



Target Protection



Target Protection Curves

Purpose

This section provides the berm dimensions required to protect target emplacements and other downrange features. It includes the berm thicknesses for most soil types and most common weapons. Refer to the individual target emplacement sections in the RDG for additional information including wall heights, angle of fire, and direction of fire requirements/limitations.

Target Berms

The berm, not the wall, protects the target equipment. The berm must be sized to protect the emplacement from repeated impacts between maintenance cycles. It must protect from all anticipated directions of fire but is thickest in the expected direction of fire. It must be thicker for larger caliber weapons and heavily used targets.

Berm Thickness

The table below shows the standard berm thicknesses for the most common rounds. Use these as the starting point and when no other information is available.

Round	Berm Thickness	
	Feet	Meters
105mm 120mm	30	9
25mm 30mm	18	5.5
6.8mm 0.50 cal	8	2.5
Pistol* 5.56mm 7.62mm	6	2

*Pistol only ranges use half the 5.56/7.62 berm thickness

Modify the standard thickness based on range type and target location, soil type and compaction, and several other factors. Except for pistol only ranges, a berm thickness of at least 4 feet is recommended to facilitate ease of maintenance. Provide rationale for berm thickness chosen.

Range Type and Target Location

It takes much less than the standard berm to protect from a few rounds; significant berm wear happens when many rounds hit the same spot. The worst case for berm wear is usually on small arms qualification ranges like the ARF and on the most used main gun targets. These types of target berms should not be reduced from the standard without approval from the installation, RDT, and the RTLP MCX. Ranges without fixed firing positions like infantry battle courses can usually use thinner berms as can rarely used ranges. Power Centers and other downrange items that are out of the primary line of fire can also usually have thinner berms.

Individual target siting may dictate added protection. For example, when an infantry target is sited near an armor target, the berm may need to be designed for the larger weapon system. Also, heavily used targets or targets in the beaten zone of other targets may need additional attention. Consider the beaten zone on armor zero targets when determining berm thicknesses.

In all cases, the designer must coordinate with the range trainer or user to determine the appropriate berm thickness.

Soil Type and Compaction

The Target Protection Design Curves at the end of this section can be used to adjust the thickness of the berm. The curves are based on weapon(s) used, soil type, and compaction. Historical experience shows that, under typical usage, well-compacted berms, designed with the recommended thickness require maintenance cycles of 6 months or more.

Other Factors

Some judgement is required as the designer/installation must balance the cost of thicker berms against the amount and frequency of maintenance required. The most heavily used ranges on an installation and ranges on installations with limited maintenance staff may need thicker berms. Low use ranges do not need as much berm.

Berm thickness can be adjusted to decrease initial construction costs. The tradeoff is that it will increase the maintenance requirements for the installation. This must be coordinated with the installation, RDT, and the RTLP MCX.

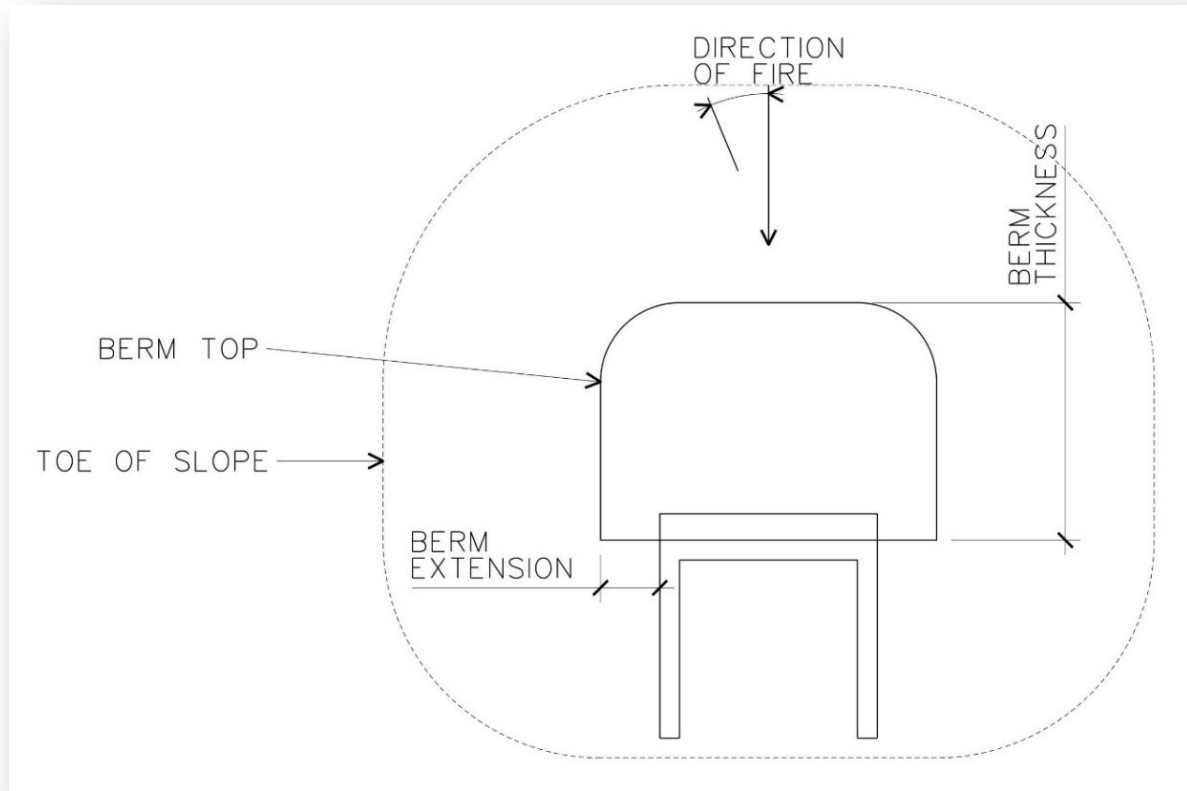
Composite berms, berm plugs, and soil amendments have been used and can be proposed but must be shown to provide sufficient protection and be cost effective.

