# SPEC CPU® 2017 Floating Point Speed Result

## Dell Inc.

**PowerEdge R6515 (AMD EPYC 72F3 8-Core Processor)**

<table>
<thead>
<tr>
<th>Metric</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>CPU2017 License</td>
<td>55</td>
</tr>
<tr>
<td>Test Sponsor</td>
<td>Dell Inc.</td>
</tr>
<tr>
<td>Tested by</td>
<td>Dell Inc.</td>
</tr>
<tr>
<td>Test Date</td>
<td>Jun-2021</td>
</tr>
<tr>
<td>Hardware Availability</td>
<td>Jul-2021</td>
</tr>
<tr>
<td>Software Availability</td>
<td>Mar-2021</td>
</tr>
<tr>
<td><strong>SPECspeed®2017_fp_base</strong></td>
<td>78.0</td>
</tr>
<tr>
<td><strong>SPECspeed®2017_fp_peak</strong></td>
<td>82.9</td>
</tr>
</tbody>
</table>

### Software

- **OS**: Red Hat Enterprise Linux 8.3 (Ootpa) 4.18.0-240.el8.x86_64
- **Compiler**: C/C++/Fortran: Version 3.0.0 of AOCC
- **Parallel**: Yes
- **Firmware**: Version 2.2.4 released Apr-2021
- **File System**: tmpfs
- **System State**: Run level 3 (multi-user)
- **Base Pointers**: 64-bit
- **Peak Pointers**: 64-bit
- **Other**: jemalloc: jemalloc memory allocator library v5.1.0
- **Power Management**: BIOS and OS set to prefer performance at the cost of additional power usage.

### Hardware

- **CPU Name**: AMD EPYC 72F3
- **Max MHz**: 4100
- **Nominal**: 3700
- **Enabled**: 8 cores, 1 chip
- **Orderable**: 1 chip
- **Cache L1**: 32 KB I + 32 KB D on chip per core
- **L2**: 512 KB I+D on chip per core
- **L3**: 256 MB I+D on chip per chip, 32 MB per core
- **Other**: None
- **Memory**: 1 TB (8 x 128 GB 4Rx4 PC4-3200AA-L)
- **Storage**: 128 GB on tmpfs
- **Other**: None

---

### Benchmark Results

<table>
<thead>
<tr>
<th>Benchmark</th>
<th>Threads</th>
<th>SPECspeed®2017_fp_base</th>
<th>SPECspeed®2017_fp_peak</th>
</tr>
</thead>
<tbody>
<tr>
<td>603.bwaves_s</td>
<td>8</td>
<td>94.0</td>
<td>99.8</td>
</tr>
<tr>
<td>607.cactuBSSN_s</td>
<td>8</td>
<td>61.8</td>
<td>78.0</td>
</tr>
<tr>
<td>619.lbm_s</td>
<td>8</td>
<td>87.3</td>
<td></td>
</tr>
<tr>
<td>621.wrf_s</td>
<td>8</td>
<td></td>
<td></td>
</tr>
<tr>
<td>627.cam4_s</td>
<td>8</td>
<td>64.8</td>
<td></td>
</tr>
<tr>
<td>628.pop2_s</td>
<td>8</td>
<td></td>
<td></td>
</tr>
<tr>
<td>638.imagick_s</td>
<td>8</td>
<td>82.1</td>
<td></td>
</tr>
<tr>
<td>644.nab_s</td>
<td>8</td>
<td></td>
<td></td>
</tr>
<tr>
<td>649.fotonik3d_s</td>
<td>8</td>
<td>64.0</td>
<td>96.4</td>
</tr>
<tr>
<td>654.roms_s</td>
<td>8</td>
<td></td>
<td>97.7</td>
</tr>
</tbody>
</table>

---

**Note**: The results are based on the specified hardware and software configurations, tested by Dell Inc. on June 2021.
Dell Inc.

