# SPEC® CPU2017 Integer Rate Result



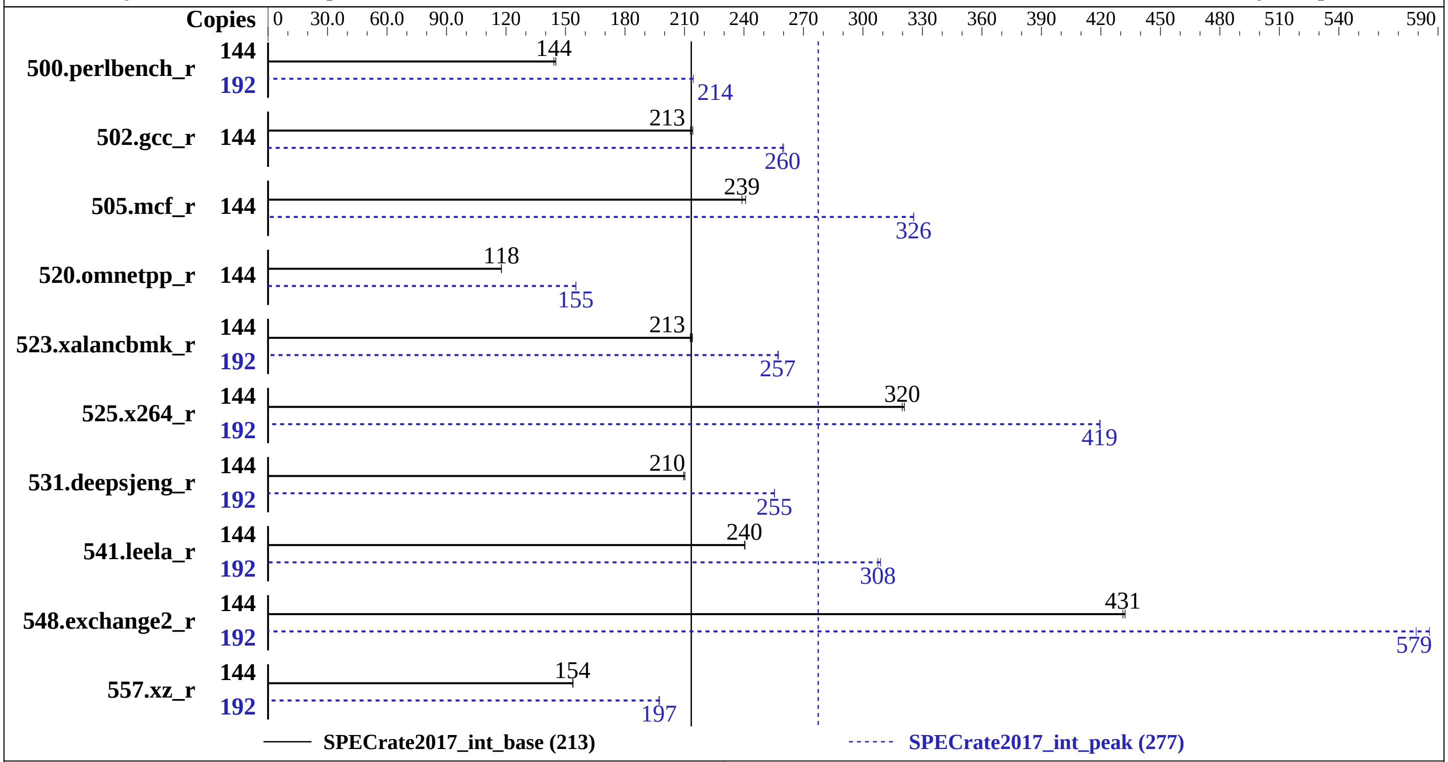
## IBM Corporation

IBM Power S924 (3.4 - 3.9 GHz, 24 core, SLES)

SPECrate2017_int_base = 213

SPECrate2017_int_peak = 277

**CPU2017 License:** 11
**Test Sponsor:** IBM Corporation
**Tested by:** IBM Corporation
**Test Date:** Mar-2018
**Hardware Availability:** Mar-2018
**Software Availability:** Apr-2018




