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TOR 18FG

user manual

X - ray Phantoms

DESCRIPTION

Test object TOR 18FG is intended to be used routinely by radiographers to check the imaging performance of conventional image-intensifier fluoroscopy and fluorography systems. This may be done on a week-to week basis, keeping an on-going record of the test results, which will indicate any deterioration in imaging performance.

Figure 1 shows the layout of the test details, which enable the following tests to be carried out:

- Brightness and contrast adjustments to the television monitor
- Television scanning linearity (circular geometry)
- Low-contrast sensitivity (finding the threshold contrast)
- Spatial resolution limit

Specifications of the X-ray contrasts and spatial frequencies in the test object are given on page 4.

POSITIONING THE TEST OBJECTS

The test object should be placed centrally, as close to as possible to the entrance plane of the image intensifier. When the system has no anti-scatter grid, position the test object so that the resolution bar patterns will be imaged at right angles to the scanning lines of the television monitor. If an anti-scatter grid is included, turn the test object through 45 degrees to avoid interference from both the scanning lines and the grid structure.

X-RAY BEAM CONDITIONS

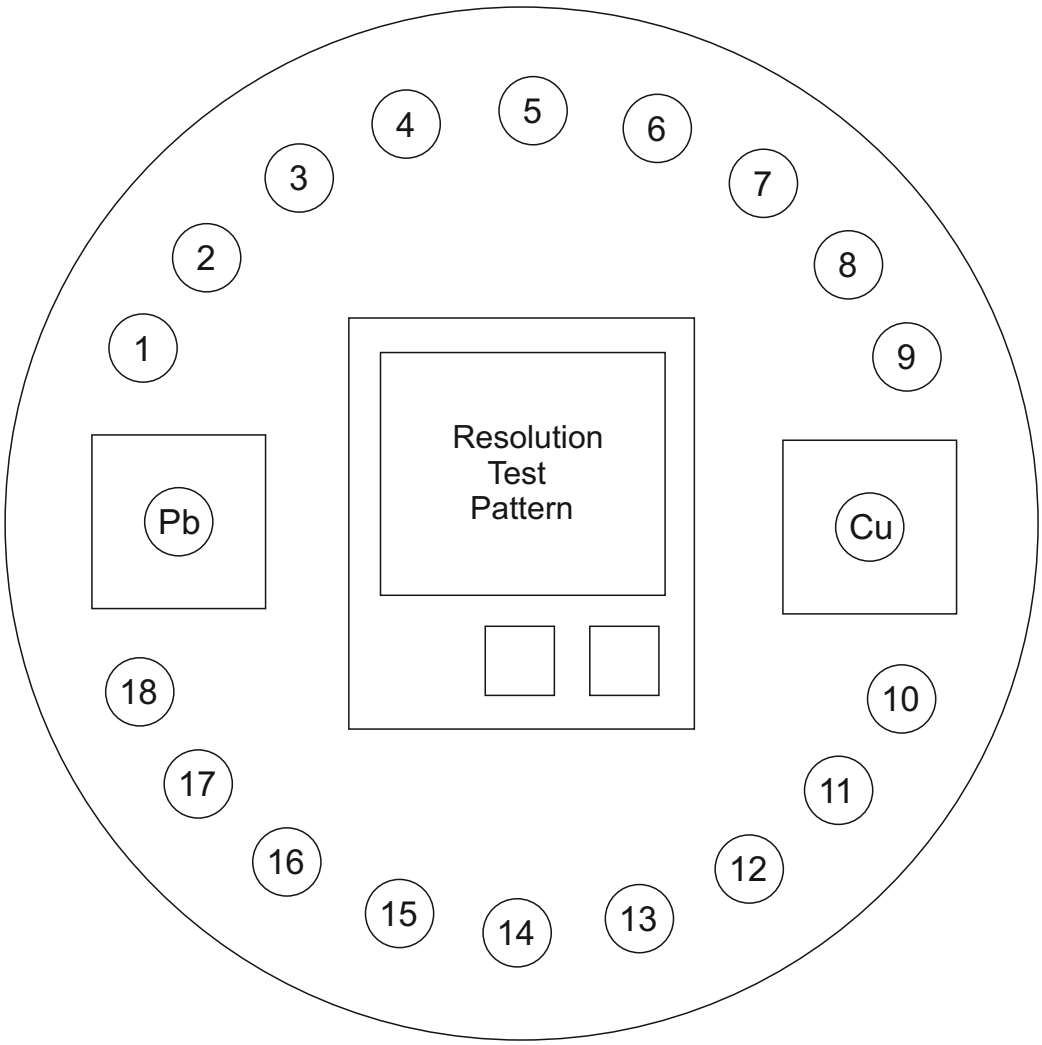
The recommended beam conditions are 70 kVp with a primary filter of 1 mm copper. Place the supplied filter as close as possible to the tube head, normally at the diaphragm housing. Select the most suitable field size for the test image, and use the appropriate exposure rate. If kVp or mA values can not be set manually, allow the automatic exposure control of the system to produce an acceptable image. The exposure conditions should be recorded; they must be the same every time, otherwise the test results can not be compared.

