:29	2:58:30	0-19	0:20:01
<i>Measurement Interval</i>	2:58:30	3:08:30	20-29	0:10:00
<b>60 second intervals</b>	<b>All ASUs</b>	<b>ASU1</b>	<b>ASU2</b>	<b>ASU3</b>
<b>0</b>	12,102.33	7,220.27	1,493.33	3,388.73
<b>1</b>	12,107.68	7,223.72	1,484.12	3,399.85
<b>2</b>	12,107.65	7,208.40	1,495.10	3,404.15
<b>3</b>	12,086.73	7,212.35	1,476.70	3,397.68
<b>4</b>	12,095.23	7,208.00	1,489.75	3,397.48
<b>5</b>	12,106.13	7,216.30	1,492.25	3,397.58
<b>6</b>	12,124.55	7,238.17	1,490.00	3,396.38
<b>7</b>	12,100.32	7,205.07	1,484.18	3,411.07
<b>8</b>	12,109.12	7,215.32	1,478.50	3,415.30
<b>9</b>	12,102.78	7,214.05	1,489.03	3,399.70
<b>10</b>	12,114.25	7,210.28	1,488.92	3,415.05
<b>11</b>	12,098.57	7,222.70	1,485.78	3,390.08
<b>12</b>	12,099.72	7,213.40	1,487.32	3,399.00
<b>13</b>	12,079.77	7,184.15	1,491.28	3,404.33
<b>14</b>	12,090.58	7,203.08	1,482.02	3,405.48
<b>15</b>	12,097.77	7,204.03	1,490.80	3,402.93
<b>16</b>	12,098.40	7,211.05	1,477.13	3,410.22
<b>17</b>	12,131.13	7,228.05	1,493.02	3,410.07
<b>18</b>	12,075.23	7,202.12	1,482.37	3,390.75
<b>19</b>	12,068.70	7,200.25	1,482.45	3,386.00
<b>20</b>	12,131.45	7,226.80	1,490.08	3,414.57
<b>21</b>	12,126.27	7,234.48	1,494.18	3,397.60
<b>22</b>	12,109.45	7,221.75	1,487.57	3,400.13
<b>23</b>	12,111.22	7,218.00	1,479.37	3,413.85
<b>24</b>	12,071.92	7,178.73	1,496.65	3,396.53
<b>25</b>	12,079.57	7,211.08	1,472.38	3,396.10
<b>26</b>	12,083.10	7,205.33	1,489.33	3,388.43
<b>27</b>	12,129.38	7,232.85	1,488.40	3,408.13
<b>28</b>	12,092.78	7,207.57	1,483.62	3,401.60
<b>29</b>	12,094.52	7,209.62	1,487.07	3,397.83
<b>Average</b>	12,102.97	7,214.62	1,486.87	3,401.48

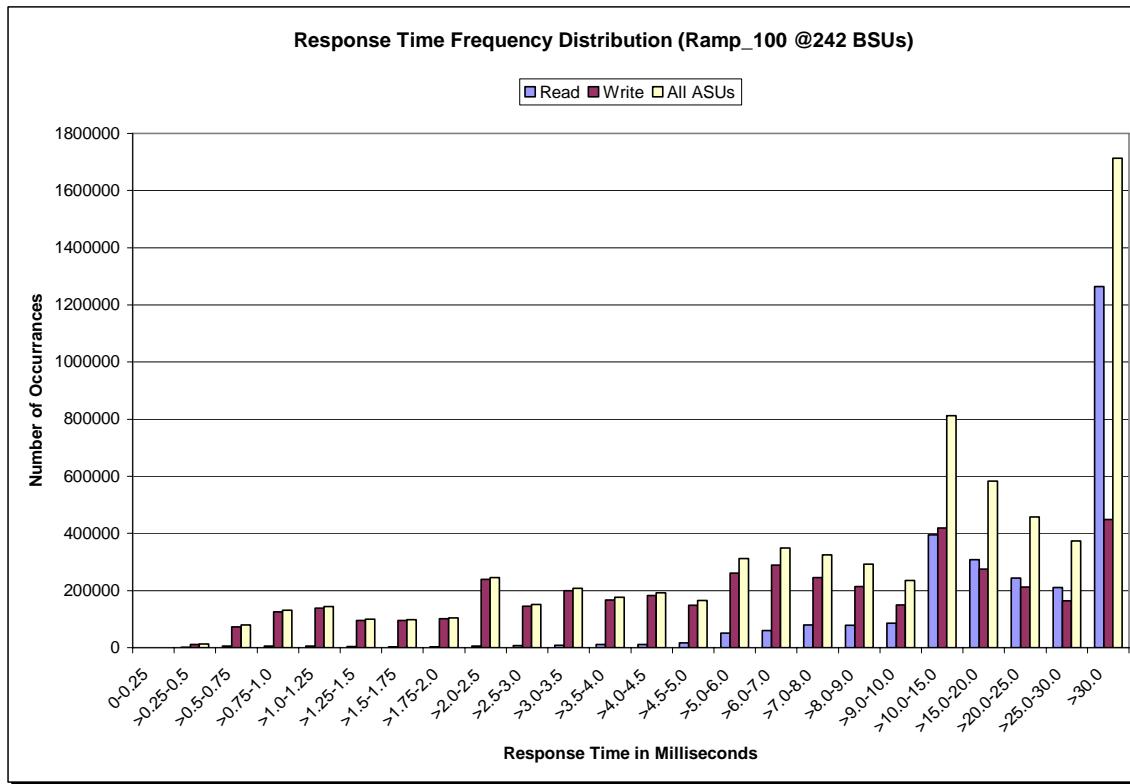
## IOPS Test Run - I/O Request Throughput Distribution Graph



## IOPS Test Run – Response Time Frequency Distribution Data

Response Time (ms)	0-0.25	>0.25-0.5	>0.5-0.75	>0.75-1.0	>1.0-1.25	>1.25-1.5	>1.5-1.75	>1.75-2.0
Read	2	1,894	6,093	6,297	5,590	4,476	3,483	2,675
Write	1	11,321	73,137	124,952	138,808	95,257	95,534	100,661
All ASUs	3	13,215	79,230	131,249	144,398	99,733	99,017	103,336
ASU1	1	1,828	10,503	24,899	41,154	31,163	30,723	33,196
ASU2	2	3,374	14,931	20,697	18,560	12,173	12,404	12,856
ASU3	-	8,013	53,796	85,653	84,684	56,397	55,890	57,284
Response Time (ms)	>2.0-2.5	>2.5-3.0	>3.0-3.5	>3.5-4.0	>4.0-4.5	>4.5-5.0	>5.0-6.0	>6.0-7.0
Read	5,859	6,506	8,217	10,714	10,995	16,604	50,804	59,655
Write	239,600	144,891	199,702	166,300	182,066	148,204	260,649	288,917
All ASUs	245,459	151,397	207,919	177,014	193,061	164,808	311,453	348,572
ASU1	84,694	41,463	53,253	42,432	44,489	45,261	91,870	104,877
ASU2	29,494	20,802	29,614	26,163	29,140	25,260	50,867	58,323
ASU3	131,271	89,132	125,052	108,419	119,432	94,287	168,716	185,372
Response Time (ms)	>7.0-8.0	>8.0-9.0	>9.0-10.0	>10.0-15.0	>15.0-20.0	>20.0-25.0	>25.0-30.0	>30.0
Read	80,235	77,991	85,498	394,492	308,040	244,330	210,301	1,264,338
Write	245,328	213,556	149,015	418,431	274,560	212,654	163,795	449,200
All ASUs	325,563	291,547	234,513	812,923	582,600	456,984	374,096	1,713,538
ASU1	110,103	103,296	96,936	486,203	442,847	396,236	342,673	1,668,554
ASU2	58,490	54,471	47,804	165,005	92,001	46,573	24,970	38,128
ASU3	156,970	133,780	89,773	161,715	47,752	14,175	6,453	6,856

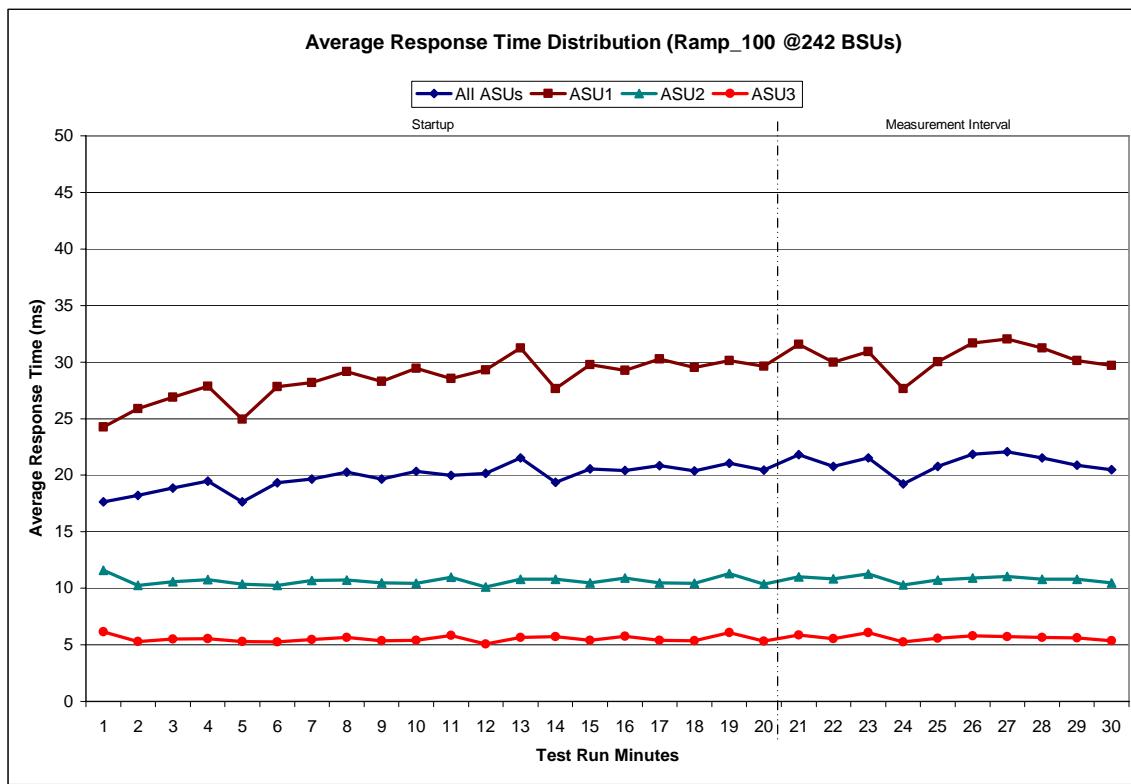
## IOPS Test Run -Response Time Frequency Distribution Graph



