SPEC CPU®2017 Floating Point Speed Result

Dell Inc.

PowerEdge R440 (Intel Xeon Gold 5220, 2.20 GHz)

$SPECspeed®2017\_fp\_base = 119$

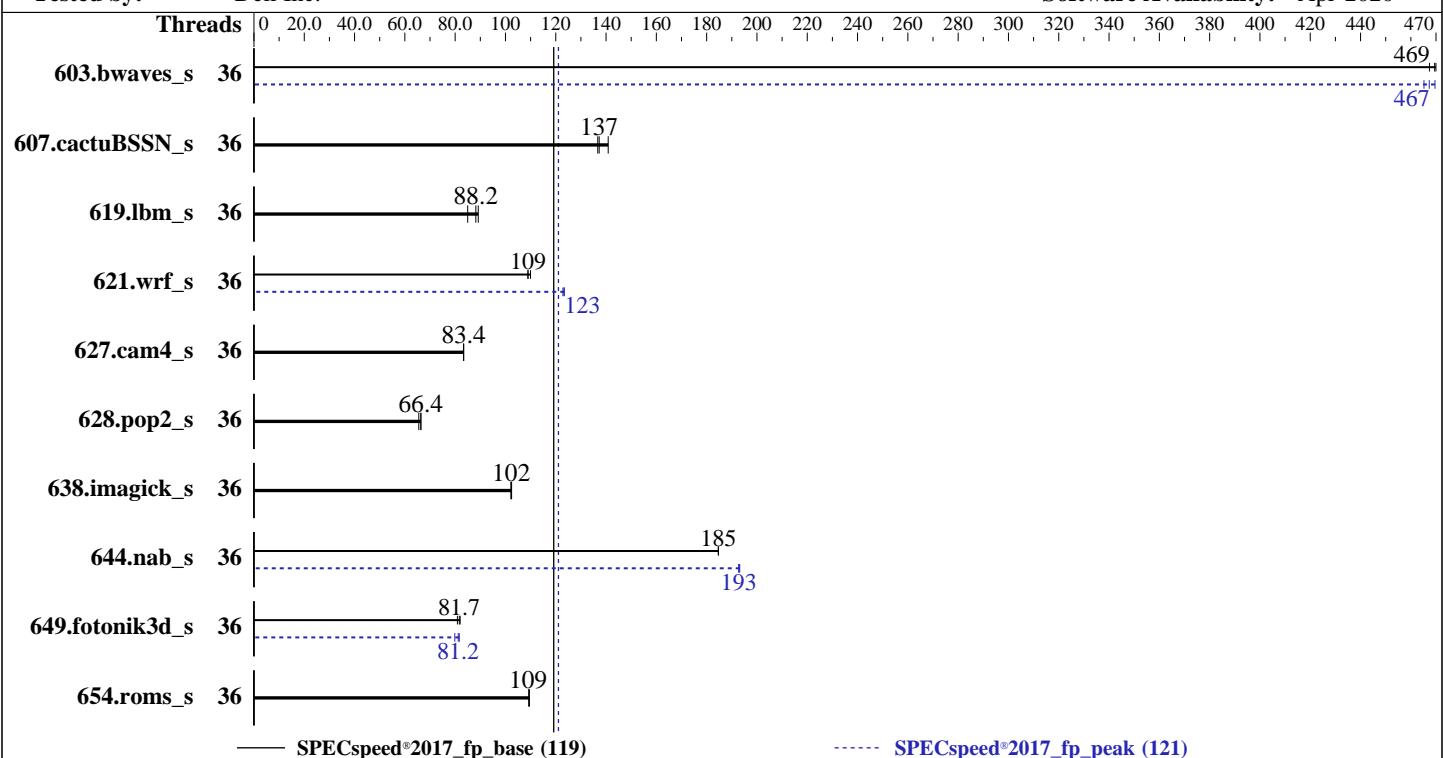$SPECspeed®2017\_fp\_peak = 121$

CPU2017 License: 55
Test Sponsor: Dell Inc.
Tested by: Dell Inc.