PowerEdge R6515 (AMD EPYC 72F3 8-Core Processor)

SPECspeed®2017_fp_base = 78.0

SPECspeed®2017_fp_peak = 82.9

Results Table

<table>
<thead>
<tr>
<th>Benchmark</th>
<th>Threads</th>
<th>Base Seconds</th>
<th>Ratio</th>
<th>Base Seconds</th>
<th>Ratio</th>
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<th>Ratio</th>
<th>Base Seconds</th>
<th>Ratio</th>
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<th>Ratio</th>
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<th>Ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>603.bwaves_s</td>
<td>8</td>
<td>157</td>
<td>377</td>
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<td>377</td>
<td>8</td>
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<tr>
<td>607.cactuBSSN_s</td>
<td>8</td>
<td>167</td>
<td>99.7</td>
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<tr>
<td>619.lbm_s</td>
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<td>621.wrf_s</td>
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<td>152</td>
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<td>627.cam4_s</td>
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<tr>
<td>638.imagick_s</td>
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<td>644.nab_s</td>
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<td>649.fotonik3d_s</td>
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<td>97.7</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Compiler Notes

The AMD64 AOCC Compiler Suite is available at
http://developer.amd.com/amd-aocc/

Submit Notes

The config file option 'submit' was used.
'numactl' was used to bind copies to the cores.
See the configuration file for details.

Operating System Notes

'ulimit -s unlimited' was used to set environment stack size limit
'ulimit -l 2097152' was used to set environment locked pages in memory limit

runcpu command invoked through numactl i.e.:
numactl --interleave=all runcpu <etc>

To limit dirty cache to 8% of memory, 'sysctl -w vm.dirty_ratio=8' run as root.
To limit swap usage to minimum necessary, 'sysctl -w vm.swappiness=1' run as root.
To free node-local memory and avoid remote memory usage,
'sysctl -w vm.zone_reclaim_mode=1' run as root.
To clear filesystem caches, 'sync; sysctl -w vm.drop_caches=3' run as root.
To disable address space layout randomization (ASLR) to reduce run-to-run variability, 'sysctl -w kernel.randomize_va_space=0' run as root.

To enable Transparent Hugepages (THP) for all allocations,

(Continued on next page)
Operating System Notes (Continued)

'echo always > /sys/kernel/mm/transparent_hugepage/enabled' and
'echo always > /sys/kernel/mm/transparent_hugepage/defrag' run as root.
To enable THP only on request for peak runs of 628.pop2_s, and 638.imagick_s,
'echo madvise > /sys/kernel/mm/transparent_hugepage/enabled' run as root.
To disable THP for peak runs of 627.cam4_s, 644.nab_s, 649.fotonik3d_s, and 654.roms_s,
'echo never > /sys/kernel/mm/transparent_hugepage/enabled' run as root.

Environment Variables Notes

Environment variables set by runcpu before the start of the run:
GOMP_CPU_AFFINITY = "0-7"
LD_LIBRARY_PATH =
    "/mnt/ramdisk/cpu2017-1.1.8-aocc300-B2/amd_speed_aocc300_milan_B_lib/lib
    "/mnt/ramdisk/cpu2017-1.1.8-aocc300-B2/amd_speed_aocc300_milan_B_lib/lib
32:" MALLOC_CONF = "retain:true"
OMP_DYNAMIC = "false"
OMP_SCHEDULE = "static"
OMP_STACKSIZE = "128M"
OMP_THREAD_LIMIT = "8"

Environment variables set by runcpu during the 607.cactuBSSN_s peak run:
GOMP_CPU_AFFINITY = "0-7"

Environment variables set by runcpu during the 619.lbm_s peak run:
GOMP_CPU_AFFINITY = "0 4 1 5 2 6 3 7"

Environment variables set by runcpu during the 654.roms_s peak run:
GOMP_CPU_AFFINITY = "0-7"

General Notes

Binaries were compiled on a system with 2x AMD EPYC 7742 CPU + 1TiB Memory using openSUSE 15.2

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: configured and built with GCC v4.8.2 in RHEL 7.4 (No options specified)
jemalloc 5.1.0 is available here:
**General Notes (Continued)**

https://github.com/jemalloc/jemalloc/releases/download/5.1.0/jemalloc-5.1.0.tar.bz2

Benchmark run from a 128 GB ramdisk created with the cmd: "mount -t tmpfs -o size=128G tmpfs /mnt/ramdisk"

**Platform Notes**

BIOS settings:
- Logical Processor : Disabled
- L3 Cache as NUMA Domain : Enabled
- Virtualization Technology : Disabled
- DRAM Refresh Delay : Performance

- System Profile : Custom
- CPU Power Management : Maximum Performance
- Memory Patrol Scrub : Disabled
- PCI ASPM L1 Link
- Power Management : Disabled
- Algorithm Performance
  - Boost Disable (ApbDis): Enabled

