

U.S.S. VESTAL

BOMB DAMAGE

Dec. 7, 1941

Pearl Harbor

Class.	Repair Ship (AR4)	Length (W.L.). . .	435'
Launched	May, 1908	Beam	60'-2"
Displacement		Drafts before damage:	
(normal). . . .	8542 tons		17' fwd. 21' aft

References:

- (a) C.O. VESTAL conf. ltr. to Cincpac, AR4/L11-1/(066), Dec. 11, 1941 (Action Report).
- (b) C.O. VESTAL conf. ltr. to Buships, AR4/A9/L11-1/(069), Dec. 27, 1941 (War Damage Report).
- (c) Comdt. N.Y. Pearl Harbor conf. ltr. to Buships C-L11-1/AR4/NY10(Y-0416), March 4, 1942.
- (d) C.O. VESTAL conf. ltr. to CNO, AR4/S88/A9/A16-3/(08)/50, January 23, 1942 (Damage Control Report).

Narrative

1. U.S.S. VESTAL was moored outboard of U.S.S. ARIZONA at Berth F-7, one of the interrupted quays off the south side of Ford Island, Pearl Harbor, on the morning of December 7, 1941. The port side of VESTAL was moored to the port side of ARIZONA. The weather was clear, with broken clouds. The depth of water here is about 45 feet.

2. The Japanese air raids commenced at about 0755 with dive bombing of the Air Station on Ford Island. Torpedo planes simultaneously attacked the ships in the harbor for ten to fifteen minutes. During the latter part of the torpedo attack, dive and high-level bombing of the ships began and lasted intermittently for about an hour.

3. VESTAL received two direct bomb hits from the dive bombers at about 0805. They were released at less than 1000 feet from flat dives. The first hit was forward near frame 43, penetrating three decks and detonating in a storeroom. The second hit was aft at about frame 110. It passed completely through the ship and exploded under water close aboard. Both bombs travelled at least 10 meters (36 feet) beyond the first point of impact before exploding. Plate I shows the bomb trajectories.

4. Fires broke out in the storerooms forward and the forward magazines were flooded as a safety precaution. Leakage from the magazines flooded the forward hold. Large compartments aft flooded as shown on Plate III. The ship started listing rapidly to port as the port locker room aft flooded; but as the starboard locker room filled, she began to right herself.

5. At about 0820, according to reference (a), a torpedo was seen to pass astern of VESTAL and strike ARIZONA, whose bow extended about 100 feet beyond VESTAL's stern. (NB: this time appears somewhat late, as the torpedo plane attack terminated about ten minutes earlier, according to most other observers). ARIZONA was also being bombed, and her forward magazines blew up soon after the torpedo hit was observed. This explosion started fires aft and amidships on VESTAL. Fuel oil on the water between the ships was ignited. The position of VESTAL became so precarious that preparations to get underway were ordered at 0830.

6. A tug pulled VESTAL clear, and she got underway on both engines (no steering gear) and maneuvered to a position bearing 210 degrees and 900 yards from McGrew's Point, where she was anchored at 0910 in 35 feet of water. A starboard list developed as the ship cast loose from ARIZONA, and increased to about seven degrees while anchored. The draft aft increased to 27 feet and the ship was still on fire in several places. It was finally decided to beach the ship to guard against the increasing probability that she would sink.

7. At 0950 the ship again got underway and was beached with her bow on Aiea Shoal with 11 feet of water forward, 18 feet amidships and 27 feet aft. The draft forward on grounding was reported by reference (a) to be 15 feet. The fact that she grounded in soft mud probably accounts for the discrepancy in the reported draft and the depth of water. The movements of the ship are indicated on the map on Plate I.

8. The bombs were probably of the armor-piercing type, 16 inches in diameter, weight 1575 lbs., containing 66.5 lbs. of explosive. If the general-purpose 250-kilogram bomb had been used, which carries a charge of 133 lbs., the damage caused should have been considerably greater. Reference (b) mentions a fragment 22 by 8 inches weighing 70 lbs. Allowing for an irregular shape, the average thickness would be about 2 inches, which is also more indicative of the armor-piercing than the general-purpose bomb.

Structural Damage

9. The first bomb hit the forecastle deck about a foot aft of frame 43, eight feet to starboard of the centerline, as shown on Plate I. It penetrated four decks of the thicknesses shown on Plate II, which add to a total of one inch of medium steel and 3-1/2 inches of wood. In addition, a longitudinal girder under the forecastle deck was fractured as shown in Photo 2, a main deck beam as shown in Photo 3, and the bulkhead of the tailor shop above and below the door was torn as shown in Photo 3 and 4.

