**Lenovo Global Technology**

**ThinkSystem ST250**
(3.60 GHz, Intel Xeon E-2246G)

**SPECrates**
- **SPECrates** $^{\text{2017 int base}} = 48.8$
- **SPECrates** $^{\text{2017 int peak}} = 50.6$

**CPU2017 License:** 9017  
**Test Sponsor:** Lenovo Global Technology  
**Tested by:** Lenovo Global Technology  
**Hardware Availability:** Mar-2020  
**Software Availability:** Apr-2020

**Test Date:** Jun-2020

**Hardware**

- **CPU Name:** Intel Xeon E-2246G
- **Max MHz:** 4800
- **Nominal:** 3600
- **Enabled:** 6 cores, 1 chip, 2 threads/core
- **Orderable:** 1 chip
- **Cache L1:** 32 KB I + 32 KB D on chip per core
- **L2:** 256 KB I+D on chip per core
- **L3:** 12 MB I+D on chip per chip
- **Other:** None
- **Memory:** 128 GB (4 x 32 GB 2Rx4 PC4-2666V-E)
- **Storage:** 1 x 960 GB SATA SSD
- **Other:** None

**Software**

- **OS:** SUSE Linux Enterprise Server 15 SP1 (x86_64)
  Kernel 4.12.14-195-default
- **Compiler:** C/C++: Version 19.1.1.217 of Intel C/C+
  Compiler for Linux;
  Fortran: Version 19.1.1.217 of Intel Fortran Compiler for Linux
- **Parallel:** No
- **Firmware:** Lenovo BIOS Version ISEI11SD 2.10 released Apr-2020
- **File System:** xfs
- **System State:** Run level 3 (multi-user)
- **Base Pointers:** 64-bit
- **Peak Pointers:** 32/64-bit
- **Other:** jemalloc memory allocator V5.0.1
- **Power Management:** BIOS set to prefer performance at the cost of additional power usage

---

**Graphical Chart:**

<table>
<thead>
<tr>
<th>SPECrate</th>
<th>Copies</th>
<th>Results</th>
</tr>
</thead>
<tbody>
<tr>
<td>500.perlbench_r</td>
<td>12</td>
<td>41.0</td>
</tr>
<tr>
<td>502.gcc_r</td>
<td>12</td>
<td>36.7</td>
</tr>
<tr>
<td>505.mcf_r</td>
<td>12</td>
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<td>520.omnetpp_r</td>
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<td>72.6</td>
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<tr>
<td>523.xalancbmk_r</td>
<td>12</td>
<td>29.3</td>
</tr>
<tr>
<td>525.x264_r</td>
<td>12</td>
<td>57.0</td>
</tr>
<tr>
<td>531.deepsjeng_r</td>
<td>12</td>
<td>40.5</td>
</tr>
<tr>
<td>541.leela_r</td>
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<td>37.8</td>
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<td>548.exchange2_r</td>
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</tr>
<tr>
<td>557.xz_r</td>
<td>12</td>
<td>30.1</td>
</tr>
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</table>

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**Legend:**

- **SPECrate 2017 int base (48.8)**
- **SPECrate 2017 int peak (50.6)**
### Results Table

<table>
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<tr>
<th>Benchmark</th>
<th>Copies</th>
<th>Seconds</th>
<th>Ratio</th>
<th>Seconds</th>
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<tr>
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<td>12</td>
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<td>42.7</td>
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<tr>
<td>mcf_r</td>
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<td>268</td>
<td>72.3</td>
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<td><strong>72.6</strong></td>
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<td>72.3</td>
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<td><strong>72.6</strong></td>
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<td>72.9</td>
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<td>539</td>
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<td><strong>110</strong></td>
<td>191</td>
<td>110</td>
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<tr>
<td>deepsjeng_r</td>
<td>12</td>
<td><strong>340</strong></td>
<td><strong>40.5</strong></td>
<td>340</td>
<td>40.4</td>
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<td>338</td>
<td>40.7</td>
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<tr>
<td>leela_r</td>
<td>12</td>
<td><strong>525</strong></td>
<td><strong>37.8</strong></td>
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<td>37.5</td>
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<td>12</td>
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<td>37.8</td>
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<td>37.8</td>
<td>525</td>
<td>37.9</td>
</tr>
<tr>
<td>exchange2_r</td>
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<td>307</td>
<td>102</td>
<td>308</td>
<td>102</td>
<td><strong>308</strong></td>
<td><strong>102</strong></td>
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<td>307</td>
<td>102</td>
<td>308</td>
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<td>30.2</td>
<td>430</td>
<td>30.1</td>
<td><strong>430</strong></td>
<td><strong>30.1</strong></td>
<td>12</td>
<td><strong>430</strong></td>
<td><strong>30.2</strong></td>
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<td>30.1</td>
<td>429</td>
<td>30.2</td>
</tr>
</tbody>
</table>

