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Analysis of Damage

***USS South Dakota* at the Naval Battle of Guadalcanal**

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USS South Dakota BB-57 on her shakedown cruise in July 1942

Introduction

There were only two battleship versus battleship actions fought in the Pacific during World War II. *Kirishima's* duel with *Washington* and *South Dakota* on 14-15 November 1942 was the first of these actions. This battle pitted two of the newest and most modern US battleships against one of Japan's oldest battleships. In this battle, *South Dakota* was badly damaged while *Kirishima* was sunk. For a detailed report on this battle, see [The Battleship Action 14-15 November 1942](#). The damage suffered by *Kirishima* that led to her sinking is discussed in the essay [Damage to Kirishima](#).

As a companion piece to the previous works, the following essay is an attempt to piece together the various historical records of both nations along with a fresh look at the photographic record in order to obtain a fuller picture of the damage suffered by *South Dakota* during this battle. The authors of this essay have long been aware of the contradictions and errors found in the BuShips report and for that reason have wanted to take a fresh look at the battle damage inflicted to *South Dakota* in order to provide the reader with a fuller, more accurate accounting of what happened to her that night. Both US and Japanese action reports have been used to reconstruct the battle, determine the types of ammunition fired at *South Dakota* and when these shots occurred. NAVSEA expert Nathan Okun participated in the writing of this essay and deserves all the credit for determining the Japanese shell types involved in each point of damage.¹

This essay will attempt to illustrate inconsistencies and inaccuracies in the BuShips report, but it will also note where the report seems accurate. In addition, as *South Dakota's* original action report is confusing in the way that it was written, this essay will attempt to clarify what damage was actually associated with each hit as recorded by the ship's crew and will use both photographs and new sketch drawings to help explain what may have occurred during each hit. In order to assist readers already familiar with this battle, this essay will use the same numbering system of the hits as was used in the original BuShips report. This essay will make a new estimate as to what was the Japanese projectile involved for each individual hit and will detail how the authors made their deductions. If there is not enough information on a particular hit for the authors to make a definitive conclusion, then this essay will note that uncertainty and give the author's best guesses.

As noted above, many previously unpublished photographs of *South Dakota's* damage were found while researching for this essay. Any of these photographs that were used to help determine the shell type for a particular hit are included in this essay for reference purposes.

Sketch drawings in this essay were all made by Robert Lundgren and are based upon the BuShips original Builder Plans for *South Dakota*.

For each hit in this essay, excerpts from BuShips' damage report and from *South Dakota's* action report are shown indented to indicate direct quotes. In these excerpts, naval phraseology, grammar and abbreviations are left as-is in order to give the reader both the flavor and substance of the documents. Obscure abbreviations are defined in footnotes at their first occurrence. The use of brackets [] in these excerpts are used to denote where paraphrasing was used to clarify the meaning of certain passages; where the original photocopy is illegible; or to note the sub-section of the report where the excerpt was found.

¹ Nathan Okun is a computer and weapons specialist who has years of research into World War II naval gunfire and ballistics. He developed the computer program FACEHARD which accurately reflects World War II shell damage on face harden armor. His formulas and knowledge were extensively used for this essay and without his help this essay would have been impossible.

Overviews of Source Documents

BuShips Damage Report

In June of 1947, BuShips issued its report on *South Dakota*'s battle damage. This report counted 26 hits and gave the author's conclusions as to the types of shells that had inflicted the damage found during their examination. This report concluded that *South Dakota* had been hit by a single 14-inch shell, eighteen 8-inch shells, six 6-inch shells and one 5-inch shell.² The accuracy of this report has never been challenged and is now considered as almost a permanent part of *South Dakota*'s history. However, this report should be looked at in light of what was going on in the Navy at the time it was written. *South Dakota* had already been decommissioned in January 1947 and by the time the report was published the Navy was in the middle of an unprecedented downsizing which saw all but one battleship removed from the fleet to be scrapped or put into mothballs. Carrier-borne aircraft had become the main striking arm of the Navy and battleship construction was now a thing of the past. Surface battles like the one that *South Dakota* had engaged in were no longer seen as likely to occur in future wars.

