SPECTROPHOTOMETERS

Spectrum scan speed and resolution

Introduction

Jenway offer a wide range of visible and UV/Vis spectrophotometers to suit all types of applications and budgets. Many of the spectrophotometers in the range have a wavelength scanning functionality which can be used to analyse simple to complex samples over a wide range of the light spectrum. In this technical note we tested each of our scanning UV/Vis spectrophotometers to see how they performed when scanning a complex sample, such as holmium perchlorate, through the UV to visible wavelengths. We measured how long it took to scan over the range 230nm to 660nm and (where applicable) the resolution at different spectral bandwidths.

Model 7205

Method

The instruments tested were models 7205, 7315, 6715 and 6850. They were set up to scan over the range 230nm to 660nm to measure the peaks of a solution of 4% holmium oxide in 10% perchloric acid, a certified reference material used for wavelength accuracy measurements. Where an instrument was able to scan at various wavelength intervals, all steps were tested.

Results

Scan speed

The data shown in Table 1 summarises how long each model took to scan a range of 430nm. All models tested are able to scan at an interval of 1nm steps, so this is highlighted for comparison between instruments. The quickest by far was the model 7205 which uses scanning diode array technology. Traditional spectrophotometers (like the other models tested) use stepper motors to select the required wavelength. With diode array technology, each wavelength is selected by electrical scanning, making it much faster and very reliable.

Scan interval	**No. data points**	**7205** Scan time (s)	**7315** Scan time (s)	**6715** Scan time (s)	**6850** Scan time (s)
5nm	86	-	68.3	26.5	26.4
2nm	215	-	102.4	-	35.8
1nm	430	**6.3**	**157.8**	**26.5**	**51.5**
0.5nm	860	-	-	27.0	82.6
0.2nm	2150	-	-	-	177.3
0.1nm	4300	-	-	31.1	334.6

Table 1: Time taken to acquire spectral data. Values are the average of three scans.

Spectrum scan speed and resolution

The model 6715 was the fastest traditional spectrophotometer in the Jenway range. It can be seen in Table 1 that there is very little difference in the time taken at each scan interval step. This is because the 6715 always scans in 0.1nm steps but can plot at different intervals. The additional time taken at shorter steps is the time required to display the data points on the screen. When the data is saved, only the readings at the selected scan interval are saved in the results file.

The full spectrum scans for each model are shown in Figure 1.

