PERFORMANCE MEASUREMENTS OF X-RAY ANTI-SCATTER GRIDS

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Could we use flat panel detectors for the measurements of grid characteristics comparable to IEC standards?

Measurement Techniques

Standard IEC Technique	Flat Panel Technique
Conventional X-ray system	Fluoroscopic DR system
Exposure readings with 6cc ion chamber (different from IEC)	Pixel readings from digital images

Measured Parameters

Transmission of Primary radiation, T_p
Transmission of Scattered radiation, T_s
Transmission of Total radiation, T_t

$$\frac{\text{Exposure (pixel) reading with grid}}{\text{Exposure (pixel) reading without grid}}$$

Calculated Parameters

Grid Selectivity, $\Sigma = T_p / T_s$

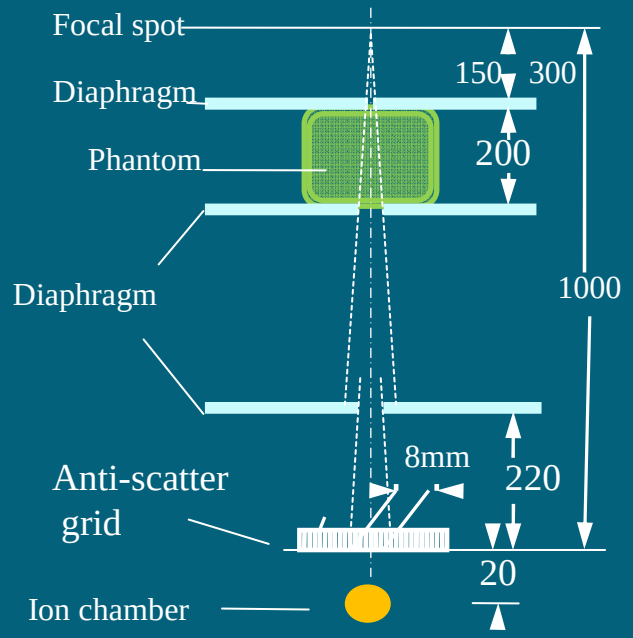
Contrast Improvement Ratio, $CIF = T_p / T_t$

Grid Exposure Factor, Bucky Factor, $B = 1 / T_t$

DMC Anti-scatter grids; Al interspaced with the ratios of 8:1, 10:1, 10:1(P), 12:1, Cross

