



CCleaner & Defraggler Performance Report

(September 2017)

Windows 7 & Windows 10
Performance Benchmark

Document: CCleaner & Defraggler Performance Report
Authors: M. Baquiran, D. Wren
Company: PassMark Software
Date: 27 September 2017
File: Piriform_CCleaner_Performance_Ed2.docx
Edition 2

Table of Contents

TABLE OF CONTENTS	2
SUMMARY	3
PRODUCTS AND VERSIONS	4
TEST RESULTS	5
BENCHMARK 1 – DISK SPACE RECOVERED FROM INITIAL CLEANUP	5
BENCHMARK 2 – DISK SPACE RECOVERED PER WEEK	5
BENCHMARK 4 – CHANGE IN FREE RAM	6
BENCHMARK 4 – MACHINE BOOT TIME	8
BENCHMARK 5 – BROWSER LOAD TIME	9
BENCHMARK 6 – MANUAL CLEANUP TIME VS. CCLEANER CLEANUP TIME	9
BENCHMARK 7 – INSTALLATION SIZE	10
BENCHMARK 8 – INSTALLATION TIME	10
BENCHMARK 9 – MEMORY USAGE DURING IDLE	11
BENCHMARK 10 – CPU USAGE DURING IDLE	11
BENCHMARK 11 – NUMBER OF ARTIFACTS & PASSWORDS CLEANED	12
CONCLUSIONS	14
DISK SPACE RECOVERED	14
RAM FREED UP	14
BOOT TIME	14
BROWSER LAUNCH TIMES	14
CLEAN UP TIME	14
INSTALLATION TIME	14
INSTALLATION SIZE	14
MEMORY USAGE	15
IDLE CPU LOAD	15
APPENDIX 1 - TEST ENVIRONMENT	16
APPENDIX 2 – METHODOLOGY DESCRIPTION	19
DISCLAIMER AND DISCLOSURE	22
CONTACT DETAILS	22

Summary

PassMark Software® conducted objective performance testing on two Piriform software products, CCleaner and Defraggler, on Windows 10 and Windows 7 between April & May 2017. This report presents details of our results and findings as well as the test methodologies that were used to obtain these results.

The aim of this benchmark was to measure and demonstrate the benefits provided by the application to a computer system's performance. This was achieved by comparing the results of performance metrics taken both before and after CCleaner and Defraggler were installed and run on different setups.

The four different setups were as follows:

- **Windows 7 Laptop – Standard Image**, in which a standard set of typical consumer applications have been installed and a typical amount of usage has occurred on the machine.
- **Windows 10 Desktop – Standard Image**, As above but with Win10.
- **Windows 7 Laptop – Extended Image**, in which a standard set of typical consumer applications were installed as well as a more extensive list of less common applications, that could be found on the PC of a heavy user. See [Appendix 1](#) for details.
- **Windows 10 Desktop – Extended Image**, As above but with Win10.

The following three rounds of testing were conducted on four different setups:

- **Baseline** - A baseline round in which CCleaner nor Defragger has been installed or run.
- **CCleaner** - A round in which CCleaner has been installed and a clean run.
- **CCleaner & Defraggler** - A round in which CCleaner and subsequently Defraggler have been installed and a clean and defrag was run (i.e. Defraggler is installed and run on top of the previous CCleaner round).

The following fourteen (11) performance metrics were carried out for each round of testing:

- Disk space recovered from initial cleanup;
- Disk space recovered per week;
- Change in free RAM;
- Machine boot time;
- Browser load time;
- Manual cleanup time vs. CCleaner cleanup time;
- Installation size;
- Installation time;
- Memory usage during idle;
- CPU usage during idle; and
- Number of artifacts & passwords cleaned.

All of PassMark Software's test methods can be replicated by third parties using the same environment to obtain similar benchmark results. Detailed descriptions of the test environment and methodologies used in our tests are available in the sections [Appendix 1 – Test Environment](#) and [Appendix 2 – Methodology Description](#) in this report.

Products and Versions

For each product, we have tested the most current and publicly available version. The names and versions of products are given below:

Manufacturer	Product Name	Product Version	Date Tested
Piriform Software Limited	CCleaner	5.28.6005 (64-bit)	April 2017
Piriform Software Limited	Defraggler	2.21.993	April 2017

Test Results

In the following charts, we have highlighted the results we obtained for CCleaner in red and the results obtained for CCleaner and Defraggler installed together in blue.

Benchmark 1 – Disk space recovered from initial cleanup

The following chart shows the disk space in megabytes (MB) that was made available after running an initial cleanup on the system using CCleaner.