**SPECrate®2017_int_base = 48.8**
**SPECrate®2017_int_peak = 50.6**

Results appear in the order in which they were run. Bold underlined text indicates a median measurement.

### Compiler Notes

The inconsistent Compiler version information under Compiler Version section is due to a discrepancy in Intel Compiler. The correct version of C/C++ compiler is: Version 19.1.1.217 Build 20200306 Compiler for Linux. The correct version of Fortran compiler is: Version 19.1.1.217 Build 20200306 Compiler for Linux.

### Submit Notes

The taskset mechanism was used to bind copies to processors. The config file option 'submit' was used to generate taskset commands to bind each copy to a specific processor. For details, please see the config file.

### Operating System Notes

Stack size set to unlimited using "ulimit -s unlimited"

### Environment Variables Notes

Environment variables set by runcpu before the start of the run:

```
LD_LIBRARY_PATH = 
"/home/cpu2017-1.1.0-ic19.1.1/lib/intel64:/home/cpu2017-1.1.0-ic19.1.1/lib/ia32:/home/cpu2017-1.1.0-ic19.1.1/je5.0.1-32"
MALOC_CONF = "retain:true"
```
**SPEC CPU®2017 Integer Rate Result**

**Lenovo Global Technology**

ThinkSystem ST250  
(3.60 GHz, Intel Xeon E-2246G)  

<table>
<thead>
<tr>
<th>SPECrate®2017_int_base</th>
<th>48.8</th>
</tr>
</thead>
<tbody>
<tr>
<td>SPECrate®2017_int_peak</td>
<td>50.6</td>
</tr>
</tbody>
</table>

**CPU2017 License:** 9017  
**Test Sponsor:** Lenovo Global Technology  
**Tested by:** Lenovo Global Technology

---

**General Notes**

Binaries compiled on a system with 1x Intel Core i9-7980XE CPU + 64GB RAM  
memory using Redhat Enterprise Linux 8.0  
Transparent Huge Pages enabled by default  
Prior to runcpu invocation  
Filesystem page cache synced and cleared with: 
`sync; echo 3>/proc/sys/vm/drop_caches`

Yes: The test sponsor attests, as of date of publication, that CVE-2017-5754 (Meltdown) is mitigated in the system as tested and documented.  
Yes: The test sponsor attests, as of date of publication, that CVE-2017-5753 (Spectre variant 1) is mitigated in the system as tested and documented.  
Yes: The test sponsor attests, as of date of publication, that CVE-2017-5715 (Spectre variant 2) is mitigated in the system as tested and documented.  
jemalloc, a general purpose malloc implementation 
built with the RedHat Enterprise 7.5, and the system compiler gcc 4.8.5 

---

**Platform Notes**

**BIOS configuration:**  
Choose Operating Mode set to Maximum Performance and then set it to Custom Mode  
Energy Efficient Turbo set to Enable  
Zero Output set to Advanced Mode  
Intel Virtualization Technology set to Disable  
Hardware Prefetcher set to Disable  
Adjacent Cache Prefetch set to Disable

Sysinfo program `/home/cpu2017-1.1.0-ic19.1.1/bin/sysinfo`  
Rev: r6365 of 2019-08-21 295195f888a3d7edbe6e6e46a485a0011  
running on linux-bfbk Mon Jun 15 23:30:34 2020

SUT (System Under Test) info as seen by some common utilities.  
For more information on this section, see  
[https://www.spec.org/cpu2017/Docs/config.html#sysinfo](https://www.spec.org/cpu2017/Docs/config.html#sysinfo)

