

Tips and Tricks for Fluorescence Detection: Extend the Lifetime of Your Xenon Flash Lamp

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Keywords

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Summary

The lifetime of xenon flash lamps is related to their operation time and flash frequency. The Thermo Scientific™ Dionex™ UltiMate™ 3000 FLD-3000 Fluorescence Detector Series offers three different lamp modes. These can be used in an effective and efficient way to achieve both the best limit of detection (LOD) and an extended lamp lifetime.

Background

Two types of lamps are commonly used as a light source for fluorescence detection: continuous lamps and flash lamps. The FLD-3000 Series detectors use a xenon flash lamp that requires only a few seconds for warm-up. Therefore, the operation time of the lamp is equal to the data acquisition time. In contrast, continuous mercury and xenon arc lamps typically need a warm-up time of more than 1 hour to reach a thermal equilibrium. To ensure that the lamp is ready for each sample, it stays usually turned on after a run and after the end of a sequence, respectively. Leaving the lamp on between sequences reduces the number of samples that can be analyzed during the lifetime of the continuous lamp. A flash lamp with an average lifetime of 4000 hours (operation at 100 Hz) can therefore process a lot more than four times the samples of a 1000 hour continuous lamp.

FLD-3000 xenon flash lamps can be operated in three different flash frequency modes. The highest frequency results in the best LOD; the lowest flash frequency achieves the longest lamp lifetime. A smart use of the lamp operation modes achieves both best detection sensitivity and extended lifetime of the flash lamp.

Solution

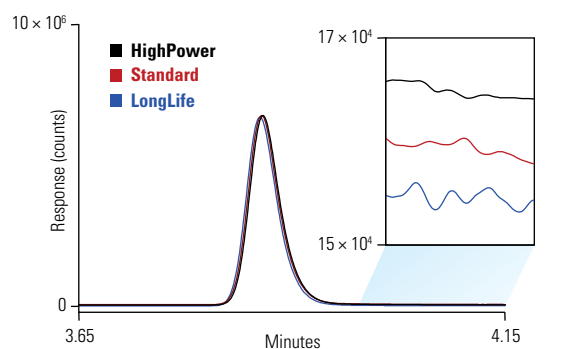
The FLD-3000 Fluorescence Detector Series is equipped with xenon flash lamps that offer three operation modes with different frequencies:

- HighPower mode with a frequency of 300 Hz
- Standard mode offers a flash rate of 100 Hz
- LongLife mode that provides a frequency of 20 Hz



Figure 1. UltiMate 3000 FLD-3000 Series Fluorescence Detector.

A change of the flash frequency has an impact on the lifetime of the lamp and on the observed baseline noise. The latter decreases with high flash frequencies, but the peak height remains constant for all lamp operation modes as shown in Figure 2.



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Figure 2. Influence of the flash lamp frequency on the signal-to-noise.

Hence, a change of the operation mode influences the signal-to-noise ratio (S/N) and not the signal height itself. The trend of the S/N in relation to the lamp mode is illustrated in Figure 3. The higher the flash frequency, the better is the resulting S/N. This relation can be roughly estimated using Equation 1:

$$\text{Noise}(F_2) = \sqrt{\frac{F_1}{F_2}} \cdot \text{Noise}(F_1),$$

with

F₁= Previous flash lamp frequency,

F₂= Planned flash lamp frequency.

Caused by photon shot noise, the baseline noise hence increases approximately by a factor of $\sqrt{3}$ (≈ 1.7) when changing the lamp mode from HighPower (300 Hz) to Standard mode (100 Hz). The noise rises by a factor of about 2.24 when the mode is switched from Standard to LongLife (20 Hz).

The FLD-3000 Series enables changes of the lamp mode during a chromatographic run. Figure 4 illustrates our recommendation for a smart use of the lamp modes. This approach combines both, an increased lamp lifetime and best S/N wherever required.

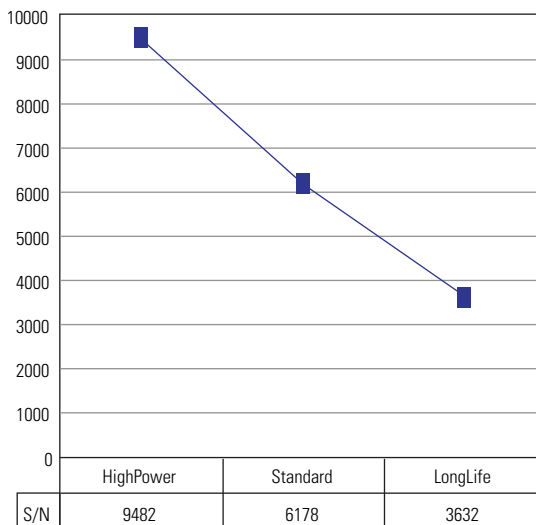
In quiet areas of the chromatogram, where no peaks of interest elute, the LongLife mode can be used. It provides sufficient S/N for monitoring the baseline, for example before the first peak elutes, or during the re-equilibration of the column (colored areas of the chromatogram). Switch to Standard or HighPower mode when peaks elute to obtain the best S/N (white part of the chromatogram).

The number of flashes during a chromatographic run is significantly reduced with this technique. In our example, the flash count is decreased by a factor of two compared to HighPower mode. This results in 100% more lamp lifetime without any drawbacks on the LOD.

Useful Links

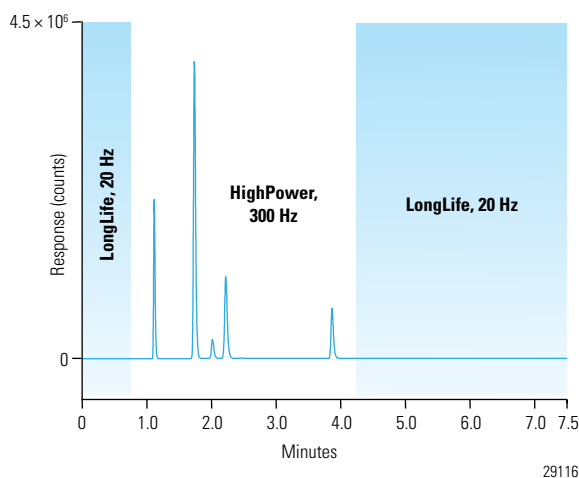
Find assistance on method development in the [Fluorescence Method Development Handbook](#) and get more information about fluorescence detection in UHPLC in Dionex, now a part of Thermo Fisher Scientific, [Technical Note 92: Combining Fluorescence Detection with UHPLC: An Overview of the Technical Requirements](#).

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Figure 3. Signal-to-noise ratio of the peak shown in Figure 2 obtained with HighPower, Standard and LongLife modes.



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Figure 4. Smart use of the lamp modes extends the lifetime of the xenon flash lamp.

References

1. Franz, H., Jendreizik, V. Fluorescence Method Development Handbook, 2013. [Online] http://www.dionex.com/en-us/webdocs/113591-Handbk-FLD-3000-Method-Develop-AN70302_E.pdf (accessed Feb 13, 2014).
2. Lakowicz, J.R. Principles of Fluorescence Spectroscopy, 3rd ed.; Springer Science+Business Media, LLC: New York, 2006

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