FIST OF THE FLEET SHIPS

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AIRCRAFT CARRIERS
Commissioned before World War II:

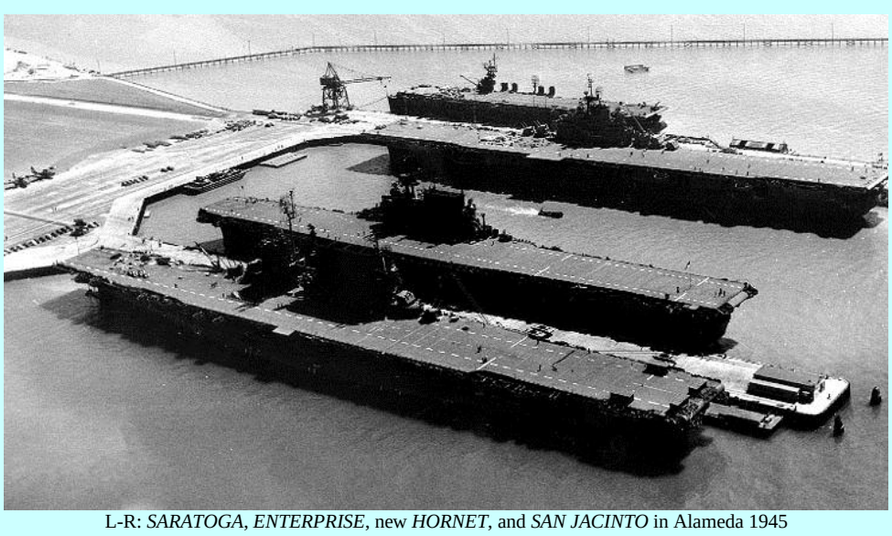
North Island, circa 1927, USS LANGLEY at pier and TD-2s overhead

USS LANGLEY (CV-1), circa May 1928

1	**LANGLEY** (11,500 tons)	7 April 1922	to AV-3 in 1938
	Sunk by Japanese aircraft 27 February 1942 near Java		
2	**LEXINGTON** (41,000 tons)	14 December 1927	ex-battle-cruiser
	Sunk l8 May 1942 by Japanese aircraft at Battle of Coral Sea		
3	**SARATOGA** (33,000 tons)	16 November 1927	ex-battle cruiser
	Survived the War, but sunk 25 July 1946 as target ship at Bikini		
4	**RANGER** (14,500 tons)	4 June 1934	Slightly larger than CVE
	Survived the War, but stricken and scraped 29 October 1947		
5	**YORKTOWN** (19,800 tons)	30 September 1937	New construction
	Sunk 6 June 1942 by Japanese submarine at Battle of Midway		
6	**ENTERPRISE** (19,800 tons)	12 May 1938	New construction
	Survived the War, but stricken and scrapped on l2 October 1956		
7	**WASP** (14,700 tons)	25 April 1940	New construction
	Sunk 15 September 1942 by Japanese submarine off Espiutu Santo		
8	**HORNET** (19,800 tons)	20 October 1941	New construction
	Sunk 26 October 1942 by Japanese aircraft at Battle of Santa Cruz		

SARATOGA was badly damaged in March 1945, but repaired and became a training carrier off Pearl Harbor until the Japanese surrender. ***ENTERPRISE***, damaged off Okinawa, was still undergoing repairs in Bremerton when the Japanese surrendered.

RANGER never saw combat in the Pacific because of her slow speed and light displacement. She served in the Atlantic until January 1944 when she became a training carrier operating out of Quonset Point. She passed through the Panama Canal in July 1944 and began providing combat training off San Diego in October 1944.



L-R: *SARATOGA*, *ENTERPRISE*, new *HORNET*, and *SAN JACINTO* in Alameda 1945

The photo above gives a relative comparison of the carriers that made the difference in the Pacific battles. ***HORNET*** (CV-12) was repaired and preparing to return to the war-zone when the Japanese surrendered. The ***SAN JACINTO*** (CVL 30) looks smaller than she really is because of photo perspective.

USS HORNET, the Museum, is moored at this same location today, although her surroundings are different and she has an angled-deck.