Direction of Fire

The direction of fire (DOF) is the horizontal angle from perpendicular to the target.

The standard berm extensions are $\frac{1}{4}$ of the berm thickness; see figure below. It provides full thickness protection for DOF of +/- 20 degrees, adequate protection to +/- 45 degrees, and protects the electronics and mechanism from errant rounds and ricochets up to 90 degrees.

On lane-based qualification ranges, the DOF is usually within a few degrees. On maneuver ranges SDZ and range safety considerations make it extremely rare to engage targets at angles larger than 30 degrees.



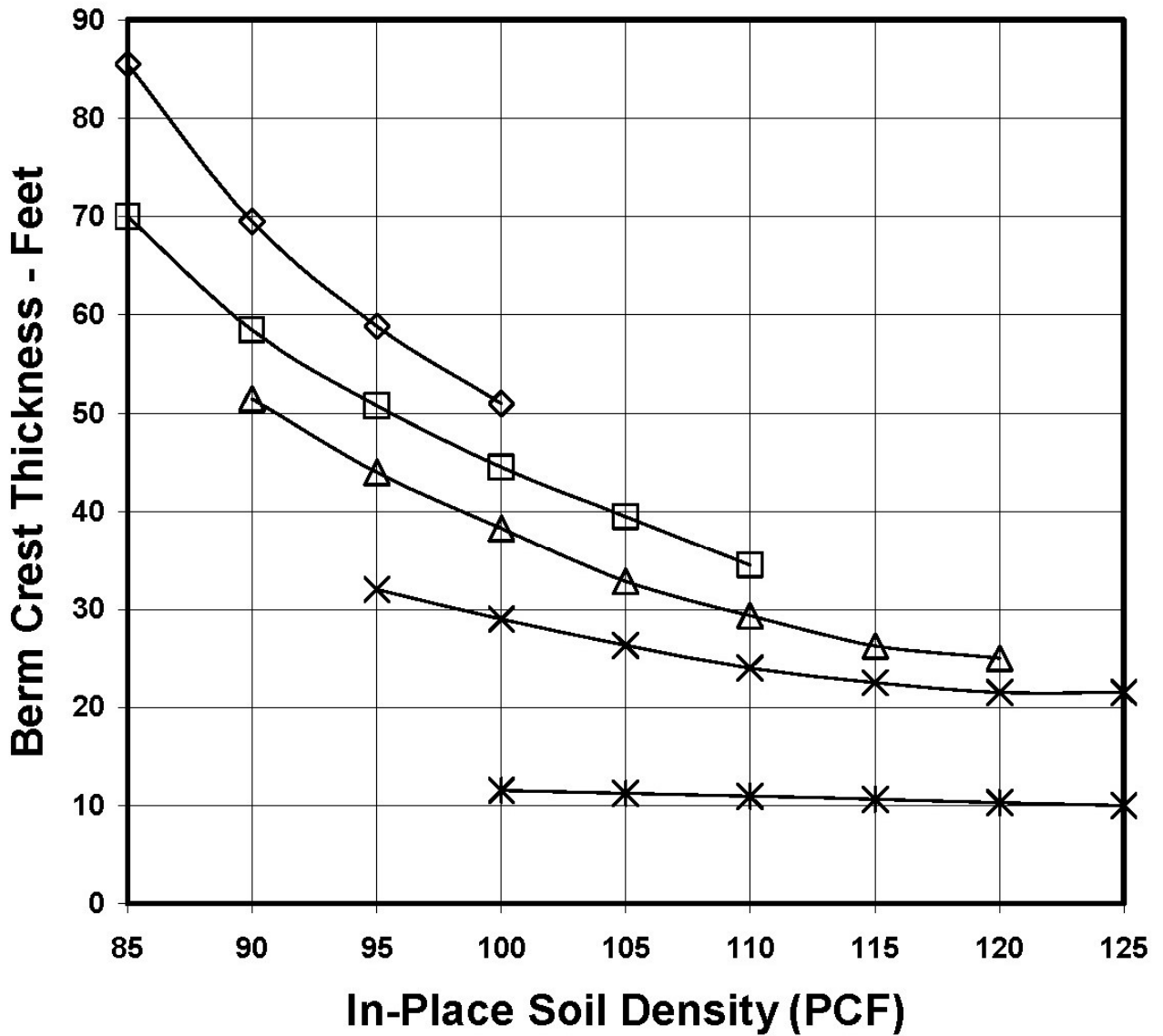
Target Protection Design Curves

The following tables provide curves for various caliber weapons, in both Metric and English units:

- 105 and 120 mm
- 25mm,
- .50cal
- 7.62 and 5.56 mm.