Sysinfo program /mnt/ramdisk/cpu2017-1.1.8-aocc300-B2/bin/sysinfo
Rev: r6622 of 2021-04-07 982a61ec99f00e6aaca64d
running on rhel-8-3-amd Tue Jun 22 06:41:51 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 : AMD EPYC 72F3 8-Core Processor
  - 1 "physical id"s (chips)
  - 8 "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 : 8
  - siblings : 8
  - physical 0: cores 0 1 2 3 4 5 6 7

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): 8
- On-line CPU(s) list: 0-7

(Continued on next page)
Dell Inc.  
PowerEdge R6515 (AMD EPYC 72F3 8-Core Processor)  

SPEC®2017_fp_base = 78.0  
SPEC®2017_fp_peak = 82.9

CPU2017 License: 55  
Test Sponsor: Dell Inc.  
Test Date: Jun-2021  
Test Date: Jun-2021  
Hardware Availability: Jul-2021  
Software Availability: Mar-2021

Thread(s) per core: 1  
Core(s) per socket: 8  
Socket(s): 1  
NUMA node(s): 8  
Vendor ID: AuthenticAMD  
CPU family: 25  
Model: 1  
Model name: AMD EPYC 72F3 8-Core Processor  
Stepping: 1  
CPU MHz: 4053.669  
BogoMIPS: 7386.34  
Virtualization: AMD-V  
L1d cache: 32K  
L1i cache: 32K  
L2 cache: 512K  
L3 cache: 32768K  
NUMA node0 CPU(s): 0  
NUMA node1 CPU(s): 1  
NUMA node2 CPU(s): 2  
NUMA node3 CPU(s): 3  
NUMA node4 CPU(s): 4  
NUMA node5 CPU(s): 5  
NUMA node6 CPU(s): 6  
NUMA node7 CPU(s): 7  
Flags: fpu vme de pse tsc msr pae mce cx8 apic sep mtrr pge mca cmov pat pse36 clflush mmx fxsr sse sse2 ht syscall nx mmxext fxsr_opt pdpe1gb rdtscp lm constant_tsc rep_good nopl nonstop_tsc cpuid nonstop_rtc rep_good nopl nonstop_tsc cpuid nonstop_rtc cpuid aperfmperf pni pclmulqdq monitor ssse3 fma cx16 pcid sse4_1 sse4_2 x2apic movbe popcnt aes xsave avx f16c rdrand lahf_lm cmp_legacy svm extapic cr8_legacy abm sse4a misalignsse 3dnowprefetch osuw ibs skinit wdt tce topext perfctr_core perfctr_nb perfctr_l3c mwaitx cpb cat_l3 cdp_l3 invpcid_single hw_pstate sme ssbd mba sev ibrs ibpb stibp vmmcall fsgsbase bmi1 avx2 smep bmi2 invpcid cqg rdt_a rdseed adx smap clflushopt clwb sha_ni xsaveopt xsave xgetbv1 xsaveas cqm llc cqm_occu l1c cqm_mbb_total cqm_mbb_local clzero irperf xsaveerptr wbnoinvd amd_ppin arat npt lbv svm_lock nrip_save tsc_scale vmcb_clean flushbyasid decodeassist pausefilter pfthreshold v_vmsave_vmload vgif umip pku ospke vaes vpclmulqdq rdpid overflow_reco smca

From numactl --hardware  
WARNING: a numactl 'node' might or might not correspond to a physical chip.  
available: 8 nodes (0-7)  
node 0 cpus: 0  
node 0 size: 128588 MB  
node 0 free: 128484 MB  
node 1 cpus: 1

(Continued on next page)

Page 5  Standard Performance Evaluation Corporation (info@spec.org)  https://www.spec.org/
Dell Inc.
PowerEdge R6515 (AMD EPYC 72F3 8-Core Processor)

SPECspeed®2017_fp_base = 78.0
SPECspeed®2017_fp_peak = 82.9

CPU2017 License: 55
Test Sponsor: Dell Inc.
Test by: Dell Inc.
Test Date: Jun-2021
Hardware Availability: Jul-2021
Software Availability: Mar-2021

