



Assessment of UXO Found at Site LA-00527

October 12, 2024

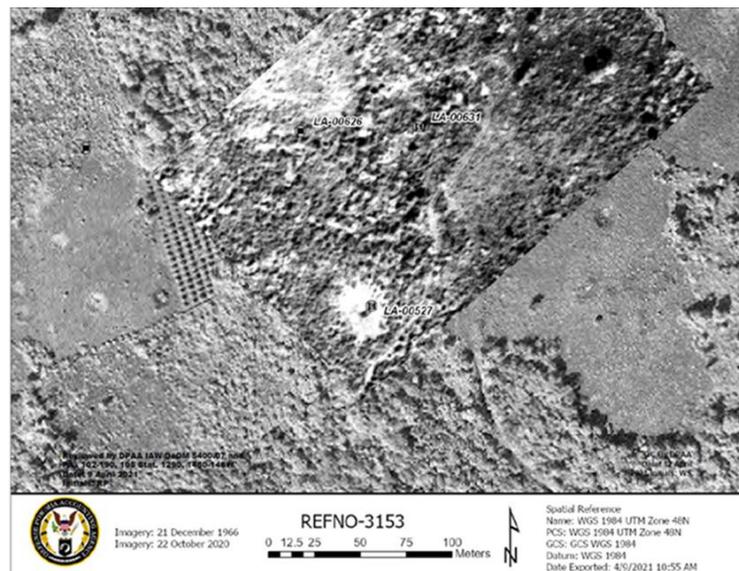
Summary

The 2023 REFNO 1781 Family Conference Report cast doubt on the REFNO 3153 aircraft at Site LA-00527 being that of REFNO 1781 based on two lines of evidence. First, reconnaissance aircraft imagery of LA-00527 from December 1966 clearly shows a crater here. DPAA's assessment is this is the REFNO 3153 crash site. This paper will show that based on the losses in this area between April 1966 (assembly date of an F-4 Outboard Flap Emergency Down Line found at LA-00527) and December 21, 1966 (imagery date), the two F-4s that could meet these criteria not only had first flights before 1966 but were shot down 9 and 72 nautical miles away respectively. This means they should be ruled out by time and distance. Second, Unexploded Ordnance (UXO) found during the two excavations of this site in 2019 could not have come from the REFNO 1781 aircraft. This paper will then attempt show while this is true, the UXO found is likely coincidental to the REFNO 3153 aircraft (i.e., not all ordnance found at a crash site is necessarily from that aircraft). It will then go on to make recommended next steps to help the resolve the identity of this aircraft.

Assessment of Imagery of LA-00527

In 2021, DPAA provided the Steadman and Beutel Families with an assessment of imagery associated with LA-00527. According to the REFNO 1781 Annual Family Conference Report ("Scrub Sheet") dated June 8, 2023, "On 9 April 2021, DPAA GIS analysts reported that wartime imagery showed that an impact crater seen at Site LA-00527 predates the REFNO 1781 loss by five years and thus the site could not be correlated with that incident. Additional photographic analysis of the wartime imagery of Site LA-00527 is recommended to further support or refute the 2021 GIS analysis." We welcome additional analysis, especially in light of the fact no wreckage is seen in this crater and there are many bomb craters nearby. However, the fact remains the 2023 Scrub Sheet also says, "Material evidence recovered at the site indicated that the site is associated with an F-4-type aircraft and that at least one individual was onboard at the time of impact." This should mean that the 3153 aircraft is an MIA loss. However, this same report says "Initial analysis of the items recovered determined them to be a parachute locking cone and anchor plates. These items are installed on both the individual aircrew emergency parachutes as well as the aircraft deceleration (drag) parachute." These need to be resolved (see Conclusions and Next Steps).

This December 21, 1966 reconnaissance photo clearly shows a significant ground disturbance approximately 25 meters in diameter at LA-00527. This ground disturbance is also found in the follow-up January 26, 1967 reconnaissance photo of this area (not shown).



