# SPEC CPU®2017 Floating Point Speed Result

Copyright 2017-2021 Standard Performance Evaluation Corporation

## Hewlett Packard Enterprise

(Test Sponsor: HPE)

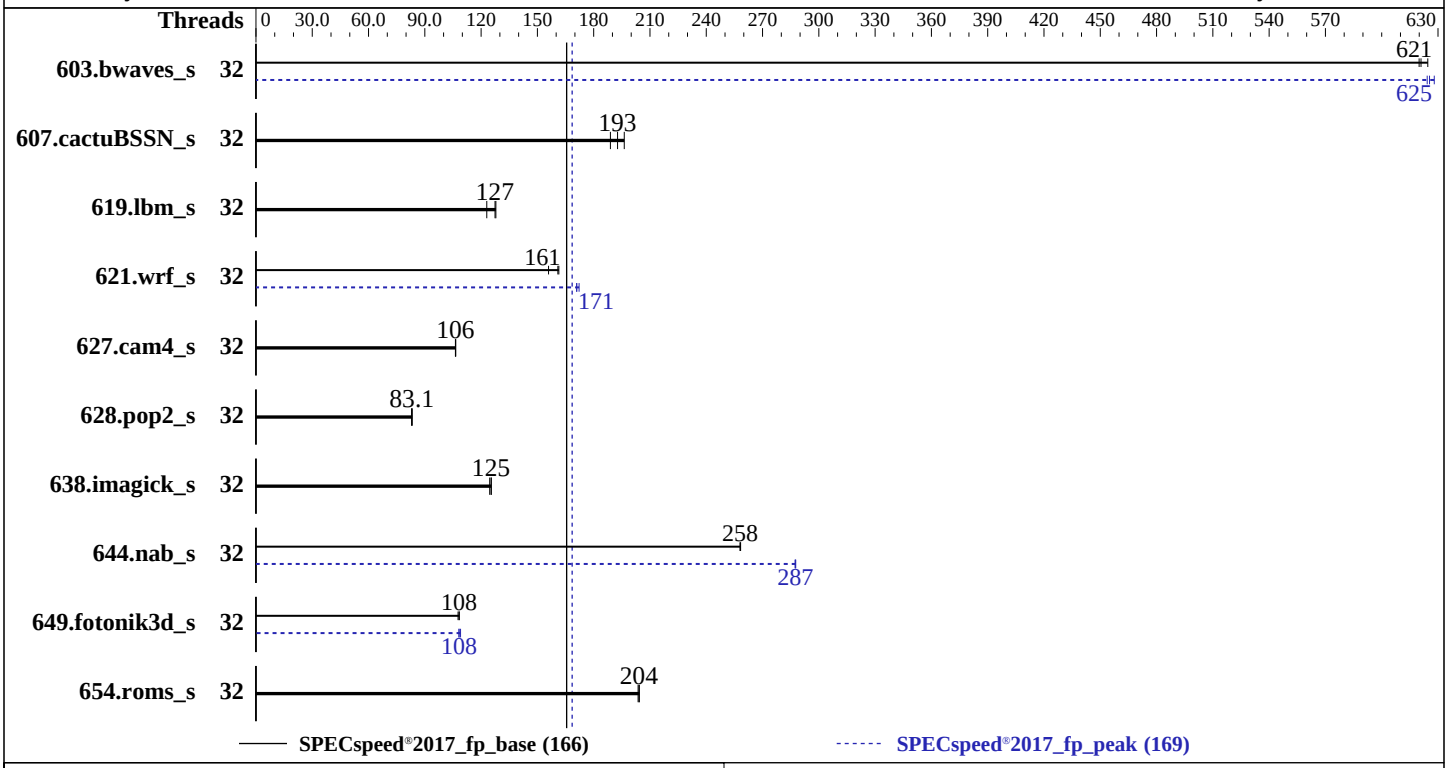
ProLiant DL360 Gen10 Plus
(2.90 GHz, Intel Xeon Gold 6326)

