



TECHNICAL REPORT 2015
April 2013

Holley Stick Performance Analysis

Steven T. Holste, Ph.D
Jeffrey J. Person

Approved for public release.

SSC Pacific
San Diego, CA 92152-5001

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EXECUTIVE SUMMARY

In October 2012, the Marine Corps Warfighting Laboratory contacted SPAWAR Systems Center Pacific (SSC Pacific) to participate in an effort to identify the preferred replacement(s) for the current Holley Stick. Accordingly, a team was formed at SSC Pacific and a plan was developed to acquire and present as many Holley Stick candidates as possible to Marines to determine their preferences.

Concurrently, contact was made with approximately 14 manufacturers for prototype systems. Of the 14 manufacturers initially contacted, 6 responded, providing 11 Holley Stick samples.

To capture relevant information concerning user preferences for the Holley Sticks, a survey was developed that incorporated eight distinct elements related to the structure and performance of the sticks. One hundred twenty-two Marines from the Engineer, Infantry, and Explosive Ordnance Device (EOD) communities, from both the West and East Coasts, participated in the survey, providing insight as to which of the candidate sticks they liked best and least (together with information related to attachments for the sticks).

This report provides details related to the Holley Stick and attachment preferences expressed by each of the three U.S. Marine Corps (USMC) OccField communities. The hypothesis that the three communities would *not* select the same stick was supported; survey results reveal that the engineers selected one stick while the infantry figuratively aligned with the EOD Marines in selecting a different stick.

At this point in the process, the candidate Holley Sticks have been handled, the surveys have been administered, and the Marines have spoken. There seems to be more than sufficient convergence of opinion among the respective OccField communities to indicate which sticks – and attachments – they prefer.

Obviously, quality of manufacture and sturdiness and reliability of the poles is paramount. Utilizing the poles that were selected and applying the requested tweaks and modifications should yield Holley Sticks that will please the respective communities.

CONTENTS

EXECUTIVE SUMMARY	.iii
1. INTRODUCTION	1
2. BACKGROUND.....	2
2.1 TASKING	3
3. ACQUISITION OF HOLLEY STICKS.....	4
4. HOLLEY STICK ANALYSIS: USER SURVEYS	4
5. TARGET POPULATION: ENGINEERS/EOD/INFANTRY	5
6. RESULTS	6
6.1 ENGINEERS.....	7
6.1.1 Component Analysis	7
6.1.2 Gut Check	8
6.1.3 Hot Wash	9
6.2 INFANTRY	9
6.2.1 Component Analysis	9
6.2.2 Gut Check	11
6.2.3 Hot Wash	12
6.3. EXPLOSIVE ORDNANCE DISPOSAL	12
6.3.1 Component Analysis	12
6.3.2 Gut Check	14
6.3.3 Hot Wash	14
7. DISCUSSION.....	15
8. RECOMMENDATIONS	16
8.1 ENGINEERS (STICK #1).....	17
8.2 INFANTRY (STICK #7)	17
8.3 EOD (STICK #7)	18
8.4 ATTACHMENTS	19
APPENDICES	
A: MANUFACTURER CONTACT INFORMATION.....	A-1
B: HOLLEY STICK USER SURVEY (U)	B-1

Figures

1. Global IED incidents, 2006–2011	1
2. OEF Casualties, 2008–2012	2
3. Percentages of KIAs and WIAs due to IEDs, 2008–2012	2
4. Marines from II MEF (II Marine Expeditionary Force), Camp Lejeune, NC, test each of the 10 Holley Stick candidates according to the eight criteria shown in the survey (which is the last part of the report). The criteria include weight, length, collapsed length, ease of assembly, usability in an operational scenario, controllability, disassembly, and ease of changing attachments	3
5. Ranks of Marines surveyed for Holley Stick analysis	6
6. Engineer stick scoring	8
7. Infantry stick scoring (excluding stick #7)	10
8. Infantry stick scoring (excluding Camp Pendleton Marines)	11
9. EOD stick scoring	13

Tables

1. Survey scores (engineers)	7
2. Gut check scores (engineers)	8
3. Survey scores (infantry without stick #7)	9
4. Survey scores (infantry without Camp Pendleton Marines)	10
5. Gut check scores (infantry)	12
6. Survey scores (EOD)	13
7. Highest scoring sticks	13
8. Gut check scores (EOD)	14
9. Gut check participation rates (by community)	14
10. Comparative analysis results (engineers)	15
11. Comparative analysis results (infantry)	16
12. Comparative analysis results (EOD)	16
13. Holley Stick attachment recommendations	19

1. INTRODUCTION

The improvised explosive device, or “IED,” continues to be the weapon of choice, particularly in asymmetric conflicts throughout the world. The term “Improvised Explosive Device” is credited to the British Army, stemming from its experience with the Irish Republican Army (IRA) in the 1970s; the IRA began to use bombs made from fertilizer and semtex¹ supposedly smuggled from Libya. Although our current interest principally involves the use of IEDs in Afghanistan, these devices are in widespread use throughout the world. For instance, the Global Campaign Against IEDs² provides the following text and graphic related to worldwide IED usage:

“Historically, IED use has occurred in all parts of the world during a variety of situations including conflict and post-conflict environments (Iraq, Afghanistan, Sudan, Somalia, Israel, Lebanon, & Palestine); illegal drug operations (Mexico, Columbia, & Peru); insurgencies (Chechnya, Russia, Nigeria, & Northern Ireland); election-related violence (Kenya, Nigeria, & Ivory Coast); religious crises (India, Pakistan, & Nigeria); ethnic conflicts (Nigeria, Rwanda, Democratic Republic of the Congo, & Serbia); and other notable acts of terror (France, Norway, Russia, United Kingdom, & United States).”

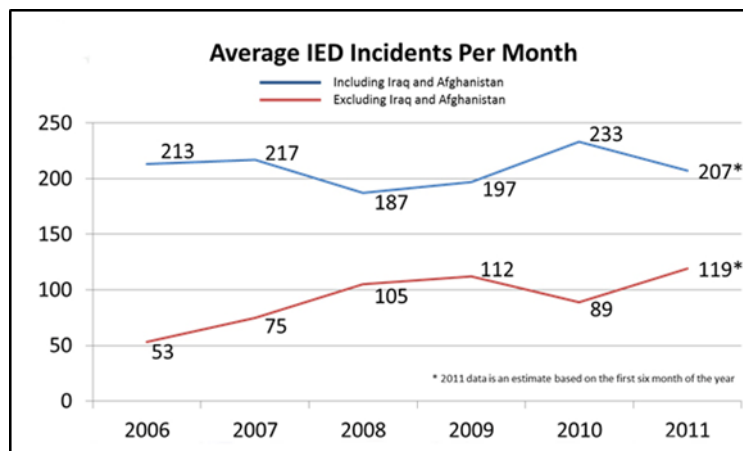


Figure 1. Global IED incidents, 2006–2011.

This context is vitally important because it provides clear evidence that the IED is in no way limited to Iraq and Afghanistan but, instead, exists as a worldwide phenomenon. The graph above is also interesting because the data indicate a very strong *negative* correlation ($r = -0.92$) between IED incidents in Iraq/Afghanistan and IED incidents in the rest of the world. In other words, between 2006 and 2011, *increases* in IED incidents in Iraq/Afghanistan tended to be accompanied by *decreases* in IED incidents elsewhere – and vice versa.

¹ Semtex, invented in the late 1950s by Stanislav Brebera in (the country then known as) Czechoslovakia, is named after Semtin, a suburb of Pardubice in the Czech Republic, where it was first manufactured in 1964.