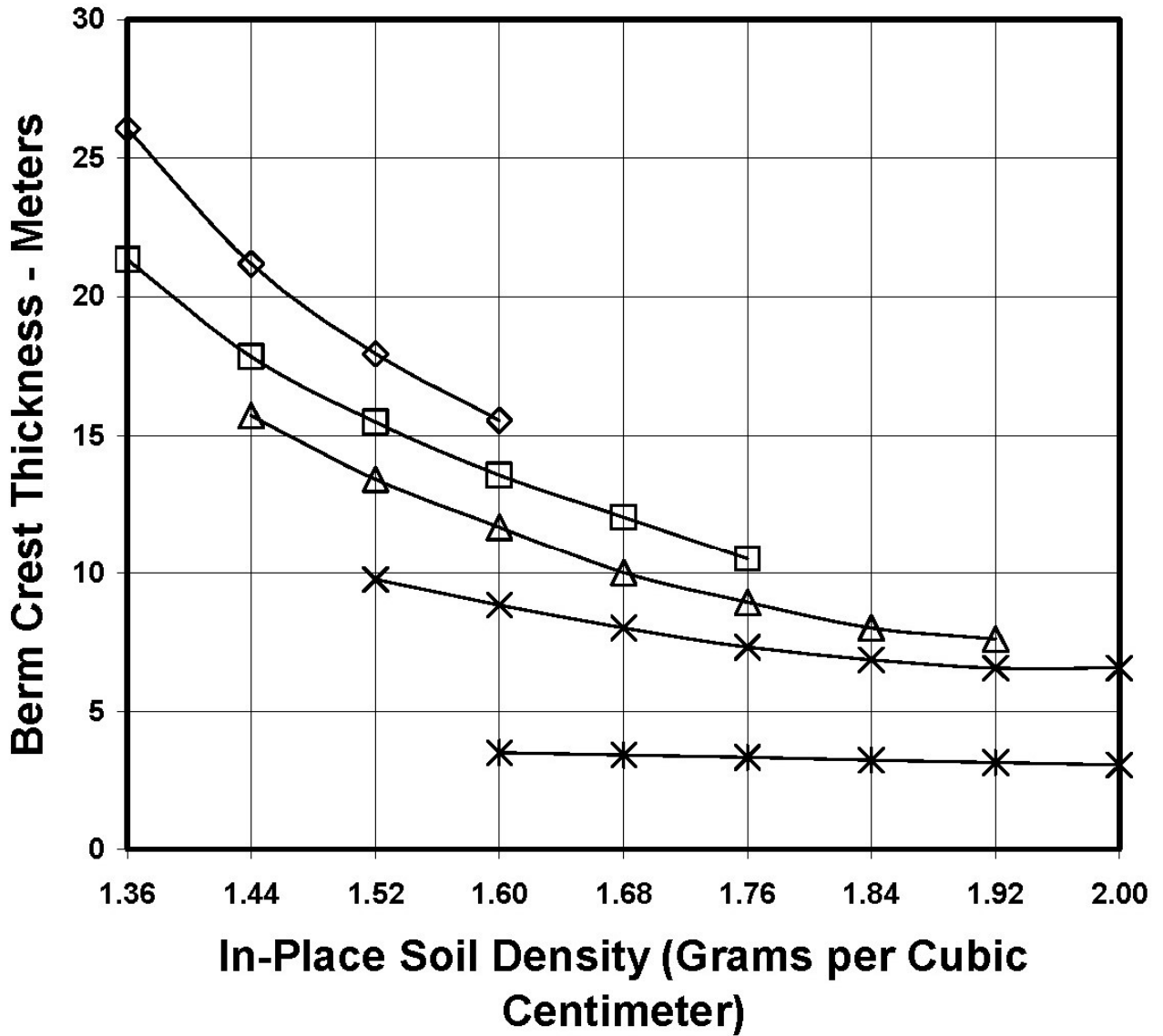
Use the appropriate curve for the largest weapon that will engage the target. Use the .50cal curves for the 6.8mm rounds and the 25mm curves for the 30mm. The 7.62 and 5.56 table covers both standard ball and Enhanced Performance Rounds (EPR) rounds. Use half the 5.56/7.62 values for pistol only ranges. The curves were developed based on testing done in the 1970's. Coordinate with the RTLP MCX for other ammunition.