SPECspeed®2017_fp_base = 166

SPECspeed®2017_fp_peak = 169

**CPU2017 License:** 3
**Test Sponsor:** HPE
**Tested by:** HPE

**Test Date:** Jun-2021
**Hardware Availability:** Jun-2021
**Software Availability:** Jun-2021




## Hardware

| | |
|---|---|
| CPU Name: | Intel Xeon Gold 6326 |
| Max MHz: | 3500 |
| Nominal: | 2900 |
| Enabled: | 32 cores, 2 chips |
| Orderable: | 1, 2 chip(s) |
| Cache L1: | 32 KB I + 48 KB D on chip per core |
| L2: | 1.25 MB I+D on chip per core |
| L3: | 24 MB I+D on chip per chip |
| Other: | None |
| Memory: | 2 TB (32 x 64 GB 2Rx4 PC4-3200AA-R) |
| Storage: | 1 x 400 GB SAS SSD, RAID 0 |
| Other: | None |

## Software

| | |
|---|---|
| OS: | Red Hat Enterprise Linux 8.3 (Ootpa)<br>Kernel 4.18.0-240.el8.x86_64 |
| Compiler: | C/C++: Version 2021.1 of Intel oneAPI DPC++/C++ Compiler Build 20201113 for Linux;<br>Fortran: Version 2021.1 of Intel Fortran Compiler Classic Build 20201112 for Linux;<br>C/C++: Version 2021.1 of Intel C/C++ Compiler Classic Build 20201112 for Linux |
| Parallel: | Yes |
| Firmware: | HPE BIOS Version U46 v1.42 05/16/2021 released May-2021 |
| 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 |

## Results Table

| Benchmark | Base | | | | | | | Peak | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Threads | Seconds | Ratio | Seconds | Ratio | Seconds | Ratio | Threads | Seconds | Ratio | Seconds | Ratio | Seconds | Ratio |
| 603.bwaves_s | 32 | **95.0** | **621** | 95.2 | 620 | 94.5 | 625 | 32 | 93.9 | 628 | **94.3** | **625** | 94.5 | 624 |
| 607.cactuBSSN_s | 32 | **86.5** | **193** | 84.9 | 196 | 88.2 | 189 | 32 | **86.5** | **193** | 84.9 | 196 | 88.2 | 189 |
| 619.lbm_s | 32 | 42.6 | 123 | **41.1** | **127** | 41.0 | 128 | 32 | 42.6 | 123 | **41.1** | **127** | 41.0 | 128 |
| 621.wrf_s | 32 | 84.8 | 156 | 81.9 | 161 | **82.2** | **161** | 32 | 76.8 | 172 | 77.4 | 171 | **77.4** | **171** |
| 627.cam4_s | 32 | 83.2 | 106 | 83.4 | 106 | **83.3** | **106** | 32 | 83.2 | 106 | 83.4 | 106 | **83.3** | **106** |
| 628.pop2_s | 32 | 143 | 83.0 | 143 | 83.3 | **143** | **83.1** | 32 | 143 | 83.0 | 143 | 83.3 | **143** | **83.1** |
| 638.imagick_s | 32 | **115** | **125** | 116 | 125 | 115 | 125 | 32 | **115** | **125** | 116 | 125 | 115 | 125 |
| 644.nab_s | 32 | **67.7** | **258** | 67.7 | 258 | 67.6 | 258 | 32 | 60.8 | 287 | 60.7 | 288 | **60.8** | **287** |
| 649.fotonik3d_s | 32 | 84.1 | 108 | **84.2** | **108** | 84.6 | 108 | 32 | 83.6 | 109 | **84.2** | **108** | 84.3 | 108 |
| 654.roms_s | 32 | **77.1** | **204** | 77.1 | 204 | 77.3 | 204 | 32 | **77.1** | **204** | 77.1 | 204 | 77.3 | 204 |