The question, then, if this is an aircraft crash, which one is it? Previous analysis done on what turned out to be an F-4 Out-board Flap Emergency Down Line showed it was stamped with an assembly date of April 1966. If DPAA's GIS assessment is correct, this would mean the 3153 aircraft must have been lost in an 8-month period between April 1 and December 12, 1966. According to Hobson, only the two F-4s below (both are OPLOSSES) fit this timeframe.

Model	Tail #	Loss Date	First Flight Date	Location relative to LA-00527
F-4C	63-7531	4/21/66	6/9/64	72 miles southeast
F-4C	63-7518	10/20/66	6/6/64	9 miles north

However, there are two problems here. First, at 72 and 9 nautical miles away respectively, their loss locations are much too far away. Second, their first flight dates in 1964 preclude them from having a part assembled in 1966. In fact, only one F-4C aircraft had a first flight date in April 1966 or later – tail number 64-0928 – but since this aircraft was retired in 1987, the HTH Team determined the 3153 aircraft must be an F-4D with a first flight on/after April 1, 1966 (see [Conclusions and Next Steps](#) for possible tail numbers). We were unable to resolve these time and distance discrepancies, leading us to conclude the 3153 aircraft must be something else.

Assessment of UXO at LA-00527

According to the Search and Recovery Report: CS19-0973, at LA-00527 “Unexploded ordnance recovered during the 2020-1LA JFA consisted of 14 BLU-26 anti-personnel mines with two additional fuzes, one MK 82 bomb, one MK 4 white phosphorous rocket, two 20-millimeter projectiles, three 7.62-millimeter projectiles, and one high explosive .50 caliber projectile. Munitions and ammunition encountered during this excavation were disposed of by EOD technicians in the UXO pit at GC 48Q XD 03138 83395 (WGS-84, EPE +/-3 m) or removed by Milsearch technicians for disposal at an off-site location.”

As a result, page 11 of the 2023 REFNO 1781 Scrub Sheet concludes, “The presence of multiple pieces of UXO at Site LA-00572 from ordnance known not to have been carried by the REFNO 1781 aircraft (Mk-24 illumination flare timer plate, 20mm high explosive incendiary projectiles, a Mk-82 bomb, and 7.62mm and .50 cal projectiles) casts additional doubt that the site is associated with the loss incident. The fact that this collection of diverse ordnance was discovered at the site suggests that the U.S. Air Force F-4 present at the site was loaded with MK-82s (and perhaps an external 20mm gun pod) and/or the site was subjected to post-crash bombing and strafing by American military aircraft, typical of a SAR operation.” We have a few comments on this conclusion, starting with this part of Laos was the intersection of Routes 911, 912, and 91, an area known as the “Chokes” and was heavily interdicted. Our expectation should be one not just of crash-specific ordnance but of a wider battlefield littered with various types of UXO from multiple aircraft over several years.

Individual Ordnance Assessments

BLU-26 Anti-personnel Mines: These bomblets were released from CBU-23/24 dispensers carried by a variety of aircraft. Given they were dropped by the untold tens of thousands, their presence does not necessarily mean they are from the 3153 aircraft and could be coincidental.

Mk-4 White Phosphorous Rocket: Similar comments to the BLU-26 – these were fired by the untold thousands and may be coincidental.

