

# Using Block Volumes Service Metrics to Calculate Block Volume Throughput and IOPS

On the Oracle Cloud Infrastructure Console

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## Revision History

The following revisions have been made to this white paper since its initial publication:

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Date	Revision
June 21, 2019	Initial publication

You can find the most recent versions of the Oracle Cloud Infrastructure white papers at <https://cloud.oracle.com/iaas/technical-resources>.



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## Overview

The Oracle Cloud Infrastructure Block Volumes service provides metrics that let you view the health, capacity, and performance of your block volumes. This paper walks you through a performance testing scenario to show how you can use these metrics to determine the performance characteristics of your block volumes.

In this scenario, you run Flexible I/O Tester (FIO) commands on an Oracle Cloud Infrastructure Compute instance against an attached block volume. Then, you compare the output to the Block Volumes service metrics that are available in the Console to correlate the performance characteristics.

## Scope and Assumptions

You should already be familiar with FIO, a tool that you can use to simulate I/O workloads for testing purposes.

The instance shape used for the tests is VM.Standard2.24. For more information about this shape, see [Compute Shapes](#). The volume size used for throughput tests is 1000 GB. The volume size used for IOPS tests is 600 GB.

Compute instances have differing amounts of available network bandwidth, based on their “size” (that is, the number of cores). These tests use a 24-core VM because the full 25-Gbps network bandwidth is also used.

The Block Volumes performance metrics and characteristics are published in [the service documentation](#).

## Block Volume Performance Metrics

The performance characteristics for block volumes are throughput, I/O operations, and latency.

The Block Volumes service metrics can help you measure the volume operations and throughput that correspond to the Compute instances that the volumes are attached to. The available metrics in the Console related to block volume performance are as follows:

- Volume Read Throughput (unit: bytes)
- Volume Write Throughput (unit: bytes)
- Volume Read Operations (unit: reads)
- Volume Write Operations (unit: writes)

For more information, see [Block Volume Metrics](#).

## Calculating Throughput

Calculate the random read throughput on one of the block volumes attached to your instance by running the following FIO command:

```
sudo fio --direct=1 --rw=randread --bs=64k --ioengine=libaio --iodepth=64
--runtime=120 --numjobs=4 --time_based --group_reporting --name=throughput-test-
job --eta-newline=1 --filename=/dev/oracleoci/oraclelvd
```

Following is an example of the output summary of the command. The last few lines show that the read throughput is 340MB/s. The command ran for 120 seconds, from 17:44:17 to 17:46:17.

```
throughput-test-job: (groupid=0, jobs=4): err= 0: pid=22474: Wed May 29 17:46:17
2019
  read: IOPS=5185, BW=324MiB/s (340MB/s) (37.0GiB/120058msec)
    slat (usec): min=3, max=73323, avg=757.32, stdev=4254.17
    clat (usec): min=693, max=430115, avg=48603.48, stdev=24652.88
      lat (usec): min=699, max=430122, avg=49362.02, stdev=25030.76
    clat percentiles (msec):
      | 1.00th= [ 12], 5.00th= [ 18], 10.00th= [ 22], 20.00th= [ 27],
      | 30.00th= [ 34], 40.00th= [ 41], 50.00th= [ 46], 60.00th= [ 52],
      | 70.00th= [ 57], 80.00th= [ 66], 90.00th= [ 81], 95.00th= [ 94],
      | 99.00th= [ 123], 99.50th= [ 140], 99.90th= [ 203], 99.95th= [ 222],
      | 99.99th= [ 279]
    bw (KiB/s): min=64512, max=126722, per=24.99%, avg=82916.28, stdev=8082.73,
samples=960
    iops: min= 1008, max= 1980, avg=1295.43, stdev=126.32, samples=960
    lat (usec): 750=0.01%, 1000=0.01%
    lat (msec): 2=0.03%, 4=0.08%, 10=0.56%, 20=7.67%, 50=49.47%
    lat (msec): 100=38.73%, 250=3.43%, 500=0.02%
    cpu: usr=0.54%, sys=1.40%, ctx=28118, majf=0, minf=2084
    IO depths: 1=0.1%, 2=0.1%, 4=0.1%, 8=0.1%, 16=0.1%, 32=0.1%, >=64=100.0%
      submit: 0=0.0%, 4=100.0%, 8=0.0%, 16=0.0%, 32=0.0%, 64=0.0%, >=64=0.0%
      complete: 0=0.0%, 4=100.0%, 8=0.0%, 16=0.0%, 32=0.0%, 64=0.1%, >=64=0.0%
      issued rwts: total=622531,0,0, short=0,0,0, dropped=0,0,0
      latency: target=0, window=0, percentile=100.00%, depth=64

Run status group 0 (all jobs):
  READ: bw=324MiB/s (340MB/s), 324MiB/s-324MiB/s (340MB/s-340MB/s), io=37.0GiB
(40.8GB), run=120058-120058msec
```

