6.1.9 ***Technique for different material thicknesses***

See Figure 19.

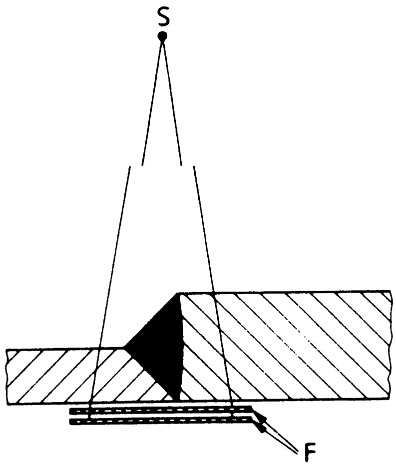


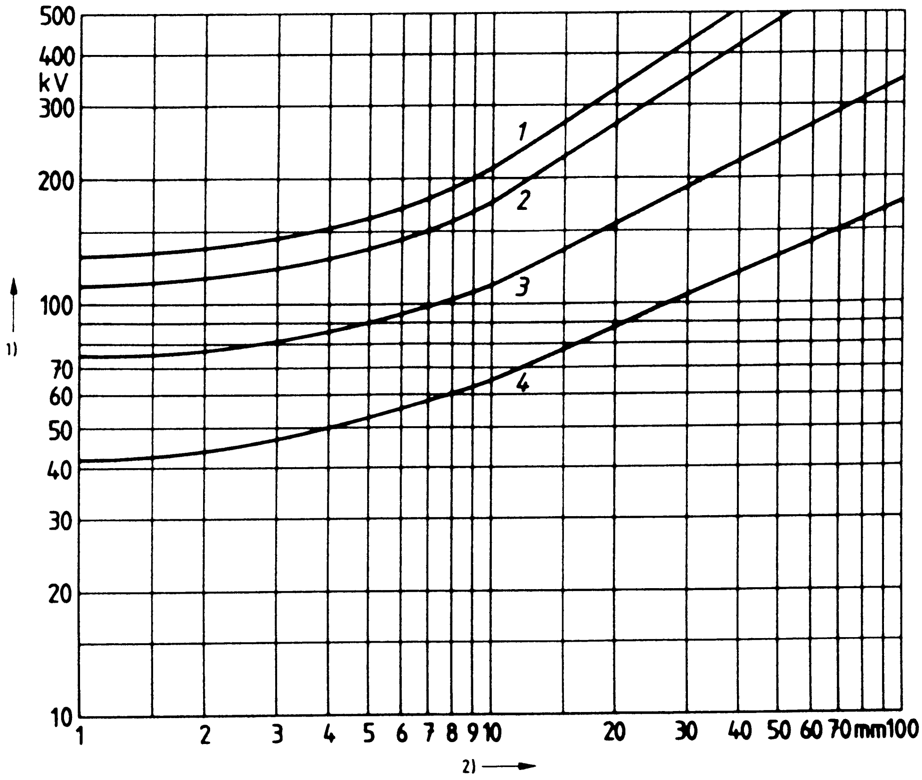
Figure 19 — Multi-film technique

6.2 Choice of tube voltage and radiation source

6.2.1 ***X-ray devices up to 500 kV***

To maintain a good flaw sensitivity, the X-ray tube voltage should be as low as possible. The maximum values of tube voltage versus thickness are given in Figure 20.

For some applications where there is a thickness change across the area of object being radiographed, a modification of technique with a slightly higher voltage may be used, but it should be noted that an excessively high tube voltage will lead to a loss of defect detection sensitivity. For steel, the increment shall be not more than 50 kV, for titanium not more than 40 kV, and for aluminium not more than 30 kV.



1 Copper/nickel and alloys
2 Steel
3 Titanium and alloys
4 Aluminium and alloys

1) X-ray voltage
2) Penetrated thickness *w*

Figure 20 — Maximum X-ray voltage for X-ray devices up to 500 kV as a function of penetrated thickness and material

6.2.2 *Other radiation sources*

The permitted penetrated thickness ranges for gamma ray sources and X-ray equipment above 1 MeV are given in Table 1.

[A1] If permitted by specification [A1], the value for Ir 192 may further be reduced to 10 mm and for Se 75 to 5 mm.

On thin steel specimens, gamma rays from Se 5, Ir 192 and Co 60 will not produce radiographs having as good a defect detection sensitivity as X-rays used with appropriate technique parameters. However, because of the advantages of gamma ray sources in handling and accessibility, Table 1 gives a range of thicknesses for which each of these gamma ray sources may be used when the use of X-rays is difficult.

For certain applications, wider wall thickness ranges may be permitted, if sufficient image quality can be achieved.

In cases where radiographs are produced using gamma rays, the travel time to position the source shall not exceed 10 % of the total exposure time.

Table 1 — Penetrated thickness range for gamma ray sources and X-ray equipment with energy from 1 MeV and above, for steel, copper and nickel-based alloys

Radiation source	Penetrated thickness, w mm	
	Test class A	Test class B
Tm 170	$w \leqslant 5$	$w \leqslant 5$
Yb 169[1)]	$1 \leqslant w \leqslant 15$	$2 \leqslant w \leqslant 12$
Se 75[2)]	$10 \leqslant w \leqslant 40$	$14 \leqslant w \leqslant 40$
Ir 192	$20 \leqslant w \leqslant 100$	$20 \leqslant w \leqslant 90$
Co 60	$40 \leqslant w \leqslant 200$	$60 \leqslant w \leqslant 150$
X-ray equipment with energy from 1 MeV to 4 MeV	$30 \leqslant w \leqslant 200$	$50 \leqslant w \leqslant 180$
X-ray equipment with energy from 4 MeV to 12 MeV	$w \geqslant 50$	$w \geqslant 80$
X-ray equipment with energy above 12 MeV	$w \geqslant 80$	$w \geqslant 100$

1) For aluminium and titanium, the penetrated material thickness is 10 mm < w < 70 mm for class A and 25 mm < w < 55 mm for class B.

2) For aluminium and titanium, the penetrated material thickness is 35 mm $\leqslant w \leqslant$ 120 mm for class A.

6.3 Film systems and screens

For radiographic testing, film system classes shall be used in accordance with EN 584-1.

For different radiation sources the minimum film system classes are given in Table 2 and Table 3.

When using metal screens, good contact between films and screens is required. This may be achieved either by using vacuum-packed films or by applying pressure.

For different radiation sources, Table 2 and Table 3 show the recommended screen materials and thicknesses.

Other screen thicknesses may be [A1) specified (A1], provided that the required image quality is achieved.