## Hardware

| | |
|---|---|
| CPU Name: | POWER9 |
| Max MHz.: | 3900 |
| Nominal: | 3400 |
| Enabled: | 24 cores, 2 chips, 8 threads/core |
| Orderable: | 1, 2 Chips |
| Cache L1: | 64 KB I + 64 KB D on chip per core |
| L2: | 512 KB I+D on chip per core |
| L3: | 120 MB I+D on chip per chip shared NUCA / 12 cores |
| Other: | None |
| Memory: | 256 GB (16 x 16 GB 1Rx4 PC4-2666V-R) |
| Storage: | 2 x 1.8 TB 10K RPM 4K SAS HDD |
| Other: | None |

## Software

| | |
|---|---|
| OS: | SUSE Linux Enterprise Server 12 SP3 4.4.114-94.11-default |
| Compiler: | C/C++: Version 16.1.0 of IBM XL C/C++ for Linux; Fortran: Version 16.1.0 of IBM XL Fortran for Linux |
| Parallel: | No |
| Firmware: | Version VL910_061 Released Feb-2018 |
| File System: | xfs |
| System State: | Run level 3 (multi-user) |
| Base Pointers: | 64-bit |
| Peak Pointers: | 64-bit |
| Other: | Post-Link Optimization (fdprpro) for Linux on POWER, version 5.6.4.0; Advance Toolchain 11.0-0 |

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# Results Table

| Benchmark | Base | | | | | | | Peak | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Copies | Seconds | Ratio | Seconds | Ratio | Seconds | Ratio | Copies | Seconds | Ratio | Seconds | Ratio | Seconds | Ratio |
| 500.perlbench_r | 144 | **1590** | **144** | 1579 | 145 | | | 192 | **1431** | **214** | 1425 | 214 | | |
| 502.gcc_r | 144 | **957** | **213** | 952 | 214 | | | 144 | **786** | **260** | 784 | 260 | | |
| 505.mcf_r | 144 | **974** | **239** | 966 | 241 | | | 144 | 715 | 326 | **715** | **326** | | |
| 520.omnetpp_r | 144 | 1606 | 118 | **1606** | **118** | | | 144 | **1217** | **155** | 1217 | 155 | | |
| 523.xalancbmk_r | 144 | **714** | **213** | 711 | 214 | | | 192 | 788 | 257 | **789** | **257** | | |
| 525.x264_r | 144 | **788** | **320** | 786 | 321 | | | 192 | **802** | **419** | 801 | 420 | | |
| 531.deepsjeng_r | 144 | **787** | **210** | 785 | 210 | | | 192 | **862** | **255** | 861 | 255 | | |
| 541.leela_r | 144 | **992** | **240** | 991 | 241 | | | 192 | 1029 | 309 | **1034** | **308** | | |
| 548.exchange2_r | 144 | **875** | **431** | 873 | 432 | | | 192 | 859 | 586 | **869** | **579** | | |
| 557.xz_r | 144 | **1013** | **154** | 1011 | 154 | | | 192 | **1052** | **197** | 1050 | 197 | | |

**SPECrate2017_int_base =** **213**

**SPECrate2017_int_peak =** **277**

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

# Peak Tuning Notes

```
The FDPR post compiler binary optimizer was used
500.perlbench fdpr options: -O3 -noasd
502.gcc fdpr options: -RC -nop -bp -bf -A 2 -ihf 20 -isf 12
505.mcf fdpr options: -O4 -RC -nop -bf  -tlo -pto  -rt 0 -kr -hr -RD -las
520.omnetpp fdpr options: -O4 -A 2 -rcl 2 -sls -dir -vrox
523.xalan fdpr options: -O3
525.x264 fdpr options: -O3 -RC -nop -bf  -tlo -pto  -rt 0 -kr -hr -RD -las -vrox
-lux -1  -lu 9 -isf 12  -si -ihf 20  -sidf 50 -bp
531.deepsjeng fdpr options: -O3 -noasd
541.leela fdpr options: -RC -nop -bp -bf -hr
557.xz fdpr options: -O4
```

# Submit Notes

```
The config file option 'submit' was used
to assign benchmark copies to specific kernel thread using
the "numactl" command (see flags file for details).
```

# Operating System Notes

```
Stack size is set to unlimited
ulimit -s unlimited
Number of huge pages allocated are 11520
echo 11520 > /proc/sys/vm/nr_hugepages
drop cache is used before invoking runcpu command
sync; echo 3 > /proc/sys/vm/drop_caches
```