For these reasons, the preparation of the damage report had been given a very low priority and the late date of its publication and the paltry seven sources listed as being used in writing it are a reflection of just how low a priority it had. There was no real attempt in this report to reconstruct the battle, no Japanese action reports were used to determine the types of guns and shells fired at her and there was little effort to develop a time line for the action in order to determine just when these hits had occurred. There are many additional photographs of *South Dakota*'s damage in the USN archives that are not part of this damage report and it is unknown if the authors of the report used any of these in generating it or if they were even aware that these photographs existed. The authors did not even make use of any of the action reports from the other US ships that had taken part in the battle.

In regards to the Japanese memories of the battle, the authors of the BuShips damage report referenced a single United States Strategic Bombing Survey (USSBS) interrogation of a Japanese Naval Officer who was a participant in this battle. This was that of Lieutenant-Commander (LCDR) Tokuno Horishi who was second in command of *Kirishima*'s secondary batteries and who was stationed in the top control point during the battle. This interrogation was superficial at best and is probably most remembered for LCDR Tokuno's estimate regarding the number of hits that *Washington* had scored on *Kirishima*. In regards to *South Dakota*'s damage, LCDR Tokuno only said that he thought *Kirishima* had hit her many times and nothing more.³

Although even this small comment was largely ignored by the USN, similar observations can be found in the action reports written by other Japanese participants at this battle including that of Admiral Kondo himself. A review of these action reports could have given the original authors of the BuShips damage report many clues in determining the shell types that had struck *South Dakota* and they may also have learned that *Kirishima* had opened fire long before the heavy cruisers. This could have been used in determining a time line and the sequence of when hits were made. BuShips had access to these reports if they had wished to use them, as the action reports had been captured and brought back to the United States shortly after the end of the war. In regards to other Japanese documents on the battle, except for one reference document on Japanese eight-inch shells, it appears that none were used in BuShips' damage assessment in order to determine shell types and performance. They did not even use the US Technical Mission's report on Japanese projectile types and fuzes which would have been very useful in

² BuShips War Damage Report # 57, page 3

³ Interrogation Nav No. 33, USSBS No. 138

determining the kinds of shells that had hit *South Dakota*. Despite these many omissions, the BuShips damage report has long been taken at face value by most authors of works on this subject.

Footnotes in this essay relating to this damage report are indicated as “BuShips War Damage Report # 57” along with the page number where the data was found.

USS South Dakota Action Report for 14-15 November 1942

This document is the official report issued by the ship for this engagement. Included with this report were several enclosures detailing various aspects of *South Dakota*'s actions during the battle. Of these, the one of most interest for this essay is Enclosure D, titled “Detailed list of damage.” This Enclosure, as its name implies, gives a detailed list of all damage received by the ship as recorded by the ship's crew. This list is broken up into sub-sections which are based upon the type of damage and further broken up based upon the location on *South Dakota* that received the specified damage. Very little attempt is made in the action report itself or in Enclosure D to separate out the damage from any one hit from the damage caused by another hit. The authors of this essay have attempted to parse and reorder this data such that the damage as enumerated in the action report including Enclosure D is now regrouped so as to assign it to a specific hit number as defined in the BuShips report.

One thing to keep in mind about *South Dakota*'s action report is that it was written soon after the battle. Errors regarding the frame number for where damage was located are common in this report, especially for that found on the ship's hull, and are almost undoubtedly the result of the crew simply not having the time or the resources necessary to completely document the damage. In contrast, BuShip's report was based more upon photographs and reports made by personnel at the Navy Yard in New York (also known as the Brooklyn Navy Yard) where *South Dakota* was repaired and who had had the time to more thoroughly document and locate where the damage was inflicted. This means that the frame numbers as noted in the BuShips report are more likely to be accurate than the frame numbers noted in the *South Dakota*'s action report. This is the reason why the frame numbers noted in the excerpts used by the authors of this essay do not always line up between the two reports.

The footnotes in this essay relating to the Action Report itself are indicated as “USS *South Dakota* Action Report” along with the page number where the data was found. The footnotes in this essay relating to Enclosure D from this action report are indicated as “USS *South Dakota* Action Report, Enclosure D” along with the page number where the data was found.

Japanese Guns and Ammunition

The Japanese ships that took *South Dakota* under fire were the battleship *Kirishima*, the heavy cruisers *Atago* and *Takao*, the light cruisers *Nagara* and *Sendai*, and the destroyers *Asagumo*, *Teruzuki*, *Ikazuchi*, *Samidare*, *Shirayuki*, *Hatsuyuki*, *Shikinami*, and *Uranami*. These ships combined carried six different calibers of guns and twelve different types of ammunition. The following table lists the type of ammunition available to the Japanese and, where known, the number of rounds actually fired during the engagement. This table thus shows all of the potential candidates for the shell hits inflicted on *South Dakota*.