	Disk Space Recovered from cleanup (MB)
Win7 Laptop - Standard Image - CCleaner	1808.29
Win10 Desktop - Standard Image - CCleaner	4147.19
Win7 Laptop - Extended Image - CCleaner	3311.72
Win10 Desktop - Extended Image - CCleaner	4226.18

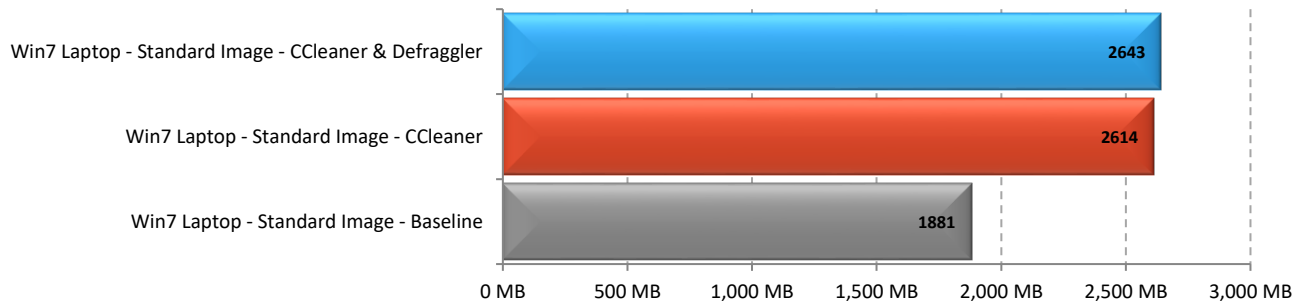
Benchmark 2 – Disk space recovered per week

The following chart shows the disk space in megabytes (MB) that was made available after a week's worth of activity has been carried out and then a subsequent cleanup using CCleaner was run.

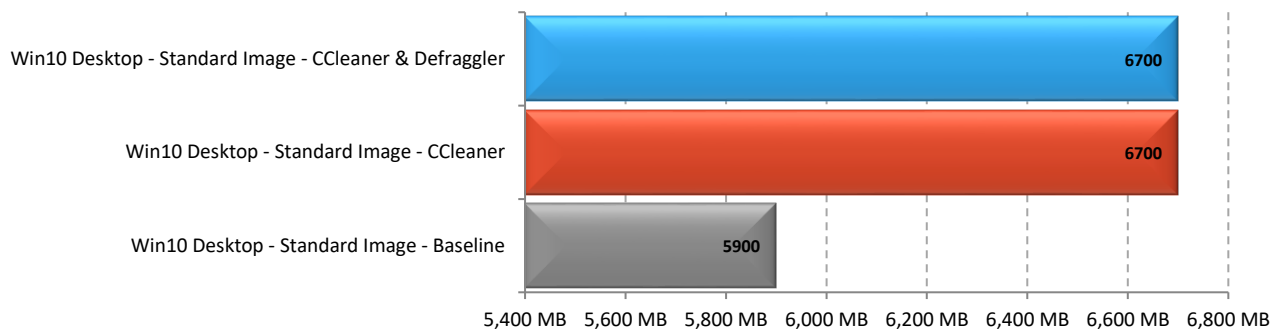
	Disk Space Recovered per week (MB)
Win7 Laptop - Standard Image - CCleaner	659.45
Win10 Desktop - Standard Image - CCleaner	305.38
Win7 Laptop - Extended Image - CCleaner	890.51
Win10 Desktop - Extended Image - CCleaner	540.54

Benchmark 4 – Change in free RAM

The following chart compares the free RAM as given in Windows Task Manager before and after each product was installed and run. The more free RAM available to the system, the better the performance. The change in free RAM for each round is noted below each chart.

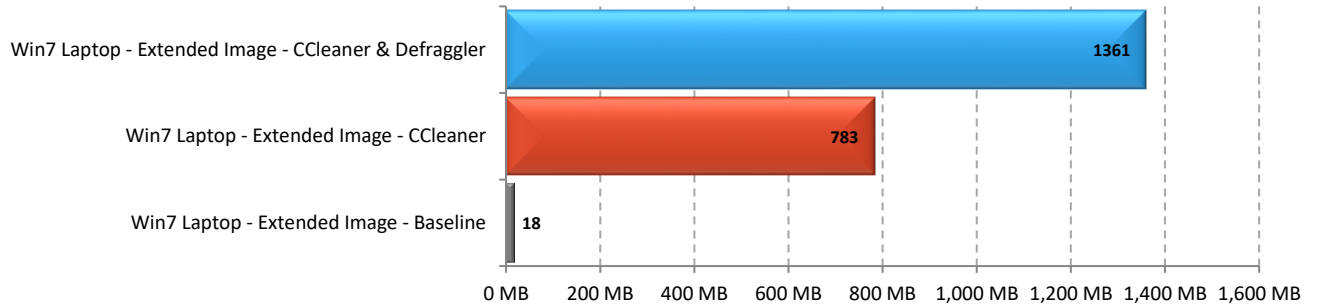


Change in free RAM from running CCleaner = 733 MB
Change in free RAM from running CCleaner & Defraggler = 762 MB