Now check the block volume metrics in the Console to see how they compare. To view the metrics from the Console, follow these steps:

1. Open the navigation menu. Under **Core infrastructure**, go to **Compute** and click **Instances**.
2. Click the instance to view its details.
3. Click **Attached Block Volumes**.
4. Click the volume to view its details.
5. Under **Resources**, click **Metrics**.
6. For **Start Time**, specify the same time that the FIO command started to run. In this example, that value is `2019-05-29 17:44`.
7. For **End Time**, specify `2019-05-29 17:50`.
8. For **Volume Read Throughput**, select `1 minute` for **Interval** and select `Sum` for **Statistic**.

The result should be similar to Figure 1. Figures 2–4 identify the three data points to use for calculating the read throughput from the FIO test.

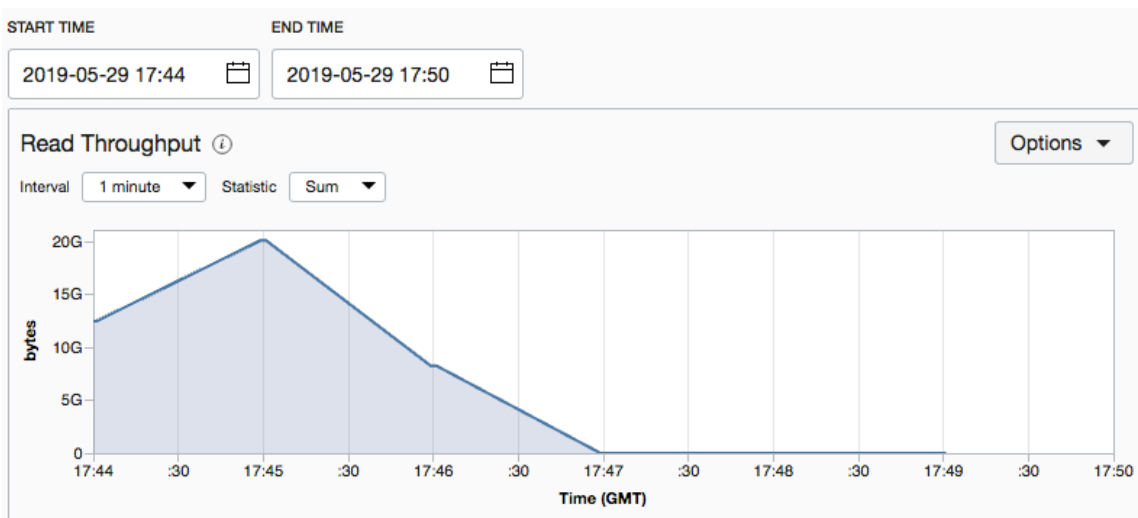


Figure 1. Read Throughput Metric for the Block Volume on 2019-05-29 from 17:44 to 17:50