Table 1 – Japanese Projectile Types⁴

HE Shells	Weight	Length	Explosive charge	Fuze	Rounds fired
14" Type 0	1,378 lbs	47.25"	63.4 lbs TNA ⁵	Type 91 Mod 1	22
8" Type 0	276.5 lbs	34.64"	18.0 lbs TNA	Type 91 Mod 1	6
6" Type 0	100 lbs	22.5"	6.5 lbs Picric acid	Type 91 Mod 1	Unknown
5.5" Type 0	83.5 lbs	21.81"	6.3 lbs Picric acid	Type 91 Mod 1	Unknown
5" Type 0	77 lbs	32.22"	4.15 lbs Picric acid	Type 91 Mod 1	Unknown *
3.9"	28.67 lbs	16.1"	2.1 lbs TNA	Type 91 Mod 1	Unknown
Armor Piercing					
14" Type 1	1,485 lbs	60.0"	24.5 lbs TNA	Type 13 Mark 4 Mod 1	27
8" Type 91	276	35.7"	6.85 lbs TNA	Type 13 Mark 4 Mod 1	91
Base fuze Common					
6" Type 04 Common	100 lbs	22.5"	6.0 lbs Picric acid	Type 13 Mark 1 Mod 1	Unknown
5.5" Capped Common Mod 1	83.5 lbs	21.65"	4.4 lbs Picric acid	Type 13 Mark 1 Mod 1	Unknown
5.5" Type 2 Common	83.5 lbs	21.81"	5.72 lbs Picric acid	Type 13 Mark 1 Mod 1	Unknown
Incendiary					
14" Type 3	1,378 lbs	48.0"	8.81 lbs Picric acid	Type 91 Mod 1	66

* A total of 49 5-inch rounds were fired by *Atago* during the battle.

Japanese Type 0 shells were nose-fuze designs that the Japanese designated as “Common” but would be called “HE” or “HC” in most other navies. In this essay, these Type 0 shells are usually called “HE” in order to distinguish them from the base-fuze Common shells which were supplied to the light cruisers and for *Kirishima*’s secondary battery.

Japanese 8-inch Type 91 AP was actually more of a semi-armor piercing shell as it did not have a true AP cap but instead was designed with a small cap head. This shell was specifically designed to penetrate the homogeneous armor used on most pre-war US heavy cruisers. The 14-inch AP shell had a true AP cap and was designed to penetrate face-hardened armor. For both the 8-inch and the 14-inch AP shells, the windscreen and cap heads were designed to come off under any impact so that the flat nose of either the 8-inch shell body or the AP cap of the 14-inch shell would give a stable trajectory underwater.

The 14-inch Type 1 AP shell varied from its older cousin the Type 91 AP in that it carried a dye load and the windscreen was angled at 21 degrees vs. 23 degrees in the older shell, otherwise the two shells were

⁴ Shell and fuze data in this table is primarily from the U.S. Naval Technical Mission to Japan Report O-19 Japanese Projectiles General Types. It should be noted that the Japanese Navy adopted metric units for their guns and projectiles in 1917 but that English units will be used throughout this essay in order to avoid confusion with the BuShips and *South Dakota* reports which used English units for these shells. The number of 14-inch rounds fired is from the testimony of LCDR Ikeda as described in *Shikikan-tachi no Taiheiyō Sensō* [The Pacific War as Described by the Senior Officers]. The number of 8-inch rounds fired is from figures given in *Atago* Direct Action Report and *Takao* Brief Action Report JT 1. This total includes some 8-inch rounds that *Atago* fired at *Washington* during the battle. *Atago* Direct Action Report also provides the number of 5-inch rounds that she fired during the battle.