## General Notes

```
Environment variables set by runcpu before the start of the run:
HUGETLB_MORECORE = "yes"
HUGETLB_VERBOSE = "0"
LD_LIBRARY_PATH = "$LD_LIBRARY_PATH:/opt/FDPR"
LD_PRELOAD = "/opt/at11.0/lib64/libhugetlbfs.so"
MALLOC_MMAP_MAX_ = "0"
TCMALLOC_MEMFS_MALLOC_PATH = "/dev/hugepages/"
XLFRTEOPTS = "intrinthds=1"
XLSMPOPTS = "spins=0:yields=0:schedule=STATIC:stack=8000000"

 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.
Post-Link Optimizer (fdprpro): sources available at https://developer.ibm.com/linuxonpower/sdk-packages/
Advance Toolchain 11.0-0: sources available at https://ibm.biz/AdvanceToolchain

For release, the compiler version numbers were updated to 16.1.0 (from 13.1.7) for the C/C++
compiler and 16.1.0 (from 15.1.7) for the Fortran compiler.
```

## Platform Notes

```
 Firmware configuration:
 Idle Power Saver mode is disabled

 Sysinfo program /spec/CPU2017/v1.0.2/bin/sysinfo
 Rev: r5797 of 2017-06-14 96c45e4568ad54c135fd618bcc091c0f
 running on linux-0at1 Thu Mar  8 19:06:43 2018

 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
   'clock : ' reported by /proc/cpuinfo may not be reliable. Use with caution.
    cpu : POWER9 (architected), altivec supported
    clock : 2750.000000MHz
    machine : CHRP IBM,9009-42A
    model : IBM,9009-42A
    platform : pSeries
    revision : 2.2 (pvr 004e 0202)

 Number of cores, from 'ppc64_cpu --cores-present' :  24
```

**(Continued on next page)**

## Platform Notes (Continued)

```
WARNING regarding the output of 'lscfg':  this utility reports resources for the system,
not the current partition.  Therefore, for a partition that has a subset of the full
system resources:
   (1) The tester may need to adjust the sysinfo-supplied 'hw_ncores'.
   (2) The tester may need to adjust the sysinfo-supplied 'hw_nchips'.

Processors, from lscfg -vp

   ^^^Note: sum of ways = 0, differs from 'ppc64_cpu --cores-present'
      192 "processors"

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 16 17 18 19 20 21 22 23 24 25 26 27
  28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48 49 50 51 52 53 54 55 56
  57 58 59 60 61 62 63 64 65 66 67 68 69 70 71 72 73 74 75 76 77 78 79 80 81 82 83 84 85
  86 87 88 89 90 91 92 93 94 95
  node 0 size: 126493 MB
  node 0 free: 33434 MB
  node 1 cpus: 96 97 98 99 100 101 102 103 104 105 106 107 108 109 110 111 112 113 114
  115 116 117 118 119 120 121 122 123 124 125 126 127 128 129 130 131 132 133 134 135 136
  137 138 139 140 141 142 143 144 145 146 147 148 149 150 151 152 153 154 155 156 157 158
  159 160 161 162 163 164 165 166 167 168 169 170 171 172 173 174 175 176 177 178 179 180
  181 182 183 184 185 186 187 188 189 190 191
  node 1 size: 124023 MB
  node 1 free: 31569 MB
  node distances:
  node   0   1
    0:  10  40
    1:  40  10

From /proc/meminfo
   MemTotal:       256529344 kB
   HugePages_Total:   11520
   Hugepagesize:      16384 kB

/usr/bin/lsb_release -d
   SUSE Linux Enterprise Server 12 SP3

From /etc/*release* /etc/*version*
   SuSE-release:
      SUSE Linux Enterprise Server 12 (ppc64le)
      VERSION = 12
      PATCHLEVEL = 3
      # This file is deprecated and will be removed in a future service pack or release.
      # Please check /etc/os-release for details about this release.
```