ORIGINAL ESSEX CLASS TECHNICAL DATA (24 ships)

The first eleven ships of this class were ordered in July 1940 at a cost of nearly $69-million each (1940 dollars). It is difficult to compare these ships against carriers of other countries since there are many technical differences that aren't obvious when looking just at tonnage or length. The number of aircraft embarked is almost as important as the safety features built into the ships structure and the training of her crew. The record of the ESSEX-Class as "survivors" of countless Kamikaze attacks during WW-II and their length of service afterwards attests to the soundness of this design.

USS WASP plus four at Ulithi Lagoon December 1944

Length overall 872'/888' (short/long)	Four Shaft 150,000 HP
Waterline length 820'	(8) 565 psi boilers
Extreme beam 147.5'	(4) 1,250 Kw generators
Waterline beam 93'	(2) 250 Kw diesel generators
Flight deck 862' x 108'	Fuel capacity 6,330 tons
Hanger deck 654' x 70'	Speed 33 knots
Design disp. 27,100 tons	Range 15,400 nm at 15 knots
Displacement 27,100 tons	Ordnance 625.5 tons
Full load 36,380 tons	AvGas 231, 650 gallons
Crew = 268 officers and 2,363 enlisted	85-100 aircraft

(2) Centerline elevators 48'-3" x 44'-3" (28,000 lbs)
(1) Deck edge elevator 60' x 34' (18,000 lbs)

Catapults	*(2) H4A (first ships)	72.5' stroke	16,000 lb A/C @	74 kts
	(1) H4B (early ships)	96' stroke	18,000 lb A/C @	78 kts
	(2) H4B (later ships)	96' stroke	18,000 lb A/C @	78 kts
	(2) H8 (27A ships)	190' stroke	25,000 lb A/C @	95 kts
	(2) C11-1 (27C ships)	215' stroke	25,000 lb A/C @	132 kts

****ESSEX*** was completed without catapults. The next six ships were completed with bi-directional athwartship catapults (H-4A) and one catapult (H-4B) on flight deck. ***ESSEX*** received two flight deck catapults during her April 1944 refit.

Topside, *USS HORNET* with SCB-27A, Jan 1954

but little changed in the hanger deck, circa 1943

SCB-27A ESSEX Class jet aircraft modernization program (1948 to 1953), included:

Side belt armor replaced with hull blister, increased beam to 101-feet, creating a narrow P&S weather deck.

Flight deck 5-inch turrets were removed.

Tripod mast replaced with single pole mast. Redesigned smokestack.

Flight deck landing area strengthened and installed higher capacity aviation crane.

Aviation elevator capacity increased to handle jet aircraft.
H4 catapults replaced by H8, with jet blast deflectors.

Increased the aviation fuel capacity and installed a jet fuel blending system (HEAF).

Created three ready rooms on 2nd deck and installed aircrew escalator to flight deck.

Fabric hanger bay fire curtains replaced with fireproof steel doors.

USS SHANGRI-LA with SCB-27C and SCB-125 conversions, January 1956

SCB-27C Essex Class hull modification program (1951 to 1954), included:

The hull blister was revised, increasing waterline beam to 103-feet.

Replaced hydraulic catapults with two C-11 steam catapults.

The #3 aircraft elevator moved to starboard deck edge unit.

SCB-125 Essex Class angled deck program (1951 to 1957), included:

The port side flight deck was modified with an angled deck.

The original open-air forecastle was enclosed to protect against future typhoons.

Improved Mk 7 dual arrestor wire systems installed and crash barriers strengthened.

Primary Fly was moved to aft edge of the island structure, and two decks higher, while improved flight deck lighting was installed.

Three ships received a longer #1 aircraft elevator (70'-3").

ORISKANY completed SCB-27A changes in 1950. Some ships received the SCB-125 and SCB-27C alterations at the same time. Nine ships, including the mothballed ***BUNKER HILL*** and ***FRANKLIN***, remained unmodified. ***LAKE CHAMPLAIN*** received only SCB-27A and was the last operational straight-deck carrier.

Those ships that received both SCB-27C and SCB-125 programs had a new full-load displacement of 40,060-tons, with a 103' beam. The widest part of the flight deck was 166.8' and these ships could no longer pass through the Panama Canal.

