NJDEP Medical Physicist's Radiographic QC Survey
Registration Number:

PLEASE PRINT			
Facility Information			
Facility Name			
NJDEP ID #			
Unit Information			
Manufacturer		Model	
Console Model #		Console serial #	
Tube serial #		Location (room)	
QC Survey Information			
Date of QC Survey			
Qualified Medical Physicist Name			
MP Assistant in Radiography Name			
CERTIFICATION STATEMENT			
I certify that, to the best of my knowledge, the information in this document and all attached documents is true, accurate and complete.			
Medical Physicist Signature		Date	
MP Assistant Signature		Date	
Summary of Areas Needing Correction			
Recommendations			
Statement of Meeting			
Date of the Meeting/Conference Call			
Persons Attending			
Registrant's Receipt of Report			
I have received this report and I agree to correct any deficiencies in accordance with N.J.A.C. 7:28-22.8(f).			
Registrant or designee signature:		Date	
If deficiencies were found, record below when corrective actions taken and by whom. Use additional sheets if needed.			

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NOTE! Please mark all tests performed by the Certified Physicist Assistant with an (*).

Item	Description	Pass	Needs Repair	N/A	NJAC 7:28
Radiographic Unit Assembly Evaluation					
1	Tube locks are operational.				2.5(b)
2	Unit is registered with DEP.				3.3(a)
3	Collimator is securely connected to the housing If in question, perform a diagnostic source assembly leakage test. Measurement [ ] mR in one hour.				15.3(b)
4	For certified units, an X-ray beam angulation indicator is present and operational.				15.3(d)1
5	SID indicator is present and accurate.				15.3(d)3
6	Control panel indicates kVp, mA, time, mAs.				15.3(f)2
7	Audible and visual indication of exposure for certified unit.				15.3(f)3
8	Visual indication of exposure uncertified unit.				15.3(f)3
9	Exposure switch for stationary units can only be activated from behind a protective barrier.				15.3(f)6
10	Protective apron(s) of $\geq$ 0.25 mm Pb equivalent is present if a person is not behind a protective barrier during exposure.				15.9(a)1i
11	Gondal shielding of $\geq$ 0.5 mm Pb equivalent is present.				15.9(a)3
12	Unit has a current radiation survey.				15.10(b)1 and 2
For Multiple tube control panels ONLY					
13	Permits activation of only one tube at a time.				15.3(h)1
14	Provides an indication of selected tube.				15.3(h)2
15	Only the selected tube is energized.				15.3(h)3
For Mobile or Portable units ONLY					
16	Collimator or spacer fame is present to limit the source to skin distance $\geq$ 12 inches.				15.3(j)2
17	SID Indicator is present and measures SID within 2%.				15.3(j)3
18	Exposure switch is a dead man type.				15.3(j)4
19	Exposure switch is on a cord $\geq$ 6 feet long.				15.3(j)4

NJDEP Medical Physicist's Radiographic QC Survey
Registration Number:

Item	Description	Pass	Needs Repair	N/A	NJAC 7:28
Collimator Assessment					
For MANUAL & PBL Collimators					
20	Controls open and close blades smoothly, adjustment is stepless.				15.3(c)1
21	X-ray/Light field congruence does not exceed 2% of SID. Measurements:				15.3(c)1
22	Minimum field size at 39.4 inches SID ≤ 2"X 2" Measurement:				15.3(c)1
23	Center alignment with bucky tray ≤ 2% SID Measurement:				15.3(d)2
For PBL Collimators ONLY **Applicable to both automatic and semi automatic PBL** *(If PBL has been properly disabled and labeled, only perform tests for Manual Collimators)					
24	X-ray production is prevented when:				
a	Either the length or width of the x-ray field larger than the image receptor size by >3% of the SID.				15.3(i)2i
b	The sum of the difference in length and width of the x-ray field is larger than the image receptor size by >4% of the SID.				15.3(i)2ii
c	The SID for which PBL is not designed for sizing.				15.3(i)2iii
25	Override is for all SID's and image receptor sizes.				15.3(i)4i
26	A key is required to override PBL.				15.3(i)4ii
27	Key remains in place during all times that PBL is overridden.				15.3(i)4iii
28	Each key switch or key is labeled as required.				15.3(i)4iv
29	Collimator controls open and close blades smoothly and adjustment is stepless.				15.3(i)5
30	Minimum Field size at a 39.4 inch SID ≤2" X 2" Measurement:				15.3(i)5
31	A change of image receptor of the same size does not cause an automatic return to PBL.				15.3(i)6
32	Any change in image receptor size or SID causes automatic return to PBL.				15.3(i)6