From `/proc/cpuinfo`  
model name : Intel(R) Xeon(R) E-2246G CPU @ 3.60GHz  
1 "physical id"s (chips)  
12 "processors"  
cores, siblings (Caution: counting these is hw and system dependent. The following excerpts from `/proc/cpuinfo` might not be reliable. Use with caution.)  
cpu cores : 6  
siblings : 12  
physical 0: cores 0 1 2 3 4 5

From `lscpu:`  
Architecture: x86_64

---

(Continued on next page)
Lenovo Global Technology
ThinkSystem ST250
(3.60 GHz, Intel Xeon E-2246G)

SPEC CPU®2017 Integer Rate Result

SPECrate®2017_int_base = 48.8
SPECrate®2017_int_peak = 50.6

CPU2017 License: 9017
Test Sponsor: Lenovo Global Technology
Test Date: Jun-2020
Tested by: Lenovo Global Technology
Hardware Availability: Mar-2020
Software Availability: Apr-2020

Platform Notes (Continued)

CPU op-mode(s): 32-bit, 64-bit
Byte Order: Little Endian
Address sizes: 39 bits physical, 48 bits virtual
CPU(s): 12
On-line CPU(s) list: 0-11
Thread(s) per core: 2
Core(s) per socket: 6
Socket(s): 1
NUMA node(s): 1
Vendor ID: GenuineIntel
CPU family: 6
Model: 158
Model name: Intel(R) Xeon(R) E-2246G CPU @ 3.60GHz
Stepping: 10
CPU MHz: 3600.000
CPU max MHz: 4800.0000
CPU min MHz: 800.0000
BogoMIPS: 7200.00
Virtualization: VT-x
L1d cache: 32K
L1i cache: 32K
L2 cache: 256K
L3 cache: 12288K
NUMA node0 CPU(s): 0-11
Flags: fpu vme de pse tsc msr pae mce cx8 apic sep mtrr pge mca cmov
pat pse36 clflush dts acpi mmx fxsr sse sse2 ss ht tm pbe syscall nx pdpe1gb rdtsscp
lm constant_tsc arch_perfmon pebs bts rep_good nopl xtopology nonstop_tsc cpuid
aperfmperf tsc_known_freq pni pclmulqdq dtes64 monitor ds_cpl vmx smx est tm2 ssse3
sdbg fma cx16 xtpr pdcm pcid sse4_1 sse4_2 x2apic movbe popcnt tsc_deadline_timer
aes xsave avx f16c rdrand lahf_lm abm 3dnowprefetch cpuid_fault epb invpcid_single
pti ssbd ibrs ibpb stibp tpr_shadow vnmi flexpriority ept vpid fsgsbased tsc_adjust
bmi1 hel avx2 smep bmi2 erms invpcid rtm mpx rdseed adx smap clflushopt intel_pt
xsavesopt xsavec xgetbv1 xsavees dtherm ida arat pln pts hwp hwp_notify hwp_act_window
hwp_epp md_clear flush_l1d

From numactl --hardware WARNING: a numactl 'node' might or might not correspond to a
physical chip.
available: 1 nodes (0)
node 0 cpus: 0 1 2 3 4 5 6 7 8 9 10 11
node 0 size: 128864 MB
node 0 free: 128297 MB
node distances:
node   0
0:  10

(Continued on next page)
Platform Notes (Continued)

From /proc/meminfo
  MemTotal:       131957504 kB
  HugePages_Total:       0
  Hugepagesize:       2048 kB

From /etc/*release* /etc/*version*
  os-release:
    NAME="SLES"
    VERSION="15-SP1"
    VERSION_ID="15.1"
    PRETTY_NAME="SUSE Linux Enterprise Server 15 SP1"
    ID="sles"
    ID_LIKE="suse"
    ANSI_COLOR="0;32"
    CPE_NAME="cpe:/o:suse:sles:15:sp1"

uname -a:
  Linux linux-bfbk 4.12.14-195-default #1 SMP Tue May 7 10:55:11 UTC 2019 (8fba516)
  x86_64 x86_64 x86_64 GNU/Linux

Kernel self-reported vulnerability status:

CVE-2018-3620 (L1 Terminal Fault):
  Mitigation: PTE Inversion; VMX: conditional cache flushes, SMT vulnerable

