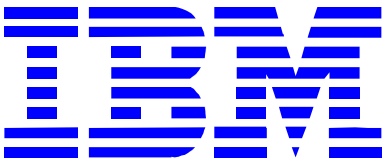

TPC Benchmark™ H Full Disclosure Report

IBM Power 780 Model 9179-MHB

Using

Sybase IQ Single Application Server Edition v.15.4

First Edition

October 14, 2011

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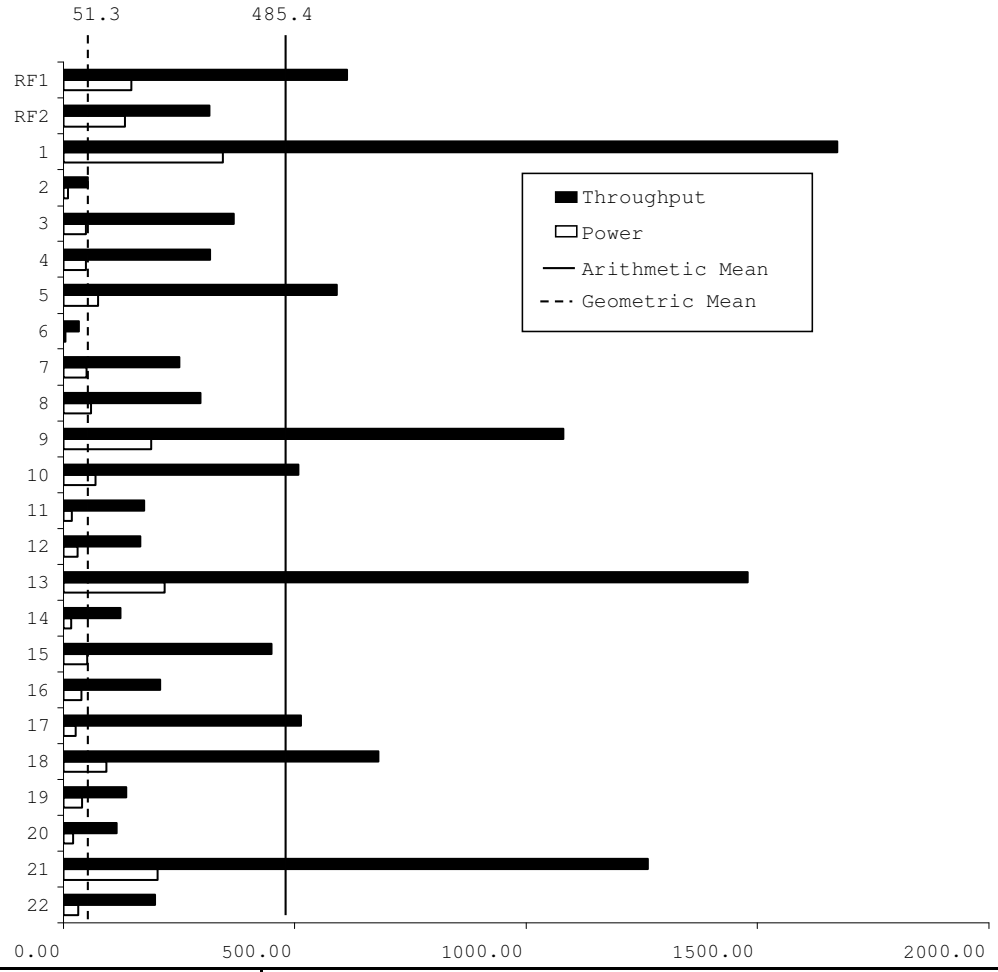
First Edition October 14, 2011

IBM
Power 780 Model 9179-MHB

TPC-H Rev 2.14.0
TPC Pricing Rev 1.6.0
Report Date: October 14, 2011

Total System Cost	Composite Query per Hour Rating	Price/Performance
$1,221,654 USD	192,001.1 QphH@3000GB	$6.37 USD $/QphH@3000GB

Database Size	Database Manager	Operating System	Other Sofware	Availability Date
3000GB	Sybase IQ Single Application Server Edition v.15.4	AIX 7.1	None	November 30, 2011



	Storage Redundancy Levels	
Database Load Time: 05:51:50	Base Tables	3
Load Includes Backup: N	Auxiliary Structures	3
Total Disk/Database Size: 5.20	DBMS Temporary Space	3
Memory/Database Size Percentage: 34.1%	OS and DBMS Software	0

System Configuration

1 IBM Power 780 Model 9179-MHB

Processors/Cores/Threads/Type	8/32/128 IBM POWER7 4.1GHz, 256KB L2/32MB L3 cache
Memory	1024 GB
Disk Controllers	20 x IBM PCI-E RAID & SSD 3Gb SAS Adapter
Disk Drawers	5 x IBM EXP 12X I/O Drawer PCIe
Disk Drives	80 x 177GB SAS SSD; 5 x 146GB 15k RPM SFF SAS Disk
Total Disk Storage	15,610 GB (GB is defined as 1024 * 1024 * 1024 bytes)