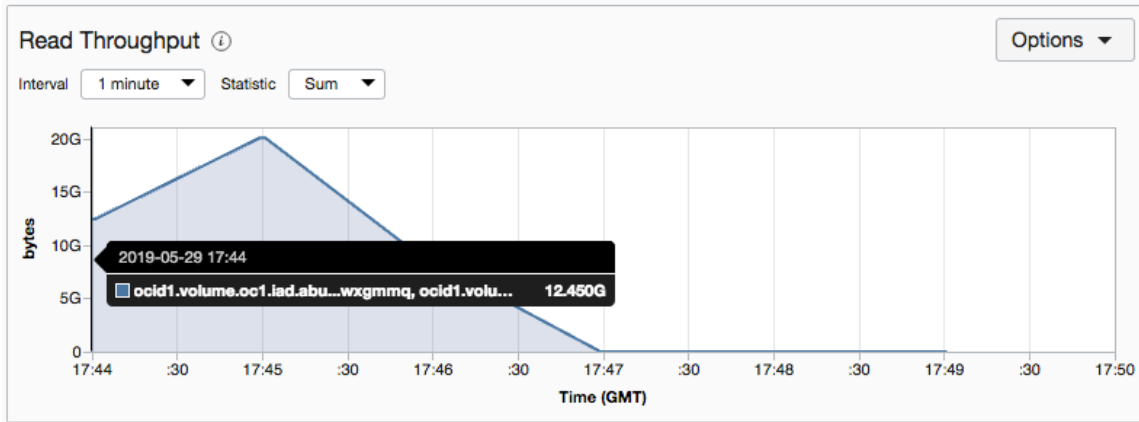


Figure 2. Read Throughput Metric Data at 2019-05-29 17:44

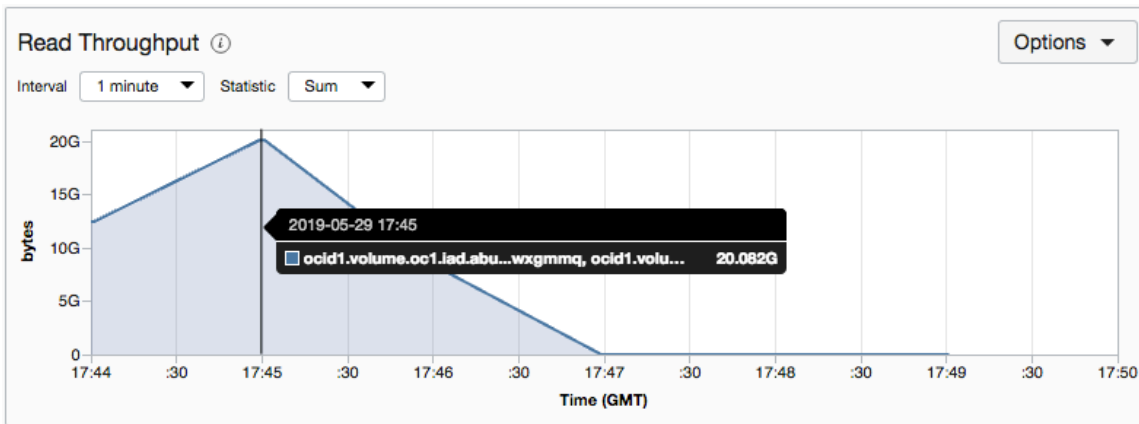


Figure 3. Read Throughput Metric Data at 2019-05-29 17:45

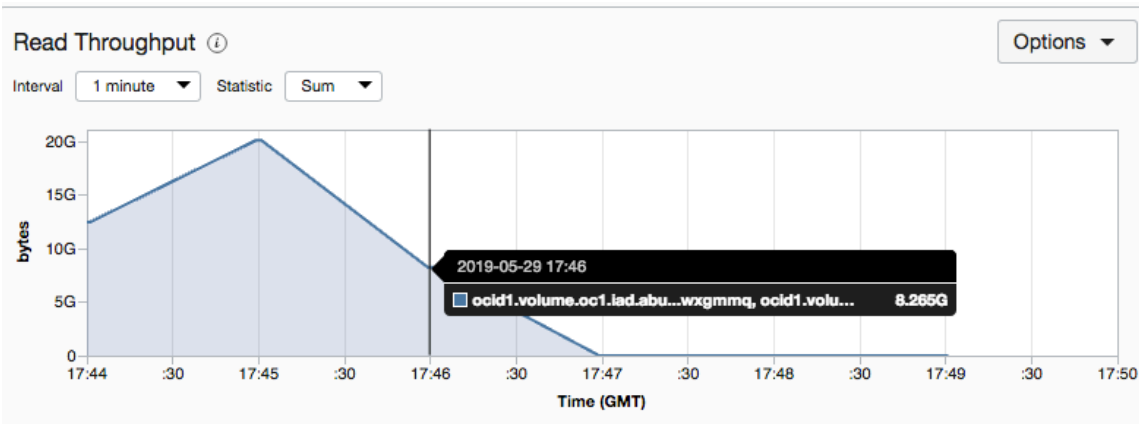


Figure 4. Read Throughput Metric Data at 2019-05-29 17:46

Add the values for the three individual data points. Divide the result by the number of seconds in the test (120) and then multiply by 1000 to get the throughput result in MB/s. For example:

```
Throughput in MB/s = ((12.450 + 20.082 + 8.265) / 120) * 1000 = 339.975 MB/s  
~ 340 MB/s
```

## Calculating IOPS

Calculate the random read/write IOPS on one of the block volumes attached to your instance by running the following FIO command:

```
sudo fio --direct=1 --rw=randrw --bs=4k --ioengine=libaio --iodepth=64 --  
runtime=120 --numjobs=4 --time_based --group_reporting --name=iops-test-job --  
eta-newline=1 --filename=/dev/oracleoci/oracleovdb
```

Following is an example of the output summary for the command. The last few lines show that the read IOPS is 12.5K and the write IOPS is 12.5K. The command ran for 120 seconds, from 18:22:17 to 18:24:17.

```
iops-test-job: (groupid=0, jobs=4): err= 0: pid=22927: Wed May 29 18:24:17 2019  
read: IOPS=12.5k, BW=48.9MiB/s (51.3MB/s) (5871MiB/120017msec)  
slat (usec): min=3, max=118179, avg=150.47, stdev=878.65  
clat (usec): min=392, max=163931, avg=6144.75, stdev=4087.94  
lat (usec): min=397, max=163936, avg=6296.45, stdev=4187.81  
clat percentiles (usec):  
| 1.00th= [ 1614], 5.00th= [ 2409], 10.00th= [ 3130], 20.00th= [ 3916],  
| 30.00th= [ 4621], 40.00th= [ 4883], 50.00th= [ 5211], 60.00th= [ 5932],  