Microarchitectural Data Sampling:
  Mitigation: Clear CPU buffers; SMT vulnerable

CVE-2017-5754 (Meltdown):
  Mitigation: PTI

CVE-2018-3639 (Speculative Store Bypass):
  Mitigation: Speculative Store Bypass disabled via prctl and seccomp

CVE-2017-5753 (Spectre variant 1):
  Mitigation: __user pointer sanitization

CVE-2017-5715 (Spectre variant 2):
  Mitigation: Indirect Branch Restricted Speculation, IBPB: conditional, IBRS_FW, STIBP:
  conditional, RSB filling

run-level 3 Jun 15 23:29

SPEC is set to: /home/cpu2017-1.1.0-ic19.1.1

From /sys/devices/virtual/dmi/id
  BIOS:     Lenovo -[ISE115D-2.10]- 04/24/2020
  Vendor:   Lenovo
  Product:  ThinkSystem ST250 -[7Y45CT00WW]-
  Product Family: ThinkSystem
  Serial:  1234567890

(Continued on next page)
Lenovo Global Technology
ThinkSystem ST250
(3.60 GHz, Intel Xeon E-2246G)

SPEC Mac SPEC Benchmark Result

Copyright 2017-2020 Standard Performance Evaluation Corporation

CPU2017 License: 9017
Test Sponsor: Lenovo Global Technology
Tested by: Lenovo Global Technology

Test Date: Jun-2020
Hardware Availability: Mar-2020
Software Availability: Apr-2020

Platform Notes (Continued)
Additional information from dmsdecodew follows. WARNING: Use caution when you interpret this section. The 'dmsdecodew' program reads system data which is "intended to allow hardware to be accurately determined", but the intent may not be met, as there are frequent changes to hardware, firmware, and the "DMTF SMBIOS" standard.
Memory:
4x SK Hynix HMAA4GUD7AJR8N-VK 32767 MB 2 rank 2666

(End of data from sysinfo program)

Compiler Version Notes

=============================================================================
C  | 502.gcc_r(peak)
Intel(R) C Compiler for applications running on IA-32, Version 2021.1 NextGen Build 20200304
Copyright (C) 1985-2020 Intel Corporation. All rights reserved.
=============================================================================
C  | 500.perlbench_r(base) 502.gcc_r(base) 505.mcf_r(base, peak)
| 525.x264_r(base, peak) 557.xz_r(base)
Intel(R) C Compiler for applications running on Intel(R) 64, Version 2021.1 NextGen Build 20200304
Copyright (C) 1985-2020 Intel Corporation. All rights reserved.
=============================================================================
C  | 500.perlbench_r(peak) 557.xz_r(peak)
Intel(R) C Intel(R) 64 Compiler for applications running on Intel(R) 64, Version 19.1.1.217 Build 20200306
Copyright (C) 1985-2020 Intel Corporation. All rights reserved.
=============================================================================
C  | 502.gcc_r(peak)
Intel(R) C Compiler for applications running on IA-32, Version 2021.1 NextGen Build 20200304
Copyright (C) 1985-2020 Intel Corporation. All rights reserved.
=============================================================================
C  | 500.perlbench_r(base) 502.gcc_r(base) 505.mcf_r(base, peak)
(Continued on next page)
Lenovo Global Technology
ThinkSystem ST250
(3.60 GHz, Intel Xeon E-2246G)

SPEC CPU®2017 Integer Rate Result
Copyright 2017-2020 Standard Performance Evaluation Corporation

SPECrated®2017_int_base = 48.8
SPECrated®2017_int_peak = 50.6

CPU2017 License: 9017
Test Sponsor: Lenovo Global Technology
Test Date: Jun-2020
Tested by: Lenovo Global Technology
Hardware Availability: Mar-2020
Software Availability: Apr-2020

Compiler Version Notes (Continued)

| Intel(R) C Compiler for applications running on Intel(R) 64, Version 2021.1
| NextGen Build 20200304
| Copyright (C) 1985-2020 Intel Corporation. All rights reserved.

| Intel(R) C Intel(R) 64 Compiler for applications running on Intel(R) 64,
| Version 19.1.1.217 Build 20200306
| Copyright (C) 1985-2020 Intel Corporation. All rights reserved.

