# Dell Inc.

PowerEdge R650 (Intel Xeon Silver 4316, 2.30 GHz)

<table>
<thead>
<tr>
<th>SPECrate®2017_fp_base = 281</th>
<th>SPECrate®2017_fp_peak = 292</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dell Inc.</td>
<td>Dell Inc.</td>
</tr>
<tr>
<td><strong>CPU2017 License:</strong> 55</td>
<td><strong>Test Date:</strong> May-2021</td>
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<tr>
<td><strong>Test Sponsor:</strong> Dell Inc.</td>
<td><strong>Hardware Availability:</strong> May-2021</td>
</tr>
<tr>
<td><strong>Tested by:</strong> Dell Inc.</td>
<td><strong>Software Availability:</strong> Feb-2021</td>
</tr>
</tbody>
</table>

## Hardware

- **CPU Name:** Intel Xeon Silver 4316
- **Max MHz:** 3400
- **Nominal:** 2300
- **Enabled:** 40 cores, 2 chips, 2 threads/core
- **Orderable:** 1,2 chips
- **Cache L1:** 32 KB I + 48 KB D on chip per core
- **L2:** 1.25 MB I+D on chip per core
- **L3:** 30 MB I+D on chip per chip
- **Other:** None
- **Memory:** 512 GB (16 x 32 GB 2Rx8 PC4-3200AA-R, running at 2666)
- **Storage:** 225 GB on tmpfs
- **Other:** None

## Software

- **OS:** Red Hat Enterprise Linux 8.3 (Ootpa) 4.18.0-240.15.1.el8_3.x86_64
- **Compiler:** C/C++: Version 2021.1 of Intel oneAPI DPC++/C++ Compiler Build 20201113 for Linux; Fortran: Version 2021.1 of Intel Fortran Compiler Classic Build 20201112 for Linux;
- **Parallel:** No
- **Firmware:** Version 1.2.1 released May-2021
- **File System:** tmpfs
- **System State:** Run level 5 (graphical multi-user)
- **Base Pointers:** 64-bit
- **Peak Pointers:** 64-bit
- **Other:** jemalloc memory allocator V5.0.1
- **Power Management:** BIOS and OS set to prefer performance at the cost of additional power usage.

## Test Results

<table>
<thead>
<tr>
<th>Benchmark</th>
<th>SPECrate®2017_fp_base</th>
<th>SPECrate®2017_fp_peak</th>
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<tbody>
<tr>
<td>503.bwaves_r</td>
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<td>519.lbm_r</td>
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<td>526.blender_r</td>
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<td>527.cam4_r</td>
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<td>538.imagick_r</td>
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<tr>
<td>544.nab_r</td>
<td>80</td>
<td>462</td>
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<tr>
<td>549.fotonik3d_r</td>
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<td>187</td>
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<tr>
<td>554.roms_r</td>
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</tbody>
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SPEC CPU®2017 Floating Point Rate Result

Dell Inc.
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CPU2017 License: 55
Test Sponsor: Dell Inc.
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SPECrate®2017_fp_base = 281
SPECrate®2017_fp_peak = 292

Results Table

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<tr>
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<th>Copies</th>
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<th>Seconds</th>
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<td>122</td>
<td>1043</td>
<td>122</td>
<td></td>
<td></td>
</tr>
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Results appear in the order in which they were run. Bold underlined text indicates a median measurement.

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:
LD_LIBRARY_PATH = 
"/mnt/ramdisk/cpu2017-1.1.5-ic2021.1/lib/intel64:/mnt/ramdisk/cpu2017-1.1.5-ic2021.1/jf5.0.1-64"
MALLOCONF = "retain:true"

General Notes
Binaries compiled on a system with 1x Intel Core i9-7980XE CPU + 64GB RAM memory using Red Hat Enterprise Linux 8.1
Transparent Huge Pages enabled by default

(Continued on next page)
Dell Inc. PowerEdge R650 (Intel Xeon Silver 4316, 2.30 GHz)

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

General Notes (Continued)

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

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.