**SPECspeed®2017_fp_base =** **166**

**SPECspeed®2017_fp_peak =** **169**

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

## Operating System Notes

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

## Environment Variables Notes

```
Environment variables set by runcpu before the start of the run:
KMP_AFFINITY = "granularity=fine,compact"
LD_LIBRARY_PATH =
     "/home/cpu2017_1.1.8/lib/intel64:/home/cpu2017_1.1.8/je5.0.1-64"
MALLOC_CONF = "retain:true"
OMP_STACKSIZE = "192M"
```

## General Notes

```
 Binaries compiled on a system with 1x Intel Core i9-7980XE 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.
 jemalloc, a general purpose malloc implementation
```

**(Continued on next page)**

## General Notes (Continued)

```
 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

Submitted_by: "Bhatnagar, Prateek" <prateek.bhatnagar@hpe.com>
Submitted: Mon Jun 21 10:21:12 EDT 2021
Submission: cpu2017-20210621-27542.sub
```

## Platform Notes

```
The system ROM used for this result contains Intel microcode version 0xd0002a0 for
the Intel Xeon Gold 6326 processor
BIOS Configuration:
 Workload Profile set to General Peak Frequency Compute
 Intel Hyper-Threading set to Disabled
 Thermal Configuration set to Maximum Cooling
 Memory Patrol Scrubbing set to Disabled
 Advanced Memory Protection set to Advanced ECC
 Last Level Cache (LLC) Prefetch set to Enabled
 Last Level Cache (LLC) Dead Line Allocation set to Disabled
 Enhanced Processor Performance set to Enabled
 Workload Profile set to Custom
    Energy/Performance Bias set to Balanced Power
    DCU Stream Prefetcher set to Disabled
    Adjacent Sector Prefetch set to Disabled
    Minimum Processor Idle Power Package C-State set to No Package State
    Numa Group Size Optimization set to Flat

 Sysinfo program /home/cpu2017_1.1.8/bin/sysinfo
 Rev: r6622 of 2021-04-07 982a61ec0915b55891ef0e16acafc64d
 running on localhost.localdomain Tue Jun  8 14:32:17 2021

 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
    model name : Intel(R) Xeon(R) Gold 6326 CPU @ 2.90GHz
       2  "physical id"s (chips)
       32 "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 : 16
       siblings  : 16
       physical 0: cores 0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15
       physical 1: cores 0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15
```

**(Continued on next page)**

## Platform Notes (Continued)

```
From lscpu from util-linux 2.32.1:
     Architecture:        x86_64
     CPU op-mode(s):      32-bit, 64-bit
     Byte Order:          Little Endian
     CPU(s):              32
     On-line CPU(s) list: 0-31
     Thread(s) per core:  1
     Core(s) per socket:  16
     Socket(s):           2
     NUMA node(s):        2
     Vendor ID:           GenuineIntel
     CPU family:          6
     Model:               106
     Model name:          Intel(R) Xeon(R) Gold 6326 CPU @ 2.90GHz
     Stepping:            6
     CPU MHz:             2737.096
     BogoMIPS:            5800.00
     Virtualization:      VT-x
     L1d cache:           48K
     L1i cache:           32K
     L2 cache:            1280K
     L3 cache:            24576K
     NUMA node0 CPU(s):   0-15
     NUMA node1 CPU(s):   16-31
     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 invpcid_single ssbd
     mba ibrs ibpb stibp ibrs_enhanced tpr_shadow vnmi flexpriority ept vpid ept_ad
     fsgsbase tsc_adjust bmi1 hle avx2 smep bmi2 erms invpcid cqm rdt_a avx512f avx512dq
     rdseed adx smap avx512ifma clflushopt clwb intel_pt avx512cd sha_ni avx512bw
     avx512vl xsaveopt xsavec xgetbv1 xsaves cqm_llc cqm_occup_llc cqm_mbm_total
     cqm_mbm_local split_lock_detect wbnoinvd dtherm ida arat pln pts avx512vbmi umip pku
     ospke avx512_vbmi2 gfni vaes vpclmulqdq avx512_vnni avx512_bitalg tme
     avx512_vpopcntdq la57 rdpid md_clear pconfig flush_l1d arch_capabilities

/proc/cpuinfo cache data
   cache size : 24576 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 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15
  node 0 size: 1002033 MB
  node 0 free: 1030610 MB
```