Test Date: Apr-2020
Hardware Availability: Feb-2020
Software Availability: Apr-2020

Threads

Benchmark	Threads	Value
603.bwaves_s	36	469 / 467
607.cactuBSSN_s	36	137
619.lbm_s	36	88.2
621.wrf_s	36	109 / 123
627.cam4_s	36	83.4
628.pop2_s	36	66.4
638.imagick_s	36	102
644.nab_s	36	185 / 193
649.fotonik3d_s	36	81.7 / 81.2
654.roms_s	36	109

—— **SPECspeed®2017_fp_base (119)**   ----- **SPECspeed®2017_fp_peak (121)**

Hardware

CPU Name: Intel Xeon Gold 5220
 Max MHz: 3900
 Nominal: 2200
Enabled: 36 cores, 2 chips
Orderable: 1,2 chips
Cache L1: 32 KB I + 32 KB D on chip per core
 L2: 1 MB I+D on chip per core
 L3: 24.75 MB I+D on chip per chip
 Other: None
Memory: 384 GB (12 x 16 GB 2Rx8 PC4-3200V-R, running at 2933)
Storage: 1.8 TB GB SATA SSD
Other: None

Software

OS: Red Hat Enterprise Linux 8.1
 kernel 4.18.0-147.el8.x86_64
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: Yes
Firmware: Version 2.7.7 released May-2020
File System: xfs
System State: Run level 3 (multi-user)
Base Pointers: 64-bit
Peak Pointers: 64-bit
Other: jemalloc memory allocator V5.0.1
Power Management: BIOS set to prefer performance at the cost of additional power usage.

SPEC CPU®2017 Floating Point Speed Result
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Dell Inc.

PowerEdge R440 (Intel Xeon Gold 5220, 2.20 GHz)

$SPECspeed®2017\_fp\_base = 119$

$SPECspeed®2017\_fp\_peak = 121$

CPU2017 License: 55
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Test Date: Apr-2020
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Results Table

Benchmark	Base							Peak						
	Threads	Seconds	Ratio	Seconds	Ratio	Seconds	Ratio	Threads	Seconds	Ratio	Seconds	Ratio	Seconds	Ratio
603.bwaves_s	36	126	467	**126**	**469**	126	470	36	**126**	**467**	126	470	127	465
607.cactuBSSN_s	36	118	141	**121**	**137**	122	137	36	118	141	**121**	**137**	122	137
619.lbm_s	36	58.7	89.2	61.6	85.0	**59.4**	**88.2**	36	58.7	89.2	61.6	85.0	**59.4**	**88.2**
621.wrf_s	36	**121**	**109**	121	109	120	110	36	108	123	107	123	**107**	**123**
627.cam4_s	36	106	83.4	106	83.3	**106**	**83.4**	36	106	83.4	106	83.3	**106**	**83.4**
628.pop2_s	36	179	66.4	**179**	**66.4**	181	65.5	36	179	66.4	**179**	**66.4**	181	65.5
638.imagick_s	36	141	102	**141**	**102**	141	102	36	141	102	**141**	**102**	141	102
644.nab_s	36	**94.6**	**185**	94.6	185	94.6	185	36	**90.6**	**193**	90.6	193	90.5	193
649.fotonik3d_s	36	113	80.9	111	82.0	**112**	**81.7**	36	**112**	**81.2**	114	79.9	112	81.6
654.roms_s	36	144	109	144	109	**144**	**109**	36	144	109	144	109	**144**	**109**
SPECspeed®2017_fp_base =		**119**												
SPECspeed®2017_fp_peak =		**121**												

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 numactl mechanism was used to bind copies to processors. The config file option 'submit'
was used to generate numactl 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:
KMP_AFFINITY = "granularity=fine,compact"
LD_LIBRARY_PATH = "/home/cpu2017/lib/intel64:/home/cpu2017/je5.0.1-64"
MALLOC_CONF = "retain:true"
OMP_STACKSIZE = "192M"
```

SPEC CPU®2017 Floating Point Speed Result

Copyright 2017-2020 Standard Performance Evaluation Corporation

Dell Inc.

PowerEdge R440 (Intel Xeon Gold 5220, 2.20 GHz)

$SPECspeed^{®}2017\_fp\_base = 119$

$SPECspeed^{®}2017\_fp\_peak = 121$

CPU2017 License: 55

Test Sponsor: Dell Inc.

Tested by: Dell Inc.

Test Date: Apr-2020

Hardware Availability: Feb-2020

Software Availability: Apr-2020

General Notes