Benchmark run from a 225 GB ramdisk created with the cmd: "mount -t tmpfs -o size=225G tmpfs /mnt/ramdisk"

Platform Notes

BIOS Settings:
    Sub NUMA Cluster : 2-Way Clustering
    Virtualization Technology : Disabled

    System Profile : Custom
    CPU Power Management : Maximum Performance
    C1E : Disabled
    C States : Autonomous
    Memory Patrol Scrub : Disabled
    Energy Efficiency Policy : Performance
    CPU Interconnect Bus Link
    Power Management : Disabled

Sysinfo program /mnt/ramdisk/cpu2017-1.1.5-ic2021.1/bin/sysinfo
Rev: r6538 of 2020-09-24 e8664e66d2d7080afeaa89d4b38e2f1c
running on localhost.localdomain Fri May 14 22:09:12 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) Silver 4316 CPU @ 2.30GHz
    2 "physical id"s (chips)
    80 "processors"

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

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CPU2017 License: 55
Test Sponsor: Dell Inc.
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Test Date: May-2021
Tested by: Dell Inc.
Software Availability: Feb-2021

Platform Notes (Continued)

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 : 20
siblings : 40

physical 0: cores 0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19
physical 1: cores 0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19

From lscpu:

Architecture: x86_64
CPU op-mode(s): 32-bit, 64-bit
Byte Order: Little Endian
CPU(s): 80
On-line CPU(s) list: 0-79
Thread(s) per core: 2
Core(s) per socket: 20
Socket(s): 2
NUMA node(s): 4
Vendor ID: GenuineIntel
CPU family: 6
Model: 106
Model name: Intel(R) Xeon(R) Silver 4316 CPU @ 2.30GHz
Stepping: 6
CPU MHz: 2937.740
BogoMIPS: 4600.00
Virtualization: VT-x
L1d cache: 48K
L1i cache: 32K
L2 cache: 1280K
L3 cache: 30720K
NUMA node0 CPU(s): 0,4,8,12,16,20,24,28,32,36,40,44,48,52,56,60,64,68,72,76
NUMA node1 CPU(s): 1,5,9,13,17,21,25,29,33,37,41,45,49,53,57,61,65,69,73,77
NUMA node2 CPU(s): 2,6,10,14,18,22,26,30,34,38,42,46,50,54,58,62,66,70,74,78
NUMA node3 CPU(s): 3,7,11,15,19,23,27,31,35,39,43,47,51,55,59,63,67,71,75,79

Flags:

(fpu vme de pse tsc msr pae mce cx8 apic sep mtrr pge mca cmov
pat pse36 clflush dtc acpi mmx fxsr sse sse2 ss ht tm pbe syscall nx pdelg rbdtscp
lm constant_tsc art arch_perfmon pebs bts rep_good nopl nonstop_tsc cpuid
aperfmperf pni pclmulqdq dtes64 monitor ds_cpl vmx smx est tm2 ssse3 sdbg fma cx16
xtrp pdcm pclid 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
intel_puin ssbd mba ibrs ibpb stibp ibrs_enhanced fsgsbase tsc_adjust bmi1 hle avx2
smep bmi2 erms invpcid cmq rdt_a avx512f avx512dq rdseed adx smap avx512ifma
clflushopt clwb intel_pt avx512cd sha ni avx512bw avx512vl xsaveopt xsave cxtb v1
xsaves cmq llc cmq_occup llc cmq_mbm_total cmq_mbm_local split_lock_detect wbinvd
dtc dtherm ida arat p11 pts avx512vbmi ume pku ospke avx512_vbmi gfn i vaes vpclmulqdq
avx512_vnni avx512_bitalg tme avx512_vpopcntdq la57 rdpid md_clear pconfig flush_l1d
arch_capabilities)

(Continued on next page)
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Test Sponsor: Dell Inc.  
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Tested by: Dell Inc.  
Hardware Availability: May-2021  
Software Availability: Feb-2021  

Platform Notes (Continued)  