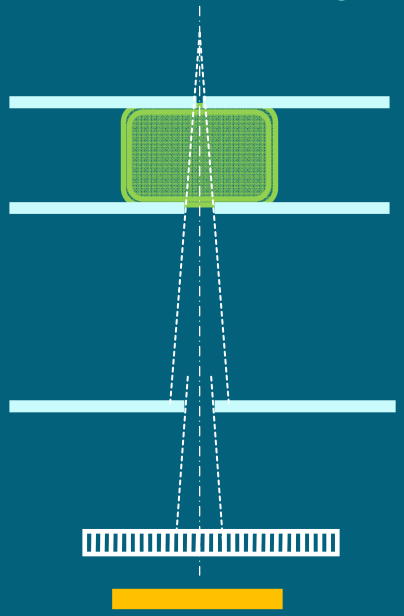
Measurement of T_p

Standard IEC Technique

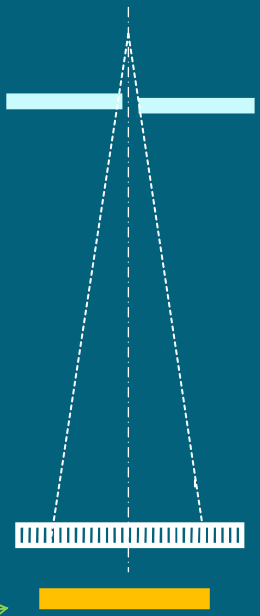


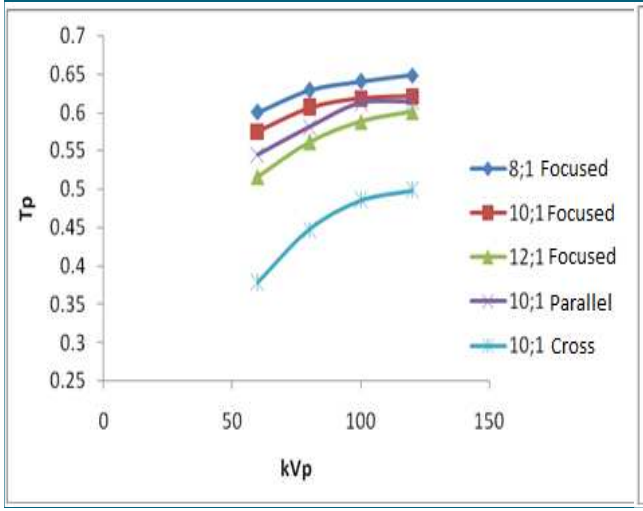
Flat Panel Technique

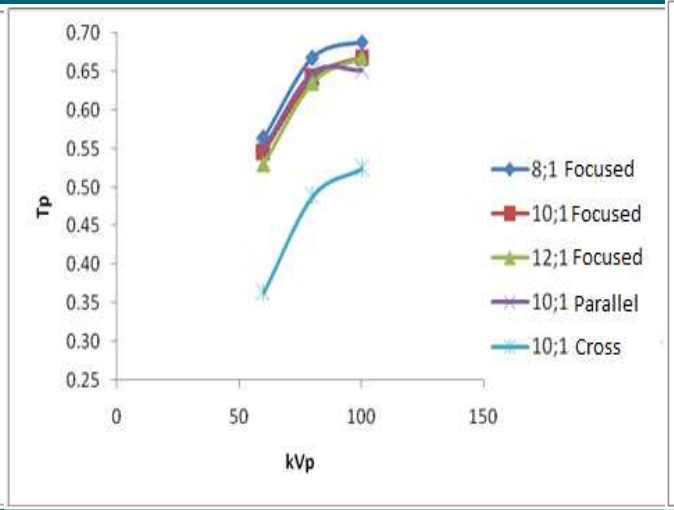
