TPC Express Benchmark™ HS
Full Disclosure Report

InspurCloud Physical Server for Data
(with 22x InspurCloud Data-Cloud Servers)

Running

InspurCloud Data Cloud Platform 5.1.0
on
CentOS Linux 8.5

TPCx-HS Version 2.0.3
Report Edition First
Report Submitted January 30, 2024
First Edition - January 2024

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Abstract

This document contains the methodology and results of the TPC Express Benchmark™ HS (TPCx-HS) test conducted in conformance with the requirements of the TPCx-HS Standard Specification, Revision 2.0.3.

The benchmark results are summarized below.

<table>
<thead>
<tr>
<th>Measured Configuration</th>
</tr>
</thead>
<tbody>
<tr>
<td>Company Name</td>
</tr>
<tr>
<td>Inspur Cloud</td>
</tr>
<tr>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>TPC Express Benchmark™ HS Metrics</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total System Cost</td>
</tr>
<tr>
<td>$704,148</td>
</tr>
</tbody>
</table>

Executive Summary

The Executive Summary follows on the next several pages.
## EXECUTIVE SUMMARY

**InspurCloud Physical Server for Data**

<table>
<thead>
<tr>
<th>Availability Date</th>
<th>TPCx-HS Performance</th>
<th>Price/Performance</th>
<th>Total System Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>January 30, 2024</td>
<td>53.19 HSPh@1TB</td>
<td>$13,238.36 $ / HSPh@1TB</td>
<td>$704,148 USD</td>
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### System Under Test Configuration Overview

<table>
<thead>
<tr>
<th>Scale Factor</th>
<th>Hadoop Software</th>
<th>Operating System</th>
<th>Other Software</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>InspurCloud Data Cloud Platform 5.1.0</td>
<td>CentOS Linux 8.5</td>
<td>N/A</td>
</tr>
</tbody>
</table>

### System Under Test Configuration Details

**Physical Storage/Scale Factor: 605.44**

- **Total Number of Servers:** 22 (22x InspurCloud Data-Cloud)
- **Total Processors/Cores/Threads:** 44/1,408/2,816

**Server Configuration:**

- **Processors**: 2x AMD EPYC 9374F 32-Core Processor
- **Memory**: 512 GiB
- **Storage Controller**: 1x Broadcom / LSI SAS3008
- **Storage Device**: 2x 960 GB SATA SSD
- **Network**: 8x 3.2 TB NVMe
- **Connectivity**: 2x Mellanox MCX556A-ECAT100 Gb 2-port (all nodes)

**Network:**

- 1x Intel i350 1 Gb (all nodes)
- 1x Intel x710 10 Gb (12 nodes)

**Connectivity:**

1x H3C S5560 Series; 1x Huawei CloudEngine 8850-64CQ-EI
### EXECUTIVE SUMMARY

<table>
<thead>
<tr>
<th>InspurCloud Physical Server for Data</th>
<th>TPCx-HS 2.0.3</th>
</tr>
</thead>
<tbody>
<tr>
<td>TPC Pricing</td>
<td>2.9.0</td>
</tr>
<tr>
<td>Report Date</td>
<td>Jan. 30, 2024</td>
</tr>
</tbody>
</table>

#### TPCx-HS 2.0.3

**Inspur Cloud Physical Server for Data**

**Report Date**: Jan. 30, 2024

**TPC Pricing**: 2.9.0

---

**Table: Pricing**

<table>
<thead>
<tr>
<th>Description</th>
<th>Part Number</th>
<th>Source</th>
<th>Unit Price</th>
<th>Qty</th>
<th>Extended Price</th>
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</thead>
<tbody>
<tr>
<td>Server Hardware</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>InspurCloud Data-Cloud Server</strong></td>
<td>P54199-B21</td>
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<td>$5,566.00</td>
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<td><strong>AMD EPYC 9374F 3.8GHz 32-core 320W Processor</strong></td>
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<td>352</td>
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<td>$420.00</td>
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<td>$73,920.00</td>
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<td><strong>1600W redundant single output power supply with inp</strong></td>
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<td>$210.00</td>
<td>44</td>
<td>$9,240.00</td>
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<tr>
<td><strong>Software</strong></td>
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<td></td>
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<tr>
<td><strong>InspurCloud Data Cloud Platform 5.1.0 Subscription Edition - 3 Years</strong></td>
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<td><strong>Monitor</strong></td>
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**Pricing**: 1 = Inspur Cloud

