Business white paper

HP Workstations and ANSYS

Running ANSYS Mechanical, Fluent and CFX

HP recommends Windows.

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HP recommends Windows.

Introduction

The purpose of this document is to provide information that will aid in selection of HP Workstations for running ANSYS Mechanical, Fluent and CFX. An ANSYS 15.0 performance study was completed on the ANSYS 15 benchmarks. Detailed results are provided for the HP Z820 Workstation running Windows 7 Professional 64-bit.* Results are also provided with use of the NVIDIA Quadro K6000, Tesla K20 and Tesla K40 GPU Compute acceleration on ANSYS Mechanical and Fluent benchmarks. Recommended configurations are provided for the HP Z420, HP Z620 and HP Z820 Workstations. Tips are also provided for running the solutions at ultimate performance.

The ANSYS Mechanical v15sp-5 benchmark required 128 GB memory. The CPU scaling is impressive. The GPU influence was very good at 1–7 CPU cores. The GPU influence was negligible at CPU core count above 8. V15sp-1 and v15sp-2 benchmarks were run simultaneous and resulted in similar ratings as when run individually. The HP Z820 provided enough CPU core and memory to allow these two simulations to run in parallel.

The ANSYS Fluent Pipes 1.2M Cell simulation was run on three different GPU compute cards. The rough estimate of 3 GB GPU memory is required for 1M Cell simulation. Fluent scaling is very impressive on as many CPU cores as available in the HP Workstation. The GPU influence is good at low CPU core count of 2. GPU influence is fair at CPU core count of 8. GPU influence is negligible at CPU core count of 16.

The ANSYS CFX Airfoil 10M node simulation was run on 2, 8 and 16 CPU cores. CFX scaling is very impressive on as many CPU cores as available in the HP Workstation.

What type of application is ANSYS Mechanical?

ANSYS Mechanical is used for mechanical and structural engineering analysis/simulation. The solution is used to compute the response of a structural system. The equation solvers that are used to drive the simulation are computational intensive. The equation solvers run on central processing unit (CPU) core(s) and in addition can run on graphics processing compute cards (GPUs). The GPU hardware is parallel computer architecture. The CPU core(s) will continue to be used for all other computations in and around the equation solver when GPU hardware is used. The large arrays of equation solvers and datasets used in the simulation require a large, fast memory system. The data storage files accessed during simulation benefit from dedicated, fast storage I/O systems. Configure as much memory as possible to minimize the I/O required for the simulation. The application has the ability to use parallel computing (both shared memory and distributed memory). The distributed memory model can run on a single machine or across machines/nodes (cluster) connected via high speed interconnect.

HP recommends Windows.

What type of application is ANSYS Fluent?

ANSYS Fluent is used for fluid flow design engineering analysis. The solvers are computational intensive and require a moderate size, fast memory system. The application has the ability to use parallel computing and can run on a single machine or across machines/nodes (cluster) connected via high speed interconnect.

What type of application is ANSYS CFX?

ANSYS CFX is used for general-purpose computational fluid dynamics (CFD). The solvers are computational intensive and require a moderate size, fast memory system. The application has the ability to use local parallel computing or distribute parallel computing across multiple machines/nodes connected via high speed interconnect.

How does the HP Workstation family provide outstanding ANSYS performance?

