Target Protection

Target Protection Curves

Purpose

This section provides the required berm dimensions required to protect target emplacements. The berm, not the wall, provides the protection for the target equipment. The section covers the berm thicknesses required for varied soil types for different weapons. The berm must protect the emplacement from all anticipated directions of fire, but is thickest in the expected direction of fire. Use thinner berms to protect the emplacement from occasional directions of fire and ricochets. The standard berm extensions are ¼ of the berm thickness; see figure below. 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

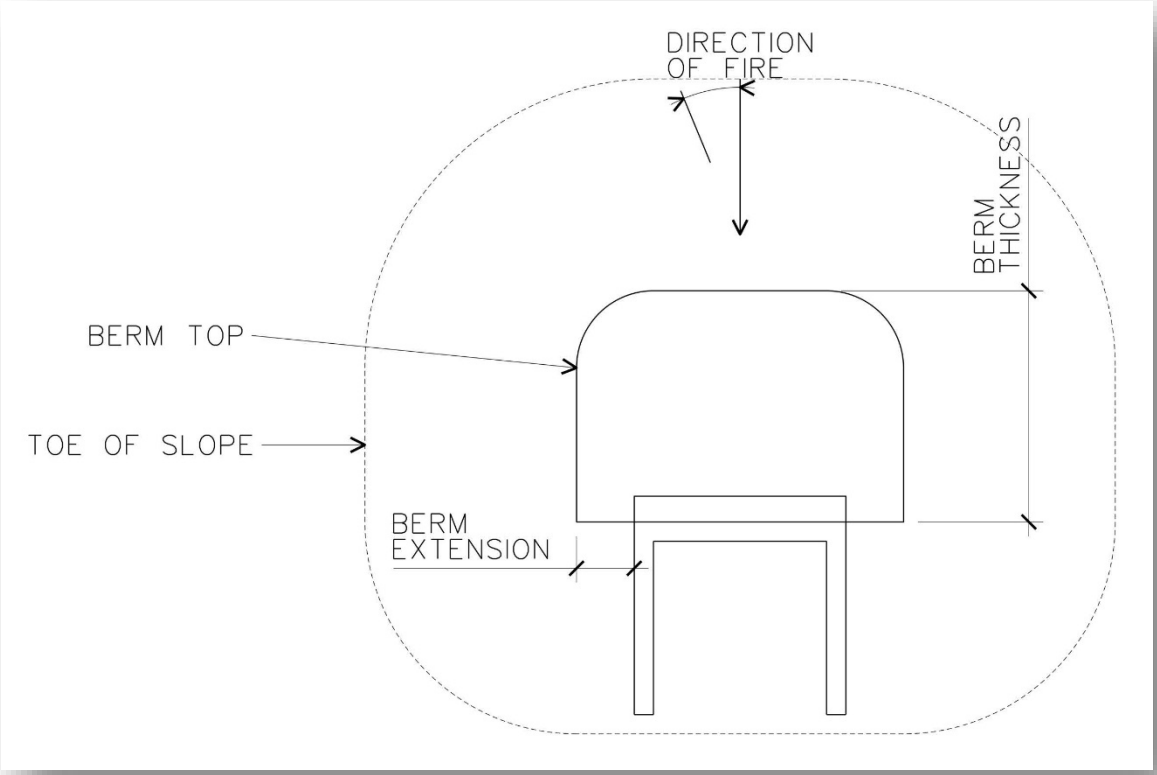
The Target Protection Design Curves at the end of this section provide the recommended minimum berm thicknesses required to protect the target emplacements from weapon firing during training. The curve thicknesses provide protection from many bullet impacts; the amount of soil needed to stop a single round is significantly less. The calculated thickness provides protection from repeated firing between maintenance cycles. The time between maintenance cycles varies depending on many things including soil types, compaction rates, weapons used, and training volume; heavily used targets usually require more maintenance.

Determine the berm thicknesses based on projectile type, soil compaction, and the in-place soil density. In addition, the designer must coordinate with the range trainer or user to determine the appropriate berm thickness for each target, since individual target siting may dictate added target protection. For example, when SIT emplacements are in front of or behind a MAT or SAT, the berm will need to withstand the largest weapon system that will engage that group of targets.

The standard curves allow some flexibility on the required thickness depending on the range type and other factors. The designer/installation must balance the cost of thicker berms against the amount of maintenance required and the risk of damage based on the weapons used and the target usage. The worst case for wear on target berms is often on small arms qualification ranges, MRF/ARF/AFF and the most used main gun targets. Historical experience shows that, under normal usage, well-compacted berms, designed with the recommended widths require maintenance cycles of 6-months or more on these type of ranges. Ranges without fixed firing positions like infantry battle courses and ranges with lower usage can use with thinner berms.