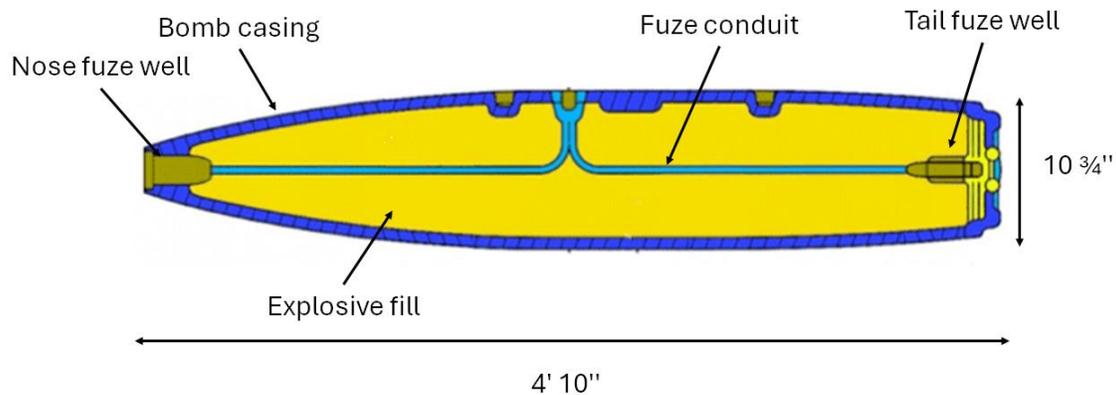
Mk-24 Illumination Flare: Such flares were dropped by O-1, UH-1, AC/C-47, C-123, AC/C-130, and F-4 aircraft. Likewise, unlike the later LUU-2 flares, the Mk-24 was not designed to consume itself prior to reaching the ground. This means Mk-24 flare pieces should be expected throughout Laos and not necessarily considered as coming from an intact flare on an aircraft. Adding to their ubiquitousness and the fact some were duds (as high as 35% in February 1969 according to a March 1969 Project CHECO Report). Our assessment is that this flare timer plate is coincidental.

However, if we assume this Mk-24 is from 3153, it should be relatively easy to determine which F-4 REFNOS were carrying Mk-24s. While we don't have a complete list, we are aware of three F-4s MIA over Laos while carrying flares – REFNOS 1518, 1781, and 1974 – but based on their Air Force Forms 484 (Missing Persons Supplementary Report), only 1518 (lost 11/5/69) was carrying Mk-24s; the others were carrying LUU-2s. We can rule out 1518 because its last known position was about 40 nautical miles north northwest of 3153. Likewise, the LUU-2 began to replace the Mk-24 sometime in 1970, so that might narrow the date range for an F-4 lost while carrying Mk-24s. Again, our assessment is this is most likely coincidental.

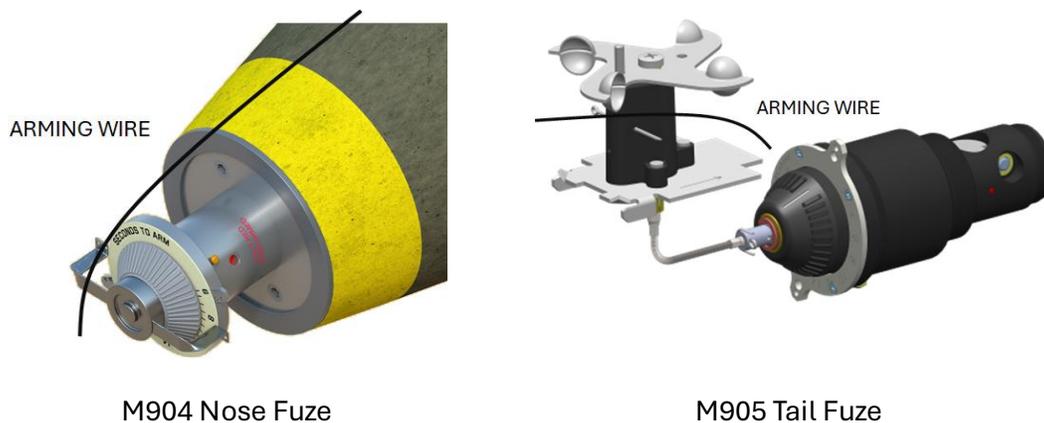
7.62mm and .50 caliber projectiles: Many aircraft carried guns of these calibers, including A-1, A/UH-1, H-3, OV-10, T-28, and H-53 aircraft, which could support the SAR hypothesis. Keep in mind that two other aircraft were shot down and crashed within 500 meters of LA-00527 – an O-1F (REFNO 0572) and a T-28D (REFNO 0571), both 17-Jan-67 – the latter of which could carry .50 caliber pods (no Form 484 is available for 0571). Likewise, SAR Logs for January 1967 are not available on the LOC website but it's reasonable to assume that such rounds were fired in support of these downed pilots, if not coincidental to the heavily-attacked nature of this area. If DPAA has access to GIS data for SARs, which ones are shown nearby? CACTA data pulls may be able to confirm the ordnance configurations involved.