IEC Geoemetry

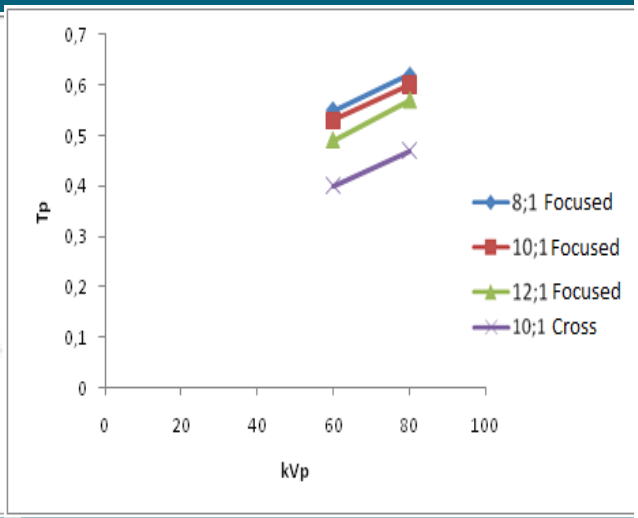


Beam Stop

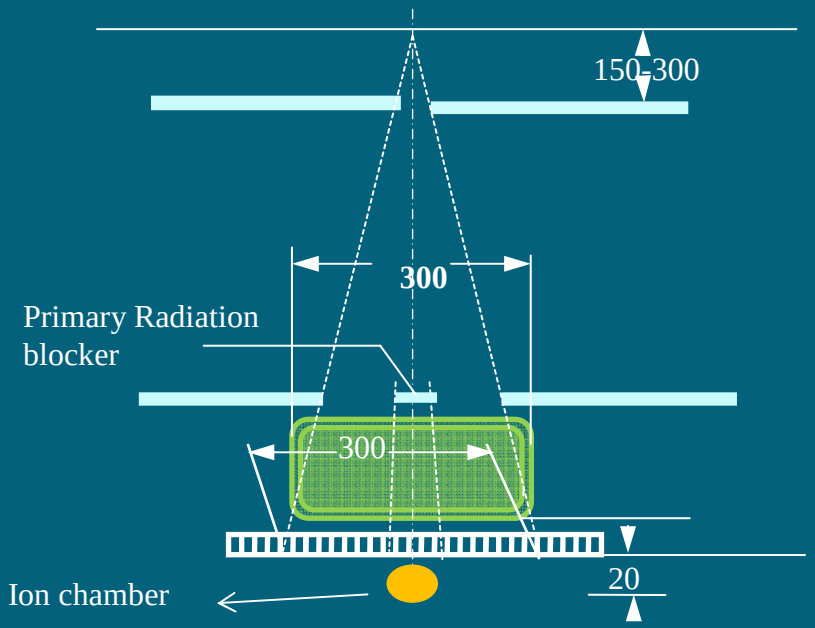


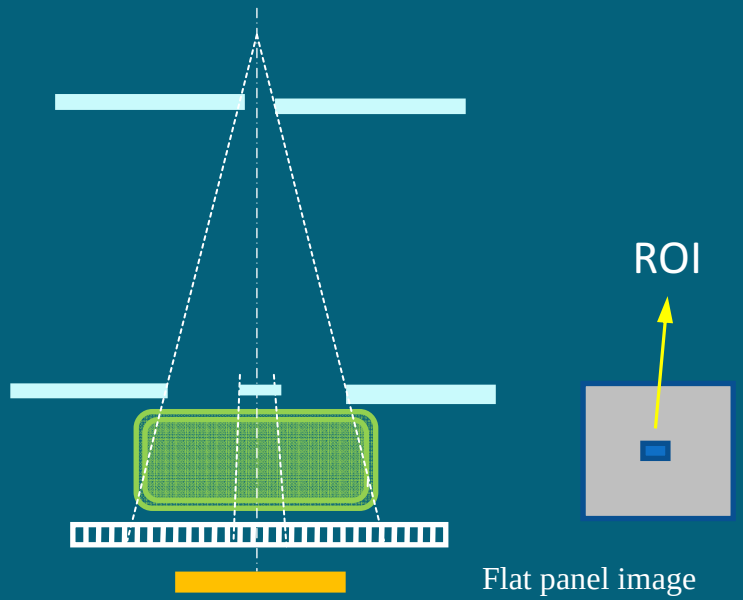






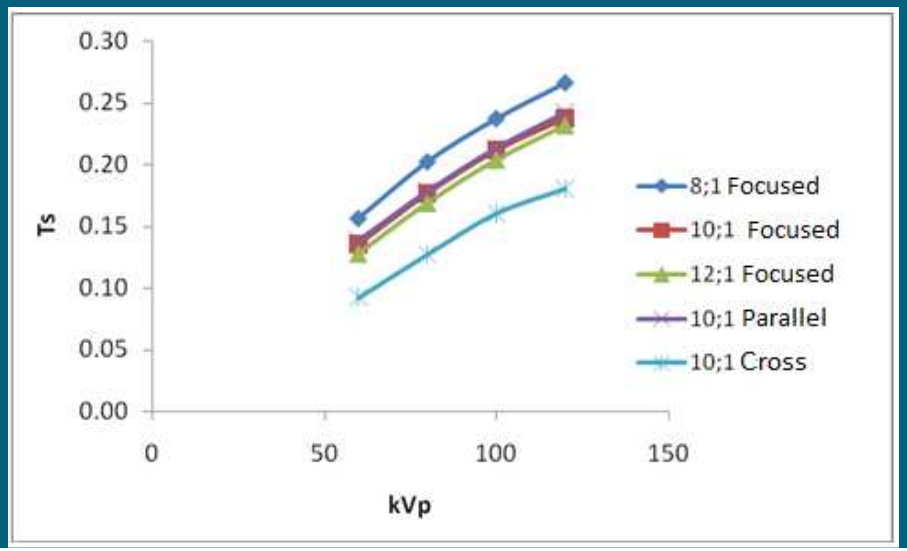
Measurement of T_s