```
Binaries compiled on a system with 1x Intel Core i9-9900K CPU + 64GB RAM
memory using Redhat Enterprise Linux 8.0
NA: 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.
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
runcpu command invoked through numactl i.e.:
numactl --interleave=all runcpu <etc>
jemalloc, a general purpose malloc implementation
built with the RedHat Enterprise 7.5, and the system compiler gcc 4.8.5
sources available from jemalloc.net or https://github.com/jemalloc/jemalloc/releases
```

Platform Notes

```
BIOS settings:
Virtualization Technology disabled
System Profile set to Custom
CPU Performance set to Maximum Performance
C States set to Autonomous
C1E disabled
Uncore Frequency set to Dynamic
Energy Efficiency Policy set to Performance
Memory Patrol Scrub set to standard
Logical Processor disabled
CPU Interconnect Bus Link Power Management disabled
PCI ASPM L1 Link Power Management disabled
UPI Prefetch enabled
LLC Prefetch disabled
Dead Line LLC Alloc enabled
Directory AtoS disabled

Sysinfo program /home/cpu2017/bin/sysinfo
Rev: r6365 of 2019-08-21 295195f888a3d7edb1e6e46a485a0011
running on localhost.localdomain Fri May 22 09:48:33 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


From /proc/cpuinfo
```

(Continued on next page)

Standard Performance Evaluation Corporation (info@spec.org)

https://www.spec.org/

Dell Inc.

PowerEdge R440 (Intel Xeon Gold 5220, 2.20 GHz)

SPECspeed®2017_fp_base = 119

SPECspeed®2017_fp_peak = 121

CPU2017 License: 55		**Test Date:**	Apr-2020
Test Sponsor:	Dell Inc.	**Hardware Availability:**	Feb-2020
Tested by:	Dell Inc.	**Software Availability:**	Apr-2020

Platform Notes (Continued)

```
    model name : Intel(R) Xeon(R) Gold 5220 CPU @ 2.20GHz
       2  "physical id"s (chips)
       36 "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 : 18
       siblings  : 18
       physical 0: cores 0 1 2 3 4 8 9 10 11 16 17 18 19 20 24 25 26 27
       physical 1: cores 0 1 2 3 4 8 9 10 11 16 17 18 19 20 24 25 26 27

 From lscpu:
       Architecture:         x86_64
       CPU op-mode(s):       32-bit, 64-bit
       Byte Order:           Little Endian
       CPU(s):               36
       On-line CPU(s) list:  0-35
       Thread(s) per core:   1
       Core(s) per socket:   18
       Socket(s):            2
       NUMA node(s):         2
       Vendor ID:            GenuineIntel
       CPU family:           6
       Model:                85
       Model name:           Intel(R) Xeon(R) Gold 5220 CPU @ 2.20GHz
       Stepping:             6
       CPU MHz:              2881.675
       CPU max MHz:          3900.0000
       CPU min MHz:          1000.0000
       BogoMIPS:             4400.00
       Virtualization:       VT-x
       L1d cache:            32K
       L1i cache:            32K
       L2 cache:             1024K
       L3 cache:             25344K
       NUMA node0 CPU(s):    0,2,4,6,8,10,12,14,16,18,20,22,24,26,28,30,32,34
       NUMA node1 CPU(s):    1,3,5,7,9,11,13,15,17,19,21,23,25,27,29,31,33,35
       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 rdtscp
       lm constant_tsc art arch_perfmon pebs bts rep_good nopl xtopology nonstop_tsc cpuid
       aperfmperf pni pclmulqdq dtes64 monitor ds_cpl vmx smx est tm2 ssse3 sdbg fma cx16
       xtpr pdcm pcid dca sse4_1 sse4_2 x2apic movbe popcnt tsc_deadline_timer aes xsave
       avx f16c rdrand lahf_lm abm 3dnowprefetch cpuid_fault epb cat_l3 cdp_l3
       invpcid_single intel_ppin ssbd mba ibrs ibpb stibp ibrs_enhanced tpr_shadow vnmi
       flexpriority ept vpid fsgsbase tsc_adjust bmi1 hle avx2 smep bmi2 erms invpcid rtm
       cqm mpx rdt_a avx512f avx512dq rdseed adx smap clflushopt clwb intel_pt avx512cd
       avx512bw avx512vl xsaveopt xsavec xgetbv1 xsaves cqm_llc cqm_occup_llc cqm_mbm_total
       cqm_mbm_local dtherm ida arat pln pts pku ospke avx512_vnni md_clear flush_l1d
```

(Continued on next page)

Dell Inc.

PowerEdge R440 (Intel Xeon Gold 5220, 2.20 GHz)

$SPECspeed^{®}2017\_fp\_base = 119$

$SPECspeed^{®}2017\_fp\_peak = 121$

CPU2017 License: 55
Test Sponsor: Dell Inc.
Tested by: Dell Inc.

Test Date: Apr-2020
Hardware Availability: Feb-2020
Software Availability: Apr-2020

Platform Notes (Continued)