20mm High Explosive Incendiary (HEI) rounds: The presence of live rounds and not spent shells does not necessarily mean they came from a gun aboard the 3153 aircraft. This is explained in T.O. 1-1M-34 Aircrew Weapons Delivery Manual USAF A-7 A-10 F-4 F-15 F-16 F-111 Series Aircraft dated June 8, 1985. When SUU-16/A and SUU-23/A 20MM gun pods stopped firing, approximately 4 to 12 live rounds were ejected. Given that no 20mm gun components were found at LA-00527, it does not seem reasonable to assume the live rounds found there are from the 3153 aircraft. Likewise, since untold hundreds of thousands of such rounds were expended over Laos, the presence of live ones here is likely coincidental.

Mk-82 Bomb: While on its face, this bomb's presence is compelling, a deeper analysis into this weapon's workings mitigate against this being from the REFNO 3153 aircraft. The Mk-80 series of general-purpose bombs was designed to accept two fuzes – one in the nose and one in the tail – and it was standard practice to double fuze whenever possible to increase the chance of detonation.



The most-common fuze pairing was an M904 in the nose and an M905 in the tail, both of which were mechanical fuzes. In order for the bomb to arm itself, upon release, wires had to be pulled and small propeller-like devices on the 904/905 had to spin a certain number of revolutions (see below).



This process aligned the fuze components (known as the fuze train) in order to enable detonation upon impact. Think of this like a key opening a lock – if the pins are not aligned, the lock will not open. Similarly, if the fuze train was not aligned (see [Appendix A for details](#)), the bomb would either not detonate or do so at reduced power (known as a low-order detonation).

Since no official dud rate for the Mk-82 in SEA is available, we extrapolated a value by starting with the total tons of bombs dropped on Laos (about 2 million) and worked from there. A rough guess is somewhere between at least 88,000 to 176,000+ Mk-82s were duds in Laos (see [Appendix B for details](#)). Likewise, there was a Mk-82 mine version known as the Mk-36 Destructor, which could be used overland and underwater with different detectors. There are certainly still Mk-36s land mines in Laos whose fuzes were never triggered (see [Appendix A for details](#)). When we checked with some SEA vets who flew F-4s over Laos, they said while the USAF occasionally dropped Mk-36s, they did so mostly near Ban Laboy Ford near the Ban Karai Pass. This makes the identity of this piece of UXO more likely to be a Mk-82 than a Mk-36.

How to tell if Mk-82 Fuzes are armed

To put a finer point on fuzes, it may be possible to determine the armed state of the Mk-82 found at LA-00527. That is, both the M904 and M905 fuzes had armed indicators (see [Appendix A for details](#)). While we have no details about EOD Technicians' findings from 2019, if an internal report

documented the arming state (armed or safe), that could determine if the bomb in question was aboard the 3153 aircraft at impact (see [Conclusions and Next Steps](#)). Here are the three scenarios.

Ordnance	Arming State	Assessment
Mk-82	Armed	Dud = coincidental
MK-36	Armed	Not triggered = coincidental
Mk-82/Mk-36	Safe	Aboard 3153 aircraft = site is not REFNO 1781 or Jettisoned = coincidental

If the bomb was armed, it meant it was released but was either a dud Mk-82 or a Mk-36 that was not triggered. Either way, it was not from the 3153 aircraft and was coincidental. If safe, then it was either from the 3153 aircraft – which rules it out as being 1781 because it was not carrying Mk-82s – or it was jettisoned and is coincidental. If so, it would mean the aircraft crashed on top of the existing UXO. The next section looks at nearby aircraft losses that could be correlated with the 3153 aircraft.