**Audited by Doug Johnson, InfoSizing**

**TPC Pricing**: 2.9.0

**Report Date**: Jan. 30, 2024

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**Prices used in TPC benchmarks reflect the actual prices a customer would pay for a one-time purchase of the stated Line Items. Individually negotiated discounts are not permitted. Special prices based on assumptions about past or future purchases are not permitted. All discounts reflect standard pricing policies for the listed Line Items. For complete details, see the pricing section of the TPC Benchmark Standard. If you find that the stated prices are not available according to these terms, please inform the TPC at pricing@tpc.org. Thank you.**
## Numerical Quantities

### Performance Run – Run 1

<table>
<thead>
<tr>
<th>Scale Factor</th>
<th>1TB</th>
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</thead>
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<td>Run Start Time</td>
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<tr>
<td>Run End Time</td>
<td>2024-01-29 18:48:40.000</td>
</tr>
<tr>
<td>Run Elapsed Time</td>
<td>68.000</td>
</tr>
<tr>
<td>HSGen Start Time</td>
<td>2024-01-29 18:47:34.000</td>
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<td>HSGen End Time</td>
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<td>HSGen Elapsed Time</td>
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<td>HSSort End Time</td>
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<td>HSVValidate End Time</td>
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<td>HSVValidate Elapsed Time</td>
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</table>

### Repeatability Run – Run 2

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<th>Scale Factor</th>
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<td>Run Start Time</td>
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<td>Run Elapsed Time</td>
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<tr>
<td>HSGen Start Time</td>
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<td>HSGen End Time</td>
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<td>HSSort Start Time</td>
<td>2024-01-29 18:49:10.000</td>
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<td>HSSort End Time</td>
<td>2024-01-29 18:49:50.000</td>
</tr>
<tr>
<td>HSSort Elapsed Time</td>
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<tr>
<td>HSVValidate Start Time</td>
<td>2024-01-29 18:49:52.000</td>
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<tr>
<td>HSVValidate End Time</td>
<td>2024-01-29 18:49:59.000</td>
</tr>
<tr>
<td>HSVValidate Elapsed Time</td>
<td>7.969</td>
</tr>
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</table>
Run Reports

Run Report for Performance Run – Run 1
====================================================
TPCx-HS Performance Metric (HSph@SF) Report

Test Run 1 Details
Total Time = 68
Total Size = 10000000000
Scale-Factor = 1

TPCx-HS Performance Metric (HSph@SF): 53.1914

====================================================

Run Report for Repeatability Run – Run 2
====================================================
TPCx-HS Performance Metric (HSph@SF) Report

Test Run 2 Details
Total Time = 68
Total Size = 10000000000
Scale-Factor = 1

TPCx-HS Performance Metric (HSph@SF): 53.1914

====================================================
### InspurCloud Physical Server for Data

**TPCx-HS** 2.0.3  
**TPC Pricing** 2.9.0  
**Report Date** Jan. 30, 2024

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<table>
<thead>
<tr>
<th>Date</th>
<th>Edition</th>
<th>Description</th>
</tr>
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<tbody>
<tr>
<td>January 30, 2024</td>
<td>First</td>
<td>Initial Publication</td>
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Clause 0 – Preamble

0.1 TPC Express Benchmark™ HS Overview

The TPC Express Benchmark™ HS (TPCx-HS) was developed to provide an objective measure of hardware, operating system and commercial Apache Hadoop File System API compatible software distributions, and to provide the industry with verifiable performance, price-performance and availability metrics. The benchmark models a continuous system availability of 24 hours a day, 7 days a week.

Even though the modeled application is simple, the results are highly relevant to hardware and software dealing with Big Data systems in general. TPCx-HS stresses both hardware and software including Hadoop run-time, Hadoop File-system API compatible systems and MapReduce layers. This workload can be used to assess a broad range of system topologies and implementation of Hadoop clusters. TPCx-HS can be used to assess a broad range of system topologies and implementation methodologies in a technically rigorous and directly comparable and vendor-neutral manner.

The TPCx-HS kit is available from the TPC (See www.tpc.org/tpcx-hs for more information). Users must sign-up and agree to the TPCx-HS User Licensing Agreement (ULA) to download the kit. Re-distribution of the kit is prohibited. All related work (such as collaterals, papers, derivatives) must acknowledge the TPC and include TPCx-HS copyright. The TPCx-HS Kit includes: TPCx-HS Specification document, TPCx-HS Users Guide documentation, shell scripts to set up the benchmark environment and Java code to execute the benchmark load.