Direction of Fire

The direction of fire (DOF) is the horizontal angle from perpendicular to the target. The standard berm provides full thickness protection for DOF of +/- 20 degrees and adequate protection to +/- 30 degrees or more. Due to SDZ and range safety considerations, it is uncommon to engage targets regularly at larger DOF; coordinate with the RTLP MCX in those cases. The standard berm will protect the electronics and mechanism from errant rounds and ricochets to much higher DOF, up 90 degrees.

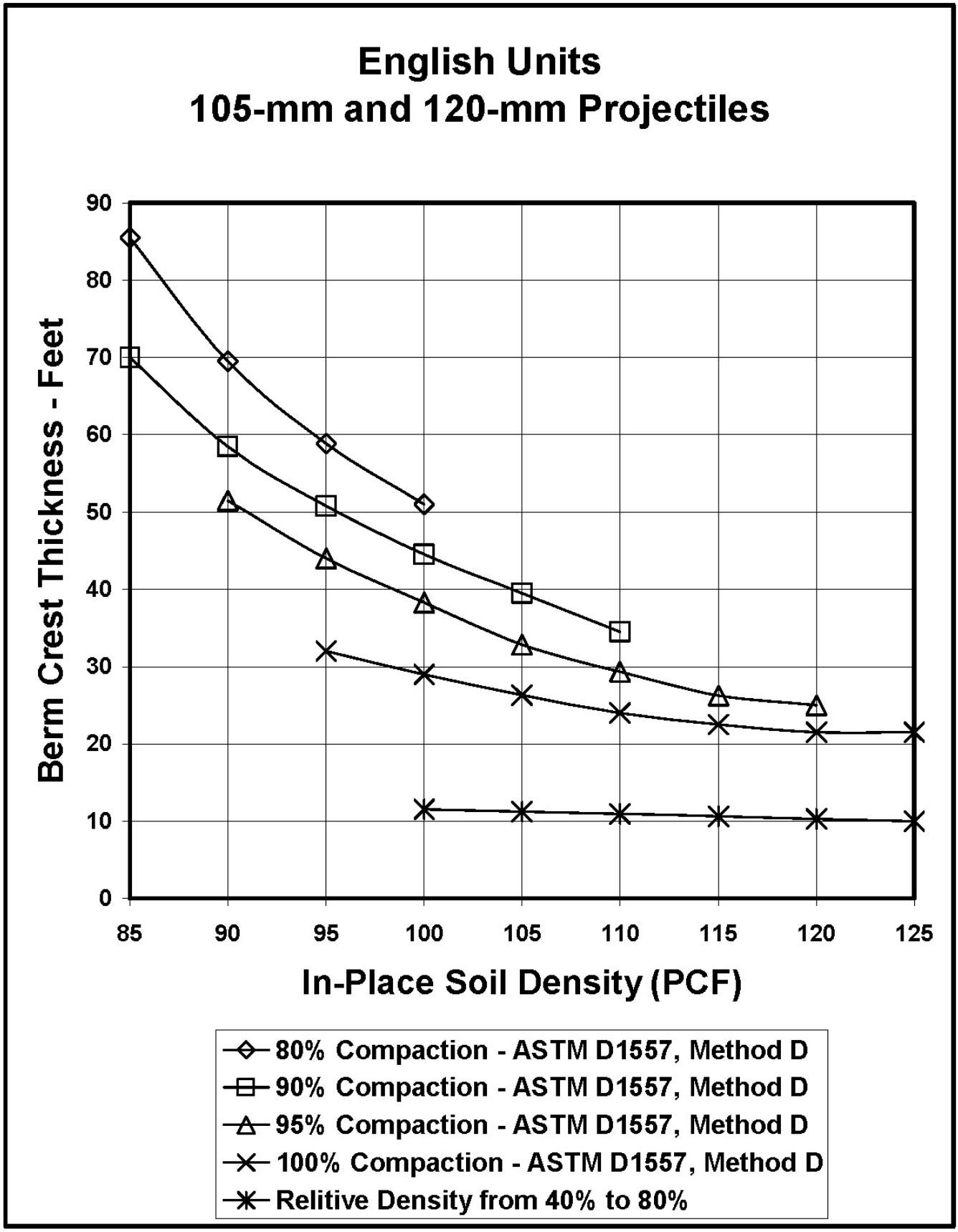


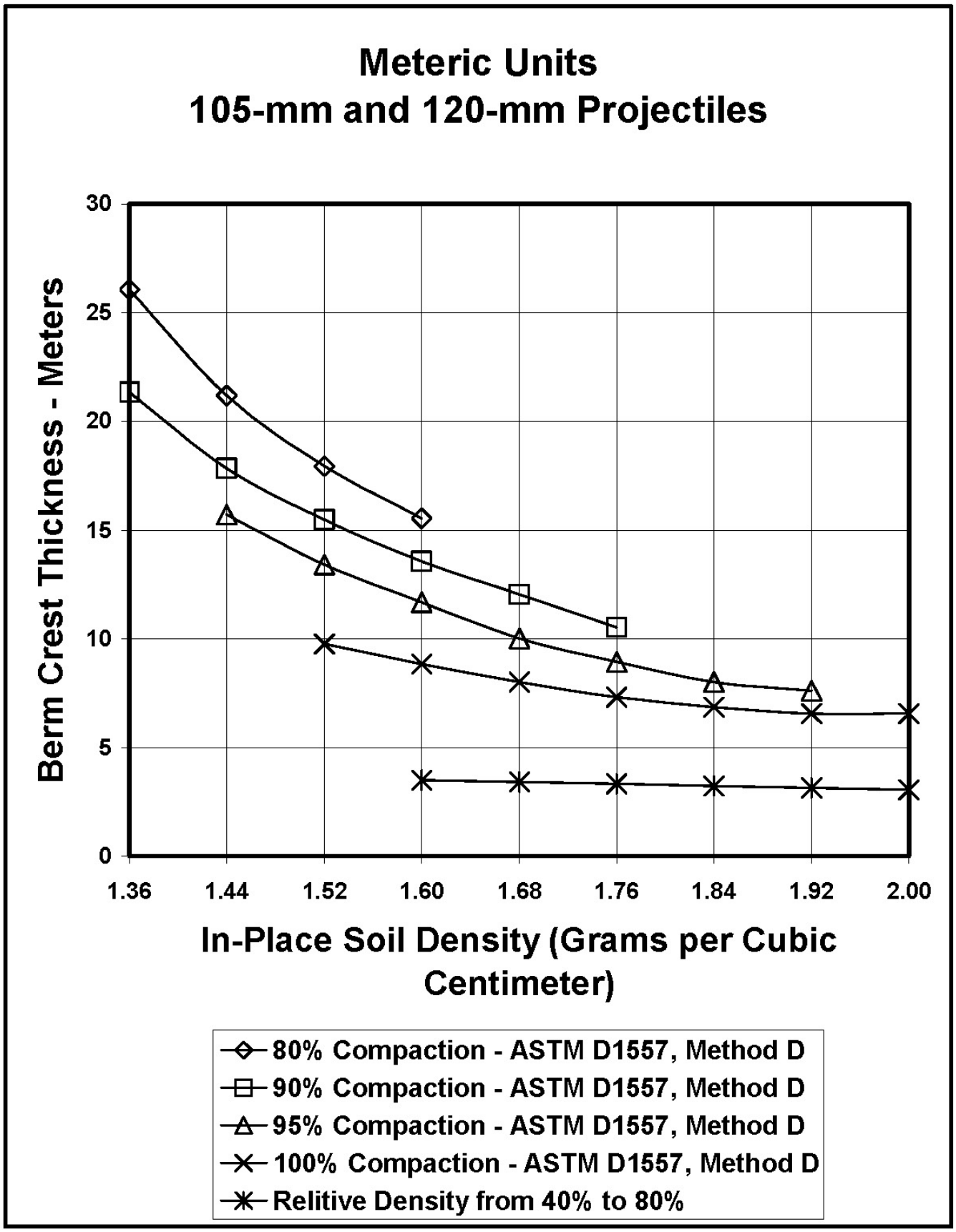
Minimum

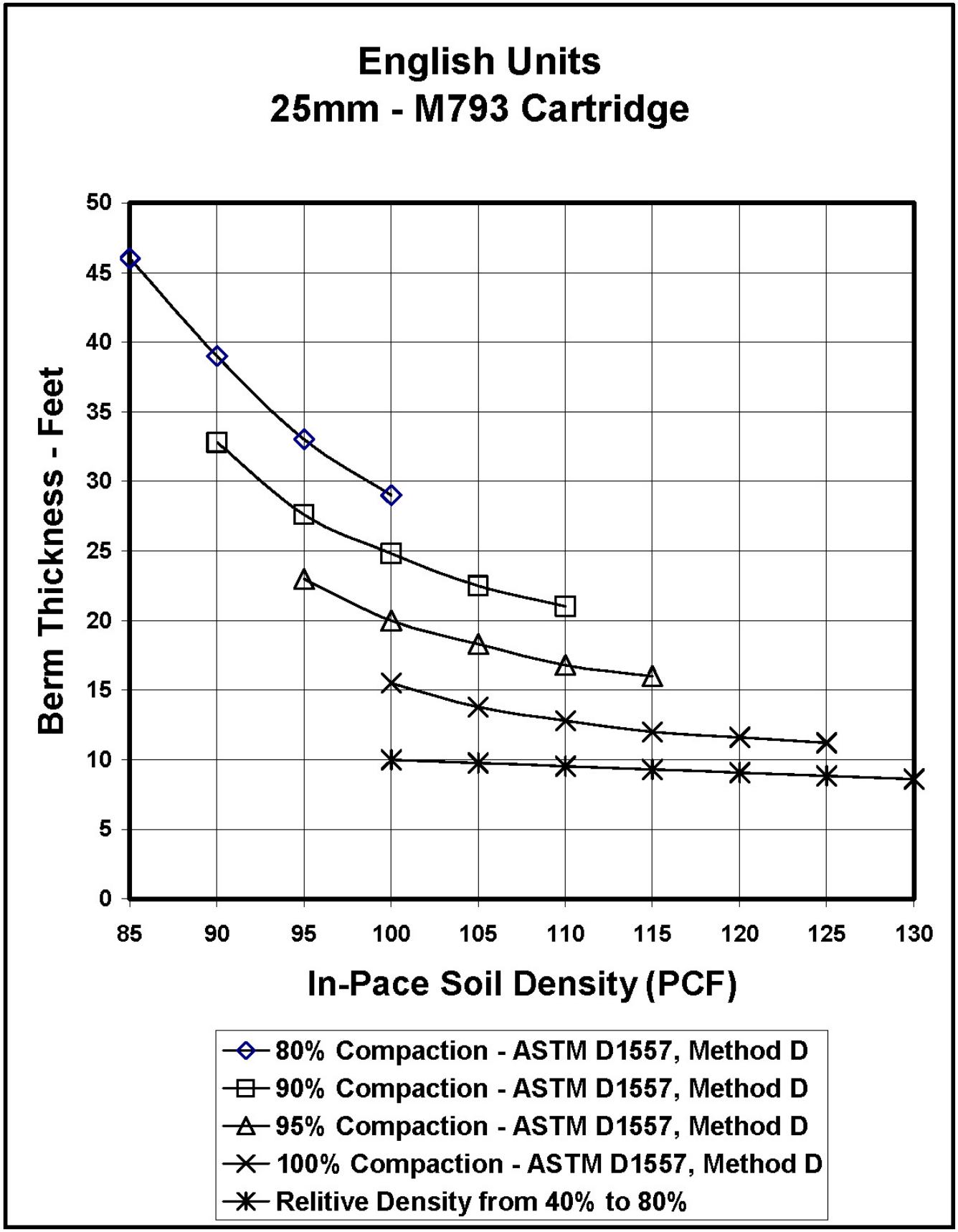
Use a berm thickness of at least 4 feet to facilitate ease of maintenance.

