FLUKE®
Biomedical

Nuclear Associates 07-638

Fluoro Contrast Test Disks

Nuclear Associates 07-614-8080

Adult Cine Attenuators

Users Manual

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Section 1
Introduction

1.1 Product Description

It is important that the percent contrast of the image intensifier tube/basic lens/cine lens combination be monitored on a regular basis.

This test should be performed annually, or whenever a new image-intensifier tube is installed, using the Fluoro Contrast Test Disks (07-638). It is a very useful test for monitoring the contrast of the image-intensifier tube/lens system over a long period of time, as part of a quality assurance-testing program on the cine imaging chain. The measurement of image-intensifier percent contrast involves imaging a lead contrast disk, which has a thickness of 1/8 inch and a diameter equal to approximately 10% of the active diameter of the input phosphor, taped to the anti-scatter grid, on center, during a 2 or 3 second cine run with the Adult Cine Attenuator (07-614-8080) or equivalent in the beam.

You will need the following materials:

- Fluoro Contrast Test Disk (07-638)
- Radiographic Ruler (07-533)
- Adult Cine Attenuator (07-614-8080)
- Sensitometer (07-417) or (07-419)
- Curve Plotting Graph Paper
- Ships Curve and Ruler

1.2 Procedure

1. Set up the Radiographic System to meet the following parameters:
   A. Large or small focal spot (75 kVp is optimal)
   B. Maximum x-ray tube image intensifier distance
   C. Correct size lead disk
   D. Optimize kVp at 75 kVp
2. Attach the radiographic ruler to the face of the image intensifier. The ruler should be centered, and positioned at a 45° angle to the long axis of the table. Select the largest mode (field size) available for this actual measurement of the useful input entrance field diameter. Remove ruler after measurement.
3. Tape the correct lead disk to the face of the image intensifier (approximately 10% of the input area). THE LEAD DISK MUST BE CENTERED!

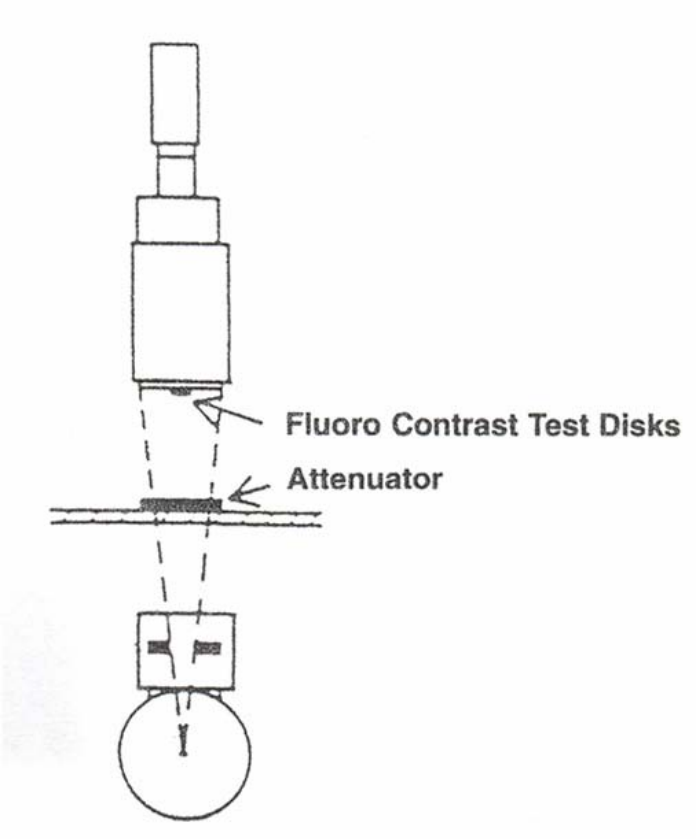


Figure 1-1.The Setup for the Image-Intensifier Tube Percent Contrast Measurement

4. Place the Adult Cine Attenuator (or equivalent) at the center of the beam, as shown in Figure 1-1.
5. Produce a test cine exposure; set the x-ray control at a minimum kVp of 75, and monitor the kVp level.
6. Produce an aperture-density series of the lead disk. Exposure runs for 3 to 5 seconds for each aperture, using the existing aperture as a base. From the base aperture, produce the following exposures using f-stop numbers: -1, -½ base, +1, +1 ½ +2.

NOTE

With some radiographic systems, it is not possible to adjust the cine camera aperture. However, most of these systems do offer a film density control. The film density control can be adjusted to achieve the on-film densities necessary for this procedure. The kVp must remain the same.