The purpose of TPC benchmarks is to provide relevant, objective performance data to industry users. To achieve that purpose, TPC benchmark specifications require that benchmark tests be implemented with systems, products, technologies and pricing that:

• Are generally available to users;

• Are relevant to the market segment that the individual TPC benchmark models or represents (e.g., TPCx-HS models and represents Hadoop run-time and Hadoop File-system API compatible systems);

• Would plausibly be implemented by a significant number of users in the market segment the benchmark models or represents.

The use of new systems, products, technologies (hardware or software) and pricing is encouraged so long as they meet the requirements above. Specifically prohibited are benchmark systems, products, technologies or pricing (hereafter referred to as "implementations") whose primary purpose is performance optimization of TPC benchmark results without any corresponding applicability to real-world applications and environments. In other words, all "benchmark special" implementations that improve benchmark results but not real-world performance or pricing, are prohibited.

The rules for pricing are included in the TPC Pricing Specification and rules for energy measurement are included in the TPC Energy Specification. Further information is available at www.tpc.org.
Clause 1 – General Items

1.1 Test Sponsor
A statement identifying the benchmark sponsor(s) and other participating companies must be provided.

This benchmark was sponsored by Inspur Cloud Information Technology Co., Ltd.

1.2 Parameter Settings
Settings must be provided for all customer-tunable parameters and options which have been changed from the defaults found in actual products, including by not limited to:

- Configuration parameters and options for server, storage, network and other hardware component incorporated into the pricing structure;
- Configuration parameters and options for operating system and file system component incorporated into the pricing structure;
- Configuration parameters and options for any other software component incorporated into the pricing structure;
- Compiler optimization options.

Comment 1: In the event that some parameters and options are set multiple times, it must be easily discernible by an interested reader when the parameter or option was modified and what new value it received each time.

Comment 2: This requirement can be satisfied by providing a full list of all parameters and options, as long as all those that have been modified from their default values have been clearly identified and these parameters and options are only set once.

The supporting files contain the parameters and options used to configure the components involved in this benchmark.

1.3 Configuration Diagrams
Diagrams of both measured and priced configurations must be provided, accompanied by a description of the differences. This includes, but is not limited to:

- Total number of nodes used;
- Total number and type of processors used/total number of cores used/total number of threads used (including sizes of L2 and L3 caches);
- Size of allocated memory, and any specific mapping/partitioning of memory unique to the test;
- Number and type of disk units (and controllers, if applicable);
- Number of channels or bus connections to disk units, including their protocol type;
- Number of LAN (e.g., Ethernet) connections and speed for switches and other hardware components physically used in the test or are incorporated into the pricing structure;
- Type and the run-time execution location of software components.
1.3.1 Measured Configuration

The measured configuration consisted of:

- Total Nodes: 22 (22x InspurCloud Data-Cloud)
- Total Processors/Cores/Threads: 44/1,408/2,816
- Total Memory: 11.00 TiB
- Total Number of Storage Drives/Devices: 220
- Total Storage Capacity: 605.44 TB

Server node details:

- 22x InspurCloud Data-Cloud Servers, each with:
  - Processors/Cores/Threads: 2/64/128
  - Processor Model: AMD EPYC 9374F 32-Core Processor
  - Memory: 512 GiB
  - Controller: 1x Broadcom / LSI SAS3008
  - Drives:
    - 2x 960 GB SATA SSD
    - 8x 3.2 TB NVMe
  - Network:
    - 2x Mellanox MCX556A-ECAT100 Gb 2-port (all nodes)
    - 1x Intel I350 1 Gb (all nodes)
    - 1x Intel X710 10 Gb (12 nodes)

Network connectivity detail:

- 1x H3C S5560 Series
- 1x Huawei CloudEngine 8850-64CQ-EI

The distribution of software components over server nodes is detailed in section 1.5.

1.3.2 Priced Configuration

There are no differences between the priced configuration and the measured configuration.
1.4 Dataset Distribution

*The distribution of dataset across all media must be explicitly described.*

Table 1-1 describes the distribution of the dataset across all media in the system.

<table>
<thead>
<tr>
<th>Server Node</th>
<th>Controller</th>
<th>Disk Drive</th>
<th>Description of Content</th>
</tr>
</thead>
<tbody>
<tr>
<td>1-22</td>
<td>SATA</td>
<td>1x 960 GB SATA</td>
<td>OS, Root</td>
</tr>
<tr>
<td>1-22</td>
<td>NVMe</td>
<td>8x 3.2 TB NVMe</td>
<td>Data, Temp</td>
</tr>
</tbody>
</table>

*Table 1-1 Dataset Distribution*

1.5 Software Components Distribution

*The distribution of various software components across the system must be explicitly described.*

Table 1-2 Describes the distribution of the software components across the system.