| Intel(R) C Compiler for applications running on IA-32, Version 2021.1 NextGen
| Build 20200304
| Copyright (C) 1985-2020 Intel Corporation. All rights reserved.

| Intel(R) C Compiler for applications running on Intel(R) 64, Version 2021.1
| NextGen Build 20200304
| Copyright (C) 1985-2020 Intel Corporation. All rights reserved.

| Intel(R) C Compiler for applications running on Intel(R) 64, Version 2021.1
| NextGen Build 20200304
| Copyright (C) 1985-2020 Intel Corporation. All rights reserved.

| Intel(R) C++ Compiler for applications running on Intel(R) 64, Version 2021.1
| NextGen Build 20200304
| Copyright (C) 1985-2020 Intel Corporation. All rights reserved.

(Continued on next page)
Lenovo Global Technology
ThinkSystem ST250
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SPECrater®2017_int_base = 48.8
SPECrater®2017_int_peak = 50.6

CPU2017 License: 9017
Test Sponsor: Lenovo Global Technology
Tested by: Lenovo Global Technology

Test Date: Jun-2020
Hardware Availability: Mar-2020
Software Availability: Apr-2020

Compiler Version Notes (Continued)

------------------------------------------------------------------------------
Fortran | 548.exchange2_r(base, peak)
------------------------------------------------------------------------------
Intel (R) Fortran Intel (R) 64 Compiler for applications running on Intel (R)
64, Version 19.1.1.217 Build 20200306
Copyright (C) 1985-2020 Intel Corporation. All rights reserved.
------------------------------------------------------------------------------

Base Compiler Invocation

C benchmarks:
icc

C++ benchmarks:
icpc

Fortran benchmarks:
ifort

Base Portability Flags

500.perlbench_r: -DSPEC_LP64 -DSPEC_LINUX_X64
502.gcc_r: -DSPEC_LP64
505.mcf_r: -DSPEC_LP64
520.omnetpp_r: -DSPEC_LP64
523.xalancbmk_r: -DSPEC_LP64 -DSPEC_LINUX
525.x264_r: -DSPEC_LP64
531.deepsjeng_r: -DSPEC_LP64
541.leela_r: -DSPEC_LP64
548.exchange2_r: -DSPEC_LP64
557.xz_r: -DSPEC_LP64

Base Optimization Flags

C benchmarks:
-m64 -qnextgen -std=c11
-Wl, -plugin-opt=-x86-branches-within-32B-boundaries -Wl,-z,muldefs
-xCORE-AVX2 -03 -ffast-math -flto -mfpmath=sse -funroll-loops
-fuse-ld=gold -qopt-mem-layout-trans=4

(Continued on next page)
### Lenovo Global Technology

**ThinkSystem ST250**
(3.60 GHz, Intel Xeon E-2246G)

---

#### SPEC CPU®2017 Integer Rate Result

<table>
<thead>
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<th>CPU2017 License: 9017</th>
<th>Test Date: Jun-2020</th>
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<tbody>
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<td>Lenovo Global Technology</td>
<td>Hardware Availability: Mar-2020</td>
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<td>Tested by: Lenovo Global Technology</td>
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</tr>
</tbody>
</table>

---

**SPECrate®2017_int_base = 48.8**

**SPECrate®2017_int_peak = 50.6**

---

#### Base Optimization Flags (Continued)

**C benchmarks** (continued):
- `-L /usr/local/IntelCompiler19/compilers_and_libraries_2020.1.217/linux/compiler/lib/intel64_lin`
- `-lqkmalloc`

**C++ benchmarks**:
- `-m64 -qnextgen -Wl,-plugin-opt=-x86-branches-within-32B-boundaries`
- `-Wl,-z,muldefs -xCORE-AVX2 -O3 -ffast-math -flto -mfpmath=sse`
- `-funroll-loops -fuse-ld=gold -qopt-mem-layout-trans=4`
- `-L /usr/local/IntelCompiler19/compilers_and_libraries_2020.1.217/linux/compiler/lib/intel64_lin`
- `-lqkmalloc`