Assessment of F-4Ds lost near LA-00527

According to Hobson, a total of 192 F-4Ds were lost in SEA (all causes). Of them, 65 were lost over Laos: 23 OPLOSSES and 42 REFNOS (a mix of resolved and unresolved cases). The following table lists all F-4Ds lost within 15 miles of LA-00527 and are sorted in ascending order by distance (nearest to farthest). It also indicates which ones had Mk-82s based on their Air Force Forms 484.

Loss Date	Serial	REFNO	Case Status	MGRS	Bearing/ Miles from LA- 00527	Had Mk- 82s?	Notes
3/10/69	65-0722	1405	Active Pursuit	48QXD 0333082680	156°/001	No*	Uncorrelated and unnumbered, found 17-Jan-96 during the 96-12L JFA
3/1/69	66-8814	1396	Resolved	48QXD 1120093170	040°/007	No	Both men's remains identified in 2012
3/29/69	66-8809	1418	Active Pursuit	48QXD 0870097600	022°/008	No	Both men out of the aircraft, one still unaccounted for
11/26/71	66-7752	1781	Active Pursuit	48QXD 1226094730	039°/008	No	Off-the-scope; MGRS is last Igloo White sensor ping
4/23/70	66-7639	1601	Active Pursuit	48QXD 1230098100	029°/009	No	Multiple eyewitnesses saw the impact
5/19/68	66-8695	1182	Active Pursuit	48QXD 2070668839	131°/013	No	One remains repatriated, one still unaccounted for
6/14/69	66-7574	1455	Non-recoverable	48QXD 0655957893	170°/014	No	One rescued, one fell from rescue helo and died
3/21/68	66-8767	1100	Active Pursuit	48QXD 1543059589	153°/015	Yes	Crash observed by FAC
10/25/69	65-0751	1505	Active Pursuit	48QXE 2090004800	041°/015	?	Crash observed by FAC

* Aircraft expended all 9 Mk-82s before it was shot down (see explanation below).

As you can see, REFNO 1405 (both men out of the aircraft, one rescued, one is a last known alive MIA) was the closest loss with Mk-82s. However, according to the survivor's debrief, all Mk-82s had been dropped by the time they were shot down. In fact, just before being shot down, he specifically told the FAC that only rocket pods remained. This means the Mk-82 UXO cannot be from the REFNO 1405 aircraft. Likewise, the next-closest aircraft lost with Mk-82s was REFNO 1100. However, since this crash 15 miles away was observed by a FAC (who orbited overhead for over two hours), it puts their site much too far away to be REFNO 3153.

Conclusions and Next Steps

Both DPAA analysts and the HTH Team have painstakingly researched multiple aspects surrounding the identity of the aircraft that crashed at LA-00527. However, we disagree with DPAA's conclusion that the REFNO 3153 aircraft cannot be the November 26, 1971 loss of REFNO 1781 based on 1966/1967 aircraft imagery and UXO found at LA-00527. In fact, we believe 1781 is the more likely candidate. Likewise, we further believe that with exceptions for things like gun barrels, UXO found at a crash site should not necessarily be assessed to have come from the aircraft that crashed there. Instead, given the staggering 2 million tons of bombs dropped on Laos, UXO must be analyzed in the context of a larger, ordnance-strewn battlefield. That said, our conclusions are enumerated below, and the next steps are prefixed with >>.

1. The 2023 Scrub Sheet states both that a parachute component found at LA-00527 indicates at least one man was in the aircraft at impact and that this component could also be from an aircraft drag chute (i.e., not life support-related). These potentially conflicting statements make its loss status unclear.

>> What is DPAA's assessment of this site's loss status – MIA, OPLOSS, or unknown?

2. Based on previous analysis of forensic evidence found at LA-00527, the aircraft that crashed here must be an F-4D with a first flight on/after April 1, 1966 (see [Appendix C](#) for a recap).
3. Neither of the two known F-4 Laos losses between the April 1966 hose tag assembly date and the December 21, 1966 reconnaissance crater photo can be a match for 3153 based on distance. Likewise, both these aircraft had first flight dates in 1964, too early to have a part assembled in 1966.
4. None of the UXO can be from the 1781 aircraft because it was not carrying any of this ordnance.
5. Since podded 20mm guns used by F-4s would eject 4 to 12 live rounds after each pass, the presence of live 20mm rounds but no associated gun components is consistent with rounds being coincidental to this site rather than being from the aircraft that crashed here. The remaining ordnance may also be coincidental or may be from a SAR effort.

