TPC Benchmark™ H

Full Disclosure Report

Dell PowerEdge R7715
(with 1x Dell PowerEdge R7715 Server)

using

Exasol 2025.2.1

First Edition
July 1, 2026 First Edition

Dell Inc.

Dell Inc. (Dell), the Sponsor of this benchmark test, believes that the information in this document is accurate as of the publication date. The information in this document is subject to change without notice. The Sponsor assumes no responsibility for any errors that may appear in this document. The pricing information in this document is believed to accurately reflect the current prices as of the publication date. However, we provide no warranty of the pricing information in this document.

Benchmark results are highly dependent upon workload, specific application requirements, system design and implementation. Relative system performance will vary as a result of these and other factors. Therefore, TPC Benchmark™ H should not be used as a substitute for a specific customer application benchmark when critical capacity planning and/or product evaluation decisions are contemplated.

All performance data contained in this report were obtained in a rigorously controlled environment. Results obtained in other operating environments may vary significantly. We do not warrant or represent that a user can or will achieve similar performance. No warranty of system performance or price/performance is expressed or implied in this report.

Dell and the Dell Logo are trademarks of Dell Inc. and/or its affiliates in the U.S. and other countries.

Third party trademarks mentioned are the property of their respective owners. The use of the word

partner does not imply a partnership relationship between Dell and any other company.

PowerEdge R7715 is a trademark of Dell.

Exasol is trademark of Exasol AG.

Ubuntu and Canonical are registered trademarks of Canonical Ltd.

AMD and EPYC are trademarks of AMD Corporation.

TPC Benchmark and TPC-H are trademarks or registered trademarks of the Transaction Processing

Performance Council (TPC).

All other brand or product names mentioned are considered trademarks or registered trademarks of their respective owners.

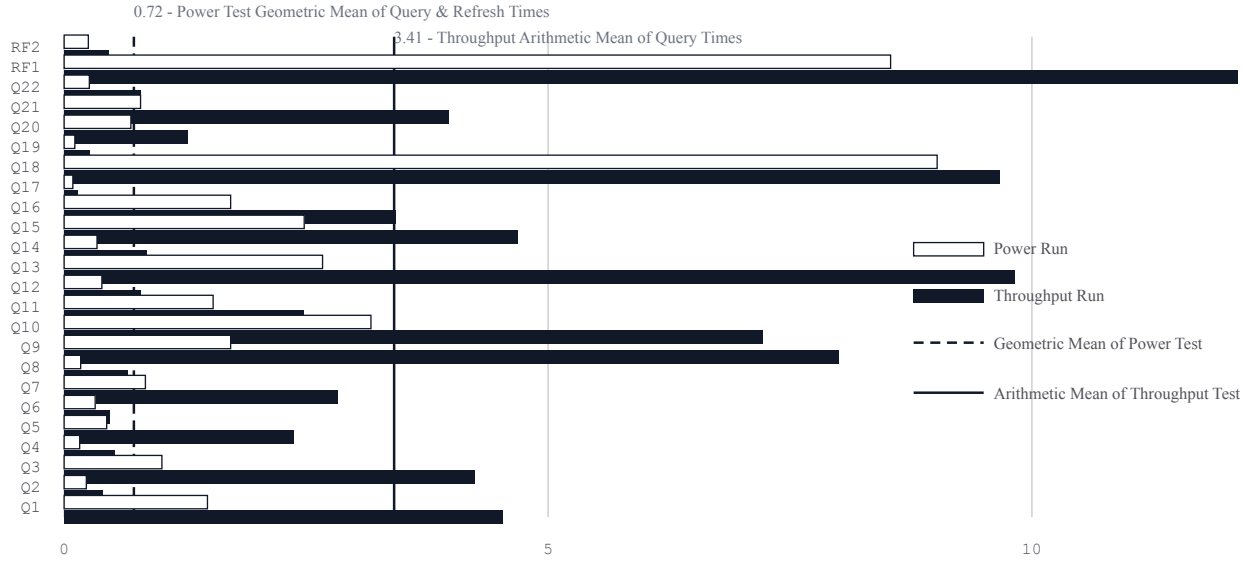
Dell PowerEdge R7715 using Exasol 2025.2.1

TPC-H Rev. 3.0.1
TPC-Pricing Rev. 2.9.0

Report Date
July 1, 2026

Total System Cost	Composite Query per Hour Metric	Price / Performance
$ 137,256.00 USD	**5,489,326.4 QphH@1000GB**	**$ 25.01 USD $ / kQphH@1000GB**

Database Size	Database Manager	Operating System	Other Software	Availability Date
1,000 GB	**Exasol 2025.2.1**	**Ubuntu 24.04.4 LTS**	**None**	**Now**



Database Load Time = 00d 00h 27m 52s
Data Storage Ratio = 8.94
Memory / DB Size = 76.8%

Storage Redundancy Levels:

Base Tables	Level One
Auxiliary Data Structures	Level One
DBMS Temporary Space	Level One
OS and DBMS Software	Level One

System Configuration:

- 1 x Dell PowerEdge R7715 Server, with:
- 768 GB RAM
- 1 x AMD EPYC 9845 160-Core Processor (320 threads)
- 1 x Dell BOSS-N1 960 GB OS device, configured as hardware RAID1 mirror with 2 x 960 GB M.2 media
- 2 x 3840 GB (3.84TB) NVMe drives in software RAID1 (md0)
- Total Storage: 8,941 GiB