IBM
Power 780 Model 9179-MHB

TPC-H Rev. 2.14.0
TPC Pricing Rev 1.6.0

Report Date:
October 14, 2011

Description	Part Number	Brand	Price Source	Unit Price	Qty	Extended Price	3-Yr. Maint. Price
Server Hardware							
9179 Model MHB	9179-MHB	IBM	1	$10,195.00	1	$10,195	$3,072
Integrated, 4 Port- 1Gb Virtual Ethernet	1803	IBM	1	$699.00	4	$2,796	
GX++ 12X DDR Adapter, Dual-port	1808	IBM	1	$1,499.00	5	$7,495	
Operator Panel	1853	IBM	1	$1,000.00	1	$1,000	
3.0 Meter 12X DDR Cable	1865	IBM	1	$623.00	10	$6,230	
146GB 15K RPM SFF SAS Disk Drive	1886	IBM	1	$652.00	5	$3,260	
Serv Interface Cable- 2, 3, and 4 Enclosure	3671	IBM	1	$2,000.00	1	$2,000	
Serv Interface Cable- 3 and 4 Enclosure	3672	IBM	1	$3,000.00	1	$3,000	
Serv Interface Cable- 4 Enclosure	3673	IBM	1	$4,000.00	1	$4,000	
Processor Cable, Two, Three or Four Drawer System	3712	IBM	1	$5,000.00	1	$5,000	
Processor Cables, Three or Four Drawer System	3713	IBM	1	$10,000.00	1	$10,000	
Processor Cables, Four-Drawer System	3714	IBM	1	$12,000.00	1	$12,000	
Bundle: 5 x #2055 and 20 x #1995 (AIX/Linux)	4367	IBM	1	$98,114.00	4	$392,456	$65,280
3.86GHz/4.14GHz TurboCore Proc Card, 0/16 Core POWER7, 16 DDR3 Memory	4982	IBM	1	$57,429.00	4	$229,716	$24,288
One Processor Activation for Processor Feature #4982	5469	IBM	1	$8,375.00	32	$268,000	$92,160
System CEC Enclosure with IBM BEZEL, I/O Backplane, and System Midplane	5597	IBM	1	$12,000.00	4	$48,000	
0/64GB DDR3 Memory (4X16GB) DIMMS - 1066MHz - POWER7 CoD Memory	5601	IBM	1	$7,720.00	16	$123,520	
System AC Power Supply, 1725 W, for Redundant Power	5632	IBM	1	$1,502.00	8	$12,016	
Disk/Media Backplane	5652	IBM	1	$4,000.00	4	$16,000	
Service Processor	5664	IBM	1	$4,000.00	2	$8,000	
FSP/Clock Pass Through Card	5665	IBM	1	$900.00	2	$1,800	
SATA Slimline DVD-RAM Drive	5762	IBM	1	$392.00	1	$392	
2-Port 10/100/1000 Base-TX Ethernet PCI Express Adapter	5767	IBM	1	$692.00	1	$692	
12X I/O Drawer PCIe, SFF disk	5802	IBM	1	$15,705.00	5	$78,525	$39,000
Power Control Cable (SPCN) - 3 meter	6006	IBM	1	$52.00	7	$364	
Power Cable -- Drawer to IBM PDU, 14-foot,250V/10A	6577	IBM	1	$19.00	18	$342	
Activation of 1 GB DDR3 POWER7 Memory	8212	IBM	1	$245.00	24	$5,880	
Activation of 100 GB DDR3 POWER7 Memory	8213	IBM	1	$24,500.00	10	$245,000	
TurboCore Mode Specify Code	9982	IBM	1	$0.00	1	$0	
7014-T42 Rack	7014-T42	IBM	1	$3,970.00	1	$3,970	$888
Front Door (Black) for High Perforation	6069	IBM	1	$550.00	1	$550	
Side Panel (Black)	6098	IBM	1	$150.00	2	$300	
PDU to Wall Powercord 14', 200-240V/24A, UTG0247, PT#12	6654	IBM	1	$240.00	6	$1,440	
Power Dist Unit - Side Mount, Universal UTG0247 Connector	7188	IBM	1	$1,000.00	5	$5,000	
7042-C08 HMC 1:7042-C08 Deskside Hardw.Mgmt.Console	7042-C08	IBM	1	$2,800.00	1	$2,800	$768
Internal Modem	0033	IBM	1	$200.00	1	$200	$576
Modem Cable - US/Canada and General Use	1025	IBM	1	$17.00	1	$17	
PCIe1Gb Ethernet UTP 2Port	5767	IBM	1	$682.00	1	$682	
Full Width Quiet Touch Keyboard -- USB, US English, #103P	5951	IBM	1	$107.00	1	$107	
Power Cord (6-foot), To Wall (125V, 15A), Plug Type #4	6470	IBM	1	$18.00	1	$18	
Ethernet Cable, 15m, Hardware Management Console to System Unit	7802	IBM	1	$33.00	1	$33	
USB Mouse	8845	IBM	1	$39.00	1	$39	
THC 14" Monitor (2 spares)	H94-1400	THC	3	$89.99	3	$270	
						$1,513,105	$226,032
Server Software							
HMC Software Support - 1 Year, plus 24x7 UPG		IBM	1	$250.00	3		$1,011
IBM AIX Standard Edition Version 7.1 Per Processor - Large POWER 7	5765-G98	IBM	1	$2,600.00	32	$83,200	
Software Maintenance for AIX Std Ed., Per Proc 1 Yr SWMA Large Pwr 7 Reg - 5771-SWM	1516	IBM	1	$650.00	32		$62,400
Software Maintenance for AIX Std Ed., Per Proc 1 Yr SWMA Large Pwr 7 7 x24 - 5771-SWM	1517	IBM	1		32		$16,416
Sybase IQ Single Application Server Edition		Sybase	2	$2,595.00	32	$83,040	
Sybase IQ Maintenance Renewal -3 Year		Sybase	2	$1,713.00	32		$54,816
				Subtotal		$166,240	$134,643
				Total		$2,040,020	
IBM Dollar Volume Discount (See Note 1.)			1			$797,688	
Sybase IQ Discount (See Note 2.)			2			$20,678	

Three-Year Cost of Ownership USD: $1,221,654

QppH 192,001

$ USD/QppH $6.37

Pricing: 1 - IBM; 2 - Sybase, 3 - TD

Note 1: Discount based on IBM guidance applies to all hardware, software and maintenance line items where Price Source=1.

Note 2: Discount based on Sybase guidance applies to all line items where Price Source=2.

Pricing is for one system or one of similar size.

Audited by Francois Raab of 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 stated prices are not available according to these terms, please inform the TPC at pricing @ tpc.org. Thank you.

IBM	IBM Power 780 Model 9179-MHB	TPC-H Rev 2.14.0 TPC Pricing Rev 1.6.0 Report Date: October 14, 2011

Numerical Quantities Summary

Measurement Results

Database Scale Factor	=	3000
Total Data Storage/Database Size	=	5.20
Start of Database Load	=	9/29/2011 05:38:21
End of Database Load	=	9/29/2011 11:30:11
Database Load Time	=	05:51:50
Query Streams for Throughput Test	=	8
TPC-H Power	=	210,368.4
TPC-H Throughput	=	175,237.4
TPC-H Composite Query-per-Hour Metric (QphH@3000GB)	=	192,001.1
Total System Price Over 3 years	=	$1,221,654 USD
TPC-H Price Performance Metric ($/QphH@3000GB)	=	$6.37 USD