- **Compute** performance
  - Intel® AVX is a new 256 bit instruction set extension to SSE and is designed for applications that are Floating Point (FP) intensive. It was released early 2011 as part of the Intel® Xeon® E5-XXXX processor family. ANSYS 15.0 was compiled to utilize Intel® AVX.
  - HP Z420, HP Z620 and HP Z820 Workstations with Windows 7 Professional 64-bit* utilize the Intel® Xeon® processor E5-XXXX family and the Intel® C602 chipset.
- **Memory** bandwidth and latency. The HP Z620 and HP Z820 with Windows 7 Professional 64-bit* have Dual QPI links in parallel with up to 8 GT/s.
- **Memory** speed up to 1866 MHz on E5-XXXX v2
- **Memory** design with 4 channels per processor
  - HP Z420 with Windows 7 Professional 64-bit* supports unbuffered DIMMs (UDIMM)
    - 8 DIMM sockets, 4 channels, 2 DIMMs per channel, up to 64 GB
  - HP Z620 with Windows 7 Professional 64-bit* supports unbuffered DIMMs (UDIMM) and registered DIMMs (RDIMM)
    - 12 DIMM sockets, 4 channels, up to 96 GB
    - 2 DIMMs per channel – CPU0 – 8 sockets
    - 1 DIMM per channel – CPU1 – 4 sockets
  - HP Z820 with Windows 7 Professional 64-bit* supports unbuffered DIMMs (UDIMM), registered DIMMs (RDIMM) and load-reduced DIMMs 1333 MHz (LRDIMM)
    - Mixing UDIMM / RDIMM / LRDIMM is not permitted
    - 16 DIMM sockets, 4 channels, up to 512 GB
    - 2 DIMMs per channel – CPU0 – 8 sockets
    - 2 DIMMs per channel – CPU1 – 8 sockets
- **Storage I/O** performance
  - PCI-Express 3.0
  - 6 Gb/s SATA and SAS ports
  - DMA bandwidth
  - 6 Gb/s hard drives (HDD) and 6 Gb/s solid state drives (SSD)
  - Storage volumes can be configured with RAID for speed and resilience
  - USB 3.0 ports
- **GPU Compute** acceleration
  - NVIDIA Quadro K6000 and Tesla K20c are supported in the HP Z420. NVIDIA Quadro K6000, Tesla K20c and K40 are a supported option in the HP Z620 and HP Z820[1] Workstations.

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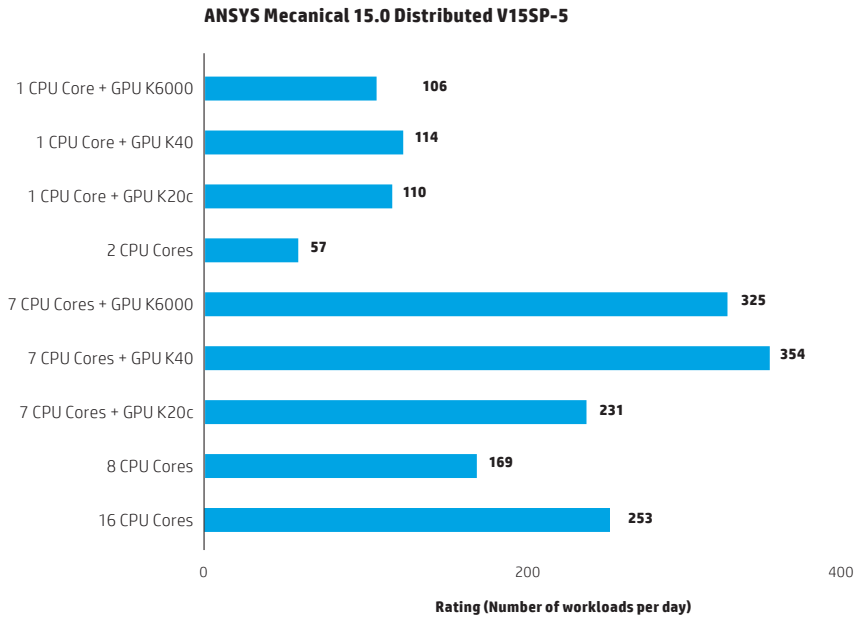
What ANSYS Mechanical 15.0 distributed performance did HP measure on the HP Z820 workstation?



HP Workstation recommendations and tips for running ANSYS Mechanical 15.0

Simulation up to 64 GB and up to 8 CPU Cores

- HP Z420 with Windows 7 Professional 64-bit,* Intel® Xeon® E5-1660 v2 6-core 3.7/4.0 tb,[2,3,4,5] 64 GB memory,[6] SSD RAID0, NVIDIA Quadro K600

Simulation up to 96 GB and up to 16 CPU Cores

- HP Z620 with Windows 7 Professional 64-bit,* 2x Intel® Xeon® E5-2667 v2 8-core 3.3/4.0tb,[2,3,4] 96 GB memory,[6] SSD RAID0, NVIDIA Quadro K2000

Simulation up to 512 GB and up to 24 CPU Cores

- HP Z820 with Windows 7 Professional 64-bit,* 2x Intel® Xeon® E5-2687W v2 8-core 3.4/4.0tb,[2,3,4] 128 GB memory,[6] SSD RAID0, NVIDIA Quadro K2000

NVIDIA GPU Compute Options

- Tesla K40
- Tesla K20c
- Quadro K6000

Memory sizing is critical. Use as much memory as possible to minimize the I/O required.