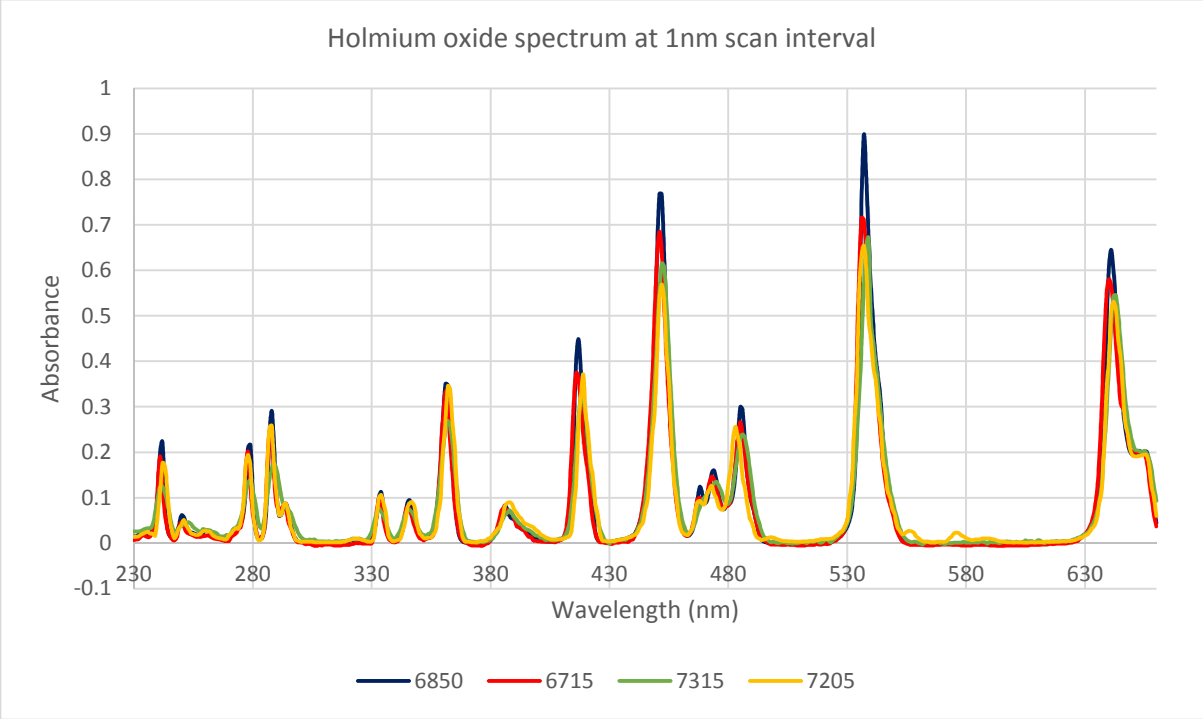

Figure 1: Holmium oxide spectrum scanned by each of the Jenway spectrophotometer models 6850, 6715, 7315 and 7205.

Resolution and spectral bandwidth

The selection of scan interval will determine how many data points are recorded for the spectrum scan. In general, the larger the scan interval the faster the data is acquired but the resolution will be lower. An example is shown in Figure 2 for data collected from the 6850 at 5nm and 0.1nm intervals over the range 460-500nm.

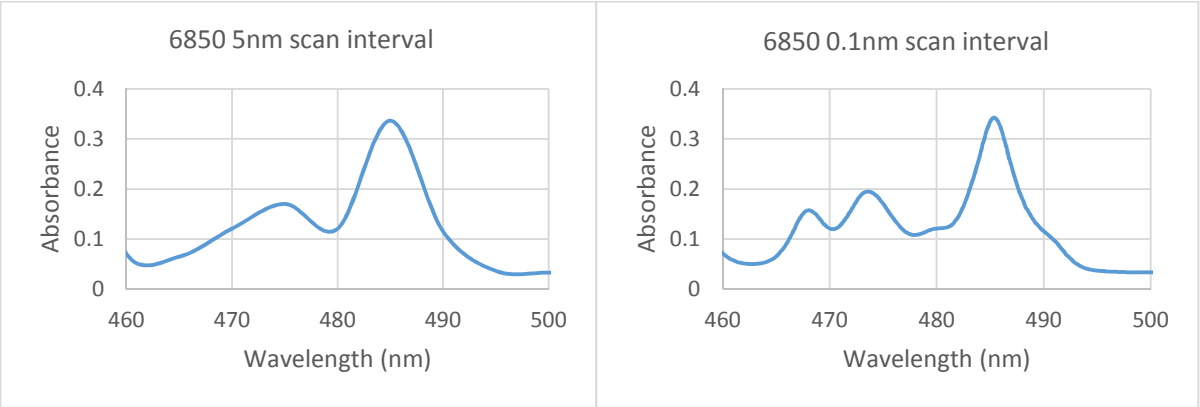

Figure 2: Resolution effects of scan interval selection. At longer scan intervals, not all peaks may be resolved.

Spectrum scan speed and resolution

Although shorter scan intervals afford better resolution, especially for complex samples, it's not always practical to scan all samples in this way. As Table 1 illustrates, this can take quite some time, so it's often sufficient to run a quicker, lower resolution scan.

Scan interval however is not the only factor which determines how well individual peaks can be resolved from each other. By far the more important factor is the quality of the instrument's optical system and more specifically the spectral bandwidth of the instrument. The models 6850 and 6715 have the smallest spectral bandwidths of the instruments tested (0.5nm (variable, but set at 2.0nm in this test) and 1.5nm respectively) and are (when using small scan intervals) able to resolve peaks from the holmum oxide spectrum which are very close together. In Figure 3, the region of the spectrum from 460nm to 500nm is enlarged to demonstrate this. At 0.1nm and up to 1nm step intervals, both the 6715 and 6850 can resolve 3 separate peaks in this region. However the model 7315, which has a spectral bandwidth of 5nm, is unable to resolve these three peaks.