**IOPS Test Run – Average Response Time (ms) Distribution Data**

<b>242 BSUs</b>	<b>Start</b>	<b>Stop</b>	<b>Interval</b>	<b>Duration</b>
<i>Start-Up/Ramp-Up</i>	2:38:29	2:58:30	0-19	0:20:01
<i>Measurement Interval</i>	2:58:30	3:08:30	20-29	0:10:00
<b>60 second intervals</b>	<b>All ASUs</b>	<b>ASU1</b>	<b>ASU2</b>	<b>ASU3</b>
<b>0</b>	17.62	24.25	11.59	6.17
<b>1</b>	18.20	25.90	10.27	5.30
<b>2</b>	18.87	26.89	10.60	5.51
<b>3</b>	19.49	27.84	10.76	5.54
<b>4</b>	17.62	24.93	10.36	5.30
<b>5</b>	19.33	27.84	10.25	5.24
<b>6</b>	19.67	28.18	10.67	5.49
<b>7</b>	20.27	29.15	10.73	5.66
<b>8</b>	19.66	28.30	10.48	5.37
<b>9</b>	20.35	29.44	10.45	5.39
<b>10</b>	19.97	28.53	10.96	5.83
<b>11</b>	20.16	29.30	10.12	5.08
<b>12</b>	21.53	31.23	10.81	5.65
<b>13</b>	19.37	27.63	10.78	5.71
<b>14</b>	20.54	29.76	10.49	5.40
<b>15</b>	20.39	29.27	10.89	5.77
<b>16</b>	20.85	30.29	10.47	5.40
<b>17</b>	20.37	29.50	10.43	5.37
<b>18</b>	21.06	30.13	11.30	6.07
<b>19</b>	20.44	29.61	10.35	5.34
<b>20</b>	21.81	31.57	11.02	5.86
<b>21</b>	20.77	29.97	10.83	5.55
<b>22</b>	21.54	30.93	11.26	6.07
<b>23</b>	19.22	27.66	10.28	5.27
<b>24</b>	20.76	30.03	10.74	5.59
<b>25</b>	21.86	31.66	10.90	5.80
<b>26</b>	22.08	32.05	11.04	5.72
<b>27</b>	21.54	31.23	10.81	5.66
<b>28</b>	20.86	30.14	10.79	5.60
<b>29</b>	20.50	29.70	10.48	5.36
<b>Average</b>	21.09	30.49	10.82	5.65

### IOPS Test Run - Average Response Time (ms) Distribution Graph



### IOPS Test Run – I/O Request Information

I/O Requests Completed in the Measurement Interval	I/O Requests Completed with Response Time = or < 30 ms	I/O Requests Completed with Response Time > 30 ms
7,261,628	5,548,090	1,713,538

### IOPS Test Run – Measured Intensity Multiplier and Coefficient of Variation

	ASU1-1	ASU1-2	ASU1-3	ASU1-4	ASU2-1	ASU2-2	ASU2-3	ASU3-1
IM	0.0350	0.2810	0.0700	0.2100	0.0180	0.0700	0.0350	0.2810
MIM	.0351	.2806	.0701	.2103	.0180	.0699	.0349	.2810
COV	.0091	.0020	.0044	.0026	.0087	.0051	.0080	.0018

**IM – Intensity Multiplier:** The ratio of I/Os for each I/O stream relative to the total I/Os for all I/O streams (ASU1-1 – ASU3-1) as required by the benchmark specification.

**MIM – Measured Intensity Multiplier:** The Measured Intensity Multiplier represents the ratio of measured I/Os for each I/O stream relative to the total I/Os measured for all I/O streams (ASU1-1 – ASU3-1). This value may differ from the corresponding Expected Intensity Multiplier by no more than 5%.

**COV – Coefficient of Variation:** This measure of variation for the Measured Intensity Multiplier cannot exceed 0.2.

## Response Time Ramp Test Phase

### Clause 5.4.2.3

The Response Time Ramp Test Phase consists of five Test Runs, one each at 95%, 90%, 80%, 50%, and 10% of the load point (100%) used to generate the SPC-1 IOPS™ primary metric. Each of the five Test Runs has a Measurement Interval of ten (10) minutes. The Response Time Ramp Test Phase immediately follows the IOPS Test Phase without any interruption or manual intervention.

The five Response Time Ramp Test Runs, in conjunction with the IOPS Test Run (100%), demonstrate the relationship between Average Response Time and I/O Request Throughput for the Tested Storage Configuration (TSC) as illustrated in the response time/throughput curve on page 12.

In addition, the Average Response Time measured during the 10% Test Run is the value for the SPC-1 LRT™ primary metric. That value represents the Average Response Time of a lightly loaded TSC.

### Clause 9.2.4.7.3

The following content shall appear in the FDR for the Response Time Ramp Phase:

1. A Response Time Ramp Distribution.
2. The human readable Test Run Results File produced by the Workload Generator for each Test Run within the Response Time Ramp Test Phase.
3. For the 10% Load Level Test Run (SPC-1 LRT™ metric) an Average Response Time Distribution.
4. A listing or screen image of all input parameters supplied to the Workload Generator.

## SPC-1 Workload Generator Input Parameters

The SPC-1 Workload Generator input parameters for the Sustainability, IOPS, and Response Time Ramp Test Runs are listed below.

`java -Xmx64m -Xms64m metrics -b 242 -s 1200`

## Response Time Ramp Test Results File

A link to each test result file generated from each Response Time Ramp Test Run list listed below.

[95% Load Level](#)

[90% Load Level](#)

[80% Load Level](#)

[50% Load Level](#)

[10% Load Level](#)

### Response Time Ramp Distribution (IOPS) Data

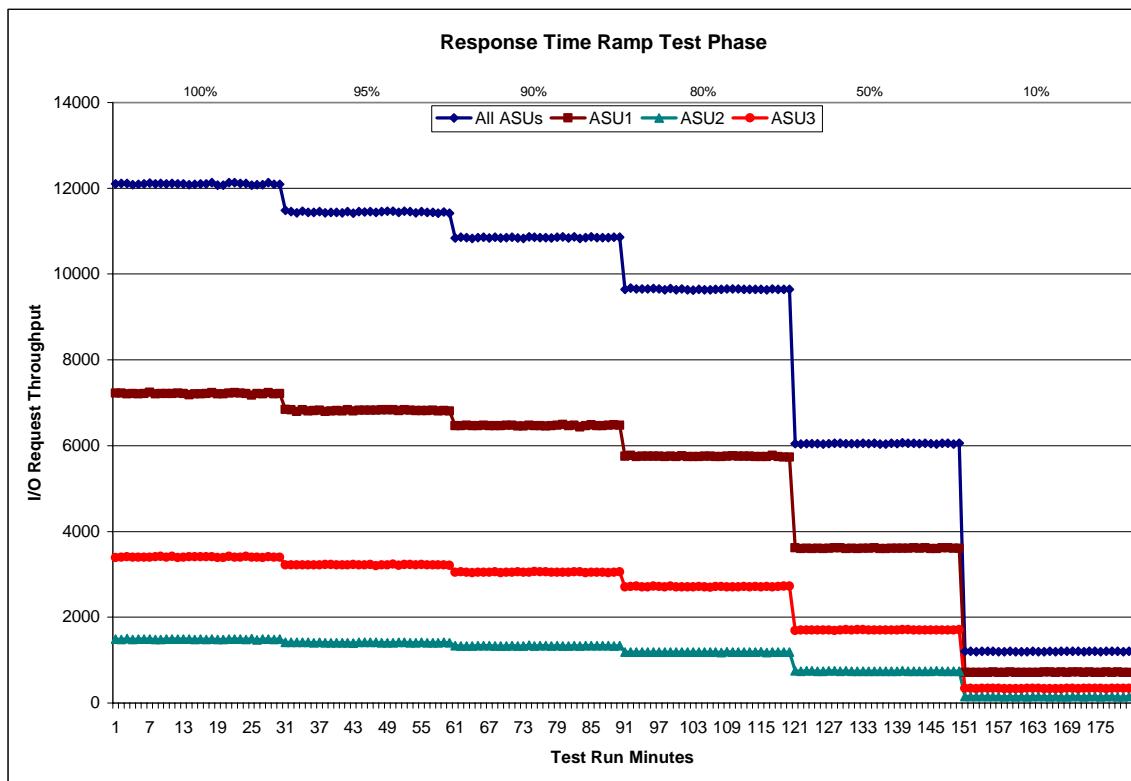
The five Test Runs that comprise the Response Time Ramp Phase are executed at 95%, 90%, 80%, 50%, and 10% of the Business Scaling Unit (BSU) load level used to produce the SPC-1 IOPS™ primary metric. The 100% BSU load level is included in the following Response Time Ramp data tables and graphs for completeness.

100% Load Level - 242 BSUs				95% Load Level - 229 BSUs					
Start	Stop	Interval	Duration	Start	Stop	Interval	Duration		
<b>Start-Up/Ramp-Up Measurement Interval</b>				<b>Start-Up/Ramp-Up Measurement Interval</b>					
(60 second intervals)				(60 second intervals)					
<b>All ASUs</b>	<b>ASU-1</b>	<b>ASU-2</b>	<b>ASU-3</b>	<b>All ASUs</b>	<b>ASU-1</b>	<b>ASU-2</b>	<b>ASU-3</b>		
0	12,102.33	7,220.27	1,493.33	3,388.73	0	11,481.97	6,847.62	1,414.82	3,219.53
1	12,107.68	7,223.72	1,484.12	3,399.85	1	11,458.33	6,833.52	1,410.33	3,214.48
2	12,107.65	7,208.40	1,495.10	3,404.15	2	11,429.90	6,800.15	1,413.47	3,216.28
3	12,086.73	7,212.35	1,476.70	3,397.68	3	11,462.58	6,832.43	1,415.13	3,215.02
4	12,095.23	7,208.00	1,489.75	3,397.48	4	11,440.22	6,808.05	1,411.03	3,221.13
5	12,106.13	7,216.30	1,492.25	3,397.58	5	11,437.40	6,818.40	1,402.85	3,216.15
6	12,124.55	7,238.17	1,490.00	3,396.38	6	11,457.77	6,825.87	1,417.52	3,214.38
7	12,100.32	7,205.07	1,484.18	3,411.07	7	11,428.10	6,799.38	1,402.70	3,226.02
8	12,109.12	7,215.32	1,478.50	3,415.30	8	11,437.43	6,805.90	1,403.08	3,228.45
9	12,102.78	7,214.05	1,489.03	3,399.70	9	11,439.87	6,813.65	1,408.58	3,217.63
10	12,114.25	7,210.28	1,488.92	3,415.05	10	11,431.52	6,809.83	1,405.30	3,216.38
11	12,098.57	7,222.70	1,485.78	3,390.08	11	11,459.03	6,830.90	1,406.02	3,222.12
12	12,099.72	7,213.40	1,487.32	3,399.00	12	11,419.42	6,802.18	1,394.28	3,222.95
13	12,079.77	7,184.15	1,491.28	3,404.33	13	11,460.77	6,827.22	1,414.53	3,219.02
14	12,090.58	7,203.08	1,482.02	3,405.48	14	11,443.92	6,819.78	1,410.82	3,213.32
15	12,097.77	7,204.03	1,490.80	3,402.93	15	11,458.60	6,823.68	1,410.12	3,224.80
16	12,098.40	7,211.05	1,477.13	3,410.22	16	11,435.72	6,821.65	1,414.30	3,199.77
17	12,131.13	7,228.05	1,493.02	3,410.07	17	11,455.02	6,832.38	1,404.17	3,218.47
18	12,075.23	7,202.12	1,482.37	3,390.75	18	11,464.33	6,835.87	1,408.18	3,220.28
19	12,068.70	7,200.25	1,482.45	3,386.00	19	11,468.93	6,835.33	1,400.10	3,233.50
20	12,131.45	7,226.80	1,490.08	3,414.57	20	11,438.57	6,815.82	1,414.23	3,208.52
21	12,126.27	7,234.48	1,494.18	3,397.60	21	11,465.70	6,829.87	1,412.28	3,223.55
22	12,109.45	7,221.75	1,487.57	3,400.13	22	11,453.85	6,823.57	1,407.65	3,222.63
23	12,111.22	7,218.00	1,479.37	3,413.85	23	11,431.35	6,815.43	1,402.15	3,213.77
24	12,071.92	7,178.73	1,496.65	3,396.53	24	11,452.30	6,816.25	1,411.57	3,224.48
25	12,079.57	7,211.08	1,472.38	3,396.10	25	11,434.80	6,815.23	1,402.05	3,217.52
26	12,083.10	7,205.33	1,489.33	3,388.43	26	11,441.73	6,822.17	1,403.08	3,216.48
27	12,129.38	7,232.85	1,488.40	3,408.13	27	11,418.45	6,801.62	1,402.70	3,214.13
28	12,092.78	7,207.57	1,483.62	3,401.60	28	11,444.65	6,818.05	1,411.85	3,214.75
29	12,094.52	7,209.62	1,487.07	3,397.83	29	11,423.03	6,808.43	1,407.58	3,207.02
<b>Average</b>	12,102.97	7,214.62	1,486.87	3,401.48	<b>Average</b>	11,440.44	6,816.64	1,407.52	3,216.29