```
     arch_capabilities

/proc/cpuinfo cache data
   cache size : 25344 KB

From numactl --hardware  WARNING: a numactl 'node' might or might not correspond to a
physical chip.
  available: 2 nodes (0-1)
  node 0 cpus: 0 2 4 6 8 10 12 14 16 18 20 22 24 26 28 30 32 34
  node 0 size: 192048 MB
  node 0 free: 191248 MB
  node 1 cpus: 1 3 5 7 9 11 13 15 17 19 21 23 25 27 29 31 33 35
  node 1 size: 193531 MB
  node 1 free: 185674 MB
  node distances:
  node   0   1
    0:  10  21
    1:  21  10

From /proc/meminfo
   MemTotal:       394834568 kB
   HugePages_Total:        0
   Hugepagesize:        2048 kB

From /etc/*release* /etc/*version*
   os-release:
      NAME="Red Hat Enterprise Linux"
      VERSION="8.1 (Ootpa)"
      ID="rhel"
      ID_LIKE="fedora"
      VERSION_ID="8.1"
      PLATFORM_ID="platform:el8"
      PRETTY_NAME="Red Hat Enterprise Linux 8.1 (Ootpa)"
      ANSI_COLOR="0;31"
   redhat-release: Red Hat Enterprise Linux release 8.1 (Ootpa)
   system-release: Red Hat Enterprise Linux release 8.1 (Ootpa)
   system-release-cpe: cpe:/o:redhat:enterprise_linux:8.1:ga

uname -a:
   Linux localhost.localdomain 4.18.0-147.el8.x86_64 #1 SMP Thu Sep 26 15:52:44 UTC 2019
   x86_64 x86_64 x86_64 GNU/Linux

Kernel self-reported vulnerability status:

CVE-2018-3620 (L1 Terminal Fault):     Not affected
Microarchitectural Data Sampling:      Not affected
CVE-2017-5754 (Meltdown):              Not affected
```

(Continued on next page)

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SPECspeed®2017_fp_base = 119

SPECspeed®2017_fp_peak = 121

CPU2017 License: 55　　　　　　　　　　　　　　　　　　　**Test Date:** Apr-2020
Test Sponsor: Dell Inc.　　　　　　　　　　　　　　　　**Hardware Availability:** Feb-2020
Tested by: Dell Inc.　　　　　　　　　　　　　　　　　　**Software Availability:** Apr-2020

Platform Notes (Continued)

```
CVE-2018-3639 (Speculative Store Bypass): Mitigation: Speculative Store Bypass disabled
                                 via prctl and seccomp
CVE-2017-5753 (Spectre variant 1):        Mitigation: usercopy/swapgs barriers and __user
                                 pointer sanitization
CVE-2017-5715 (Spectre variant 2):        Mitigation: Enhanced IBRS, IBPB: conditional,
                                 RSB filling


run-level 3 May 22 05:33 last=5

SPEC is set to: /home/cpu2017
   Filesystem              Type  Size  Used Avail Use% Mounted on
   /dev/mapper/rhel-home xfs   1.7T   29G  1.7T   2% /home