/proc/cpuinfo cache data  
cache size : 30720 KB  

From numactl --hardware WARNING: a numactl 'node' might or might not correspond to a  
physical chip.  
available: 4 nodes (0-3)  
node 0 cpus: 0 4 8 12 16 20 24 28 32 36 40 44 48 52 56 60 64 68 72 76  
node 0 size: 125982 MB  
node 0 free: 112891 MB  
node 1 cpus: 2 6 10 14 18 22 26 30 34 38 42 46 50 54 58 62 66 70 74 78  
node 1 size: 127017 MB  
node 1 free: 127843 MB  
node 2 cpus: 1 5 9 13 17 21 25 29 33 37 41 45 49 53 57 61 65 69 73 77  
node 2 size: 126379 MB  
node 2 free: 128445 MB  
node 3 cpus: 3 7 11 15 19 23 27 31 35 39 43 47 51 55 59 63 67 71 75 79  
node 3 size: 126602 MB  
node 3 free: 128396 MB  
node distances:  
node 0  1  2  3  
0: 10 11 20 20  
1: 11 10 20 20  
2: 20 20 10 11  
3: 20 20 11 10  

From /proc/meminfo  
MemTotal: 527804512 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  
(Continued on next page)
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Software Availability: Feb-2021

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Platform Notes (Continued)

uname -a:

    Linux localhost.localdomain 4.18.0-240.15.1.el8_3.x86_64 #1 SMP Wed Feb 3 03:12:15 EST 2021 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: conditional, RSB filling
CVE-2020-0543 (Special Register Buffer Data Sampling): Not affected
CVE-2019-11135 (TSX Asynchronous Abort): Not affected

run-level 5 May 14 16:46

SPEC is set to: /mnt/ramdisk/cpu2017-1.1.5-ic2021.1

Filesystem     Type   Size  Used Avail Use% Mounted on
tmpfs          tmpfs  225G  6.9G  219G   4% /mnt/ramdisk

From /sys/devices/virtual/dmi/id
Vendor: Dell Inc.
Product: PowerEdge R650
Product Family: PowerEdge
Serial: 1234567

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:

    7x 00AD00B300AD HMAA4GR7A8R8-N-XN 32 GB 2 rank 3200, configured at 2666
9x 00AD063200AD HMAA4GR7A8R8-N-XN 32 GB 2 rank 3200, configured at 2666
16x Not Specified Not Specified

BIOS:

    BIOS Vendor: Dell Inc.
    BIOS Version: 1.2.1
    BIOS Date: 05/06/2021
    BIOS Revision: 1.2

(Continued on next page)
## Platform Notes (Continued)

(End of data from sysinfo program)

### Compiler Version Notes

<table>
<thead>
<tr>
<th>Language</th>
<th>Compiler Details</th>
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<td>C</td>
<td>519.lbm_r(base, peak) 538.imagick_r(base, peak) 544.nab_r(base, peak)</td>
</tr>
<tr>
<td>C++</td>
<td>508.namd_r(base, peak) 510.parest_r(base, peak)</td>
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<tr>
<td>C++, C</td>
<td>511.povray_r(peak)</td>
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</tbody>
</table>

Intel(R) oneAPI DPC++/C++ Compiler for applications running on Intel(R) 64, Version 2021.1 Build 20201113
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Intel(R) oneAPI DPC++/C++ Compiler for applications running on Intel(R) 64, Version 2021.1 Build 20201113
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Intel(R) C++ Intel(R) 64 Compiler Classic for applications running on Intel(R) 64, Version 2021.1 Build 20201112_000000
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Intel(R) C Intel(R) 64 Compiler Classic for applications running on Intel(R) 64, Version 2021.1 Build 20201112_000000
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(Continued on next page)
Compiler Version Notes (Continued)