**Response Time Ramp Distribution (IOPS) Data (Continued)**

90% Load Level - 217 BSUs				80% Load Level - 193 BSUs							
Start-Up/Ramp-Up		Start		Stop		Interval		Duration			
Measurement Interval		3:38:39	3:58:40	0-19	0:20:01	Start-Up/Ramp-Up		4:08:44	4:28:45	0-19	0:20:01
(60 second intervals)		All ASUs	ASU-1	ASU-2	ASU-3	(60 second intervals)		All ASUs	ASU-1	ASU-2	ASU-3
0	10,843.05	6,461.88	1,333.70	3,047.47		0	9,643.22	5,754.08	1,183.60	2,705.53	
1	10,857.48	6,465.70	1,333.40	3,058.38		1	9,667.48	5,767.45	1,188.77	2,711.27	
2	10,849.73	6,471.23	1,329.07	3,049.43		2	9,654.70	5,746.52	1,186.87	2,721.32	
3	10,829.22	6,462.28	1,327.48	3,039.45		3	9,648.15	5,754.55	1,186.97	2,706.63	
4	10,852.73	6,462.80	1,340.45	3,049.48		4	9,651.12	5,751.35	1,190.70	2,709.07	
5	10,861.55	6,474.12	1,337.83	3,049.60		5	9,658.67	5,751.52	1,186.38	2,720.77	
6	10,841.33	6,462.85	1,335.82	3,042.67		6	9,653.93	5,755.10	1,187.98	2,710.85	
7	10,857.47	6,465.97	1,332.87	3,058.63		7	9,636.90	5,746.93	1,182.53	2,707.43	
8	10,835.25	6,467.68	1,333.40	3,034.17		8	9,658.03	5,748.50	1,187.28	2,722.25	
9	10,847.15	6,469.30	1,329.43	3,048.42		9	9,632.43	5,743.97	1,185.02	2,703.45	
10	10,857.67	6,469.88	1,337.07	3,050.72		10	9,654.20	5,759.35	1,187.15	2,707.70	
11	10,841.93	6,451.85	1,331.08	3,059.00		11	9,637.08	5,745.73	1,185.40	2,705.95	
12	10,831.02	6,454.73	1,332.43	3,043.85		12	9,628.08	5,742.55	1,183.27	2,702.27	
13	10,865.70	6,469.97	1,345.27	3,050.47		13	9,646.27	5,745.60	1,183.82	2,716.85	
14	10,863.02	6,468.25	1,333.08	3,061.68		14	9,637.32	5,751.48	1,184.67	2,701.17	
15	10,852.05	6,461.98	1,335.12	3,054.95		15	9,634.63	5,753.33	1,184.42	2,696.88	
16	10,846.08	6,451.38	1,337.43	3,057.27		16	9,643.40	5,745.52	1,182.43	2,715.45	
17	10,840.07	6,466.15	1,331.30	3,042.62		17	9,644.28	5,743.80	1,181.40	2,719.08	
18	10,859.85	6,474.87	1,335.63	3,049.35		18	9,650.23	5,752.47	1,191.95	2,705.82	
19	10,868.85	6,489.57	1,332.63	3,046.65		19	9,652.90	5,765.53	1,183.98	2,703.38	
20	10,841.15	6,468.43	1,327.22	3,045.50		20	9,650.82	5,752.83	1,188.22	2,709.77	
21	10,869.52	6,473.92	1,340.63	3,054.97		21	9,646.95	5,748.17	1,187.53	2,711.25	
22	10,825.92	6,437.92	1,333.13	3,054.87		22	9,640.85	5,747.62	1,185.82	2,707.42	
23	10,845.05	6,466.62	1,337.07	3,041.37		23	9,638.88	5,739.72	1,183.35	2,715.82	
24	10,870.17	6,480.12	1,342.87	3,047.18		24	9,641.02	5,743.43	1,194.43	2,703.15	
25	10,848.73	6,460.98	1,336.90	3,050.85		25	9,635.55	5,739.93	1,181.50	2,714.12	
26	10,849.27	6,468.22	1,336.73	3,044.32		26	9,657.30	5,768.18	1,186.95	2,702.17	
27	10,851.17	6,475.85	1,334.73	3,040.58		27	9,640.90	5,740.18	1,189.70	2,711.02	
28	10,861.47	6,481.00	1,332.15	3,048.32		28	9,642.42	5,736.03	1,184.70	2,721.68	
29	10,858.07	6,470.10	1,334.38	3,053.58		29	9,639.95	5,735.13	1,185.25	2,719.57	
Average		10,852.05	6,468.32	1,335.58	3,048.15	Average		9,643.46	5,745.12	1,186.75	2,711.60
50% Load Level - 121 BSUs				10% Load Level - 24 BSUs				Start-Up/Ramp-Up			
Start-Up/Ramp-Up		Start		Stop		Interval		Start		Stop	
Measurement Interval		4:38:48	4:58:49	0-19	0:20:01			5:08:52	5:28:53	0-19	0:20:01
(60 second intervals)		All ASUs	ASU-1	ASU-2	ASU-3	(60 second intervals)		All ASUs	ASU-1	ASU-2	ASU-3
0	6,048.77	3,612.68	745.92	1,690.17		0	1,201.38	714.93	147.98	338.47	
1	6,041.03	3,599.13	744.50	1,697.40		1	1,203.62	714.15	150.17	339.30	
2	6,049.43	3,604.75	747.53	1,697.15		2	1,199.43	715.35	148.52	335.57	
3	6,049.65	3,601.38	749.83	1,698.43		3	1,203.52	715.77	148.40	339.35	
4	6,049.25	3,608.45	743.42	1,697.38		4	1,204.57	713.57	149.72	341.28	
5	6,034.80	3,598.48	741.07	1,695.25		5	1,208.38	718.70	150.02	339.67	
6	6,048.48	3,603.88	747.37	1,697.23		6	1,199.80	712.22	148.13	339.45	
7	6,055.28	3,611.87	749.77	1,693.65		7	1,196.62	715.85	146.72	334.05	
8	6,057.03	3,614.72	741.53	1,700.78		8	1,201.22	717.62	148.18	335.42	
9	6,048.77	3,597.53	745.83	1,705.40		9	1,193.62	712.83	145.72	335.07	
10	6,047.08	3,606.37	742.25	1,698.47		10	1,195.07	711.00	148.30	335.77	
11	6,048.88	3,595.15	744.58	1,709.15		11	1,196.92	712.10	146.43	338.38	
12	6,055.42	3,607.03	742.30	1,706.08		12	1,201.08	710.58	148.90	341.60	
13	6,045.22	3,607.55	740.78	1,696.88		13	1,198.02	713.40	147.45	337.17	
14	6,053.55	3,612.98	741.97	1,698.60		14	1,197.65	716.72	147.83	333.10	
15	6,040.90	3,600.63	743.98	1,696.28		15	1,203.60	720.32	146.90	336.38	
16	6,039.58	3,597.18	741.03	1,701.37		16	1,194.82	711.20	148.03	335.58	
17	6,051.22	3,609.33	743.57	1,698.32		17	1,201.38	719.27	146.93	335.18	
18	6,047.52	3,603.23	744.68	1,699.60		18	1,201.50	714.57	146.37	340.57	
19	6,067.62	3,611.23	748.75	1,707.63		19	1,206.32	719.67	148.12	338.53	
20	6,058.43	3,609.60	742.97	1,705.87		20	1,207.13	721.32	150.27	335.55	
21	6,056.28	3,616.57	744.15	1,695.57		21	1,193.67	710.22	146.35	337.10	
22	6,043.95	3,607.18	740.25	1,696.52		22	1,207.68	719.12	148.30	340.27	
23	6,051.73	3,613.45	743.10	1,695.18		23	1,204.35	714.50	149.45	340.40	
24	6,044.78	3,600.33	741.03	1,703.42		24	1,195.53	711.05	146.87	337.62	
25	6,040.78	3,597.78	748.18	1,694.82		25	1,202.12	718.10	148.00	336.02	
26	6,053.93	3,614.50	740.10	1,699.33		26	1,201.63	715.18	149.35	337.10	
27	6,055.78	3,614.03	743.62	1,698.13		27	1,201.93	717.03	146.63	338.27	
28	6,040.48	3,606.02	740.07	1,694.40		28	1,194.50	711.93	144.13	338.43	
29	6,052.42	3,605.55	740.12	1,706.75		29	1,201.88	716.10	148.25	337.53	
Average		6,049.86	3,608.50	742.36	1,699.00	Average		1,201.04	715.46	147.76	337.83

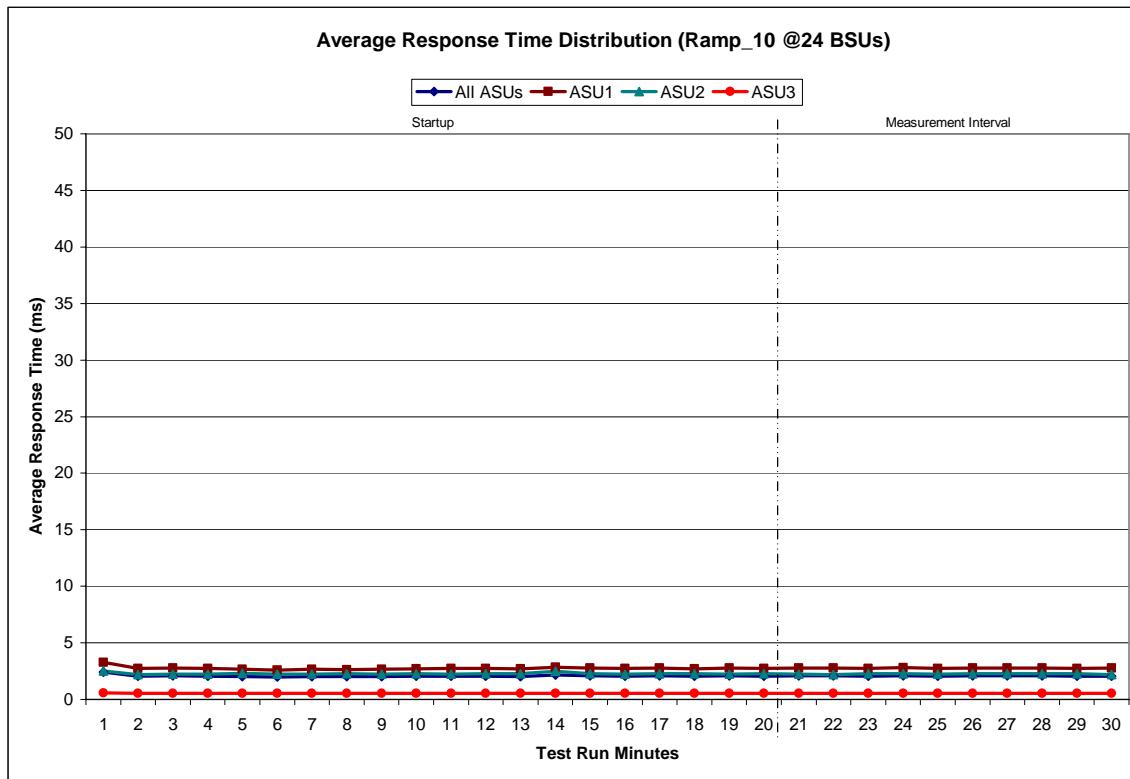
### Response Time Ramp Distribution (IOPS) Graph



