Technical Bulletin

DuraFlex Printhead Hydration Settings

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Introduction

This Technical Bulletin describes the printhead hydration modes used by DuraFlex printers and their settings. DuraFlex inks are formulated to ensure that dehydration in the nozzles is recoverable, provided the viscosity of the ink has not risen to the point where the ink cannot be ejected. Dehydration of ink should be minimized, as it may give rise to solid or semi-solid deposits which could be a source of nozzle blockages and other effects, leading to PQ issues.

Keeping the ink within each of the printhead nozzles hydrated is therefore a critical requirement for proper functioning of printheads. The DuraFlex product includes both software and hardware designed to minimize evaporation and dehydration of ink at the printhead surface.

To maintain printhead hydration, without interrupting printing, several different ink ejection modes are available as per *Table 1*. These methods are outlined below:

Table 1 – Printhead Hydration Modes

Hydration Mode	Details
Keep Wet Spit (KWS)	Consists of additional ink ejections, performed to ensure that all nozzles fire with at least a minimum frequency such that hydrated ink is always available in any printhead nozzle on demand. Two ejection methods are used: • Intra-page KWS is ejected continuously onto the print media in a pattern that is invisible to the naked eye • Inter-page KWS is ejected onto media between pages (inter-page gap)
Declog Spit	A declog spit is an energetic ejection of ink which is specifically aimed at clearing nozzles which may have partially dehydrated.
Inter-Page Ejections	Consists of a dense, short burst of ink that is ejected onto the pre-page spit target area. This method of keeping nozzles hydrated is most effective for shorter page lengths, where the time between spit bars, and therefore the risk of dehydration, is minimized.

Hydration Examples

This technical bulletin outlines a number of example printhead hydration configurations. It is important to review the *DuraFlex Software Release Notes R5.2.2* to understand the variety of options and constraints related to these and other configurations. Not every possibility is listed. Rather, some common options are shown to provide a flavor for how the configurations work. The configurations rely on a mix of settings in `hwparamstore.json` and via the PES interface. Hence, some options must be configured prior to run time while others can be adjusted in between print jobs or prior to print jobs.

An additional constraint is that there must be enough distance between the TOF and the print zone to accommodate the variety of hydration ejections that are configured. For these examples, the assumption is that the `mediaReadyOffset` (i.e. TOF offset) plus the `yOffset` is at least 300 mm. Also, any modes that require an interpage gap must have sufficient space to fit the desired hydration ejections. Note that when the settings chosen are not valid, there will be information in the log files that explain the constraints. Here is an example of the constraints for `DeclogMode` set to `ALL_PAGES`:

`DeclogMode::ALL_PAGES` requires:

1. `firstPrePageSpitLength` to be greater than 1148.87µm
2. The sum of `firstPrePageSpitLength`, `prePageSpitGap`, and `interPageGap` must be less than the smallest `mediaReadyOffset` setting + `yOffset`
3. `secondaryPrePageSpitLength` to be greater than 1148.87µm
4. The sum of `secondaryPrePageSpitLength`, `prePageSpitGap`, and `interPageGap` must be less than the smallest `mediaReadyOffset` setting + `yOffset`

There are two types of parameters for some settings. For parameters, such as `declogMode`, there is a default initial setting that can readily be changed via the PES interface by reading the settings via `getSettings()`, modifying the `declogMode` value, then writing the settings back via `storeSettings()`.

