**Heads Cleaning & Wiper calibration**

**Embedded Software Design Review**



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# Introduction

## Background

To maintain the orifice plate from being dirty during printing and prevent the heads block from missing nozzles.

The user needs to run the “Head clean & wiper” wizard during long printing. (Up to 99 hours)

This document defines SW changes requires to remind the user cleaning the heads/Wiper during long printing.

The document was based on “SRS – Printing stop for head cleaning “.

It describes the changes need to make on EM side.

## Design Goals

* + 1. To increase the reliability, and enable long quality printing on Objet1000.
    2. To remind user to make manual cleaning, after every “X” printing hours when using materials that requires often cleaning. (As “ABS” material).
    3. To make sure the code is partible and configurable.   
       - It will be easy to add this mechanism for new printers in the future.   
       - It will be easy to add more materials that require often cleaning.  
       - It will be easy to change the timer reminder windows.
    4. Reuse:

- Exist “PrePrint” mechanism. If necessary, it forces the user to run “HC&WC” wizard before   
 printing.  
 - Relevant pages/functions from head cleaning wizard, and wiper calibration.

**Objet Family.**

Combine the heads cleaning wizard and wiper wizard to one union wizard.  
- Remove the irrelevant pages from the wizard.  
- Remove the irrelevant sections from menu.  
- Add new section into the menu (“Heads clean and wiper wizard”)

**ObjetFamiliy.**

Add a new Boolean parameter into parameter manager: “Recommend\_HC\_WC\_DuringPrint".  
Objet1000 the flag will initialize to “true”.

Other machines, this flag will initialize to “false”.

**GUI.**

EM needs to popup the relevant windows messages to the user (warnings)

**EM -OS Communication.**

EM will send “Stop” command, when the user starts “HC&WC”.

EM will send the alert message and time for clean (It will be described in section 2.5.6)

EM – Master.

OS – Slave.

## 1.3. Abbreviations and Acronyms

|  |  |
| --- | --- |
| **Abbreviation** | **Description** |
| GUI | Graphic User Interface. |
| UI | User Interface. |
| HC&WC | Heads cleaning and wiper calibration. |
| SW | Software |
| DR | Design Review |
| EM | Embedded application |
| OS | Objet Studio |
| ObjetFamiliy | Machines: Objet1000, Objet500, Objet350, Objet260 |
| Asynchronous window | Application keeps running and doesn’t wait to user interference (Click on a button). |
| Synchronous window | Application stops and wait to user interference (Click on a button) |

# Architecture and Implementation

## 2.1. Time sequence – Pre Printing, when using materials that requires often cleaning.



## 2.2. Time sequence – During Printing, when using materials that requires often cleaning.



## 2.3. Logging

Writing into the logs starts with “HC\_WC: ” and belongs to “LOG\_TAG\_PRINT” tag.

Following scenarios will be written into log file:

2.3.1. The completion and cancellation of the wizard shall be logged as follows:  
 2.3.1.1. “Head & wiper cleaning during printing was complete after %d Digital ABS hours” (with time  
 stamp), at wizard completion.

2.3.1.2. “Head & wiper cleaning during printing was cancelled after %d Digital ABS hours” with time   
 stamp),at wizard cancellation.

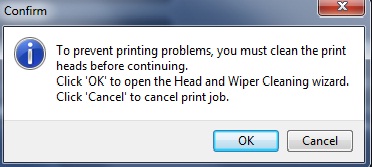
2.3.2. Every post of warning message shall be reported to the log file as well:

2.3.2.1. Initial message: “Head & wiper cleaning during printing needs to be performed within %d Digital ABS hours” (with time stamp).

* + - 1. Three time-based messages, every time popup reminder display to user.
      2. When user click on a button (User choice)

## 2.4. User Interface

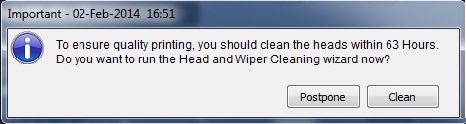
2.4.1. Before moving to preprint sequence when **“Time printing via ASB”>99 Hours.** (Pop up an   
 asynchronous window).