Dell PowerEdge R7715 using Exasol 2025.2.1

TPC-H Rev. 3.0.1
TPC-Pricing Rev. 2.9.0

Report Date
July 1, 2026

Description	Part	Key	Unit Price	Qty	Ext. Price $	3 Yr. Maint. Price $
HARDWARE COMPONENTS						
PowerEdge R7715 Server	210-BNRJ	1	232,476.97	1	232,476.97	0.00
Chassis with up to 8 E3.S NVMe Direct Drives	321-BLML	1	0.00	1	0.00	0.00
AMD EPYC 9845 2.10GHz, 160C/320T, 320 Cache (390W) DDR5-6400	338-CRRW	1	0.00	1	0.00	0.00
Heatsink for GPU Configuration (CPU greater than 240W)	412-BCBC	1	0.00	1	0.00	0.00
Performance Optimized	370-AHLL	1	0.00	1	0.00	0.00
6400MT/s RDIMMs	370-BCCX	1	0.00	1	0.00	0.00
64GB RDIMM, 6400MT/s, Dual Rank	370-BCCZ	1	0.00	12	0.00	0.00
C30, No RAID for NVME chassis	780-BCDO	1	0.00	2	0.00	0.00
No Controller	405-AACD	1	0.00	1	0.00	0.00
No Hard Drive	400-ABHL	1	0.00	1	0.00	0.00
3.84TB NVMe Read Intensive AG Drive E3s Gen5 with carrier	400-BOMP	1	0.00	2	0.00	0.00
Performance BIOS Settings	384-BBBL	1	0.00	1	0.00	0.00
UEFI BIOS Boot Mode with GPT Partition	800-BBDM	1	0.00	1	0.00	0.00
No Energy Star	387-BBEY	1	0.00	1	0.00	0.00
PowerEdge 2U High Performance Platinum Fan	384-BDTQ	1	0.00	1	0.00	0.00
Dual,Redundant(1+1),Hot-Plug MHS PSU,3200W MM HLAC(Only for 200-240Vac)Titanium	450-BDTD	1	0.00	1	0.00	0.00
No Power Cord	450-AAGG	1	0.00	1	0.00	0.00
Riser Config 8, 2 x16 LP Slots (Gen5), 3 x16 DW FH Slots (Gen5)	330-BCZT	1	0.00	1	0.00	0.00
PowerEdge R7715 Motherboard V2	329-BLHZ	1	0.00	1	0.00	0.00
Broadcom 57412 Quad Port 10GbE Base-T adapter, OCP 3.0 NIC +Sec	540-BFPS	1	0.00	1	0.00	0.00
No OCP Blanks or Cables Required	780-BCZQ	1	0.00	1	0.00	0.00
No Cables Required	470-AEYU	1	0.00	1	0.00	0.00
No Cables Required	470-AEYU	1	0.00	1	0.00	0.00
Dell Luggage Tag, PowerEdge R7715	321-BLFN	1	0.00	1	0.00	0.00
PowerEdge 2U Standard Bezel	325-BFWZ	1	0.00	1	0.00	0.00
BOSS-N1 controller card + with 2 M.2 960GB (RAID 1) (22x80)	403-BDMC	1	0.00	1	0.00	0.00
No Operating System, No Utility Partition, BOSS	611-BBBX	1	0.00	1	0.00	0.00
No Media Required	605-BBFN	1	0.00	1	0.00	0.00
Secure Enterprise Key Manager License 3.0	634-CSHS	1	0.00	1	0.00	0.00
Secured Component Verification	634-CSHT	1	0.00	1	0.00	0.00
iDRAC10, Enterprise 17G	634-CSHY	1	0.00	1	0.00	0.00
Dell Connectivity Client - Enabled	379-BFXS	1	0.00	1	0.00	0.00
Dell Connectivity Module 17G	634-CZRP	1	0.00	1	0.00	0.00
Dell Secure Onboarding Client 17G - Disabled	634-CZWJ	1	0.00	1	0.00	0.00
Blank Left Ear Module	350-BCYL	1	0.00	1	0.00	0.00
iDRAC Legacy Password for OCP cards	379-BETF	1	0.00	1	0.00	0.00
No Rack Rails	770-BBBS	1	0.00	1	0.00	0.00
PowerEdge Shipping	340-DNSW	1	0.00	1	0.00	0.00
PowerEdge R7715 Shipping	340-DRYL	1	0.00	1	0.00	0.00
PowerEdge 2U Shipping Material	340-DPDX	1	0.00	1	0.00	0.00
PowerEdge No CCC, No CE Label Marking	389-FHHY	1	0.00	1	0.00	0.00
3Yr ProSupport and 4hr Onsite Service - 3 Years	199-BONO	1	23,237.68	1	0.00	23,237.68
Basic Next Business Day 36 Months	709-BBFM	1	0.01	1	0.00	0.01
Secure Enterprise Key Manager License 3.0	817-BBBP	1	249.00	1	249.00	0.00
Dell 24 Monitor S2425H includes spares	210-BMGX	1	99.99	3	299.97	0.00
Keyboard/Mouse includes spares	570-AAKV,580-ADJC	1	20.38	3	61.14	0.00
HARDWARE COMPONENTS Subtotal					**233,087.08**	**23,237.69**

Dell PowerEdge R7715 using Exasol 2025.2.1

TPC-H Rev. 3.0.1
TPC-Pricing Rev. 2.9.0

Report Date
July 1, 2026

Description	Part	Key	Unit Price	Qty	Ext. Price $	3 Yr. Maint. Price $
SOFTWARE COMPONENTS						
Exasol 1TB License (monthly subscription)	N/A	2	2,000.00	36	72,000.00	0.00
Ubuntu Support by Dell, 3yr Premium Sub, 1 Physical with Unlimited VMs	528-BBUZ	1	4,699.00	1	4,699.00	0.00
SOFTWARE COMPONENTS Subtotal					**76,699.00**	**0.00**
Total					**309,786.08**	**23,237.69**
Dell Large Purchase Discount (75%)*					**-178,339.56**	**-17,428.27**

Three-Year Cost of Ownership: **$ 137,256.00**
QphH@1000GB: **5,489,326.4**
$/kQphH@1000GB: **$ 25.01**

Price Key: 1 DELL
2 Exasol

** Dell Discount based upon total system cost as purchased by a regular customer.*

Audited by Doug Johnson, InfoSizing Inc. (www.sizing.com)

Prices used in TPC benchmarks reflect the actual prices a customer would pay for a one-time purchase of the stated components. 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 components. For complete details, see the pricing sections of the TPC benchmark specifications. If you find that the stated prices are not available according to these terms, please inform the TPC at pricing@tpc.org.

Dell PowerEdge R7715 using Exasol 2025.2.1

TPC-H Rev. 3.0.1
TPC-Pricing Rev. 2.9.0

Report Date
July 1, 2026

Numerical Quantities

Measurement Results

Database Scale Factor	1,000 GB
Total Data Storage / Database Size	8.94
Percentage Memory / Database Size	76.8%
Start of Database Load	2026-04-15 16:03:59
End of Database Load	2026-04-15 16:31:51
Database Load Time	00d 00h 27m 52s
Query Streams for Throughput Test	7
TPC-H Power	4,998,746.0
TPC-H Throughput	6,028,052.6
TPC-H Composite Query-per-Hour Metric (QphH@1000GB)	5,489,326.4
Total System Price Over 3 Years	$137,256.00
TPC-H Price/ Performance Metric ($/kQphH@1000GB)	$25.01