The most critical improvement was Carrier Control Approach (CCA) radar. Until the angled-deck carrier, night operations were the same as daylight, except it was **DARK**.

Order of Commissioning and combat deployment during World War II:

(The **Fist of the Fleet** made deployments in those ships in **bold print**.)

9	**ESSEX**	31 Dec 1942	Korea, to CVS 1960
22	INDEPENDENCE (L)	14 Jan 1943	sunk off Californian 1951
16	LEXINGTON	17 Feb 1943	to CVS 1962 - AVT 1969 - museum
23	PRINCETON (L)	25 Feb 1943	sunk 24 October 1944

24	BELLEA WOOD (L)	31 Mar 1943	to France September 1953
10	**YORKTOWN**	17 April 1943	to CVS 1957- museum 1973
17	**BUNKER HILL**	24 May 1943	damaged 11 April 1945
25	COWPENS (L)	26 May 1943	to AVT-1 in May 1959
26	MONTEREY (L)	17 June 1943	to AVT-2 in May 1959
28	CABOT (L)	24 July 1943	to Spain August 1960
11	INTREPID	16 Aug 1943	Vietnam as CVS – museum 1974
27	LANGLEY (L)	31 Aug 1943	to France January 1947
18	WASP	24 Nov 1943	to CVS 1956
29	BATAAN (L)	17 Nov 1943	to AVT-4 in May 1959
12	**HORNET**	29 Nov 1943	to CVS 1958 – museum 1970
30	SAN JACINTO (L)	15 Dec 1943	to AVT-5 May 1959
13	FRANKLIN	31 Jan 1944	damaged 19 March 1945
19	HANCOCK	15 April 1944	Vietnam, laid up 1976
14	**TICONDEROGA**	8 May 1944	Vietnam, to CVS 1969
20	BENNINGTON	6 August 1944	to CVS 1959
38	**SHANGRI-LA**	15 Sept 1944	to CVS 1959
15	RANDOLPH	9 Oct 1944	to CVS 1959
31	B. H. RICHARD	26 Nov 1944	Korea & Vietnam – laid up 1971

The nine light carriers of INDEPENDENCE-Class were built on light cruiser hulls. These ships had a design displacement of 11,000 tons (15,800 tons loaded) and 623' in length, and could make 32 knots. These ships operated with about 45 aircraft (fighters and torpedo planes).

Angled-deck USS ANTIETAM off Virginia Capes, January 1953

The otherwise unmodified USS Antietam received an angled-deck and began carrier tests in 1953. Originally, all landings were with paddles, but she later received a mirror installation. She served several years as the training carrier.

Ready for combat deployment after cease fire:

36	*ANTIETAM	28 Jan 1945	Korea, to CVS 1953
21	**BOXER**	16 April 1945	Korea, to LPH 1959
39	LAKE CHAMPLAIN	3 June 1945	Korea, to CVS 1957

* *ANTIETAM* arrived in the Western Pacific in time for the Japanese surrender.

Commissioned after Japanese surrender:

41	**MIDWAY (B)**	10 Sept 1945	Vietnam to museum 2004
42	F. D. ROOSEVELT	27 Oct 1945	Vietnam, stricken 1972
37	PRINCETON	18 Nov 1945	Korea to LPH 1959
40	TARAWA	8 Dec 1945	to CVS in 1955 (no 27A)
33	KEARSARGE	2 March 1946	Korea to CVS 1958
32	LEYTE	11 April 1946	Korea, laid up 1959
47	**PHILIPPINE SEA**	11 May 1946	Korea to CVS and LPH
48	SAIPAN (L)	14 July 1946	to AGMR-2 1966
45	**VALLEY FORGE**	3 Nov 1946	Korea, to CVS 1955
49	WRIGHT (L)	7 Sept 1947	to CC-2 1965
43	**CORAL SEA (B)**	1 Oct 1947	Vietnam, stricken 30 April 1990
34	*ORISKANY	25 Sept 1950	Korea &Vietnam, laid up 1976
35	REPRISAL	40% complete, explosive tests then scrapped	
44	IWO JIMA	Keel laid, then broken up and scrapped	
58	UNITED STATES	Broken up 19 days after keel laid	

The missing ship numbers (46, and 50 through 57) were cancelled.