Intel(R) C++ Intel(R) 64 Compiler Classic for applications running on Intel(R) 64, Version 2021.1 Build 20201112_000000
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Intel(R) C Intel(R) 64 Compiler Classic for applications running on Intel(R) 64, Version 2021.1 Build 20201112_000000
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------------------------------------------------------------------------------
C++, C |
511.povray_r(base) 526.blender_r(base, peak)
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Intel(R) oneAPI DPC++/C++ Compiler for applications running on Intel(R) 64,
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------------------------------------------------------------------------------
C++, C, Fortran |
507.cactuBSSN_r(base, peak)
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Intel(R) Fortran Intel(R) 64 Compiler Classic for applications running on
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------------------------------------------------------------------------------
Fortran |
503.bwaves_r(base, peak) 549.fotonik3d_r(base, peak)
554.roms_r(base, peak)
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Intel(R) Fortran Intel(R) 64 Compiler Classic for applications running on
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Fortran, C |
521.wrf_r(base, peak) 527.cam4_r(base, peak)
------------------------------------------------------------------------------

Intel(R) Fortran Intel(R) 64 Compiler Classic for applications running on
(Continued on next page)
### Compiler Version Notes (Continued)

Intel(R) 64, Version 2021.1 Build 20201112_000000
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Intel(R) oneAPI DPC++/C++ Compiler for applications running on Intel(R) 64,
Version 2021.1 Build 20201113
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---

### Base Compiler Invocation

**C benchmarks:**
- icx

**C++ benchmarks:**
- icpx

**Fortran benchmarks:**
- ifort

**Benchmarks using both Fortran and C:**
- ifort icx

**Benchmarks using both C and C++:**
- icpx icx

**Benchmarks using Fortran, C, and C++:**
- icpx icx ifort

### Base Portability Flags

- 503.bwaves_r: -DSPEC_LP64
- 507.cactusBSSN_r: -DSPEC_LP64
- 508.namd_r: -DSPEC_LP64
- 510.parest_r: -DSPEC_LP64
- 511.povray_r: -DSPEC_LP64
- 519.lbm_r: -DSPEC_LP64
- 521.wrf_r: -DSPEC_LP64 -DSPEC_CASE_FLAG -convert big_endian
- 526.blender_r: -DSPEC_LP64 -DSPEC_LINUX -funsigned-char
- 527.cam4_r: -DSPEC_LP64 -DSPEC_CASE_FLAG
- 538.imagick_r: -DSPEC_LP64
- 544.nab_r: -DSPEC_LP64
- 549.fotonik3d_r: -DSPEC_LP64
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Dell Inc.

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SPECrare®2017_fp_base = 281
SPECrare®2017_fp_peak = 292

C benchmarks:
- \(-w\) \(-std=c11\) \(-m64\) \(-Wl,-z,\) muldefs \(-xCORE-AVX512\) \(-Ofast\) \(-ffast-math\)
- \(-flto\) \(-mfpmath=sse\) \(-funroll-loops\) \(-qopt-mem-layout-trans=4\)
- \(-mbranches-within-32B-boundaries\) \(-ljemalloc\)
- \(-L/usr/local/jemalloc64-5.0.1/lib\)

C++ benchmarks:
- \(-w\) \(-m64\) \(-Wl,-z,\) muldefs \(-xCORE-AVX512\) \(-Ofast\) \(-ffast-math\) \(-flto\)
- \(-mfpmath=sse\) \(-funroll-loops\) \(-qopt-mem-layout-trans=4\)
- \(-mbranches-within-32B-boundaries\) \(-ljemalloc\)
- \(-L/usr/local/jemalloc64-5.0.1/lib\)

Fortran benchmarks:
- \(-w\) \(-m64\) \(-Wl,-z,\) muldefs \(-xCORE-AVX512\) \(-O3\) \(-ipo\) \(-no-prec-div\)
- \(-qopt-prefetch\) \(-ffinite-math-only\)
- \(-qopt-multiple-gather-scatter-by-shuffles\) \(-qopt-mem-layout-trans=4\)
- \(-nostandard-realloc-lhs\) \(-align\) array32byte \(-auto\)
- \(-mbranches-within-32B-boundaries\) \(-ljemalloc\)
- \(-L/usr/local/jemalloc64-5.0.1/lib\)

