A RIFLE VALUE OF 3

John Ferry introduced a rifle value of "3" in certain PDTs for the Overland Campaign. The Weapons Effectiveness tables in the model PDTs included as part of this package utilize those of the Overland 5 version with minor modification. My research occurred independently of John's work on Overland and can act as validation for the values which he established for rifle effectiveness.

Brent Nosworthy devotes an entire chapter in his study of Civil War tactics and weaponry to "The Effectiveness of the Rifled Musket". He begins with a lengthy discussion of Paddy Griffith's 1989 publication which asserts the average Civil War fire fight to have taken place at 141 yards. His conclusion is that as an *average* this is a fair assessment. The focus of this document will be on the rifle at 1 hex range.

The effectiveness of rifled muskets was a subject which was relevant to the combatants of that era and Nosworthy relates primary source accounts wherein ammunition expenditure was weighed against computed (re: reported) casualties. These reports were both Confederate and Union as well as from European observers at the time. One example was from Rosecrans at Murfreesboro (Stones River) who detailed 14,560 Confederates killed or wounded. 20,000 Union artillery shells felled 728 men. This left an estimated 2 million rounds of small arms fire to "hit" 13,832 Confederates, a ratio of 1/145. At Gaines Mill the hit ratio was approximately 1/100. A British observer in the Mexican War noted a 1/125 ratio for American troops on their opponents. One of the higher reported ratios was in the battle of the Wilderness, despite the nature of the terrain. Even here though, the ratio was only .9% - 1.5% or 15 hits per thousand rounds depending upon one's accepted casualty figures. Generally, the hit ratio clustered around 1% and there is no report of any figure greater than 1.5%. Summarizing all of these historical accounts, Nosworthy includes the following sentence as the last in a rather unremarkable paragraph:

"On average, therefore, a 500-man regiment would have inflicted somewhere between 3.4 and 7.5 casualties per volley."

As part of his historical narrative this statement carries no more significance than any other. However, in attempting to determine the actual effectiveness of small arms in these games, this is a gold mine. How does one equate a "volley" with fire in these games? I ask the following question: If an historical regiment and an "HPS" regiment both have "full" cartridge pouches, and fire until they expend all their ammunition, should they not produce the same average number of casualties?

The hit ratio reported for the Wilderness fighting compared to Stones River or Gaines Mill, for example, is an outlier, but it is important as an upper bound. In analyzing the differences between the historical regiment and its HPS counterpart, I will use the midpoint of 3.4-7.5 or 5.45 (1.1% hit ratio for a 500-man regiment). In fact, if one wants to think in very general (no pun intended) terms, the comparison could be of two 500-man "armies" that will fire all their ammunition and then the battle is ended.

Although 40 rounds per man was the norm, 60 would not be unusual and this is the number with which I will "arm" the historical regiment. To use 40 would make the comparison with HPS even more lopsided. The HPS regiment will get its usual 24 rounds – it will statistically change its ammunition status after firing 24 times. The analysis assumes both regiments exhaust their ammunition supply. To equate a *volley* between the two regiments, I divide 60/24 to get 2.5. I multiply the historical figure by 2.5 and this becomes the *expected value* or the *mean* by which I compare historical/HPS.

In establishing the actual PDT value for the rifle, however, I used the midpoint of 5.45 and 7.5 which is 6.5. Every factor which could affect fire (terrain, for example) is already "baked in" the historical figure (5.45). It is a measure of entire battles. The PDT value can be suppressed in a number of ways which can be anticipated, but are too variable to establish a clear percentage.

1. Defensive benefits such as terrain or breastworks will impact fire results, but they are local features whose overall effect on an entire battle is unknown.
2. I assume that overall fire is 50% at ½ value and 50% at full value. More than 50% of fire may occur at less than full value.
3. Fire occurs at other than 1 hex range.
4. Both "D" and LOW AMMO units may fire; the former with sub-optimal results and the latter randomly occurring.
5. The Fatigue status of units can affect resulting fire.

All of the above factors will tend to move the established mean of 6.5 towards the historical 5.45 in an entirely variable fashion.

The following table shows the mean value of casualties for the historical 500-man regiment, a 500-man HPS regiment with a PDT rifle value of "2.9" and a 500-man HPS regiment with the current PDT value of "4". All fire takes place at 1 hex with no defensive modifiers.