* ***ORISKANY*** was mothballed in late 1945 while 85% complete. This ship was later completed to SCB-27A standards and commissioned in 1950.

The two SAIPAN-Class ships were built as light carriers, based on the hull design of the BALTIMORE-Class heavy cruiser. These ships had a design displacement of 14,500 tons (19,600 tons loaded) and 684' in length, but could make 33 knots. Both these ships served as training carriers off Pensacola and were later converted (AGMR-2 and CC-2).

The three MIDWAY-Class carriers were "monsters" of their day, designated as CVBs – 60% larger than the ESSEX-Class. These ships had a design displacement of 45,000 tons (55,000 loaded) and 968' in length with a fully armored flight and hanger deck, designed to carry 137 aircraft (WW-II types). These were the last ships designed and completed as straight-deck carriers. They picked up another 17,000 tons during their conversion to angled-deck carriers in the mid-1950s.

There were also 104 escort carriers (CVE) commissioned between 2 June 1941 and 15 January 1946, plus another 33 hulls transferred to the Royal Navy. Six American CVEs were lost to enemy action. **All served with distinction!**

Commissioned after the Korean War:

59	FORRESTAL	1 Oct 1955	Vietnam, stricken 1993
60	SARATOGA	14 Apr 1956	6th Fleet, stricken 1994
61	**RANGER**	10 Aug 1957	**Vietnam, stricken 2004**
62	**INDEPENDENCE**	10 July 1958	Vietnam, stricken 2004
63	KITTY HAWK	29 Apr 1961	Vietnam, laid up 2008
64	**CONSTELLATION**	27 Oct 1961	Vietnam, stricken 2003
65	ENTERPRISE	25 Nov 1961	Vietnam, active 2010
66	AMERICA	23 Jan 1965	Vietnam, stricken 1996
67	KENNEDY	7 Sept 1968	6th Fleet, active 2008

The four carriers of the FORRESTAL-Class had a design displacement of 60,000 tons (76,000 tons loaded) and nearly 1,050' in length, but could make 34 knots. ***USS FORRESTAL*** was originally designed as a straight-deck, but hastily redesigned during construction for an angled-deck. The four ships of the KITTY HAWK-Class are similar in size to ***FORRESTAL***, but with a smaller island structure located further aft.

The ***USS ENTERPRISE*** is classed by herself as the first nuclear-powered carrier. Her flight deck is about 50'-longer and the design is 10,000 tons heavier than KITTY HAWK-Class and with a very distinctive island structure. However, her main difference is "under the hood." The ship's eight nuclear reactors will push her along at more than 35 knots – some say a LOT more.

Commissioned after the Vietnam War:

68	NIMITZ	3 May 1975	CVN
69	EISENHOWER	18 Oct 1977	CVN
70	**VINSON**	13 Mar 1982	CVN
71	ROOSEVELT	25 Oct 1986	CVN
72	**LINCOLN**	11 Nov 1989	CVN
73	WASHINGTON	4 July 1992	CVN
74	**STENNIS**	2 Dec 1995	CVN
75	TRUMAN	25 July 1998	CVN
76	**REAGAN**	12 July 2003	CVN
77	BUSH	10 January 2009	CVN

STRAIGHT DECK TRIVIA

By Scott Smith

The original Essex-Class ships were fitted with 16 arresting wires and five barriers. The #12 wire was often removed since it crossed the aft aircraft elevator. Four of these wires (#13 through #16) were directly adjacent to the barriers and seldom used. Engaging a late wire (#8 or #9) could put the aircraft into the barrier. However, barriers were raised and lowered remotely by an operator in the starboard catwalk. Many planes were "saved" when the operator lowered the barriers the instant the hook caught a wire.

The early ESSEX Class ships were also fitted with 11 arresting wires and three Davis barriers on the bow. Somebody wanted aircraft to land over the bow while steaming astern (20 knots). This capability was demonstrated but never used. The bow wires and barriers were officially removed by 1944.