SETTING THE MONITOR CONTROLS

Observe the light and dark squares, and set the brightness and contrast controls so that both circles are clearly visible within the squares. The range between black and white should be as wide as possible, with a true black level in the dark (Pb) circle, and without peak-white glare. The monitor will then be correctly adjusted for the following tests, and for most clinical radiological work.

The circular rim surrounding the test details should appear perfectly circular on the monitor screen. If not, it indicates the vertical and/or horizontal time base scans need adjusting. It is unlikely to be due to geometric distortion in the image intensifier, which is normally 'pincushion' distortion caused by the curvature of the input screen, although other effects can be caused by external magnetic fields.

Figure 1: Layout of test details (not to scale)



MEASURING LOW-CONTRAST SENSITIVITY

The ability of an X-ray system to image low-contrast details depends on the levels of noise and contrast loss (due to scatter), which can change over a period of time. The 18 circular discs form a series of gradually decreasing contrasts, and the measurement consists of determining which disc lies at the threshold of visibility.

The measurement should be made at a fixed distance from the monitor, because viewing distance affects the perception of image noise. The recommended distance is about four times the diameter of the monitor circle, although this is not critical.

This type of measurement requires some practice and experience before consistent results are obtained. As viewing experience is gained, the psycho-physical threshold of an observer should stabilise, and details of lower contrast may be detected. The least-visible disc is determined simply by counting the number that can be detected, and the value of the threshold contrast can be found from the specification table. For modern fluoroscopy systems, an average value of threshold contrast should be about 0.03 (11 or 12 discs visible) in the 25cm field size.

N.B. to be able to compare test results and so detect system deterioration, the same conditions must be observed each time the test is carried out. This means not only the same X-ray exposure conditions but also the same viewing conditions, with a correctly adjusted monitor and a standardised viewing distance. Room lighting can be at normal levels, although lights should not be seen reflected in the monitor screen.

MEASURING THE RESOLUTION LIMIT

The resolution limit is a simple indicator of the sharpness of the system, which depends on optimum focusing of the image components (intensifier, optical lenses, television camera etc.) and which may deteriorate with time. Measurement of the resolution limit requires the test pattern to be imaged under conditions of high contrast and low noise. Remove the 1 mm copper filter, and select a low tube voltage, about 50 kVp. Increase the exposure rate as much as possible without saturating the camera (seen as 'flaring' on the monitor); the X-ray quantum noise is then at a minimum. Where exposure conditions are set automatically, it may be necessary to place some additional light-element material in the beam, which will attenuate the beam without unduly 'hardening' it. Perspex (PMMA) is such a material. Paper is also suitable, and one or more telephone directories (for example) placed in the beam close to the tube may be helpful in obtaining the required beam conditions.

At a comfortable viewing distance, which can be much closer than before, observe the resolution pattern on the monitor screen, and note those groups where the bars and spaces are all visible. From the specification table, determine the highest spatial frequency that can be resolved in this way. This should be done for each available field size. Average values for modern fluoroscopy systems are 1.25 line pairs per mm for 25 cm field size, 1.6 line pairs per mm for the 15 cm field size.