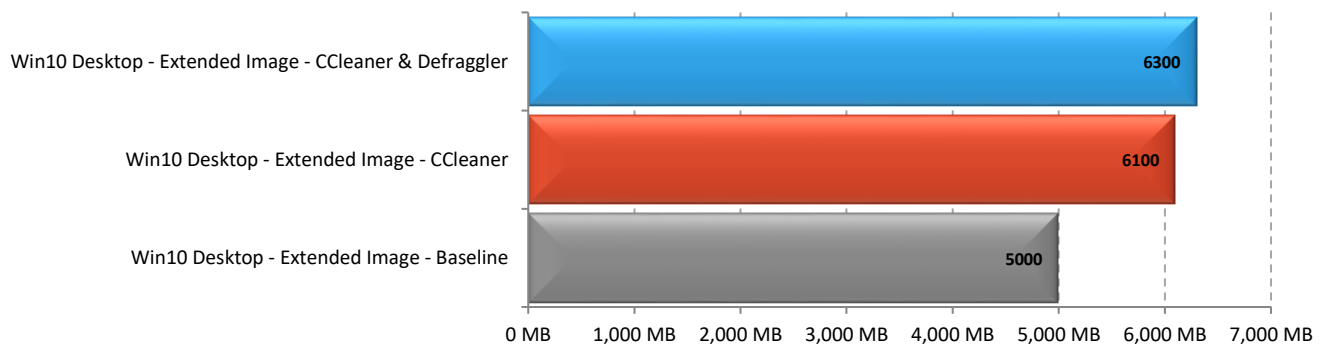


Change in free RAM from running CCleaner = 700 MB
Change in free RAM from running CCleaner & Defraggler = 700 MB¹

¹ Values rounded to the nearest 100 MB as Windows 10 only reports approximate numbers in GB.



Change in free RAM from running CCleaner = 1343 MB
Change in free RAM from running CCleaner & Defraggler = 1343 MB

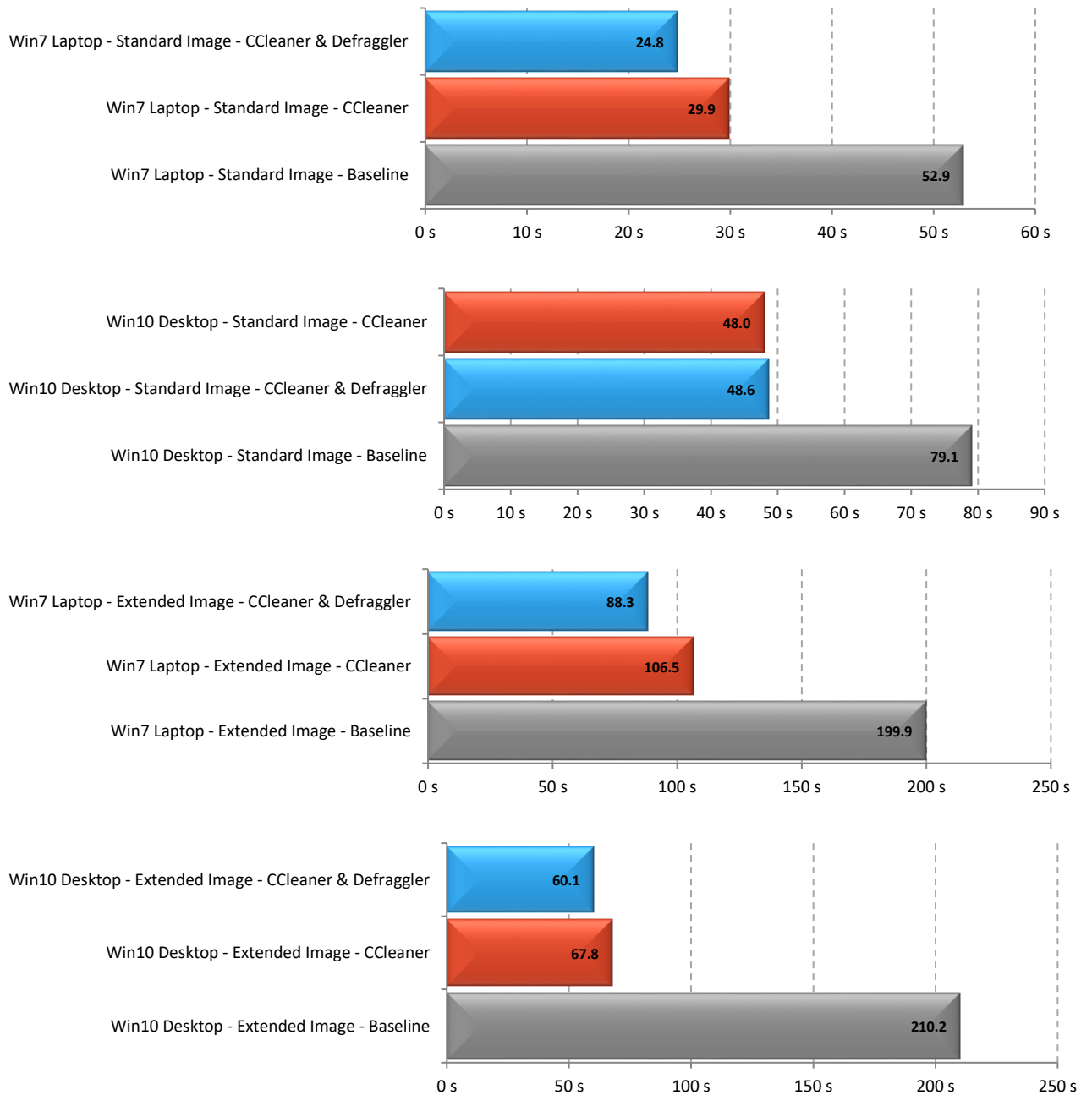


Change in free RAM from running CCleaner = 1100 MB
Change in free RAM from running CCleaner & Defraggler = 1300 MB²

² Values rounded to the nearest 100 MB as Windows 10 only reports approximate numbers in GB.