7. In the darkroom, add a sensitometric exposure to the film with the disk images. The sensitometric exposures must be processed with the disk images.
8. Process as normal.
9. From the sensitometric strip, measure the film densities and draw a characteristic curve.

10. Identify the aperture-density series where the Log E difference between the exposed "black" area and the "unexposed" area within the lead disk are the greatest. Most frequently, this will be the density that is 0.05 to 0.10 density above gross fog.

11. Carefully measure the film density of the disk image in the center of the image where the lead disk absorbs the x-rays. Record this density.
12. With the densitometer, find the highest density in the "black" area that surrounds the disk. Record this density.
13. On the characteristic curve, draw horizontal lines that correspond to the two identified film densities.
14. Where these lines intersect the characteristic curve, find the log relative exposure number for each density.
15. Subtract the low Log E number from the high Log E number.
16. The number that remains will be converted to the contrast ratio. On the chart (see page 5), find the log exposure number; the corresponding number is the contrast ratio. A scientific calculator with a log function will also calculate this number.
17. A contrast ratio of 12:1 is considered minimum for cardiac angiography. A contrast ratio of 20:1 to 25:1 is optimum.

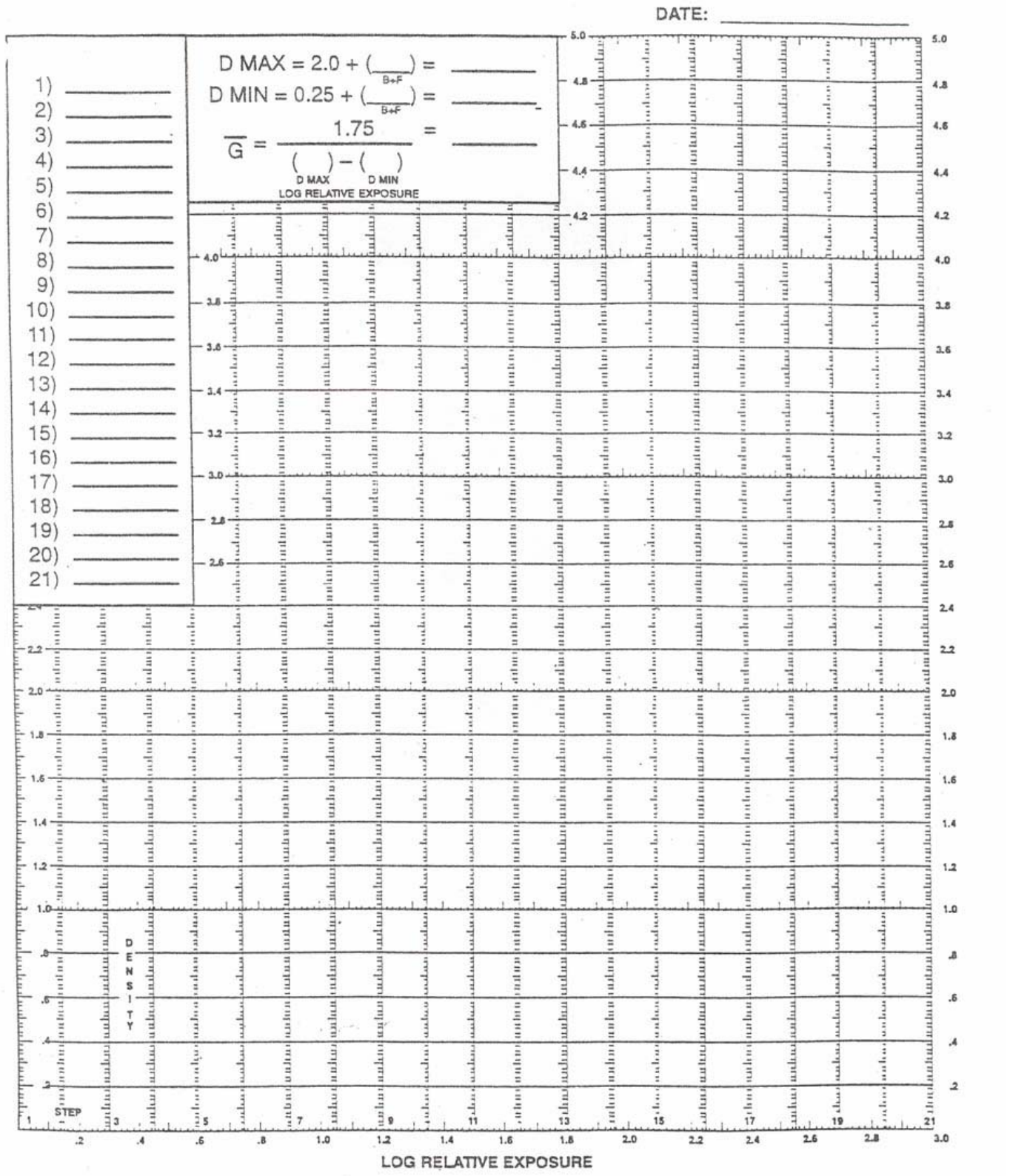
NOTE

A Contrast Ratio above 25:1 increases the visibility of quantum mottle (noise).