**SPC-1 LRT™ Average Response Time (ms) Distribution Data**

<b>24 BSUs</b>	<b>Start</b>	<b>Stop</b>	<b>Interval</b>	<b>Duration</b>
<i>Start-Up/Ramp-Up</i>	5:08:52	5:28:53	0-19	0:20:01
<i>Measurement Interval</i>	5:28:53	5:38:53	20-29	0:10:00
<b>60 second intervals</b>	<b>All ASUs</b>	<b>ASU1</b>	<b>ASU2</b>	<b>ASU3</b>
<b>0</b>	2.42	3.26	2.54	0.58
<b>1</b>	2.05	2.74	2.18	0.53
<b>2</b>	2.08	2.77	2.25	0.53
<b>3</b>	2.05	2.73	2.24	0.53
<b>4</b>	2.02	2.67	2.31	0.53
<b>5</b>	1.97	2.60	2.23	0.53
<b>6</b>	2.01	2.66	2.23	0.53
<b>7</b>	2.00	2.64	2.26	0.54
<b>8</b>	2.02	2.66	2.24	0.54
<b>9</b>	2.05	2.71	2.28	0.53
<b>10</b>	2.06	2.74	2.22	0.53
<b>11</b>	2.05	2.72	2.28	0.53
<b>12</b>	2.03	2.69	2.27	0.53
<b>13</b>	2.16	2.86	2.48	0.53
<b>14</b>	2.07	2.75	2.25	0.53
<b>15</b>	2.05	2.72	2.24	0.53
<b>16</b>	2.08	2.77	2.28	0.53
<b>17</b>	2.03	2.69	2.28	0.53
<b>18</b>	2.07	2.78	2.24	0.53
<b>19</b>	2.05	2.73	2.26	0.53
<b>20</b>	2.08	2.76	2.22	0.53
<b>21</b>	2.08	2.78	2.20	0.53
<b>22</b>	2.06	2.74	2.28	0.54
<b>23</b>	2.09	2.80	2.25	0.53
<b>24</b>	2.05	2.74	2.23	0.53
<b>25</b>	2.08	2.77	2.28	0.53
<b>26</b>	2.09	2.79	2.28	0.53
<b>27</b>	2.08	2.77	2.27	0.53
<b>28</b>	2.06	2.74	2.27	0.53
<b>29</b>	2.07	2.76	2.20	0.53
<b>Average</b>	2.07	2.77	2.25	0.53

### SPC-1 LRT™ Average Response Time (ms) Distribution Graph



**SPC-1 LRT™ (10%) – Measured Intensity Multiplier and Coefficient of Variation**

	ASU1-1	ASU1-2	ASU1-3	ASU1-4	ASU2-1	ASU2-2	ASU2-3	ASU3-1
IM	0.0350	0.2810	0.0700	0.2100	0.0180	0.0700	0.0350	0.2810
MIM	.0353	.2815	.0698	.2092	.0177	.0699	.0354	.2813
COV	.0123	.0043	.0153	.0120	.0147	.0171	.0210	.0058

**IM – Intensity Multiplier:** The ratio of I/Os for each I/O stream relative to the total I/Os for all I/O streams (ASU1-1 – ASU3-1) as required by the benchmark specification.

**MIM – Measured Intensity Multiplier:** The Measured Intensity Multiplier represents the ratio of measured I/Os for each I/O stream relative to the total I/Os measured for all I/O streams (ASU1-1 – ASU3-1). This value may differ from the corresponding Expected Intensity Multiplier by no more than 5%.

**COV – Coefficient of Variation:** This measure of variation for the Measured Intensity Multiplier cannot exceed 0.2.

## Repeatability Test

### Clause 5.4.3

*The Repeatability Test demonstrates the repeatability and reproducibility of the SPC-1 IOPS™ and SPC-1 LRT™ primary metrics generated in earlier Test Runs.*

*There are two identical Repeatability Test Phases. Each Test Phase contains two Test Runs. Each of the Test Runs will have a Measurement Interval of no less than ten (10) minutes. The two Test Runs in each Test Phase will be executed without interruption or any type of manual intervention.*

*The first Test Run in each Test Phase is executed at the 10% load point. The Average Response Time from each of the Test Runs is compared to the SPC-1 LRT™ primary metric. Each Average Response Time value must be less than the SPC-1 LRT™ primary metric plus 5%.*

*The second Test Run in each Test Phase is executed at the 100% load point. The I/O Request Throughput from the Test Runs is compared to the SPC-1 IOPS™ primary metric. Each I/O Request Throughput value must be greater than the SPC-1 IOPS™ primary metric minus 5%. In addition, the Average Response Time for each Test Run cannot exceed 30 milliseconds.*

*If any of the above constraints are not met, the benchmark measurement is invalid.*

### Clause 9.2.4.7.3

*The following content shall appear in the FDR for each Test Run in the two Repeatability Test Phases:*

1. *A table containing the results of the two Repeatability Test Phases. The content, appearance, and format of the table are specified in Table 9-11.*
2. *An I/O Request Throughput Distribution (data and graph).*
3. *An Average Response Time Distribution (data and graph).*
4. *The human readable Test Run Results File produced by the Workload Generator.*
5. *A listing or screen image of all input parameters supplied to the Workload Generator.*

## SPC-1 Workload Generator Input Parameters

The SPC-1 Workload Generator input parameters for the Repeatability Test Runs are listed below.

```
java -Xmx64m -Xms64m repeat1 -b 242 -s 1200
java -Xmx64m -Xms64m repeat2 -b 242 -s 1200
```

## Repeatability Test Results File

The values for the SPC-1 IOPS™, SPC-1 LRT™, and the Repeatability Test measurements are listed below.

	SPC-1 IOPS™	SPC-1 LRT™
<i>Primary Metrics</i>	12,102.97	2.07
<i>Repeatability Test Phase 1</i>	12,106.47	2.05
<i>Repeatability Test Phase 2</i>	12,102.28	2.06

A link to the test result file generated from each Repeatability Test Run list is listed below.

[Repeatability Test Phase 1, Test Run 1 \(LRT\)](#)

[Repeatability Test Phase 1, Test Run 2 \(IOPS\)](#)

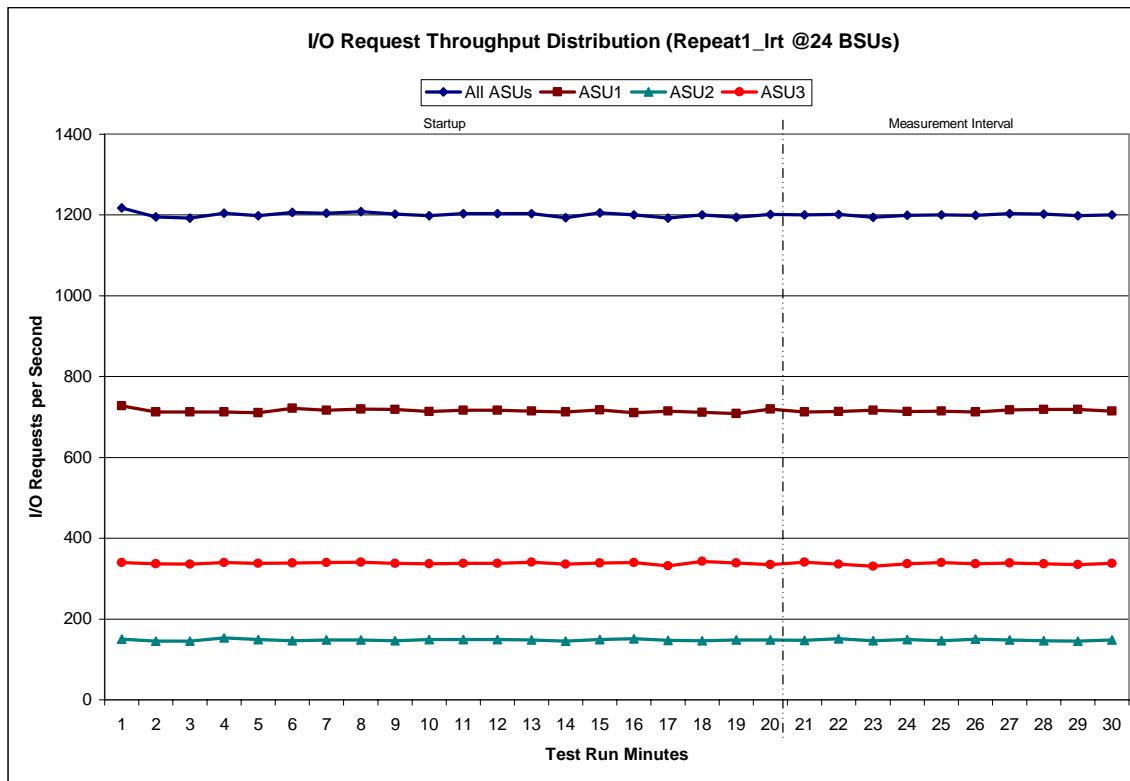
[Repeatability Test Phase 2, Test Run 1 \(LRT\)](#)

[Repeatability Test Phase 2, Test Run 2 \(IOPS\)](#)

### Repeatability 1 LRT - I/O Request Throughput Distribution Data

<b>24 BSUs</b>	<b>Start</b>	<b>Stop</b>	<b>Interval</b>	<b>Duration</b>
<i>Start-Up/Ramp-Up</i>	16:07:40	16:27:40	0-19	0:20:00
<i>Measurement Interval</i>	16:27:40	16:37:40	20-29	0:10:00
<b>60 second intervals</b>	<b>All ASUs</b>	<b>ASU1</b>	<b>ASU2</b>	<b>ASU3</b>
<b>0</b>	1,217.52	727.73	149.78	340.00
<b>1</b>	1,194.95	713.02	145.47	336.47
<b>2</b>	1,192.50	712.28	144.82	335.40
<b>3</b>	1,204.73	712.42	152.92	339.40
<b>4</b>	1,198.03	710.92	149.17	337.95
<b>5</b>	1,206.77	722.10	146.18	338.48
<b>6</b>	1,204.57	716.43	148.48	339.65
<b>7</b>	1,208.93	719.38	148.62	340.93
<b>8</b>	1,202.47	719.10	145.75	337.62
<b>9</b>	1,198.63	713.12	148.82	336.70
<b>10</b>	1,203.93	717.02	149.60	337.32
<b>11</b>	1,203.47	717.05	148.83	337.58
<b>12</b>	1,203.18	714.32	148.47	340.40
<b>13</b>	1,193.38	712.63	145.50	335.25
<b>14</b>	1,205.15	717.97	148.68	338.50
<b>15</b>	1,200.48	710.43	150.80	339.25
<b>16</b>	1,192.47	714.50	146.72	331.25
<b>17</b>	1,200.37	711.92	145.80	342.65
<b>18</b>	1,194.73	708.20	148.05	338.48
<b>19</b>	1,201.28	719.32	147.75	334.22
<b>20</b>	1,199.95	712.73	146.90	340.32
<b>21</b>	1,201.17	713.82	151.43	335.92
<b>22</b>	1,194.62	717.08	146.45	331.08
<b>23</b>	1,199.88	713.73	149.38	336.77
<b>24</b>	1,200.77	714.73	146.35	339.68
<b>25</b>	1,199.75	712.93	149.68	337.13
<b>26</b>	1,203.85	717.28	148.25	338.32
<b>27</b>	1,202.07	718.63	146.47	336.97
<b>28</b>	1,198.05	718.67	145.10	334.28
<b>29</b>	1,200.17	714.93	147.68	337.55
<b>Average</b>	1,200.03	715.46	147.77	336.80