Measurement Intervals

Measurement Interval in Throughput Test (Ts)	=	10,847

Duration of Stream Execution

		Date and Time Stamps						Duration
Stream ID	Seed Used	Query Start		RF1 Start		RF2 Start		Queries
		Query End		RF1 End		RF2 End		RFs
Stream 00	929113011	9/29/2011	15:53:26	9/29/2011	15:50:56	9/29/2011	16:21:45	0:28:11
		9/29/2011	16:21:37	9/29/2011	15:53:24	9/29/2011	16:23:58	0:04:46
Stream 01	929113012	9/29/2011	16:23:58	9/29/2011	16:24:58	9/29/2011	16:30:59	2:57:17
		9/29/2011	19:21:15	9/29/2011	16:30:58	9/29/2011	16:35:52	0:10:54
Stream 02	929113013	9/29/2011	16:23:59	9/29/2011	16:35:52	9/29/2011	16:47:23	3:00:46
		9/29/2011	19:24:45	9/29/2011	16:47:22	9/29/2011	16:51:49	0:15:57
Stream 03	929113014	9/29/2011	16:23:59	9/29/2011	16:51:49	9/29/2011	17:16:06	2:58:39
		9/29/2011	19:22:38	9/29/2011	17:16:06	9/29/2011	17:20:38	0:28:49
Stream 04	929113015	9/29/2011	16:23:59	9/29/2011	17:20:38	9/29/2011	17:37:13	2:59:43
		9/29/2011	19:23:42	9/29/2011	17:37:13	9/29/2011	17:42:31	0:21:53
Stream 05	929113016	9/29/2011	16:23:59	9/29/2011	17:42:31	9/29/2011	17:47:20	2:54:59
		9/29/2011	19:18:58	9/29/2011	17:47:20	9/29/2011	17:52:15	0:09:44
Stream 06	929113017	9/29/2011	16:23:59	9/29/2011	17:52:15	9/29/2011	17:57:15	2:58:19
		9/29/2011	19:22:18	9/29/2011	17:57:15	9/29/2011	18:04:28	0:12:13
Stream 07	929113018	9/29/2011	16:23:58	9/29/2011	18:04:28	9/29/2011	18:09:25	2:57:02
		9/29/2011	19:21:00	9/29/2011	18:09:25	9/29/2011	18:14:02	0:09:34
Stream 08	929113019	9/29/2011	16:23:59	9/29/2011	18:14:00	9/29/2011	18:22:39	2:57:02
		9/29/2011	19:21:01	9/29/2011	18:22:39	9/29/2011	18:28:54	0:14:54

TPC-H Timing Intervals (in seconds)

Stream ID	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	Q11	Q12
Stream 0	344.6	9.6	48.2	49.3	75.4	4.4	49.5	59.8	189.2	69.1	18.3	30.8
Stream 01	1468.2	74.4	360.5	191.1	473.4	32.5	159.7	314.5	1039.3	499.0	118.3	177.7
Stream 02	1613.6	46.4	384.0	207.3	669.9	36.1	338.2	353.1	1042.1	399.0	232.2	224.4
Stream 03	1303.0	44.9	182.3	321.9	551.9	25.3	317.6	292.9	1351.4	592.1	264.1	115.7
Stream 04	1826.5	54.3	147.8	322.6	709.5	37.9	292.1	308.8	992.8	614.9	193.9	169.7
Stream 05	1995.2	63.6	518.3	363.9	783.5	43.1	243.4	333.0	869.0	448.2	152.1	146.4
Stream 06	1953.1	44.3	357.8	261.9	502.4	23.6	262.2	189.2	1061.6	577.9	261.9	199.0
Stream 07	1641.1	46.0	567.6	295.7	545.4	16.6	183.2	286.4	1086.0	484.2	104.4	106.9
Stream 08	1585.5	48.7	428.8	575.5	490.4	56.6	205.9	288.3	1199.8	443.2	65.9	188.5
Minimum	1303.0	44.3	147.8	191.1	473.4	16.6	159.7	189.2	869.0	399.0	65.9	106.9
Average	1673.3	52.8	368.4	317.5	590.8	34.0	250.3	295.8	1080.3	507.3	174.1	166.0
Maximum	1995.2	74.4	567.6	575.5	783.5	56.6	338.2	353.1	1351.4	614.9	264.1	224.4
Stream ID	**Q13**	**Q14**	**Q15a**	**Q16**	**Q17**	**Q18**	**Q19**	**Q20**	**Q21**	**Q22**	**RF1**	**RF2**
Stream 0	218.7	17.1	51.9	38.4	27.1	92.4	39.8	20.4	203.8	32.6	147.3	133.2
Stream 01	1685.6	156.4	481.5	196.8	610.5	637.1	158.3	138.6	1423.4	239.6	359.9	293.0
Stream 02	1815.3	179.7	437.6	257.4	637.2	694.4	118.3	126.2	782.2	251.6	690.6	266.1
Stream 03	1167.8	107.3	593.8	167.3	577.5	724.4	158.2	124.9	1518.1	216.5	1456.8	272.2
Stream 04	1604.9	82.1	479.2	200.0	399.9	630.3	97.6	40.5	1373.5	204.3	994.7	317.2
Stream 05	1446.3	116.4	291.2	165.6	457.3	492.9	85.1	95.1	1259.0	130.4	289.5	294.6
Stream 06	1244.5	135.5	472.6	258.3	447.9	1048.5	84.9	129.9	959.9	222.6	299.8	433.1
Stream 07	1453.4	107.3	388.6	231.6	515.4	718.4	209.5	115.4	1359.4	158.9	296.6	277.0
Stream 08	1413.4	96.1	453.1	194.9	465.2	495.7	173.3	154.6	1435.6	163.1	516.4	375.4
Minimum	1167.8	82.1	291.2	165.6	399.9	492.9	84.9	40.5	782.2	130.4	289.5	266.1
Average	1478.9	122.6	449.7	209.0	513.9	680.2	135.7	115.7	1263.9	198.4	613.0	316.1
Maximum	1815.3	179.7	593.8	258.3	637.2	1048.5	209.5	154.6	1518.1	251.6	1456.8	433.1

Abstract

This report documents the full disclosure information required by the TPC Benchmark™ H Standard Specification Revision 2.14.0 dated June 16, 2011 for measurements on the IBM Power 780 Model 9179-MHB.

The software used includes IBM AIX Version 7.1 operating system with Sybase IQ Single Application Server Edition v.15.4.

Preface

TPC Benchmark™ H Standard Specification was developed by the Transaction Processing Performance Council (TPC). It was released on February 26, 1999, and most recently revised (Revision 2.14.0) on June 16, 2011. This is the full disclosure report for benchmark testing of the IBM Power 780 Model 9179-MHB according to the TPC Benchmark™ H Standard Specification.

TPC Benchmark™ H is a Decision Support benchmark. It is a suite of business oriented queries and concurrent updates. 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 (e.g., via a point and click GUI interface);
- 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.