² <http://www.campaignagainstiads.org/ied-factsheet.html>

2. BACKGROUND

The Marine Corps Warfighting Laboratory (MCWL), in concert with the Joint Improvised Explosive Device Defeat Organization (JIEDDO), have been investigating the impact of IEDs on U.S. Forces in Afghanistan and Iraq, seeking means to defeat or mitigate the ongoing impact of IEDs on U.S. and coalition forces. Figure 2 depicts OEF casualties from 2008 through 2012, indicating Total and IED-caused Killed in Action (KIA) and Wounded in Action (WIA) statistics³.

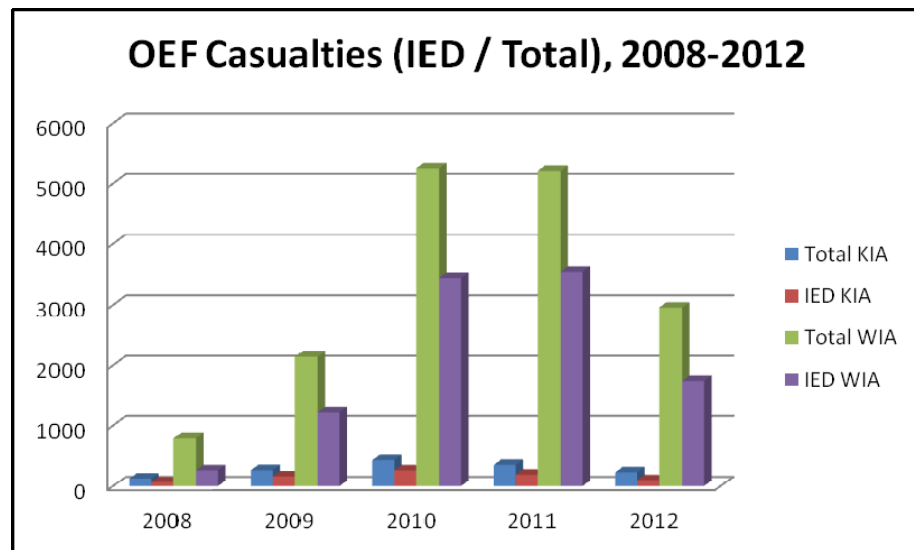


Figure 2. OEF Casualties, 2008-2012.

Data can be harvested from Figure 2 to reflect the percentages of KIAs and WIAs that are directly attributable to IEDs. This information, in turn, is shown in Figure 3.

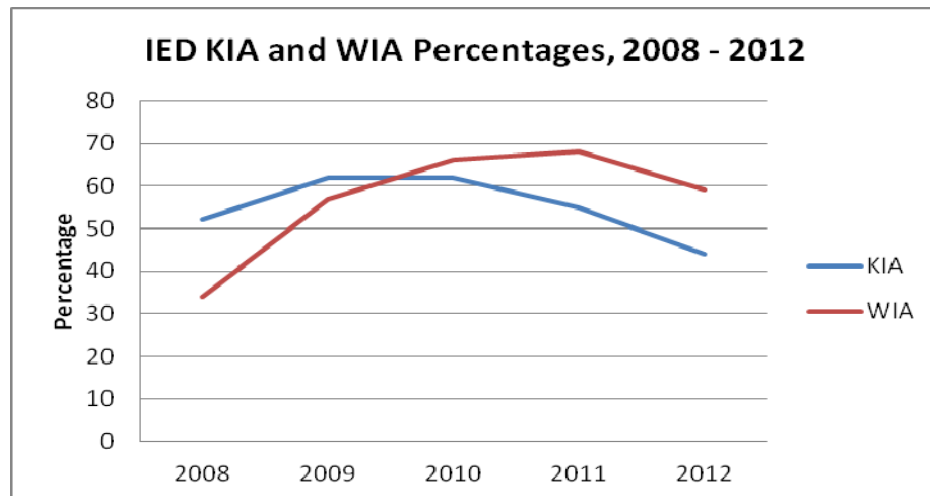


Figure 3. Percentages of KIAs and WIAs due to IEDs, 2008–2012.

³ Source: https://www.dmdc.osd.mil/dcas/pages/report_oef_month.xhtml

As Figure 3 demonstrates, IED-inflicted KIAs peaked at 62% of all KIAs in 2009–2010, gradually decreasing to 44% in 2012. At the same time, IED-inflicted WIAs peaked at 68% of all WIAs in 2011, decreasing to 59% in 2012. Taken together, Figures 1 through 3 clearly reveal the IED as a worldwide scourge and, in particular, one that has exerted a deadly impact on United States and coalition forces in Iraq and Afghanistan.

One of the tools that coalition forces have been using to detect and defeat IEDs is, in essence, a long stick with a hook or some other device at the end to probe dirt, objects, structures, etc. from a distance. These sticks are often quite simple (constructed of bamboo, wood, and aluminum) and tend to range in length from a few feet to between 10 and 20 feet. Often referred to as the “Holley Stick⁴,” they collectively represent a classic example of Marines and soldiers taking the initiative and developing a field expedient to address an important problem.

The various Holley Sticks that have been fielded tend to diverge along a number of important criteria (including length (collapsed and extended), weight, type of attachment(s), etc.) and to demonstrate varying degrees of capability. However, despite their differences, each of them tends to have significant drawbacks and shortcomings. Consequently, JIEDDO and MCWL together have elected to investigate the types and capabilities of potential Holley Stick replacements among U.S. manufacturers.

2.1 TASKING

In this connection, Major Scott Baley of the Marine Corps Warfighting Laboratory contacted SSC Pacific in October 2012 to participate in an effort to identify the preferred Holley Stick replacement candidate(s). Accordingly, a team was formed at SSC Pacific and a plan was developed to acquire and present as many Holley Stick candidates as possible to Marines to determine out their preferences (see Figure 4).



Figure 4. Marines from II MEF (II Marine Expeditionary Force), Camp Lejeune, NC, test each of the 10 Holley Stick candidates according to the eight criteria shown in the survey (see Appendix B). The criteria include weight, length, collapsed length, ease of assembly, usability in an operational scenario, controllability, disassembly, and ease of changing attachments.

⁴ The Holley Stick is named after Marine Gunnery Sergeant Floyd E. Holley, who was assigned to the 7th Engineer Support Battalion, 1st Marine Logistics Group, I Marine Expeditionary Force and died 29 Aug 2010 while supporting combat operations in Helmand Province, Afghanistan.

Central to this effort was the explicit understanding that different Military Occupational Specialty (MOS) communities within the Marine Corps very likely have different applications, priorities, and preferences regarding the Holley Sticks. Accordingly, SSC Pacific developed a plan targeting three key occupational communities: explosive ordnance disposal (EOD), infantry, and engineers.

3. ACQUISITION OF HOLLEY STICKS

Initial contact was made with more than a dozen manufacturers for prototype systems. Four fundamental criteria were articulated as desirable for the Holley Stick candidates:

- Collapsed length (no more than 2.5 feet)
- Fully extended length (no less than 12 feet)
- Weight (not to exceed 4 pounds)
- Generally sturdy, rigid, and able to withstand abuse

Of the 14 manufacturers initially contacted, six responded (for a 42.9% response rate), providing 11 Holley Stick samples. Details of the manufacturers and the individual Holley Stick candidates are shown in Appendix A. The sticks were shipped to SSC Pacific, arriving between approximately 19 September 2012 and 24 October 2012. Many of the manufacturers elected to not respond, since their sticks tended to significantly exceed the threshold weight requirement. The manufacturers were advised that Marines from both coasts would be handling the sticks in realistic and less-than-pristine environments; consequently, although the sticks were to be returned following the analyses, it was understood that they might well be damaged or broken. The responsive manufacturers understood the goal and were genuinely engaged in the process, many times offering to provide many stick variants, but the survey requirements limited the number of sticks received from any given manufacturer.

4. HOLLEY STICK ANALYSIS: USER SURVEYS

To capture relevant information on user preferences for the Holley Sticks, a survey was developed that incorporated eight distinct elements, shown below.