**Fortran benchmarks**:
- `-m64 -Wl,-plugin-opt=-x86-branches-within-32B-boundaries -Wl,-z,muldefs`
- `-xCORE-AVX2 -O3 -ipo -no-prec-div -qopt-mem-layout-trans=4`
- `-nostandard-realloc-lhs -align array32byte -auto`
- `-mbranches-within-32B-boundaries`
- `-L /usr/local/IntelCompiler19/compilers_and_libraries_2020.1.217/linux/compiler/lib/intel64_lin`
- `-lqkmalloc`

---

#### Peak Compiler Invocation

**C benchmarks**:
- icc

**C++ benchmarks**:
- icpc

**Fortran benchmarks**:
- ifort

---

#### Peak Portability Flags

- `500.perlbench_r: -DSPEC_LP64 -DSPEC_LINUX_X64`
- `502.gcc_r: -D_FILE_OFFSET_BITS=64`
- `505.mcf_r: -DSPEC_LP64`
- `520.omnetpp_r: -DSPEC_LP64`
- `523.xalancbmk_r: -DSPEC_LP64 -DSPEC_LINUX`
- `525.x264_r: -DSPEC_LP64`
- `531.deepsjeng_r: -DSPEC_LP64`
- `541.leela_r: -DSPEC_LP64`
- `548.exchange2_r: -DSPEC_LP64`

(Continued on next page)
Lenovo Global Technology
ThinkSystem ST250
(3.60 GHz, Intel Xeon E-2246G)

Peak Portability Flags (Continued)

557.xz_r: -DSPEC_LP64

Peak Optimization Flags

C benchmarks:

500.perlbench_r: -Wl,-z,muldefs -prof-gen(pass 1) -prof-use(pass 2)
-xCORE-AVX2 -ipo -O3 -no-prec-div
-qopt-mem-layout-trans=4 -fno-strict-overflow
-mbranches-within-32B-boundaries
-L/usr/local/IntelCompiler19/compilers_and_libraries_2020.1.217/linux/compiler/lib/intel64_lin
-lqkmalloc

502.gcc_r: -m32
-L/usr/local/IntelCompiler19/compilers_and_libraries_2020.1.217/linux/compiler/lib/ia32_lin
-std=gnu89
-Wl,-plugin-opt=-x86-branches-within-32B-boundaries
-Wl,-z,muldefs -fprofile-generate(pass 1)
-fprofile-use=default.profdata(pass 2) -xCORE-AVX2 -flto
-Ofast(pass 1) -O3 -ffast-math -qnextgen -fuse-ld=gold
-qopt-mem-layout-trans=4 -L/usr/local/jemalloc32-5.0.1/lib
-ljemalloc

505.mcf_r: basepeak = yes

525.x264_r: -m64 -qnextgen -std=c11
-Wl,-plugin-opt=-x86-branches-within-32B-boundaries
-Wl,-z,muldefs -xCORE-AVX2 -flto -O3 -ffast-math
-fuse-ld=gold -qopt-mem-layout-trans=4 -fno-alias
-L/usr/local/IntelCompiler19/compilers_and_libraries_2020.1.217/linux/compiler/lib/intel64_lin
-lqkmalloc

C++ benchmarks:

520.omnetpp_r: basepeak = yes

523.xalancbmk_r: basepeak = yes

(Continued on next page)
Lenovo Global Technology
ThinkSystem ST250
(3.60 GHz, Intel Xeon E-2246G)

SPECrate®2017_int_base = 48.8
SPECrate®2017_int_peak = 50.6

CPU2017 License: 9017
Test Sponsor: Lenovo Global Technology
Tested by: Lenovo Global Technology

Test Date: Jun-2020
Hardware Availability: Mar-2020
Software Availability: Apr-2020

Peak Optimization Flags (Continued)

531.deepsjeng_r: basepeak = yes
541.leela_r: basepeak = yes
Fortran benchmarks:
548.exchange2_r: basepeak = yes

The flags files that were used to format this result can be browsed at
http://www.spec.org/cpu2017/flags/Lenovo-Platform-SPECcpu2017-Flags-V1.2-SKL-J.html

You can also download the XML flags sources by saving the following links:
http://www.spec.org/cpu2017/flags/Intel-ic19.1u1-official-linux64_revA.xml
http://www.spec.org/cpu2017/flags/Lenovo-Platform-SPECcpu2017-Flags-V1.2-SKL-J.xml

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For questions about this result, please contact the tester. For other inquiries, please contact info@spec.org.

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