Measurement Interval

Measurement Interval in Throughput Test (Ts)	91.97 seconds

Duration of Stream Execution

Run	Stream	Seed	Query	Total Time	RF1	RF2
Power Run	Power	415163151	2026-04-15 16:34:01.091 2026-04-15 16:34:30.823	00:00:29.731	2026-04-15 16:33:52.541 2026-04-15 16:34:01.081	2026-04-15 16:34:30.837 2026-04-15 16:34:31.087
Throughput	1	415163152	2026-04-15 16:34:31.107 2026-04-15 16:35:45.436	00:01:14.329	2026-04-15 16:34:31.103 2026-04-15 16:34:44.885	2026-04-15 16:34:44.895 2026-04-15 16:34:45.377
Throughput	2	415163153	2026-04-15 16:34:31.107 2026-04-15 16:35:46.457	00:01:15.350	2026-04-15 16:34:45.380 2026-04-15 16:34:58.709	2026-04-15 16:34:58.720 2026-04-15 16:34:59.412
Throughput	3	415163154	2026-04-15 16:34:31.107 2026-04-15 16:35:46.759	00:01:15.652	2026-04-15 16:34:59.421 2026-04-15 16:35:13.671	2026-04-15 16:35:13.678 2026-04-15 16:35:14.195
Throughput	4	415163155	2026-04-15 16:34:31.107 2026-04-15 16:35:47.412	00:01:16.305	2026-04-15 16:35:14.199 2026-04-15 16:35:27.750	2026-04-15 16:35:27.757 2026-04-15 16:35:28.295
Throughput	5	415163156	2026-04-15 16:34:31.107 2026-04-15 16:35:45.683	00:01:14.575	2026-04-15 16:35:28.302 2026-04-15 16:35:42.383	2026-04-15 16:35:42.396 2026-04-15 16:35:42.953
Throughput	6	415163157	2026-04-15 16:34:31.107 2026-04-15 16:35:46.988	00:01:15.881	2026-04-15 16:35:42.963 2026-04-15 16:35:53.194	2026-04-15 16:35:53.199 2026-04-15 16:35:53.505
Throughput	7	415163158	2026-04-15 16:34:31.107 2026-04-15 16:35:45.054	00:01:13.947	2026-04-15 16:35:53.509 2026-04-15 16:36:02.758	2026-04-15 16:36:02.764 2026-04-15 16:36:03.067

Dell PowerEdge R7715 using Exasol 2025.2.1

TPC-H Rev. 3.0.1
TPC-Pricing Rev. 2.9.0

Report Date
July 1, 2026

TPC-H Timing Intervals (in seconds)

Stream ID	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	Q11	Q12
0	1.48	0.23	1.01	0.16	0.44	0.32	0.84	0.17	1.72	3.17	1.54	0.39
1	4.69	0.40	4.95	0.61	2.63	0.61	3.37	0.68	9.05	7.30	2.61	0.76
2	5.10	0.44	5.53	0.57	2.92	0.56	3.40	0.84	8.78	7.32	3.03	0.76
3	4.60	0.41	4.25	0.57	2.60	0.41	3.05	0.81	8.89	8.05	2.15	0.87
4	5.28	0.51	4.31	0.54	2.67	0.39	2.70	0.71	8.53	8.97	2.69	0.88
5	4.88	0.44	4.46	0.57	2.50	0.43	2.93	0.74	8.95	7.34	2.67	0.87
6	5.09	0.44	4.66	0.57	2.71	0.42	3.18	0.67	8.24	8.26	2.37	0.86
7	5.12	0.36	4.75	0.53	2.49	0.63	3.13	0.62	9.83	7.32	2.72	0.94
Qi Min	1.48	0.23	1.01	0.16	0.44	0.32	0.84	0.17	1.72	3.17	1.54	0.39
Qi Avg	4.53	0.40	4.24	0.52	2.37	0.47	2.83	0.66	8.00	7.22	2.47	0.79
Qi Max	5.28	0.51	5.53	0.61	2.92	0.63	3.40	0.84	9.83	8.97	3.03	0.94
Stream ID	**Q13**	**Q14**	**Q15**	**Q16**	**Q17**	**Q18**	**Q19**	**Q20**	**Q21**	**Q22**	**RF1**	**RF2**
0	2.67	0.34	2.48	1.72	0.09	9.02	0.11	0.69	0.79	0.26	8.54	0.25
1	10.33	0.85	4.56	3.57	0.16	9.64	0.29	1.45	4.90	0.84	13.78	0.48
2	10.22	0.84	4.67	3.29	0.15	9.77	0.29	1.45	4.55	0.79	13.33	0.69
3	11.02	0.79	5.68	3.94	0.14	9.84	0.36	1.39	4.81	0.93	14.25	0.52
4	11.37	0.95	5.72	3.97	0.17	9.34	0.26	0.79	4.62	0.87	13.55	0.54
5	11.21	1.07	4.46	3.31	0.15	10.33	0.28	1.47	4.48	0.99	14.08	0.56
6	11.66	0.78	5.41	4.05	0.16	10.31	0.27	1.65	3.21	0.82	10.23	0.31
7	10.10	1.21	4.53	3.59	0.13	9.07	0.24	1.34	4.43	0.82	9.25	0.30
Qi Min	2.67	0.34	2.48	1.72	0.09	9.02	0.11	0.69	0.79	0.26	8.54	0.25
Qi Avg	9.82	0.85	4.69	3.43	0.14	9.67	0.26	1.28	3.97	0.79	12.13	0.46
Qi Max	11.66	1.21	5.72	4.05	0.17	10.33	0.36	1.65	4.90	0.99	14.25	0.69

Table of Contents

TPC Benchmark H Overview

The TPC Benchmark™ H (TPC-H) is a Decision Support benchmark. It is a suite of business-oriented adhoc queries and concurrent modifications. The queries and the data populating the database have been chosen to have broad industry-wide relevance while maintaining a sufficient degree of ease of implementation. This benchmark illustrates Decision Support systems that:

Examine large volumes of data

Execute queries with a high degree of complexity

Give answers to critical business questions

TPC-H evaluates the performance of various Decision Support systems by the execution of sets of queries against a standard database under controlled conditions. The TPC-H queries:

Give answers to real-world business questions

Simulate generated ad-hoc queries

Are far more complex than most OLTP transactions

Include a rich breadth of operators and selectivity constraints

Generate intensive activity on the part of the database server component of the system under test

Are executed against a database complying to specific population and scaling requirements

Are implemented with constraints derived from staying closely synchronized with an on-line production database

General Items

Benchmark Sponsor

> *A statement identifying the benchmark sponsor(s) and other participating companies must be provided.*

This TPC-H benchmark is sponsored by Dell Inc. The benchmark implementation was developed and engineered by Exasol AG.