10. The bomb was deflected by the rod, bar and pipe stock stowed in A-14-1/2, and exploded on the centerline at about frame 39. An opening about 9 by 9 feet was blown in the lower platform deck, but the hole in the upper platform deck, as seen in Photo 5, shows no evidence of blast

from below. No fragments penetrated the hull. The closely-packed rods, pipes and bars, stored in racks, were most effective in stopping this heavy bomb and in smothering the explosion. Numerous very small fragments were recovered, and one large one previously mentioned in paragraph 8.

11. The bomb entrance hole in the forecastle deck was about 2 feet in diameter. Holes in successive decks were progressively larger, as may be seen from the photographs. Quite likely the bomb was tumbling, due to striking the heavy longitudinal girder shown in Photo 2.

12. Blast bulged the covers on the centerline hatch between frames 32 and 36 on the upper platform deck, and the deck plating between beams was also bulged up. This is surprisingly little damage. It can be explained, however, by the small amount of explosive in an armor-piercing bomb and by the absorption of fragments and blast energy in the rods, pipes and bars.

13. The other bomb struck a hatch on the main deck at frame 111, about 17 feet to port of the centerline. It went completely through the ship, as shown on Plate III, penetrating a total thickness of about 2-1/8 inches of steel as indicated by the sketch. It also fractured a main deck longitudinal and a beam under the lower platform deck. Photo 6 shows the hole in the lower platform deck. No other photographs of the internal damage caused by this bomb are available.

14. This bomb presumably exploded fairly close to the hull, but did very little structural damage. The hole in the outer bottom in tanks D-87-F and D-86-F was about 6 by 4 feet. It was probably enlarged to this size by the explosion. Seams were opened and rivets loosened in the inner bottom tank D-82-F. The inner bottom in way of D-82-F and D-87-F was raised between frames 105 and 112, shearing numerous rivets. Floors 108 and 109 were damaged and longitudinal No. 3 (port) was broken out between frames 108 and 110.

15. As in the case of the first bomb, the entrance hole on the main deck was about 2 feet in diameter and the holes in successive decks were progressively larger.

Flooding; Damage Control

16. Compartments D-1, C-1-1/2 and C-3 flooded immediately up to the waterline, which rose to 27-1/2 feet and flooded these spaces with water and fuel oil from the ruptured tanks. The compartments involved contain the blacksmith, shipfitter and boiler shops, locker rooms, and metal and pipe storerooms as shown on Plate III. The ship took an initial list to port, as the port locker room filled first; but this was reduced as the starboard locker room flooded, and the list changed to starboard as the tug pulled the bow away from ARIZONA. Free surface due to the flooding aft and magazine flooding forward had reduced the metacentric height by about 2-1/2 feet, which left the net metacentric height slightly negative, or at least nearly zero.

Combined with this was the inclining moment due to flooding C-3 (the pipe stowage in the starboard side of the engine room) while C-2, the corresponding compartment to port, did not flood. The cause of flooding in C-3 cannot be established from the references. There is a door from C-3 to D-1-1/2, but this was apparently closed, and the references imply that the compartment flooded through two small holes in the bulkhead. As mentioned in paragraph 6, the starboard list reached 7 degrees before the ship was finally beached.

17. Bulkheads at frames 99 and 117 were shored and numerous small leaks in them were plugged. No deflections of these bulkheads were noted. Leakage into the engine room bilges was pumped back into D-1-1/2 rather than overboard, to prevent any addition to the oil fire already raging between the ships. The amount so pumped was just enough to prevent flooding the engines.

18. D-1 and D-1-1/2 drain through four 2-1/2-inch sluice valves into the shaft alleys. These valves were opened and apparently some pumping was done; but it was futile to control the flooding by thus pumping the shaft alleys. Furthermore, no suction could be taken from the damaged oil tanks (which might have been desirable to reduce the flow of oil to the water outside) because the suction manifold was submerged in D-1 and had also been broken by the bomb.

Fires and Miscellaneous Damage

19. The explosion of the bomb which struck forward started fires in A-14-1/2 and A-9, in paper, baled rag and waste stowages. The forward magazines A-5-M, 6-M and 7-M were flooded as a precautionary measure after some of the ammunition had been removed. The forward hold (A-3) and the small arms magazine (A-3-1/2-M) flooded because of leakage from the forward magazines. Free surfaces in these compartments contributed to the loss of metacentric height discussed in paragraph 16.