The TPC-H operations are modeled as follows:

- The database is continuously available 24 hours a day, 7 days a week, for ad-hoc queries from multiple end users and data modifications against all tables, except possibly during infrequent (e.g., once a month) maintenance sessions;
- The TPC-H database tracks, possibly with some delay, the state of the OLTP database through on-going refresh functions which batch together a number of modifications impacting some part of the decision support database;
- Due to the world-wide nature of the business data stored in the TPC-H database, the queries and the refresh functions may be executed against the database at any time, especially in relation to each other. In addition, this mix of queries and refresh functions is subject to specific ACIDity requirements, since queries and refresh functions may execute concurrently;

- To achieve the optimal compromise between performance and operational requirements, the database administrator can set, once and for all, the locking levels and the concurrent scheduling rules for queries and refresh functions.

The minimum database required to run the benchmark holds business data from 10,000 suppliers. It contains almost ten million rows representing a raw storage capacity of about 1 gigabyte. Compliant benchmark implementations may also use one of the larger permissible database populations (e.g., 100 gigabytes), as defined in Clause 4.1.3.

The performance metric reported by TPC-H is called the TPC-H Composite Query-per-Hour Performance Metric (QphH@Size), and reflects multiple aspects of the capability of the system to process queries. These aspects include the selected database size against which the queries are executed, the query processing power when queries are submitted by a single stream, and the query throughput when queries are submitted by multiple concurrent users. The TPC-H Price/Performance metric is expressed as $/QphH@Size. To be compliant with the TPC-H standard, all references to TPC-H results for a given configuration must include all required reporting components (see Clause 5.4.6). The TPC believes that comparisons of TPC-H results measured against different database sizes are misleading and discourages such comparisons.

The TPC-H database must be implemented using a commercially available database management system (DBMS) and the queries executed via an interface using dynamic SQL. The specification provides for variants of SQL, as implementers are not required to have implemented a specific SQL standard in full.

TPC-H uses terminology and metrics that are similar to other benchmarks, originated by the TPC and others. Such similarity in terminology does not in any way imply that TPC-H results are comparable to other benchmarks. The only benchmark results comparable to TPC-H are other TPC-H results compliant with the same revision.

Despite the fact that this benchmark offers a rich environment representative of many decision support systems, this benchmark does not reflect the entire range of decision support requirements. In addition, the extent to which a customer can achieve the results reported by a vendor is highly dependent on how closely TPC-H approximates the customer application. The relative performance of systems derived from this benchmark does not necessarily hold for other workloads or environments. Extrapolations to any other environment are not recommended.

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

Benchmark sponsors are permitted several possible system designs, provided that they adhere to the model described in Clause 6. A full disclosure report (FDR) of the implementation details, as specified in Clause 8, must be made available along with the reported results.

1.0 General Items

1.1. Benchmark Sponsor

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

This benchmark was sponsored by International Business Machines Corporation.

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 but not limited to:

- *Data Base 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.*

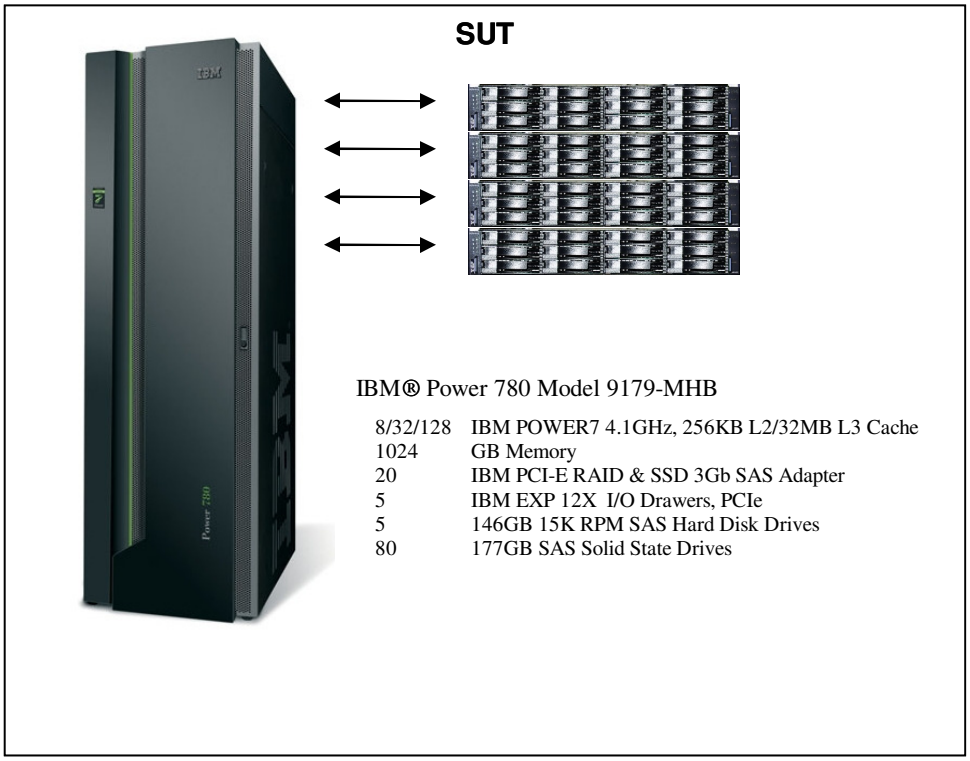
The Supporting Files Archive contains the tuning and configuration options used.

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 the protocol type*
- *Number of LAN (e.g. Ethernet) connections, including routers, work stations, terminals, etc., that were physically used in the test or are incorporated into the pricing structure*
- *Type and run-time execution location of software components (e.g. DBMS, query processing tools/languages, middle-ware components, software drivers, etc.)*

IBM Power 780 Model 9179-MHB Benchmark Configuration:



The measured and priced configurations are identical.