- Weight of the stick
- Length of the stick – fully extended
- Length of the stick – collapsed
- Ease of Assembly (clamps/screws)
- Usability in an operational scenario
- Controllability of the stick
- Disassembly of the stick
- Ease of changing attachment

Although these eight categories, arguably, are not entirely orthogonal, they do capture the key items of interest expressed by Major Baley, MCWL, and JIEDDO.

Each of the eight categories uses a six-point Lickert scale with scores ranging from 1 through 5, where 1 means “Poor,” 3 means “Average,” and 5 means “Excellent” – plus a sixth option, “N/A,” when the Marine believed that the category was irrelevant to the stick in question. Summing across the eight categories, then, a given stick could receive a score ranging from 8 (meaning it was

considered “Poor” in all categories) to 40 (meaning it was considered “Excellent” in all categories). An “N/A” marking was scored as zero.

In addition to scoring the sticks using the Lickert scale, the Marines were encouraged to provide additional written comments about each stick they reviewed, identifying specific strengths and weaknesses as well as ways to improve the stick. At the end of the survey, the Marines were also asked four summary questions:

1. Of the sticks that you just tested, which one would you select if you had to go into an operation and use it tomorrow?
2. If you did have to use the stick you just selected in an operation tomorrow, what specific improvements would you make to the stick?
3. Of the poles that you tested, are there any you think wouldn’t work at all in an operational environment?
4. What attachments would you want on the sticks?

The survey is presented in Appendix B.

5. TARGET POPULATION: ENGINEERS/EOD/INFANTRY

As mentioned previously, different MOS communities within the Marine Corps are likely to have different wants and needs regarding the Holley Stick. Consequently, SSC Pacific worked with MCWL and the Marines of I Marine Expeditionary Force (Camp Pendleton, CA) and II Marine Expeditionary Force (Camp Lejeune, NC) to schedule time with the three key occupational communities (engineers, EOD, and infantry).

Beginning in the latter part of November 2012 and running through mid-January 2013, SSC Pacific met with Marines from:

7 th Engineer Support Battalion	19 Nov 2012	Camp Pendleton
1 st Combat Engineer Battalion		
1 st EOD Company	30 Nov 2012	Camp Pendleton
8 th Engineer Support Battalion	12 Dec 2012	Camp Lejeune
2 nd Combat Engineer Battalion		
2 nd EOD Company		
3 rd Battalion, 8 th Marine Regiment	13 Dec 2012	Camp Lejeune
2 nd Battalion, 5 th Marine Regiment	14 Jan 2013	Camp Pendleton

One hundred twenty-two Marines participated in the Holley Stick Survey, including 44 engineers, 44 EOD Marines, and 34 infantry Marines. The rank and Occupational Field (OccField) breakdowns are shown in Figure 5.

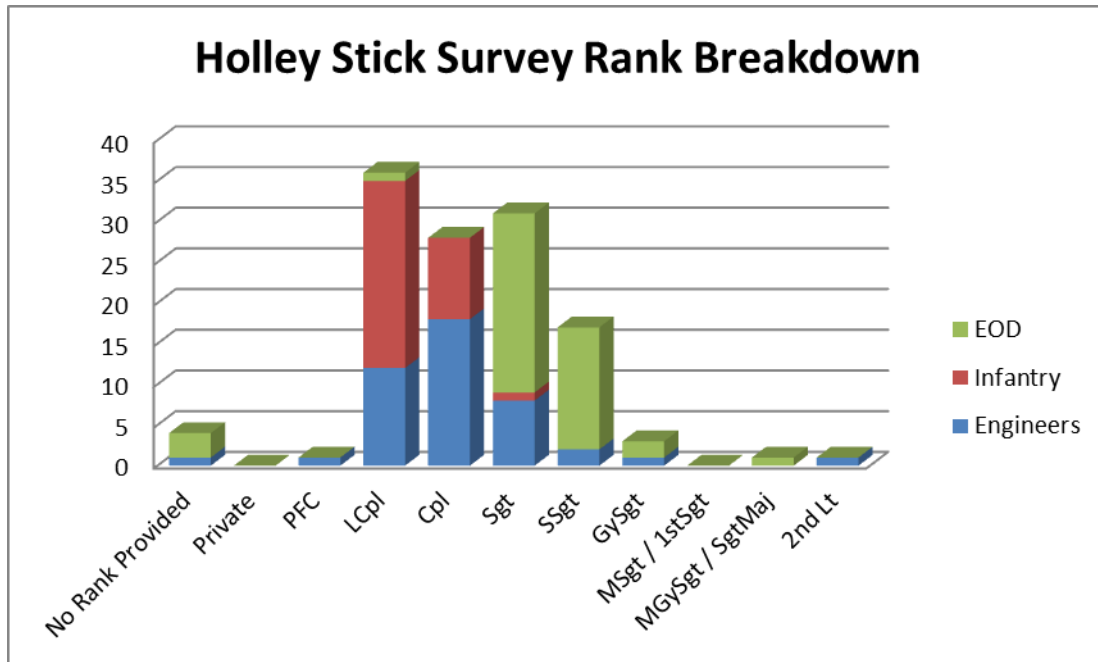


Figure 5. Ranks of Marines surveyed for Holley Stick analysis.

6. RESULTS

The results obtained from each of the OccField groupings are divided into three categories of analysis.

The first, which we have termed “**Component Analysis**,” reflects the summing of the scores across the eight distinct elements that were described in Section 4. Implicitly, each of the eight elements is treated as equivalent in terms of importance and, consequently, contribution to the final score.

The second category, which we have termed “**Gut Check**,” involves a tabulation of the Marines’ response to the first of the four summary questions at the end of the survey: “Of the sticks that you just tested, which one would you select if you had to go into an operation and use it tomorrow?” After having methodically reviewed each of the 10 candidate Holley Sticks, the Marine is then asked to indicate which stick he⁵ believes to be the best—a sort of “gut check.” The response therefore may involve intuitive, emotional, and cognitive aspects. Additionally, it may reflect the fact that – contrary to the implicit assumptions of the first category of analysis—the eight distinct elements comprising the component analysis may *not* be of equal value or weight.

Lastly, the third and final category of analysis is termed “**Hot Wash**.” This analysis follows a sort of “decision by committee” process in which the senior Marine(s) present at the various scheduled “stick-off” events conducts a hot wash of the exercise and attempts to develop consensus as to which of the candidate sticks was best for that OccField’s particular use. The body of literature addressing group decision making is quite large, reflecting both pro and con. For instance, on the plus side of the ledger, the group may have the opportunity to hear and weigh novel or minority views that individual members might not have otherwise considered. On the flip side of the coin, group decision making dynamics sometimes lead to suboptimal decisions if senior members overrule or exclude more junior

⁵ The use of the male pronoun is appropriate, reflecting the fact that 100% of the Marines in the survey were male.

members or the process known as “groupthink” takes over. Finally, it is important to note that the Hot Wash analysis did not occur at each “stick-off” event; it developed and was utilized more frequently towards the end of the data-gathering process.

6.1 ENGINEERS

Forty-four Marine engineers participated in the survey, including Marines from both Camp Pendleton and Camp Lejeune.

6.1.1 Component Analysis

The resultant survey scores for the engineers are shown in Table 1, ordered from the highest to lowest scoring sticks.

Since the highest possible score that any given stick could receive from a Marine was 40 points, as described previously, the highest score that a stick could earn in this survey was 1760 points (40 points x 44 Marines). Consequently, the most highly rated stick in this survey – stick 1, with 1295 points – earned only about **73.6%** of the total possible points. This reflects the simple fact that each of the candidate sticks has its own distinctive strengths and weaknesses, cited by the Marines in the surveys. The scoring results are shown in Figure 6.

Table 1. Survey scores (engineers).