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 but not limited to:*
>
> - *Database Tuning Options*
> - *Optimizer/Query execution options*
> - *Query processing tool/language configuration parameters*
> - *Recovery/commit options*
> - *Consistency/locking options*
> - *Operating system and configuration parameters*
> - *Configuration parameters and options for any other software component incorporated into the pricing structure*
> - *Compiler optimization options*
> - *This requirement can be satisfied by providing a full list of all parameters and options, as long as all those which have been modified from their default values have been clearly identified and these parameters and options are only set once.*

The Supporting Files Archive contains the database and OS parameters used in this benchmark.

Configuration Diagram

> *Diagrams of both measured and priced configurations must be provided, accompanied by a description of the differences. This includes, but is not limited to:*
>
> - *Number and type of processors.*
> - *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, including routers, workstations, terminals, etc., that were physically used in the test or are incorporated into the pricing structure.*
> - *Type and the run-time execution location of software components (e.g., DBMS, query processing tools/languages, middle-ware components, software drivers, etc.).*

The System Under Test (SUT), depicted in Figure 1.1, that was used to obtain the results in this benchmark consists of the following components:

Qty	System Component
1 x	Dell PowerEdge R7715 server, with:
	768 GB RAM
	AMD EPYC 9845 160-Core Processor (320 threads)
	Dell BOSS-N1 960 GB OS device, configured as hardware RAID1 mirror with 2 x 960 GB M.2 media
	2x 3,840 GB Enterprise NVMe in software RAID1 (md0)

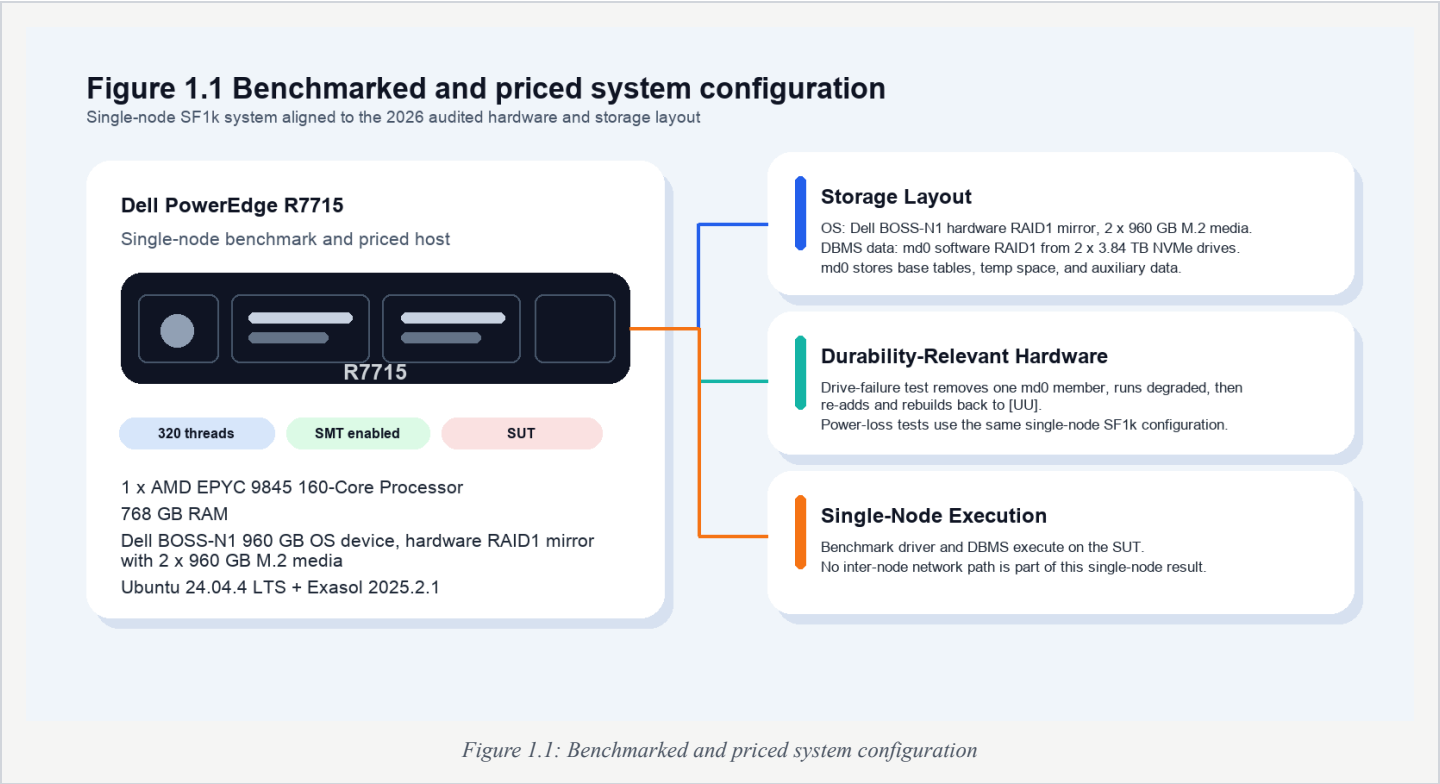


Figure 1.1: Benchmarked and priced system configuration

The benchmark was executed on a single-node system under test (SUT). The server uses 2 x 3.84 TB NVMe drives configured as software RAID1 device md0 for DBMS data storage and a Dell BOSS-N1 960 GB OS device configured as hardware RAID1 mirror with 2 x 960 GB M.2 media. The CPU hyperthreading was enabled.

Priced configuration and benchmarked configuration are identical.

Clause 1: Logical Database Design Related Items

Database Definition Statements

> *Listings must be provided for all table definition statements and all other statements used to set up the test and qualification databases.*

The Supporting Files Archive contains the build scripts that define the tables and indices for the TPC-H database.

Physical Organization

> *The physical organization of tables and indices, within the test and qualification databases, must be disclosed. If the column ordering of any table is different from that specified in Clause 1.4, it must be noted.*

Physical organization requires no user input. All the database data is placed on the same partition.

Horizontal Partitioning

> *Horizontal partitioning of tables and rows in the test and qualification databases (see Clause 1.5.4) must be disclosed.*

This is a single-node system. No effective horizontal partitioning across multiple nodes was used. Any internal local data placement is managed by Exasol on the single SUT and does not distribute data across cluster nodes.

Replication

> *Any replication of physical objects must be disclosed and must conform to the requirements of Clause 1.5.7.*

No replication was used.

Clause 2: Queries and Refresh Functions

Query Language

> *The query language used to implement the queries must be identified.*

SQL was the query language uniquely used throughout this benchmark.