Benchmarks using both Fortran and C:
- \(-w\) \(-m64\) \(-std=c11\) \(-Wl,-z,\) muldefs \(-xCORE-AVX512\) \(-Ofast\) \(-ffast-math\)
- \(-flto\) \(-mfpmath=sse\) \(-funroll-loops\) \(-qopt-mem-layout-trans=4\) \(-O3\) \(-ipo\)
- \(-no-prec-div\) \(-qopt-prefetch\) \(-ffinite-math-only\)
- \(-qopt-multiple-gather-scatter-by-shuffles\)
- \(-mbranches-within-32B-boundaries\) \(- nostandard-realloc-lhs\)
- \(-align\) array32byte \(-auto\) \(-ljemalloc\) \(-L/usr/local/jemalloc64-5.0.1/lib\)

Benchmarks using both C and C++:
- \(-w\) \(-m64\) \(-std=c11\) \(-Wl,-z,\) muldefs \(-xCORE-AVX512\) \(-Ofast\) \(-ffast-math\)
- \(-flto\) \(-mfpmath=sse\) \(-funroll-loops\) \(-qopt-mem-layout-trans=4\)
- \(-mbranches-within-32B-boundaries\) \(-ljemalloc\)
- \(-L/usr/local/jemalloc64-5.0.1/lib\)

Benchmarks using Fortran, C, and C++:
- \(-w\) \(-m64\) \(-std=c11\) \(-Wl,-z,\) muldefs \(-xCORE-AVX512\) \(-Ofast\) \(-ffast-math\)
- \(-flto\) \(-mfpmath=sse\) \(-funroll-loops\) \(-qopt-mem-layout-trans=4\) \(-O3\)
- \(-no-prec-div\) \(-qopt-prefetch\) \(-ffinite-math-only\)
- \(-qopt-multiple-gather-scatter-by-shuffles\)
- \(-mbranches-within-32B-boundaries\) \(- nostandard-realloc-lhs\)
- \(-align\) array32byte \(-auto\) \(-ljemalloc\) \(-L/usr/local/jemalloc64-5.0.1/lib\)
Dell Inc.

PowerEdge R650 (Intel Xeon Silver 4316, 2.30 GHz)

**SPEC CPU®2017 Floating Point Rate Result**

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

**SPECrate®2017_fp_base = 281**  
**SPECrate®2017_fp_peak = 292**  

**Test Date:** May-2021  
**Hardware Availability:** May-2021  
**Software Availability:** Feb-2021

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**Peak Compiler Invocation**

- **C benchmarks:**
  - icx

- **C++ benchmarks:**
  - icpx

- **Fortran benchmarks:**
  - ifort

- **Benchmarks using both Fortran and C:**
  - ifort icx

- **Benchmarks using both C and C++:**
  - 511.povray_r: icpc icc
  - 526.blender_r: icpx icx

- **Benchmarks using Fortran, C, and C++:**
  - icpx icx ifort

---

**Peak Portability Flags**

Same as Base Portability Flags

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**Peak Optimization Flags**

- **C benchmarks:**
  - 519.lbm_r: basepeak = yes
  - 538.imagick_r: basepeak = yes

- **C++ benchmarks:**

(Continued on next page)
## Peak Optimization Flags (Continued)

```plaintext
508.namd_r: basepeak = yes


Fortran benchmarks:

503.bwaves_r: basepeak = yes

549.fotonik3d_r: basepeak = yes


Benchmarks using both Fortran and C:

521.wrf_r: basepeak = yes

527.cam4_r: basepeak = yes

Benchmarks using both C and C++:


526.blender_r: basepeak = yes

Benchmarks using Fortran, C, and C++:

507.cactuBSSN_r: basepeak = yes
```

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

Dell Inc.
PowerEdge R650 (Intel Xeon Silver 4316, 2.30 GHz)

| SPECrate®2017_fp_base | 281 |
| SPECrate®2017_fp_peak | 292 |

CPU2017 License: 55
Test Sponsor: Dell Inc.
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Test Date: May-2021
Hardware Availability: May-2021
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You can also download the XML flags sources by saving the following links:
http://www.spec.org/cpu2017/flags/Intel-ic2021-official-linux64_revA.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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