Benchmark 4 – Machine boot time

This metric measures the amount of time taken for the machine to boot into the operating system. When software is set to launch at Windows startup, it can significantly delay the startup of the operating system. Shorter times indicate that the installation and use of the applications have had a positive effect on the boot performance of the system.



Benchmark 5 – Browser load time

The following chart compares the average launch times of the default browser (Microsoft Edge on Windows 10 and Internet Explorer on Windows 7) after rebooting the machine.

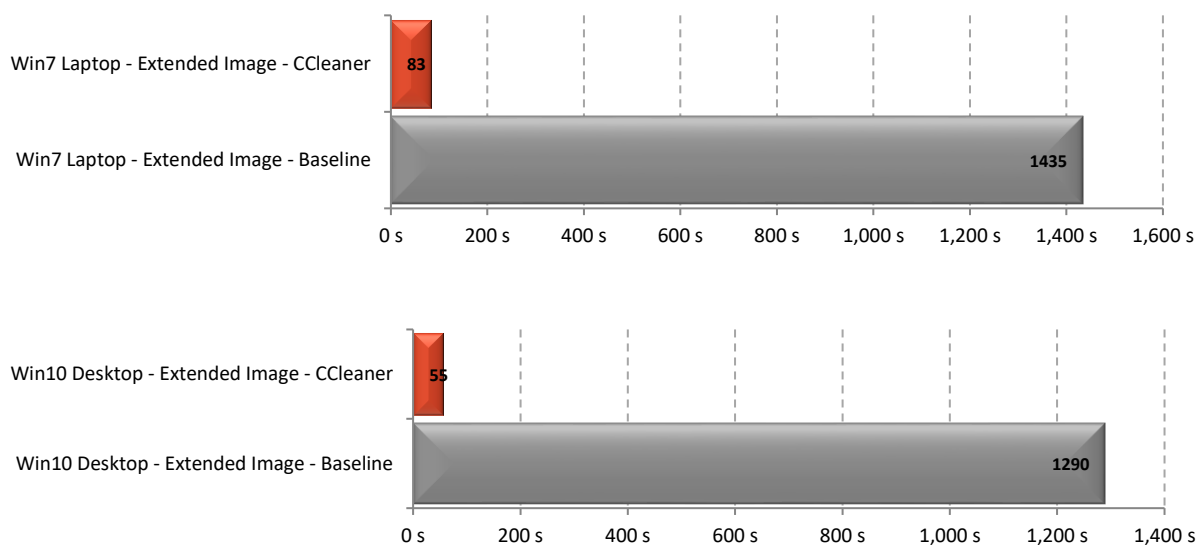
Round	Browser Launch Average (ms)
Win7 Laptop - Standard Image Baseline	2505
Win7 Laptop - Standard Image - CCleaner	1924
Win7 Laptop - Standard Image - CCleaner & Defraggler	1569
Win10 Desktop - Standard Image Baseline	538
Win10 Desktop - Standard Image - CCleaner	539
Win10 Desktop - Standard Image - CCleaner & Defraggler	529
Win7 Laptop - Extended Image Baseline	7283
Win7 Laptop - Extended Image - CCleaner	8721
Win7 Laptop - Extended Image - CCleaner & Defraggler	7442
Win10 Desktop - Extended Image Baseline	2831
Win10 Desktop - Extended Image - CCleaner	2808
Win10 Desktop - Extended Image - CCleaner & Defraggler	2911

Note on browser load time

As CCleaner is a browser cleaning tool it can have a slightly negative effect on load time the first time a user opens a browser after cleaning, due to the refreshing of cached items.

Benchmark 6 – Manual cleanup time vs. CCleaner cleanup time

The following chart compares the time it takes to run a cleanup using CCleaner against the time it takes to run an equivalent cleanup manually in Windows. Note that this was conducted on the extended image only.



Benchmark 7 – Installation size

The following table compares the total size of files added during the installation of each products. Note: The installation size shown for Defraggler is for Defraggler only and not for Defraggler & CCleaner cumulatively.

Round	Installation Size (MB)
Win7 Laptop - Standard Image - CCleaner	21.8
Win7 Laptop - Standard Image - Defraggler	24.1
Win10 Desktop - Standard Image - CCleaner	27.8
Win10 Desktop - Standard Image - Defraggler	30.8
Win7 Laptop - Extended Image - CCleaner	35.2
Win7 Laptop - Extended Image - Defraggler	25.5
Win10 Desktop - Extended Image - CCleaner	33.3
Win10 Desktop - Extended Image - Defraggler	57.9

Benchmark 8 – Installation time

The following chart compares the minimum time it takes for the product to be fully functional and ready for use by the end user. Note: The installation time shown for Defraggler is for Defraggler only and not for Defraggler & CCleaner cumulatively.