Verifying Method for Random Number Generation

> *The method of verification for the random number generation must be described unless the supplied DBGEN and QGEN were used.*

TPC supplied versions 3.0.0 of DBGEN and QGEN were used in this benchmark.

Generating Values for Substitution Parameters

> *The method used to generate values for substitution parameters must be disclosed. If QGEN is not used for this purpose, then the source code of any non-commercial tool used must be disclosed. If QGEN is used, the version number, release number, modification number, and patch level of QGEN must be disclosed.*

QGEN version 3.0.0 was used to generate the substitution parameters.

Query Text and Output Data from Qualification Database

> *The executable query text used for query validation must be disclosed along with the corresponding output data generated during the execution of the query text against the qualification database. If minor modifications (see Clause 2.2.3) have been applied to any functional query definition or approved variants in order to obtain executable query text, these modifications must be disclosed and justified. The justification for a particular minor query modification can apply collectively to all queries for which it has been used. The output data for the power and throughput tests must be made available electronically upon request.*

The Supporting Files Archive contains the qualification query text and query output. The standard queries were used throughout with the following modifications:

Quoting of reserved keyword „value“ (Q11)

LIMIT syntax used to restrict the number of output rows (Q2,Q3,Q10,Q18,Q21)

Naming of columns of sub-select in Q13

Used approved variant A of Q15 (Appendix B): ‘with clause’ instead of “create view/drop view”

Query Substitution Parameters and Seeds Used

> *The query substitution parameters used for all performance tests must be disclosed in tabular format, along with the seeds used to generate these parameters.*

The Supporting Files Archive contains the query seeds in RUN/test.log and in the generated stream SQL files; run1results.zip also contains the generated substitution-parameter files.

Isolation Level

> *The isolation level used to run the queries must be disclosed. If the isolation level does not map closely to the levels defined in Clause 3.4, additional descriptive detail must be provided.*

The queries and transactions were run with the isolation level 3.

Source Code of Refresh Functions

> *The details of how the refresh functions were implemented must be disclosed (including source code of any non-commercial program used).*

The Supporting Files Archive contains the source code of the refresh functions.

Clause 3: Database System Properties

ACID Properties

> *The ACID (Atomicity, Consistency, Isolation, and Durability) properties of transaction processing systems must be supported by the system under test during the timed portion of this benchmark. Since TPC-H is not a transaction processing benchmark, the ACID properties must be evaluated outside the timed portion of the test.*

All ACID tests were conducted according to specification. The Supporting Files Archive contains the source code of the ACID test scripts.

Atomicity Requirements

> *The system under test must guarantee that transactions are atomic; the system will either perform all individual operations on the data, or will assure that no partially completed operations leave any effects on the data.*

Atomicity of the Completed Transactions

> *Perform the ACID Transaction for a randomly selected set of input data and verify that the appropriate rows have been changed in the ORDERS, LINEITEM, and HISTORY tables.*

The following steps were performed to verify the atomicity of the completed ACID transactions:

1. The total price from the ORDERS table and the extended price from the LINEITEM table were retrieved for a randomly selected order key.
2. One ACID Transaction was performed using the order key from step 1.
3. The ACID Transaction was committed.
4. The total price from the ORDERS table and the extended price from the LINEITEM table were retrieved for the same order key.
5. It was verified that the appropriate rows had been changed.

Atomicity of Aborted Transactions

> *Perform the ACID Transaction for a randomly selected set of input data, substituting a ROLLBACK of the transaction for the COMMIT of the transaction. Verify that the appropriate rows have not been changed in the ORDERS, LINEITEM, and HISTORY tables.*

The following steps were performed to verify the atomicity of the completed ACID transactions:

1. The total price from the ORDERS table and the extended price from the LINEITEM table were retrieved for a randomly selected order key.
2. One ACID Transaction was performed using the order key from step 1. The transaction was stopped prior to the commit.
3. The ACID Transaction was rolled back.
4. The total price from the ORDERS table and the extended price from the LINEITEM table were retrieved for the same order key.
5. It was verified that the appropriate rows had not been changed.

Consistency Requirements

> *Consistency is the property of the application that requires any execution of transactions to take the database from one consistent state to another. A consistent state for the TPC-H database is defined to exist when:*

```
O_TOTALPRICE = SUM(trunc(trunc(L_EXTENDEDPRICE*(1-L_DISCOUNT),2)*(1+L_TAX),2))
For each ORDER and LINEITEM defined by (O_ORDERKEY = L_ORDERKEY).
```

Consistency Test

> *Verify that ORDERS and LINEITEM tables are initially consistent, submit the prescribed number of ACID Transactions with randomly selected input parameters, and re-verify the consistency of the ORDERS and LINEITEM.*

The following queries were executed before and after the durability tests to show that the database was always in a consistent state both initially and after submitting transactions:

```
SELECT *
FROM (
SELECT o_orderkey, o_totalprice – sum(trunc(trunc(l_extendedprice * (1–l_discount),2)*(1+l_tax),2)) part_res
FROM orders, lineitem
WHERE o_orderkey=l_orderkey
GROUP BY o_orderkey, o_totalprice
) WHERE not part_res=0;
```

The following steps were performed to verify the consistency of ACID transactions:

1. The consistency of the ORDERS and LINEITEM tables was verified.
2. 100 transactions were prepared.
3. No failure was induced during this consistency test.
4. The consistency of the ORDERS and LINEITEM tables was re-verified.

Isolation Requirements

> *Operations of concurrent transactions must yield results, which are indistinguishable from the results, which would be obtained by forcing each transaction to be serially executed to completion in some order.*

The steps of the isolation tests were adapted to the Exasol isolation environment.