The flight deck was constructed of 3"-thick laminated wood planking over thin steel plating and between rows of steel aircraft securing rails. The eleven planks laid between the securing rails were easily replaced after battle damage. This light construction left a lot to be desired for the occupants immediately below the flight

deck. On one ship, an F4U engaged the barrier and nosed-over. One propeller blade penetrated the flight deck into the compartment below. Rather than remove the blade and seal the hole, it was cut off flush with the deck and became a permanent fixture below.

> The thin flight deck steel easily rusted through, especially in the landing area where the steel flexed from landing impact. Repairs required removal the wood planking, so many ships had leaky roofs. Aboard *USS Lake Champlain* there were several leaks in the 02-level avionics shop. These were marked in wet weather and painted in dry weather – until a large section of the overhead insulation came down during a particularly bad storm.

The *USS ESSEX* was "finished" without catapults (unavailable). The next six ships were fitted with the H-4A bi-directional athwart ship catapult on the hangar deck, actually two separate catapults that created a hump across hangar bay #1. A single H-4B flight deck catapult was installed on the starboard side. While the hanger deck catapult worked reasonably well with 1941-vintage aircraft aboard the pre-war carriers, it had problems with the new heavier aircraft. This "rain free" catapult was removed as each ship visited a shipyard for repairs or refit.

Hydraulic catapults worked in reverse of the arresting gear engines. A hydraulic piston separated two sets of sheaves. The wire roved on the sheaves passed up to the flight deck shuttle. The sheaves were forced apart by hydraulic pressure, pulling the shuttle towards the bow. The hydraulic fluid was flammable and the high pressures involved often created leaks that were easily ignited. Most propeller aircraft were usually deck launched from near the island structure.

Later ships were constructed with two H-4 catapults on the flight deck and the hangar deck catapult was deleted. The Navy's first F9F-2/5 Panther and F2H-2 Banshee jets began carrier operations during Korea, and the H-4 catapults were straining to get them airborne. The apparent solution was the installation of H-8 catapults that was part of the SCB-27A modernization.

> The Panther had a single 6,250-lbs thrust engine and a maximum weight of 18,721 lbs. The Banshee has two engines totaling 6,500 lbs of thrust and a maximum weight of 22,312 lbs. Then *USS Lake Champlain* reported for duty in Korea with some F3D Skynights. *LAKE CHAMPLAIN* had H-8 catapults, but the F3D had a maximum weight of 26,850 lbs with the same engines as the Banshee. It wasn't long before the F3Ds were operating from a shore base.

The H-8 catapult was the largest hydraulic catapult in service and was used with jets on 27A ships during and after the Korean War. Unlike a steam catapult, with its gradual acceleration and longer stroke, the H-8 catapult had instantaneous acceleration and a very short-stroke! The smart flight crew usually ate something before a scheduled catapult launch to keep the stomach from collapsing.

> Borax was routinely added as a water conditioner to the water-brake of the H-8 catapults. Aboard *LAKE CHAMPLAIN*, however, one new sailor poured in a box of the hand-cleaner Boraxo instead, creating a huge mass of bubbles when the catapult was next fired.

The ESSEX-Class carrier's gasoline fuel system held 231,650-gallons and was a marvel of engineering. The lower deck saddle tanks (tanks inside tanks) pumped gasoline out the top and allowed seawater into the bottom so the tanks were always full of liquid. After refueling aircraft, seawater was pumped out of the tanks, allowing fuel to drain from all upper deck plumbing. This plumbing was then purged with carbon dioxide to remove any remaining fire hazard. Post-war carriers used the same fuel system until piston-engine aircraft no longer operated from carriers.

The original ESSEX Class design had twin 5"/38 mounts fore-and-aft of the island structure. After WW-II, these guns were fired only during practice and they were removed with the SCB-27A modernization. However, most sailors learned not to be on the flight deck during firing. Sometimes pilots were trapped in their aircraft parked near the island when a bogey attacked the ship. There were reports of serious hearing loss and even shatter canopies just from the nearby blast.