Windows 7 64-bit Professional* Service Pack 1

HP recommends Windows.

Windows 7 64-bit Professional* uses physical memory for dynamic buffer cache when available. The buffer cache prevents disk I/O transactions. Memory is much faster than disk I/O. Additional memory for the OS is necessary.

Read the ANSYS Mechanical APDL Parallel Processing Guide—

- Chapter 2: Using Shared Memory ANSYS
- Chapter 3: GPU Accelerator Capability
- Chapter 4: Using Distributed ANSYS

There is a Device state management tool that can be used to manage NVIDIA Tesla settings: %SystemDrive%\Program Files\NVIDIA Corporation\NVSMI\nvidia-smi.exe

On machines containing multiple GPU accelerator devices, the ANSYS program will pick the first available GPU accelerator device that is supported.

Conditions that will cause GPU not to be used:

- Partial pivoting is activated when using the sparse solver
- Memory saving option is activated (MSAVE,ON) when using the PCG solver
- A non-supported equation solver is used
- On Windows OS, the use of Remote Desktop may disable the use of a GPU device when in driver model is WDDM mode.

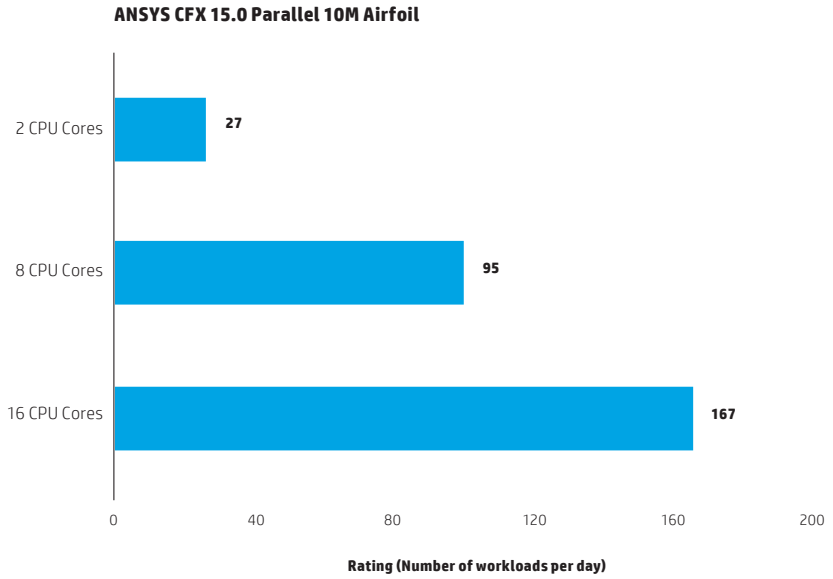
Operating System Setting	Default	Recommend
Windows 7 Professional 64-bit*		Service Pack 1
Control Panel/Power Options	Balanced	High Performance

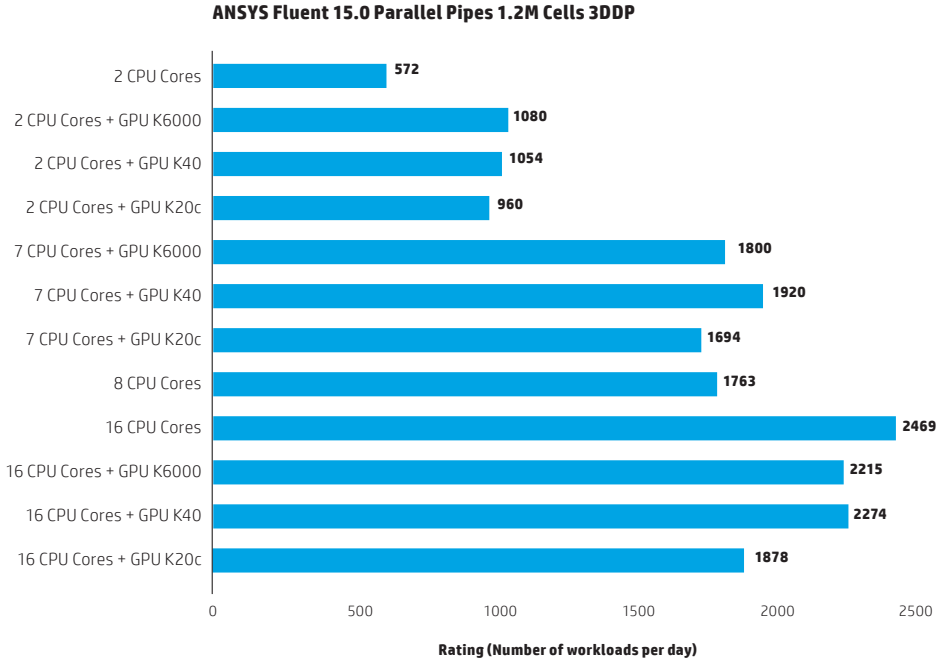
OS Setting	Default	Recommend
Power/OS Power Management/Runtime Power lanagement	Enable	Enable
Power/OS Power Management/Idle Power Savings	Extended	Normal
Power/OS Power Management/Turbo Mode[7]	Enable	Enable
Advanced/Device Options/Hyper-Threading[8]	Enable	Disable
Advanced/Bus Options/NUMA (HP Z620 and HP Z820 Dual processor)	Enable	Disable