Stick Number	Total Score
1	1295
7	1280
10	1279
8	1223
4	1213
11	1192
6	1121
2	1066
5	1024
9	526
Average	1122

Although the scoring produced an orderly sequence of sticks, naturally it turns out that things aren’t quite that simple. Due to normal sampling variability, we utilized inferential statistics to understand the results. Utilizing the two-tailed within-subjects t-Test with an alpha (α) of 0.05, it turns out that there is no statistically significant difference between any of the top five sticks. In other words, sticks 1, 7, 10, 8, and 4 effectively tied for first place. Visually, Figure 6 tends to lend credence to this assertion. Moving down the table, it turns out that the sixth pick (stick 11) is significantly different statistically from the top two sticks (sticks 1 and 7)—but it is not significantly different from the number three stick (stick 10), and so on.

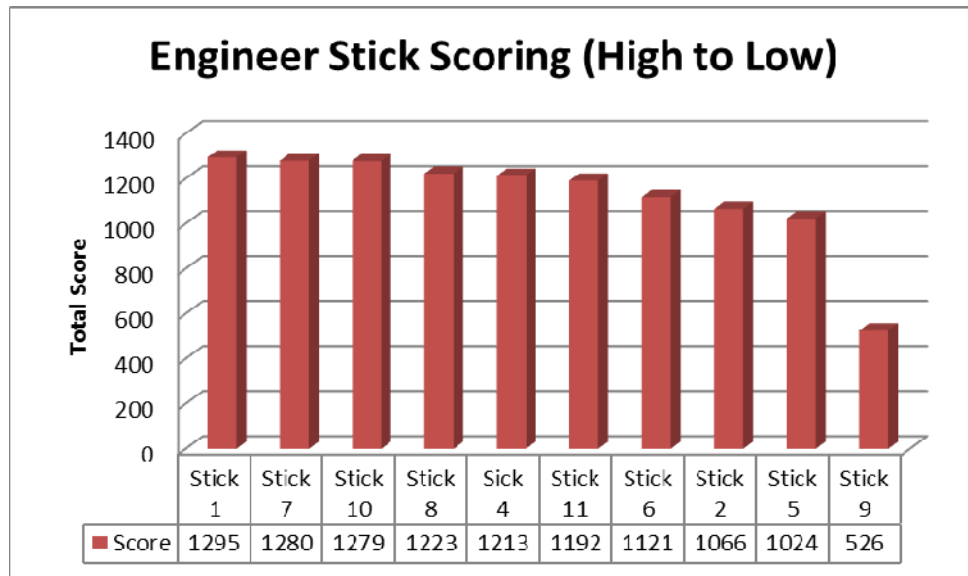


Figure 6. Engineer stick scoring.

Stick 9, which, as both Table 1 and Figure 5 demonstrate, was last place with just 526 points (29.9% of the total possible), requires some discussion. This stick is a heavy, complicated, multi-segmented, electrically operated stick. The Marines found no use whatsoever for this stick and it generated substantially more negative verbiage in the comments section of the surveys than any other stick. Furthermore, it was by far the most frequently cited stick when Marines responded to the third of the survey's four summary questions ("Of the poles that you tested, are there any you think wouldn't work at all in an operational environment?") Thirty-four "votes" were spread across the 10 sticks; stick 9 alone received 21, or 61.8% of these; the next highest "vote"-getters were sticks 5 and 6, which received three votes each.

6.1.2 Gut Check

The "Gut Check" scores for the engineers are shown in Table 2, ordered from the highest to lowest scoring sticks.

Table 2. Gut check scores (engineers).

Stick Number	Total Score
1	10
4	10
7	2
2	1
10	1
5	0
6	0
8	0
9	0
11	0
Average	2.4

In this table, **sticks 1 and 4** clearly lead the pack. At the same time, fully half of the sticks (5, 6, 8, 9, and 11) received no votes whatsoever. However, it is worth noting that there are only 24 votes – meaning a participation rate of just 24/44, or 54.5% – in this analysis. It is difficult and potentially risky to have much confidence in these results when, for whatever reason, nearly half of the Marine engineers elected not to respond to this summary question.

6.1.3 Hot Wash

As mentioned previously, not all of the Marines participated in the Hot Wash analysis. In the case of the engineers, only the east coast engineers executed a Hot Wash, so this section reflects only their input. Following their Hot Wash, the east coast engineers settled on **stick #1**.

6.2 INFANTRY

Thirty-four infantry Marines participated in the survey, including Marines from both Camp Pendleton and Camp Lejeune. The infantry analysis poses a peculiar problem due to the removal and retention of one of the candidate Holley Sticks (stick #7) by the Marine Corps Warfighting Laboratory, subsequent to the East Coast infantry “stick-off” but prior to the West Coast infantry “stick-off.” Consequently, the Marines from 3rd Battalion, 8th Marine Regiment interacted with all 10 sticks, whereas the Marines from 2nd Battalion, 5th Marine Regiment interacted with only nine of the sticks. We therefore, unfortunately, were left with two options, both suboptimal:

1. Perform the analyses using only the nine sticks that all of the infantry Marines saw, thereby excluding stick #7; or
2. Perform the analyses using all 10 sticks but excluding the West Coast Marines of 2/5.

Both analyses are presented below. As it turns out, a third course of action (COA) emerges as a result of the extremely favorable reviews of stick #7.

6.2.1 Component Analysis

The resultant survey scores for the infantry (excluding stick #7) are shown in Table 3, ordered from the highest to lowest scoring sticks.

Table 3. Survey scores (infantry without stick #7).

Stick Number	Total Score
8	1038
10	1033
11	958
1	931
5	828
4	822
6	788
2	674
9	354
Average	825

Similarly, the survey scores for the infantry (excluding the Marines of 2/5, Camp Pendleton) are shown in Table 4, ordered from the highest to lowest scoring sticks.

Table 4. Survey scores (infantry without Camp Pendleton Marines).

Stick Number	Total Score
8	766
7	763
10	727
11	703
1	662
4	600
5	664
6	562
2	498
9	275
Average	612

Examination of these two tables shows a remarkable consistency; they are virtually identical, with two exceptions: Table 4 includes stick #7 (very highly rated, in second place but statistically indistinguishable from stick #8 in first place, as discussed further below) whereas Table 3 is forced to exclude stick #7; and sticks #4 and #5, which are adjacent to one another in both tables, swap positions between the two tables. Apart from that, the two tables reflect the same ordering. This, unfortunately, reinforces the critical importance of stick #7 (whose removal was not discovered until the morning of the 2nd Battalion, 5th Marines “stick-off”). Turning to Table 3, the highest scoring stick (stick #8) scored 1038 points—which is **76.3%** of the maximum possible score (40 points x 34 Marines = 1380 points). In the case of Table 4, the highest scoring stick (again, stick #8) scored 766 points—which is **76.6%** of the maximum possible score (40 points x 25 Marines = 1000 points). These scoring similarities suggest that the Camp Lejeune Marines and the Camp Pendleton Marines have remarkably similar Holley Stick preferences. The scoring results for both analyses are shown in Figures 7 and 8.