The entry in the PES IDL file for `declogMode` looks like:

```
optional KPesCommon.DeclogMode declogMode;
```

For parameters that are set up “with a factory default,” such as `firstPrePageSpitLength`, the “`isFactoryDefault`” property of the parameter must be set to False, along with setting the value property. The entry in the PES IDL file for `firstPrePageSpitLength` looks like:

```
optional KPesCommon.DistanceUmWithFactoryDefault firstPrePageSpitLength;
```

Setting these parameters looks like:

```
settings = pes.getSettings()
settings.firstPrePageSpitLength.isFactoryDefault = False
settings.firstPrePageSpitLength.value = 90000
pes.storeSettings(settings)
```

For reference, the declog modes are mapped to integers as follows:

```
NONE = 1
PRE_JOB = 2
FIRST_PAGE = 3
ALL_PAGES = 4
SACRIFICIAL_ONLY = 5
SACRIFICIAL_ALL = 6
SYSTEM_DEFAULT = 7
```

For the examples, assume the following are the initial PES interface parameter settings:

```
settings = pes.getSettings()
settings.declogMode = 7
settings.allowInterPageEjections.isFactoryDefault = True
settings.prePageSpitIntensityPct[1].isFactoryDefault = True
settings.prePageSpitIntensityPct[2].isFactoryDefault = True
settings.prePageSpitIntensityPct[3].isFactoryDefault = True
settings.prePageSpitIntensityPct[4].isFactoryDefault = True
settings.firstPrePageSpitLength.isFactoryDefault = True
settings.secondaryPrePageSpitLength.isFactoryDefault = True
settings.prePageSpitGap.isFactoryDefault = True
settings.interPageGap.isFactoryDefault = True
pes.storeSettings(settings)
```


Similarly, these are the initial `hwparamstore.json` settings:

Example hwparamstore.json:


```
        "inJobMaintenance":
        {
            "defaultFirstPrePageSpitLengthUm": 0,
            "defaultSecondaryPrePageSpitLengthUm": 0,
            "defaultPrePageSpitGapUm": 0,
            "defaultSacrificialPageLengthUm": 0,
            "defaultInterPageGapUm": 0,
            "defaultDeclogMode": "PRE_JOB",
            "defaultPrePageSpitIntensityPct":
            {
                "cyan":    0,
                "magenta": 0,
                "yellow":  0,
                "black":   0
            },
            "defaultAllowInterPageEjections": false,
            "declog":
            {
                "firstPage": {
                    "declogSpits": 20,
                    "preheatOnDurationNsec": 27,
                    "preheatOffDurationNsec": 437,
                    "preheatPulseCycles": 25,
                    "mainPulseDurationNsec": 347,
                    "span": 20
                },
                "secondaryPages": {
                    "declogSpits": 20,
                    "preheatOnDurationNsec": 27,
                    "preheatOffDurationNsec": 437,
                    "preheatPulseCycles": 25,
                    "mainPulseDurationNsec": 347,
                    "span": 20
                }
            },
            "interPageSpitbars": {
                "cyan":
                {
                    "delayLines": 1000,
                    "periodLines": 100,
                    "heightLines": 10,
                    "mask": 255
                },
                "magenta":
                {
                    "delayLines": 1000,
                    "periodLines": 100,
                    "heightLines": 10,
                    "mask": 255
                },
                "yellow":
                {
                    "delayLines": 1000,
                    "periodLines": 100,
                    "heightLines": 10,
                    "mask": 255
                },
                "black":
                {
                    "delayLines": 1000,
                    "periodLines": 100,
                    "heightLines": 10,
                    "mask": 255
                }
            }
        },
```


Example 1 – Pre-Job Declog, KWS Between Pages, no Interpage Spit Bars

This configuration will trigger a declog spit right after the printhead reaches the print zone and then start printing KWS. This is the typical setup for a standard roll-to-roll print configuration and can work well for a cut sheet system with the proper level of KWS configured.

Modify the `heightLines` to zero for each of cyan, magenta, yellow, and black in the `interPageSpitbars` section of `hwparamstore.json` to disable spit bars.