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## Platform Notes (Continued)

```
    os-release:
       NAME="SLES"
       VERSION="12-SP3"
       VERSION_ID="12.3"
       PRETTY_NAME="SUSE Linux Enterprise Server 12 SP3"
       ID="sles"
       ANSI_COLOR="0;32"
       CPE_NAME="cpe:/o:suse:sles:12:sp3"

 uname -a:
    Linux linux-0at1 4.4.114-94.11-default #1 SMP Thu Feb 1 19:28:26 UTC 2018 (4309ff9)
    ppc64le ppc64le ppc64le GNU/Linux

 run-level 3 Mar 8 15:59

 SPEC is set to: /spec/CPU2017/v1.0.2
    Filesystem              Type  Size  Used Avail Use% Mounted on
    /dev/mapper/spec-speclv xfs   1.6T  1.2T  432G  74% /spec

 (End of data from sysinfo program)
 Sysinfo output is not correct for the disk information. Two disks, each of 1.8 TB
 capacity each were used. After the volumes were created, the available capacity reported
 for each disk was 1.6 TB. One disk is used for the operating system, compilers,
 libraries and Advance Toolchain, and another disk is used for the SPEC tree.
```

## Compiler Version Notes

```
==============================================================================
 CC  500.perlbench_r(base) 502.gcc_r(base) 505.mcf_r(base) 525.x264_r(base)
      557.xz_r(base)
------------------------------------------------------------------------------
IBM XL C/C++ for Linux, V13.1.7 (Beta 2)
Version: 13.01.0007.0000
Driver Version: 13.1.7(C/C++) Level: 180226 ID: _znni8Ra7Eeid4OHRoHeItA
C/C++ Front End Version: 13.1.7(C/C++) Level: 180226 ID:
  _7h4RcReEEeid4OHRoHeItA
High-Level Optimizer Version: 13.1.7(C/C++) and 15.1.7(Fortran) Level: 180227
  ID: _q9W8QRvXEeiwhLbSB1AWhQ
Low-Level Optimizer Version: 13.1.7(C/C++) and 15.1.7(Fortran) Level: 180226
  ID: _mRjxcBdjEeid4OHRoHeItA
------------------------------------------------------------------------------

==============================================================================
 CXXC 520.omnetpp_r(base) 523.xalancbmk_r(base) 531.deepsjeng_r(base)
      541.leela_r(base)
------------------------------------------------------------------------------
```

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## Compiler Version Notes (Continued)

```
IBM XL C/C++ for Linux, V13.1.7 (Beta 2)
Version: 13.01.0007.0000
Driver Version: 13.1.7(C/C++) Level: 180226 ID: _znni8Ra7Eeid4OHRoHeItA
C/C++ Front End Version: 13.1.7(C/C++) Level: 180226 ID:
  _7h4RcReEEeid4OHRoHeItA
High-Level Optimizer Version: 13.1.7(C/C++) and 15.1.7(Fortran) Level: 180227
  ID: _q9W8QRvXEeiwhLbSB1AWhQ
Low-Level Optimizer Version: 13.1.7(C/C++) and 15.1.7(Fortran) Level: 180226
  ID: _mRjxcBdjEeid4OHRoHeItA
------------------------------------------------------------------------------

==============================================================================
CC   500.perlbench_r(peak) 502.gcc_r(peak) 505.mcf_r(peak) 525.x264_r(peak)
     557.xz_r(peak)
------------------------------------------------------------------------------
IBM XL C/C++ for Linux, V13.1.7 (Beta 2)
Version: 13.01.0007.0000
Driver Version: 13.1.7(C/C++) Level: 180226 ID: _znni8Ra7Eeid4OHRoHeItA
C/C++ Front End Version: 13.1.7(C/C++) Level: 180226 ID:
  _7h4RcReEEeid4OHRoHeItA
High-Level Optimizer Version: 13.1.7(C/C++) and 15.1.7(Fortran) Level: 180227
  ID: _q9W8QRvXEeiwhLbSB1AWhQ
Low-Level Optimizer Version: 13.1.7(C/C++) and 15.1.7(Fortran) Level: 180226
  ID: _mRjxcBdjEeid4OHRoHeItA
------------------------------------------------------------------------------

==============================================================================
CXXC 520.omnetpp_r(peak) 523.xalancbmk_r(peak) 531.deepsjeng_r(peak)
     541.leela_r(peak)
------------------------------------------------------------------------------
IBM XL C/C++ for Linux, V13.1.7 (Beta 2)
Version: 13.01.0007.0000
Driver Version: 13.1.7(C/C++) Level: 180226 ID: _znni8Ra7Eeid4OHRoHeItA
C/C++ Front End Version: 13.1.7(C/C++) Level: 180226 ID:
  _7h4RcReEEeid4OHRoHeItA
High-Level Optimizer Version: 13.1.7(C/C++) and 15.1.7(Fortran) Level: 180227
  ID: _q9W8QRvXEeiwhLbSB1AWhQ
Low-Level Optimizer Version: 13.1.7(C/C++) and 15.1.7(Fortran) Level: 180226
  ID: _mRjxcBdjEeid4OHRoHeItA
------------------------------------------------------------------------------

==============================================================================
 FC  548.exchange2_r(base)
------------------------------------------------------------------------------
IBM XL Fortran for Linux, V15.1.7 (Beta 2)
Version: 15.01.0007.0000
Driver Version: 15.1.7(Fortran) Level: 180226 ID: _znni8Ra7Eeid4OHRoHeItA
```