| 70.00th= [ 6783], 80.00th= [ 7898], 90.00th= [ 9241], 95.00th= [ 10814],  
| 99.00th= [ 22414], 99.50th= [ 31327], 99.90th= [ 47973], 99.95th= [  
56886],  
| 99.99th= [100140]  
bw (KiB/s): min= 8248, max=14976, per=24.99%, avg=12520.27, stdev=938.78,  
samples=960  
iops: min= 2062, max= 3744, avg=3130.01, stdev=234.70, samples=960  
write: IOPS=12.5k, BW=48.9MiB/s (51.3MB/s) (5871MiB/120017msec)  
slat (usec): min=3, max=112365, avg=149.63, stdev=867.45  
clat (usec): min=478, max=179211, avg=13984.93, stdev=8679.88  
lat (usec): min=486, max=179217, avg=14135.79, stdev=8725.78  
clat percentiles (msec):  
| 1.00th= [ 3], 5.00th= [ 5], 10.00th= [ 6], 20.00th= [ 8],  
| 30.00th= [ 9], 40.00th= [ 11], 50.00th= [ 12], 60.00th= [ 15],  
| 70.00th= [ 18], 80.00th= [ 21], 90.00th= [ 25], 95.00th= [ 28],  
| 99.00th= [ 45], 99.50th= [ 53], 99.90th= [ 74], 99.95th= [ 89],  
| 99.99th= [ 130]  
bw (KiB/s): min= 8688, max=14856, per=24.99%, avg=12519.41, stdev=922.13,  
samples=960  
iops: min= 2172, max= 3714, avg=3129.80, stdev=230.54, samples=960  
lat (usec): 500=0.01%, 750=0.01%, 1000=0.02%  
lat (msec): 2=1.44%, 4=10.97%, 10=53.59%, 20=22.94%, 50=10.68%
```



```
lat (msec): 100=0.33%, 250=0.02%
cpu: usr=2.62%, sys=6.75%, ctx=163832, majf=0, minf=42
IO depths: 1=0.1%, 2=0.1%, 4=0.1%, 8=0.1%, 16=0.1%, 32=0.1%, >=64=100.0%
  submit: 0=0.0%, 4=100.0%, 8=0.0%, 16=0.0%, 32=0.0%, 64=0.0%, >=64=0.0%
  complete: 0=0.0%, 4=100.0%, 8=0.0%, 16=0.0%, 32=0.0%, 64=0.1%, >=64=0.0%
  issued rwt: total=1503007,1503029,0, short=0,0,0, dropped=0,0,0
  latency: target=0, window=0, percentile=100.00%, depth=64
```