English Units 105-mm and 120-mm Projectiles



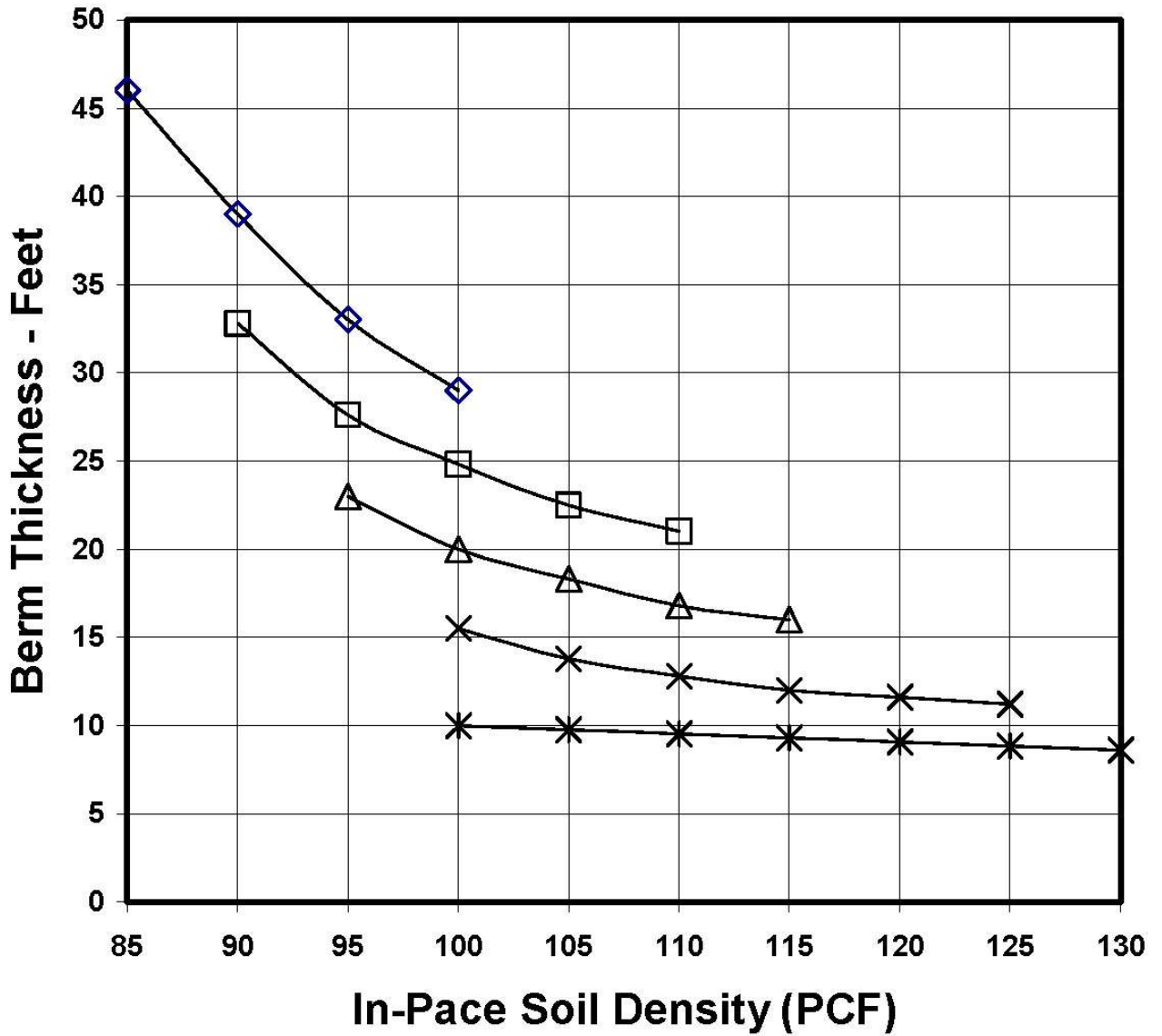
- ◆ 80% Compaction - ASTM D1557, Method D
- 90% Compaction - ASTM D1557, Method D
- △ 95% Compaction - ASTM D1557, Method D
- × 100% Compaction - ASTM D1557, Method D
- * Relative Density from 40% to 80%