	Installation Time (sec)
Win7 Laptop - Standard Image - CCleaner	9
Win7 Laptop - Standard Image - Defraggler	5
Win10 Desktop - Standard Image - CCleaner	10
Win10 Desktop - Standard Image - Defraggler	6
Win7 Laptop - Extended Image - CCleaner	17
Win7 Laptop - Extended Image - Defraggler	16
Win10 Desktop - Extended Image - CCleaner	9
Win10 Desktop - Extended Image - Defraggler	9

Benchmark 9 – Memory usage during idle

The following chart gives the average amount of RAM used by CCleaner during a period of system idle. This average is taken from a sample of fifteen memory snapshots taken at roughly 60 seconds apart after reboot.

Note: As CCleaner has a process that runs in the background even when the app windows is closed and Defraggler doesn't, there was no memory usage to measure for Defraggler in its idle state.

	Average Memory Usage during System Idle (MB)
Win7 Laptop - Standard Image - CCleaner	19.1
Win10 Desktop - Standard Image - CCleaner	14.7
Win7 Laptop - Extended Image - CCleaner	17.0
Win10 Desktop - Extended Image - CCleaner	12.2

Benchmark 10 – CPU usage during idle

The following chart compares the average CPU usage during system idle.

Round	CPU Usage During Idle (%)
Win7 Laptop - Standard Image Baseline	0.5%
Win7 Laptop - Standard Image - CCleaner	1.3%
Win7 Laptop - Standard Image - CCleaner & Defraggler	1.2%
Win10 Desktop - Standard Image Baseline	0.6%
Win10 Desktop - Standard Image - CCleaner	1.7%
Win10 Desktop - Standard Image - CCleaner & Defraggler	1.8%
Win7 Laptop - Extended Image Baseline	3.6%
Win7 Laptop - Extended Image - CCleaner	0.9%
Win7 Laptop - Extended Image - CCleaner & Defraggler	1.3%
Win10 Desktop - Extended Image Baseline	8.1%
Win10 Desktop - Extended Image - CCleaner	7.6%
Win10 Desktop - Extended Image - CCleaner & Defraggler	4.2%

Benchmark 11 – Number of artifacts & passwords cleaned

OSForensics is a tool designed to enable governments and security agencies to digitally extract forensic evidence from computers quickly, with high performance file searches and indexing. This test compared the number artifacts and passwords extracted by OSForensics before and after CCleaner was run.

Notes on items cleaned

It is not the intention of CCleaner to remove all artifacts as doing so would have a negative effect on the performance of the machines and / or the user experience. CCleaner states that “CCleaner cleans to a safe maximum. System, program and user setting files required for correct operation are not deleted”.

Examples of data fully deleted:

- Browser cookies
- Browsing history
- Cached passwords
- Crash dumps
- Temp files

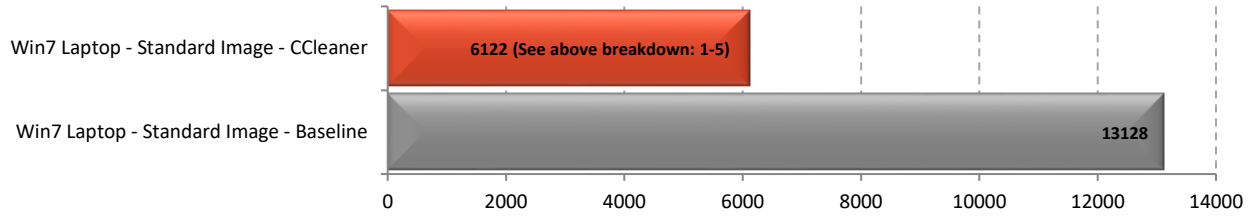
Example of items partially deleted:

- Pre-fetch data
- Jump lists

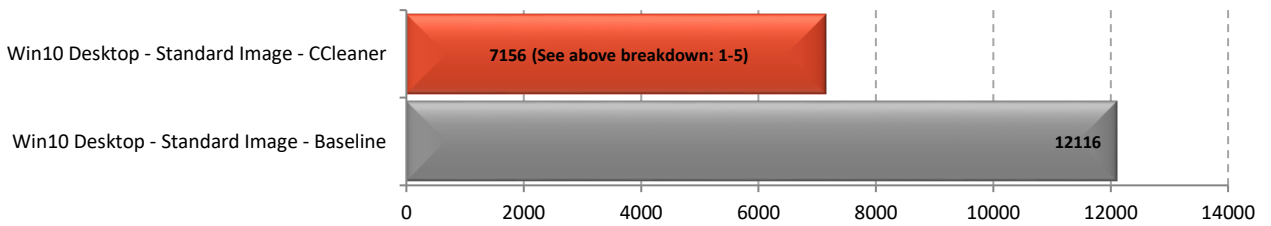
Items that are not deleted, or cannot be completely deleted (35% of all items), fall into the following five categories and typical percentages:

1. **System related (34.8%)** – removal of these items would cause potential impact to system stability and performance, or removal is impossible as items are integral to the system.
2. **Startup items (0.2%)** – the user can choose to remove these items using CCleaner via the Startup management section of the application.
3. **User behavior whilst cleaning (0.2%)** – CCleaner cannot clean items which are open during cleaning, for example OSForensics, which was required to be open for the purposes of the test.
4. **Personal preference (0.1%)** – these items are considered to be the user’s personal preference or data that users would potentially like to retain e.g. browser bookmarks or Skype chat logs.
5. **Auto-generated (0.1%)** – these are items that CCleaner clears but are regenerated by the system immediately.