⁵ TNA = Japanese Tri-Nitro-Aniso, designated as Type 91 bakuyaku (Model 1931 Explosive). This was a more stable burster than the picric acid (Shimose) used in older Japanese projectiles. Both picric acid and TNA were about 10% more powerful but less stable than the Explosive D used as the burster in USN projectiles.

nearly identical. The Type 1 AP was introduced in 1941 and Japanese records of ammunition expenditure use this designation for the AP projectiles that *Kirishima* fired at this battle. Dye colors assigned for the 14-inch Type 1 Mod 1 AP for the *Kongō* class were as follows: *Kongō* – Type 1 Mod 3 dye color, which was red. *Hiei* – No dye color. *Haruna* – Type 1 Mod 2 dye color, which was yellow. *Kirishima* – Type 1 Mod 4 dye color, which was either green or blue, and *Kirishima*'s dye color at this battle was blue.⁶

The 14-inch incendiary Type 3 shell was unique in that it had a large wood adapter at its nose covered with thin metal. The long fuze rod that ran lengthwise through this projectile normally broke if the shell struck something solid and the thin sides ripped apart so the shell would disintegrate against even modest steel structures. This shell is also officially designated an AA shell which was its primary purpose. These were the shells that the Japanese thought had devastated the US airbase on Guadalcanal during the successful bombardment on 12 October 1942. *Kirishima* was loaded with this type shell for her initial salvos and fired more of this type during the battle than any other shell type, probably because they were already in the hoists and guns at the start of the battle. In order to reduce barrel wear, *Kirishima*'s guns were initially loaded with reduced charges or else with only two bags of powder rather than the usual four bags.

The fact that his guns were loaded with Incendiary rounds and reduced charges is a fairly clear indication that Admiral Kondo was not looking for a fight with US naval units. His plan for the Bombardment Group was that it was to shell Henderson Field and that only his light forces were to deal with any US naval units encountered. When the battle first started, Admiral Kondo deliberately kept his Bombardment Group away from the action and did not bring his force to join in until he thought that the battle had been won when he saw that *South Dakota* had been silenced. So, the fact that he had Type 3 Incendiary shells loaded in advance represents his mission planning and does not indicate that he was surprised or caught off guard as was Admiral Abe at the earlier battle on 12 November.

The kinds of fuzes used in the Japanese shells are of interest, as the damage pattern will often show whether a particular hit was from a shell with a delay-type fuze or from one with an instantaneous fuze. The following table shows the fuzes used by the Japanese in this battle.

Table 2 – Japanese Fuze Types⁷

Fuze	Year adopted	Weight	Location	Delay
Type 13 Mark 1 Mod 1	December 1941	957 grams	Base Fuze	Non-Delay
Type 13 Mark 4 Mod 1	June 1932	1,355 grams	Base Fuze	0.4 second delay
Type 91 Mod 1	January 1932	577 grams	Nose fuze	0-55 second Mechanical Time Fuze

The Type 13 Mark 1 Mod 1 fuze was introduced in December of 1941 and this was used in the 6-inch and 5.5-inch base-fuzed shells. This fuze gave trouble owing to the breakdown of mercury fulminate during storage and this problem resulted in many duds during the war.⁸

⁶ U.S. Naval Technical Mission to Japan Report O-17 Japanese Projectile Fuzes and *Kaigun Hōjutsu-shi* [The History of Naval Gunnery]

⁷ The data in this table is primarily from U.S. Naval Technical Mission to Japan Report O-17 Japanese projectile Fuzes

⁸ U.S. Naval Technical Mission to Japan Report O-17 Japanese projectile Fuzes

The Type 13 Mark 4 Mod 1 fuze was introduced in June of 1932 and was used in 8-inch and 14-inch AP projectiles. This fuze had a long delay of 0.4 seconds which allowed the shells equipped with it to have a long underwater trajectory if they fell short of their target. However, if the shell hit above the waterline, this long fuze delay also meant that the projectile was likely to pass right through a ship's structure without detonating unless it hit heavy armor.

For the nose-fuzed HE projectiles at the battle in 1942, the Type 91 Mod 1 fuze, which was first introduced in 1932, was still in use. In 1943 this fuze would be re-designated as Type 0 for shells above 8-inches in caliber and in 1944 as Type 4 Mark 1 when used with the 6-inch and 5.5-inch shells. It was discovered that all mechanical time fuzes used in these shells acted as a percussion fuze (probably due to the shoulder of the striker fracturing) against steel plates as thin as 6 mm (just under 0.25 inches). They could therefore be used against surface ships, detonating on impact, or for bombardment purposes against land targets.⁹ Their official designation and primary purpose, however, was for AA projectiles, including the 14-inch caliber Type 3.