Run status group 0 (all jobs):

```
  READ: bw=48.9MiB/s (51.3MB/s), 48.9MiB/s-48.9MiB/s (51.3MB/s-51.3MB/s),
io=5871MiB (6156MB), run=120017-120017msec
  WRITE: bw=48.9MiB/s (51.3MB/s), 48.9MiB/s-48.9MiB/s (51.3MB/s-51.3MB/s),
io=5871MiB (6156MB), run=120017-120017msec
```

Now check the block volume metrics in the Console to see how they compare. To view the metrics from the Console, follow these steps:

1. Open the navigation menu. Under **Core Infrastructure**, go to **Compute** and click **Instances**.
2. Click the instance to view its details.
3. Click **Attached Block Volumes**.
4. Click the volume to view its details.
5. Under **Resources**, click **Metrics**.
6. For **Start Time**, specify the same time that the FIO command started to run. In this example, that value is `2019-05-29 18:22`.
7. For **End Time**, specify `2019-05-29 18:26`.
8. For **Volume Read IOPS**, select `1 minute` for **Interval** and select `Sum` for **Statistic**.

The result should be similar to Figure 5. Figures 6–8 identify the three data points to use for calculating the read IOPS from the FIO test.

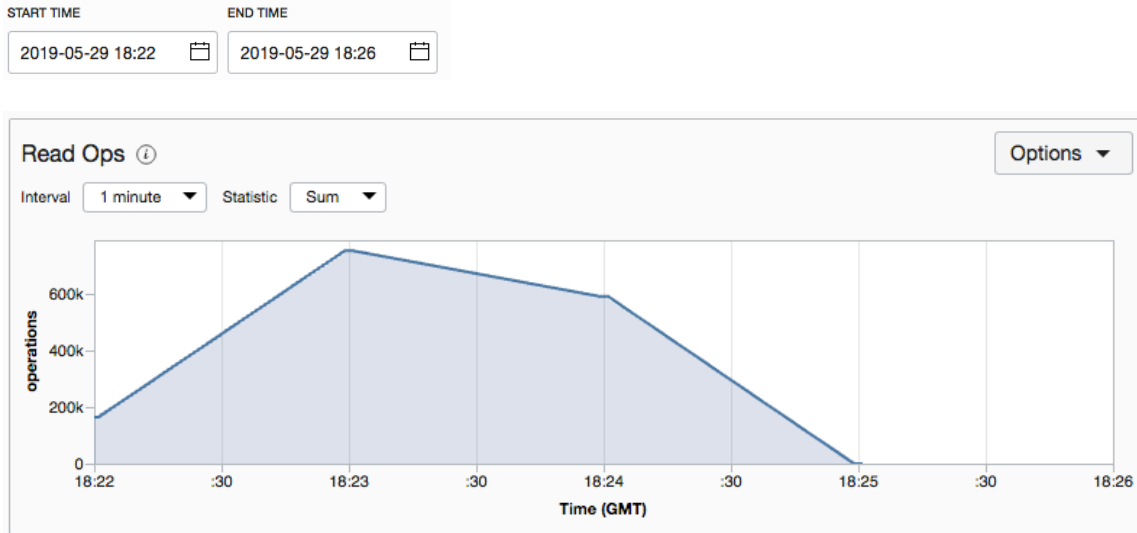


Figure 5. Read Operations Metric for the Block Volume on 2019-05-29 from 18:22 to 18:26

