

Cargo containers and trucks carry a wide range of materials, including liquids which can be difficult to penetrate with x rays. Locating contraband materials or weapons of mass destruction in these containers requires high-energy x rays generated from linear accelerator x-ray sources. While isotopic gamma sources can penetrate these large containers they do not provide the superior spatial resolution that is obtainable with linear accelerator-based systems. X-ray backscatter techniques do not provide sufficient energy to penetrate large objects, so only objects close to the surface can be seen.

To obtain clear visual information of the contents of these large vessels the inspection system must generate enough energy to penetrate the clutter and provide sufficient spatial and contrast resolution to resolve the details in the resultant image. BIR manufactures its own detectors in three levels of resolution. It also offers linear accelerator systems in a wide range of x-ray source energies. The combination of the source energies and detector pitch should be optimized for the application to provide the highest image quality. Table A illustrates the maximum penetration lengths through steel and water of BIR systems at varying source energy levels.

Energy	Steel	Water
3 MV	279 mm 11 in	183 cm 72 in
4 MV	330 mm 13 in	229 cm 90 in
6 MV	381 mm 15 in	297 cm 117 in
9 MV	406 mm 16 in	342 cm 135 in

Table A

Another fact that is often misunderstood with penetration is that the equivalent path length through water is linear compared to the path length through steel at all energy levels. This is not the case in practice, in fact the assumption that the equivalent path through water is always 8 times longer than through steel is not true at all energy levels. It is only true at 6 MV. Table B illustrates the difference between path lengths through steel and water at varying source-energy levels.

What Table B illustrates is that the equivalent path length through water based on the maximum path length thru steel is not a constant. It varies depending on the energy level of the source.

At a Source Energy of	Multiply Steel Path length by
2.2 MV	6.7
3 MV	6.9
4 MV	7.2
6 MV	7.8
9 MV	8.4

Table B

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