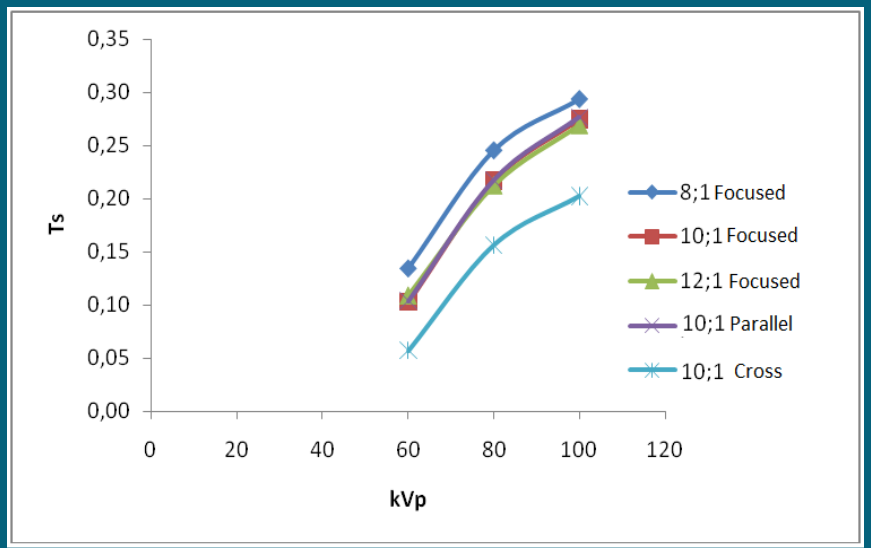




Standard IEC Technique

Flat Panel Technique

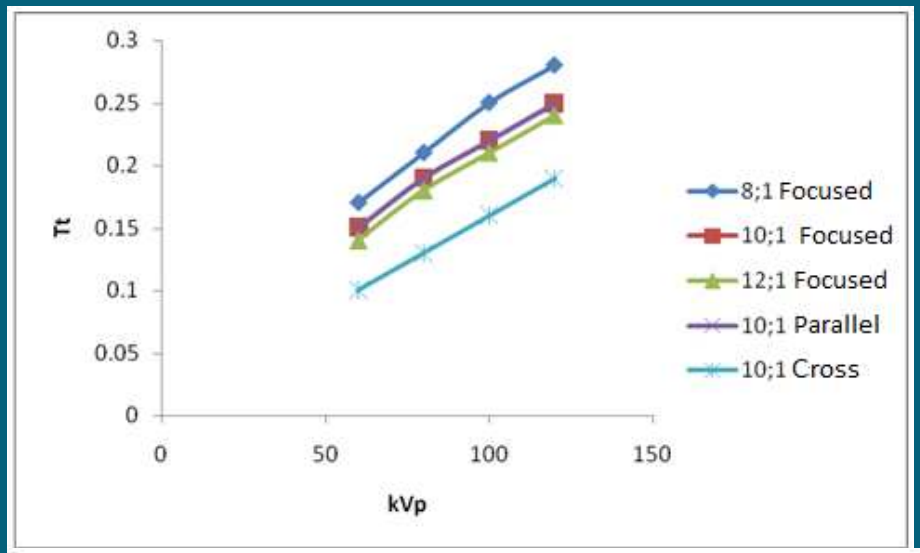


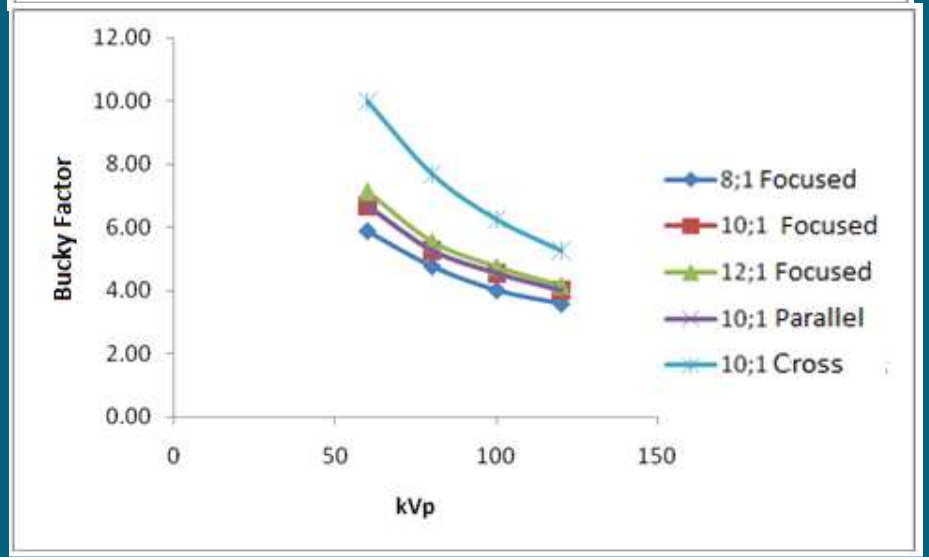


Measurement of T_t and Bucky Factor ($1/T_t$)