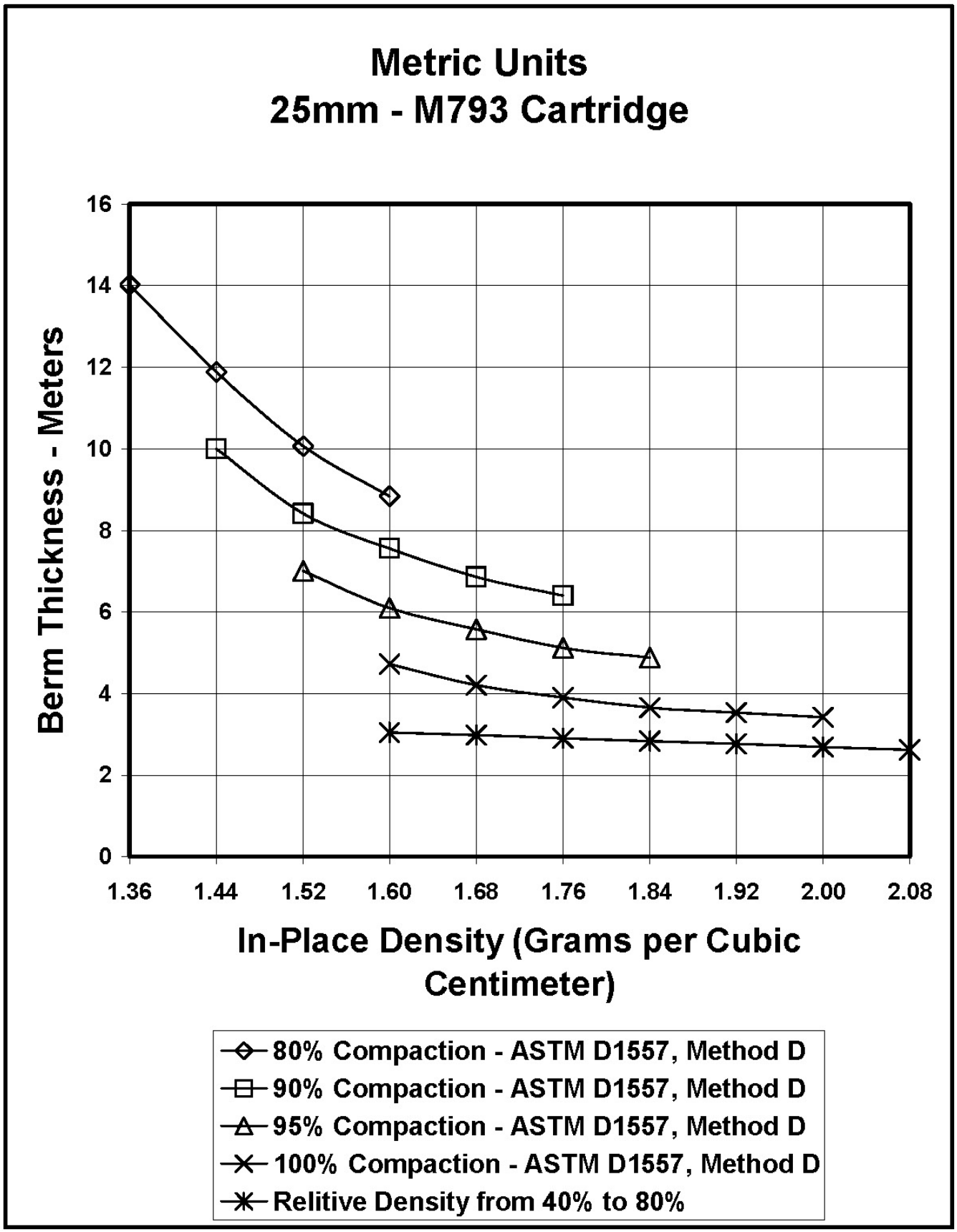
Target Protection Design Curves

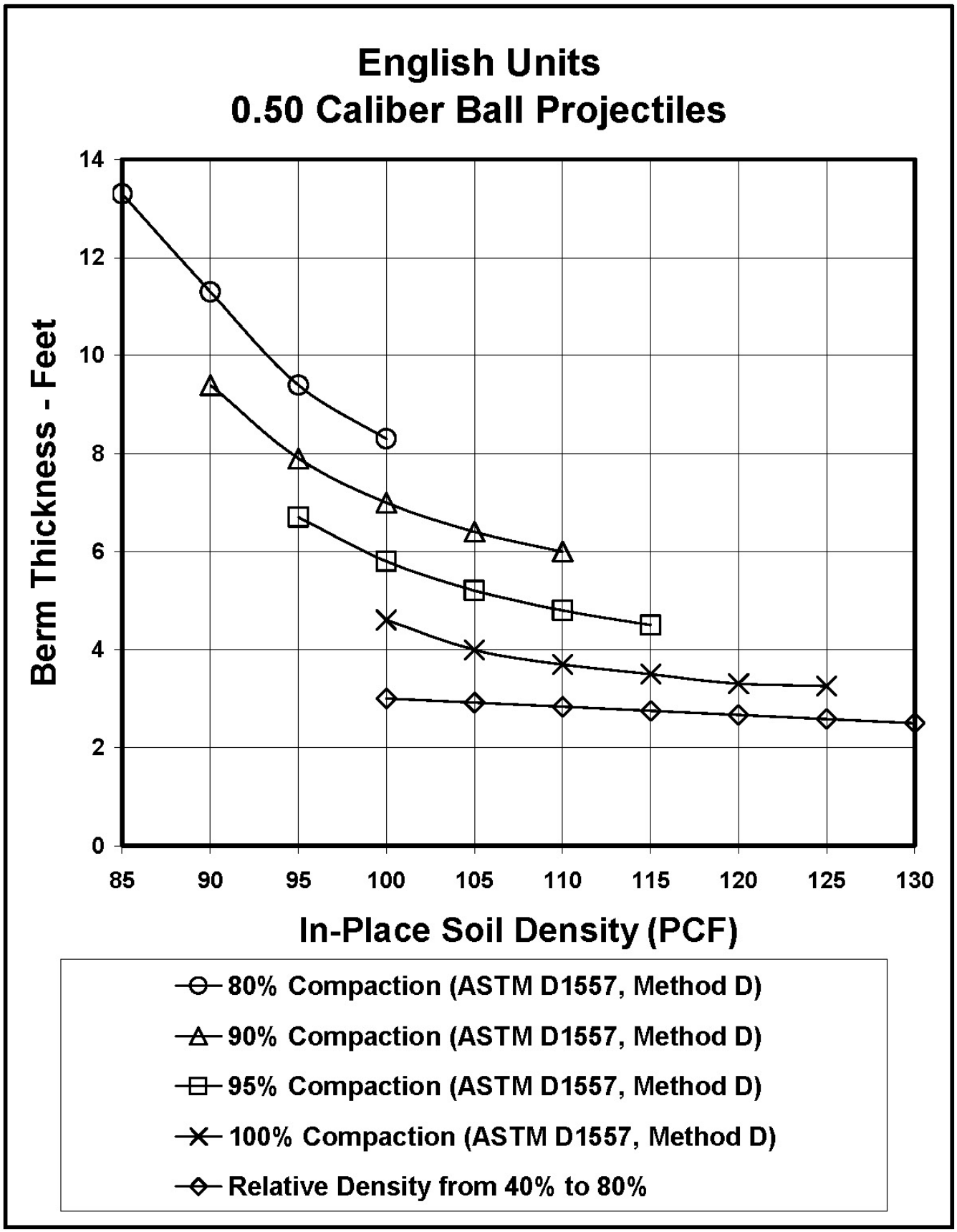
The following tables provide curves for various caliber weapons: 105 and 120 mm, 25mm, .50cal, and 7.62 and 5.56 mm. Use the appropriate curve the largest weapon that will engage the particular target. Note that the 7.62 and 5.56 table covers both standard ball and Enhanced Performance Rounds (EPR) rounds.