Metric Units 105-mm and 120-mm Projectiles



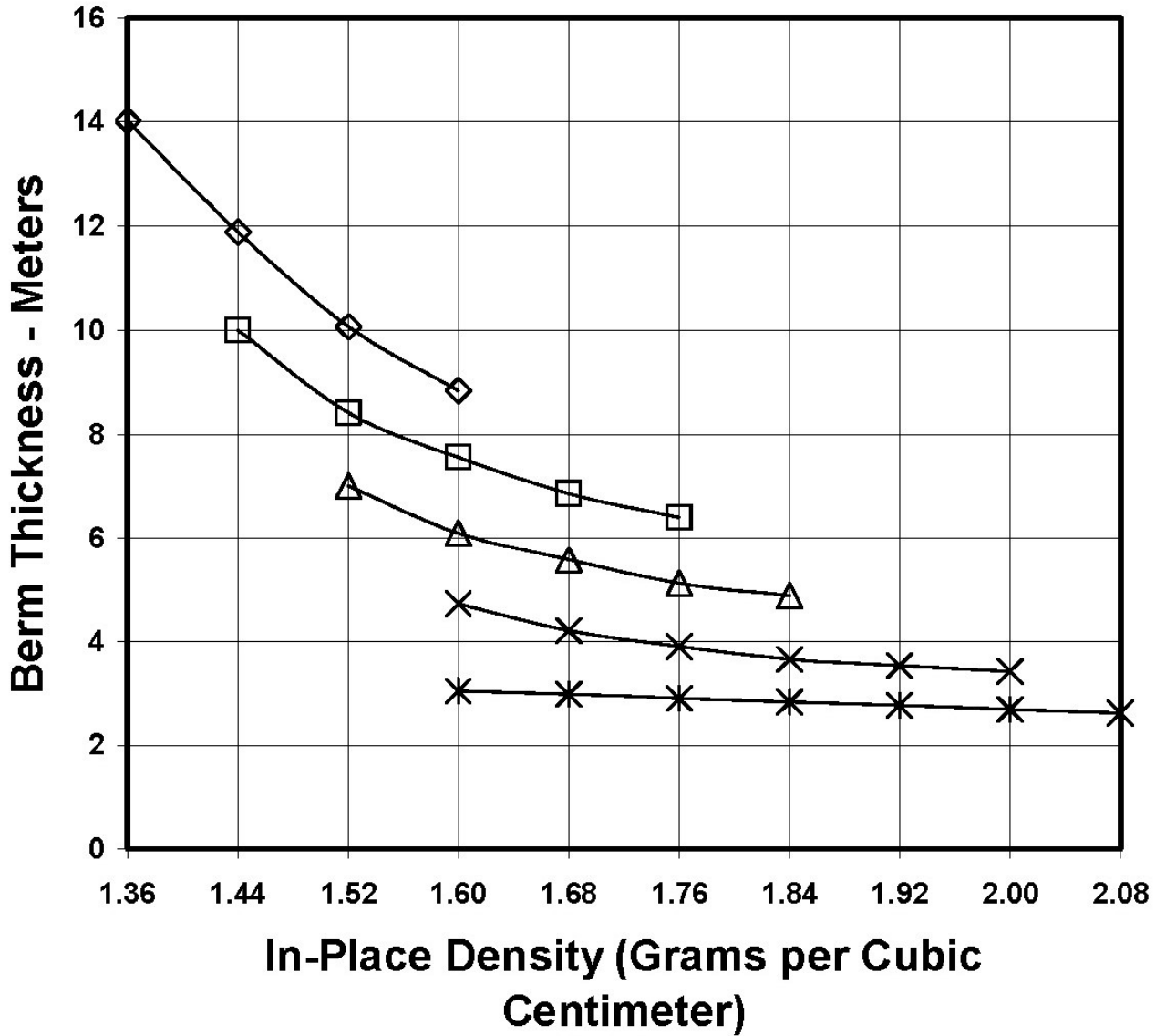
- ◇— 80% Compaction - ASTM D1557, Method D
- 90% Compaction - ASTM D1557, Method D
- △— 95% Compaction - ASTM D1557, Method D
- ×— 100% Compaction - ASTM D1557, Method D
- *— Relative Density from 40% to 80%