2.0 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 File	Pathname
1	DB creation scripts	benchmark_scripts.zip	SupportingFiles/Clause1/db_creation/
	OS tuning parameters	benchmark_scripts.zip	SupportingFiles/Clause1/os_tune.txt
2	Query validation text	benchmark_scripts.zip	SupportingFiles/Clause2/q*.sql
	Query validation output	benchmark_scripts.zip	SupportingFiles/Clause2/q*.out
	Query substitution parameters	benchmark_scripts.zip	SupportingFiles/Clause2/opts.*
	Query substitution seeds	benchmark_scripts.zip	SupportingFiles/Clause2/stream_seeds
	Refresh function details	benchmark_scripts.zip	SupportingFiles/Clause2/create_refresh_functions.sql
3	ACID test scripts	benchmark_scripts.zip	SupportingFiles/Clause3/ACID_scripts/
	ACID test results	benchmark_scripts.zip	SupportingFiles/Clause3/ACID_results/
4	DB load scripts	benchmark_scripts.zip	SupportingFiles/Clause4/scripts/
	DB load query text	benchmark_scripts.zip	SupportingFiles/Clause4/sql/
5	Execution log	benchmark_scripts.zip	SupportingFiles/Clause5/console.log
	Refresh streams query text	benchmark_scripts.zip	SupportingFiles/Clause5/update_*
6	Implementation scripts	benchmark_scripts.zip	SupportingFiles/Clause6/

3.0 Clause 1: Logical Database Design Related Items

3.1. Table Definitions

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 table definitions used.

3.2. Database 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.

The Supporting Files Archive contains the index definitions used.

3.3. Horizontal Partitioning

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

Horizontal partitioning was used for the lineitem and orders tables. The Supporting Files Archive contains the partitioning definitions used.

3.4. Replication

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

No replication was used.

4.0 Clause 2: Query and Refresh Function Related Items

4.1. Query Language

The query language used to implement the queries must be identified (e.g.,"RALF/SQL-Plus").

SQL was the query language used.

4.2. QGen Version

The version number, release number, modification number and patch level of QGen must be disclosed.

The supplied QGen version 2.14.0 was used.

4.3. Query Text

The executable query text used for query validation must be reported in the supporting files archive 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 definitions 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 Supporting Files Archive contains the query text and the output of the executed query text.

The functional query definitions and variants used in this disclosure use the following minor query modifications.

1. In Q1, Q4, Q5, Q6, Q10, Q12, Q14, Q15 and Q20, the “dateadd” function is used to perform date arithmetic
2. In Q2, Q3, Q10, Q18 and Q21, the “top” function is used to restrict the number of output rows
3. In Q7, Q8 and Q9, the “year” function is used to extract part of a date
4. The semicolon ';' is used as a command delimiter

4.4. Query Substitution Parameters and Seeds

All query substitution parameters used during the performance test must be disclosed in tabular format, along with the seeds used to generate these parameters.

The Supporting Files Archive contains the substitution parameters and seeds used in the performance tests.

4.5. Isolation Level

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

The isolation level used to run the queries was Level 3.

4.6. Refresh Functions

The details of how the refresh functions were implemented must be reported in the supporting files archive (including source code of any non-commercial program used).

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

5.0 Clause 3: Database System Properties Related Items

The results of the ACID tests must be disclosed along with a description of how the ACID requirements were met. All code (including queries, stored procedures, etc.) used to test the ACID requirements and their entire output must be reported in the supporting files archive.

All ACID tests were conducted according to specification. The Atomicity, Isolation, Consistency and Durability tests were performed on the IBM Power 780 Model 9179-MHB. The Supporting Files Archive contains the source code for the ACID tests and the output from the ACID tests.

5.1. 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.

5.1.1. Atomicity of Completed Transaction

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

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

1. The total price from the ORDER table and the extended price from the LINEITEM table were retrieved for a randomly selected orderkey, o_key, and l_linenumber, l_key. The number of records in the HISTORY table with selected o_key, l_key was also retrieved.
2. The ACID transaction T1 was executed for the Orderkey used in Step 1.
3. The ACID transaction committed.
4. The total price and the extended price were retrieved for the same orderkey used in step 1 and step 2. It was verified that: T1.EXTENDEDPRICE = OLD.EXTENDEDPRICE + ((T1.DELTA) * (OLD.EXTENDEDPRICE/OLD.QUANTITY)), T1.TOTALPRICE = OLD.TOTALPRICE + ((T1.EXTENDEDPRICE-OLD.EXTENDEDPRICE)*(1-DISCOUNT)*(1+TAX)), and that the number of records in the history table with o_key, l_key used in step 1 had increased by 1.

5.1.2. 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 ORDER, LINEITEM, and HISTORY tables.

The following steps were performed to verify the atomicity of the aborted ACID transaction:

1. The total price from the ORDER table and the extended price from the LINEITEM table were retrieved for a random Orderkey. The number of records in the HISTORY table was also retrieved.
2. The ACID transaction was executed for the Orderkey used in step 1.
3. The transaction was rolled back.

4. The total price and the extended price were retrieved for the same orderkey used in step 1 and step 2. It was verified that the extended price and the total price were the same as in step 1. The number of records in the HISTORY table was retrieved again and verified to be the same as in step1.

5.2. 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.

5.2.1. Consistency Condition

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 ORDERS and LINEITEM defined by (O_ORDERKEY=L_ORDERKEY)

The following queries were executed before and after a measurement to show that the database was always in a consistent state both initially and after a measurement. Check the implementation if

```
SELECT sum ("truncate" ("truncate"( round(cast(l_extendedprice as numeric(26,16)),2) *
            (1 - round(cast(l_discount as numeric(26,16)),2)),2) *
            (1 + round(cast(l_tax as numeric(26,16)),2)) , 2))
        FROM lineitem WHERE l_orderkey = o_key;
```

is equal to o_total of order table.

5.2.2. Consistency Tests

Verify that the ORDERS and LINEITEM tables are initially consistent as defined in Clause 3.3.2.1, based on a random sample of at least 10 distinct values of O_ORDERKEY.

The queries defined in 5.2.1, "Consistency Condition" were run after initial database build and prior to executing the ACID transaction. The queries showed that the database is in a consistent state.

After executing 10 streams of 100 ACID transactions each, the queries defined in 5.2.1, "Consistency Condition" were run again. The queries showed that the database was still in a consistent state.

5.3. Isolation Requirements

5.3.1. Isolation Test 1

This test demonstrates 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. 1st session: Started an ACID transaction with a randomly selected O_KEY, L_KEY and DELTA. The transaction was delayed for 10 seconds just prior to the Commit.
2. 2nd session: Started an ACID query for the same O_KEY as in the ACID transaction. The query completed without blocking and did not see any of the uncommitted changes made by the ACID transaction.

3. 1st session: the ACID transaction resumed and successfully completed the Commit.

5.3.2. Isolation Test 2

This test demonstrates isolation for the read-write conflict of read-write transaction and read-only transaction when the read-write transaction is rolled back.