20. The fires gave off a great deal of smoke. Nine 50-pound CO₂ cylinders were dropped into A-14-1/2 and the compartment isolated as well as possible to check the fire. The hatch covers were sprung, however, and the fire was finally extinguished by flooding the lower half of the compartment with fire hoses.

21. Rescue breathing apparatus was used satisfactorily. Asbestos suits would have been useful but were not available.

22. There were minor fires on the weather decks caused by the explosions and conflagration on ARIZONA. These were controlled by fifteen-pound CO₂ extinguishers and fire hoses. Paint was scorched over considerable areas on the port side from frame 80 to the stern; this may be seen in Photo 1.

23. The forward fire main was broken on the berth deck, but the damaged section was isolated and bypassed by hose jumpers. The main power and lighting cables serving the forward part of the ship were ruptured by the bomb (see Photos 2 and 3, for example), and the flooding aft grounded out the power and light in the engine room and in the after part of the ship. Whether any lighting remained, or when lighting was restored in the affected areas, is not explained in the references. This loss of lighting emphasized the great value of portable electric lanterns, a feature which constantly recurs in the reports of other damaged ships.

24. Miscellaneous damage, all caused by the ARIZONA magazine explosion and by the fires on VESTAL, included:

(a) Damaged or missing in the area abaft the amidships deck house:

Life line stanchions; flagstaff.
Upper port accommodation ladder.
Two companionway hatches and hatch coamings.
Three shop skylight covers.
One 10-foot punt.
The garbage hopper.
Various lines, shrouds, slings, halyards, etc.

(b) On the boat and superstructure decks:

Broken ladders and hand rails.
Broken windows and airport lenses.
Damaged vent cowls.
Burned awnings and weather screens.
Two life rafts missing and four burned.

(c) Damage to boats was superficial: broken taffrails, thwarts, beadings, etc., and much lost or damaged boat equipment.

25. There was, of course, a great deal of damage to the contents of the storerooms A-16-1/2 and A-14-1/2. One row of stock bins containing pipe fittings was completely obliterated, and the bomb appears to have exploded in a metal rack containing pipe, tubing and bar metal.

Repairs by the Ship's Force

26. Salvage pumps were obtained from the Navy Yard and the ship was gradually unwatered. A patch was built and placed over the hole in the hull. Divers sealed this patch and the water was pumped out until a form could be built between frames 108 and 110. Concrete was poured into the form to within 4 inches of the inner bottom, which plugged the hole completely and permitted the compartments to be pumped dry. Photo 7 shows the hole in the inner bottom, through which the concrete can be seen, and Photo 8 shows the temporary patch as it appeared when the ship was docked at the Navy Yard.

27. Practically all of the damage, with the exception of that to the outer and inner bottoms aft, was completely repaired by the ship's force.

Discussion

23. The most remarkable feature of this incident is the reduction in the effectiveness of the first bomb by the pipe and bar stowage. Because of it, the hull was not pierced and the large compartments between frames 27 and 47 did not flood. Had this bomb gone through the ship as the other one did, the ship would have settled to a draft of about 25 feet with a further free-surface reduction of about 4 inches in metacentric height. She would probably not have capsized, as some 11 feet of freeboard would have remained; but the extra flooding would have added considerably to the repair job. The armor-piercing bombs were probably intended for ARIZONA. It was fortunate for VESTAL that the 250-kilogram bombs, so freely used elsewhere that morning, were not the type which struck her, as these bombs contain much more explosive and are more effective against unarmored ships than armor-piercing bombs.

29. VESTAL had to be beached because flooding was progressive through lack of watertight integrity. Not only did flooding spread from areas actually damaged, but it also spread from leaking magazine boundaries. This adds another example to the many cases on record of the dangers of boundaries which are supposedly watertight and actually are not. This ship, however, is thirty-two years old and has had a varied career. Regardless of how or why the progressive flooding occurred, it is not surprising. The watertight integrity of old ships should be viewed with suspicion. Commanding Officers of such ships should anticipate leakage through bulkheads and decks unless corrective measures are taken. All practicable steps to improve the tightness of boundaries and fittings should be accomplished by the ship's force, with necessary assistance from repair activities.