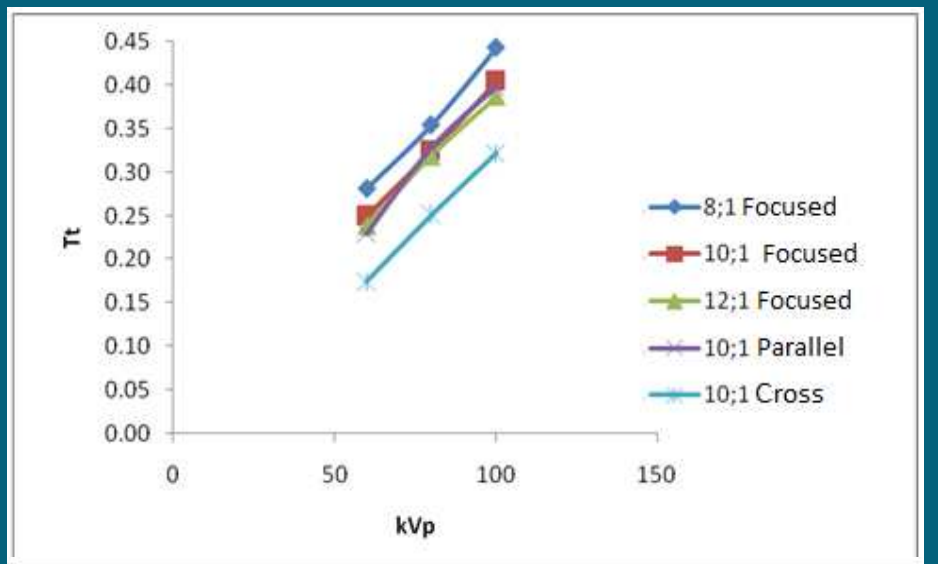
Same irradiation geometry with T_s measurements, but the lead blocker is removed