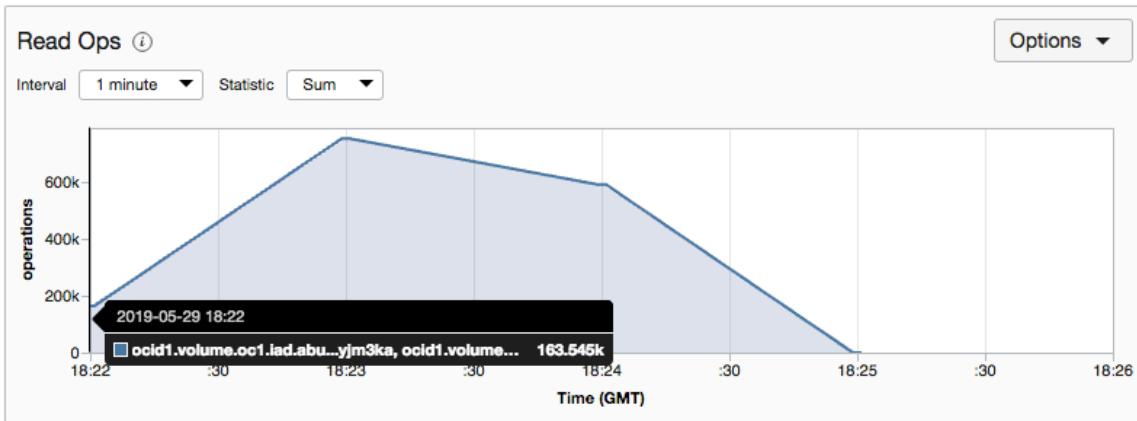


Figure 6. Read Operations Metric Data at 2019-05-29 18:22

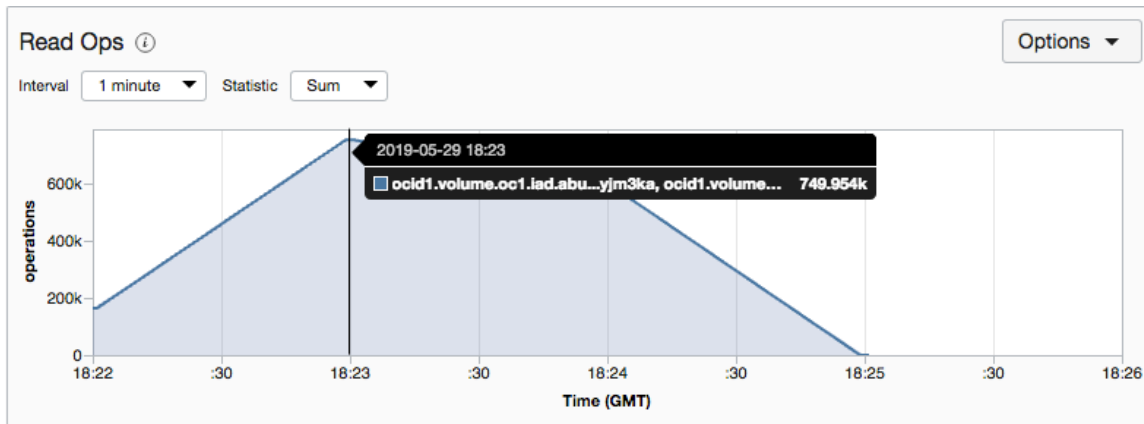


Figure 7. Read Operations Metric Data at 2019-05-29 18:23

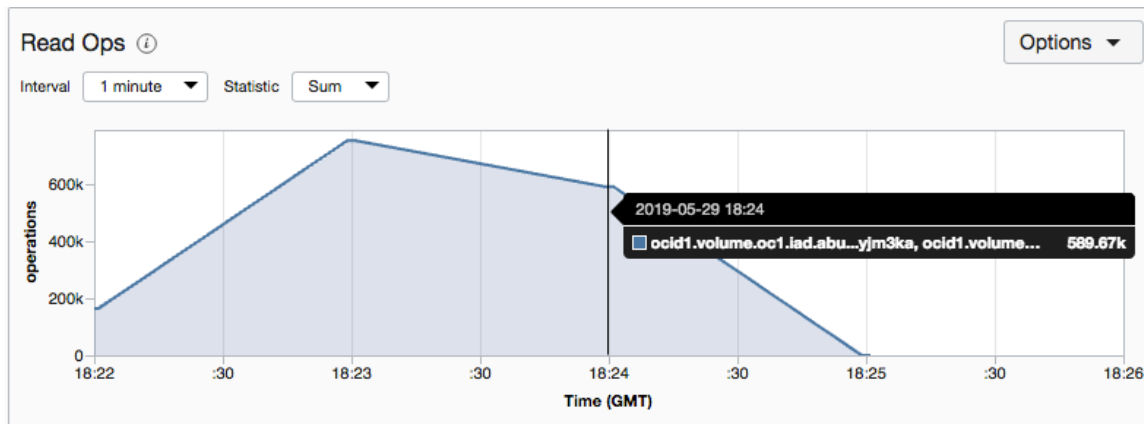


Figure 8. Read Operations Metric Data at 2019-05-29 18:24

Add the values for the three individual data points. Divide the result by the number of seconds in the test (120) and then multiply by 1000 to get the read IOPS result. For example:

$$\text{Read IOPS} = ((163.545k + 749.954k + 589.67k) / 120) * 1000 = 12.5K$$

To get the values for calculating the write IOPS, use the same start time and end time values on the block volume's metrics and then set the following for the **Volume Write Operations** metric:

- Set **Interval** to 1 minute.
- Set **Statistic** to Sum.

The result should be similar to Figure 9. Figures 10–12 identify the three data points to use for calculating the write IOPS from the FIO test.



Figure 9. Write Operations Metric for the Block Volume on 2019-05-29 from 18:22 to 18:26