STRAIGHT-DECK NIGHT FLYING

By Scott Smith

The first night landing was aboard *USS LANGLEY* on 5 February 1925. It was unintentional as Lt. H. J. Brow accidentally (?) stalled while practicing approaches. The first intentional night landing was on 8 April 1925 by Lt. John D. Price off San Diego. During the mid-1930s, night flying become more routine. Pilots qualified with ten hours of night flying and ten night landings, usually during a full moon (and clear sky). Remember, this was in biplanes without navigation aids, with unreliable radios, and with gyros that tumbled from even modest maneuvers.

Generally, early WW-II carrier-based aircraft had no night mission capability and limited emphasis on instrument flying. Yet in the months before Pearl Harbor, pilots still endured their yearly night qualifications (six night takeoffs and landings). Early versions of radar were being installed in the larger ships. Finally in 1943 a radar was installed in some TBF Avengers and pilots braved the night sky to explore this new capability. Otherwise, it was a daylight war, with some exceptions:

The first night recovery of WW-II was on 7 December 1941 aboard *ENTERPRISE*. Some aircraft were launched late in the afternoon to search for the Japanese fleet and these returned after dark. All the ship's lights were turned-on to help the aircraft recover. There were similar night recoveries of daylight strike aircraft at other times during the war.

Search aircraft were routinely launched prior to sunrise with a planned recovery during daylight. The intent was for these aircraft to reach their primary search area by sunrise. Fighter sweeps were also launched before sunrise to catch Japanese aircraft on the ground at sunrise.

LCDR Edward "Butch" O'Hare was experimenting with night intercept tactics when he was killed 26 November 1943. The "Bat Team" tactics involved a TBF-1C equipped with ASB radar and two F6F-3 Hellcats (no radar) to shoot down the Japanese bombers when close enough to see their exhaust flames. Somehow they got in the middle of a Japanese formation and a Japanese nose gunner apparently shot down Butch.

Task Force 58 had VF(N)-101 with four F4U-2 night fighters (AIA radar) on 16 January 1944. By July, this squadron had destroyed 5 Japanese bombers, damaged 4 others, with 1 probable. By June 1944, Task Force 58 was operating 27 F6F-3N Hellcats (APS-6 radar), so the night Corsairs were turned over to the Marines.

Thirty-four F4U-1 aircraft were converted to night fighters (F4U-2). This AIA radar installation had a metal waveguide from the wing antenna to the transmitter-receiver in the fuselage. All later radars had the antenna and transmitter-receiver in the wing-pod. The AIA radar was discontinued when the APS-6 was developed.

On the night of 16 February 1944, *ENTERPRISE* launched radar equipped Avengers on the first night strike of the war against Truk. Two Japanese tankers and five freighters were sunk, and five others were damaged. The Avengers used skip bombing rather than unreliable torpedoes, while the radar found the targets and provided the weapons release point.

It was learned German submarines had a receiver to detect radar signals. ASW carriers (CVEs) started all-night radar patrols for submarines in January 1944. These flights effectively kept the submarines submerged with little time to recharge batteries. At first, the planes carried extra fuel, but no bombs, and recovered after sunrise the next morning. Later, these ships began launching at night to pursue submarine contacts and by Spring they were using cyclic flight operations day and night.

During 1943, the Japanese were using land-based night reconnaissance aircraft and began developing tactics for night torpedo attacks. Generally, these tactics involved dropping flares on one side of our task force while their torpedo bombers attacked from the opposite side. The cruiser *DENVER* was the first victim of these tactics on 13 November 1943. A month later, the new *LEXINGTON* was torpedoed, but survived.

By 1944, better radar was being installed in carrier-based aircraft. The TBF/TBM Avengers had their primitive ASB radar replaced with the much improved APS-4 search radar. The APS-4 was also installed in the F6F-3E, while the F6F-3N Hellcats were equipped with the new APS-6 intercept radar. At the same time, aircraft carrier masts were sprouting several improved types of radar to provide better fighter control from ship-board Combat Information Centers (CIC).

The early ASB was an "A-scope" radar, providing only target distance as the radar beam was manually swept through the aircraft's forward sector. The APS-4 was a "B-scope" radar, providing both bearing and distance on a tiny 4"-diameter radar indicator tube. The APS-6 was similar to the APS-4, but had a spiral sweep gun-aim mode. The B-scope caused an annoying distortion to the radar display when used for land navigation, but this was not a problem when looking for ships or enemy aircraft.