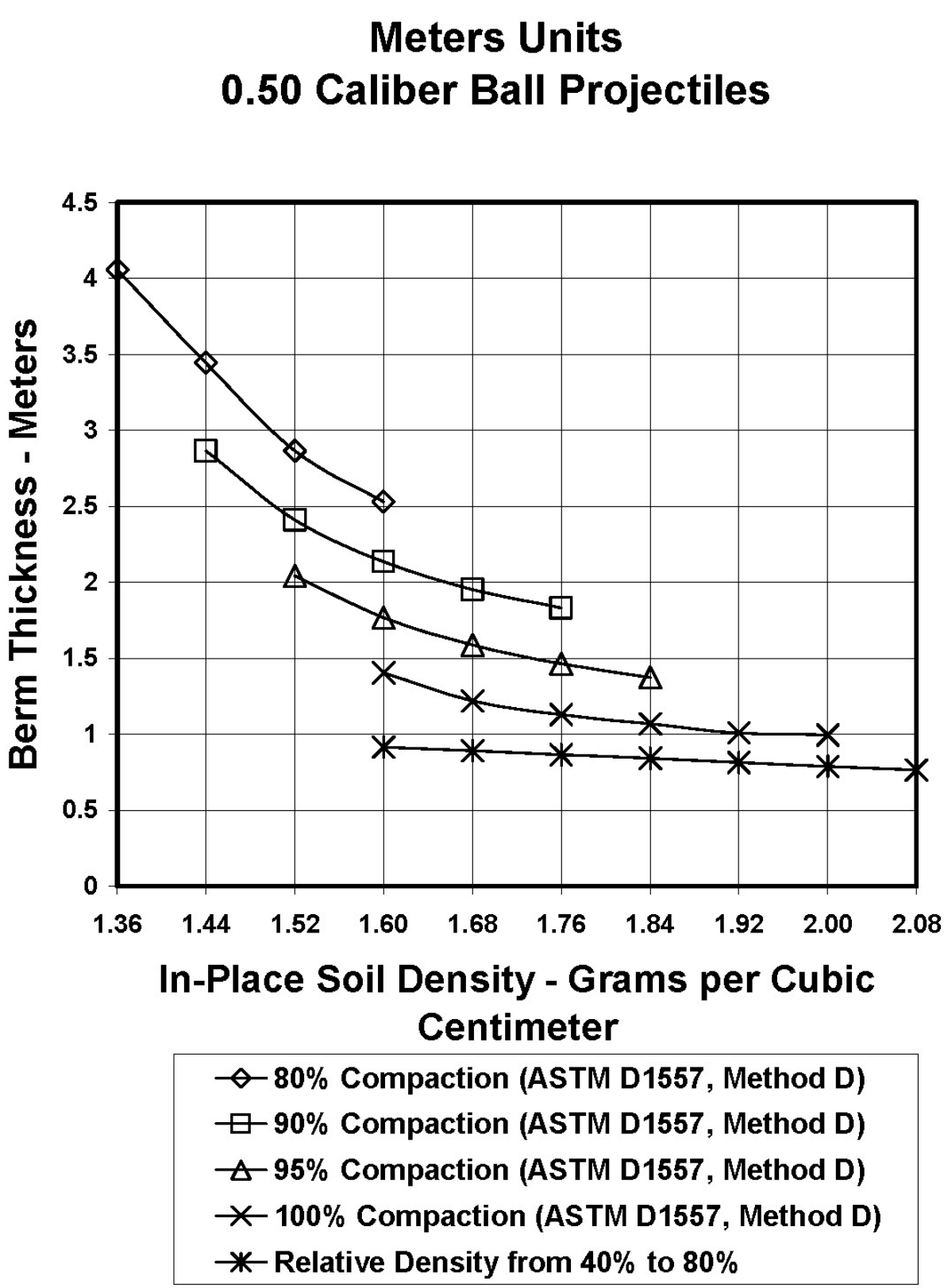

English Units
105-mm and 120-mm Projectiles
Berm Crest Thickness - Feet
90
80
70
60
50
40
30
20
10
0
85
90
95
100
105
110
115
120
125
In-Place Soil Density (PCF)
80% Compaction - ASTM D1557, Method D
90% Compaction - ASTM D1557, Method D
95% Compaction - ASTM D1557, Method D
100% Compaction - ASTM D1557, Method D
Relitive Density from 40% to 80%