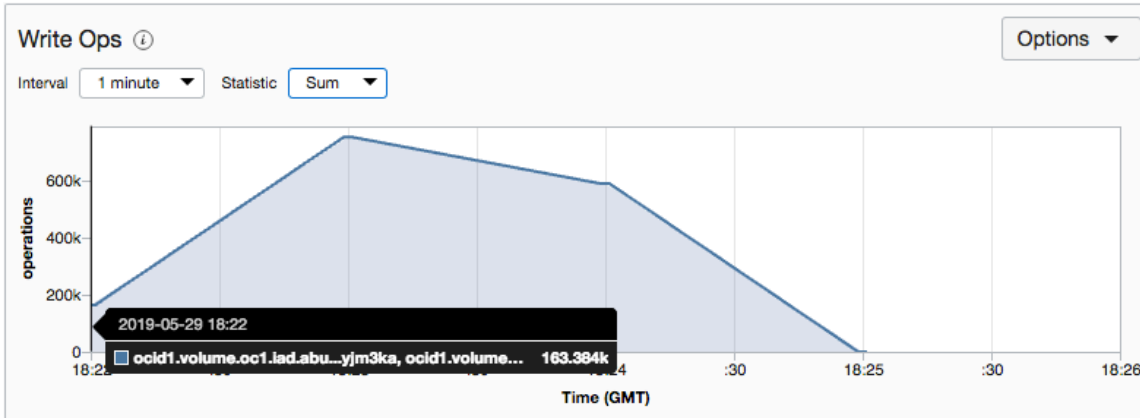


Figure 10. Write Operations Metric Data at 2019-05-29 18:22

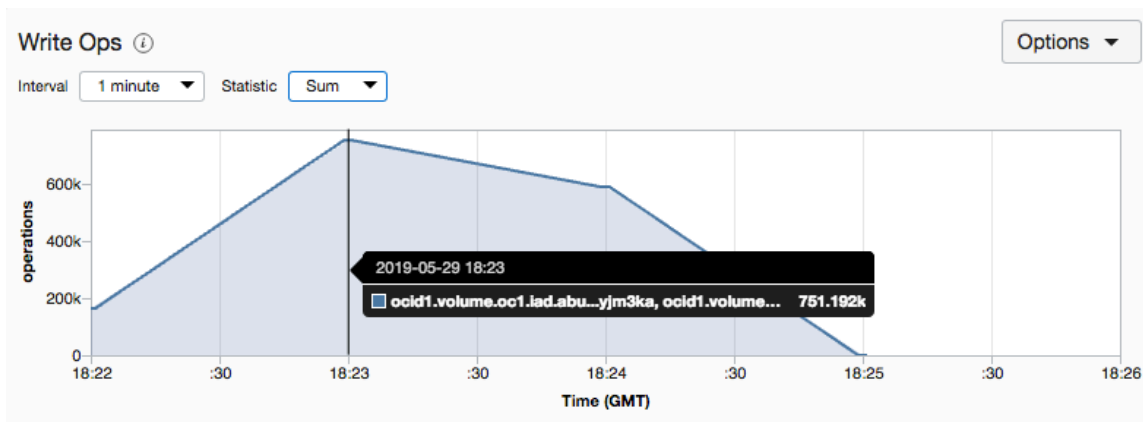


Figure 11. Write Operations Metric Data at 2019-05-29 18:23

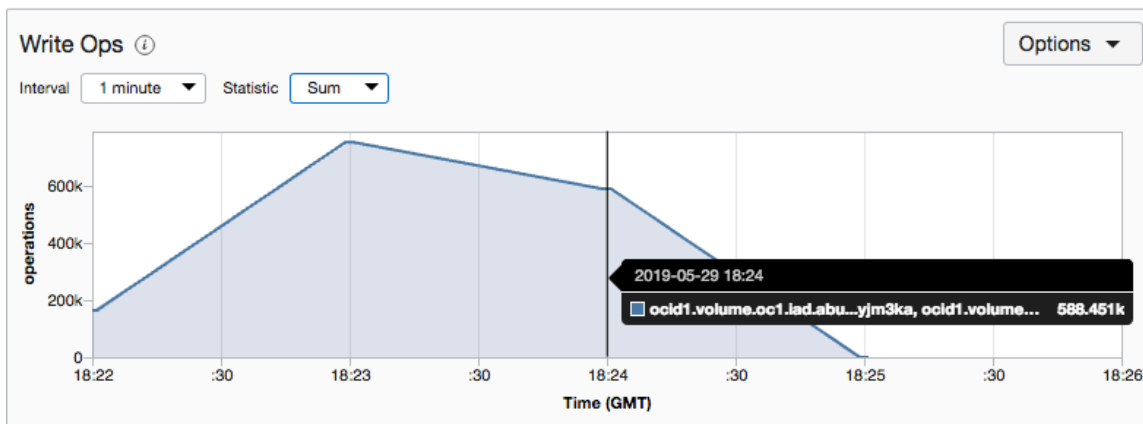


Figure 12. Write Operations Metric Data at 2019-05-29 18:24

Add the values for the three individual data points. Divide the result by the number of seconds in the test (120) and then multiply by 1000 to get the write IOPS result. For example:

$$\text{Write IOPS} = ((163.384k + 751.192k + 588.451k) / 120) * 1000 = 12.5K$$

## Conclusion

This paper explains how to obtain block volume performance metrics from the Console and establish their consistency and performance. For information about obtaining the same information through the API, see the [Block Volumes documentation](#).




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