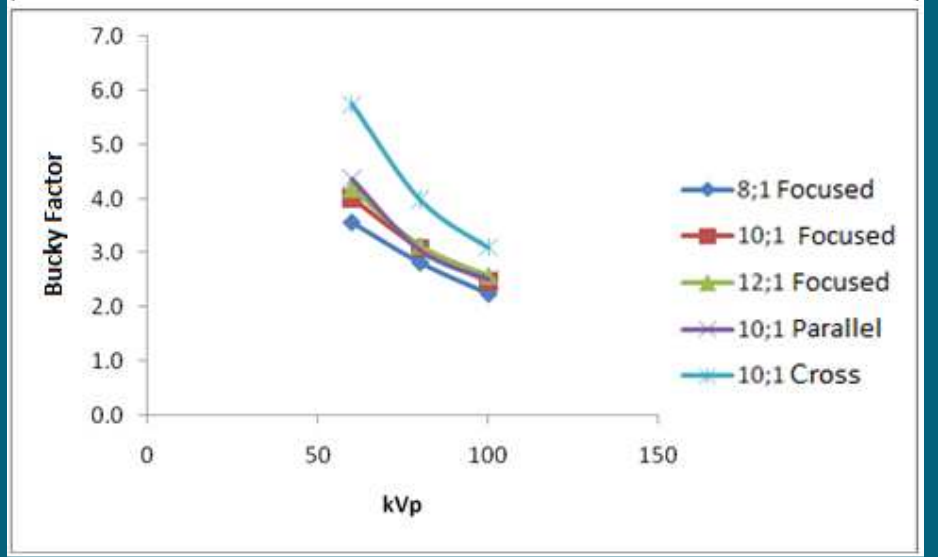
Standard IEC Technique





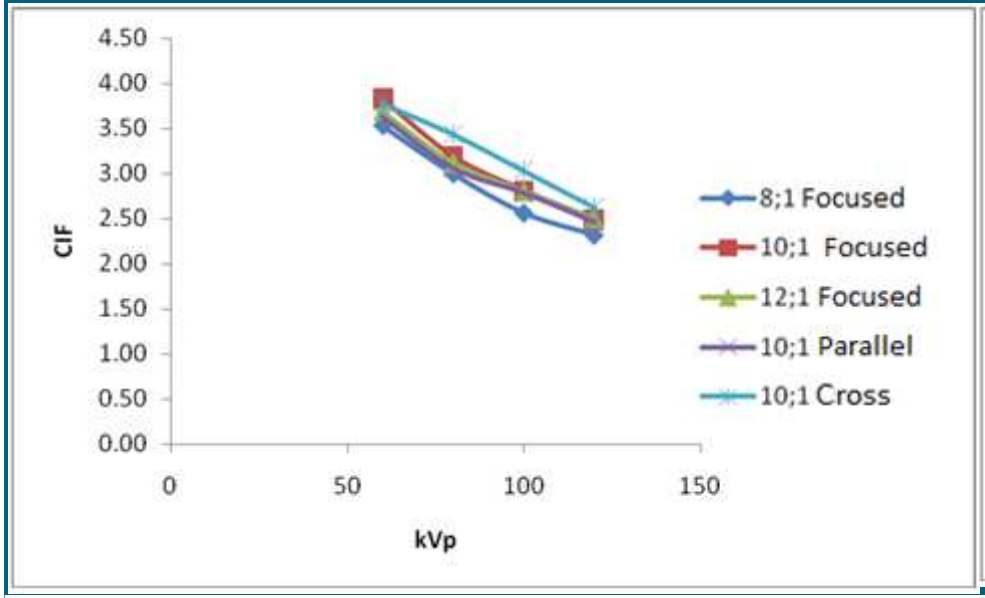
Flat Panel Technique



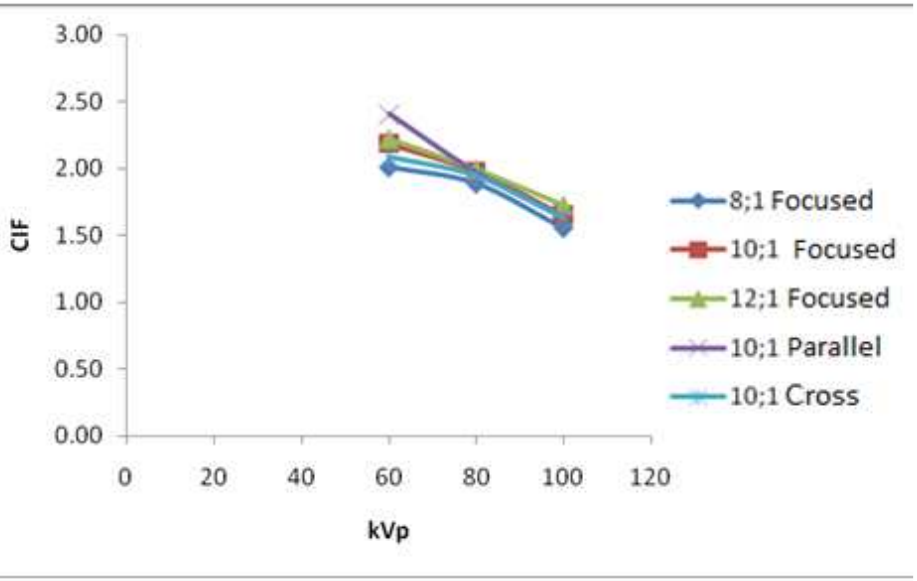


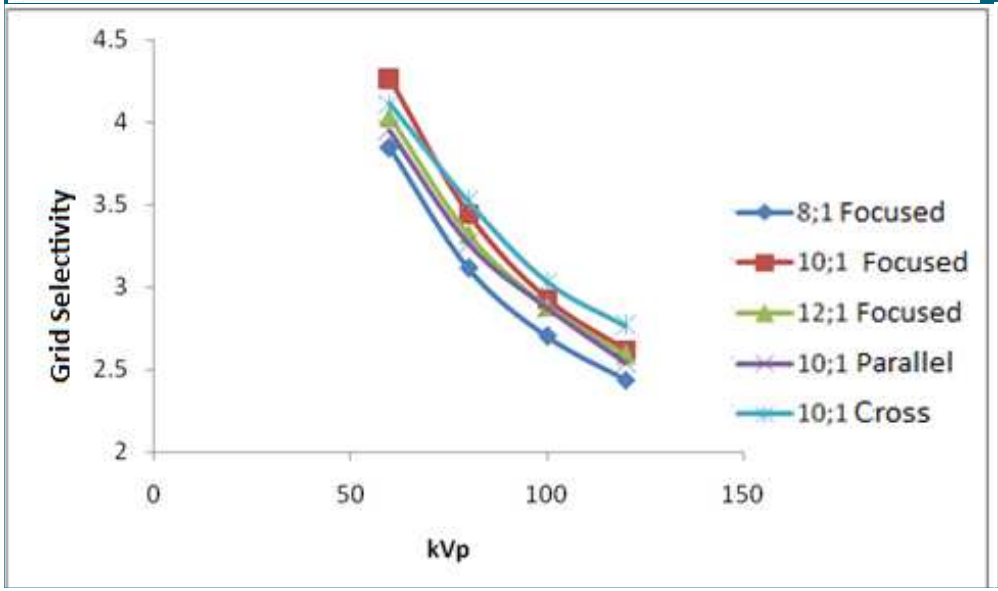
Contrast Improvement Factor (T_p / T_t) and Grid Selectivity (T_p /T_s)