English Units 25mm - M793 Cartridge



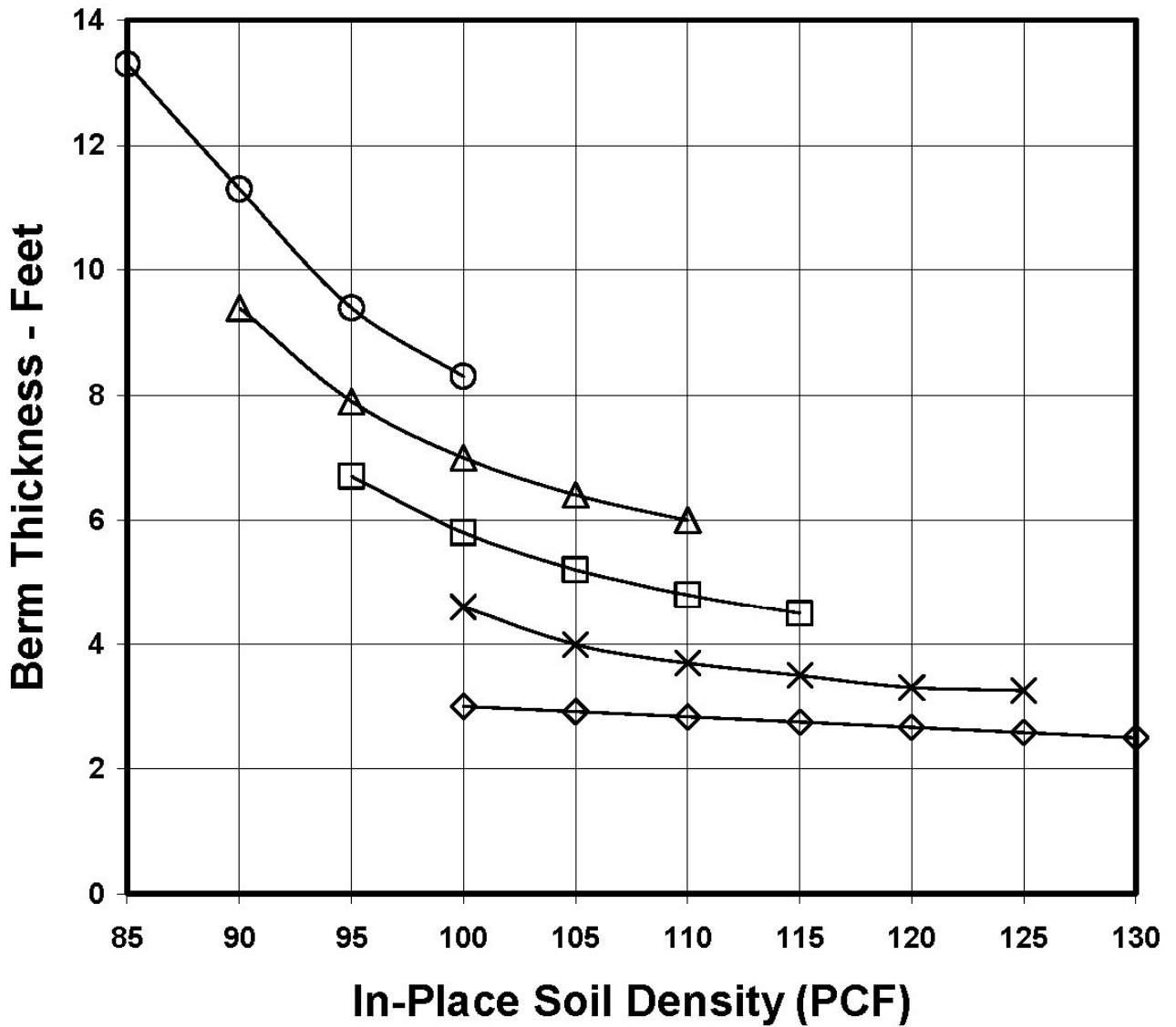
- ◆ 80% Compaction - ASTM D1557, Method D
- 90% Compaction - ASTM D1557, Method D
- △ 95% Compaction - ASTM D1557, Method D
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Metric Units 25mm - M793 Cartridge



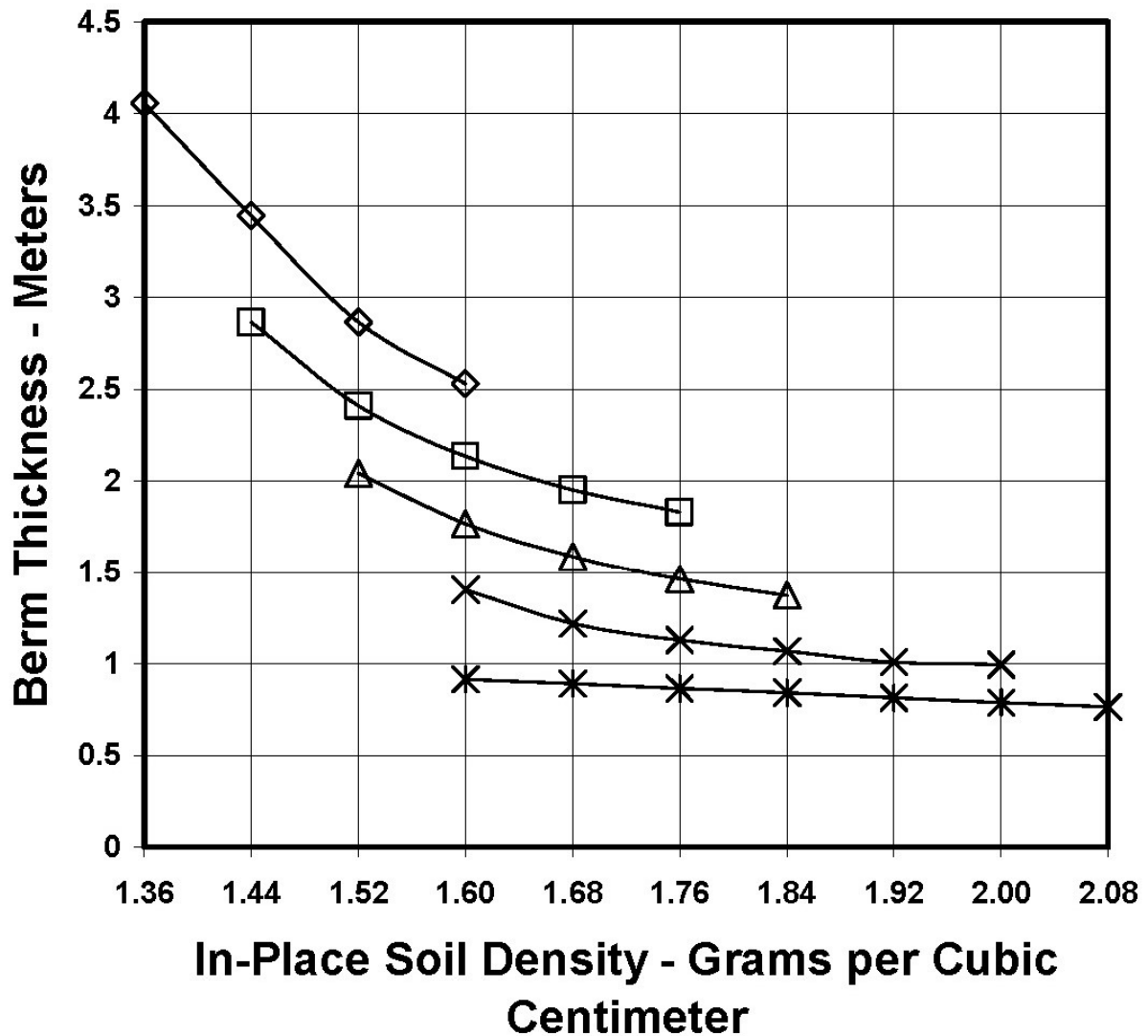
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- × 100% Compaction - ASTM D1557, Method D
- * Relative Density from 40% to 80%