NJDEP Medical Physicist's Radiographic QC Survey
Registration Number:

Item	Description	Pass	Needs Repair	N/A	NJAC 7:28
For Diaphragms or Fixed Collimator ONLY					
33	SID and image receptor size is marked on each diaphragms.				15.3(c)2
34	A beam limiting device is available for all combinations of SID's and image receptor sizes used by the facility.				15.3(c)2
35	Each device limits the beam size to the size of the image receptor size.				15.3(c)3
Collimator Illumination					
36	Illumination is at least 15 ft candles (160 lux) when measured at 39.4 inches. Measurement:				15.3(c)1i
Half Value Layer					
37	Measured ____ mm Al @ ____ kVp See Form #1				15.3(e)1
mA or mAs Linearity					
38	mA linearity does not exceed 10%. See Forms #5				15.3(g)6i
39	mAs linearity does not exceed 10%. See Forms #6				15.3(g)6ii
kVp Accuracy / Reproducibility					
40	kVp accuracy does not exceed 10% or Mfg. Specs. See Form #2				15.3(g)4
41	kVp reproducibility does not exceed 5%. See Form #3				15.3(g)5

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Registration Number:

Item	Description	Pass	Needs Repair	N/A	NJAC 7:28
Timer Accuracy/ Reproducibility					
42	Timer accuracy does not exceed 10% or Mfg. Specs. Test can be excluded for mAs units. See Attached Form #4				15.3(g)1
43	Timer reproducibility may not exceed: 5% for certified units **OR** 7% for uncertified units. See Attached Form #3				15.3(g)2I or 15.3(g)2ii
45	Exposure reproducibility may not exceed: 5% for certified units **OR** 7% for uncertified units. See Attached Form #3				15.3(g)3I or 15.3(g)3ii
AEC Control, Reproducibility, Tracking, Density Control					
46	A device is on control panel that indicates when AEC mode is selected.				15.3(f)7i
47	Audible and visual indication of exposure for certifies units.				15.3(f)7ii
48	Visual indication of exposure for uncertified units.				15.3(f)7iii
ESE Measurement					
49	Procedure(s) Used (i.e. AP L/S pine, AP or PA Chest, AP abdomen, AP foot) ☐				22.8a
	According to the facility's technique chart, the following factors below were used				
	mA ☐ mAs ☐ Time ☐				
	kVp ☐ SID ☐				
	Film-Screen speed ☐				
	AEC Cells Activated ☐				
	Density Control ☐				
	ESE Measurement ☐ mR				
50	Are facility's techniques for this and other procedures within the normal diagnostic range? YES ☐ NO ☐				
51	Attach a copy of the appropriate NEXT or State chart, identifying the measured ESE. Provide recommendations if appropriate.				