<table>
<thead>
<tr>
<th>HDFS</th>
<th>ZooKeeper</th>
<th>Spark</th>
</tr>
</thead>
<tbody>
<tr>
<td>Node</td>
<td>NameNode</td>
<td>DataNode</td>
</tr>
<tr>
<td>1, 2</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>3</td>
<td>X</td>
<td>X</td>
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<td>4</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>5-22</td>
<td>X</td>
<td></td>
</tr>
</tbody>
</table>

*Table 1-2 Software Component Distribution*

*Distributed file system implementation and corresponding Hadoop File System API version must be disclosed.*

InspurCloud Data Cloud Platform 5.1.0 (fully HDFS compatible at the API level).

*Map/Reduce implementation and corresponding version must be disclosed.*

InspurCloud Data Cloud Platform 5.1.0 (compatible equivalent to Hadoop 3.1.4).
Clause 2 – Workload Related Items

2.1 Hardware & Software Tunables

*Script or text used to set for all hardware and software tunable parameters must be reported.*

The Supporting File Archive contains all configuration scripts.

2.2 Run Report

*The run report generated by TPCx-HS benchmark kit must be reported.*

The Supporting File Archive contains the full run report. Following are extracts from the run report that lists the performance summary for both runs.

```
Run Report for Run 1 – Performance Run
===========================================
TPCx-HS Performance Metric (HSph@SF) Report

Test Run 1 Details
Total Time = 68
Total Size = 10000000000
Scale-Factor = 1

TPCx-HS Performance Metric (HSph@SF): 53.1914

===========================================

Run Report for Run 2 – Repeatability Run
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TPCx-HS Performance Metric (HSph@SF) Report

Test Run 2 Details
Total Time = 68
Total Size = 10000000000
Scale-Factor = 1

TPCx-HS Performance Metric (HSph@SF): 53.1914

===========================================
```

2.3 Benchmark Kit Identification

*Version number of TPCx-HS kit and checksum for HSGen, HSSort and HSValidate Programs must be reported.*

<table>
<thead>
<tr>
<th>Kit Version</th>
<th>2.0.3</th>
</tr>
</thead>
<tbody>
<tr>
<td>File</td>
<td>MD5</td>
</tr>
<tr>
<td>BigData_cluster_validate_suite.sh</td>
<td>57f7cd68251a9aba0feb6648630f5da</td>
</tr>
<tr>
<td>HSDataCheck.sh</td>
<td>faeff3091759a98080be4e39f7896a</td>
</tr>
<tr>
<td>TPCx-HS-master_Spark.jar</td>
<td>19f3ce092066e056b884a85ee92fb77c</td>
</tr>
<tr>
<td>TPCx-HS-master.sh</td>
<td>b776e15d2d187186ea7911d9ce87e3a7</td>
</tr>
</tbody>
</table>

2.4 Benchmark Kit Changes

TPCx-HS-master.sh had minor syntax modifications to properly redirect stderr to stdout.
Clause 3 – SUT Related Items

3.1 Data Storage Ratio

The data storage ratio must be disclosed.

Table 3-1 describes the details of the storage devices configured on the system and their capacity.

<table>
<thead>
<tr>
<th>Quantity</th>
<th>Capacity (TB)</th>
<th>Total (TB)</th>
</tr>
</thead>
<tbody>
<tr>
<td>44</td>
<td>0.96</td>
<td>42.24</td>
</tr>
<tr>
<td>176</td>
<td>3.20</td>
<td>563.20</td>
</tr>
</tbody>
</table>

Table 3-1 Storage Device Capacities

Scale Factor = 1

Data Storage Ratio = (Total Storage (TB) / SF) = 605.44

3.2 Memory Ratio

The Scale Factor to memory ratio must be disclosed.

Total Configured Memory (TiB) = 11.00

Scale Factor to Memory Ratio = (SF / Total Memory(TiB)) = 0.09
Clause 4 – Metrics Related Items

4.1 HSGen Time
The HSGen time must be disclosed for Run1 and Run2.

<table>
<thead>
<tr>
<th></th>
<th>Run 1</th>
<th>Run 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>HSGen</td>
<td>14.815</td>
<td>15.218</td>
</tr>
</tbody>
</table>

Table 4-1 HSGen Times

4.2 HSSort Time
The HSSort time must be disclosed for Run1 and Run2.

<table>
<thead>
<tr>
<th></th>
<th>Run 1</th>
<th>Run 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>HSSort</td>
<td>41.650</td>
<td>41.546</td>
</tr>
</tbody>
</table>