English Units 0.50 Caliber Ball Projectiles



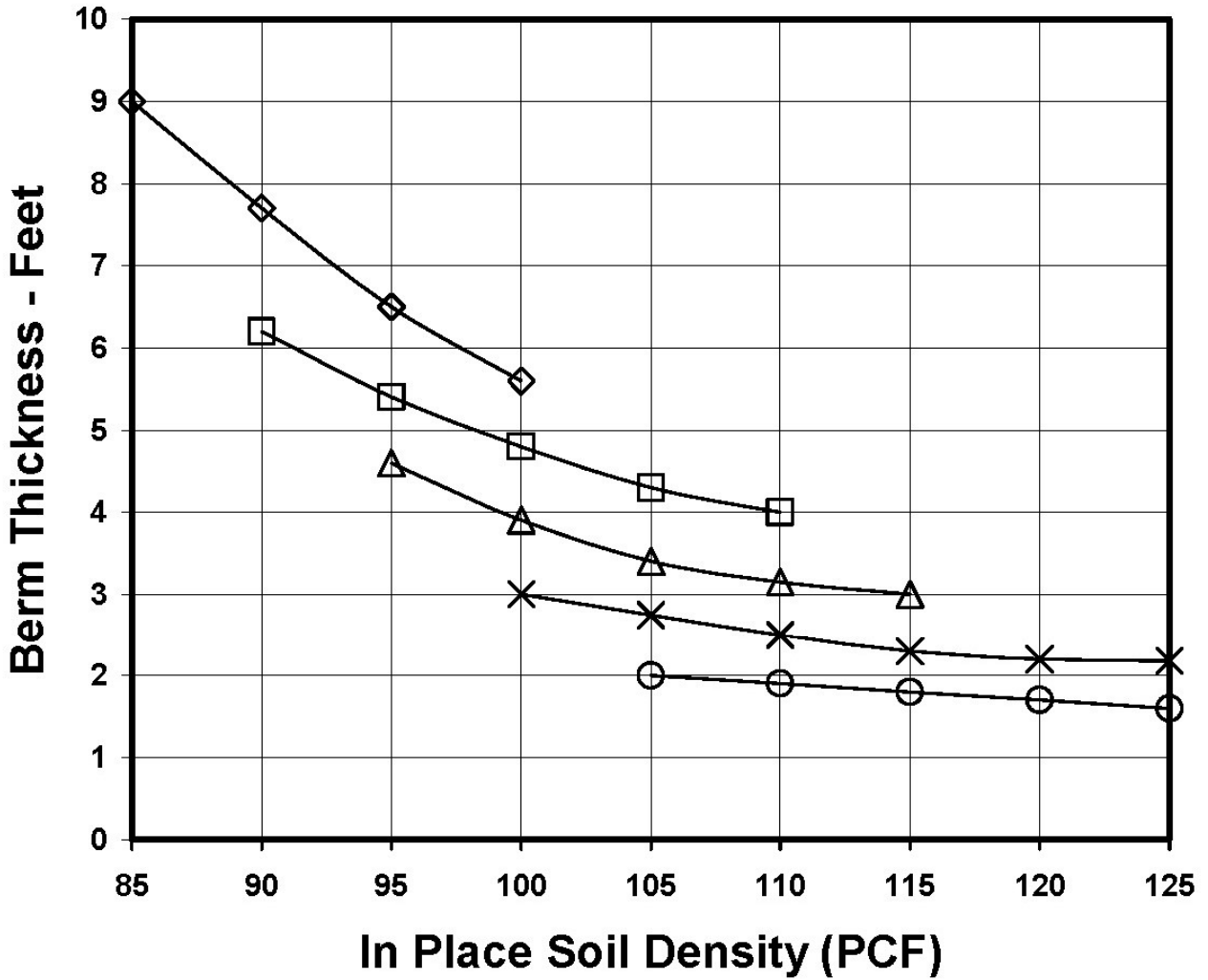
- 80% Compaction (ASTM D1557, Method D)
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- × 100% Compaction (ASTM D1557, Method D)
- ◇ Relative Density from 40% to 80%