The figures below are cross sections of some of the different types of projectiles used during this battle, showing how they were constructed.¹⁰

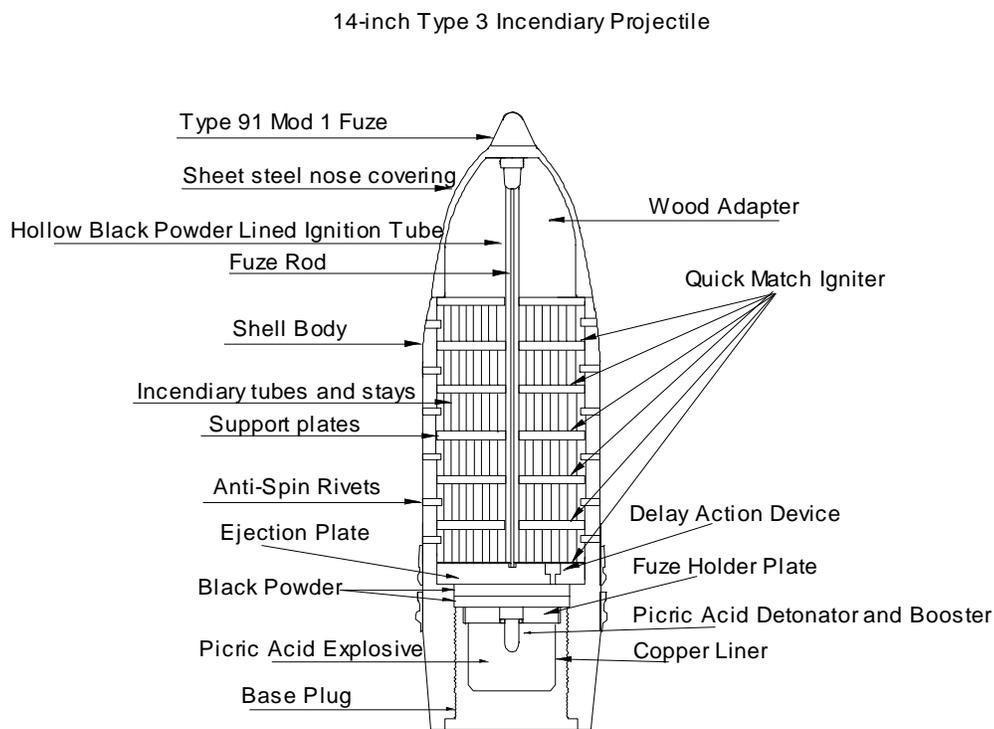


Figure 1 – Japanese 14-inch Type 3 Incendiary Projectile

⁹ U.S. Naval Technical Mission to Japan Report O-17 Japanese Projectile Fuzes

¹⁰ These drawings are based upon sketches in the two-volume book BuOrd OP 1667, Japanese Explosive Ordnance