Table 4-2 HSSort Times

4.3 HSVValidate Time
The HSVValidate time must be disclosed for Run1 and Run2.

<table>
<thead>
<tr>
<th></th>
<th>Run 1</th>
<th>Run 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>HSVValidate</td>
<td>8.771</td>
<td>7.969</td>
</tr>
</tbody>
</table>

Table 4-3 HSVValidate Times

4.4 HSDataCheck Times
Both HSDataCheck times must be disclosed for Run1 and Run2.

<table>
<thead>
<tr>
<th></th>
<th>Run 1</th>
<th>Run 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>HSDataCheck (pre-sort)</td>
<td>2.000</td>
<td>2.000</td>
</tr>
<tr>
<td>HSDataCheck (post-sort)</td>
<td>2.000</td>
<td>2.000</td>
</tr>
</tbody>
</table>

Table 4-4 HSDataCheck Times

4.5 Performance & Price-Performance
The performance metric (HSph@SF) must be disclosed for Run1 and Run2. Price-performance metric ($/HSph@SF) must be disclosed for the performance run.

<table>
<thead>
<tr>
<th></th>
<th>Run 1</th>
<th>Run 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>HSph@1TB</td>
<td>53.19</td>
<td>53.19</td>
</tr>
</tbody>
</table>

Table 4-5 Performance Metrics

Run 1 Price-Performance: 13,238.36 $/ HSph@1TB
Auditor’s Information & Letter of Attestation

The auditor’s agency name, address, phone number, and Attestation letter must be included in the full disclosure report. A statement should be included specifying who to contact in order to obtain further information regarding the audit process.

This benchmark was audited by Doug Johnson, InfoSizing.

www.sizing.com
63 Lourdes Drive
Leominster, MA 10453
978-343-6562

This benchmark’s Full Disclosure Report (FDR) can be downloaded from www.tpc.org.

A copy of the auditor’s Letter of Attestation follows.
Zheng Wei  
Inspur Cloud Information Technology Co., Ltd.  
No.1036 Inspur Road  
Jinan City  
China  

January 30, 2024

I verified the TPC Express Benchmark™ HS v2.0.3 performance of the following configuration:

Platform:  
InspurCloud Physical Server for Data with  
22x InspurCloud Data-Cloud Servers

Operating System:  
CentOS Linux 8.5

Apache Hadoop  
InspurCloud Data Cloud Platform 5.1.0 (using Spark)

Compatible Software:  

The results were:

**Performance Metric**  
53.19 HSph@1TB

Run Elapsed Time  
68.00 Seconds

**Cluster**  
22x InspurCloud Data-Cloud Servers; each with:

<table>
<thead>
<tr>
<th>CPUs</th>
<th>2x AMD® EPYC 9374F 32-Core Processor</th>
</tr>
</thead>
<tbody>
<tr>
<td>Memory</td>
<td>512 GIB</td>
</tr>
<tr>
<td>Storage</td>
<td></td>
</tr>
<tr>
<td>Qty</td>
<td>Size</td>
</tr>
<tr>
<td>2</td>
<td>960 GB</td>
</tr>
<tr>
<td>8</td>
<td>3.2 TB</td>
</tr>
</tbody>
</table>

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

The following verification items were given special attention:

- All TPC-provided components were verified to be v2.0.3.
- No modifications were made to any of the Java code.
- Any and all modifications to shell scripts were reviewed for compliance.
- All checksums were validated for compliance.
- The generated dataset was properly scaled to 1 TB.
• The generated dataset and the sorted dataset were replicated 3-ways.
• The elapsed times for all phases and runs were correctly measured and reported.
• The Storage and Memory Ratios were correctly calculated and reported.
• The system pricing was verified for major components and maintenance.
• The major pages from the FDR were verified for accuracy.

Additional Audit Notes:

None.

Respectfully Yours,

[Signature]

Doug Johnson, Certified TPC Auditor
## Supporting Files Index

<table>
<thead>
<tr>
<th>Clause</th>
<th>Description</th>
<th>Archive File Pathname</th>
</tr>
</thead>
<tbody>
<tr>
<td>Clause 1</td>
<td>Parameters and options used to configure the system</td>
<td>SupportingFiles/Clause1</td>
</tr>
<tr>
<td>Clause 2</td>
<td>Configuration scripts and Run Report</td>
<td>SupportingFiles/Clause2</td>
</tr>
<tr>
<td>Clause 3</td>
<td>System configuration details</td>
<td>SupportingFiles/Clause3</td>
</tr>
</tbody>
</table>
Third-Party Price Quotes

All components are available directly through the test sponsor, Inspur Cloud.