>> If DPAA has access to all SAR effort locations, we recommend they check to see which ones were nearby. Perhaps there was a SAR at LA-00527 that better-explains the presence of these UXO.

6. Given Mk-24 flares did not consume themselves prior to reaching the ground and had significant dud rates, the presence of a timer plate should not be considered as coming from the REFNO 3153 aircraft. It is more likely it is coincidental.
7. The closest aircraft lost to LA-00527 with Mk-82s was REFNO 1405. However, the surviving pilot's debrief clearly states they had expended all their Mk-82s prior to being shot down, which means this UXO must either be from another aircraft loss or coincidental.
8. The next nearest loss to LA-00527 that was carrying Mk-82s was REFNO 1100, the March 21, 1968 shoot down of 1Lts Peter Hesford and Aubrey Stowers (both remain unaccounted for) in F-4D 66-8767 at 48Q XD 15430 59589. However, given their crash site (which was verified by a FAC) is 15 nautical miles south southwest of LA-00527, makes them too far away to be a possibility for 3153.

>> If DPAA's assessment is correct that the Mk-82 is from the 3153 aircraft, what other losses could explain the identity of this aircraft?

9. Without details from the EOD Technician, the armed state of the Mk-82 UXO cannot be assessed. However, if it was determined the bomb was armed, this means it was released from an aircraft but failed to detonate, making it likely this weapon is coincidental to this site.

>> If DPAA's JFA process involves an EOD Tech creating a report assessing the state of UXO, check to see if this bomb was armed or not. If armed, this means this UXO must be coincidental; if not armed, it's either from the REFNO 3153 aircraft, which rules out it as being 1781, or it was jettisoned and is therefore coincidental.

Given all the items above, we believe the aircraft that crashed at LA-00527 was an F-4D with a first flight on/after April 1, 1966 that was not carrying Mk-82s, and is an off-the-scope loss. If we are correct, the most likely candidate for this site is Capt Jim Steadman and 1Lt Bob Beutel, lost in F-4D 66-7752, which had a first flight on June 30, 1967 and is an off-the-scope loss. However, we cannot say for certain this is the case.

Appendix A – Mk-82 Details: Configurations, Fuze Train, and Armed Indicators

There were three variants of the Mk-82 General Purpose 500-pound bomb used in Southeast Asia.

1. Low-drag or “Slick”



When an aircraft was releasing the bomb at medium to high altitude, low-drag fins were used to give the weapon maximum impact velocity and/or range.

2. High-drag or “Snakeye”



This configuration was used when the aircraft was releasing the bomb at low altitude. High-drag tail fins popped open to slow the bomb down so the attacking aircraft could escape the blast.