14-inch Type 0 Common Projectile

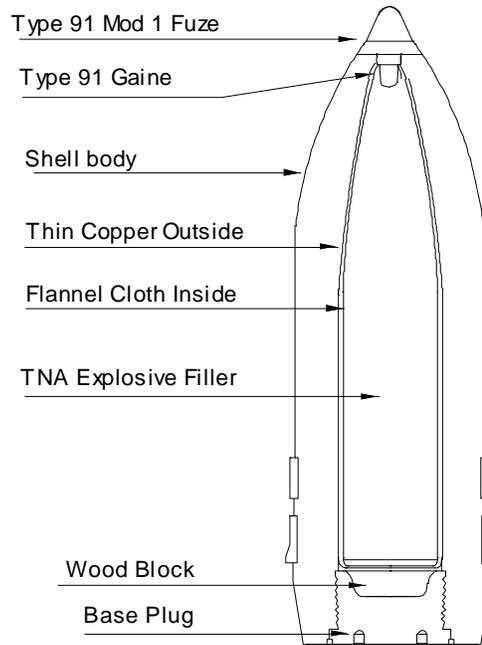


Figure 2 – Japanese 14-inch Type 0 Common (HE) Projectile

14-inch Type 1 AP Projectile

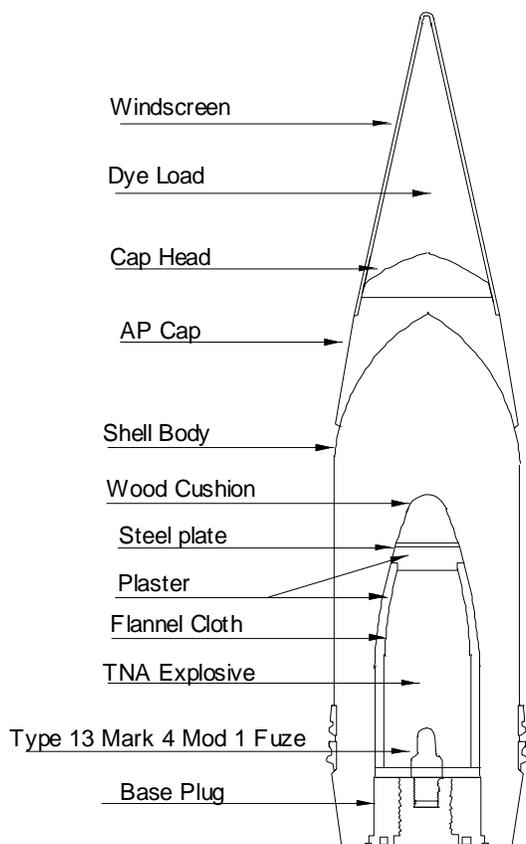


Figure 3 – Japanese 14-inch Type 1 AP Projectile

8-Inch Type 91 AP Projectile

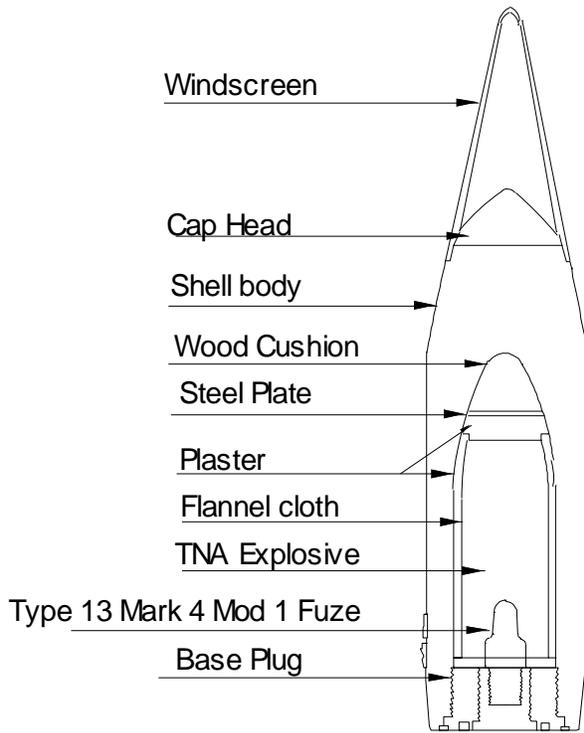


Figure 4 – Japanese 8-inch Type 91 AP Projectile