N.B. the monitor controls should not be altered for these measurements, even though better results may be obtained by reducing Brightness or increasing Contrast. As noted above, viewing conditions must always be standardised on each test occasion, if comparable results are to be obtained.

SPECIFICATIONS OF THE TEST DTAILS

18 circular details, diameter 8 mm. The following table gives the X-ray contrasts of the discs for beam conditions of 70 kVp (constant potential) with 1 mm copper filtration. These should be regarded as nominal values; actual contrasts will depend on the kV waveform, etc. They are also subject to manufacturing tolerances of ±5%.

Disc Number	Contrast
1	0.167
2	0.148
3	0.128
4	0.109
5	0.088
6	0.075
7	0.067
8	0.053
9	0.045

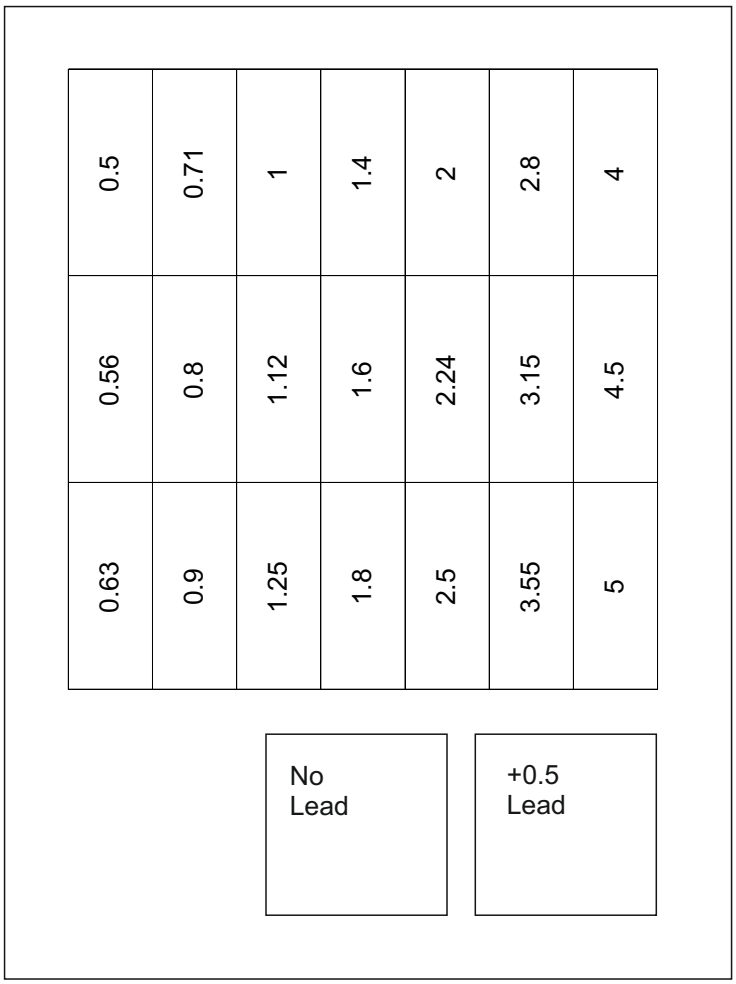
Disc Number	Contrast
10	0.039
11	0.032
12	0.027
13	0.022
14	0.017
15	0.015
16	0.013
17	0.011
18	0.009

Resolution test Patterns: there are 21 separate groups of bar patterns, each group comprising 5 bars and 4 spaces, giving 4½ 'line pairs'. The following table gives the spatial frequencies in line pairs per mm.

Group Number	Sp.freq.
1	0.5
2	0.56
3	0.63
4	0.71
5	0.8
6	0.9
7	1
8	1.12
9	1.25
10	1.40
-	-

Group Number	Sp.freq.
11	1.6
12	1.8
13	2
14	2.24
15	2.5
16	2.8
17	3.15
18	3.55
19	4
20	4.50
21	5

Layout for Type 18 (0.5 – 5.0 LP/mm) Resolution Test Pattern:



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