Meters Units 0.50 Caliber Ball Projectiles



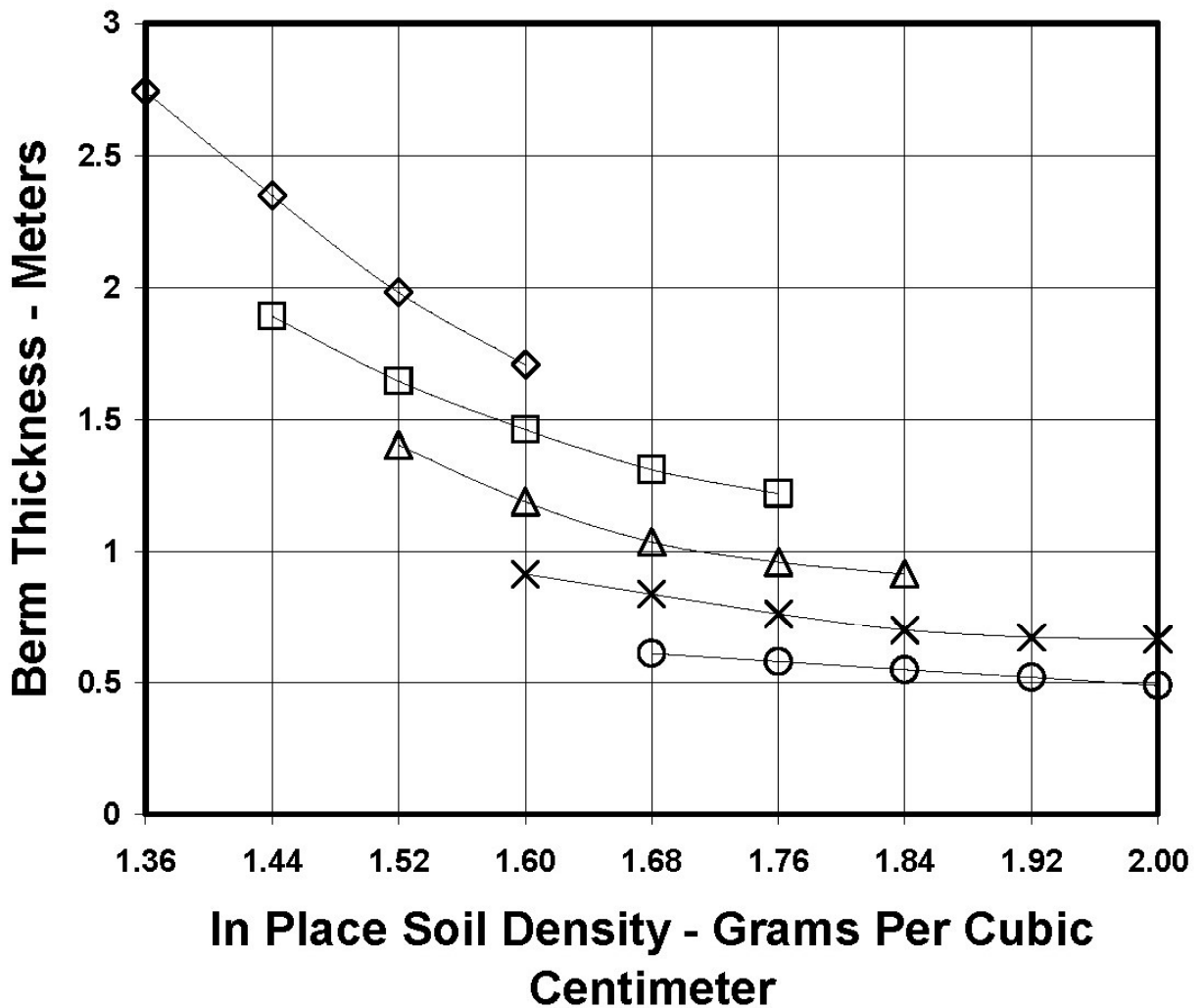
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- *— Relative Density from 40% to 80%

English Units 5.56 and 7.62 Caliber Ball Projectiles



- ◇— 80% Compaction (ASTM D1557, Method D)
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- △— 95% Compaction (ASTM D1557, Method D)
- ×— 100% Compaction (ASTM D1557, Method D)
- Relative Density from 40% to 80%

Metric Units 5.56 and 7.62 Caliber Ball Projectiles



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