Isolation Test 1 – Read-Write Conflict with Commit

> *Demonstrate isolation for the read-write conflict of a read-write transaction and a read-only transaction when the read-write transaction is committed*

The following steps were performed to satisfy the test of isolation for a read-only and a read-write committed transaction:

1. Start a query and verify that the row was retrieved.
2. Start an update transaction, read and update the same row. Wait before commit.
3. Start the same query and verify that the row retrieved has not changed.
4. Commit the update transaction
5. Start the same query and verify that the new row is retrieved

Isolation Test 2 – Read-Write Conflict with Rollback

> *Demonstrate isolation for the read-write conflict of a read-write transaction and a read-only transaction when the read-write transaction is rolled back.*

The following steps were performed to satisfy the test of isolation for a read-only and a rolled back read-write transaction:

1. Start a query and verify that the row was retrieved.
2. Start an update transaction, read and update the same row. Wait before commit.
3. Start the same query and verify that the row retrieved has not changed.
4. Rollback the update transaction
5. Start the same query and verify that the old row (step 1) is retrieved

Isolation Test 3 – Write-Write Conflict with Commit

> *Demonstrate isolation for the write-write conflict of two update transactions when the first transaction is committed.*

The following steps were performed to verify isolation of two update transactions:

1. Start a query and verify that the row was retrieved.
2. Start an update transaction, read and update the same row. Wait before commit.
3. Start another update transaction, read and try to update the same row and verify that the transaction is forced to rollback.
4. commit the update transaction
5. Start the same query and verify that the new row is retrieved

Isolation Test 4 – Write-Write Conflict with Rollback

> *Demonstrate isolation for the write-write conflict of two update transactions when the first transaction is rolled back.*

The following steps were performed to verify isolation of two update transactions after the first one is rolled back:

1. Start a query and verify that the row was retrieved.
2. Start an update transaction, read and update the same row. Wait before commit.
3. Start another update transaction, read and try to update the same row and verify that the transaction is forced to rollback.
4. Rollback the update transaction
5. Start the same query and verify that the old row (step 1) is retrieved.

Isolation Test 5 – Concurrent Read and Write Transactions on Different Tables

> *Demonstrate the ability of read and write transactions affecting different database tables to make progress concurrently.*

The following steps were performed to demonstrate the ability of read and write transactions affecting different tables to make progress concurrently:

1. Start a query and verify that the row was retrieved.
2. Start an update transaction, read and update the same row. Wait before commit.
3. Start a second transaction that does the following: Select random values of PS_PARTKEY and PS_SUPPKEY. Return all columns of the PARTSUPP table for which PS_PARTKEY and PS_SUPPKEY are equal to the selected values.
4. Verify that the read transaction completes.
5. Commit the update transaction.
6. Start the same query and verify that the new row is retrieved.

Isolation Test 6 – Update Transactions during Continuous Read-Only Query Stream

> *Demonstrate the continuous submission of arbitrary (read-only) queries against one or more tables of the database does not indefinitely delay update transactions affecting those tables from making progress.*

The following query was used to ensure sufficient execution time to perform the test:

```
SELECT l1.l_quantity,
SUM(l2.l_extendedprice),
SUM(l3.l_extendedprice),
SUM(l3.l_quantity)
FROM lineitem l1, lineitem l2, lineitem l3, lineitem l4, lineitem l5
WHERE l1.l_shipdate <= DATE '1998-12-01' -0
AND l1.l_orderkey = l2.l_orderkey
AND l1.l_linenumber = l2.l_linenumber
AND l1.l_extendedprice = l3.l_extendedprice
AND l3.l_quantity < 30
AND l4.l_quantity = l1.l_quantity
AND l4.l_orderkey < 150
AND l5.l_receiptdate = l1.l_receiptdate
AND l5.l_partkey <140
GROUP BY l1.l_quantity;
COMMIT;
```

1. A Transaction, T1, which executed the above query against the qualification database, was started using a randomly selected DELTA.
2. An ACID Transaction, T2, was started for a randomly selected O_KEY, L_KEY and DELTA.
3. T2 completed and appropriate rows in the ORDERS, LINEITEM and HISTORY tables had been changed.
4. T1 was still executing.
5. Transaction T1 completed executing the query.

Durability Requirements

> *The tested system must guarantee durability: the ability to preserve the effects of committed transactions and insure database consistency after recovery from any one of the failures listed in Clause 3.5.3.*

Exasol has serializable isolation level with table level lock concurrency control. The durability script ran the ACID transaction executable with ADDITIONALWAITTIME=5, adding a five-second delay before commit after the stream reached the configured 100 committed transactions. Since only one update transaction can execute at any one time, the delay should guarantee that an active update transaction is in-flight at the time of the induced failure.

The following steps were performed for the durability test:

1. The consistency of the ORDERS and LINEITEM tables was verified.
2. 1000 transactions for each of the 21 execution streams were prepared.
3. After that at least 100 ACID transactions were submitted from each of the 21 execution streams.
4. A durability failure was induced (see details for each failure below).
5. After restoration of the system the consistency of the ORDERS and LINEITEM tables was re-verified.
6. The durability success files and the HISTORY table were compared.

All durability tests were performed on the single-node SF1k SUT.

Permanent Unrecoverable Failure of Any Durable Medium

> *Guarantee the database and committed updates are preserved across a permanent irrecoverable failure of any single durable medium containing TPC-H database tables or recovery log tables.*

The permanent durable-medium failure test was executed by removing one member of software RAID1 device md0 during the durability run.

System Crash

> *Guarantee the database and committed updates are preserved across an instantaneous interruption (system crash/system hang) in processing which requires the system to reboot to recover.*

The system crash, memory failure, and loss of external power requirements were satisfied by the single-node power-loss durability test.

Memory Failure

> *Guarantee the database and committed updates are preserved across failure of all or part of memory (loss of contents). See the previous section.*

The system crash, memory failure, and loss of external power requirements were satisfied by the single-node power-loss durability test.

Loss of External Power

Loss of External Power: Guarantee the database and the effects of committed updates are preserved during the loss of all external power to the SUT for an indefinite time period.

Loss of external power was tested on the SUT during the durability run. The submitted power-failure result records the durability streams being stopped during the failure window; after recovery, the operator resumed the script and the final consistency check and HISTORY-table comparison succeeded.

No separate multi-node crash or spare-node replacement workflow applied to this single-node SUT.

Drive Failure Workflow

> *Guarantee the database and committed updates are preserved across failure of one durable medium in the software RAID1 data volume.*

This test was executed on the SUT using software RAID1 device md0 built from nvme0n1p1 and nvme1n1p1.

This test was executed in the following order:

- One RAID1 member device was removed from md0 during the durability run. The array continued in degraded state [U_] while the database remained available.
- The removed device was rescanned and re-added to md0. The initial automatic recovery step did not detect the device, so the RAID member was added manually with mdadm.
- After the member was re-added, md0 rebuilt to a clean [UU] state and the durability consistency checks and HISTORY-table comparison succeeded.

Clause 4: Scaling and Database Population

Ending Cardinality of Tables

> *The cardinality (e.g., the number of rows) of each table of the test database, as it existed at the completion of the database load (see clause 4.2.5) must be disclosed.*

The following table lists the TPC Benchmark H defined tables and the row count for each table as they existed upon completion of the build.