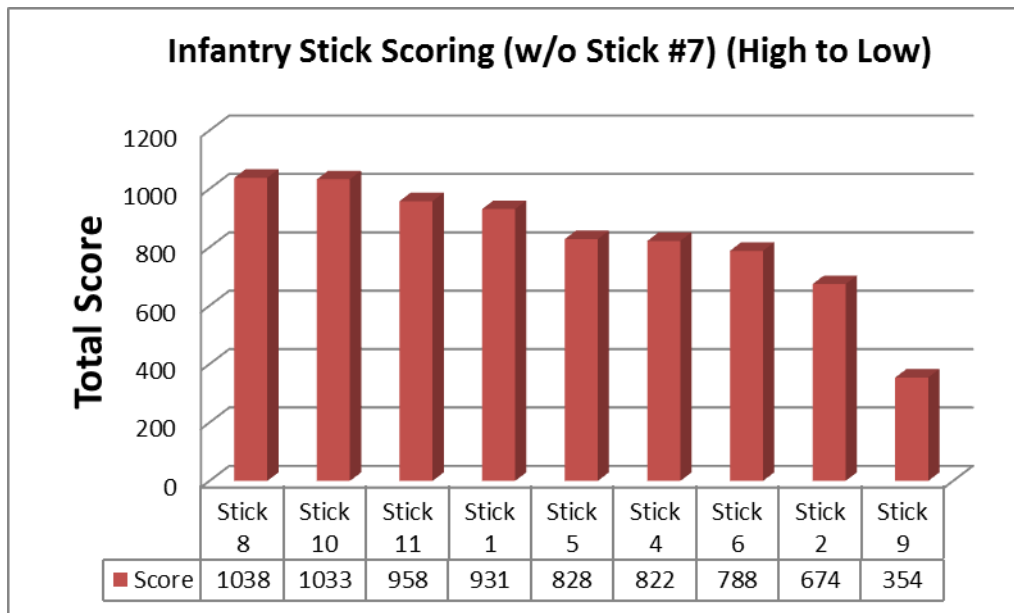


Figure 7. Infantry stick scoring (excluding stick #7).

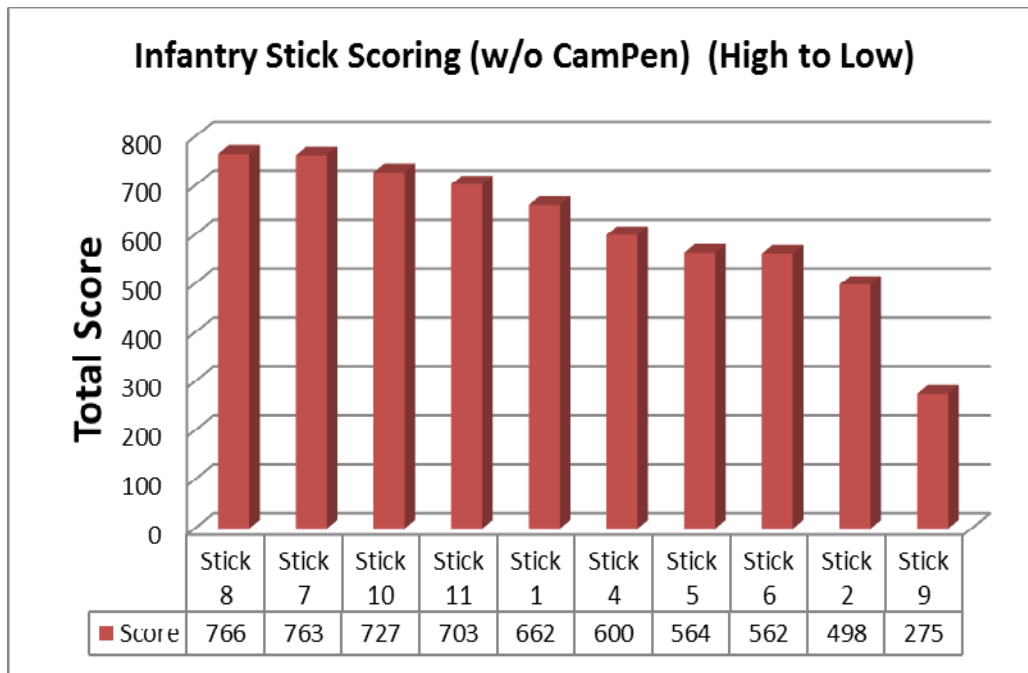


Figure 8. Infantry stick scoring (excluding Camp Pendleton Marines).

We begin the infantry analysis by excluding stick #7 (i.e., utilizing the results summarized in Table 3 and Figure 7) to include both the East Coast and West Coast Marines. Once again, we employ the two-tailed within-subjects t -Test with an alpha (α) of 0.05. In this case, it turns out that there is no statistically significant difference between the top two sticks. In other words, **sticks 8 and 10** effectively tied for first place. Additionally, sticks 8 and 10 both achieved scores statistically greater than the next stick (stick #11). Visually, Figure 7 supports these conclusions.

We continue the infantry analysis by including stick #7 and therefore excluding the Camp Pendleton Marines of 2/5 (i.e., utilizing the results summarized in Table 4 and Figure 8), employing the same statistical tests. Things become a bit dicey because we have reduced n (the sample size, i.e., the number of Marines participating) from 34 to 25, which makes it more difficult to detect differences reliably. Using only the 25 Camp Lejeune Marines from 3/8, it turns out that there is no statistically significant difference between the top *five* sticks. In other words, **sticks 8, 7, 10, 11, and 1** effectively tied for first place. Additionally, sticks 8, 7, 10, and 11 are all statistically greater than Stick #4; of the top five sticks, only stick #1 is not statistically greater than the sixth stick (stick #4).

6.2.2 Gut Check

The “Gut Check” scores for the infantry are shown in Table 5, ordered from the highest to lowest scoring sticks. Unlike the component analysis, running parallel Gut Check analysis is unnecessary; the reason is apparent in Table 5.

Table 5. Gut check scores (infantry).

Stick Number	Total Score
7	10
8	6
10	6
1	3
Original Yellow	2
2	1
4	0
5	0
6	0
9	0
11	0
Average	2.5

In this tabulation, there are a total of 28 votes, for a participation rate of 28/34, or 82.4%. In addition to identifying the “winner,” this table reveals many interesting points. First, two Marines decided to submit a “write-in” candidate and included the “Original Yellow” Holley Stick, which is still used in many places. Although the “Original Yellow” (or “Sickle Stick”) write-in earned only two votes, placing it far down in the pack, it still scored higher than six of the other candidates that scored only 1 or 0 votes. The second point is that **stick #7** wins the Gut Check (with sticks 8 and 10 tied for second place)—*even though this stick was only seen by a subset of the infantry Marines* (25 out of 34, or 73.5%). Stick #7 earned the most votes while being reviewed by only 73.5% of the infantry Marines, while every other stick earned fewer votes while being reviewed by 100% of the infantry Marines. Since stick #7 was the highest vote-getter among the Camp Lejeune-based infantry Marines, it is logical to assume that it would have had some degree of popularity among the Camp Pendleton-based Infantry Marines as well. Consequently, it is clear that—if the Camp Pendleton-based infantry Marines had had the opportunity to handle and review it—stick #7 would have earned even more votes; furthermore, due to the zero-sum nature of the scoring, some of its competitors therefore would have earned even fewer, thus further extending stick #7’s lead.

6.2.3 Hot Wash

The Marines of 3/8—who interacted with all ten sticks—preferred **stick #7**. The Marines of 2/5—who did *not* have the opportunity to interact with Stick #7—indicated a preference for **stick #10**.

6.3. EXPLOSIVE ORDNANCE DISPOSAL

Forty-four EOD Marines participated in the survey, including Marines from both Camp Pendleton and Camp Lejeune.

6.3.1 Component Analysis

The resultant survey scores for the EOD Marines are shown in Table 6, ordered from the highest to lowest scoring sticks.

Table 6. Survey scores (EOD).

Stick Number	Total Score
7	1419
1	1178
8	1153
11	1145
10	1119
4	1045
6	940
5	933
2	844
9	327
Average	1010

The EOD scoring for the 10 sticks is shown in Figure 9.