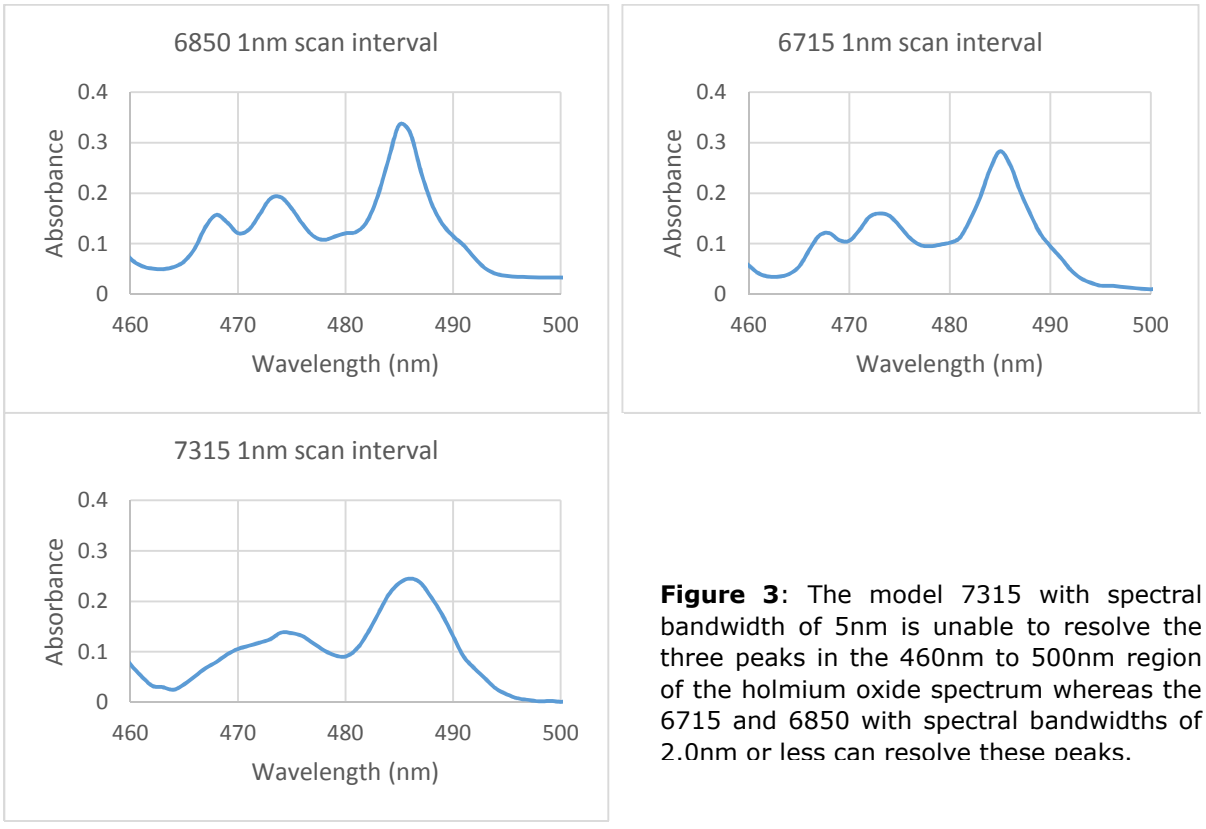

Figure 3: The model 7315 with spectral bandwidth of 5nm is unable to resolve the three peaks in the 460nm to 500nm region of the holmium oxide spectrum whereas the 6715 and 6850 with spectral bandwidths of 2.0nm or less can resolve these peaks.

• Conclusions

Choosing a scanning spectrophotometer will depend on your application. For very rapid and basic screening, the 72 series models are ideal. The 7310 and 7315 models may not be the fastest scanning instruments but offer the user a wide range of additional features at a competitive price. For more advanced applications, the models 6715 and 6850 offer superior optics combined with rapid scanning and analysis options.