USA Naval Ballistic Limit Method

(Write up by: Jeff Duquette)

CP = More than 50% of the mass of the projectile passes completely through the armor.
PP = Some but 50% or less of the projectile makes it through the armor.

The USA method for determination of BL(N) would be to employ an "up and down" firing method until 3 complete penetrations (CP) and 3 partial penetrations (PP) are obtained within a velocity spread no greater than 100-fps (in some documents 120-fps).
Or; If the zone of mixed PP and CP results is greater than 100-fps, "fire additional rounds to obtain a minimum of 3 CP and 3PP in the mixed zone.
Or; If no mixed zone is obtained, **average the velocities of the lowest CP and the highest PP.**
Or; If the mixed zone is less than 100-fps, **average the velocities of the 3 lowest CPs and three highest PPs**.
Or; If there are an uneven number of PPs and CPs within the mixed zone, than one of two weighted averages is employed to determine the limit velocity. The first weight average applies if the number of PPs in the mixed zone exceeds the number of CPs in the mixed zone:

EQUATION 1
$BL = VA + [((Np - Nc)/(Np + Nc)) \times (Vhp - VA)$

VA = Average of all velocities in the mixed zone
Np = the number of PPs in the mixed zone
Nc = the number of CPs in the mixed zone
Vhp = the velocity of the highest PP

The second weighted average applies if the number of CPs in the mixed zone exceeds the number of PPs in the mixed zone:

EQUATION 2
$BL = VA - [((Nc - Np)/(Nc + Np)) \times (VA - Vlc)$

VA = Average of all velocities in the mixed zone
Np = the number of PPs in the mixed zone
Nc = the number of CPs in the mixed zone
Vlc = the velocity of the lowest CP
-----end

How Does this work?

Let's say our test results in a particular plate being struck 8 times with the following results.

Impact Vz (m/s)	Result
756.3	PP
760	PP
762	PP
772.2	CP
773.1	CP
774.5	CP
776.6	CP
777.8	CP

This results in a Limit Velocity of 766 m/s.
If this was a German test the result would be 780 m/s.
A 1.8% difference.

Of course this is pretty rare that there is no overlap of PP and CP.