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

1. 1st session: Performed the ACID transaction for a random O_KEY, L_KEY and DELTA. The transaction was delayed for 10 seconds just prior to the Rollback.
2. 2nd session: Started an ACID query for the same O_KEY as in the ACID transaction. The query completed without blocking and did not see any of the uncommitted changes made by the ACID transaction.
3. 1st session: the ACID transaction resumed and successfully completed the Rollback.

5.3.3. Isolation Test 3

This test demonstrates 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 refresh transactions:

1. 1st session: Started an ACID transaction T1 for a randomly selected O_KEY, L_KEY and DELTA. The transaction was delayed for 30 seconds just prior to the COMMIT.
2. 2nd session: Started a second ACID transaction T2 for the same O_KEY, L_KEY, and for a randomly selected DELTA2. This transaction was forced to wait.
3. 1st session: The ACID transaction T1 was released and the Commit was executed, releasing the record. With the LINEITEM record now released, the ACID transaction T2 completed.
4. Verified that:

   T2.L_EXTENDEDPRICE = T1.L_EXTENDEDPRICE +
   (DELTA*(T1.L_EXTENDEDPRICE)/T1.L_QUANTITY)

5.3.4. Isolation Test 4

This test demonstrates isolation for write-write conflict of two update transactions when the first transaction is rolled back.

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

1. 1st session: Started an ACID transaction T1 for a randomly selected O_KEY, L_KEY, and DELTA. The transaction was delayed for 30 seconds just prior to the rollback.
2. 2nd session: Started a second ACID transaction T2 for the same O_KEY, L_KEY used by the 1st session. This transaction was forced to wait.
3. 1st session: Rollback the ACID transaction T1. With the LINEITEM record now released, the ACID transaction T2 completed.

4. Verified that T2.L_EXTENDEDPRICE = T1.L_EXTENDEDPRICE

5.3.5. Isolation Test 5

This test demonstrates the ability of read and write transactions affecting different database tables to make progress concurrently.

1. 1st session: Started an ACID transaction, T1, for a randomly selected O_KEY, L_KEY and DELTA. The ACID transaction was suspended prior to COMMIT.
2. 2nd session: Started a second ACID transaction, T2, which selected random values of PS_PARTKEY and PS_SUPPKEY and returned all columns of the PARTSUPP table for which PS_PARTKEY and PS_SUPPKEY were equal to the selected values.
3. T2 completed.
4. T1 was allowed to complete.
5. It was verified that the appropriate rows in the ORDERS, LINEITEM and HISTORY tables have been changed.

5.3.6. Isolation Test 6

This test demonstrates that 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.

1. 1st session: A transaction T1, which executed TPC-H query 1 with a randomly selected DELTA was started.
2. 2nd session: Before T1 completed, an ACID transaction T2, with randomly selected values of O_KEY, L_KEY and DELTA, was started.
3. T2 completed and appropriate rows in the ORDERS, LINEITEM and HISTORY tables had been changed.
4. T1 completed executing query 1.

5.4. Durability Requirements

The SUT must guarantee durability: the ability to preserve the effects of committed transactions and ensure database consistency after recovery from any one of the failures listed in Clause 3.5.3.

5.4.1. Loss of Disk and Controller

These tests were combined and conducted on the qualification database. The following steps were performed:

1. The consistency condition described in section 5.2.1 was verified.
2. The current count of the total number of records in the HISTORY table was determined giving hist1.
3. A test to run ACID transactions on each of 10 execution streams was started such that each stream executes a different set of transactions.

4. At least 100 ACID transactions were completed from each of the execution streams.
5. While ACID transactions continued to be executed by all execution streams, one of the disks containing Sybase database table data, database indices and transaction log was removed from the enclosure along with the SAS controller. Because the logical volumes on the disks were in RAID1 configuration with another controller the execution streams continued running ACID transactions.
6. The system was shutdown down .
7. The system was rebooted and the database was restarted.
8. Step 2 was performed giving hist2. It was verified that hist2 – hist1 was greater than or equal to the number of records in the success file.
9. The consistency condition described in section 5.2.1 was verified.

5.4.2. Loss of System Power

These tests was conducted on the qualification database. The following steps were performed:

1. . The consistency condition described in section 5.2.1 was verified.
2. The current count of the total number of records in the HISTORY table was determined giving hist1.
3. A test to run ACID transactions on each of 10 execution streams was started such that each stream executes a different set of transactions.
4. At least 100 ACID transactions were completed from each of the execution streams.
5. While ACID transactions continued to be executed by all execution streams, the system was powered off by pulling the power cable..
6. The system was powered back on and rebooted and the database was restarted.
7. Step 2 was performed giving hist2. It was verified that hist2 – hist1 was greater than or equal to the number of records in the success file.
8. The consistency condition described in section 5.2.1 was verified.

6.0 Clause 4: Scaling and Database Population Related Items

6.1. 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 contains the TPC Benchmark™ H defined tables and the number of rows for each table as they existed upon build completion:

Table	Rows
Lineitem	18,000,048,306
Orders	4,500,000,000
Customer	450,000,000
Supplier	30,000,000
Part	600,000,000
Partsupp	2,400,000,000
Nation	25
Region	5

6.2. Distribution of Tables and Logs

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

Sybase IQ Single Application Server Edition v.15.4 was configured on an IBM Power 780 Model 9179-MHB server. The system had

- 20 IBM PCI-E 3Gb SAS adapters
- 5 IBM EXP 12X I/O drawers
- 80 177GB SAS solid state drives
- 5 146GB 15K RPM SFF SAS hard disk drives

The database tables and indexes are allocated across the solid state drives in RAID 1 configuration.

Controller	**Disk Count**	**Raid Level**	**Size (GB)**	**Content**
1	4	1	244 100	DB Main DB Temp
3	4	1	244 100	DB Main DB Temp

Controller	Disk Count	Raid Level	Size (GB)	Content
4	4	1	244	DB Main
			100	DB Temp
6	4	1	244	DB Main
			100	DB Temp
8	4	1	244	DB Main
			100	DB Temp
9	4	1	244	DB Main
			100	DB Temp
10	4	1	244	DB Main
			100	DB Temp
12	4	1	244	DB Main
			100	DB Temp
14	4	1	244	DB Main
			100	DB Temp
15	4	1	244	DB Main
			100	DB Temp
16	4	1	244	DB Main
			100	DB Temp
18	4	1	244	DB Main
			100	DB Temp
20	4	1	244	DB Main
			100	DB Temp
21	4	1	244	DB Main
			100	DB Temp
22	4	1	244	DB Main
			100	DB Temp
35	4	1	244	DB Main
			100	DB Temp
37	4	1	244	DB Main
			100	DB Temp
39	4	1	244	DB Main
			100	DB Temp
57	4	1	244	DB Main
			100	DB Temp

Controller	Disk Count	Raid Level	Size (GB)	Content
59	4	1	244 100	DB Main DB Temp

6.3. Mapping of Database Partitions/Replications

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

The lineitem and orders tables were partitioned by year. The database was not replicated.