Platform Notes (Continued)

node 1 size: 129023 MB
don node 1 free: 125433 MB
donode 2 cpus: 2
donode 2 size: 129023 MB
donode 2 free: 128902 MB
donode 3 cpus: 3
donode 3 size: 129023 MB
donode 3 free: 128786 MB
donode 4 cpus: 4
donode 4 size: 129023 MB
donode 4 free: 128921 MB
donode 5 cpus: 5
donode 5 size: 129023 MB
donode 5 free: 128886 MB
donode 6 cpus: 6
donode 6 size: 128985 MB
donode 6 free: 128985 MB
donode 7 cpus: 7
donode 7 size: 116910 MB
donode 7 free: 116910 MB

donode distances:

node 0 1 2 3 4 5 6 7
0:  10  11 11 11 11 11 11 11
1:  11  10 11 11 11 11 11 11
2:  11  11 10 11 11 11 11 11
3:  11  11 11 10 11 11 11 11
4:  11  11 11 11 10 11 11 11
5:  11  11 11 11 11 10 11 11
6:  11  11 11 11 11 11 10 11
7:  11  11 11 11 11 11 11 10

From /proc/meminfo
MemTotal:       1044071420 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"

(Continued on next page)
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CPU2017 License: 55
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Tested by: Dell Inc.

Platform Notes (Continued)

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 rhel-8-3-amd 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): Mitigation: Speculative Store Bypass disabled via prctl and seccomp
CVE-2018-3639 (Speculative Store Bypass): Mitigation: usercopy/swapgs barriers and __user pointer sanitation
CVE-2017-5753 (Spectre variant 1): Mitigation: Full AMD retpoline, IBPB: conditional, IBRS_FW, STIBP: disabled, RSB filling
CVE-2017-5715 (Spectre variant 2): Not affected
CVE-2020-0543 (Special Register Buffer Data Sampling): Not affected
CVE-2019-11135 (TSX Asynchronous Abort): Not affected

run-level 3 Jun 22 04:07

SPEC is set to: /mnt/ramdisk/cpu2017-1.1.8-aocc300-B2
Filesystem     Type   Size  Used Avail Use% Mounted on
tmpfs          tmpfs  128G  4.0G  125G   4% /mnt/ramdisk

From /sys/devices/virtual/dmi/id
Vendor: Dell Inc.
Product: PowerEdge R6515
Product Family: PowerEdge
Serial: HTDRG13

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:
8x 802C8632802C 72ASS16G72L2-3G2B3 128 GB 4 rank 3200
8x Not Specified Not Specified

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Test Date: Jun-2021  
Tested by: Dell Inc.  
Hardware Availability: Jul-2021  
Software Availability: Mar-2021

Platform Notes (Continued)

BIOS:
  BIOS Vendor: Dell Inc.  
  BIOS Version: 2.2.4  
  BIOS Date: 04/12/2021  
  BIOS Revision: 2.2

(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)  
---

AMD clang version 12.0.0 (CLANG: AOCC_3.0.0-Build#78 2020_12_10) (based on LLVM Mirror.Version.12.0.0)  
Target: x86_64-unknown-linux-gnu  
Thread model: posix  
InstalledDir: /opt/AMD/aocc-compiler-3.0.0/bin

---
C++, C, Fortran
| 607.cactuBSSN_s(base, peak)  
---

AMD clang version 12.0.0 (CLANG: AOCC_3.0.0-Build#78 2020_12_10) (based on LLVM Mirror.Version.12.0.0)  
Target: x86_64-unknown-linux-gnu  
Thread model: posix  
InstalledDir: /opt/AMD/aocc-compiler-3.0.0/bin

AMD clang version 12.0.0 (CLANG: AOCC_3.0.0-Build#78 2020_12_10) (based on LLVM Mirror.Version.12.0.0)  
Target: x86_64-unknown-linux-gnu  
Thread model: posix  
InstalledDir: /opt/AMD/aocc-compiler-3.0.0/bin

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

(Continued on next page)
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Target: x86_64-unknown-linux-gnu
Thread model: posix
InstalledDir: /opt/AMD/aocc-compiler-3.0.0/bin

Base Compiler Invocation

C benchmarks:
clang

Fortran benchmarks:
flang

Benchmarks using both Fortran and C:
flang clang

Benchmarks using Fortran, C, and C++:
clang++ clang flang

Base Portability Flags

603.bwaves_s: -DSPEC_LP64
607.cactuBSSN_s: -DSPEC_LP64
619.lbm_s: -DSPEC_LP64
621.wrf_s: -DSPEC_CASE_FLAG -Mbyteswapio -DSPEC_LP64

(Continued on next page)
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### Base Portability Flags (Continued)