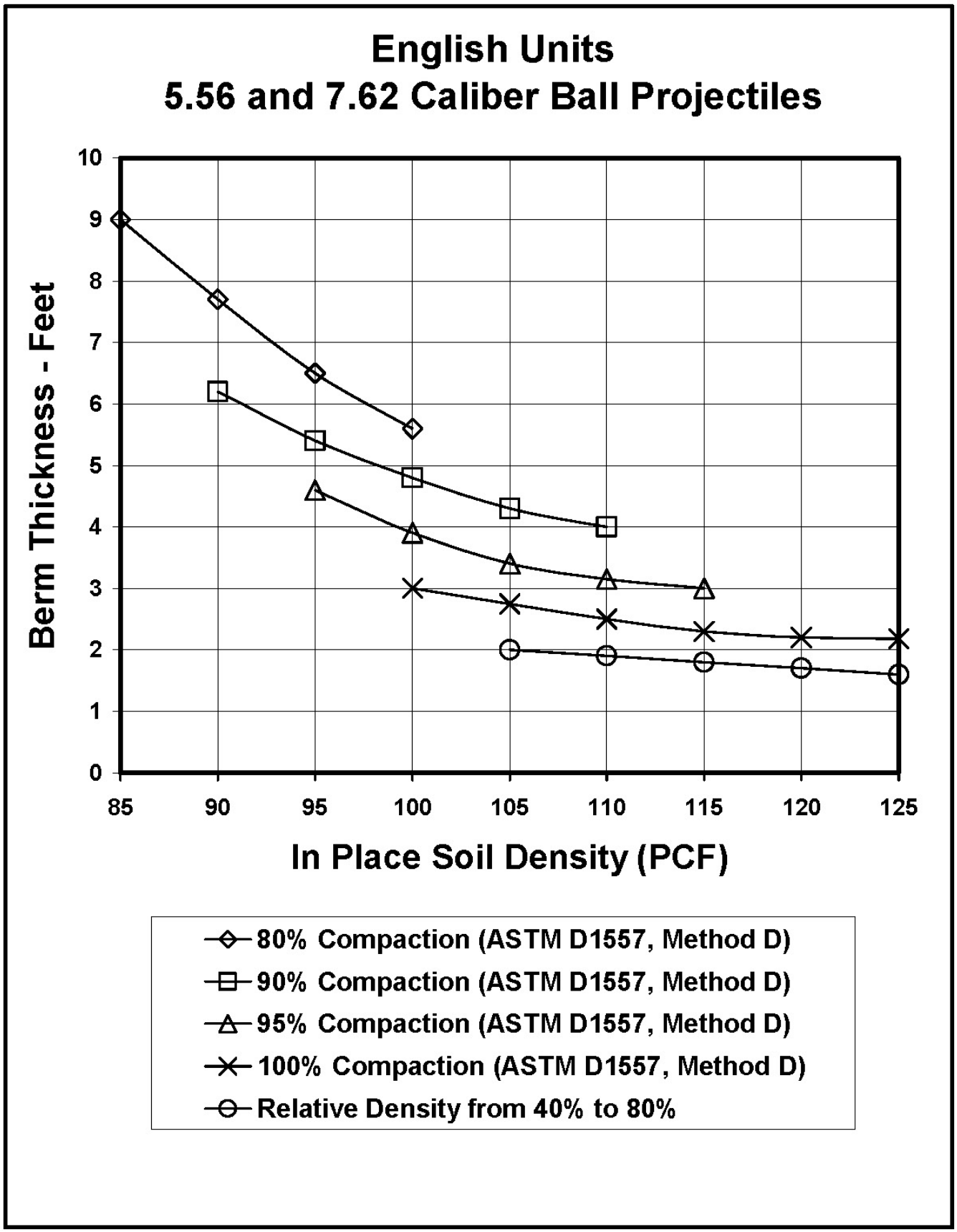

Meteric Units
105-mm and 120-mm Projectiles
Berm Crest Thickness - Meters
30
25
20
15
10
5
0
1.36
1.44
1.52
1.60
1.68
1.76
1.84
1.92
2.00
In-Place Soil Density (Grams per Cubic Centimeter)
80% Compaction - ASTM D1557, Method D
90% Compaction - ASTM D1557, Method D
95% Compaction - ASTM D1557, Method D
100% Compaction - ASTM D1557, Method D
Relitive Density from 40% to 80%

