

# OES Technology Comparison



**CCD and CMOS  
versus  
PMT**



	<b>Arun CCD and CMOS based spectrometer</b>	<b>PMT based spectrometer</b>	<b>Advantage/ Disadvantage</b>
<b>Size</b>	Compact size, fits on a standard desk.	Large free-standing unit normally floor mounted.	CCD/CMOS much smaller
<b>Samples</b>	Solid metal samples about 25mm diameter and 1 mm thick (minimum)	Solid metal samples about 25mm diameter and 1 mm thick (minimum)	Same
<b>Excitation</b>	Repetitive Capacitor Discharge (spark)	Repetitive Capacitor Discharge (spark)	Same
<b>Frequency</b>	100,200,300, 400 Hz excitation frequency adjustable	100,200,300, 400 Hz excitation frequency adjustable	Same
<b>Light dispersion</b>	Holographic Diffraction Grating	Holographic Diffraction Grating	Same
<b>Wavelength Separation</b>	Electronic, light sensitive pixels 7 microns wide	Mechanically etched exit slit 30, 50, 80 microns wide	Electronics more reliable
<b>Light Measurement</b>	Thousands of pixels on each CCD viewing total spectrum	At Least one Photo Multiplier Tube per element	CCD/ CMOS much smaller
<b>Detection Technology</b>	Charge Coupled Device using Solid State Silicon Chip	Glass encapsulated Photo Multiplier Tube	Solid state more reliable
<b>Dispersion Adjustment</b>	Continuous electronic peak searching	Mechanical adjustment of entrance slit	Electronics more reliable
<b>Focal Length</b>	Normally 250-350mm	Normally 750- 1000mm	CCD/ CMOS much smaller
<b>Wavelength Range</b>	160 nm - 470 normal, 160 -780 optional	160 nm - 470 normal, 160 -780 optional, low Nitrogen 149 possible	Similar
<b>Optical Chamber</b>	Small focal length does not need vacuum chamber or pump. Ultraviolet range can be purged with Argon or Nitrogen.	The optic is relatively large and normally needs a vacuum chamber. The vacuum pump can be a maintenance problem.	PMT larger and heavier
<b>Data Acquisition</b>	Serial readout of CCDs and analogue to digital conversion giving a picture of the spectrum produced with data on all elements present	Individual integration and analogue to digital conversion of the signals from the PMTs installed. Only those elements measured.	PMT more complex
<b>Data Management</b>	Standard Personal Computer	Standard Personal Computer	Same
<b>Communications</b>	Spectrometer to PC - USB. PC to Network LAN	Spectrometer to PC- USB Ethernet. PC to Network LAN	Same
<b>Calibration</b>	Certified Samples (CRM) are used to create curves for each element required in the material to be analysed.	Certified Samples (CRM) are used to create curves for each element required in the material to be analysed.	Same
<b>Re-standardisation</b>	Calibration curves are adjusted, normalized, drift corrected or re-standardise using setting up samples (SUS)	Calibration curves are adjusted, normalized, drift corrected or re-standardise using setting up samples (SUS)	Same



	<b>Arun CCD and CMOS based spectrometer</b>	<b>PMT based spectrometer</b>	<b>Advantage/ Disadvantage</b>
<b>Capital Cost</b>	Usually lower as not related to channel number	Usually more expensive as each element (PMT) adds to cost	CCD and CMOS lower
<b>Performance</b>	The performance can be demonstrated on CRMs in terms of precision/repeatability and accuracy	The performance can be demonstrated on CRMs in terms of precision/repeatability and accuracy	Same
<b>Maintenance</b>	Due to the absence of a vacuum pump and vacuum chamber there is less maintenance and lower PM costs.	Vacuum pumps and other mechanical components mean that maintenance and PM costs can be higher.	CCD and CMOS lower cost
<b>Consumption of Power</b>	The low power electronics and lack of vacuum pump means consumption is low 75w in standby 160w when analysing	The vacuum chamber must be kept under vacuum. The electrical usage of a PMT unit could be 5 to 10 times higher than.	CCD and CMOS lower cost
<b>Consumption of Argon</b>	The system is programmed so that gas is only turned on when analysing.	Most of the older MPT units do not have argon save mode	CCD and CMOS lower cost
<b>Purge Gas</b>	Argon or Nitrogen purge is needed for the ultraviolet range if carbon, phosphorous, sulphur etc. to be measured.	No need as vacuum used	Need to consider in total costs
<b>Start /Restart times</b>	Optic can be purged rapidly in about 30 minutes.	If the vacuum is lost it can take 24 hours to pump down. Instrument and the pump usually kept running continuously	CCD and CMOS lower cost
<b>Upgrading</b>	If elements need adding this only involves calibration	If elements need adding this involves addition hardware of PMT and electronics. Calibration also needed.	CCD and CMOS cheaper
<b>Lifetime</b>	The CCD chip like other solid-state devices has an indefinite life and Arun Technology has supplied several thousand units over 25 years without a chip failure. CCDs use low voltage.	The Photo Multiplier tube is a mechanically assembled, glass encapsulated tube and must operate with high voltage in a vacuum, so failures are not unknown.	CCD and CMOS longer life
<b>Customer Acceptance</b>	The advantages of CCD units over PMT units have been recognized by both manufacturers and users. More than 70% of spectrometers for Metals Analysis are now CCD based.	PMT units are still manufactured and preferred by some users. However, it is generally accepted that there is no difference in performance.	Customer choice

