

RCT/HPT Site Standard OJT Program  
OJE Evaluator Reference

Course Number:     **022301**  
 Course Title:        RCT/HPT OJT/OJE Task – Count Rate Meters  
 Task Title:           Count Rate Meter  
 Form(s)              N/A  
 Terminal Objective:  Demonstrate use of Count Rate Meters

<b>Objectives – Part A</b>	
<b>Method</b>	<b>Task</b>
D	<p>Discuss the type of detector(s) used</p> <p><u>GM</u></p> <p><i>The Eberline E-140/Ludlum Model-3 utilizes a Geiger Mueller(GM) Detector, typically either the P-11 “Pancake” probe or the shielded HP 210T probe.</i></p> <p><u>PAM</u></p> <p><i>The Bicron Surveyor X utilizes a scintillation detector probe with a Zinc Sulfide(ZnS) coating</i></p> <p><u>2360</u></p> <p><i>The 2360 uses DP6BD dual phosphor scintillator using Zinc Sulfide (ZnS)for alpha detection on a NE102 plastic scintillator for beta.</i></p>
D	<p>Discuss the types of radiation detected by the instrument</p> <p><i>The GM probe will respond to alpha, beta and photon (gamma, X-ray) radiation, however it is not calibrated for alpha and photon is subtracted as background</i></p> <p><i>The PAM probe responds to alpha radiation. Too thin for beta response and not the right material for photon response. (Note the PAM may be Gamma Sensitive)</i></p> <p><i>The 2360 DP6BD probe responds to alpha, beta, photon and neutron radiation. Photon and neutron are interfering radiations.</i></p>

## Objectives – Part A

Method	Task
D	<p>Discuss the ranges for which the instrument is valid</p> <p><u>GM- E140N</u></p> <ul style="list-style-type: none"> <li>• <i>The E-140 / BNW-Series has X1, X10, X100 scales</i></li> <li>• <i>Readout scale 0-1,000 cpm</i></li> <li>• <i>Maximum range is 100,000 cpm</i></li> <li>• <i>Above 50,000 cpm, correction may be needed for losses</i></li> </ul> <p><u>Ludlum Model 3</u></p> <ul style="list-style-type: none"> <li>• <i>X0.1, X1, X10, X100 scale multipliers</i></li> <li>• <i>Meter readout 0-5K cpm</i></li> <li>• <i>Maximum range is 500,000 cpm</i></li> <li>• <i>May have a scaler function</i></li> <li>• <i>Above 50,000 cpm, correction may be needed for dead time losses</i></li> </ul> <p><u>PAM</u></p> <ul style="list-style-type: none"> <li>• <i>The meter scale is 0 – 1,000 cpm with multiplier ranges of 1X, 10X, 100X (max cpm 100,000)</i></li> <li>• <i>The Bicron Surveyor X has preset response times for each range.</i></li> <li>• <i>Has 12 sec. Response time on X1 scale</i></li> <li>• <i>May have a scaler function</i></li> </ul> <p><u>2360</u></p> <ul style="list-style-type: none"> <li>• <i>X1, X10, X100, X1000 scale multipliers</i></li> <li>• <i>Meter readout 0-500 cpm</i></li> <li>• <i>Maximum range is 500,000 cpm</i></li> <li>• <i>Has a scaler function</i></li> </ul>
D	<p>Discuss the precautions and limitations associated with the use of the instrument</p> <p><u>GM</u></p> <ul style="list-style-type: none"> <li>• <i>Mylar window on probe(s) is thin and easily damaged</i></li> <li>• <i>Defects in cord can lead to erroneous readings</i></li> </ul>

**Objectives – Part A**

Method	Task
	<ul style="list-style-type: none"> <li>• <i>If introduced to a high radiation field (gamma) the instrument could “saturate” and result in a zero reading</i></li> <li>• <i>Instrument can under respond at higher count rates (&gt;50,000 cpm) due to “dead time” losses by as much as 40%-95%(100K to 500k cpm)</i></li> </ul> <p><u>PAM</u></p> <ul style="list-style-type: none"> <li>• <i>The body and probe of a PAM is considered “married” and cannot be changed out if defective without recalibration by PNNL</i></li> <li>• <i>Due to the fragile nature of the probe face tears/defects are easily encountered and may cause light leakage into the detector which will cause an erroneous reading (and possibly saturation) of the instrument</i></li> <li>• <i>Saturation caused by large light-leaks will cause a high scale response on the meter and constant audible.</i></li> <li>• <i>The probe is an scintillation detector and is sensitive to temperature shock</i></li> <li>• <i>The efficiency ranges ~12-15%</i></li> <li>• <i>The over-range alarm only works when the audio is disabled</i></li> <li>• <i>Faulty PMT (photo multiplier tubes) will cause the PAM to have a noisy response when the probe is shaken or moved.</i></li> </ul> <p><u>2360</u></p> <ul style="list-style-type: none"> <li>• <i>Avoid contact with internal components which could cause electrical discharge.</i></li> <li>• <i>Turn the unit off and wait 1 minute before changing batteries.</i></li> <li>• <i>Sensitive to EMF</i></li> <li>• <i>Not generally affected by humidity</i></li> <li>• <i>Are sensitive to large temperature changes (outdoor to indoor)allow 1 hr acclimation</i></li> <li>• <i>Can have varying levels of crosstalk between alpha &amp; beta channels</i></li> <li>• <i>Will respond to gamma &amp; neutron as interfering radiation.</i></li> <li>• <i>The probe is an scintillation detector and is sensitive to temperature shock</i></li> <li>• <i>Uses correction factor of 10 for both alpha and beta</i></li> <li>• <i>Separate tone emitted for alpha &amp; beta</i></li> </ul>

Objectives – Part A	
Method	Task
D	<p>Discuss the advantages and disadvantages associated with the use of the instrument</p> <p><u>GM</u></p> <ul style="list-style-type: none"> <li>• Cords, batteries and probes can be changed by technicians</li> <li>• Instrument is not sensitive to electromagnetic fields or temperature and / or humidity fluctuations</li> <li>• Only calibrated for beta/gamma</li> </ul> <p><u>PAM</u></p> <ul style="list-style-type: none"> <li>• The Bicron Surveyor instrument is not sensitive to temperature shock or changes to humidity</li> <li>• Radon interferes with detection of heavier isotopes (Pu-239, Am-241)</li> <li>• It can under respond as much as 20% when measuring Uranium</li> </ul> <p><u>2360</u></p> <ul style="list-style-type: none"> <li>• Measure both alpha and beta with one instrument</li> <li>• One correction factor for both alpha and beta</li> <li>• 100 cm<sup>2</sup> probe</li> <li>• Built in scaler with multiple times</li> <li>• Not affected by dead time losses above 50,000 cpm</li> <li>• Sensitive to light leaks</li> <li>• Probe somewhat fragile due to mylar window and PMT tube.</li> <li>• Can be affected by neutron and gamma</li> </ul>

Objectives – Part B	
Method	Task
P	Demonstrate proper scan speed for each instrument type
P	Demonstrate a 100cm <sup>2</sup> direct survey