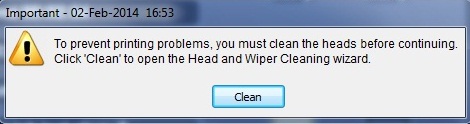
2.1.2. During preprint when: **“Time printing via ASB”<**33 hours (Pop up an asynchronous window).



2.1.3. During print or preprint when: 33 Hours<**“Time printing via ASB”<**99 Hours (Pop up an   
 asynchronous window).



2.1.4. During Printing when **“Time printing via ASB”>99 Hours** (Pop up an   
 asynchronous window).

****

**Before pop up the window, need to check if the window is exist and close the window**.

In every message, pop up time will be mention in the message.  
 Messages will be placed in the front center of the main Gui.

Every message has relevant title and date, relevant Icon, relevant string, relevant buttons.

2.4.2.   
 Adding new window for MRW edge cases as described in section 2.5.14.

2.4.3. Every time user press on of the buttons:  
 - The message will be close  
 - The signal tower will turn off ( If necessary).

- Sending message to Objet Studio to close the window

## 2.5. Embedded Application

**2.5.0.** Create dynamic message window. (For asynchronous windows)  
 Adding method that find handle to the window.  
 Implement method that changing window. (captions, buttons, Image)

**2.5.1.** **Adding new method CMachineSequencer::** **HC\_WC\_MessagesLogSignalTowerAlert ()**  
 **The function will check the following inputs:**   
 - HCW\_EnableAlertMsgs. If the material is “dirty” and “ObjetFamily” the flag is true.  
 - Recommend\_HC\_WC\_DuringPrint. The flag is “true” for machines that using this mechanism during printing.  
 - HCW\_timeBetweenAlertMessages -Time between Alert Messages when printing using “dirty” material  
 - Print/ Pre -print sequence.

**According to “Pre Printing”/”During Printing diagram and the above input:**  - Turn on the signal tower (If necessary).  
 - Write into the log (If necessary).  
 - Pop up window (If necessary).  
 - Sending message to studio (If necessary).  
 - Avoid printing (If necessary).

**2.5.2.** **Pre - Print sequence:**  
 Updating “CMachineManager::PrePrintPhase()” calls “**HC\_WC\_MessagesLogSignalTowerAlert(false)”**

**2.5.3. Printing sequence:**  
 Updating “CMachineSequencer::PrintingSequence()” calls “**HC\_WC\_MessagesLogSignalTowerAlert(true)"**  
**2.5.4.** **Adding to “HostMessages.h” “TtypeAlert” enum**

typedef enum   
 {  
 NO\_ACTION\_NEEDED, **//0**  
 REMINDER, **//1**  
 WARNING, **//2**  
 ALERT, **//3** CLOSE\_WINDOW **//4**  
 }**TtypeAlert;**

**2.5.5.** **Adding to “HostMessages.h” new struct.**

Adding to “HostMessages.h” - new struct

**typedef struct**{  
 BYTE bTypeAlert;  
 BYTE bRemainingHours;  
} **TAlertMsg;**

**2.5.6. Adding new operation code into “HostCommands.def”**

- During printing EM send to OS every 4 seconds sturct (“TPrinterStatusMsg”).  
 The struct includes information printer status. (“CHostComm::ReplyStatus(void)”)

**The following changes in this section exist only on “OBJET\_MACHINE”:**  
We will increase “TPrinterStatusMsg” struct by “**TAlertMsg struct” struct.(2 bytes).  
  