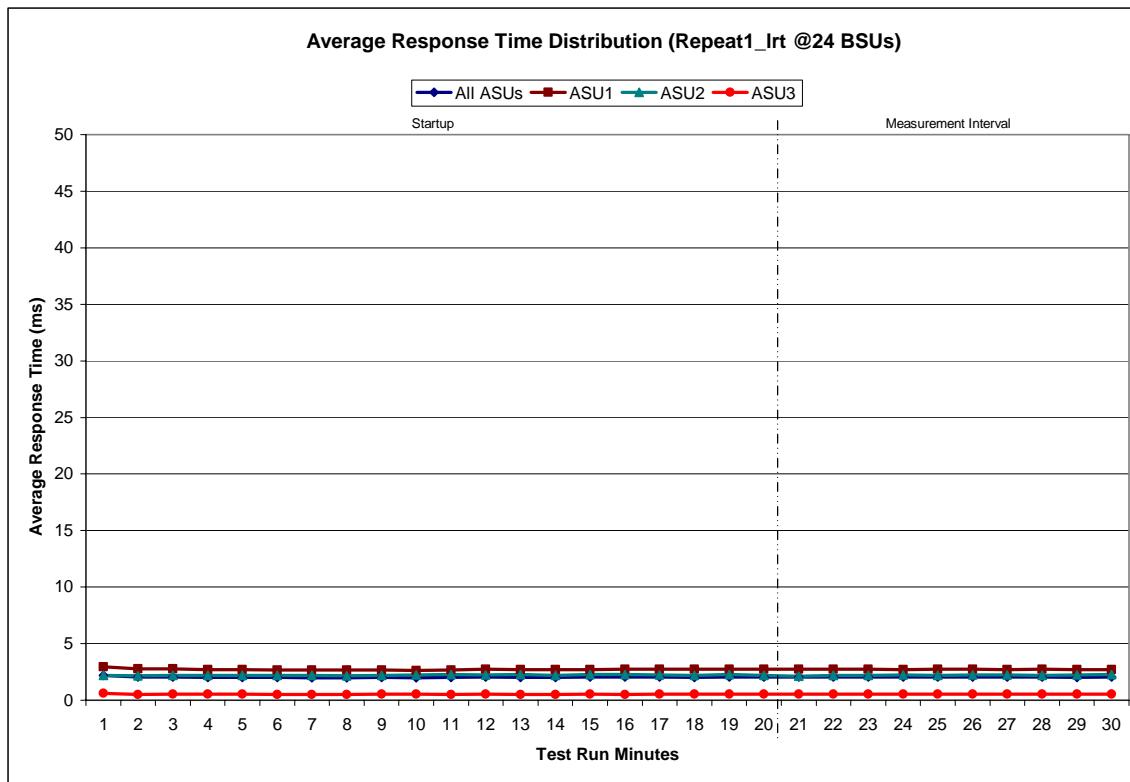
## Repeatability 1 LRT - I/O Request Throughput Distribution Graph



**Repeatability 1 LRT -Average Response Time (ms) Distribution Data**

<b>24 BSUs</b>	<b>Start</b>	<b>Stop</b>	<b>Interval</b>	<b>Duration</b>
<i>Start-Up/Ramp-Up</i>	16:07:40	16:27:40	0-19	0:20:00
<i>Measurement Interval</i>	16:27:40	16:37:40	20-29	0:10:00
<b>60 second intervals</b>	<b>All ASUs</b>	<b>ASU1</b>	<b>ASU2</b>	<b>ASU3</b>
<b>0</b>	2.20	2.95	2.20	0.60
<b>1</b>	2.07	2.77	2.18	0.52
<b>2</b>	2.07	2.77	2.19	0.52
<b>3</b>	2.03	2.71	2.19	0.53
<b>4</b>	2.01	2.69	2.18	0.52
<b>5</b>	2.00	2.66	2.18	0.52
<b>6</b>	2.00	2.65	2.20	0.52
<b>7</b>	2.00	2.66	2.16	0.52
<b>8</b>	2.02	2.68	2.20	0.52
<b>9</b>	2.00	2.64	2.22	0.53
<b>10</b>	2.01	2.65	2.27	0.52
<b>11</b>	2.06	2.75	2.23	0.53
<b>12</b>	2.03	2.70	2.26	0.52
<b>13</b>	2.03	2.70	2.20	0.52
<b>14</b>	2.04	2.71	2.27	0.52
<b>15</b>	2.05	2.73	2.27	0.52
<b>16</b>	2.05	2.72	2.22	0.52
<b>17</b>	2.03	2.73	2.19	0.53
<b>18</b>	2.05	2.73	2.25	0.53
<b>19</b>	2.04	2.72	2.18	0.53
<b>20</b>	2.03	2.73	2.14	0.52
<b>21</b>	2.06	2.74	2.21	0.52
<b>22</b>	2.06	2.74	2.19	0.53
<b>23</b>	2.03	2.70	2.25	0.52
<b>24</b>	2.06	2.75	2.21	0.53
<b>25</b>	2.04	2.72	2.22	0.53
<b>26</b>	2.04	2.71	2.23	0.52
<b>27</b>	2.06	2.75	2.18	0.53
<b>28</b>	2.03	2.69	2.22	0.53
<b>29</b>	2.05	2.72	2.27	0.53
<b>Average</b>	2.05	2.73	2.21	0.53

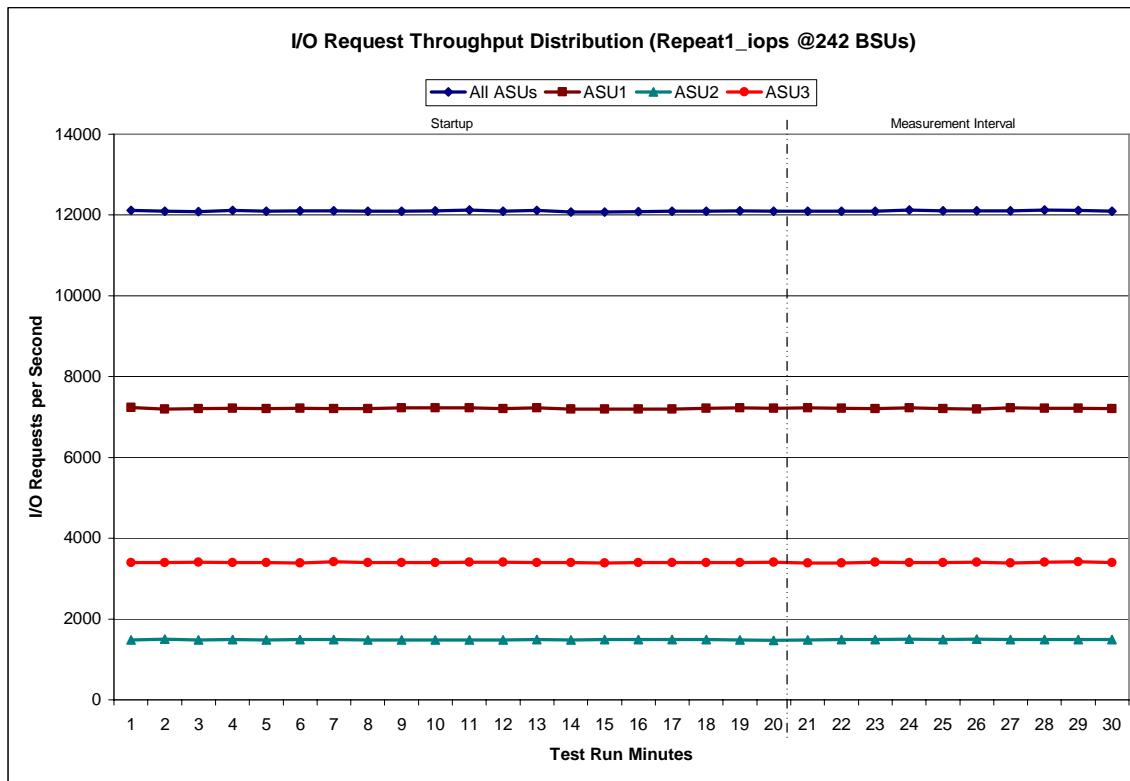
### Repeatability 1 LRT -Average Response Time (ms) Distribution Graph



**Repeatability 1 IOPS – I/O Request Throughput Distribution Data**

<b>242 BSUs</b>	<b>Start</b>	<b>Stop</b>	<b>Interval</b>	<b>Duration</b>
<i>Start-Up/Ramp-Up</i>	16:37:43	16:57:44	0-19	0:20:01
<i>Measurement Interval</i>	16:57:44	17:07:44	20-29	0:10:00
<b>60 second intervals</b>	<b>All ASUs</b>	<b>ASU1</b>	<b>ASU2</b>	<b>ASU3</b>
<b>0</b>	12,116.15	7,233.07	1,483.03	3,400.05
<b>1</b>	12,099.40	7,197.43	1,501.07	3,400.90
<b>2</b>	12,086.50	7,202.42	1,481.42	3,402.67
<b>3</b>	12,115.68	7,218.35	1,496.03	3,401.30
<b>4</b>	12,090.17	7,206.43	1,483.58	3,400.15
<b>5</b>	12,105.07	7,221.55	1,495.33	3,388.18
<b>6</b>	12,106.50	7,203.18	1,491.10	3,412.22
<b>7</b>	12,091.97	7,211.25	1,482.52	3,398.20
<b>8</b>	12,098.95	7,224.30	1,480.28	3,394.37
<b>9</b>	12,107.65	7,223.10	1,483.42	3,401.13
<b>10</b>	12,122.20	7,230.62	1,482.55	3,409.03
<b>11</b>	12,093.15	7,204.87	1,481.57	3,406.72
<b>12</b>	12,119.25	7,229.37	1,490.30	3,399.58
<b>13</b>	12,079.38	7,192.03	1,486.23	3,401.12
<b>14</b>	12,073.23	7,195.97	1,489.23	3,388.03
<b>15</b>	12,080.78	7,200.90	1,488.23	3,391.65
<b>16</b>	12,094.98	7,201.17	1,494.63	3,399.18
<b>17</b>	12,098.62	7,211.87	1,488.10	3,398.65
<b>18</b>	12,103.82	7,222.80	1,481.40	3,399.62
<b>19</b>	12,098.95	7,219.15	1,473.88	3,405.92
<b>20</b>	12,090.58	7,222.95	1,479.93	3,387.70
<b>21</b>	12,098.18	7,221.10	1,487.12	3,389.97
<b>22</b>	12,096.33	7,203.88	1,489.62	3,402.83
<b>23</b>	12,124.30	7,231.28	1,497.18	3,395.83
<b>24</b>	12,103.58	7,211.40	1,495.88	3,396.30
<b>25</b>	12,106.30	7,196.87	1,498.33	3,411.10
<b>26</b>	12,107.92	7,227.35	1,491.95	3,388.62
<b>27</b>	12,121.12	7,219.53	1,494.48	3,407.10
<b>28</b>	12,120.20	7,215.72	1,491.80	3,412.68
<b>29</b>	12,096.18	7,204.35	1,492.22	3,399.62
<b>Average</b>	12,106.47	7,215.44	1,491.85	3,399.18