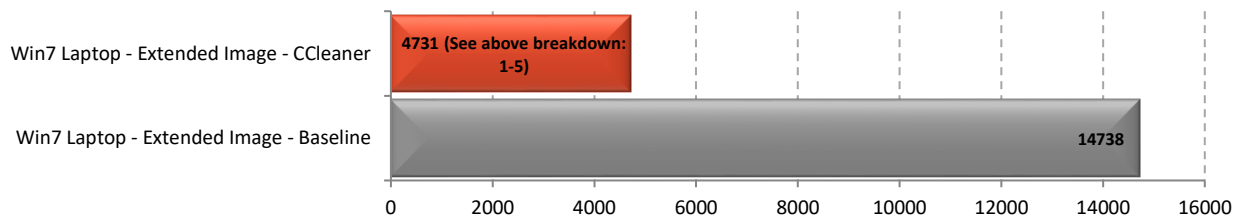
The following charts compare the number artifacts and passwords extracted by OSForensics before and after CCleaner was run. The final result is the difference between these two values, noted below each chart.



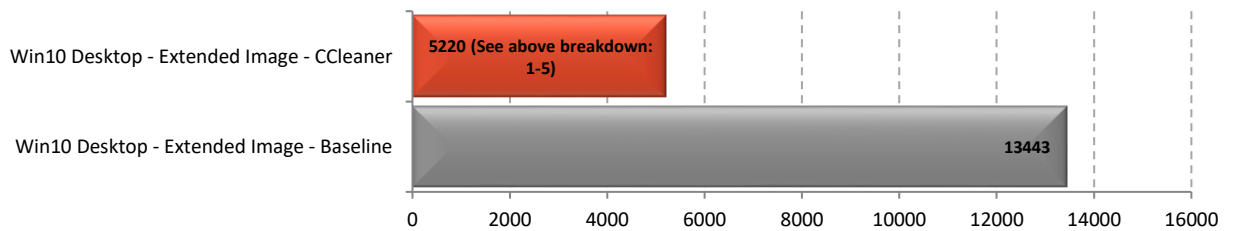
Number of items cleaned by CCleaner = 7006



Number of items cleaned by CCleaner = 4960



Number of items cleaned by CCleaner = 10007



Number of items cleaned by CCleaner = 8223

Conclusions

All of the following conclusions apply only to the specific scenarios tested.

Clean machines, with no third-party software installed, will likely show significantly less benefit than what was observed in the tested scenarios. While machines with a very large amount of 3rd party software or limited hardware resources will likely gain additional benefits, beyond what we observed.

Disk space recovered

On average, CCleaner can recover around 3,400 MB of disk space on the first clean, and then around 600 MB in the week following. If run weekly for a year, this would give an estimated total recovered disk space of 34,500 MB.

RAM Freed up

Across all four images, the average percentage of free RAM available (out of the machine's total RAM) increased from 41% to 56% after using CCleaner and Defraggler. This gives a 14% improvement, which is a 36% relative improvement.

Boot time

Across all four images, the aggregate boot time was seen to be 53% faster using CCleaner and after subsequently running Defraggler, 59% faster.

Browser launch times

Across all four images, the aggregate browser launch time was seen to be 5% faster after running CCleaner and Defraggler. However, the results are sensitive to initial conditions. Likely external influences such as variable internet latency, initial file fragmentation state & caching state also influenced the results to increase the error margin in the test results.

Clean up time

Many of the cleaning activities that CCleaner performs can be done manually if the user has sufficient knowledge and time. A comparison of a manual clean up, by an experienced engineer, to the automated process in CCleaner, showed using CCleaner is 20 times faster than performing the same clean manually.

Installation time

On average, CCleaner takes 11 seconds to install.

On average, Defraggler takes 8.75 seconds to install.

Installation size

On average, CCleaner's installation size is 29.55MB

On average, Defraggler's installation size is 34.57MB.

Memory usage

When installed, CCleaner has an almost negligible impact on idle memory usage, at less than 16MB (which is approximately 0.2% of the installed RAM on the machines tested).

Idle CPU load

When installed, both CCleaner and Defraggler have an almost negligible impact on CPU usage, when idle. The additional CPU load was too low to be accurately measured.