6.4. Implementation of RAID

Implementations may use data redundancy mechanism(s). The type of data redundancy mechanism(s) and any configuration parameters (e.g., RAID level used) must be disclosed for each device.

	RAID Level	Storage Redundancy Level
Base Tables	1	3
Auxiliary Data Structures	1	3
DBMS Temporary Space	1	3
OS and DBMS Software	n/a	0

6.5. 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 (see Appendix D) must be reported in the in the supporting files archive.

The supplied DBGen version 2.14.0 was used.

6.6. Database Loading

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

The database load time was **5:51:50**

.

6.7. Data Storage Ratio

The data storage ratio must be disclosed. It is computed by dividing the total data storage of the priced configuration (expressed in GB) by the size chosen for the test database as defined in clause 4.1.3.1. Let r be the ratio. The reported value for r must be rounded to the nearest 0.01.

The calculation of the data storage ratio is shown in the following table:

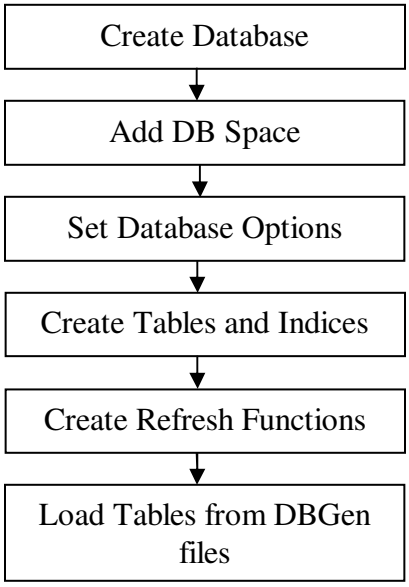
Disk Type	Number of Disks	Space per Disk	Sub-Total Disk Space	Database Size	Data Storage Ratio
146GB HDD	5	146 GB	730 GB		
177GB SSD	80	186 GB	14,880 GB		

Total			15,610	3,000 GB	5.20

6.8. Database Load Details

The details of the database load must be reported in the supporting file archive. 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 files generated by DBGen. The Supporting Files Archive contains the scripts used to load the database. The following is a basic diagram of the steps involved:



6.9. Qualification and Test Database Differences

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

The qualification database and test database were created using functionally equivalent scripts.

6.10. 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 diving this number by the size chosen for the test database as defined in Clause 4.1.3.1.

The memory to database size percentage is 34.1%.

7.0 Clause 5: Performance Metrics and Execution Rules Related Items

7.1. 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 reported in the supporting files archive including listings of scripts, command logs and system activity.

Auditor requested queries were run against the database to verify correctness of the database load. The database server was stopped, and the database server was restarted. The Supporting Files Archive contains the scripts and logs of the activity that occurred. The time taken by the activities between Load and Performance Tests are now reported as the Databae Load Time.

7.2. 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
2. Stream 00 Execution
3. RF2 Refresh Function

7.3. Timing Intervals for Each Query and Refresh Function

The timing intervals (see Clause 5.3.7) for each query and for both refresh functions must be reported for the power test.

See Numerical Quantities Summary in the Executive Summary.

7.4. Number of Streams for the Throughput Test

The number of query streams used for the throughput test must be disclosed.

See Numerical Quantities Summary in the Executive Summary.

7.5. Start and End Date/Times for Each Query Stream

The start time and finish time for each query stream for the throughput test must be disclosed.

See Numerical Quantities Summary in the Executive Summary.

7.6. Total Elapsed Time for the Measurement Interval

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

See Numerical Quantities Summary in the Executive Summary.

7.7. Refresh Function Start Date/Time and Finish Date/Time

The start time and finish time for each refresh function in the refresh stream for the throughput test must be disclosed.

See Numerical Quantities Summary in the Executive Summary

7.8. Performance Metrics

The computed performance metric, related numerical quantities and price/performance metric must be disclosed.

See Numerical Quantities Summary in the Executive Summary.

7.9. The Performance Metric and Numerical Quantities from Both Runs

The performance metric (QphH@Size) and the numerical quantities (TPC-H Power@Size and TPC-H Throughput@Size) from both runs must be disclosed.

	TPC-H Power@3000GB	TPC-H Through-put@3000GB	QphH@3000GB
Run 1	210,732.6	176,277.5	192,736.6
Run 2	210,368.4	175,237.4	192,001.1

7.10. System Activity between Tests

Any activity on the SUT that takes place between the conclusion of Run1 and the beginning of Run2 must be fully disclosed including system activity, listings of scripts or command logs along with any system reboots or database restarts.

7.11. Query Output Validation Test

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

The Supporting Files Archive contains the Query Output Validation Test output.

8.0 Clause 6: SUT and Driver Implementation Related Items

8.1. Driver

A detailed textual description of how the driver performs its functions, how its various components interact and any product functionalities or environmental settings on which it relies and all related source code, scripts and configuration files must be reported in the supporting files archive. The information provided should be sufficient for an independent reconstruction of the driver.

The Supporting Files Archive contains the source code used for the driver and all scripts used in connection with it.

The run_tpch script is used to execute the TPC-H benchmark. The run_tpch script is invoked with the desired run scope ("all" for complete execution of the benchmark) and the number of query streams to execute for the throughput test. The execution of the run_tpch script will create and load the database, run the power test and throughput test sequences and generate reports.

Each power test submits the SQL for execution of the power update stream. The power test waits for RF1 to complete and then executes the power test query stream. After completion of the power test query stream the update stream executes RF2 and the power test waits for completion of the update stream.

Each throughput test submits the 8 query streams for execution in parallel. After waiting 60 seconds, the throughput refresh stream is submitted for execution. The throughput test then waits for completion of all streams.

8.2. Implementation Specific Layer

If an implementation specific layer is used, then a detailed description of how it performs its functions, how its various components interact and any product functionalities or environmental setting on which it relies must be disclosed.