	HISTORICAL REGIMENT	**HPS (2.9)**	**HPS (4)**
MEAN TOTAL CASUALTIES – 24 FIRE ROUNDS	**390**	**522**	**720**
MEAN CASUALTIES PER ROUND AT FULL VALUE	**16.25** [1]	**21.75**	**30**
MEAN CASUALTIES (50% @ ½; 50% AT FULL VALUE) [2]		**16.31**	**22.5**
MEAN CASUALTIES (100% @ ½ VALUE) [3]		**10.875**	**15**

[1] **Assumed hit ratio of 1.3% (6.5); Historical is 1.1% (5.45). Value is 2.5 x 6.5 = 16.25**

[2] **Assumes that unit fires at ½ value 50% of time and full value the remaining 50%**

[3] **Assumes that unit fires at ½ value 100% of the time**

The latter entry in the table is for illustrative purposes. It demonstrates that with a value of 4 for rifles, this unit could fire at ½ value 100% of the time and still nearly match the mean value of casualties for the historical regiment. Although "2.9" is the calculated value of the rifle at 1 hex, a value of "3" works quite well for game purposes.

MORALE CHECKS AND ROUTING

In the HPS system it is *absolute* hits which are the important factor, not *percentage relative to unit size.* A 100-man regiment can take 25 hits (25% casualty ratio) and a 500-man regiment the same amount (5% casualty ratio), and yet have the same chance of being forced to take a morale check. The following tables are instructive:

PROBABILITY (%) OF A DEFENDER TAKING A MORALE CHECK UNDER VARIOUS FIRE SITUATIONS

	+10%	0	-5%	-10%	-20%	-30%	-40% [1]
500 (4)[2]	**33.0 (56.9)**	**30.0 (54.5)**	**28.5 (53.3)**	**27.0 (51.9)**	**24.0 (49.0)**	**21.0 (45.6)**	**18.0 (41.8)**
500 (3)	**25.0 (49.7)**	**22.5 (47.4)**	**21.4 (46.1)**	**20.3 (44.8)**	**18.0 (41.8)**	**15.8 (38.7)**	**13.5 (35.1)**
400 (3)	**19.8 (44.2)**	**18.0 (41.8)**	**17.1 (40.6)**	**16.2 (39.3)**	**14.4 (36.5)**	**12.6 (33.5)**	**10.8 (30.1)**
200 (3)	**9.9 (28.4)**	**9.0 (26.5)**	**8.6 (25.6)**	**8.1 (24.5)**	**7.2 (22.4)**	**6.3 (20.1)**	**5.4 (17.8)**

[1] Modification to offensive fire
[2] Size of firing unit, rifle factor, average casualties (Morale Check %)

From this table one can see that a unit with a +10% fire bonus will average 33 hits causing a 56.9% chance that the defending unit will be forced to take a Morale Check. The same unit firing at -40% still generates a 41.8% chance of a Morale Check. The calculations are as follows:

33/(33+25) = 33/58 = 56.9%   18/(18+25) = 18/43 = 41.8%

Determination of Morale Check percentages is described in the User documentation of the game.

The table demonstrates that there is not a straight linear relationship between casualties and the chance of a Morale Check. Note the figures for 500(3) and 200(3) at -10%. The average casualties are 2.5 times greater (20.3 and 8.1), but the Morale Check differential is less than 2 (44.8 and 24.5). *Reducing the effectiveness of the rifle will not abnormally alter game play*, because even smaller volumes of fire will not move the Morale Check percentage proportionally.

The following table lists the percentage (%) chance that a unit will ROUT after taking offensive fire.

	C (0)	D (0)	E (0)	C (-1)	D (-1)	E (-1)	C (-2)	D (-2)	E (-2) [1]
500 (4); 0 modifier	**18.2**	**27.3**	**36.3**	**27.3**	**36.3**	**45.4**	**36.3**	**45.4**	**54.5** [2]
500 (4); -40% modifier	**13.9**	**20.9**	**27.9**	**20.9**	**27.9**	**34.8**	**27.9**	**34.8**	**41.8**
500 (4); 0 modifier; ½ value							**25.0**	**31.3**	**37.5**
500 (4); -40% modifier; ½ value	**8.8**	**13.2**	**17.6**						

[1] Unit quality (C, D, E) and any modifiers
[2] Size of firing unit, rifle factor, fire modifier, Rout percentage per unit quality and modifiers
The calculation of Rout percentage: (Morale Check % x Chance of FAILING Morale Check)

The above table only lists C, D and E rated troops, and it focuses on a rifle value of "4". For many USA units a -2 modification in a Morale Check will almost guarantee a Rout with all the effect to adjacent units. For example, the chance that an E-rated regiment at -2 will Rout is equal to its chance of taking a Morale Check. It will always FAIL the Morale Check. Negative modifiers to lower rated troops have a much greater impact than similar deductions to higher rated (A and B). A B-rated regiment at -2 has the same routing potential as a C-rated at -1. This does not appear to be a great difference, but it is. *A reduction in casualties produces less FATIGUE* which, although it has no impact on a unit's Morale Check probabilities, can contribute greatly to whether a defensive unit will ROUT.