Table	Rows
LINEITEM	5,999,989,709
ORDERS	1,500,000,000
PARTSUPP	800,000,000
PART	200,000,000
CUSTOMER	150,000,000
SUPPLIER	10,000,000
NATION	25
REGION	5

Distribution of Tables and Logs Across Media

> *The distribution of tables and logs across all media must be explicitly described for the tested and priced systems.*

The tested single-node configuration uses a Dell BOSS-N1 960 GB OS device, configured as hardware RAID1 mirror with 2 x 960 GB M.2 media, for the Ubuntu OS installation. DBMS data, DBMS temporary space, and auxiliary structures are stored on local software RAID1 device md0, built from two 3.84 TB NVMe drives. The distribution table lists effective mirrored capacity: 894 GiB for the BOSS OS mirror and 3,577 GiB for md0. The Data Storage Ratio table follows the auditor workbook and counts configured physical disk capacity across all BOSS and NVMe devices.*

Partition Name	Type	Partition Size** / Devices	Content
Dell BOSS-N1	OS device (mirror)	894 GiB usable on 2 x 960 GB BOSS media	Ubuntu OS installation
md0	software RAID1	3,577 GiB usable on 2 x 3.84 TB NVMe drives	DBMS data, DBMS temporary space, auxiliary structures

* Disk manufacturer definition of 1 GB is 10^9 bytes

** In this calculation 1 GiB is defined as 2^30 bytes

Mapping of Database Partitions/Replication

> *The mapping of database partitions/replications must be explicitly described.*

This is a single-node system. No effective horizontal partitioning or replication across multiple nodes was used. All database partitions reside on the single SUT.

The benchmark data path uses local software RAID1 on device md0. Base tables, auxiliary data structures, and DBMS temporary space are stored on this mirrored device.

Implementation of RAID

> *Implementations may use some form of RAID to ensure high availability. If used for data, auxiliary storage (e.g. indexes) or temporary space, the level of RAID must be disclosed for each device.*

Please refer to chapter 4.2.

DBGEN Modifications

> *The version number, release number, modification number, and patch level of DBGEN must be disclosed. Any modifications to the DBGEN (see Clause 4.2.1) source code must be disclosed. In the event that a program other than DBGEN was used to populate the database, it must be disclosed in its entirety.*

The supplied DBGEN version 3.0.0 was used, no modifications were made.

Database Load Time

> *The database load time for the test database (see Clause 4.3) must be disclosed.*

See Numerical Quantities Summary in the Executive Summary.

Data Storage Ratio

> *The data storage ratio must be disclosed. It is computed by dividing the configured disk capacity of the priced configuration by the size chosen for the test database as defined in Clause 4.1.3.1. The reported value follows the auditor workbook value to two decimal places. For the reporting of configured disk capacity, gigabyte (GB) is defined to be 2^30 bytes.*

Disk Type	GB per disk*	GiB per disk**	# of disks	Total (GiB)**
Internal (BOSS-N1 OS media)	960 GB	894 GiB	2	1,788
Internal NVMe (DBMS data)	3,840 GB	3,576 GiB	2	7,153
Total Storage				8,941
Data Storage Ratio				8.94

* Disk manufacturer definition of 1 GB is 10^9 bytes

** In this calculation 1 GiB is defined as 2^30 bytes

Database Load Mechanism Details and Illustration

> *The details of the database load must be disclosed, including a block diagram illustrating the overall process. Disclosure of the load procedure includes all steps, scripts, input and configuration files required to completely reproduce the test and qualification databases.*

The database was loaded from flat files staged on the tested configuration. DBGEN was used to create the flat files.

The following block diagram describes the process used to load the database.

Database load workflow

Qualification Database Configuration

> *Any differences between the configuration of the qualification database and the test database must be disclosed.*

The qualification database used identical scripts to create and load the data with changes to adjust for the database scale factor.

Memory to Database Size Percentage

> *The memory to database size percentage must be disclosed. It is computed by multiplying by 100 the total memory size priced on the SUT (see clause 6.2.1) and dividing this number by the size chosen for the test database as defined in Clause 4.1.3.1.*

Nodes	RAM per Node	Total Memory	Scale Factor	Memory to Database Size Ratio
1	768 GB	768 GB	1,000	76.8%

Clause 5: Performance Metrics and Execution Rules Related Items

System Activity between Load and Performance Tests

> *Any system activity on the SUT that takes place between the conclusion of the load test and the beginning of the performance test must be fully disclosed.*

There is no activity on the SUT between the conclusion of the load test and the beginning of the performance test.

Steps in the Power Test

> *The details of the steps followed to implement the power test (e.g., system boot, database restart, etc.) must be disclosed.*

The following steps were used to implement the power test:

1. RF1 refresh function from update stream
2. Stream 0 execution from query stream
3. RF2 refresh function from same update stream

Timing Interval for Each Query and Refresh Functions

> *The timing intervals (see Clause 5.3.7) for each query of the measured set for both refresh functions must be reported for the power test.*

See Numerical Quantities Summary in the Executive Summary.

Number of Streams for the Throughput Test

> *The number of execution streams used for the throughput test must be disclosed.*

One stream was used for the refresh pairs. The number of query streams used is listed in the Numerical Quantities Summary in the Executive Summary.

Start and End Date/Time of Each Query Stream

> *The start time and finish time for each query stream must be reported for the throughput test.*

See Numerical Quantities Summary in the Executive Summary.

Total Elapsed Time of the Measurement Interval

> *The total elapsed time of the measurement interval (see Clause 5.3.6) must be reported for the throughput test.*

See Numerical Quantities Summary in the Executive Summary.

Refresh Function Start Date/Time and Finish Date/Time

> *Start and finish time for each update function in the update stream must be reported for the throughput test.*

See Numerical Quantities Summary in the Executive Summary.

Performance Metrics

> *The computed performance metric, related numerical quantities and price performance metric must be reported.*

See Numerical Quantities Summary in the Executive Summary.

The Performance Metric and Numerical Quantities from Both Runs

> *A description of the method used to determine the reproducibility of the measurement results must be reported. This must include the performance metrics (QppH and QthH) from reproducibility runs.*

	Run 1	Run 2
QphH@1000GB	5,628,923.9	5,489,326.4
QppH@1000GB	4,868,735.1	4,998,746.0
QthH@1000GB	6,507,806.1	6,028,052.6

System Activity between Performance Tests

> *Any activity on the SUT that takes place between the conclusion of Run 1 and the beginning of Run 2 must be disclosed.*

There was no system activity between Run 1 and Run 2.

Documentation to satisfy Clause 5.2.7

All documentation necessary to satisfy Clause 5.2.7 must be made available upon request.

Exasol documentation is publicly available at Exasol.com

Query Output Validation

The output of the Query Output Validation Test must reported in the supporting files archive.

The Supporting Files Archive contains the output of the validation test.