NJDEP Medical Physicist's Radiographic QC Survey
Registration Number:

Item	Description	Pass	Needs Repair	N/A	NJAC 7:28
Image Quality Evaluation (Recommendation)					
52	List Procedure(s) Used (i.e. AP L/Spine, AP or PA Chest, AP abdomen, AP foot)				22.8(a)

Compare Phantom standards with what is visualized on the facility's radiograph

	Phantom Test Item	Phantom Standard	Facility Result
53	Noise/artifacts		
54	Uniformity		
55	High Contrast Resolution		
56	Low Contrast Resolution		
57	Low Contrast Detail		
58	Background Density		
59			

Comments:

NJDEP Medical Physicist's Radiographic QC Survey
Registration Number:

Item 61					
QA Manual satisfies the requirements of N.J.A.C. 7:28-22.4.					
7:28-22.4	REQUIRED ITEM	Pass	Not in Manual	**Not Adequate**	**Not Current**
(a)1	List of identified individuals responsible for QA/QC program				
(a)2I	QC Tests to be performed & required frequencies (See item 62)				
(a)2ii	List of Equipment to be tested				
(a)2iii	Acceptability limits for each test (See item 62)				
(a)2iv	Description of each QC test procedure				
(a)2v	Sample forms for each QC test performed				
(a)2vi	Processor Maintenance & Chemical Solutions				
(a)2vii	Annual Medical Physicist's QC Survey				
(a)3	Policies and Procedures				
(a)3i	Holding Patients and for individuals present in the room during Exposure				
(a)3ii	Pregnant patients and employees				
(a)3iii	Gonadal shielding				
(a)3iv	Orientation Program				
(a)3v	Proper use and maintenance of equipment				
(a)3vi	Employee responsibilities concerning personnel radiation Monitoring				
(a)3vii	Release of films				
(a)3viii	Labeling films				
(a)3ix	Radiation Safety Survey				
(a)3x	Technique Chart				
(a)3xi	Rules on Radiation Safety				
(a)4i	Plan for Corrective Action: after X-ray Equipment service or repair				
(a)4ii	Plan for Corrective Action: after processor repair or service				
(a)5	Record Keeping				
(a)5i	Most recent 1 year of QC tests maintained				
(a)5ii	Initial Medical Physicist's QC Survey + 2 most recent Surveys				
(a)5iii	Corrective Action for most recent 2 years				
(a)5iv	Personnel Monitoring				
(a)6	Reference Manuals				
(a)7	Annual QA Program Review				
Comments:					

NJDEP Medical Physicist's Radiographic QC Survey
Registration Number:

Item 62						
Review all QC tests for compliance with the minimum frequencies and standards as per N.J.A.C. 7:28-22.5						
Required Item	**Required Frequency**	**Pass**	**Not Performed**	**Not Performed at Required Frequency**	**Does Not Meet Standard**	**N/A**
Equipment Warm Up	Daily					
Processor Quality Control	Daily					
If manual processing, the time-temperature method is used.						
Laser Film Printer Quality Control	Weekly					
Darkroom Cleanliness	Weekly					
Processor Maintenance and Chemical Solutions	2 months					
Facility's Equipment Visual Checklist	Quarterly					
Film and Chemical Shelf Life	Quarterly					
Light Field/X-ray Field Alignment	Quarterly					
Repeat Analysis	Semiannual					
Artifact Evaluation	Semiannual					
Analysis of Fixer Retention	Semiannual					
Darkroom Fog	Semiannual					
Cassette Integrity/Screen Cleanliness	Annual					
Lead Aprons, Gloves, Gonadal and Thyroid Shield Integrity Check	Annual					
Annual Medical Physicist QC Survey	Annual					
Annual QA Program Review	Annual					
QC tests are performed using acceptable procedures.						
Corrective action was taken in accordance with N.J.A.C. 7:28-22.5.						
Records of all applicable QC tests and corrective action are maintained in accordance with N.J.A.C. 7:28-22.5.						
Comments:						

NJDEP Medical Physicist's Radiographic QC Survey
Registration Number:

Form #1

Half-Value Layer (HVL)

Minimum of three (3) measurements: One measurement for zero mm Al, one measurement before actual HVL and one measurement near actual HVL.

kVp Set =		
mS Set =	mA Set =	mAs Set =
mm Al.	kVp Measured	mR Measured
0 mm Al		
mm Al @ kVp		

NJDEP Medical Physicist's Radiographic QC Survey
Registration Number:

Form #2

kVp Accuracy

Provide measurements in diagnostic range for minimum of six (6) different kVp settings. Exceptions are: Single purpose units, such as dedicated Chest units, which may use a limited kVp range.

mA Set =	mS Set =	mAs Set=			
kVp Set	kVp Measured	% kVp Error	mR Measured	Passed	Needs Repair

% Accuracy = $\frac{(\text{measured value} - \text{set value}) \times 100}{\text{set value}}$

NJDEP Medical Physicist's Radiographic QC Survey
Registration Number:

Form # 3

Reproducibility For kVp, Time, and Exposure

Record measurements for kVp, mS or mAs, and mR for a minimum of four (4) exposures.

mA Set =	mS Set =	mAs Set =	
kVp Set	kVp Measured	mS or mAs Measured	mR Measured
Mean			
Coefficient of variation			

$$C = \frac{s}{\overline{X}} = \frac{1}{\overline{X}} \left[\sum_{i=1}^{n} \frac{(X_i - \overline{X})^2}{n-1} \right]^{1/2}$$

Where:

s = estimated standard deviation of population

X_i = ith observation in sample

$\overline{X}$ = mean value of observations in sample

n = number of observations in sample

Reproducibility For:	Passed	Needs Repair
kVp		
Time or mAs		
Exposure		

NJDEP Medical Physicist's Radiographic QC Survey
Registration Number:

Form # 4

Timer Accuracy

Minimum of four (4) measurements in diagnostic range.
Exclude timer accuracy measurements for mAs units.

kVp Set =		mA Set =			
mS Set	mS Measured	% mS Error	mR Measured	Passed	Needs Repair

$$\% \text{ Accuracy} = \frac{(\text{measured value} - \text{set value}) \times 100}{\text{set value}}$$

NJDEP Medical Physicist's Radiographic QC Survey
Registration Number:

Procedure for Determining Linearity of X-Ray Tube Current (mA) Selector Units

1. Determine the mA settings most commonly used by the facility. If only one mA setting is used by facility, linearity need not be tested.

2. Using the lowest mA setting in 1 above and the next consecutive clinically used mA setting, make a minimum of 3 but no more than 10 exposures at each setting. The difference between these settings should not be greater than a factor of 2 (ex. between 100 mA and 200 mA NOT 100 mA and 300mA).

   - *These settings may include any 2 focal spot sizes except where 1 is equal to or less than 0.45 mm and the other is greater than 0.45 mm. (Source: 21 CFR Part 1020.31(c)3) Note: if the focal spot sizes are not known, it is recommended that both settings be from the same focal spot size.*

   - *The same exposure time and kVp setting are used for all exposures.*

3. **For each exposure**, record on form #5 (below), all applicable exposure settings, the kVp measured and mR measured. Calculate and record the mR/mAs for each exposure.

4. **For each mA setting,** calculate and record the average mR/mAs. Average is calculated within a single mA setting not between all mA settings tested. You need only test linearity between mA settings used clinically by facility.

5. Using the average mR/mAs calculated in 4 above and the following formula, calculate and record linearity between consecutive mA settings (ex. between 100 mA and 200 mA; between 200mA and 300mA):

   $$|x_1 - x_2| \leq 0.10\,(x_1 + x_2)$$

   Where x_1 and x_2 are the average mR/mAs values obtained at each of the 2 mA settings.

6. Determine compliance and check the appropriate box.

   According to N.J.A.C. 7:28-15.3(g)6, the average mR/mAs obtained at any 2 mA settings shall not differ by more than 0.10 times their sum.

It is recommended that at least one linearity test be performed for each focal spot size that is used by the facility. If for example only the large focal spot is used, the small focal spot does not need to be tested. For x-ray units where multiple mA settings are used, it is recommended that linearity be determined using a series of 4 different mA settings.