6-inch Type 0 Common Projectile

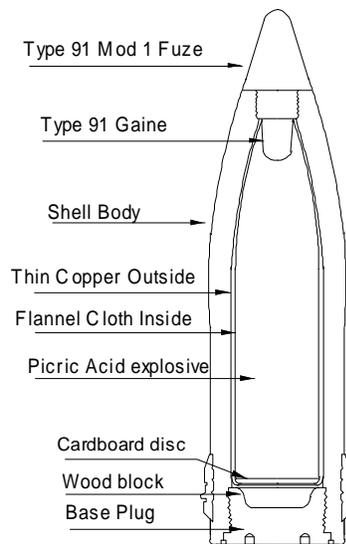


Figure 5 – Japanese 6-inch Type 0 Common (HE) Projectile

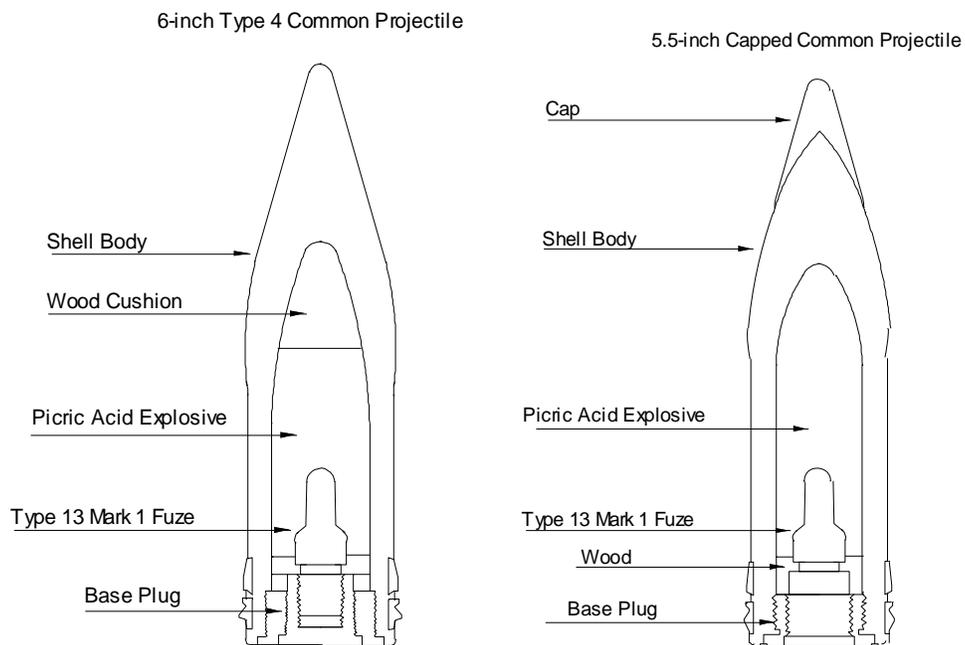


Figure 6 – Japanese mid-caliber Base-Fuzed Common Projectiles

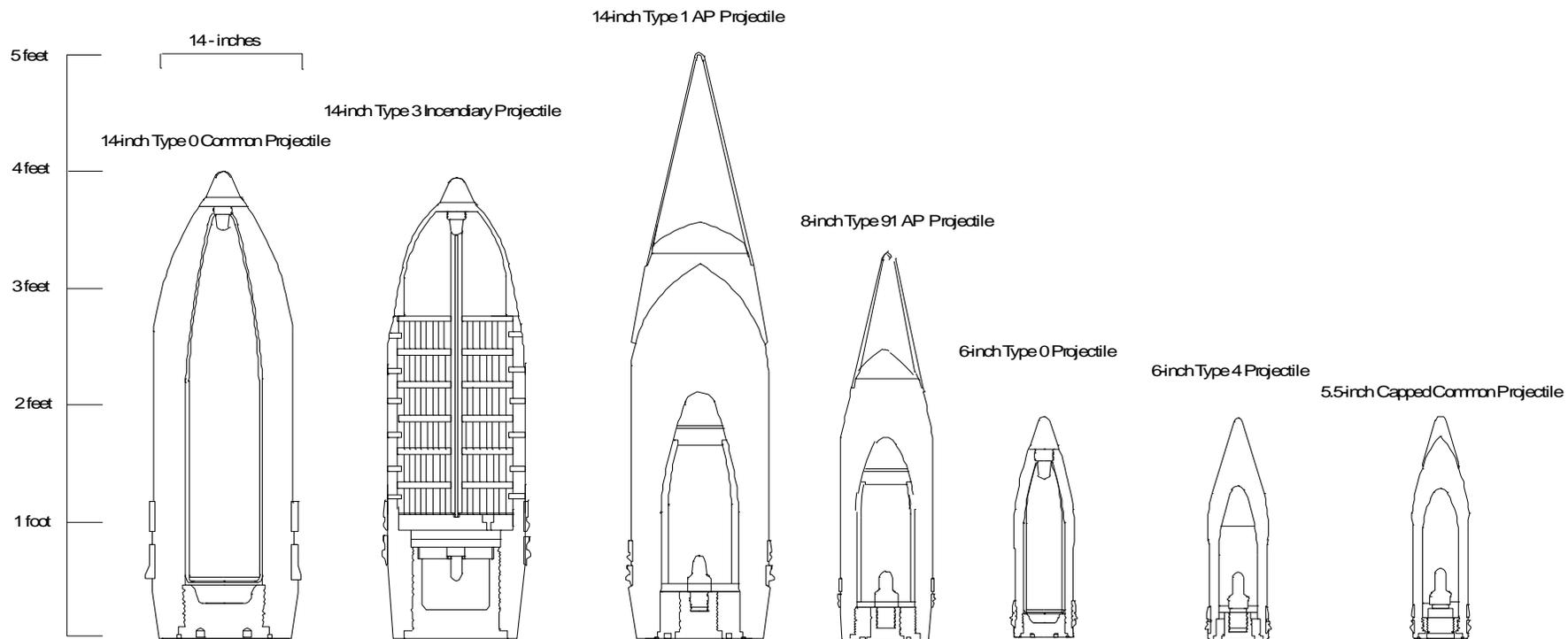


Figure 7 – Japanese projectiles in scale to each other