Clause 6: SUT and Driver Implementation Related Items

Driver

> *A detailed description of how the driver performs its functions must be supplied, including any related source code or scripts. This description should allow an independent reconstruction of the driver.*

All stream executions are performed by a script. QGEN is used to produce query text.

For each power-test run:

1. A shell script is started, executes RF1 and then waits for the query stream to complete.
2. A shell script is started, executes the 22 queries in the required order for stream 0 and then signals to the shell script started in step 1.
3. The shell script started in step 1 is released and executes RF2.

For each throughput-test run:

1. The queries as generated by QGEN are submitted in the order defined by Clause 5.3.5.4 from the driver in several streams (the number of streams is listed in the Numerical Quantities).
2. In parallel with the queries, pairs of RF1/RF2 are executed sequentially in one update stream.

The source code of the used scripts are disclosed in the Supporting Files Archive.

Implementation Specific Layer (ISL)

> *If an implementation specific layer is used, then a detailed description of how it performs its functions must be supplied, including any related source code or scripts. This description should allow an independent reconstruction of the implementation-specific layer.*

The scripts used to implement the ISL are disclosed in the Supporting Files Archive.

Profile-Directed Optimization

> *If profile-directed optimization as described in Clause 5.2.9 is used, such use must be disclosed.*

Profile-directed optimization was not used.

Clause 7: Pricing

Hardware and Software Used in the Priced System

The priced system is the same as the benchmarked system. Hardware and software pricing details are shown in the pricing summary pages at the front of this report and in Appendix A.

Total Three Year Price

The total three-year cost of ownership is $137,256.00. The reported price/performance is $25.01 / kQphH@1000GB.

Availability Date

System Hardware: Now.

Exasol 2025.2.1: Now.

Clause 8: Full Disclosure

Supporting Files Index Table

An index for all files and/or directories included in the Supporting Files Archive as required by Clauses 8.3.2 through 8.3.8 must be provided in the report.

Clause	Description	Archive Files	Pathname
1	Parameter Settings	benchmark_scripts.zip	RUN/params.log
1	DB Creation Scripts	benchmark_scripts.zip	KIT/sql/create_user.sql KIT/sql/create_schema.sql KIT/sql/create_indices.sql KIT/sql/analyze_database.sql
1	Hardware and RAID Verification	benchmark_scripts.zip	RUN/SF1k_hwinfo-node2.tgz ACID/r7715-node2/ ACID/Dura-2026-05-07.node2.drive-failure/fail-raid.log
1	Toolkit Common Scripts	benchmark_scripts.zip	KIT/scripts
2	Minor query modifications	benchmark_scripts.zip	KIT/tpch_archives/TPC-H_Tools_v3.0.0.zip.patch
3	ACID Test Scripts	benchmark_scripts.zip	KIT/ACID/
3	ACID Test Results	benchmark_scripts.zip	ACID/
4	Database Load Scripts	benchmark_scripts.zip	KIT/scripts/load_init.sh
4	Qualification Test Results	benchmark_scripts.zip	VLD/
5	Query Output Results	run1results.zip	RUN/run1/
5	Query Output Results	run2results.zip	RUN/run2/
6	Source Codes and Scripts of Driver	benchmark_scripts.zip	KIT/scripts/query_streams KIT/scripts/tpc_h_run_full.sh
7	There are no files to be included for Clause 7.	N/A	N/A
8	Query Parameters and Seeds	run1results.zip run2results.zip	RUN/run1/substitution_parameters*.txt RUN/run1/stream*.sql RUN/run2/stream*.sql
8	Executable Query Text	run1results.zip run2results.zip	RUN/run1/stream*.sql RUN/run2/stream*.sql
8	RF function source code	benchmark_scripts.zip	KIT/scripts/tpc_h_run_full.sh

Clause 9: Audit Related Items

Auditor's Report

> *The auditor's agency name, address, phone number, and Attestation letter with a brief audit summary report indicating compliance 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 implementation of the TPC Benchmark H was audited by Doug Johnson of InfoSizing, a certified TPC-H auditor. Further information regarding the audit process may be obtained from:

Doug Johnson

InfoSizing

63 Lourdes Drive

Leominster, MA 01453

Phone: 978-343-6562

Email: doug@sizing.com

TPC Benchmark H Full Disclosure Report and other information can be downloaded from the Transaction Processing Performance Council website at www.tpc.org

InfoSizing

TPC Certified Auditor

Benchmark sponsor: Jay Engh
Dell Technologies
One Dell Way
Round Rock, TX 78682

June 18, 2026

I verified the TPC Benchmark H (TPC-H™ v3.0.1) performance of the following configuration:

Platform:	Dell PowerEdge R7715
Operating System:	Ubuntu 24.04.4
Database Manager:	Exasol 2025.2.1
Other Software:	n/a

The results were:

Performance Metric	**5,489,326.4 QphH@1000GB**
TPC-H Power	4,998,746.0
TPC-H Throughput	6,028,052.6
Database Load Time	00d 00h 27m 52s

Server	**Dell PowerEdge R7715, with:**		
CPUs	1x AMD EPYC 9845 160-Core Processor (320 threads)		
Memory	768 GiB		
Disks	***Qty***	***Size***	***Type***
	2	960 GB	M.2 SSD RAID1
	2	3.84 TB	NVMe SSD RAID1

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:

- The database records were defined with the proper layout and size
- The database population was generated using DBGen
- The database was properly scaled to 1000GB and populated accordingly
- The compliance of the database auxiliary data structures was verified
- The database load time was correctly measured and reported
- The required ACID properties were verified and met

- The query input variables were generated by QGen
- The query text was produced using minor modifications and one query variant (Q15A)
- The execution of the queries against the SF1 database produced compliant answers
- A compliant implementation specific layer was used to drive the tests
- The throughput tests involved 7 query streams
- The ratio between the longest and the shortest query was such that no query timings were adjusted
- The execution times for queries and refresh functions were correctly measured and reported
- The repeatability of the measured results was verified
- 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,

Doug Johnson, TPC Certified Auditor

Appendix A: Pricing Information

Organization	Address
Exasol, Inc.	268 Bush Street #3841, San Francisco, CA 94104-3503, USA
Dell, Inc.	One Dell Way, Round Rock, TX 78682, United States

Product	Part Number	Unit Price $/Mo	Qty	Ext. Price $
Exasol Database	Exasol 1TB Subscription [1)]	$2,000	36	$72,000
Total				$72,000

1) Includes software support 24x7.

Pricing validity date: July 1, 2029.

Exasol Pricing Contact

Silvia Kargl

sales@exasol.com