NVIDIA Tesla GPU Accelerator Setting	Default	Recommend
ECC Mode	Enable	Enable
Driver Model	TCC Mode	TCC Mode
Driver Version		276.28 and up

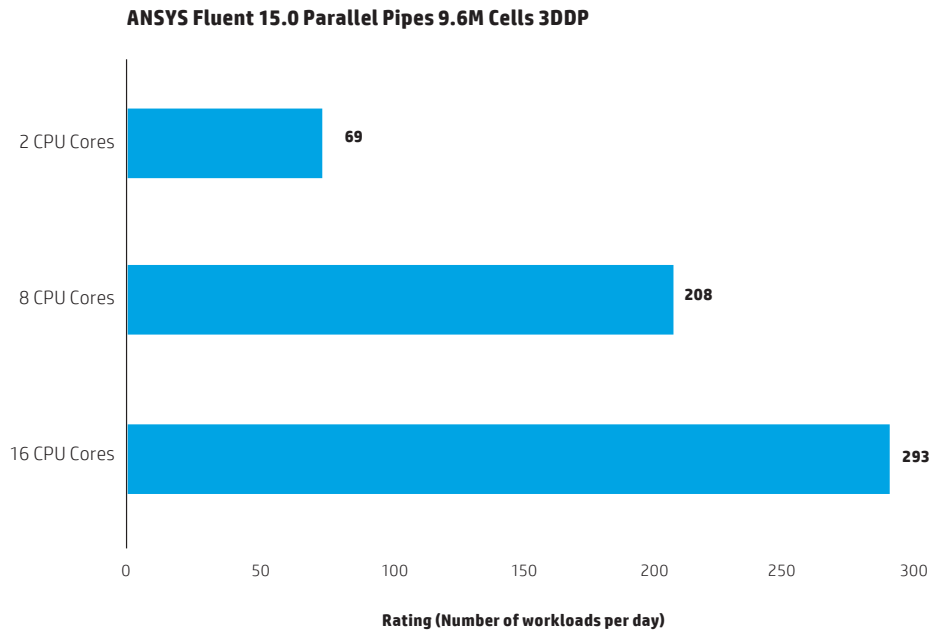
HP recommends Windows.

What ANSYS Fluent and CFX 15.0 performance did HP measure on the HP Z820 workstation?





HP recommends Windows.



HP Workstations recommendations and tips for running ANSYS 14.5.7 Fluent or CFX

Fluent and CFX Analysis up to 64 GB, 8-core

- HP Z420 with Windows 7 Professional 64-bit,* Intel® Xeon® E5-1660 v2 6-core 3.7/4.0 tb,[2,3,4,5] 64 GB memory,[6] SSD,[9,10] NVIDIA Quadro K600

Fluent and CFX Analysis up to 96 GB, 16-core

- HP Z620 with Windows 7 Professional 64-bit,* 2x Intel® Xeon® E5-2667 v2 8-core 3.3/4.0tb,[2,3,4] 96 GB memory,[6] SSD,[9,10] NVIDIA Quadro K2000

Fluent and CFX Analysis up to 512 GB, 16-core

- HP Z820 with Windows 7 Professional 64-bit,* 2x Intel® Xeon® E5-2687w v2 8-core 3.4/4.0tb,[2,3,4] 128 GB memory,[6] SSD,[9,10] NVIDIA Quadro K2000