Standard IEC Technique



Flat Panel Technique





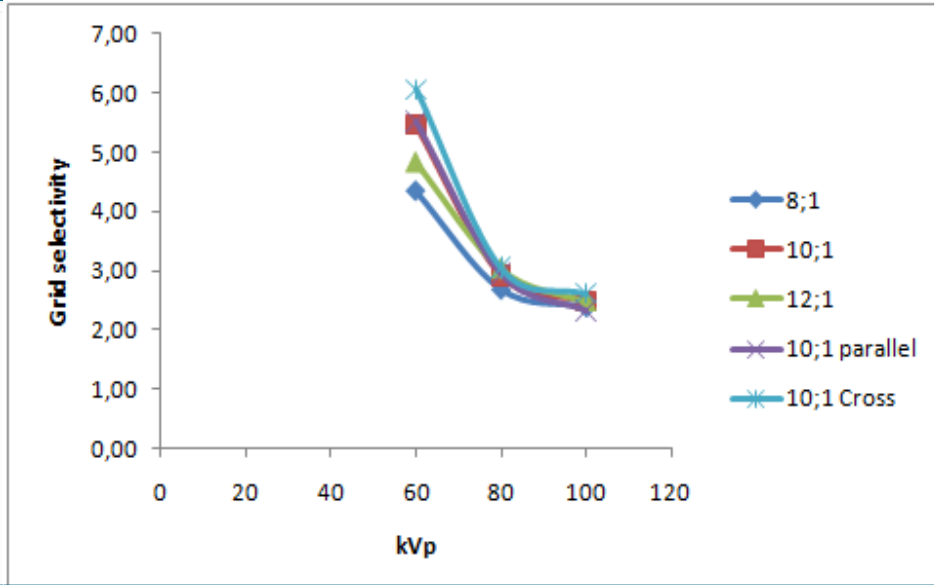
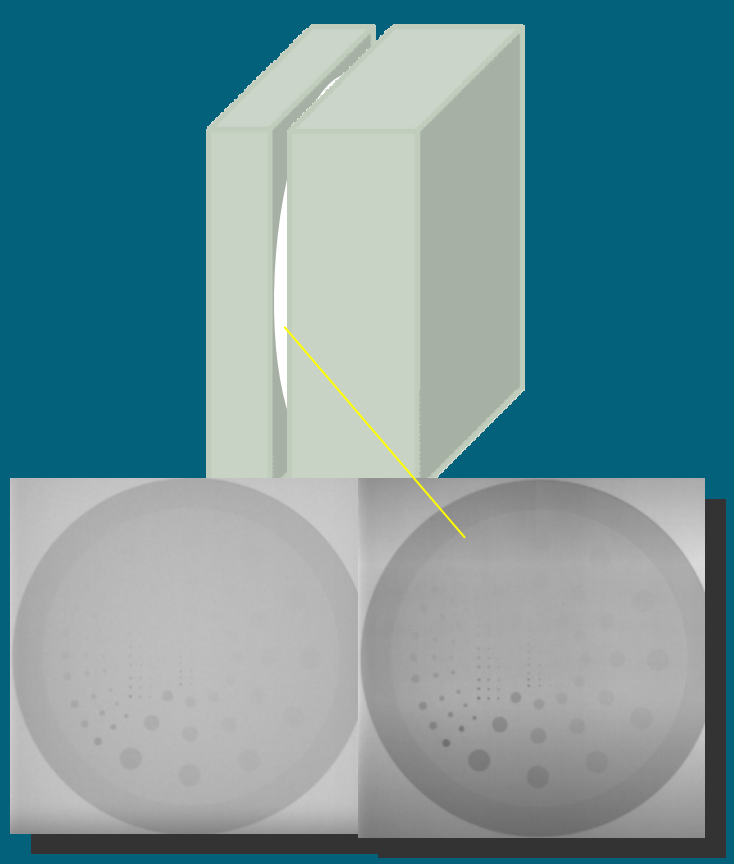
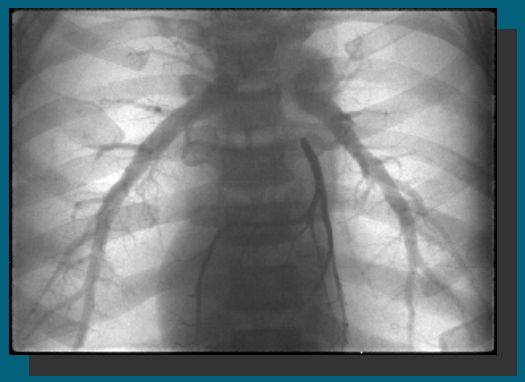
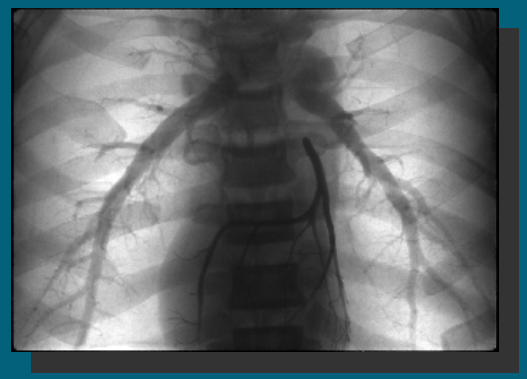