**(Continued on next page)**

## Platform Notes (Continued)

```
   node 1 cpus: 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31
   node 1 size: 1004107 MB
   node 1 free: 1025512 MB
   node distances:
   node   0   1
     0:  10  20
     1:  20  10

 From /proc/meminfo
    MemTotal:       2113495792 kB
    HugePages_Total:       0
    Hugepagesize:       2048 kB

 /sbin/tuned-adm active
     Current active profile: throughput-performance

 From /etc/*release* /etc/*version*
    os-release:
       NAME="Red Hat Enterprise Linux"
       VERSION="8.3 (Ootpa)"
       ID="rhel"
       ID_LIKE="fedora"
       VERSION_ID="8.3"
       PLATFORM_ID="platform:el8"
       PRETTY_NAME="Red Hat Enterprise Linux 8.3 (Ootpa)"
       ANSI_COLOR="0;31"
    redhat-release: Red Hat Enterprise Linux release 8.3 (Ootpa)
    system-release: Red Hat Enterprise Linux release 8.3 (Ootpa)
    system-release-cpe: cpe:/o:redhat:enterprise_linux:8.3:ga

 uname -a:
    Linux localhost.localdomain 4.18.0-240.el8.x86_64 #1 SMP Wed Sep 23 05:13:10 EDT 2020
    x86_64 x86_64 x86_64 GNU/Linux

 Kernel self-reported vulnerability status:

 CVE-2018-12207 (iTLB Multihit):                        Not affected
 CVE-2018-3620 (L1 Terminal Fault):                     Not affected
 Microarchitectural Data Sampling:                      Not affected
 CVE-2017-5754 (Meltdown):                              Not affected
 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:
```

**(Continued on next page)**

## Platform Notes (Continued)

```
                                                      conditional, RSB filling
 CVE-2020-0543 (Special Register Buffer Data Sampling): Not affected
 CVE-2019-11135 (TSX Asynchronous Abort):               Not affected

 run-level 3 Jun 8 10:32

 SPEC is set to: /home/cpu2017_1.1.8
    Filesystem             Type  Size  Used Avail Use% Mounted on
    /dev/mapper/rhel00-home xfs   372G  216G  157G  58% /home

 From /sys/devices/virtual/dmi/id
     Vendor:         HPE
     Product:        ProLiant DL360 Gen10 Plus
     Product Family: ProLiant
     Serial:         CN701108CQ

 Additional information from dmidecode 3.2 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:
     32x Micron 36ASF8G72PZ-3G2B2 64 GB 2 rank 3200

 BIOS:
    BIOS Vendor:       HPE
    BIOS Version:      U46
    BIOS Date:         05/16/2021
    BIOS Revision:     1.42
    Firmware Revision: 2.42

 (End of data from sysinfo program)
```

## Compiler Version Notes

```
==============================================================================
C               | 619.lbm_s(base, peak) 638.imagick_s(base, peak)
                | 644.nab_s(base)
------------------------------------------------------------------------------
Intel(R) C Intel(R) 64 Compiler Classic for applications running on Intel(R)
  64, Version 2021.1 Build 20201112_000000
Copyright (C) 1985-2020 Intel Corporation.  All rights reserved.
------------------------------------------------------------------------------

==============================================================================
C               | 644.nab_s(peak)
------------------------------------------------------------------------------
```