Every** “TPrinterStatusMsg” **message includes by default the following data:  
typedef struct**{  
 BYTE bTypeAlert = NO\_ACTION\_NEEDED  
 BYTE bRemainingHour =0;  
} **TAlertMsg;**When EM pop up the window was described in section 2.4.2.   
“TPrinterStatusMsg” send one time message with relevant “TAlertMsg” data, and keep sending the default message**.  
- The above change demand to change protocol version.** The current protocol version number is “6”.  
 The new protocol version number will be “8”, because the protocol studio – desktop is “7”.  
 **CHostComm::ReplyVersions(void)  
 { …  
 strcpy(PrinterVersionMsg.HostPrinterProtocol,"8"  
 ….  
 }**

**Need to include the “SlicePackHdrtag” changes from version 7.**

**2.5.7.** EM to **Studio message:**

A. During printing - When user decide to run “HC&WC”, EM send Stop command to Studio:

|  |  |  |
| --- | --- | --- |
| **Operation code** | **Value(HEX)** | **Description** |
| CMD\_STOP | 0x44 | Command –Stop ( and clear) printing |

Enable “Online” button, after pressing On Stop sequence done.

**2.5.8.** Adding array ”bool m\_HC\_WC\_Msg\_Was\_Display [3]” flags to “CMachineSequencer” class, to avoid  
 popup the same message during printing, when the user close the window:  
 When pop up the relevant window, application will update the relevant flag to ‘true’.   
 The EM will Initialize the array “m\_HC\_WC\_Msg\_Was\_Display[3]” to “false” during “pre-Print” sequence.

**2.5.9.** Adding the following fields to Machine Sequencer:  
 - m\_StopNeededForHCWC (also Get(), Set() functions)

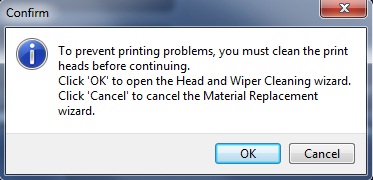
- m\_runHCW (also Get(), Set() functions)

**2.5.10.**   
 When finish running Head and wiper cleaning wizard successfully**,**   
 **The application will initialize the following parameters:**  
 - Reset counter “LAST\_HCW\_ACTIVATION\_TIME\_COUNTER\_ID”.   
 **The parameters won’t be initialized if the wizard was cancelled or failed.**

**2.5.11.** **Head cleaning & wiper cleaning wizard, according “Head & Wiper Cleaning During   
 Printing Wizard Flow Chart\_ver3.vsd” document.**  
 - Removing “Wiper cleaning” wizard from the menu.  
 - Rename the menu “Head Cleaning Wizard” to “Head & Wiper wizard”.  
 - After HC was run successfully initiliaze the following params:  
 a) “LAST\_HCW\_ACTIVATION\_TIME\_COUNTER\_ID”  
 b) “m\_HC\_WC\_Msg\_Was\_Display” array.  
 c) “m\_StopNeededForHCWC”  
 d) “m\_runHCW “

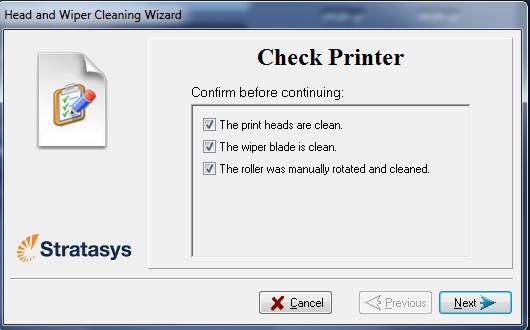
**2.5**.**12.** **Signal tower** –  
Signal tower mechanism use **periodic** checks, the mechanism activates/deactivates the signal tower as described “Signal Tower Advanced DR.docx” document.  
  
During the Preprint/Print operations, need to activate the signal tower as was described in diagrams 2.1 - 2.2.  
This check happens only one time **(Not periodic operation)** if necessary it activate the signal tower, and there is a chance the changes might be override by Signal tower periodic checks.  
 It demands adding new list for yellow color in the signal tower:  
 **bool ReasonToBlinkYellow [**WASTE\_IS\_FULL\_OR\_NO\_RESIGN, RECOMMAND\_HC\_WC**];** The constructor will initialize the indexes to “false’.Every time the application needs to **activate** the relevant color, the application will change the relevant index to “true”, and will activate the signal tower.  
 Every time the application needs to **deactivate** the relevant color, the application will change the relevant index to “false”, and check. The application will deactivate the relevant color only when all indexes in the array are “false”,  
 - It demands to change “Signal Tower Advanced DR.docx” document.  
 - Add array for each color.  
 - Changing exist code.  
 - Add new code for the HC&WC.