18. If a contrast ratio of 12:1 or lower is found, the following parameters should be considered:
    - Focus of the image intensifier
    - Gassy image intensifier
    - Image intensifier age

Log Exposure/Image Intensifier Contrast Ratio

Log Exposure	Contrast Ratio	Percent Contrast (R-1)/(R+1)
0.60	4:1	60
0.65	4.5:1	64
0.70	5:1	67
0.74	5.5:1	69
0.78	6:1	71
0.81	6.5:1	73
0.85	7:1	75
0.88	7.5:1	76
0.90	8:1	78
0.93	8.5:1	79
0.95	9:1	80
0.98	9.5:1	81
1.00	10:1	82
1.02	10.5:1	82.6
1.04	11:1	83.3
1.06	11.5:1	84.0
1.08	12:1	84.6
1.10	12.5:1	85.2
1.12	13:1	85.7
1.13	13.5:1	86.2
1.15	14:1	86.7
1.16	14.5:1	87.1
1.18	15:1	87.5
1.19	15.5:1	87.9
1.20	16:1	88.2
1.22	16.5:1	88.5
1.23	17:1	88.9
1.24	17.5:1	89.2
1.26	18:1	89.5
1.27	18.5:1	89.7
1.28	19:1	90.0
1.29	19.5:1	90.2
1.30	20:1	90.5
1.32	21:1	90.9
1.34	22:1	91.3
1.36	23:1	91.7
1.38	24:1	92.0
1.40	25:1	92.3
1.41	26:1	92.6
1.43	27:1	92.9
1.45	28:1	93.1
1.46	29:1	93.3
1.48	30:1	93.5
1.49	31:1	93.8
1.50	32:1	93.9
1.52	33:1	94.1
1.53	34:1	94.3
1.56	36:1	94.6
1.58	38:1	94.9
1.60	40:1	95.1
1.62	42:1	95.3


DATE: _____
1) _____
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19) _____
20) _____
21) _____
D MAX = 2.0 + (____/B+F) = _____
D MIN = 0.25 + (____/B+F) = _____
G = 1.75 / (D MAX) − (D MIN) = _____
LOG RELATIVE EXPOSURE
DENSITY
STEP
LOG RELATIVE EXPOSURE

1.3 Apertures & F-Stop Numbers

One of the current ways to control film density (and by far the best choice) when doing cinefluorography is by adjustments made at the aperture opening. That is, the f-stop of the camera lens. This procedure is readily accomplished with the use of external apertures (Waterhouse Stops) or with some of the older cameras, the use of the internal aperture control. The Waterhouse Stops may be made from x-ray film, exposed and processed to D-Max. The formula for determining the f-stop number is as follows:

$$\text{F-Stop} = \frac{\text{Focal Length of Lens}}{\text{Effective Aperture of Lens (Diameter)}}$$

$$\text{Example: } \frac{\text{100 mm Lens}}{\text{25 mm Aperture (Diameter)}} = \text{F/4.0}$$

This formula can be used for determining the f-stop openings for all lens focal lengths.

		75 mm LENS	**82 mm LENS**	**85 mm LENS**	**100 mm LENS**
*	F/1.2	63 mm	68 mm	71 mm	83 mm
	F/1.4	54 mm	59 mm	61 mm	71 mm
*	F/1.7	44 mm	48 mm	50 mm	59 mm
	F/2.0	38 mm	41 mm	43 mm	50 mm
*	F/2.4	31 mm	34 mm	35 mm	42 mm
	F/2.8	27 mm	29 mm	30 mm	36 mm
*	F/3.4	22 mm	24 mm	25 mm	29 mm
	F/4.0	19 mm	21 mm	21 mm	25 mm
*	F/4.8	16 mm	17 mm	18 mm	21 mm
	F/5.6	13 mm	15 mm	15 mm	18 mm
*	F/6.7	11 mm	12 mm	13 mm	15 mm
	F/8.0	9 mm	10 mm	11 mm	13 mm

** ½ f-stop numbers*

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