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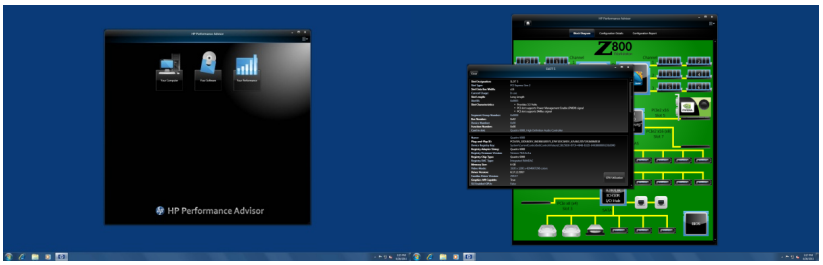
Tips for running ANSYS 14.5.7 Fluent or CFX

HP Performance Advisor can be used to install graphics drivers, select BIOS settings and help characterize ANSYS memory usage. Download from hp.com/go/hpperformanceadvisor



Operating System Setting	Default	Recommend
Windows 7 Professional 64-bit*		Service Pack 1
Control Panel/Power Options	Balanced	High Performance

System Bios Setting	Default	Recommend
Power/OS Power Management/ Runtime Power Management	Enable	Enable
Power/OS Power Management/Idle Power Savings	Extended	Normal
Power/OS Power Management/Turbo Mode[7]	Enable	Enable
Advanced/Device Options/Hyper-Threading[8]	Enable	Disable
Advanced/Bus Options/NUMA (HP Z620 and HP Z820 Dual processor)	Enable	Enable

HP recommends Windows.

Notes

* Not all features are available in all editions of Windows 7. Systems may require upgraded and/or separately purchased hardware to take full advantage of Windows 7 functionality. See microsoft.com/windows/windows-7/ for details.

1 NVIDIA Tesla K20 and C2075 on the HP Z820 requires the 1125W power supply.

2 Multi-Core is designed to improve performance of certain software products. Not all customers or software applications will necessarily benefit from use of this technology. 64-bit computing on Intel® architecture requires a computer system with a processor, chipset, BIOS, operating system, device drivers, and applications enabled for Intel® 64 architecture. Processors will not operate (including 32-bit operation) without an Intel® 64 architecture-enabled BIOS. Performance will vary depending on your hardware and software configurations.

3 64-bit computing on Intel architecture requires a computer system with a processor, chipset, BIOS, operating system, device drivers, and applications enabled for Intel® 64 architecture. Processors will not operate (including 32-bit operation) without an Intel 64 architecture-enabled BIOS. Performance will vary depending on your hardware and software configurations. See intel.com/info/em64t for more information.

4 Intel's numbering is not a measurement of higher performance.

5 Although the Intel® Xeon® E5-2600 processor family supports dual processors, the HP Z420 Workstation does not support dual processor configurations.

6 Each processor supports up to 2 channels (HP Z230 CMT/HP Z230 SFF) or 4 channels (HP Z420/HP Z620/HP Z820) of DDR3 memory. To realize full performance at least 1 DIMM must be inserted into each channel. To get full 8 channel support, 2 processors MUST be installed.

7 Intel® Turbo Boost technology requires a PC with a processor with Intel Turbo Boost capability. Intel Turbo Boost performance varies depending on hardware, software and overall system configuration. See intel.com/technology/turboboost for more information.

8 Intel HT Technology (HT) is designed to improve performance of multi-threaded software products and requires a computer system with a processor supporting HT and an HT-enabled chipset, BIOS and operating system. Please contact your software provider to determine compatibility. Not all customers or software applications will benefit from the use of HT. See intel.com/info/hyperthreading for more information.

9 SATA hardware RAID is not supported on Linux systems. The Linux kernel, with built-in software RAID, provides excellent functionality and performance. It is a good alternative to hardware-based RAID. Please visit h20000.www2.hp.com/bc/docs/support/SupportManual/c00060684/c00060684.pdf for RAID capabilities with Linux. HP Z200 does not support RAID 10 because of drive bay limitation.

10 For hard drives, 1 GB = 1 billion bytes; TB = 1 trillion bytes. Actual formatted capacity is less. Up to 20 GB of hard drive (or system disk) is reserved for system recovery software for Windows 7.

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4AA4-1772ENW, June 2014