3. Mk-36 Destructor Mine

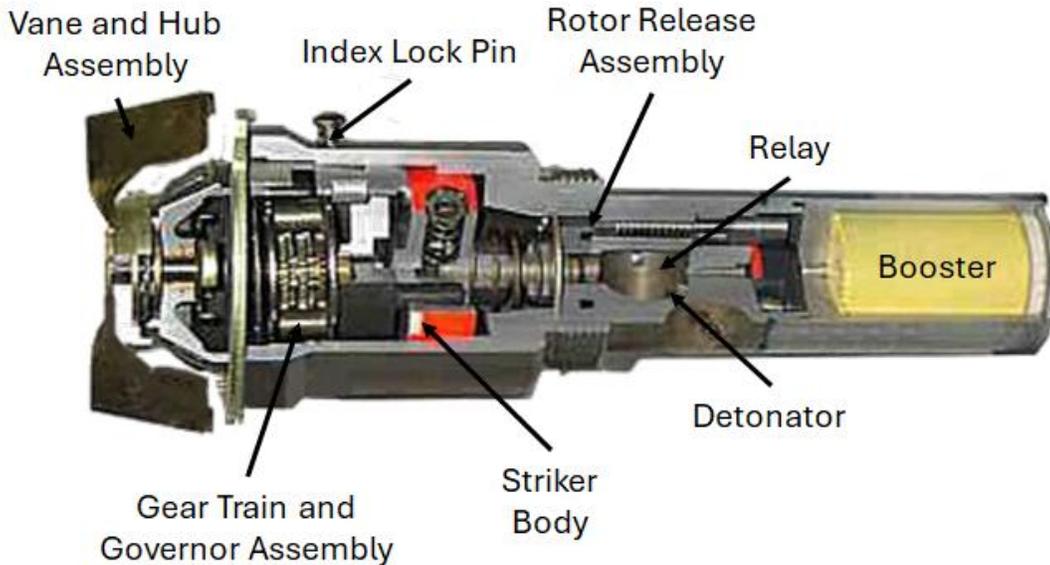


An externally similar variant to the Snakeye but less common, was a sea mine or land mine created by adding different sensors (motion, magnetic field, water pressure) to a Mk-82. After release, these mines would “wait” until the appropriate stimulus was received.

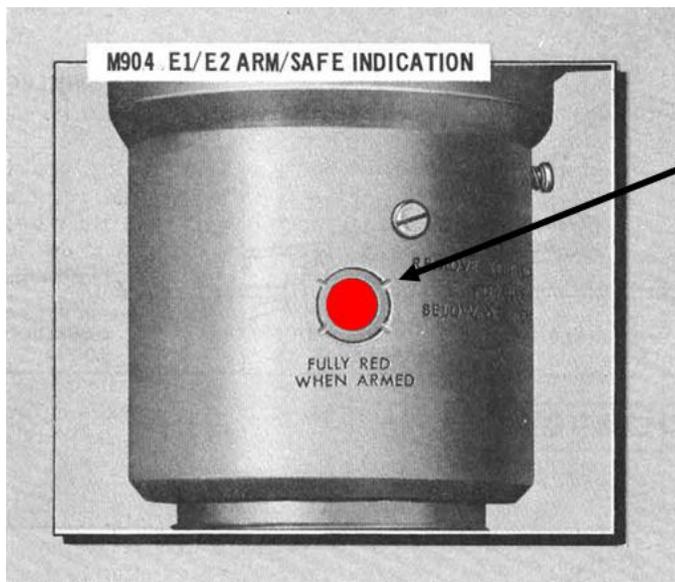
The following image of a Mk-81 (a 250-pounder but had the same overall layout) shows the nose fuze, arming wires, and tail fuze.



The main components of the M904 nose fuze train are shown in the diagram below. If the train was not aligned (akin to a key opening a lock), the bomb would either not detonate or due to impact forces, only detonate partially, known as a low-order detonation. Various 21st century weapons range reports assess Mk-82 low-order rates at less than 1%.



Both the M904 and M905 had mechanical indicators to alert aircrew and groundcrew if the bombs were armed (see below). While the indicator in the M904 in the nose may have been visible to the EOD Technician during the LA-00527 excavations in 2019, the M905 in the tail was likely not. If an EOD Technician's report is available, it should be checked to see if the weapon was armed or not.



Appendix B – Mk-82 Dud Rate Calculations

Starting with the total of about 2 million total tons of bombs dropped on Laos alone and using an average bomb weight (all types) of 900 pounds, yields about 4.4 million individual bombs dropped. According to [Generative AI](#), the response to “Approximately what percentage of bombs dropped in Vietnam were Mk-82s?” was, “According to available data, approximately 50% of bombs dropped in Vietnam were Mk-82s, making it the most commonly used bomb type during the war.”

