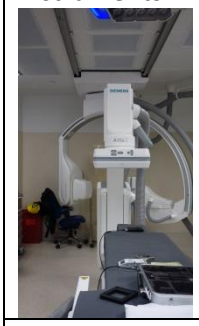
Draft Training Video Script

Exposure Reproducibility

Video	Voice	Text Overlay
CRCPD logo		Testing Exposure Reproducibility
Presenter	Exposure reproducibility is a test is to determine whether a given technique setting on an x-ray machine will consistently produce a similar amount of radiation each time the setting is used. It is important that a machine provide a consistent, that is, reproducible exposure. For screen-film machines reproducibility is important to image quality. Not enough exposure and the image will require a retake which increases patient exposure. Too much exposure might require a retake but certainly means unnecessary patient exposure. With the newer digital imaging technologies, post processing of the image makes reproducibility less of an image quality question and more of a patient exposure issue.	Consistent exposures assure patient dose can be optimized
Instruments 	The only equipment needed to test reproducibility is an exposure monitoring instrument and a calculator	Be sure exposure instrument is in current calibration
Presenter demonstrating set-up with instrument and x-ray machine 	To perform the test, position the exposure monitoring instrument's probe near the center of the x-ray beam and at an appropriate distance from the tube. An appropriate distance would be where the patient would be located – either midline or skin entrance would work as long as the distance remains the same throughout the test series. Ensure the automatic exposure control, also known as the photo-timer, is disabled. Test both small and large focal spots for those machines that have them. You should perform this reproducibility test for at least three different mA or mAS settings using the same kVp. Ideally, these should be across the range of mA or mAS typically used on this x-ray machine.	
Presenter	Select the kilovolt peak, milliamperage and time in milliseconds or "mAS" to be tested. Take a series of four exposures at this setting and record the four exposure results.	Set kVp, mA & time or mAS
215 220 217 213	Here is a series of four exposures taken at 80 kVp, 100 mA on a small focal spot, for 100 milliseconds and a mAS of 10.	
215 220 217	The average of the four exposures is determined by adding the four exposures and dividing by four.	$E_{AVG} = (E_1 + E_2 + E_3 + E_4)/4$

213 865 /4 = 216.25		
215 220 max 217 213 min 865 /4 = 216.25	Next, find the difference between the highest and the lowest test exposures and multiply by 12. In this case 220 minus 213 is 7. 7 times 12 is 84 which is less than the average exposure of 216 millirem. Therefore the 100 mA small focal spot is reproducible.	$(E_{max} - E_{min})X\ 12 \leq E_{avg}$
325 370 max 330 318 min 1343 /4 = 335.75	The next test series is still at 80 kVp and 100 milliseconds but now at 150 milliamps on the large focal spot. The mAS is 15. The difference from maximum to minimum exposure is 370 minus 318 or 52 millirem. Twelve times 52 is 624 which exceeds the average exposure of 336. When a mA station or mAS setting is found to be not reproducible, repeat the test again with four more exposures. Radiographic machines can glitch on a single exposure, especially on settings not commonly used by the facility. However, if the station setting is truly not reproducible the problem can be repeated.	
321 min 331 340 max 325 1317 /4 = 329.25	A repeat test at 80 kVp, 100 milliseconds at 150 milliamps on the large focal spot gave these results. The difference between maximum and minimum is now 19 millirem and twelve times 19 is 228 which is less than the average of 329 millirem. Even though the 150 mA large focal spot does have one result that is too high from the first series, the second series of four exposures is found to be reproducible.	
420 min 431 480 max 457 1788 /4 = 447	For the third mAS at 80 kVp, we used 200 mA on a large focal spot for 100 milliseconds. The mAS is 20. The first set of exposures has a difference 60 between maximum and minimum. Twelve times 60 is 720 which exceeds the average of 447 and thus these results are not reproducible.	
435 min 460 441 491 max 1827 /4 = 456.75	A repeat test 80 kVp, 100 milliseconds at 200 milliamps on the large focal spot give these results. The difference between maximum and minimum is now 56 which times 12 is 672. This still exceeds the average of 457 and therefore this mAS station is not reproducible.	
Presenter	In summary, when testing reproducibility at least three different mA or mAS settings should be used. If any setting fails the first test of four exposures, repeat the test to confirm the non-compliance. A machine must be reproducible before the exposure linearity test can be performed which is covered in a different module. If you have any questions, please submit them to our Questions and Answers on the CRCPD website.	
	Finally, as a radiation control program inspector, your efforts to verify that x-ray machines produce consistent exposures is part of the task of assuring patients receive the best quality image without unnecessary radiation exposure.	
Credits	CRCPD web link for Q&A Thanks to Florida RCP for photos	