- 627.cam4_s: -DSPEC_CASE_FLAG -DSPEC_LP64
- 628.pop2_s: -DSPEC_CASE_FLAG -Mbyteswapio -DSPEC_LP64
- 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 -mno-adx -mno-sse4a -W1,-mlllvm -W1,-region-vectorize
- -W1,-mlllvm -W1,-function-specialize
- -W1,-mlllvm -W1,-align-all-nofallthru-blocks=6
- -W1,-mlllvm -W1,-reduce-array-computations=3 -O3 -march=znver3
- -fveclib=AMDLIBM -ffast-math -flto -fstruct-layout=5
- -mlllvm -unroll-threshold=50 -mlllvm -inline-threshold=1000
- -fremap-arrays -mlllvm -function-specialize -flv-function-specialization
- -mlllvm -enable-gvn-hoist -mlllvm -global-vectorize-slp=true
- -mlllvm -enable-licm-vrp -mlllvm -reduce-array-computations=3 -z muldefs
- -DSPEC_OPENMP -fopenmp -fopenmp=libomp -lomp -lamdlibm -ljemalloc
- -lflang -lflangrti

#### Fortran benchmarks:

- -m64 -mno-adx -mno-sse4a -W1,-mlllvm -W1,-enable-X86-prefetching
- -W1,-mlllvm -W1,-enable-licm-vrp -W1,-mlllvm -W1,-region-vectorize
- -W1,-mlllvm -W1,-function-specialize
- -W1,-mlllvm -W1,-align-all-nofallthru-blocks=6
- -W1,-mlllvm -W1,-reduce-array-computations=3 -Hz,1,0x1 -O3
- -march=znver3 -fveclib=AMDLIBM -ffast-math -Mrecursive
- -mlllvm -fuse-tile-inner-loop -funroll-loops
- -mlllvm -extra-vectorizer-passes -mlllvm -lsr-in-nested-loop
- -mlllvm -enable-licm-vrp -mlllvm -reduce-array-computations=3
- -mlllvm -global-vectorize-slp=true -z muldefs -DSPEC_OPENMP -fopenmp
- -fopenmp=libomp -lomp -lamdlibm -ljemalloc -lflang -lflangrti

#### Benchmarks using both Fortran and C:

- -m64 -mno-adx -mno-sse4a -W1,-mlllvm -W1,-enable-X86-prefetching
- -W1,-mlllvm -W1,-enable-licm-vrp -W1,-mlllvm -W1,-region-vectorize
- -W1,-mlllvm -W1,-function-specialize
- -W1,-mlllvm -W1,-align-all-nofallthru-blocks=6
- -W1,-mlllvm -W1,-reduce-array-computations=3 -O3 -march=znver3
- -fveclib=AMDLIBM -ffast-math -flto -fstruct-layout=5
- -mlllvm -unroll-threshold=50 -mlllvm -inline-threshold=1000
- -fremap-arrays -mlllvm -function-specialize -flv-function-specialization

(Continued on next page)
**SPEC CPU®2017 Floating Point Speed Result**

**Dell Inc.**

PowerEdge R6515 (AMD EPYC 72F3 8-Core Processor)

<table>
<thead>
<tr>
<th>SPECspeed®2017_fp_base</th>
<th>SPECspeed®2017_fp_peak</th>
</tr>
</thead>
<tbody>
<tr>
<td>78.0</td>
<td>82.9</td>
</tr>
</tbody>
</table>

**CPU2017 License:** 55  
**Test Date:** Jun-2021  
**Test Sponsor:** Dell Inc.  
**Hardware Availability:** Jul-2021  
**Tested by:** Dell Inc.  
**Software Availability:** Mar-2021

### Base Optimization Flags (Continued)

Benchmarks using both Fortran and C (continued):

- `-mllvm -enable-gvn-hoist -mllvm -global-vectorize-slp=true`
- `-mllvm -enable-licm-vrp -mllvm -reduce-array-computations=3 -Hz,1,0x1`
- `-Mrecursive -mllvm -fuse-tile-inner-loop -funroll-loops`
- `-mllvm -extra-vectorizer-passes -mllvm -lslr-in-nested-loop -z muldefs`
- `-DSPEC_OPENMP -fopenmp -fopenmp=libomp -lomp -lamdlibm -ljemalloc`
- `-lflang -lflangrti`

### Base Other Flags

**C benchmarks:**

- `-Wno-unused-command-line-argument -Wno-return-type`

**Fortran benchmarks:**

- `-Wno-unused-command-line-argument -Wno-return-type`

**Benchmarks using both Fortran and C:**

- `-Wno-unused-command-line-argument -Wno-return-type`

**Benchmarks using Fortran, C, and C++:**

- `-Wno-unused-command-line-argument -Wno-return-type`
Dell Inc.
PowerEdge R6515 (AMD EPYC 72F3 8-Core Processor)