From /sys/devices/virtual/dmi/id
   BIOS:    Dell Inc. 2.7.7 05/06/2020
   Vendor:  Dell Inc.
   Product: PowerEdge R440
   Product Family: PowerEdge
   Serial:  F9TD613


Additional information from dmidecode follows.  WARNING: Use caution when you interpret
this section. The 'dmidecode' 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:
    12x 002C069D002C 36ASF4G72PZ-3G2E2 32 GB 2 rank 3200
    4x Not Specified Not Specified

(End of data from sysinfo program)
```

Compiler Version Notes

```
==============================================================================
C                  | 619.lbm_s(base, peak) 638.imagick_s(base, peak)
                   | 644.nab_s(base, 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++, C, Fortran | 607.cactuBSSN_s(base, peak)
------------------------------------------------------------------------------
Intel(R) C++ Intel(R) 64 Compiler for applications running on Intel(R) 64,
  Version 19.1.1.217 Build 20200306
```

(Continued on next page)

SPEC CPU®2017 Floating Point Speed Result

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PowerEdge R440 (Intel Xeon Gold 5220, 2.20 GHz)

$SPECspeed^{®}2017\_fp\_base = 119$

$SPECspeed^{®}2017\_fp\_peak = 121$

CPU2017 License:	55	**Test Date:**	Apr-2020
Test Sponsor:	Dell Inc.	**Hardware Availability:**	Feb-2020
Tested by:	Dell Inc.	**Software Availability:**	Apr-2020

Compiler Version Notes (Continued)

```
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) 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.
--------------------------------------------------------------------------


==========================================================================
Fortran         | 603.bwaves_s(base, peak) 649.fotonik3d_s(base, peak)
                | 654.roms_s(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.
--------------------------------------------------------------------------