2.5.13. Adding new parameter “Recommend\_HC\_WC\_DuringPrint”, and “Tool Tip” as describe in section 2.6.1

**2.5.14.** **Handling MRW edge case:  
 Before opening the MRW, the application will check “if the counter is higher than 99 hours”?**  
 If ‘true’, the application popup a message window:   
 

If user pushes “Ok” button, It will open the “Head & Wiper cleaning” wizard.  
If user pushes “Cancel” button, It will open the “Head & Wiper cleaning” wizard.

**2.5.15** **Python changes:**   
 - Moving to new XCleaningPosition, YCleaningPosition.  
 - Remove the Popup message “Is there a model on the tray”, and moving the tray to “Pins position”.  
 - Changing “bmp” files, changing strings according to “technical writer” requests.  
 - Add new check boxes to cleaning page: "The wiper blade is clean.", "The roller was manually rotated and   
 cleaned."

  
 - Changing the Axis movements: Z, T, X, Y.  
 - Adding “Motors.WipeWasteTank()” – Go to T purge position.  
 - During “PurgePhasePage” adding Home T motion, and removing Z Home motion.  
 Home to T, Y, X.

## 2.6. Parameters

2.6.1. “Recommend\_HC\_WC\_DuringPrint” – Disable Boolean parameter, using for installation.

default value is ‘1’ (true) on Objet1000 and ‘0’ (false) on other machines.

When the parameter is true, the system remind to the user to run heads cleans & wiper calibration

wizard.  
Technician can disable/enable the mechanism by changing “Recommend\_HC\_WC\_DuringPrint”.

* + 1. On “ObjetFamiliy” init “HCW\_ HCW\_TimeoutBetweenAlertMsgs” parameter to “33”.
    2. As long as there is digital ABS resin in the system “HCW\_enableAlertMsgs” flag is true.

The parameter is visible, but the user can’t change it. (It change during print to “true”)

# 3. Development

## 3.1 Limitations & risks

The mechanism is not full automatic:  
3.1.1 Running the wizard demands user interference.  
3.1.2. After running the wizard, the user needs to press on “Online” from EM, and also needs resume the job   
 manually from OS.

## Development Stages

* + 1. All development will be done on “Objet1000\_100.3.X.X\_HS\_Plus” version.  
       “http://srv-ire-svn/svn/ControlSW/Releases/Objet1000\_100.3.X.X\_HS\_Plus”
    2. Learning communication between EM – studio.
    3. Learning signal tower behavior (reading SRS, DR, code review) to get global solution for edge cases.
    4. Create dynamic message window as was described in section 2.5.0.
    5. In first stage, implement and “EnableLongPrintingUsingDirtyMaterial()” will be added to the project, the method implements sections 2.1-2.2. (Pop up messages, Logs, Signal tower, send message to Studio).
    6. Demo presentation
    7. Final DR
    8. Final code.
    9. Test section 3.2.4 by SIM.
    10. Combine CH & WC to one union wizard. (was described in “Head & Wiper Cleaning During Printing Wizard Flow Chart\_ver2.vsd” and section 2.5.10 )
    11. Test section 3.2.6 by SIM.(it was described in section 2.4.1.)
    12. Development and tests to MRW as described in section 2.5.12. (Using Simulator).
    13. Global tests on Objet1000 as describe in section 5.

# 4. Operation

* “Recommend\_HC\_WC\_DuringPrint” parameter must be checked in Parameters Manger in order for this feature to work.

## Installation

* + 1. Install new embedded executable.
    2. Need to add “Recommend\_HC\_WC\_DuringPrint =1” into “Q2RT.cfg” file.
    3. Update “HCW\_timeBetweenAlertMessages =33” into “Q2RT.cfg” file.
    4. Update the new values for “XCleaningPosition”, “YCleaningPosition” in “Q2RT.cfg”, “Q2rt.ref” files.