Appendix 1 - Test Environment

Performance testing was carried out on the following machines:

Test Machine 1: Low-End Laptop

Model:	DELL Inspiron N5010
CPU:	Intel Core i5 M 450 @ 2.40 GHz
Video Card:	ATI Mobility Radeon HD 5000 Series
RAM:	6GB DDR3 RAM
HDD (Main Boot Drive):	500 GB 5400 RPM
O/S:	Windows 7 Home Premium

Test Machine 2: Mid-Range Desktop

Model:	Lenovo H50W-50 i5
CPU:	Intel Core i5-4460 CPU @ 3.20GHz 3.20 GHz
Video Card:	NVIDIA GeForce GT 705
RAM:	8GB DDR3 RAM
SSD (Main Boot Drive for Standard Image):	Samsung 850 PRO 512GB
HDD (Main Boot Drive for Extended Image):	Western Digital Green 2.0TB WD20WZRX
2nd Drive:	Samsung 1000GB 7200RPM HD103UJ
O/S:	Windows 10 Pro 64bit

State of Machines

In order to test the performance benefits of CCleaner & Defraggler, PassMark created two images for each test machine. The first image recorded the state of the operating system (i.e. the boot drive) after moderate usage and the second image recorded the state of the operating system after heavy usage. These images included the following:

1. Standard Image

- Windows OS (fully patched). Windows 7 32-bit on the low-end machine and Windows 10 64-bit on the high-end machine.
- This image will include standard applications that many people will have installed on their computer over time. These applications should not corrupt the software environment, but should contribute to some startup overhead and registry bloat.
- Applications
 - Note: Some of the following applications may not be applicable to the system that is being installed (e.g. drivers which apply to certain manufacturers). In this case, the application will not be omitted.
 - Adobe Flash Player
 - Adobe Reader
 - Apple Safari
 - Apple QuickTime
 - Apple iTunes
 - Apple Software Update
 - Apple Mobile Device Support
 - Bonjour
 - Dropbox

- Google Chrome
- Google Earth <https://www.google.com/earth/>
- Google Picasa
- Google Toolbar
- Microsoft Internet Explorer
- Microsoft Silverlight
- Microsoft Visual Studio 2010 Tools or Office Runtime
- Microsoft Windows Live Messenger
- Microsoft Office 2016
- Microsoft Office File Validation Add-In
- Microsoft One Drive
- Mozilla Firefox
- Mozilla Maintenance Service
- Real Player
- Realtek High Definition Audio Driver
- Realtek Ethernet Controller Driver
- Realtek Card Reader
- Sun Java Runtime Environment
- Synaptics Pointing Device Driver
- Steam
- VLC media player
- Full video card driver packages matching the video card hardware installed in the machine.
- Usage
 - 300+ Internet Sites visited
 - A selection of applications will be uninstalled randomly and reinstalled randomly (should help create fragmentation & registry issues)
 - A large number of songs will be loaded into iTunes.

2. Extended Image

- This image is created from the Standard image and includes some more commonly installed applications as well as some less common ones.
- Applications:
 - Adobe AIR
 - Adobe Photoshop CC (trial)
 - Adobe Illustrator (trial)
 - Ask.com Toolbar
 - The Elder Scrolls V: Skyrim
 - Assassin's Creed IV: Black Flag
 - Avast Free Antivirus
 - Microsoft One Drive
 - Skype
 - uTorrent
 - Yahoo Messenger
 - Yahoo Widgets
 - VMWare Workstation
 - Teamviewer
 - Google hangouts
 - Google Drive
 - Driver booster
 - Malwarebytes
 - WhatsApp for PC
 - Spotify

- Evernote Clipper
 - YTD video downloader
- This image also contains applications that have been selected because they specifically add unwanted startup entries to the registry.
 - Weatherbug
 - Big Fish Game Manager
 - Flip Words

Appendix 2 – Methodology Description

Benchmark 1 – Disk space recovered

Similar to Benchmark 2, OSForensics was used to create signatures of the C: drive before and after a cleanup has been conducted using each product. The before and after was compared and the difference was calculated to get the total disk space recovered.

Benchmark 2 – Disk space recovered per week

After the initial cleanup using CCleaner was performed, a week's worth of activity was performed and then the cleanup performed again. A snapshot of the C:\ drive was taken before and after the subsequent cleanup is performed, similar to the method for [Benchmark 3](#).

A week's of activity was emulated by carrying out activities such as:

- Browsing a set of web pages
- Downloading and applying a Microsoft hotfix (applies to Win7 only since individual hotfixes cannot be applied in Win10)
- Installing and/or Uninstalling a set of applications

Benchmark 3 – Change in free RAM

For this benchmark, the test machine was rebooted and after a five-minute idle period, a Windows screenshot was taken of Windows Task Manager's performance tab. On Windows 10 this was the Available Physical Memory. On Windows 7 this was the Free Physical Memory.

Benchmark 4 – Machine boot time

Note: Before running either of the below boot tests with CCleaner installed, all startup applications will be manually disabled via the CCleaner Startup tab.

Windows 10

PassMark Software uses tools available from the *Windows Performance Toolkit* (as part of the Microsoft Windows 10 ADK obtainable from the [Microsoft Website](#)).

The Boot Performance (fast startup) test is ran as an individual assessment via the Windows Assessment Console. The network connection is disabled and the login password is removed to avoid interruption to the test. The final result is taken as the total boot duration excluding BIOS load time.

Windows 7

PassMark Software uses tools available from the Windows Performance Toolkit version 4.6 (as part of the Microsoft Windows 7 SDK obtainable from the Microsoft Website) with a view to obtaining more precise and consistent boot time results on the Windows 7 platform.