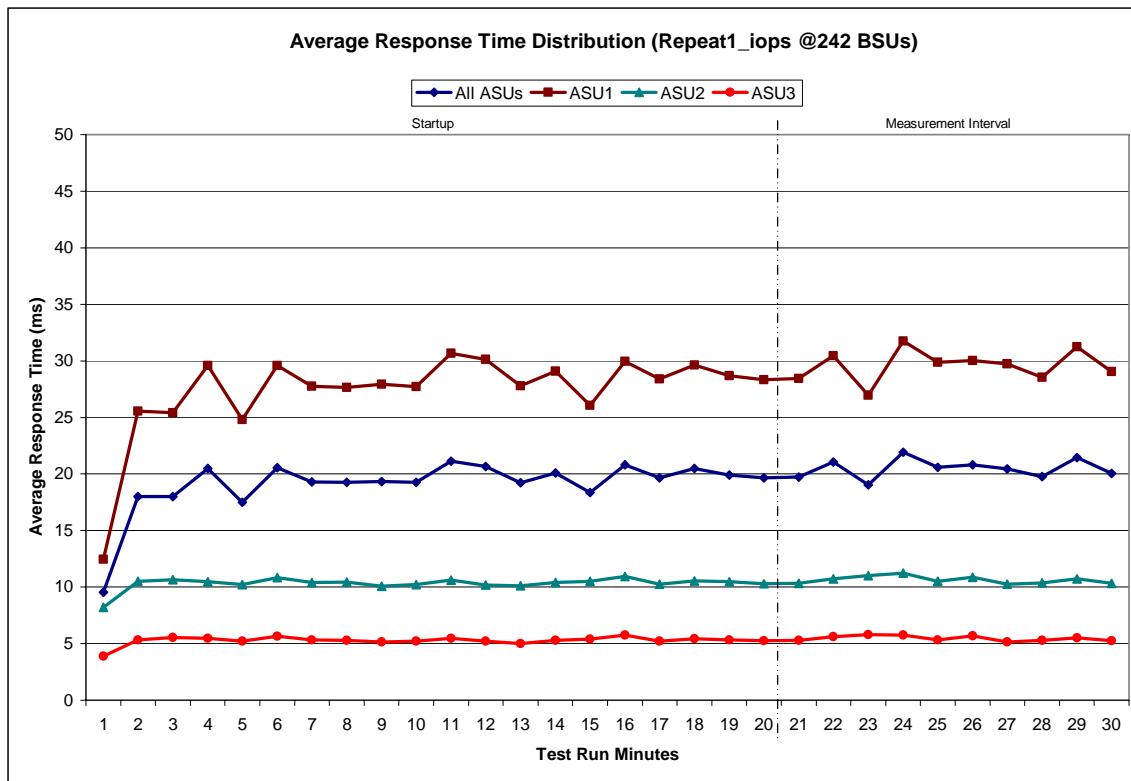
## Repeatability 1 IOPS - I/O Request Throughput Distribution Graph



**Repeatability 1 IOPS -Average Response Time (ms) Distribution Data**

<b>242 BSUs</b>	<b>Start</b>	<b>Stop</b>	<b>Interval</b>	<b>Duration</b>
<i>Start-Up/Ramp-Up</i>	16:37:43	16:57:44	0-19	0:20:01
<i>Measurement Interval</i>	16:57:44	17:07:44	20-29	0:10:00
<b>60 second intervals</b>	<b>All ASUs</b>	<b>ASU1</b>	<b>ASU2</b>	<b>ASU3</b>
0	9.52	12.45	8.20	3.88
1	18.01	25.57	10.50	5.34
2	18.00	25.40	10.65	5.54
3	20.47	29.60	10.49	5.48
4	17.51	24.82	10.22	5.20
5	20.57	29.59	10.83	5.64
6	19.30	27.77	10.40	5.33
7	19.25	27.63	10.44	5.31
8	19.35	27.92	10.09	5.14
9	19.25	27.71	10.24	5.21
10	21.14	30.67	10.63	5.49
11	20.66	30.12	10.19	5.21
12	19.24	27.80	10.12	5.01
13	20.09	29.09	10.42	5.30
14	18.35	26.07	10.51	5.39
15	20.81	29.94	10.93	5.76
16	19.64	28.39	10.26	5.23
17	20.49	29.62	10.55	5.45
18	19.91	28.70	10.49	5.34
19	19.64	28.33	10.29	5.27
20	19.74	28.45	10.35	5.28
21	21.07	30.45	10.74	5.62
22	19.05	26.98	11.00	5.80
23	21.94	31.75	11.23	5.76
24	20.59	29.87	10.50	5.34
25	20.79	30.02	10.87	5.68
26	20.46	29.73	10.25	5.17
27	19.77	28.55	10.36	5.30
28	21.47	31.24	10.72	5.52
29	20.05	29.04	10.34	5.26
<b>Average</b>	20.49	29.61	10.63	5.47

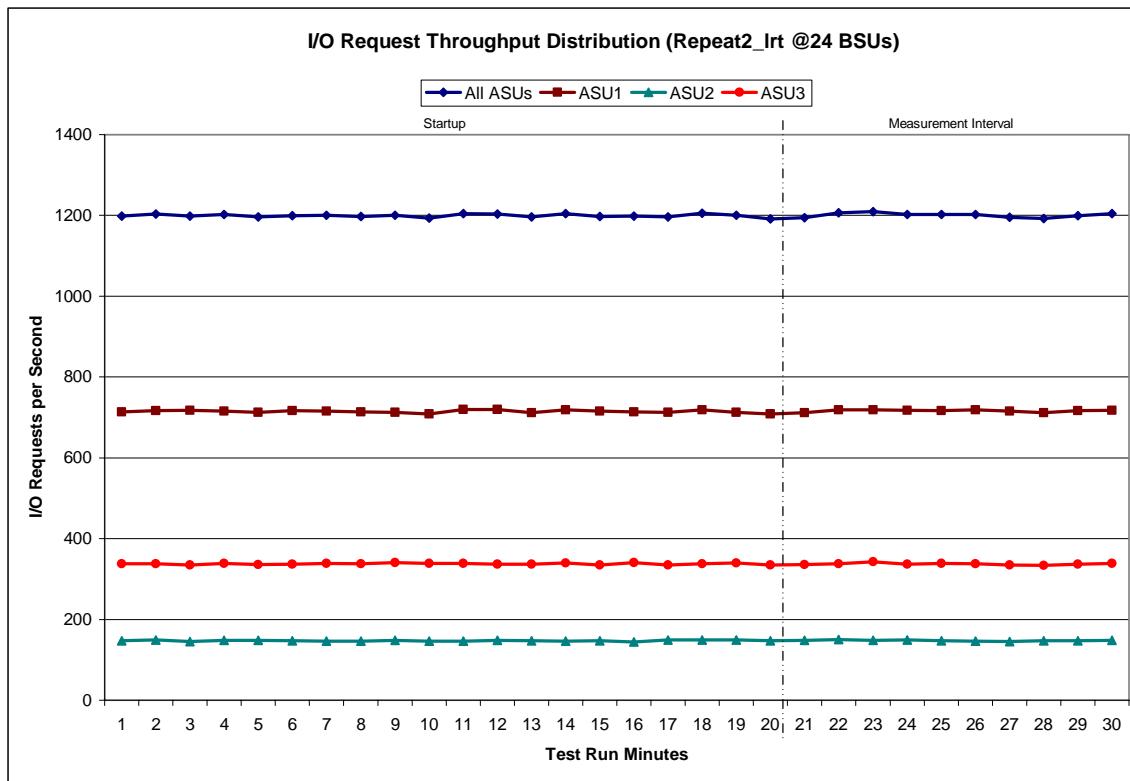
### Repeatability 1 IOPS -Average Response Time (ms) Distribution Graph



## Repeatability 2 LRT - I/O Request Throughput Distribution Data

<b>24 BSUs</b>	<b>Start</b>	<b>Stop</b>	<b>Interval</b>	<b>Duration</b>
<i>Start-Up/Ramp-Up</i>	17:07:52	17:27:52	0-19	0:20:00
<i>Measurement Interval</i>	17:27:52	17:37:52	20-29	0:10:00
<b>60 second intervals</b>	<b>All ASUs</b>	<b>ASU1</b>	<b>ASU2</b>	<b>ASU3</b>
<b>0</b>	1,198.30	713.93	146.93	337.43
<b>1</b>	1,203.03	716.92	148.93	337.18
<b>2</b>	1,198.10	718.05	145.62	334.43
<b>3</b>	1,202.65	716.03	148.18	338.43
<b>4</b>	1,196.07	712.42	148.22	335.43
<b>5</b>	1,199.87	716.13	147.03	336.70
<b>6</b>	1,200.38	715.75	145.75	338.88
<b>7</b>	1,197.12	713.72	146.23	337.17
<b>8</b>	1,200.87	712.23	148.28	340.35
<b>9</b>	1,193.50	708.38	146.05	339.07
<b>10</b>	1,204.48	719.32	146.65	338.52
<b>11</b>	1,203.87	719.55	148.17	336.15
<b>12</b>	1,196.20	711.93	147.30	336.97
<b>13</b>	1,204.62	718.65	145.97	340.00
<b>14</b>	1,197.38	715.38	147.43	334.57
<b>15</b>	1,198.68	713.80	144.62	340.27
<b>16</b>	1,195.92	712.33	149.25	334.33
<b>17</b>	1,205.25	718.70	149.40	337.15
<b>18</b>	1,200.77	712.30	148.93	339.53
<b>19</b>	1,191.42	708.75	147.62	335.05
<b>20</b>	1,194.53	711.33	148.07	335.13
<b>21</b>	1,206.25	718.95	149.75	337.55
<b>22</b>	1,209.30	718.50	147.92	342.88
<b>23</b>	1,202.35	717.15	148.80	336.40
<b>24</b>	1,202.45	717.07	147.10	338.28
<b>25</b>	1,202.10	718.27	146.33	337.50
<b>26</b>	1,195.87	715.25	145.57	335.05
<b>27</b>	1,192.43	711.48	147.40	333.55
<b>28</b>	1,199.37	716.25	146.95	336.17
<b>29</b>	1,204.38	717.63	148.35	338.40
<b>Average</b>	1,200.90	716.19	147.62	337.09

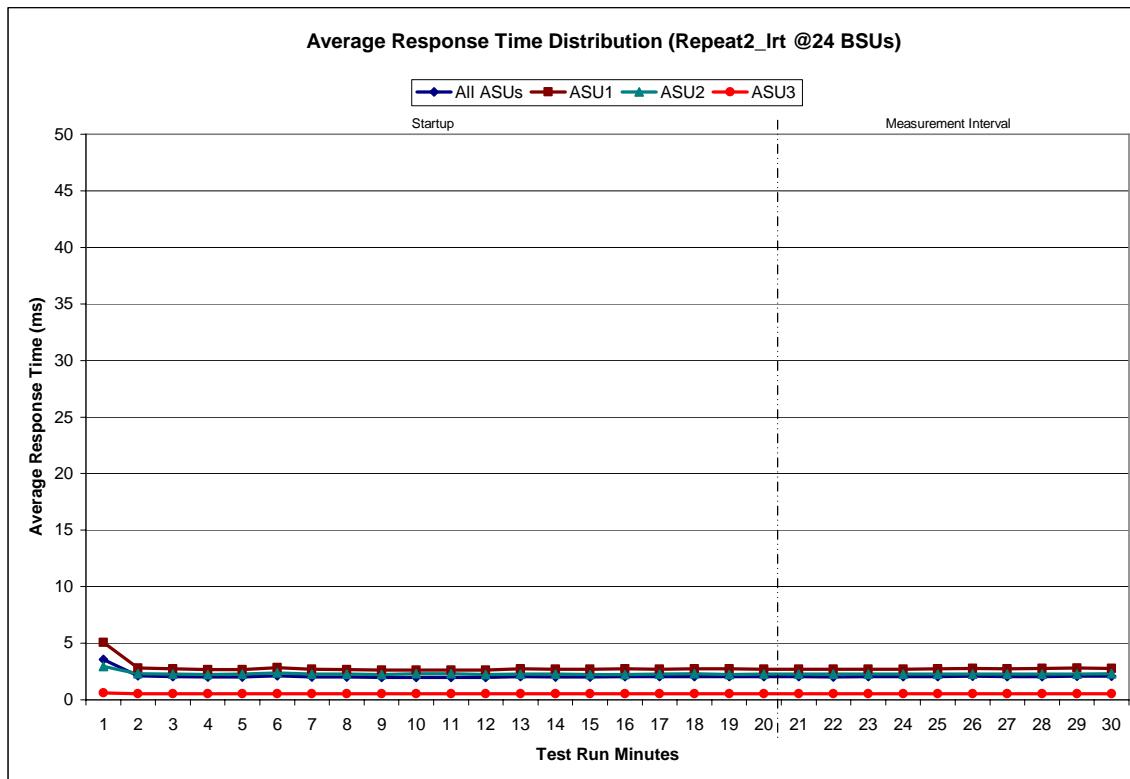
## Repeatability 2 LRT - I/O Request Throughput Distribution Graph