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## Compiler Version Notes (Continued)

```
Fortran Front End and Run Time Version: 15.1.7(Fortran) Level: 180226 ID:
  _-t6CIRqxEeiwhLbSB1AWhQ
Fortran Transformer Version: 15.1.7(Fortran) Level: 180226 ID:
  _J6BfYRi8Eeid4OHRoHeItA
High-Level Optimizer Version: 13.1.7(C/C++) and 15.1.7(Fortran) Level: 180227
  ID: _q9W8QRvXEeiwhLbSB1AWhQ
Low-Level Optimizer Version: 13.1.7(C/C++) and 15.1.7(Fortran) Level: 180226
  ID: _mRjxcBdjEeid4OHRoHeItA
------------------------------------------------------------------------------

==============================================================================
FC   548.exchange2_r(peak)
------------------------------------------------------------------------------
IBM XL Fortran for Linux, V15.1.7 (Beta 2)
Version: 15.01.0007.0000
Driver Version: 15.1.7(Fortran) Level: 180226 ID: _znni8Ra7Eeid4OHRoHeItA
Fortran Front End and Run Time Version: 15.1.7(Fortran) Level: 180226 ID:
  _-t6CIRqxEeiwhLbSB1AWhQ
Fortran Transformer Version: 15.1.7(Fortran) Level: 180226 ID:
  _J6BfYRi8Eeid4OHRoHeItA
High-Level Optimizer Version: 13.1.7(C/C++) and 15.1.7(Fortran) Level: 180227
  ID: _q9W8QRvXEeiwhLbSB1AWhQ
Low-Level Optimizer Version: 13.1.7(C/C++) and 15.1.7(Fortran) Level: 180226
  ID: _mRjxcBdjEeid4OHRoHeItA
------------------------------------------------------------------------------
```

## Base Compiler Invocation

C benchmarks:
`/opt/ibm/xlC/13.1.7/bin/xlc_at -qlanglvl=extc99`

C++ benchmarks:
`/opt/ibm/xlC/13.1.7/bin/xlC_at`

Fortran benchmarks:
`/opt/ibm/xlf/15.1.7/bin/xlf95_at`

## Base Portability Flags

500.perlbench_r: `-DSPEC_LP64 -DSPEC_LINUX_PPC_LE`
502.gcc_r: `-DSPEC_LP64`
505.mcf_r: `-DSPEC_LP64`
520.omnetpp_r: `-DSPEC_LP64`

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# Base Portability Flags (Continued)

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:
-lhugetlbfs -qipa=noobject -qalias=noansi -O5 -qarch=pwr9 -qtune=pwr9

C++ benchmarks:
-lhugetlbfs -qipa=noobject -O4 -qarch=pwr9 -qtune=pwr9 -ltcmalloc

Fortran benchmarks:
-lhugetlbfs -qipa=noobject -O4 -qarch=pwr9 -qtune=pwr9 -qprefetch=dscr=1

# Base Other Flags

C benchmarks:
-qsuppress=1500-036 -qsuppress=1500-029

C++ benchmarks:
-qsuppress=1500-036 -qsuppress=1500-029

Fortran benchmarks:
-qsuppress=1500-036 -qsuppress=1500-029

# Peak Compiler Invocation

C benchmarks:
/opt/ibm/xlC/13.1.7/bin/xlc_at -qlanglvl=extc99

C++ benchmarks:
/opt/ibm/xlC/13.1.7/bin/xlC_at

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# Peak Compiler Invocation (Continued)