By mid-1944, *INDEPENDENCE* began operating as a night carrier with nine Avengers and 18 Hellcats. *ENTERPRISE* took up this mission in January 1945, followed by *SARATOGA* and *BON HOMME RICHARD*. These ships also operated during daytime, especially during miserable weather.
After the war, the Navy went through some drastic changes. Ships were moth-balled, jets began to appear, and the specter of nuclear war hung over everyone. One of the more important changes was a concerted effort to improve instrument training. About 1948, the Navy began a serious program to increase pilot instrument and night skills. At the time, the Navy had three instrument cards:

The **Green Card** was issued to experienced pilots (over 1200 flight hours) who had demonstrated skill at instrument flying. At the time, this meant successfully flying a single-engine partial-panel instrument approach while hooded in an SNB (Secret Navy Bomber) under the critical eye of an instrument instructor. This card allowed the pilot to take off under any weather conditions and land when weather conditions were at or above minimums for an approved instrument approach. Instrument instructors all held Green Cards, but had enough common-sense not to fly in really bad weather.

The **White Card** was issued to pilots who had completed a certified instrument training program, typically flown while hooded in an SNB (also called the Bug Smasher) under the watchful eye of an instrument instructor. This card allowed the pilot to take off and land when weather conditions were at or above minimums for an approved instrument approach.

The **Red Card** was issued to everybody else. Take off and landings were limited to VFR conditions. This card was deleted about 1952.

Instrument training was only part of the equation. The other part was the airplane and its performance in unpleasant weather. One important element was radar, if for no other reason than to detect and avoid violent weather conditions. Yet, few of the early jet aircraft had radar and flying above a severe storm was not always possible. Even a modest hail storm acted like a ball-peen hammer pounding on the wing leading edges, increasing drag and destroying wing efficiency to where there might not be enough thrust to effect a landing at any speed.

Piston-engine aircraft usually didn't even try to fly on-top, but flying through the middle often found freezing temperatures, with ice building up on the wings and carburetor ice choking the engine. Both destructive of aircraft performance in a situation where it was needed just to escape the storm. Of course, those willing to risk flying below the storm might find their way blocked by low altitude rocko-cumulus clouds.

Another part of the equation was navigation equipment. Prior to 1954, carrier-based piston-engine aircraft found their way from one place to another using the low-frequency radio range system – pilots listening for the monotonous Morse code 'A' and 'N' tones to stay on course. It was very simple and reliable, but could be made unusable from static in heavy rain or with ice (or oil) on the antenna. The AD-5 and AD-6 came along in early 1954 and were equipped with a radio direction finder (ADF) – it also could get music and ball-games. Of course the jets had been using this equipment for several years.

The Low Altitude OMNI Range (VOR) system started about 1950, adding a very accurate method of navigation, but it was never installed in carrier-based aircraft. It was installed, however, in the lowly Beechcraft used for instrument training – offering a tantalizing glimpse of the future when TACAN (VORTAC) would came along in 1955.

> In really bad weather, the flight crew might evoke the following technical blessing before takeoff: Omni, Omni, VOOOOORTAC!

Beginning in1948, our attack carriers normally embarked three night flying detachments. The pilots of these squadrons received extra night and instrument training, but still had a higher than average accident rate. The West Coast ships embarked night fighters, usually F4U-5Ns from VC-3, night attack aircraft (AD-4N) from VC-35, and AEW aircraft (AD-4W) from VC-11. The East Coast ships embarked the same types of aircraft from VC-4, VC-33, and VC-12. By 1951, the three Midway-class carriers also embarked nuclear delivery detachments from VC-4 (four F2H-2B) and VC-33 (four AD-4B), with an AJ Savage squadron ready to deploy from Port Lyautey (near Kenitra, Morocco) in case some dictator got too excited.