**SPECspeed®2017_fp_base = 78.0**

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</tbody>
</table>

### Peak Compiler Invocation

**C benchmarks:**
- `clang`

**Fortran benchmarks:**
- `flang`

**Benchmarks using both Fortran and C:**
- `flang clang`

**Benchmarks using Fortran, C, and C++:**
- `clang++ clang flang`

### Peak Portability Flags

Same as Base Portability Flags

### Peak Optimization Flags

**C benchmarks:**
- `619.lbm_s: -m64 -mno-adx -mno-sse4a`
- `-Wl,-mlibv -Wl,-function-specialize`
- `-Wl,-mlibv -Wl,-align-all-nofallthru-blocks=6`
- `-Wl,-mlibv -Wl,-reduce-array-computations=3 -Ofast`
- `-march=znver3 -fveclib=AMDLIBM -ffast-math -ffito`
- `-fstruct-layout=5 -mlibm -unroll-threshold=50`
- `-fremap-arrays -fllvm-function-specialization`
- `-mlibv -inline-threshold=1000 -mlibv -enable-gvn-hoist`
- `-mlibv -global-vectorize-slp=true`
- `-mlibv -function-specialize -mlibv -enable-licm-vrp`
- `-mlibv -reduce-array-computations=3 -DSPEC_OPENMP -fopenmp`
- `-fopenmp=libomp -lomp -ldl -ljemalloc -lflang`

**Fortran benchmarks:**
- `638.imagick_s: basepeak = yes`
- `644.nab_s: basepeak = yes`

(Continued on next page)
Dell Inc.  

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**Peak Optimization Flags (Continued)**

649.fotonik3d_s: basepeak = yes

654.roms_s: -m64 -mno-adx -mno-sse4a  
-W1,-mllvm -W1,-enable-X86-prefetching  
-W1,-mllvm -W1,-enable-licm-vrp  
-W1,-mllvm -W1,-function-specialize  
-W1,-mllvm -W1,-align-all-nofallthru-blocks=6  
-W1,-mllvm -W1,-reduce-array-computations=3 -Ofast  
-march=znver3 -fveclib=AMDLIBM -ffast-math -Mrecursive  
-mllvm -reduce-array-computations=3  
-mllvm -global-vectorize-slp=true -mllvm -enable-licm-vrp  
-DSPEC_OPENMP -fopenmp -fopenmp=libomp -lomp -lamdlibm  
-ljemalloc -lflang  

Benchmarks using both Fortran and C:

621.wrf_s: basepeak = yes

627.cam4_s: basepeak = yes

628.pop2_s: basepeak = yes

Benchmarks using Fortran, C, and C++:

-m64 -mno-adx -mno-sse4a -std=c++98  
-W1,-mllvm -W1,-x86-use-vzeroupper=false -Wl,-mllvm -Wl,-enable-licm-vrp  
-W1,-mllvm -W1,-function-specialize  
-W1,-mllvm -W1,-align-all-nofallthru-blocks=6  
-W1,-mllvm -W1,-reduce-array-computations=3 -Ofast -march=znver3  
-fveclib=AMDLIBM -ffast-math -flto -fstruct-layout=5  
-mllvm -unroll-threshold=50 -fremap-arrays -flv-function-specialization  
-mllvm -inline-threshold=1000 -mllvm -enable-gvn-hoist  
-mllvm -global-vectorize-slp=true -mllvm -function-specialize  
-mllvm -enable-licm-vrp -mllvm -reduce-array-computations=3  
-finline-aggressive -mllvm -unroll-threshold=100 -mllvm -reroll-loops  
-mllvm -aggressive-loop-unswitch -Mrecursive -DSPEC_OPENMP -fopenmp  
-fopenmp=libomp -lomp -lamdlibm -ljemalloc -lflang

---

**Peak Other Flags**

C benchmarks:

- Wno-unused-command-line-argument -Wno-return-type

Fortran benchmarks:

- Wno-unused-command-line-argument -Wno-return-type

(Continued on next page)
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Benchmarks using Fortran, C, and C++:
-Wno-unused-command-line-argument -Wno-return-type

The flags files that were used to format this result can be browsed at

You can also download the XML flags sources by saving the following links:

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