Example hwparamstore.json:

```
"interPageSpitbars": {
   "cyan":
   {
       "delayLines": 1000,
       "periodLines": 100,
       "heightLines": 0,
       "mask": 255
   },
   "magenta":
   {
       "delayLines": 1000,
       "periodLines": 100,
       "heightLines": 0,
       "mask": 255
   },
   "yellow":
   {
       "delayLines": 1000,
       "periodLines": 100,
       "heightLines": 0,
       "mask": 255
   },
   "black":
   {
       "delayLines": 1000,
       "periodLines": 100,
       "heightLines": 0,
       "mask": 255
   }
}
```

- Set `declogMode = 2`
- Set `allowInterPageEjections = TRUE`

Example PES commands:

```
settings = pes.getSettings()
settings.declogMode = 2
settings.allowInterPageEjections.isFactoryDefault = False
settings.allowInterPageEjections.value = True
pes.storeSettings(settings)
```

Example 2 – Declog Prior to Each Page, KWS Between Pages, No Interpage Spit Bars

This configuration will trigger a declog spit prior to the start of the first page and then prior to the start of subsequent pages. KWS will print between pages. The interpage gaps must be spaced enough to allow the set declog print length. This means that for cut sheet applications, the media must feed with

gaps larger than the `secondaryPrePageSpitLength`. For roll-to-roll applications, the `interPageGap` must be set to a value larger than `secondaryPrePageSpitLength`.

The settings shown here with a length of 50,000 µm are an example. The size can be tuned for a particular application. It is useful to check the size of a start-of-job declog spit and use that length for the `firstPrePageSpitLength` to ensure good hydration. The length of a start-of-job declog gets longer as print speed increases.

If the `prePageSpitGap` is 0, the print will start immediately after the declog spit.

Modify the `heightLines` to 0 for each of cyan, magenta, yellow, and black in the `interPageSpitbars` section of `hwparamstore.json` to disable spit bars.

- Set `declogMode = 4`
- Set `allowInterPageEjections = TRUE`
- Set `firstPrePageSpitLength = 50000`
- Set `secondaryPrePageSpitLength = 50000`

Example 3 – First Page Declog, KWS Between Pages, and Inter-page Spit Bars

This configuration will trigger the declog spit just before the first page of a job and will enable spit bars in-between subsequent cut sheet pages.

The default configuration for spit bars will produce a black spitbar 10 lines tall (in the print direction) that first prints 1000 lines after the end of the previous page and then repeats every 100 lines. The settings can be changed in the `hwparamstore.json` file to suit specific needs based on the print environment, print system configuration, and time between cut sheet pages.

Modify the `heightLines` to 10 for each of cyan, magenta, yellow, and black in the `interPageSpitbars` section of `hwparamstore.json` .

- Set `declogMode = 3`
- Set `allowInterPageEjections = TRUE`

Example 4 – Sacrificial Page Declog, KWS Between Pages, no Inter-page Spit Bars

This configuration will start printing KWS but will not trigger a declog spit until the first page of a job triggers the TOF. This is typically used for cut-sheet applications where it is desirable to avoid spitting the declog spit onto a belt (assuming no spittoon).

Change the `heightLines` to for cyan, magenta, yellow, and black to equal zero (0) in the `interPageSpitbars` section of `hwparamstore.json`.

- Set `declogMode = 5`
- Set `allowInterPageEjections = TRUE`

Example 5 – First Page Declog, KWS Between Pages, Inter-page Spit Bars, Pre-page Spits, Pre-page Spit Gap

This configuration will provide a strong amount of hydration and is useful for longer gaps between cut sheet pages, extra airflow in the print zone, and dry conditions.

It sets up a declog spit just before the first page, has a pre-page spit 10 mm tall, has interpage spit bars 10 lines tall starting after 1000 lines from the prior page and repeating every 100 lines, and provides a 10 mm gap between interpage spit bars and pages (based on `prePageSpitGap`). It is more suitable for cut sheet applications with a spittoon due to the number of spits between pages.

Modify the `heightLines` to 10 for each of cyan, magenta, yellow, and black in the `interPageSpitbars` section of `hwparamstore.json`

- Set `declogMode = 3`
- Set `allowInterPageEjections = TRUE`
- Set `prePageSpitIntensity = 50`
- Set `firstPrePageSpitLength = 90000`
- Set `secondaryPrePageSpitLength = 10000`
- Set `prePageSpitGap = 10000`