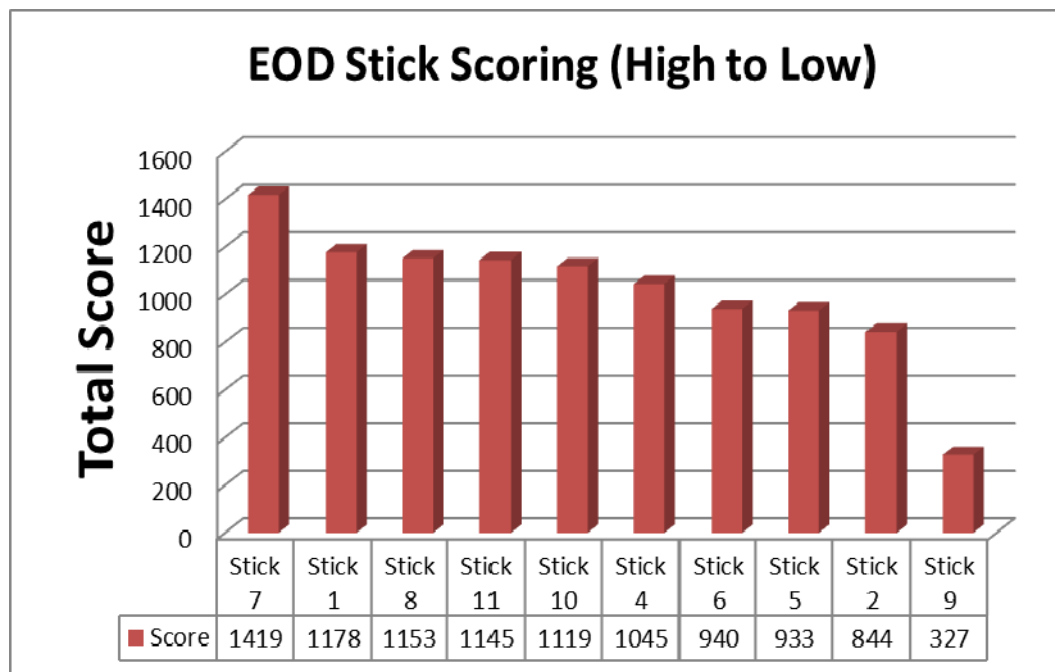


Figure 9. EOD stick scoring.

Both the EOD and engineer analyses consisted of 44 Marines—so, as with the engineers, the highest possible score that a stick could earn is 1760 (44 x 40) points. The highest scoring stick in the current analysis is stick #7, which earned 1419 points, or 80.6% of the maximum possible score. This is the largest score (in terms of both points and percentage) that any stick has earned in any of the analyses, as depicted in Table 7.

Table 7. Highest scoring sticks.

Community	Stick Number	Score	Percentage
Engineers	1	1295	73.6%
Infantry	8	1038	76.3%
EOD	7	1419	80.6%

Additionally, the difference between the first stick and the remainder is much more pronounced and visually obvious in this analysis, as Figure 9 reveals. Continuing our review with statistical analyses (once again utilizing the two-tailed within-subjects t-Test with an alpha (α) of 0.05), stick #7 is the solo winner in the Component Analysis, well ahead of the second-place stick (stick #1). The second and third place sticks (sticks 1 and 8), meanwhile, are statistically indistinguishable, meaning they tied for second place.

6.3.2 Gut Check

The “Gut Check” scores for the EOD Marines are shown in Table 8, ordered from the highest to lowest scoring sticks.

Table 8. Gut check scores (EOD).

Stick Number	Total Score
7	29
1	10
11	3
2	1
8	1
4	0
5	0
6	0
9	0
10	0
Average	

In this tabulation, there are a total of 44 votes, for a participation rate of 44/44, or 100%—by far the highest participation rate among the three communities, as shown in Table 9.

Table 9. Gut check participation rates (by community).

Community	Participation
Engineers	54.5%
Infantry	82.4%
EOD	100.0%

The “Gut Check” scores reflect a very strong preference for **stick #7**, with 29 (65.9%) of the votes cast. A distant second, stick #1 earned 10 votes (22.7%); similarly, stick #11 came in a distant third with three votes (6.8%). Consequently, the EOD “Gut Check” scores strongly reinforce the “Component Analysis”—both approaches clearly identify stick #7 as the preferred Holley Stick candidate.

6.3.3 Hot Wash

Finally, in the Hot Wash events following the administration of the survey on both the east and west coasts, EOD Marines jointly reaffirmed their preference for **stick #7**.

7. DISCUSSION

One hundred twenty-two Marines handled and interacted with a sample consisting of 10 candidate Holley Stick replacement poles. These poles, in turn, were provided in response to a request by SPAWAR Systems Center Pacific for counter-IED pole samples meeting certain criteria, as discussed above.

While it is true that 122 Marines cannot perfectly characterize the preferences of the entire FY2013 USMC end strength of 236,900 (active and reserve) Marines, our goal here was to measure the professional recommendations of a representative sample from the engineer, EOD, and infantry communities.

The research was conducted as a double-blind survey. In other words, neither the Marines nor the investigators knew which sticks were manufactured by which companies—or even which companies were involved. (The sole exception to this was the project lead who created an Excel spreadsheet to cross-reference the manufacturers with each of the numbered sticks; however, he actively withheld this information from everyone else on the team.) Even though it is improbable that any of us, directly or indirectly, would have financial interest in any of the manufacturers, the use of double-blind research ensures that our sole fiduciary responsibility was, and remains, to assist in identifying the very best tool possible for the Marines.

Several analytical techniques were employed to test and measure the various capabilities of the sticks from different perspectives. The “Component Analysis” measured the individual components and component capabilities of each stick. The “Gut Check” analysis required each Marine—who had, at that point, handled each and every one of the sticks—to indicate which stick was his favorite and, more to the point, which stick he would choose to take with him on an operation tomorrow. Finally, the “Hot Wash” provided an opportunity for each group of Marines to gather, having already finished the Component Analysis and Gut Check, and to engage in a give-and-take to attempt to achieve consensus as to which stick was the best for that particular OccField community.

Shown below, Table 10 reflects the successive analyses of the 44 engineers. As depicted in the Table 10, five sticks tied for first place in the Component Analysis, two sticks tied for first place in the Gut Check, and one stick emerged as the lone preference in the Hot Wash. As it turns out, a single stick (**stick #1**) achieved a first-place standing in each of the successive analyses, as shown in the highlighting below.

Table 10. Comparative analysis results (engineers).

Engineers		
Component Analysis	Gut Check	Hot Wash
1 , 7, 10, 8, 4	1 , 4	1

Table 11 reflects the results obtained with the 34 infantry Marines. The infantry analysis, as described previously, was just a bit messy due to the unanticipated removal by MCWL of one of the most popular sticks (stick #7) prior to the stick-off event with 2nd Battalion, 5th Marines. We therefore generated two sub-groupings for further analysis: one that involved *all* of the Marines but excluded stick #7, and a second grouping that involved *all* of the sticks but excluded the West Coast infantry Marines of 2/5. Although neither of these sub-groupings is ideal, we proceeded with the analysis nonetheless and some interesting results emerged. Upon review, the Component Analysis preferences of all of the infantry Marines collectively were essentially identical to those of just the East Coast (3/8) Marines. Specifically, the stick rankings were the same with two exceptions: (1) sticks 4 and 5—which were adjacent in both rankings and which scored in the lower half of the scale

—were reversed; and (2) the rankings that included both the West and East Coast Marines necessarily excluded stick #7.

Table 11. Comparative analysis results (infantry).

Infantry			
Sub-Grouping	Component Analysis	Gut Check	Hot Wash
Excluding stick 7	8, 10	7	10
Excluding 2/5	8, 7, 10, 11, 1		7

Consequently, a “Gut Check” analysis that grouped all of the infantry Marines together was evaluated. Even though the Marines of 2/5 did not have the opportunity to interact with stick #7, that stick nonetheless emerged as the highest vote getter. Of course, the “Hot Wash” results were almost guaranteed to differ since the 2/5 Marines did not have the opportunity to evaluate stick #7. Nonetheless, in view of the demonstrated similarities in preferences of the 2/5 and 3/8 Marines in their respective evaluations of the various sticks, it seems both logical and highly probable that **stick #7** would have emerged as the overall preference of the infantry Marines, if only that stick had been made available to all of them for review.