# 5. Testing

5.1.1. First test as describe in the following table.  
 During tests, I will use “counters” in order to simulate 33 -9 9 printing hours.

|  |  |  |
| --- | --- | --- |
| Material | Pre - Print | During Printing |
| After 22 printing hours -**Vero white.** | Make sure there is no regression code. | Make sure there is no regression code. |
| After 33 printing hours -**Vero white.** | Make sure there is no regression code. | Make sure there is no regression code. |
| After 66 printing hours -**Vero white.** | Make sure there is no regression code. | Make sure there is no regression code. |
| After 99 printing hours -**Vero white.** | Make sure there is no regression code. | Make sure there is no regression code. |
| After 22 printing hours - **ABS.** | 1. **EM**: Make sure there is no regression code. 2. **EM**: Check the pop up message. 3. **EM**: Check the log file 4. **EM**: Check the signal tower. 5. **Studio**: Check the Gui. | 1. **EM**: Make sure there is no regression code. 2. **EM**: Check the pop up message. 3. **EM**: Check the log file 4. **EM**: Check the signal tower. 5. **Studio**: Check the Gui. |
| After 33 printing hours - **ABS.** | 1. **EM**: Make sure there is no regression code. 2. **EM**: Check the pop up message. 3. **EM**: Check the log file 4. **EM**: Check the signal tower. 5. **Studio**: Check the Gui. | 1. **EM**: Check the pop up message. 2. **EM**: Check the log file 3. **EM**: Check the signal tower. 4. **Studio**: Check the Gui. |
| After 66 printing hours - **ABS.** | 1. **EM**: Make sure there is no regression code. 2. **EM**: Check the pop up message. 3. **EM**: Check the log file 4. **EM**: Check the signal tower. 5. **Studio**: Check the Gui. | 1. **EM**: Check the pop up message. 2. **EM**: Check the log file 3. **EM**: Check the signal tower. 4. **Studio**: Check the Gui. |
| After 99 printing hours - **ABS.** | 1. **EM**: Make sure there is no regression code. 2. **EM**: Check the pop up message. 3. **EM**: Check the log file 4. **EM**: Check the signal tower. 5. **Studio**: Check the Gui. | 1. **EM**: Check the pop up message. 2. **EM**: Check the log file 3. **EM**: Check the signal tower. 4. **Studio**: Check the Gui. |

5.2.1 Running MRW: after 100 printing hours with ABS material, without running the CH\_WC.  
 Expected behavior: Pop up window will demand to run HC&WC.  
 MRW window won’t be open.

5.2.2 Running MRW: less than 99 printing hours with ABS material, without running the CH\_WC.  
 MRW window will be open as expected.

5.3.1 Test Signal tower no regression code.  
5.3.2 Test the signal tower new application as described in 2.1-2.2 diagram.  
5.3.3 Edge case for signal tower:   
 - Waste is full, resign is empty, application offer to have HC&WC.  
 We have three reasons to activate the yellow color.  
 Now, replace to empty waste tank, replace to full resin tank.  
 Expected behavior: the signal tower will keep blinking yellow, because application suggests running “HC&WC”.  
  
**\* Since EM code will be ready before OS, the new communication code will disable in the first stage.  
 After OS code will be ready, I will test the communication between EM – OS.**

# 6. Effort Estimation

**Effort estimation is 24 working days, including implementation and testing.**

|  |  |
| --- | --- |
| Learning communication between EM- Studio/Signal tower behavior, | 4 Days |
| Implement dynamic window (section 2.5.0) | 2 day |
| Implementing “HC\_WC\_MessagesLogSignalTowerAlert () – section 3.2.5 | 3 Days |
| Adding changes on HC | 2 Days |
| Adding fixes to signal tower DR. Implementing section 2.5.10 | 2 Days |
| Development MRW as described in section 2.5.14 | 1 day |
| Implement OS-EM, EM-OS messaging (2.5.6, 2.5.7) | 2 days. |
| Testing Using the Simulator | 4 days. |
| Testing on machine | 4 days. |

**\*Time evaluation may be change according to:**

* Machine time availability
* SRS changes during the development
* Unexpected regression code on the E.B.