**Repeatability 2 LRT -Average Response Time (ms) Distribution Data**

<b>24 BSUs</b>	<b>Start</b>	<b>Stop</b>	<b>Interval</b>	<b>Duration</b>
<i>Start-Up/Ramp-Up</i>	17:07:52	17:27:52	0-19	0:20:00
<i>Measurement Interval</i>	17:27:52	17:37:52	20-29	0:10:00
<b>60 second intervals</b>	<b>All ASUs</b>	<b>ASU1</b>	<b>ASU2</b>	<b>ASU3</b>
0	3.56	5.08	2.96	0.60
1	2.11	2.81	2.29	0.53
2	2.06	2.73	2.28	0.53
3	2.00	2.65	2.23	0.52
4	2.01	2.66	2.28	0.52
5	2.13	2.83	2.37	0.53
6	2.03	2.70	2.27	0.53
7	2.02	2.67	2.28	0.52
8	1.99	2.63	2.24	0.53
9	1.99	2.63	2.30	0.52
10	2.00	2.63	2.30	0.53
11	1.99	2.63	2.24	0.52
12	2.05	2.72	2.28	0.53
13	2.03	2.69	2.26	0.53
14	2.03	2.70	2.24	0.53
15	2.04	2.72	2.23	0.53
16	2.04	2.71	2.25	0.53
17	2.06	2.74	2.31	0.53
18	2.05	2.73	2.25	0.53
19	2.04	2.70	2.27	0.53
20	2.05	2.72	2.27	0.53
21	2.03	2.69	2.28	0.53
22	2.04	2.72	2.27	0.53
23	2.04	2.71	2.28	0.53
24	2.05	2.72	2.27	0.53
25	2.08	2.77	2.26	0.53
26	2.06	2.75	2.26	0.52
27	2.07	2.75	2.26	0.52
28	2.09	2.79	2.28	0.53
29	2.09	2.78	2.30	0.53
<b>Average</b>	2.06	2.74	2.27	0.53

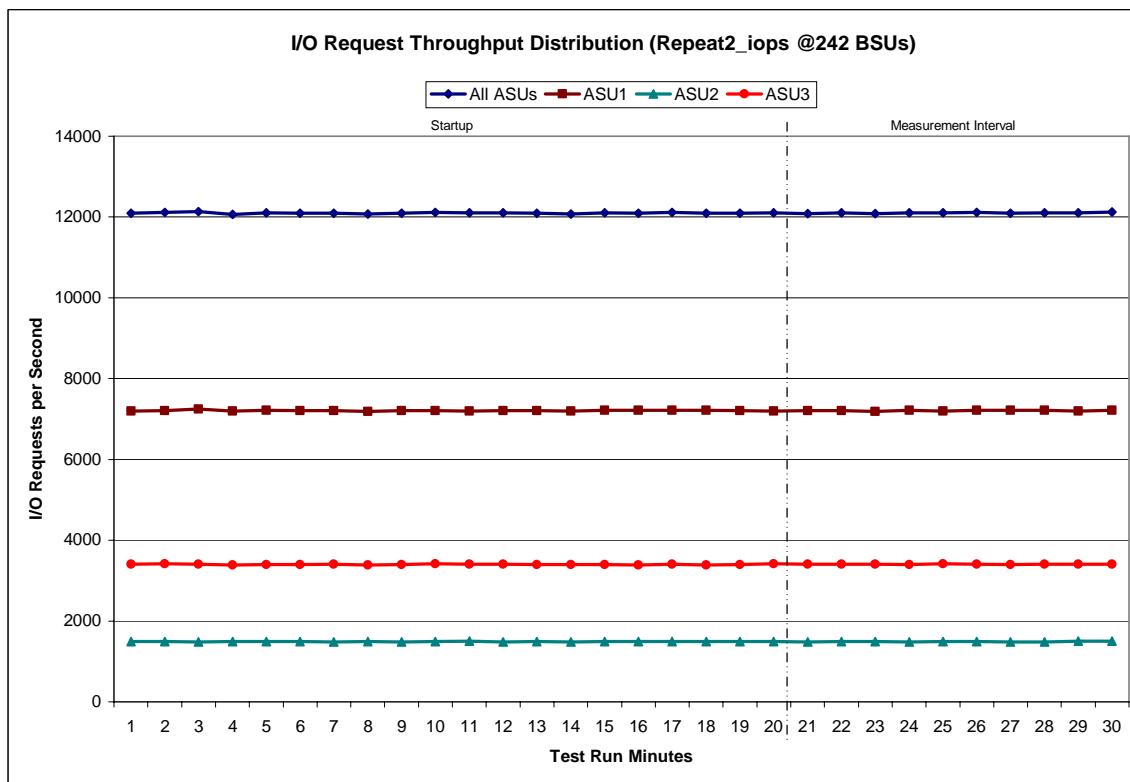
## Repeatability 2 LRT -Average Response Time (ms) Distribution Graph



## Repeatability 2 IOPS – I/O Request Throughput Distribution Data

<b>242 BSUs</b>	<b>Start</b>	<b>Stop</b>	<b>Interval</b>	<b>Duration</b>
<i>Start-Up/Ramp-Up</i>	17:37:56	17:57:57	0-19	0:20:01
<i>Measurement Interval</i>	17:57:57	18:07:57	20-29	0:10:00
<b>60 second intervals</b>	<b>All ASUs</b>	<b>ASU1</b>	<b>ASU2</b>	<b>ASU3</b>
<b>0</b>	12,093.73	7,196.97	1,490.35	3,406.42
<b>1</b>	12,113.28	7,209.17	1,490.55	3,413.57
<b>2</b>	12,134.72	7,243.17	1,486.47	3,405.08
<b>3</b>	12,068.25	7,193.63	1,486.68	3,387.93
<b>4</b>	12,107.02	7,217.62	1,491.10	3,398.30
<b>5</b>	12,097.45	7,211.05	1,487.82	3,398.58
<b>6</b>	12,099.72	7,210.37	1,485.43	3,403.92
<b>7</b>	12,070.57	7,191.45	1,489.15	3,389.97
<b>8</b>	12,091.87	7,207.35	1,485.75	3,398.77
<b>9</b>	12,113.88	7,209.60	1,489.68	3,414.60
<b>10</b>	12,106.07	7,197.23	1,498.03	3,410.80
<b>11</b>	12,101.25	7,207.85	1,483.17	3,410.23
<b>12</b>	12,096.93	7,211.30	1,491.18	3,394.45
<b>13</b>	12,079.33	7,197.58	1,484.70	3,397.05
<b>14</b>	12,101.75	7,212.25	1,488.48	3,401.02
<b>15</b>	12,097.20	7,215.00	1,491.40	3,390.80
<b>16</b>	12,111.87	7,213.60	1,489.43	3,408.83
<b>17</b>	12,097.00	7,220.08	1,492.15	3,384.77
<b>18</b>	12,092.90	7,202.60	1,493.53	3,396.77
<b>19</b>	12,107.38	7,201.33	1,491.78	3,414.27
<b>20</b>	12,085.80	7,203.07	1,480.83	3,401.90
<b>21</b>	12,106.37	7,203.23	1,491.82	3,411.32
<b>22</b>	12,084.32	7,189.67	1,488.28	3,406.37
<b>23</b>	12,104.55	7,221.53	1,483.27	3,399.75
<b>24</b>	12,100.98	7,199.70	1,489.30	3,411.98
<b>25</b>	12,111.33	7,214.97	1,489.07	3,407.30
<b>26</b>	12,096.13	7,217.42	1,485.48	3,393.23
<b>27</b>	12,104.20	7,219.33	1,479.52	3,405.35
<b>28</b>	12,105.43	7,201.13	1,497.65	3,406.65
<b>29</b>	12,123.67	7,216.38	1,499.55	3,407.73
<b>Average</b>	12,102.28	7,208.64	1,488.48	3,405.16

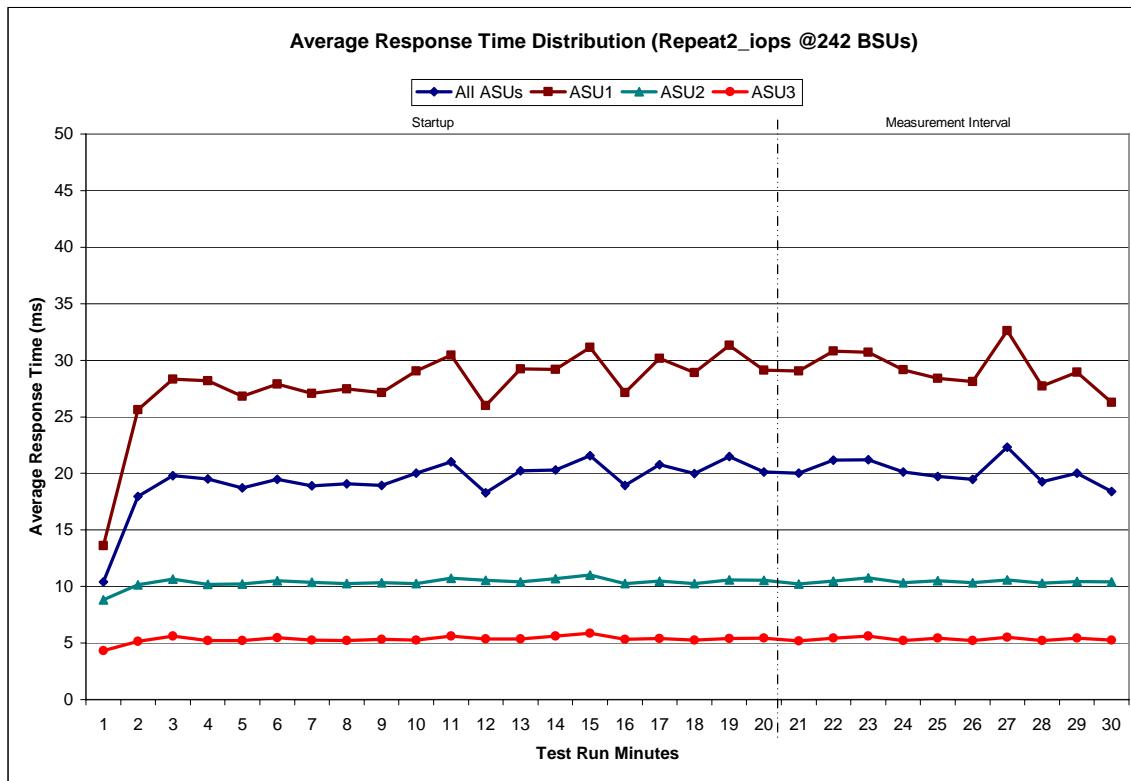
## Repeatability 2 IOPS - I/O Request Throughput Distribution Graph



**Repeatability 2 IOPS – Average Response Time (ms) Distribution Data**

<b>242 BSUs</b>	<b>Start</b>	<b>Stop</b>	<b>Interval</b>	<b>Duration</b>
<i>Start-Up/Ramp-Up</i>	17:37:56	17:57:57	0-19	0:20:01
<i>Measurement Interval</i>	17:57:57	18:07:57	20-29	0:10:00
<b>60 second intervals</b>	<b>All ASUs</b>	<b>ASU1</b>	<b>ASU2</b>	<b>ASU3</b>
<b>0</b>	10.40	13.62	8.81	4.30
<b>1</b>	17.96	25.63	10.17	5.16
<b>2</b>	19.79	28.32	10.67	5.62
<b>3</b>	19.51	28.18	10.19	5.20
<b>4</b>	18.71	26.82	10.21	5.23
<b>5</b>	19.46	27.91	10.50	5.48
<b>6</b>	18.89	27.07	10.38	5.26
<b>7</b>	19.09	27.45	10.27	5.23
<b>8</b>	18.95	27.15	10.33	5.33
<b>9</b>	20.03	29.05	10.26	5.25
<b>10</b>	21.03	30.47	10.74	5.63
<b>11</b>	18.28	25.99	10.56	5.35
<b>12</b>	20.21	29.23	10.39	5.36
<b>13</b>	20.30	29.21	10.70	5.61
<b>14</b>	21.55	31.12	11.00	5.88
<b>15</b>	18.94	27.13	10.25	5.33
<b>16</b>	20.76	30.15	10.47	5.40
<b>17</b>	20.00	28.92	10.27	5.25
<b>18</b>	21.48	31.32	10.58	5.42
<b>19</b>	20.14	29.11	10.55	5.42
<b>20</b>	20.03	29.05	10.22	5.18
<b>21</b>	21.16	30.82	10.47	5.45
<b>22</b>	21.19	30.71	10.75	5.63
<b>23</b>	20.12	29.14	10.35	5.23
<b>24</b>	19.72	28.39	10.51	5.43
<b>25</b>	19.49	28.11	10.31	5.22
<b>26</b>	22.31	32.62	10.57	5.52
<b>27</b>	19.26	27.72	10.30	5.21
<b>28</b>	20.03	28.93	10.45	5.42
<b>29</b>	18.40	26.26	10.42	5.27
<b>Average</b>	20.17	29.18	10.44	5.36