==========================================================================
Fortran, C      | 621.wrf_s(base, peak) 627.cam4_s(base, peak)
                | 628.pop2_s(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.
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.
--------------------------------------------------------------------------
```

Base Compiler Invocation

C benchmarks:
```
icc
```

Fortran benchmarks:
```
ifort
```

Benchmarks using both Fortran and C:
```
ifort icc
```

Benchmarks using Fortran, C, and C++:
```
icpc icc ifort
```

Standard Performance Evaluation Corporation (info@spec.org)   https://www.spec.org/

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Base Portability Flags

603.bwaves_s: `-DSPEC_LP64`
607.cactuBSSN_s: `-DSPEC_LP64`
619.lbm_s: `-DSPEC_LP64`
621.wrf_s: `-DSPEC_LP64 -DSPEC_CASE_FLAG -convert big_endian`
627.cam4_s: `-DSPEC_LP64 -DSPEC_CASE_FLAG`
628.pop2_s: `-DSPEC_LP64 -DSPEC_CASE_FLAG -convert big_endian`
`-assume byterecl`
638.imagick_s: `-DSPEC_LP64`
644.nab_s: `-DSPEC_LP64`
649.fotonik3d_s: `-DSPEC_LP64`
654.roms_s: `-DSPEC_LP64`

Base Optimization Flags

C benchmarks:
```
-m64 -std=c11 -xCORE-AVX2 -ipo -O3 -no-prec-div -qopt-prefetch
-ffinite-math-only -qopt-mem-layout-trans=4 -qopenmp -DSPEC_OPENMP
-mbranches-within-32B-boundaries
```

Fortran benchmarks:
```
-m64 -Wl,-z,muldefs -DSPEC_OPENMP -xCORE-AVX2 -ipo -O3 -no-prec-div
-qopt-prefetch -ffinite-math-only -qopt-mem-layout-trans=4 -qopenmp
-nostandard-realloc-lhs -mbranches-within-32B-boundaries
-L/usr/local/jemalloc64-5.0.1/lib -ljemalloc
```

Benchmarks using both Fortran and C:
```
-m64 -std=c11 -Wl,-z,muldefs -xCORE-AVX2 -ipo -O3 -no-prec-div
-qopt-prefetch -ffinite-math-only -qopt-mem-layout-trans=4 -qopenmp
-DSPEC_OPENMP -mbranches-within-32B-boundaries -nostandard-realloc-lhs
-L/usr/local/jemalloc64-5.0.1/lib -ljemalloc
```

Benchmarks using Fortran, C, and C++:
```
-m64 -std=c11 -Wl,-z,muldefs -xCORE-AVX2 -ipo -O3 -no-prec-div
-qopt-prefetch -ffinite-math-only -qopt-mem-layout-trans=4 -qopenmp
-DSPEC_OPENMP -mbranches-within-32B-boundaries -nostandard-realloc-lhs
-L/usr/local/jemalloc64-5.0.1/lib -ljemalloc
```

Peak Compiler Invocation

C benchmarks:
```
icc
```

(Continued on next page)

Dell Inc.

PowerEdge R440 (Intel Xeon Gold 5220, 2.20 GHz)

$SPECspeed^{®}2017\_fp\_base = 119$

$SPECspeed^{®}2017\_fp\_peak = 121$

CPU2017 License: 55	**Test Date:** Apr-2020
Test Sponsor: Dell Inc.	**Hardware Availability:** Feb-2020
Tested by: Dell Inc.	**Software Availability:** Apr-2020

Peak Compiler Invocation (Continued)

Fortran benchmarks:
`ifort`

Benchmarks using both Fortran and C:
`ifort icc`

Benchmarks using Fortran, C, and C++:
`icpc icc ifort`

Peak Portability Flags

`Same as Base Portability Flags`

Peak Optimization Flags

C benchmarks:

619.lbm_s: `basepeak = yes`

638.imagick_s: `basepeak = yes`

644.nab_s: `-m64 -std=c11 -Wl,-z,muldefs -xCORE-AVX2 -ipo -O3`
`-no-prec-div -qopt-prefetch -ffinite-math-only`
`-qopt-mem-layout-trans=4 -qopenmp -DSPEC_OPENMP`
`-mbranches-within-32B-boundaries`
`-L/usr/local/jemalloc64-5.0.1/lib -ljemalloc`

Fortran benchmarks:

603.bwaves_s: `-m64 -Wl,-z,muldefs -prof-gen`(pass 1) `-prof-use`(pass 2)
`-DSPEC_SUPPRESS_OPENMP -DSPEC_OPENMP -ipo -xCORE-AVX2`
`-O3 -no-prec-div -qopt-prefetch -ffinite-math-only`
`-qopt-mem-layout-trans=4 -qopenmp -nostandard-realloc-lhs`
`-mbranches-within-32B-boundaries`
`-L/usr/local/jemalloc64-5.0.1/lib -ljemalloc`

649.fotonik3d_s: `Same as 603.bwaves_s`

654.roms_s: `basepeak = yes`

Benchmarks using both Fortran and C:

(Continued on next page)

Dell Inc.

PowerEdge R440 (Intel Xeon Gold 5220, 2.20 GHz)

SPECspeed®2017_fp_base = 119

SPECspeed®2017_fp_peak = 121

CPU2017 License: 55

Test Sponsor: Dell Inc.

Tested by: Dell Inc.

Test Date: Apr-2020

Hardware Availability: Feb-2020

Software Availability: Apr-2020

Peak Optimization Flags (Continued)

621.wrf_s: `-m64 -std=c11 -Wl,-z,muldefs -prof-gen`(pass 1)
`-prof-use`(pass 2) `-ipo -xCORE-AVX2 -O3 -no-prec-div`
`-qopt-prefetch -ffinite-math-only -qopt-mem-layout-trans=4`
`-DSPEC_SUPPRESS_OPENMP -qopenmp -DSPEC_OPENMP`
`-mbranches-within-32B-boundaries -nostandard-realloc-lhs`
`-L/usr/local/jemalloc64-5.0.1/lib -ljemalloc`

627.cam4_s: `basepeak = yes`

628.pop2_s: `basepeak = yes`

Benchmarks using Fortran, C, and C++:

607.cactuBSSN_s: `basepeak = yes`

The flags files that were used to format this result can be browsed at
`http://www.spec.org/cpu2017/flags/Intel-ic19.1u1-official-linux64_revA.html`
`http://www.spec.org/cpu2017/flags/Dell-Platform-Flags-PowerEdge-revE10.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/Dell-Platform-Flags-PowerEdge-revE10.xml`

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

Tested with SPEC CPU®2017 v1.1.0 on 2020-05-22 10:48:32-0400.
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