The performance tests are executed using the dbisqlc and iqisql utilities. The dbisqlc and iqisql utilities are Sybase-provided utilities which allow SQL statements to be executed against a Sybase IQ database. The dbisqlc and iqisql utilities are invoked from the command line on the SUT. They read input from files containing SQL statements and sends results to stdout. The dbisqlc utility uses information in the .odbc.ini file to connect to the database while iqisql uses information in the interfaces file to connect to the database.

The ACID tests are performed using the dbtest utility. The dbtest utility is a Sybase-provided utility, similar to dbisqlc, but providing additional scripting capabilities. It is invoked from the command-line on the SUT. It reads input from files that determine how and what to execute. It uses information in the .odbc.ini file to connect to the database.

8.3. Profile-Directed Optimization

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

Profile-directed optimization was not used.

9.0 Clause 9: Audit Related Items

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 whom to contact in order to obtain further information regarding the audit process.

This implementation of the TPC Benchmark H was audited by Francois Raab of InfoSizing, a certified TPC-H auditor. Further information regarding the audit process may be obtained from:

Francois Raab
InfoSizing
531 Crystal Hills Blvd.
Manitou Springs, CO 80829
(719) 473-7555

INFO SIZING

TPC TRANSACTION PROCESSING PERFORMANCE COUNCIL CERTIFIED AUDITOR

Lotus Douglas
Manager, Power Systems Performance
IBM 11501 BURNET RD
AUSTIN TX 78758-3400

Peter Thawley
Sr. Director & Architect, CTO Office
3 Sybase Drive
Dublin, CA 94568

October 13, 2011

I verified the TPC Benchmark™ H performance of the following configuration:

Platform: **IBM Power 780 Model 9179-MHB**

Database Manager: **Sybase IQ Single Application Server Edition v.15.4**

Operating System: **AIX 7.1**

The results were:

CPU (Speed)	Memory	Disks	**QphH@3,000 GB**
IBM Power 780 Model 9179-MHB			
8 x IBM POWER7 (4.1GHz)	1024 GB (32MB L3)	80 x 177GB SAS SSD 5 x 146GB 15Krpm SAS	**192,001.1**

In my opinion, this performance result was produced in compliance with the TPC's 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 3,000GB and populated accordingly
- The compliance of the database auxiliary data structures was verified
- The database load time was correctly measured and reported

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- 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 no query variant
- 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 8 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,

François Raab
President

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Appendix - A Pricing Information

International Business Machines Corporation
11501 Burnett RD
Austin, TX 78758

October 5, 2011

Below is the quote requested for the IBM Power 780 System.

Server Hardware	**PN/FC**	**Qty**
9179 Model MHB	9179-MHB	1
Integrated, 4 Port- 1Gb Virtual Ethernet	1803	4
GX++ 12X DDR Adapter, Dual-port	1808	5
Operator Panel	1853	1
3.0 Meter 12X DDR Cable	1865	10
146GB 15K RPM SFF SAS Disk Drive	1886	5
Serv Interface Cable- 2, 3, and 4 Enclosure	3671	1
Serv Interface Cable- 3 and 4 Enclosure	3672	1
Serv Interface Cable- 4 Enclosure	3673	1
Processor Cable, Two, Three or Four Drawer System	3712	1
Processor Cables, Three or Four Drawer System	3713	1
Processor Cables, Four-Drawer System	3714	1
Bundle: 5 x #2055 and 20 x #1995 (AIX/Linux)	4367	4
3.86GHz/4.14GHz TurboCore Proc Card, 0/16 Core POWER7, 16 DDR3 Memory	4982	4
One Processor Activation for Processor Feature #4982	5469	32
System CEC Enclosure with IBM BEZEL, I/O Backplane, and System Midplane	5601	16
System AC Power Supply, 1725 W, for Redundant Power	5632	8
Disk/Media Backplane	5652	4
Service Processor	5664	2
FSP/Clock Pass Through Card	5665	2
SATA Slimline DVD-RAM Drive	5762	1
2-Port 10/100/1000 Base-TX Ethernet PCI Express Adapter	5767	1
12X I/O Drawer PCIe, SFF disk	5802	5
Power Control Cable (SPCN) - 3 meter	6006	7
Power Cable -- Drawer to IBM PDU, 14-foot,250V/10A	6577	18
Activation of 1 GB DDR3 POWER7 Memory	8212	24
Activation of 100 GB DDR3 POWER7 Memory	8213	10
TurboCore Mode Specify Code	9982	1
7014-T42 Rack	7014-T42	1
Front Door (Black) for High Perforation	6069	1
Side Panel (Black)	6098	2
PDU to Wall Powercord 14', 200-240V/24A, UTG0247, PT#12	6654	6
Power Dist Unit - Side Mount, Universal UTG0247 Connector	7188	5
7042-C08 HMC 1:7042-C08 Deskside Hardw.Mgmt.Console	7042-C08	1
Internal Modem	0033	1
Modem Cable - US/Canada and General Use	1025	1
PCIe1Gb Ethernet UTP 2Port	5767	1
Full Width Quiet Touch Keyboard -- USB, US English, #103P	5951	1
Power Cord (6-foot), To Wall (125V, 15A), Plug Type #4	6470	1
Ethernet Cable, 15m, Hardware Management Console to System Unit	7802	1
USB Mouse	8845	1
Monitor		
IBM AIX Standard Edition Version 7.1 Per Processor - Large POWER 7	5765-G98	32

Total Hardware Cost	$1,512,835
Total Software Cost	$83,200
Total 3 year Hardware and Software Maintenance	$305,859
Total IBM Discount	$(797,688)
Three Year Total Cost of Ownership USD	$1,104,206

For additional information, please contact me directly:
Dan Hebrank
IBM Sales & Distribution, STG Sales
1-314-283-4674
http:/www.ibm.com/products

For:

Company IBM
Contact Brian Vicknair
Phone (512) 286-9081
Fax vicknair@us.ibm.com
Address 11500 Burnet Road, Austin, TX 78758

Quotation for Software and Support

SYBASE Sales Rep: Chuck Mayfield
Phone: 704-644-6119
Fax:
Sybase Inc. 1 Sybase Drive, Dublin, CA 94568

	Catalogue Number	Product Description	License Type	Machine	P/S	List Price Per Unit	Quantity	Price	Discount	Extended Price
1	11545	Sybase IQ Single App Svr, per cpu core	CP	POWER	P	2,595	32	83,040	12,456	70,584.00
3	98480	3 yr support Single App Svr, per cpu core				1,713	32	54,816	8,222	46,593.60
4		Discounts:								
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Licence + 3 year support

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