NJDEP Medical Physicist's Radiographic QC Survey
Registration Number:

Form # 5

mA linearity

Take between 3 and 10 readings at each mA setting and use to calculate the average mR/mAs. This average is calculated within a single mA setting not between all mA settings tested. You need only test linearity between mA settings used clinically by facility. If only one mA setting is used by facility, linearity need not be tested.

kVp set ____ time set ____

mA set	Calculate mAs	Focal spot (circle)	kVp Measured	mR Measured	Calculate mR/mAs	Average mR/mAs*
		L S				
		L S				
		L S				
		L S				

*Use this number in form below to determine if mA between consecutive settings is linear. Compare linearity between consecutive mA settings (ex. between 200 mA and 300 mA) Where x_1 and x_2 are the average mR/mAs values obtained at each of the 2 mA settings.

List mA stations being compared	**Calculate linearity** $\lvert x_1-x_2 \rvert \leq 0.10\,(x_1 + x_2)$	**Pass**	**Needs Repair**

NJDEP Medical Physicist's Radiographic QC Survey
Registration Number:

Procedure for Determining Linearity of
X-Ray Current-Exposure Time Product (mAs) Selector Units

1. Determine the mAs settings most commonly used by the facility.

2. Using the lowest mAs setting in #1 above and the next consecutive clinically used mAs setting, make a minimum of 3 but no more than 10 exposures at each setting. The difference between these settings should not be greater than a factor of 2 (ex. between 10 mAs and 20 mAs NOT 10 mAs and 30 mAs).

   - *These settings may include any 2 focal spot sizes except where 1 is equal to or less than 0.45 mm and the other is greater than 0.45 mm. (Source: 21 CFR Part 1020.31(c)3) Note: if the focal spot sizes are not known, it is recommended that both settings be from the same focal spot size.*

   - *The same kVp setting is used for all exposures.*

3. **For each exposure**, record on form 6 (below) all applicable exposure settings, the kVp measured and mR measured. Calculate and record the mR/mAs for each exposure.

4. **For each mAs setting,** calculate and record the average mR/mAs. Average is calculated within a single mAs setting <u>not</u> between all mAs settings tested. You need only test linearity between mAs settings used clinically by facility.

5. Using the average mR/mAs calculated in 4 above and the following formula, calculate and record linearity between consecutive mAs settings (ex. between 10 mAs and 20 mAs; between 20 mAs and 30 mAs):

   $$|x_1 - x_2| \leq 0.10\,(x_1 + x_2)$$

   Where x_1 and x_2 are the average mR/mAs values obtained at each of the 2 mAs settings.

6. Determine compliance and check the appropriate box.

   According to N.J.A.C. 7:28-15.3(g)6, the average mR/mAs obtained at any 2 mAs settings shall not differ by more than 0.10 times their sum.

It is recommended that at least one linearity test be performed for each focal spot size that is <u>used</u> by the facility and when the focal spot size is known or selectable. If for example only the large focal spot is used, the small focal spot does not need to be tested. For x-ray units, where multiple mAs settings are used, it is recommended that linearity be determined using a series of 4 different mAs settings.

NJDEP Medical Physicist's Radiographic QC Survey
Registration Number:

Form 6

mAs Linearity

Take between 3 and 10 readings at each mAs setting and use to calculate the average mR/mAs. This average is calculated within a single mAs setting not between all mAs settings tested. You need only test linearity between mAs settings used clinically by facility. If only one mAs setting is used by facility, linearity need not be tested.

kVp set [ ]

mAs set	Focal spot (circle)	kVp Measured	mR Measured	Calculate mR/mAs	Average mR/mAs*
	L S				
	L S				
	L S				
	L S				

*Use this number in table below to determine if mAs between consecutive settings is linear.
Linearity between consecutive mAs settings (ex. between 20 mAs and 30 mAs).
Where x_1 and x_2 are the average mR/mAs values obtained at each of the 2 mAs settings.

List mAs stations being compared	**Calculate linearity** $\lvert x_1-x_2 \rvert \leq 0.10\,(x_1 + x_2)$	**Pass**	**Needs Repair**