Image quality measurements







Contrast improvement with grid

	Extremity (65 kVp)	Skull (70 kVp)	Chest (80 kVp)	Chest (Antm
8:1	1.27	1.74	1.32	1.82
10:1 (P)	1.37	1.92	1.41	1.91
10:1 (C)	1.44	1.98	1.48	1.81

Results and Discussions

- T_p reduces with grid ratio, cross grid has the lowest value
- T_p increase with beam energy

  Slowly increases with standart technique and saturates at high energies
  Increase is faster for FP technique

- T_p values of 10:1 (f), 12:1 (f) and 10:1 (p) grids are almost similar for FP technique
- Although the readings of FP technique with IEC geometry slightly higher for high energies, results are comparable among the techniques
- Pixel saturation may occur for T_p at high energies in FP beam stop technique
- T_s increases with beam energy, and reduces with grid ratio.
  Similar behaviors for standard and FP techniques
- T_s values of 10:1 and 12:1 grids are very close to each other for both techniques
- Lower T_s values were found for standard technique
- The size of the lead blocker and/or detector size is important for the T_s measurements

Results and Discussions

- T_t values increase with beam energy and decrease with grid ratio. Similar behaviour for both techniques
- No obvious differences among the T_t of 10:1, and 12:1 grids
- Higher T_t values were found for FP technique due to its larger solid angle
- Differences of the BF between different ratio grids reduces with beam energy. Results of 10:1 and 12:1 grids are almost same.
- CIF of different grids reduces with energy, however differences between the grids are very small.
- BF of cross grid is quite high then others, but its CIF and Σ values are close to others
- Differences of CIF values of different ratio grids are close to each other
- Regarding to the variation of BF and CIF with energy, different ratio grids can be better discriminated for standard technique.
- Grid selectivity is a better parameter than CIF for the separation of different ratio grids.

Results and Discussions

Different ratio grids can be better separable for standard technique at different beam qualities. T_p measurements can be suggested for this purpose.

Slightly different values have been found for the BFs. There is an under estimation for FP technique due to the larger solid angle of flat detector

- Grids may exhibit different performance than their stated specifications
- Flat panel detectors can be used for grid tests and comparable results to IEC technique can be obtained.
- Beam stop technique with flat panel is easy to implement for T_p and T_s measurements
- Image quality phantoms give only a gross estimation of grid performances

THANK YOU