According to a June 2004 Range Sustainability Environmental Program Assessment done at the Navy’s Fallon Weapons Range in Nevada, the Mk-82 dud rate from another range was about 4%. This comports with a 2013 SAIC Environmental Assessment for Eglin AFB, FL that said the expected Mk-82 dud rate was “less than 5%.” We then took the lower 4% value and doubled it to account for the effects of combat operations. That is, you need to consider the rate at which weapons are released within parameters (e.g., bombs dropped too low to arm were not a weapon’s reliability issue) along with the rate at which the weapons fuzed and the rate at which the explosive charge denoted. This yields the following equation:

Dud Rate = weapons released within parameters rate x fuze reliability rate x explosive reliably rate

That said, looking at the table below, a rough guess is at least 88,000 to as many as 176,000 or more Mk-82s hit Laos but did not detonate. However, it’s entirely possible the dud rate was even higher than this.

Total Tons of Bombs	Avg. Bomb Weight	Total # Bombs	% Mk-82s	Total # Mk-82s	Dud Rate	Total # Mk-82 Duds
2,000,000	900	4,400,000	50%	2,200,000	4%	88,000
2,000,000	900	4,400,000	50%	2,200,000	8%	176,000

More specifically, the equations are:

$(2,000,000 \text{ total bomb tons} \times 2,000 \text{ pounds/ton}) \div 900 \text{ avg. pounds/bomb} = 4,400,000 \text{ total bombs}$

$4,400,000 \text{ total bombs} \times 50\% \text{ Mk-82} = 2,200,000 \text{ Mk-82s}$

$2,200,000 \text{ Mk-82s} \times 4\% \text{ dud rate} = 88,000 \text{ Mk-82 duds (minimum)}$

Appendix C – Previous analysis of aircraft wreckage found at LA-005027

This appendix is included for the benefit of readers who have not seen the Archival Research Committee (ARC) Team’s September 2022 report titled, “Analysis of The Loss of Owl 08 (REFNO 1781) on November 26, 1971” and Healing Through History’s August 2023 report titled, “Assessment of Possible Tail Numbers Associated with Site LA-00527/REFNO 3153”. In these reports, the following forensic evidence was analyzed and led to the conclusion the 3153 aircraft was an F-4D.

- A dataplate from a General Electric J79-15 engine was found, indicating the aircraft must be an F-4C, F-4D, or RF-4C, the only aircraft powered by this engine subtype.

- An AIM-7 Sparrow missile launcher component was found, ruling out the aircraft being an RF-4C, which did not have such launchers.
- A hose tag from F-4 Outboard Flap Emergency Down Line (a compressed air line found in the leading-edge flaps) had an assembly date of April 1966. Since only one F-4C aircraft had a first flight on/after this date and that aircraft was retired in 1987, the aircraft in question must be an F-4D with a first flight on/after April 1966.

The 2023 REFNO 1781 Scrub Sheet states, “There are multiple uncorrelated F-4 crash sites within the general area of loss have yet to be associated with known incidents.” Likewise, the 2021 Scrub Sheet “Of the 11 off-the-scope losses believed to have crashed in Laos, six of them are F-4s, which includes REFNO 1781.” The HTH Team believes those six off-the-scope losses are shown below. We further believe that five such losses can be ruled out as being 3153 based on an incompatible engine type or excessive distance. If REFNO 3153 is an off-the-scope loss, then the most likely candidate is REFNO 1781.

Model	REFNO	Serial	Loss Date	Notes
F-4E	1366	67-0286	1/26/69	Incompatible engine subtype (J79-17 vs. J79-15)
F-4D	1465	66-7697	7/12/69	LA-00608 may be this case’s site but at 75 miles north northwest of LA-00527, it’s too far away
F-4D	1518	66-7748	11/5/69	SAR Log location based on friendly eyewitnesses puts it 38 miles north northwest of LA-00527, which is too far away
F-4E	1772	68-0316	9/30/71	Incompatible engine subtype (J79-17 vs. J79-15)
F-4D	1781	66-7752	11/26/71	A possibility based on final Igloo White sensor hit
F-4D	1794	66-7573	12/31/71	Last-known position was 25 miles northwest of LA-00527 and heading further north, which puts it too far away

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