### Repeatability 2 IOPS – Average Response Time (ms) Distribution Graph



### Repeatability 1 (LRT)

#### Measured Intensity Multiplier and Coefficient of Variation

	ASU1-1	ASU1-2	ASU1-3	ASU1-4	ASU2-1	ASU2-2	ASU2-3	ASU3-1
IM	0.0350	0.2810	0.0700	0.2100	0.0180	0.0700	0.0350	0.2810
MIM	.0351	.2823	.0699	.2089	.0180	.0702	.0350	.2807
COV	.0176	.0063	.0141	.0058	.0389	.0150	.0212	.0065

**IM – Intensity Multiplier:** The ratio of I/Os for each I/O stream relative to the total I/Os for all I/O streams (ASU1-1 – ASU3-1) as required by the benchmark specification.

**MIM – Measured Intensity Multiplier:** The Measured Intensity Multiplier represents the ratio of measured I/Os for each I/O stream relative to the total I/Os measured for all I/O streams (ASU1-1 – ASU3-1). This value may differ from the corresponding Expected Intensity Multiplier by no more than 5%.

**COV – Coefficient of Variation:** This measure of variation for the Measured Intensity Multiplier cannot exceed 0.2.

### Repeatability 1 (IOPS)

#### Measured Intensity Multiplier and Coefficient of Variation

	ASU1-1	ASU1-2	ASU1-3	ASU1-4	ASU2-1	ASU2-2	ASU2-3	ASU3-1
IM	0.0350	0.2810	0.0700	0.2100	0.0180	0.0700	0.0350	0.2810
MIM	.0350	.2811	.0701	.2099	.0181	.0700	.0351	.2808
COV	.0079	.0015	.0045	.0036	.0109	.0042	.0067	.0024

### Repeatability 2 (LRT)

#### Measured Intensity Multiplier and Coefficient of Variation

	ASU1-1	ASU1-2	ASU1-3	ASU1-4	ASU2-1	ASU2-2	ASU2-3	ASU3-1
IM	0.0350	0.2810	0.0700	0.2100	0.0180	0.0700	0.0350	0.2810
MIM	.0349	.2820	.0699	.2096	.0183	.0700	.0346	.2807
COV	.0186	.0043	.0202	.0088	.0258	.0144	.0184	.0040

### Repeatability 2 (IOPS)

#### Measured Intensity Multiplier and Coefficient of Variation

	ASU1-1	ASU1-2	ASU1-3	ASU1-4	ASU2-1	ASU2-2	ASU2-3	ASU3-1
IM	0.0350	0.2810	0.0700	0.2100	0.0180	0.0700	0.0350	0.2810
MIM	.0350	.2808	.0701	.2098	.0180	.0699	.0351	.2814
COV	.0062	.0020	.0049	.0016	.0093	.0058	.0048	.0016

## Data Persistence Test

### Clause 6

*The Data Persistence Test demonstrates the Tested Storage Configuration (TSC):*

- *Is capable of maintaining data integrity across a power cycle.*
- *Ensures the transfer of data between Logical Volumes and host systems occurs without corruption or loss.*

*The SPC-1 Workload Generator will write 16 block I/O requests at random over the total Addressable Storage Capacity of the TSC for ten (10) minutes at a minimum of 25% of the load used to generate the SPC-1 IOP™ primary metric. The bit pattern selected to be written to each block as well as the address of the block will be retained in a log file.*

*The Benchmark Configuration will be shutdown and restarted using a power off/power on cycle at the end of the above sequence of write operations. In addition, any caches employing battery backup must be flushed/emptied.*

*The SPC-1 Workload Generator will then use the above log file to verify each block written contains the correct bit pattern.*

### Clause 9.2.4.8

*The following content shall appear in this section of the FDR:*

1. *A listing or screen image of all input parameters supplied to the Workload Generator.*
2. *For the successful Data Persistence Test Run, able illustrating key results. The content, appearance, and format of this table are specified in Table 9-12. Information displayed in this table shall be obtained from the Test Run Results File referenced below in #3.*
3. *For the successful Data Persistence Test Run, the human readable Test Run Results File produced by the Workload Generator.*

## SPC-1 Workload Generator Input Parameters

The SPC-1 Workload Generator input parameters for the Data Persistence Test are listed below.

```
java -Xmx256m -Xms256m persist1 -b 242
java -Xmx256m -Xms256m persist2
```

## Data Persistence Test Results File

A link to each test result file generated from each Data Persistence Test is listed below.

[Persistence 1 Test Results File](#)

[Persistence 2 Test Results File](#)

## Data Persistence Test Results

Data Persistence Test Results	
Data Persistence Test Run Number: 1	
Total Number of Logical Blocks Written	28,811,248
Total Number of Logical Blocks Verified	22,708,176
Total Number of Logical Blocks that Failed Verification	0
Time Duration for Writing Test Logical Blocks	10 minutes
Size in Bytes of each Logical Block	512
Number of Failed I/O Requests in the process of the Test	0

In some cases the same address was the target of multiple writes, which resulted in more Logical Blocks Written than Logical Blocks Verified. In the case of multiple writes to the same address, the pattern written and verified must be associated with the last write to that address.

## **TESTED STORAGE CONFIGURATION (TSC) AVAILABILITY DATE**

### **Clause 9.2.4.9**

*The FDR shall state: "The Tested Storage Configuration, as documented in this Full Disclosure Report will be available for shipment to customers on MM DD YY." Where Tested Storage Configuration is the TSC Configuration Name as described in Clause 9.2.4.3.3 and MM is month, DD is the day, and YY is the year of the date that the configuration, as documented, is available for shipment to customers.*

The IBM TotalStorage DS4300 with Turbo Option (*non-mirrored write cache*), as documented in this Full Disclosure Report will become available for customer purchase and shipment on September 12, 2003.

## **PRICING INFORMATION**

### **Clause 9.2.4.11**

*A statement of the respective calculations for pricing must be included.*

Pricing information may found in the Tested Storage Configuration Pricing section on page 13.

## **ANOMALIES OR IRREGULARITIES**

### **Clause 9.2.4.10**

*The FDR shall include a clear and complete description of any anomalies or irregularities encountered in the course of executing the SPC-1 benchmark that may in any way call into question the accuracy, verifiability, or authenticity of information published in this FDR.*

There were no anomalies or irregularities observed during the course of the benchmark measurement of the IBM TotalStorage DS4300 with Turbo Option (*non-mirrored cache*).

## **APPENDIX A: TSC CONFIGURATION SCRIPT**

```

/* SPC-1 configuration script */
/* for the 2882 with 54 drives. */

set controller[a] mode = active;
set controller[b] mode = active;

create volume drives[ 0,1 0,2 0,3 0,4 0,5 0,6 0,7 0,8 0,9 0,10 0,11 0,12 0,13 0,14 1,1
1,2 1,3 1,4 1,5 1,6 1,7 1,8 1,9 1,10 1,11 1,12 1,13 1,14 2,1 2,2 ]
RAIDLevel=1
segmentSize=128
userLabel="LUN 0"
capacity=205324mb
owner = A;

create volume drives[ 2,3 2,4 2,5 2,6 2,7 2,8
2,9 2,10 2,11 2,12 2,13 2,14 ]
RAIDLevel=1
segmentSize=512
userLabel="LUN 1"
capacity=205324mb
owner = b;

create volume drives[ 3,1 3,2 3,3 3,4 3,5 3,6
3,7 3,8 3,9 3,10 3,11 3,12 ]
RAIDLevel=1
segmentSize=64
userLabel="LUN 2"
capacity=45628mb
owner = b;

set volume["LUN 0"] mirrorEnabled = False writeCacheEnabled = True cacheWithoutBatteryEnabled = False readAheadMultiplier = 0;
set volume["LUN 1"] mirrorEnabled = False writeCacheEnabled = True cacheWithoutBatteryEnabled = False readAheadMultiplier = 0;
set volume["LUN 2"] mirrorEnabled = False writeCacheEnabled = True cacheWithoutBatteryEnabled = False readAheadMultiplier = 0;

set storageArray cacheFlushStop = 70 cacheFlushStart = 70;

set storageArray defaultHostType = "Windows 2000/Server 2003 Non-Clustered";

set controller[a] HostNVSRAMByte[0x01, 0x17]=0x01;
set controller[b] HostNVSRAMByte[0x01, 0x17]=0x01;

/* Setup for RDAC failover environment */

set controller[a] HostNVSRAMByte[0x00, 0x24]=0x00;
set controller[a] HostNVSRAMByte[0x01, 0x24]=0x00;
set controller[a] HostNVSRAMByte[0x02, 0x24]=0x00;
set controller[a] HostNVSRAMByte[0x03, 0x24]=0x00;
set controller[a] HostNVSRAMByte[0x04, 0x24]=0x00;
set controller[a] HostNVSRAMByte[0x05, 0x24]=0x00;
set controller[a] HostNVSRAMByte[0x06, 0x24]=0x00;
set controller[a] HostNVSRAMByte[0x07, 0x24]=0x00;
set controller[a] HostNVSRAMByte[0x08, 0x24]=0x00;
set controller[a] HostNVSRAMByte[0x09, 0x24]=0x00;
set controller[a] HostNVSRAMByte[0x0a, 0x24]=0x00;
set controller[a] HostNVSRAMByte[0x0b, 0x24]=0x00;
set controller[a] HostNVSRAMByte[0x0c, 0x24]=0x00;

```

```
set controller[a] HostNVSRAMByte[0x0d, 0x24]=0x00;
set controller[a] HostNVSRAMByte[0x0e, 0x24]=0x00;
set controller[a] HostNVSRAMByte[0x0f, 0x24]=0x00;

set controller[b] HostNVSRAMByte[0x00, 0x24]=0x00;
set controller[b] HostNVSRAMByte[0x01, 0x24]=0x00;
set controller[b] HostNVSRAMByte[0x02, 0x24]=0x00;
set controller[b] HostNVSRAMByte[0x03, 0x24]=0x00;
set controller[b] HostNVSRAMByte[0x04, 0x24]=0x00;
set controller[b] HostNVSRAMByte[0x05, 0x24]=0x00;
set controller[b] HostNVSRAMByte[0x06, 0x24]=0x00;
set controller[b] HostNVSRAMByte[0x07, 0x24]=0x00;
set controller[b] HostNVSRAMByte[0x08, 0x24]=0x00;
set controller[b] HostNVSRAMByte[0x09, 0x24]=0x00;
set controller[b] HostNVSRAMByte[0x0a, 0x24]=0x00;
set controller[b] HostNVSRAMByte[0x0b, 0x24]=0x00;
set controller[b] HostNVSRAMByte[0x0c, 0x24]=0x00;
set controller[b] HostNVSRAMByte[0x0d, 0x24]=0x00;
set controller[b] HostNVSRAMByte[0x0e, 0x24]=0x00;
set controller[b] HostNVSRAMByte[0x0f, 0x24]=0x00;
```