The boot process is first optimized with xbootmgr.exe using the command “xbootmgr.exe - trace boot –prepSystem” which prepares the system for the test over six optimization boots. The boot traces obtained from the optimization process are discarded.

After boot optimization, the benchmark is conducted using the command "xbootmgr.exe -trace boot -numruns 5". This command boots the system five times in succession, taking detailed boot traces for each boot cycle.

Finally, a post-processing tool was used to parse the boot traces and obtain the BootTimeViaPostBoot value. This value reflects the amount of time it takes the system to complete all (and only) boot time processes. The final result is an average of five boot traces.

Benchmark 5 – Browser load time

The average launch time of the default browser (Microsoft Edge on Windows 10 and Internet Explorer on Windows 7) interface was taken using *AppTimer*. For each round, a total of fifteen samples from five sets of three browser launches were taken, with a reboot before each set to clear caching effects by the operating system. When compiling the results, the first of each set was separated out so that there was a set of values for the initial launch after reboot and a set for subsequent launches. The final result for this test is an average of the subsequent launch average and the initial launch time. *AppTimer* is publicly available from the [PassMark Website](#).

Benchmark 6 – Manual cleanup time vs. CCleaner cleanup time

This test compared the time to complete the following two cleanup methods:

1. A manual cleanup in which cleanup tasks were run manually by removing them via Windows explorer. The process included tasks equivalent to that of a clean run by CCleaner. This will be timed manually and will include:
 - Clearing browser/s cookies, history, temporary files, form data, passwords, and autocomplete data.
 - Clearing recent file lists from Microsoft Office applications.
 - Clearing recent file lists from Adobe applications.
 - Clearing Windows recent items.
 - Clearing recent items from the Windows start menu.
 - Clearing Windows temporary files, crash dumps, and Windows log files.
2. Running a cleanup with CCleaner using the default settings. The time is obtained from an accurate reading given by the program itself or when this is not available, manually with a stopwatch. **Note:** After running the CCleaner cleanup, all startup applications are manually disabled via the CCleaner Startup tab.

Benchmark 7 – Installation size

Using PassMark’s *OSForensics* we created initial and post-installation disk signatures for each product. These disk signatures recorded the amount of files and directories, and complete details of all files on that drive (including file name, file size, checksum, etc.) at the time the signature was taken.

The initial disk signature was taken immediately prior to installation of the product. A subsequent disk signature was taken immediately following a manual update and system reboot after product installation. Using **OSForensics**, we compared the two signatures and calculated the total disk space consumed by files that were new, modified, and deleted during product installation. Our result for this metric reflects the total size of all newly added files during installation.

Benchmark 8 – Installation time

This test measures the minimum installation time a product requires to be fully functional and ready for use by the end user. This was timed manually using a stopwatch. Note that to reduce variability, user response and reaction times, for e.g. time to read the text displayed or enter in a license key were not included in this time.

Benchmark 9 – Memory usage during idle

The command-line utility *memlog* was used to record snapshots of process memory usage during a period of system idle. Snapshots were taken every minute, beginning after a 5-minute idle period following a boot. This will be done only once per round for a total of 15 samples. The sum of the average memory usages for each process was calculated to give the final result.

Note: CCleaner has a process that runs in the background even when the app windows is closed, whereas Defraggler does not. Thus there was no memory usage to measure for Defraggler in the idle state.

Benchmark 10 – CPU usage during idle

A tool called CPUAvg was used to measure the average CPU usage during a period of system idle. CPUAvg was run for a total of 5 minutes (beginning after a 5-minute idle period immediately after a boot). CPUAvg takes periodic measurements of CPU usage and automatically calculates the average recorded CPU usage upon completion. This average is used as the result.

Benchmark 11 – Number of artifacts & passwords cleaned

PassMark software used the OSForensics Recent Activity and Password Recovery features to measure the number of artifacts and passwords that have been cleaned up by each product. Before each product's cleaning function is run, sample artifacts and passwords were placed on the test machine. OSForensics was then run to extract artifacts and passwords from the machine both before and after the CCleaner's cleaning function was executed. The difference in the number of artifacts and passwords extracted before and after gives the final result.

Disclaimer and Disclosure

This report only covers versions of products that were available at the time of testing. The tested versions are as noted in the "Products and Versions" section of this report.

Disclaimer of Liability

While every effort has been made to ensure that the information presented in this report is accurate, PassMark Software Pty Ltd assumes no responsibility for errors, omissions, or out-of-date information and shall not be liable in any manner whatsoever for direct, indirect, incidental, consequential, or punitive damages resulting from the availability of, use of, access of, or inability to use this information.

Disclosure

Piriform Software Limited funded the production of this report. The list of products tested and the metrics included in the report were selected by Piriform.

Trademarks

All trademarks are the property of their respective owners.

Contact Details

PassMark Software Pty Ltd

Level 5

63 Foveaux St.

Surry Hills, 2010

Sydney, Australia

Phone + 61 (2) 9690 0444

Fax + 61 (2) 9690 0445

Web www.passmark.com