Finally, the results of the successive analyses for the EOD Marines are shown in Table 12. The EOD Marines present the simplest and most straightforward outcome of any of the OccFields surveyed, with a clear and unambiguous preference for **stick #7** across the board.

Table 12. Comparative analysis results (EOD).

Explosive Ordnance Disposal		
Component Analysis	Gut Check	Hot Wash
7	7	7

Even before administering the first survey, we anticipated that the different OccFields would very likely express preferences for different Holley Sticks. That expectation was, in large part, validated. The engineers gravitated towards **stick #1**. The infantry (in our view) preferred **stick #7**. And, the EOD Marines unequivocally favored **stick #7**. Consequently, it turns out that there was some overlap in the preferences – the choices were not mutually exclusive.

However, the identification of the basic stick preferences was only part of the assignment. Recommendations for ways to improve the stick(s) were also solicited from the Marines; we turn to that topic next.

8. RECOMMENDATIONS

In the course of observing over 120 Marines handle the various sticks, a number of comments were heard over and over again. Many had to do with the length of the poles (e.g., the collapsed lengths should be *shorter* while the extended lengths should be *longer*), the weight of the poles (they should weigh *less*), etc. Naturally, many of the requests seem mutually exclusive – for example, make the poles longer but make them weigh less. Still, no doubt some progress can be made in these areas.

It is important to convey to the manufacturer(s) a clear understanding of the environment in which these poles will be employed. Among the putative characteristics of this environment are the following: (1) Significant swings in temperature and atmospheric conditions, including rain and snow; (2) dirty conditions combined with a very fine, abrasive dust; and (3) potentially infrequent and incomplete maintenance. Clearly, the replacement Holley Sticks need to be well made and

reliable, provide adequate sensory and tactile feedback to the operators, and be capable of performing their intended mission in hostile and unforgiving terrain.

The comments that were acquired from each Marine occurred basically in two phases. First, they offered comments about each individual stick as they worked with it, prior to moving onto the next stick. Second, after having handled and interacted with all of the sticks, each Marine identified the stick that he, personally, preferred and then offered specific suggestions to improve that stick. (The reader will, no doubt, observe some correlation between the pre- and post-decisional comments.)

8.1 ENGINEERS (STICK #1)

While handling stick #1—their chosen stick—the engineers commented primarily on two characteristics of the stick. First, they addressed the length of the stick; there were five comments indicating that the extended length of the stick was not long enough and three comments indicating that the stick was too long when it was fully collapsed. The other area of concern had to do with the clamping mechanism; four comments highlighted concern with the durability of the stick shaft and clamping mechanism, including the absence of a positive lock.

Subsequent to handling all of the sticks, and after identifying stick #1 as their preferred stick, the engineers offered the following observations and recommendations for its improvement:

- Lighten the pole a bit, if possible
- Increase the *extended* length of the pole (*three comments*)
- Improve the clamps—e.g., use the clamps from stick #5
- Provide a means of cleaning the pole—after prolonged use in-country, it will be difficult to extend/collapse
- Decrease the *collapsed* length of the pole (*two comments*)
- Use a subdued color for the pole (*Note: stick #1 was bright red*)
- The pole should have a better handle
- The blade/attachment should have more curvature
- The attachment should have a round tip
- Use non-metallic attachments

8.2 INFANTRY (STICK #7)

While handling stick #7, the infantry Marines' comments similarly focused on the length of the stick and the clamping mechanism. Seven comments indicated a preference for a lengthening of this stick and one comment indicated concern about the strength and durability of the stick clamping mechanism.

Then, subsequent to handling all of the sticks, and after identifying stick #7 as their preferred stick, the infantry Marines offered the following observations and recommendations for its improvement:

- Needs carrying strap(s)
- Needs to be longer, e.g., 2 feet longer (*five comments*)
- Needs to be lighter
- Needs different mechanism for attaching the attachments (“extra bolts that have nuts instead of the bolts screwing straight into the stick head”)
- The threaded end of the pole, where the attachments are threaded on, should be metal, not plastic (*two comments*)

8.3 EOD (STICK #7)

While handling stick #7, the EOD Marines' principal suggestions involved improving the stick clamps and making them stronger (eight comments) and changing the threaded tool attachment point at the end of the stick from plastic to something sturdier, e.g., aluminum (three comments).

Finally, subsequent to handling all of the sticks and after identifying stick #7 as their preferred stick, the EOD Marines offered the following observations and recommendations to improve that stick:

- Stick should be held together with polymer epoxy
- Shorten the collapsed length (e.g., by 1 to 2 feet)
- Lengthen the stick (e.g., by 1 to 2 feet)
- Improve the latches (e.g., use the latches from stick #5 or stick #11 and change the latches from plastic to metal) (*12 comments*)
- Change pole to tactical colors (*Note: stick #7, like stick #1, was bright red*) (*two comments*)
- Use a carrying strap (e.g., a one-point sling) for carrying the pole (*two comments*)
- Stowable (i.e., retractable) hook
- Make the threaded part of the stick (i.e., the tip) metal rather than plastic

8.4 ATTACHMENTS

Lastly, the Marines jointly offered the following suggestions on the attachments (presented in order of decreasing frequency of mention) as listed in Table 13.

Table 13. Holley Stick attachment recommendations.

Comment	Frequency
Non-conductive, non-metallic blade	14
Carrying strap(s), sling, perhaps a clip to attach to flak	7
Dual-hook attachment to help stabilize	5
Instead of having to screw the hooks on the attachment ending, have them permanently attached to the ending so you can just change them out	3
Multiple options for length of sickles	3
Hook with teeth/Hook and claw	3
The sickle stick head should be metal or something other than plastic – otherwise it will strip out	3
Similar to the attachment on Stick #2	3
Attachments that don't require tools	2
A smooth, curved hook, 3 to 6"	2
Blade needs more of a curvature	2
Curved, dull sickle-shaped blade	2
Attachment is too sharp – catches on too much	1
A 5 to 8" sickle	1
Blade attachments made of fiberglass, aluminum, and plastic	1
A three-hooked sickle head	1
Simple sickle-type blade	1
Make it so the hook can fold down	1
Attachments that attach with pins and not screws	1
Use wingnuts for all screws on the attachments	1
Picatinny tool attachment	1
Snap-on attachments	1
Attachment moves if not tightened – change hex to T-handle	1
Prefer screws that are easier to take off with a Gerber	1
One-piece attachments	1
Avoid carrying bags	1
Pouch	1
Thumbscrew to change the angle of the hooks	1
Lighter, easier to assemble attachments	1
No easily breakable, skinny carbon hooks	1
Extra sections for the pole	1
Spare parts with each pole due to so much plastic	1

At this point in the process, the candidate Holley Sticks had been handled, the surveys had been administered, and the Marines had spoken. Although any survey benefits from a larger n (sample size), there seems to be more than sufficient convergence of opinion among the respective OccField communities to indicate which sticks (and which attachments) they prefer. This is particularly true of the EOD community, as there is very little room for equivocation regarding EOD Holley Stick preference; nonetheless, the data for each of the communities seems compelling.

Obviously, quality of manufacture and sturdiness and reliability of the poles is paramount. Utilizing the poles that they selected and applying the requested tweaks and modifications should yield Holley Sticks that will please the respective communities.