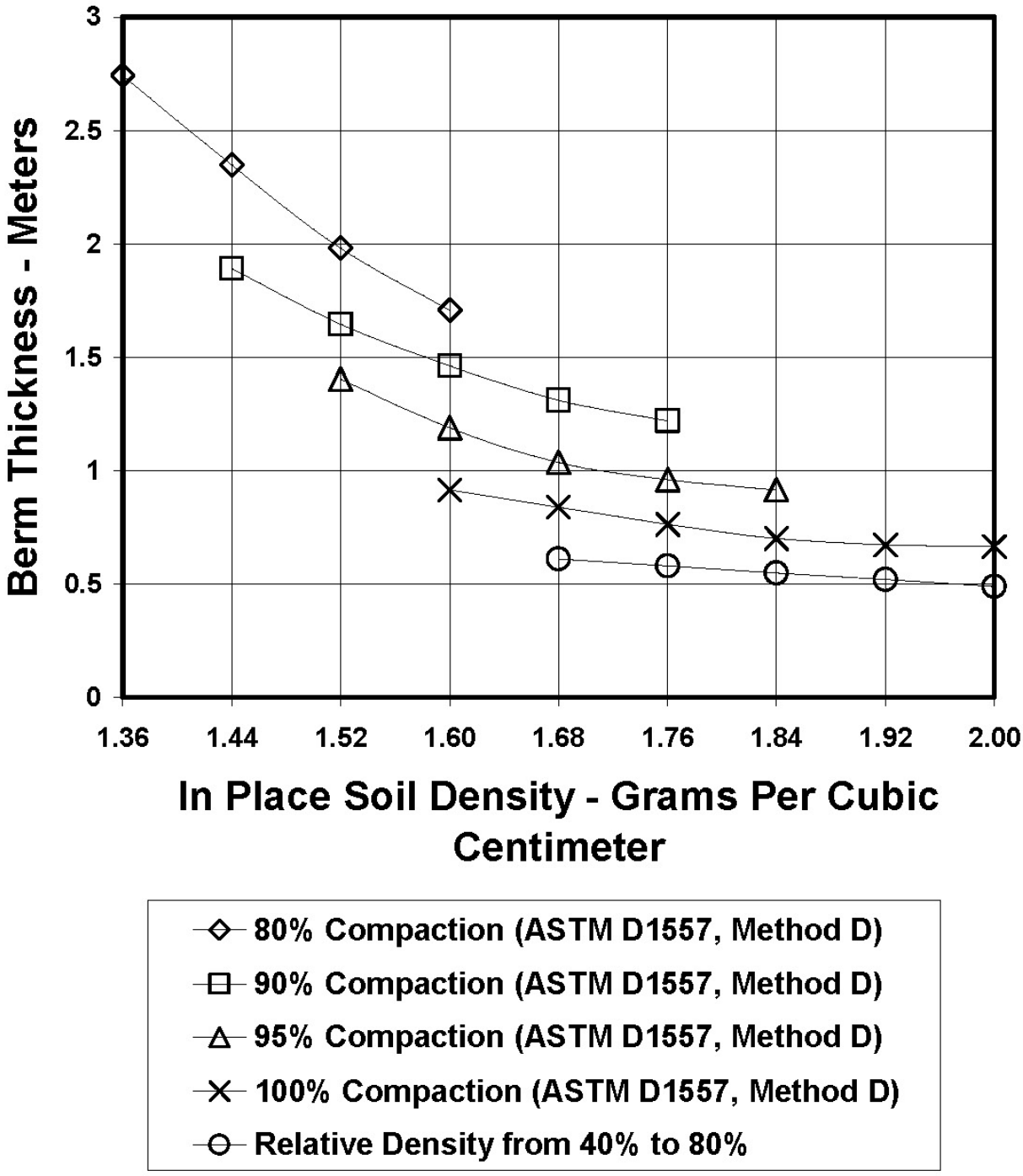

English Units
25mm - M793 Cartridge
Berm Thickness - Feet
50
45
40
35
30
25
20
15
10
5
0
85
90
95
100
105
110
115
120
125
130
In-Pace Soil Density (PCF)
80% Compaction - ASTM D1557, Method D
90% Compaction - ASTM D1557, Method D
95% Compaction - ASTM D1557, Method D
100% Compaction - ASTM D1557, Method D
Relitive Density from 40% to 80%


Metric Units
25mm - M793 Cartridge
Berm Thickness - Meters
16
14
12
10
8
6
4
2
0
1.36
1.44
1.52
1.60
1.68
1.76
1.84
1.92
2.00
2.08
In-Place Density (Grams per Cubic Centimeter)
80% Compaction - ASTM D1557, Method D
90% Compaction - ASTM D1557, Method D
95% Compaction - ASTM D1557, Method D
100% Compaction - ASTM D1557, Method D
Relitive Density from 40% to 80%


English Units
0.50 Caliber Ball Projectiles
Berm Thickness - Feet
14
12
10
8
6
4
2
0
85
90
95
100
105
110
115
120
125
130
In-Place Soil Density (PCF)
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%


Meters Units
0.50 Caliber Ball Projectiles
Berm Thickness - Meters
4.5
4
3.5
3
2.5
2
1.5
1
0.5
0
1.36
1.44
1.52
1.60
1.68
1.76
1.84
1.92
2.00
2.08
In-Place Soil Density - Grams per Cubic Centimeter
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
5.56 and 7.62 Caliber Ball Projectiles
Berm Thickness - Feet
10
9
8
7
6
5
4
3
2
1
0
85
90
95
100
105
110
115
120
125
In Place Soil Density (PCF)
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%


Meteric Units
5.56 and 7.62 Caliber Ball Projectiles
Berm Thickness - Meters
3
2.5
2
1.5
1
0.5
0
1.36
1.44
1.52
1.60
1.68
1.76
1.84
1.92
2.00
In Place Soil Density - Grams Per Cubic Centimeter
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%