Fortran benchmarks:
`/opt/ibm/xlf/15.1.7/bin/xlf95_at`

# Peak Portability Flags

Same as Base Portability Flags

# Peak Optimization Flags

C benchmarks:

500.perlbench_r: `-Wl,-q -lhugetlbfs -qpdf1`(pass 1) `-qpdf2`(pass 2) `-O3 -qarch=pwr9 -qtune=pwr9 -qinline=level=10 -qprefetch=dscr=1 -qipa=noobject:partition=large -qalias=noansi -qstrict=nans -qfdpr`

502.gcc_r: `-Wl,-q -lhugetlbfs -qpdf1`(pass 1) `-qpdf2`(pass 2) `-O3 -qarch=pwr9 -qtune=pwr9 -ltcmalloc -Wl,-z,muldefs -qipa=noobject -qalias=noansi -qfdpr`

505.mcf_r: `-Wl,-q -lhugetlbfs -qpdf1`(pass 1) `-qpdf2`(pass 2) `-O5 -qarch=pwr9 -qtune=pwr9 -qdatasmall -qprefetch=dscr=4 -ltcmalloc -qipa=noobject -qfdpr`

525.x264_r: `-Wl,-q -lhugetlbfs -qpdf1`(pass 1) `-qpdf2`(pass 2) `-O5 -qarch=pwr9 -qtune=pwr9 -qnounroll -qrestrict -qprefetch=dscr=7 -ltcmalloc -qipa=noobject -qfdpr`

557.xz_r: `-Wl,-q -lhugetlbfs -qpdf1`(pass 1) `-qpdf2`(pass 2) `-O5 -qarch=pwr9 -qtune=pwr9 -qpagesize=16M -qprefetch=dscr=7 -ltcmalloc -qipa=noobject -qfdpr`

C++ benchmarks:

520.omnetpp_r: `-Wl,-q -lhugetlbfs -qpdf1`(pass 1) `-qpdf2`(pass 2) `-O5 -qarch=pwr9 -qtune=pwr9 -qlibansi -qprefetch=dscr=1 -ltcmalloc -qipa=noobject -qfdpr`

523.xalancbmk_r: `-Wl,-q -lhugetlbfs -qpdf1`(pass 1) `-qpdf2`(pass 2) `-O5 -qarch=pwr9 -qtune=pwr9 -qpagesize=16M -qprefetch=dscr=7 -ltcmalloc -qipa=noobject -qfdpr`

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# Peak Optimization Flags (Continued)

531.deepsjeng_r: -Wl,-q -lhugetlbfs -qpdf1(pass 1) -qpdf2(pass 2) -O2 -qarch=pwr9 -qtune=pwr9 -qipa -qrestrict -qprefetch=dscr=1 -qipa=noobject -qfdpr

541.leela_r: -Wl,-q -lhugetlbfs -qpdf1(pass 1) -qpdf2(pass 2) -O5 -qarch=pwr9 -qtune=pwr9 -qenum=small -funroll-all-loops -qinline=level=10 -qprefetch=dscr=6 -qipa=noobject -qfdpr

Fortran benchmarks:
-lhugetlbfs -qpdf1(pass 1) -qpdf2(pass 2) -O3 -qarch=pwr9 -qtune=pwr9:smt4 -qhot -qsimd=noauto -qsmallstack -qprefetch=dscr=1 -ltcmalloc -qipa=noobject

# Peak Other Flags

C benchmarks:
-qsuppress=1500-036 -qsuppress=1500-029

C++ benchmarks:
-qsuppress=1500-036 -qsuppress=1500-029

Fortran benchmarks:
-qsuppress=1500-036 -qsuppress=1500-029 -qsuppress=cmpmsg

The flags files that were used to format this result can be browsed at
http://www.spec.org/cpu2017/flags/IBM_Linux_9009_S.html
http://www.spec.org/cpu2017/flags/IBM_XL_Linux_1317_flags.html

You can also download the XML flags sources by saving the following links:
http://www.spec.org/cpu2017/flags/IBM_Linux_9009_S.xml
http://www.spec.org/cpu2017/flags/IBM_XL_Linux_1317_flags.xml



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

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