**(Continued on next page)**

## Compiler Version Notes (Continued)

```
Intel(R) oneAPI DPC++/C++ Compiler for applications running on Intel(R) 64,
  Version 2021.1 Build 20201113
Copyright (C) 1985-2020 Intel Corporation. All rights reserved.
------------------------------------------------------------------------------

==============================================================================
C               | 619.lbm_s(base, peak) 638.imagick_s(base, peak)
                | 644.nab_s(base)
------------------------------------------------------------------------------
Intel(R) C Intel(R) 64 Compiler Classic for applications running on Intel(R)
  64, Version 2021.1 Build 20201112_000000
Copyright (C) 1985-2020 Intel Corporation.  All rights reserved.
------------------------------------------------------------------------------

==============================================================================
C               | 644.nab_s(peak)
------------------------------------------------------------------------------
Intel(R) oneAPI DPC++/C++ Compiler for applications running on Intel(R) 64,
  Version 2021.1 Build 20201113
Copyright (C) 1985-2020 Intel Corporation. All rights reserved.
------------------------------------------------------------------------------

==============================================================================
C++, C, Fortran | 607.cactuBSSN_s(base, peak)
------------------------------------------------------------------------------
Intel(R) C++ Intel(R) 64 Compiler Classic for applications running on
  Intel(R) 64, Version 2021.1 Build 20201112_000000
Copyright (C) 1985-2020 Intel Corporation.  All rights reserved.
Intel(R) C Intel(R) 64 Compiler Classic for applications running on Intel(R)
  64, Version 2021.1 Build 20201112_000000
Copyright (C) 1985-2020 Intel Corporation.  All rights reserved.
Intel(R) Fortran Intel(R) 64 Compiler Classic for applications running on
  Intel(R) 64, Version 2021.1 Build 20201112_000000
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 Classic for applications running on
  Intel(R) 64, Version 2021.1 Build 20201112_000000
Copyright (C) 1985-2020 Intel Corporation.  All rights reserved.
------------------------------------------------------------------------------

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

**(Continued on next page)**

## Compiler Version Notes (Continued)

```
                | 628.pop2_s(base, peak)
------------------------------------------------------------------------------
Intel(R) Fortran Intel(R) 64 Compiler Classic for applications running on
  Intel(R) 64, Version 2021.1 Build 20201112_000000
Copyright (C) 1985-2020 Intel Corporation.  All rights reserved.
Intel(R) C Intel(R) 64 Compiler Classic for applications running on Intel(R)
  64, Version 2021.1 Build 20201112_000000
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

## 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-AVX512 -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-AVX512 -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-AVX512 -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-AVX512 -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 (except as noted below):
```
icc
```

644.nab_s: `icx`

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 -Wl,-z,muldefs -xCORE-AVX512 -Ofast -ffast-math
-flto -mfpmath=sse -funroll-loops -fiopenmp
-DSPEC_OPENMP -qopt-mem-layout-trans=4
-fimf-accuracy-bits=14:sqrt
-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-AVX512
-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:

621.wrf_s: -m64 -std=c11 -Wl,-z,muldefs -prof-gen(pass 1)
-prof-use(pass 2) -ipo -xCORE-AVX512 -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

**(Continued on next page)**

## Peak Optimization Flags (Continued)

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/HPE-Platform-Flags-Intel-V1.0-ICX-revC.html`
`http://www.spec.org/cpu2017/flags/Intel-ic2021-official-linux64_revA.html`

You can also download the XML flags sources by saving the following links:
`http://www.spec.org/cpu2017/flags/HPE-Platform-Flags-Intel-V1.0-ICX-revC.xml`
`http://www.spec.org/cpu2017/flags/Intel-ic2021-official-linux64_revA.xml`


SPEC CPU and SPECspeed are registered trademarks of the Standard Performance Evaluation Corporation. All other brand and product names appearing in this result are trademarks or registered trademarks of their respective holders.

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



Tested with SPEC CPU®2017 v1.1.8 on 2021-06-08 05:02:17-0400.
Report generated on 2021-07-06 18:41:19 by CPU2017 PS formatter v6442.
Originally published on 2021-07-06.