APPENDIX A: MANUFACTURER CONTACT INFORMATION

Stick #	Manufacturer	Address
1	MithiX Pro	3591 Way Back Road Farmersville, TX 75442 (800) 956-3398
2	Ordnance Holdings, Inc.	P.O. Box 696 Drexel Hill, PA 19026 (267) 350-9069
3	Allen Vanguard	2461 South Clark Street Arlington, VA 22202 (571) 512-3274
4	Will-Burt Company	169 South Main Street Orrville, OH 44667 (330) 682-7015
5	MithiX Pro	3591 Way Back Road Farmersville, TX 75442 (800) 956-3398
6	K-Tek / M. Klemme Technology Corporation	1384 – F Poinsettia Avenue Vista, CA 92081 (760) 727-0593
7	MithiX Pro	3591 Way Back Road Farmersville, TX 75442 (800) 956-3398
8	Will-Burt Company	169 South Main Street Orrville, OH 44667 (330) 682-7015
9	Dexter Innovative Solutions LLC	61 East River Street Orange, MA 01364-1801 (978) 544-2751
10	Will-Burt Company	169 South Main Street Orrville, OH 44667 (330) 682-7015
11	MithiX Pro	3591 Way Back Road Farmersville, TX 75442 (800) 956-3398

APPENDIX B – HOLLEY STICK USER SURVEY (U)

Name: _____ Rank: _____ Date: _____

Unit: _____ NIPR e-mail address: _____

Telephone #: _____

Non-attribution policy in effect. Name, Rank, email is intended only for further research by the survey team. No personally identifiable information will be released or included in final report.

1. Stick 1

For questions A-H, use the following scale: **1=Poor; 3=Average; 5=Excellent**

A. Weight of the stick	1	2	3	4	5	N/A
B. Length of the stick	1	2	3	4	5	N/A
C. Collapsed Length	1	2	3	4	5	N/A
D. Ease of Assembly (Clamps/Screws)	1	2	3	4	5	N/A
E. Usability in an operational scenario	1	2	3	4	5	N/A
F. Controllability of the stick	1	2	3	4	5	N/A
G. Disassembly of stick	1	2	3	4	5	N/A
H. Ease of changing attachment	1	2	3	4	5	N/A

Feedback (What did you like, what would you change)?:

2. Stick 2

A. Weight of the stick	1	2	3	4	5	N/A
B. Length of the stick	1	2	3	4	5	N/A
C. Collapsed Length	1	2	3	4	5	N/A
D. Ease of Assembly (Clamps/Screws)	1	2	3	4	5	N/A
E. Usability in an operational scenario	1	2	3	4	5	N/A
F. Controllability of the stick	1	2	3	4	5	N/A
G. Disassembly of stick	1	2	3	4	5	N/A

H. Ease of changing attachment	1	2	3	4	5	N/A
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Feedback (What did you like, what would you change)?:

3. Stick 3

A. Weight of the pole	1	2	3	4	5	N/A
B. Length of the pole	1	2	3	4	5	N/A
C. Collapsed Length	1	2	3	4	5	N/A
D. Ease of Assembly (Clamps/Screws)	1	2	3	4	5	N/A
E. Usability in an operational scenario	1	2	3	4	5	N/A
F. Controllability of the stick	1	2	3	4	5	N/A
G. Disassembly of stick	1	2	3	4	5	N/A
H. Ease of changing attachment	1	2	3	4	5	N/A

Feedback (What did you like, what would you change)?:

4. Stick 4

A. Weight of the stick	1	2	3	4	5	N/A
B. Length of the stick	1	2	3	4	5	N/A
C. Collapsed Length	1	2	3	4	5	N/A
D. Ease of Assembly (Clamps/Screws)	1	2	3	4	5	N/A
E. Usability in an operational scenario	1	2	3	4	5	N/A
F. Controllability of the stick	1	2	3	4	5	N/A
G. Disassembly of stick	1	2	3	4	5	N/A
H. Ease of changing attachment	1	2	3	4	5	N/A

Feedback (What did you like, what would you change)?:

5. Stick 5

A. Weight of the pole	1	2	3	4	5	N/A
B. Length of the pole	1	2	3	4	5	N/A
C. Collapsed Length	1	2	3	4	5	N/A
D. Ease of Assembly (Clamps/Screws)	1	2	3	4	5	N/A
E. Usability in an operational scenario	1	2	3	4	5	N/A
F. Controllability of the stick	1	2	3	4	5	N/A
G. Disassembly of stick	1	2	3	4	5	N/A
H. Ease of changing attachment	1	2	3	4	5	N/A

Feedback (What did you like, what would you change)?:

6. Stick 6

A. Weight of the pole	1	2	3	4	5	N/A
B. Length of the pole	1	2	3	4	5	N/A
C. Collapsed Length	1	2	3	4	5	N/A
D. Ease of Assembly (Clamps/Screws)	1	2	3	4	5	N/A
E. Usability in an operational scenario	1	2	3	4	5	N/A
F. Controllability of the stick	1	2	3	4	5	N/A
G. Disassembly of stick	1	2	3	4	5	N/A
H. Ease of changing attachment	1	2	3	4	5	N/A

Feedback (What did you like, what would you change)?:

7. Stick 7

A. Weight of the pole	1	2	3	4	5	N/A
B. Length of the pole	1	2	3	4	5	N/A
C. Collapsed Length	1	2	3	4	5	N/A
D. Ease of Assembly (Clamps/Screws)	1	2	3	4	5	N/A
E. Usability in an operational scenario	1	2	3	4	5	N/A
F. Controllability of the stick	1	2	3	4	5	N/A
G. Disassembly of stick	1	2	3	4	5	N/A
H. Ease of changing attachment	1	2	3	4	5	N/A

Feedback (What did you like, what would you change)?:

8. Stick 8

A. Weight of the pole	1	2	3	4	5	N/A
B. Length of the pole	1	2	3	4	5	N/A
C. Collapsed Length	1	2	3	4	5	N/A
D. Ease of Assembly (Clamps/Screws)	1	2	3	4	5	N/A
E. Usability in an operational scenario	1	2	3	4	5	N/A
F. Controllability of the stick	1	2	3	4	5	N/A
G. Disassembly of stick	1	2	3	4	5	N/A
H. Ease of changing attachment	1	2	3	4	5	N/A

Feedback (What did you like, what would you change)?:

9. Stick 9

A. Weight of the pole	1	2	3	4	5	N/A
B. Length of the pole	1	2	3	4	5	N/A
C. Collapsed Length	1	2	3	4	5	N/A
D. Ease of Assembly (Clamps/Screws)	1	2	3	4	5	N/A
E. Usability in an operational scenario	1	2	3	4	5	N/A
F. Controllability of the stick	1	2	3	4	5	N/A
G. Disassembly of stick	1	2	3	4	5	N/A
H. Ease of changing attachment	1	2	3	4	5	N/A

Feedback (What did you like, what would you change)?:

10. Stick 10

A. Weight of the pole	1	2	3	4	5	N/A
B. Length of the pole	1	2	3	4	5	N/A
C. Collapsed Length	1	2	3	4	5	N/A
D. Ease of Assembly (Clamps/Screws)	1	2	3	4	5	N/A
E. Usability in an operational scenario	1	2	3	4	5	N/A
F. Controllability of the stick	1	2	3	4	5	N/A
G. Disassembly of stick	1	2	3	4	5	N/A
H. Ease of changing attachment	1	2	3	4	5	N/A

Feedback (What did you like, what would you change)?:

11. Stick 11

A. Weight of the pole	1	2	3	4	5	N/A
B. Length of the pole	1	2	3	4	5	N/A
C. Collapsed Length	1	2	3	4	5	N/A
D. Ease of Assembly (Clamps/Screws)	1	2	3	4	5	N/A
E. Usability in an operational scenario	1	2	3	4	5	N/A
F. Controllability of the stick	1	2	3	4	5	N/A
G. Disassembly of stick	1	2	3	4	5	N/A
H. Ease of changing attachment	1	2	3	4	5	N/A

Feedback (What did you like, what would you change)?:

Of the sticks that you just tested, which one would you select if you had to go into an operation and use it tomorrow? _____

If you did have to use the stick, you just selected, in an operation tomorrow, what specific improvements would you make to the stick?

Of the poles that you tested, are there any you think wouldn't work at all in an operational environment? _____

What attachments would you want on the sticks?

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