> AEW stands for Airborne Early Warning, and the AD-4W was also known unofficially as the Guppy. These aircraft had a large radome between the landing gear and two radar operators in the aft fuselage. The radar was the APS-20, designed during WW-II to detect low-flying Kamikaze aircraft. The first carrier-based AEW aircraft was the TBM-3W, operational in 1946, and the radar cost way more than the airframe that carried it.

During the Korean War, air group squadrons made some pre-dawn launches, but night recoveries were avoided. It was usually considered safer to send the few late returnees to the beach rather than risk a night recovery with an inexperienced pilot. The North Koreans were never a serious threat at night, Thus, both the night fighters and night attack planes flew night heckler missions, with an anti-submarine patrol launched before dawn. Night recoveries required a lot of deck respotting. A dedicated night carrier was being considered when the war came to an end.

Night launches were usually by catapult. The number of embarked aircraft required a large number of aircraft parked on the flight deck, leaving little room for a deck launch. Of course, the catapult was normally a sure-fire method of getting airborne. However, pilots were always alert for the symptoms of a cold-shot, which usually meant an even colder swim.

> During a period in 1952/53, ADs were using the 300-gallon Mk-8 external fuel tank. The original tank had no internal baffles and was restricted from catapulting unless the tank was completely empty or absolutely full. Even full, one tank came off during a night catapult launch, drenching planes waiting to launch with gasoline, but no fire. Later versions of this tank had baffles. These tanks were later replaced by a more aerodynamic design.

There was one universal flaw with a catapult launch that was disconcerting to say the least. As the catapult accelerated the aircraft down the track, the pilot also felt the acceleration. In the pilot's side vision were the dim lights in the catwalks which also gave the sensation of acceleration. The problem began at the end of the catapult stroke. The plane was flung out over the dark water and both acceleration stimuli stopped. Even when

on instruments, there was an overwhelming feeling the aircraft had stopped in mid-air. It often took several minutes on instruments before this deep-seated sensation subsided.

Night deck launches were a problem on a dark night. There was no reference point for directional control and deck launches were always visual. Some efforts were made to position a destroyer ahead of the carrier to provide a visual reference. However, there were times when there weren't enough destroyers, or someone on the Bridge thought there was a good horizon. Planes would often take off and shortly wonder off on various headings since that good horizon usually had no vertical references.

All the straight-deck carriers used hydraulic catapults. The unmodified Essex-class had the H-4 catapult which was operating at near maximum capacity to launch a loaded AD-4N. The 27A ships and the Midway-class had the H-8 catapult which could easily launch any aircraft of that period. However, the instantaneous acceleration literally collapsed the stomach and forced the pilot's eyeballs off the instrument panel. There was always a period of mental confusion at the end of the catapult stroke.

The AD-4N had two 400-Hz motor-generators that provided power to the gyro instruments. There was a selector switch, but a circuit was supposed to automatically switch from one power-source to the other when a failure was detected. Unfortunately, this circuit was obtained from the lowest-bidder. Instead of detecting a flaw in any of the three electrical phases, it only reacted to a particular phase failure. If the other two phases failed, no warning flag appeared and the gyros would be unreliable. This flaw was finally detected by a pilot who popped out below the clag with enough altitude to visually recover and manually switch to the other power-source.

Vertigo was a constant threat at night. Fortunately, there was not much to look at outside the cockpit and the plane's radar frequently detected something interesting. However, the wingman could count on getting vertigo while flying in the clag no matter how smooth the flight leader flew. This was easily solved by dropping back a quarter-mile and following the leader on radar.

For these night detachments, flying from straight-deck carriers was just like day flying, except it was dark. Aircraft waiting for recovery circled in the DOG pattern. Pilots could see the lights of the ships turning into the wind, but the carrier usually showed only the red mast-head light. As the ship increased speed, the phosphorescence of the ship's wake would get longer. The signals gang would send a CHARLIE on blinker as the ship approached the recovery heading. The first section in the DOG pattern would enter the break, just like a day recovery.

> The unmodified straight-deck and 27A carriers were without CCA approach radar. There was no legal instrument approach prior to TACAN, which came to the fleet about 1955. The CIC radar could provide radar vectors to return to the ship, but minimum range limitations precluded any radar assistance for landing.

The night detachments normally flew in two-plane sections, but might join into a four-plane division for recovery. There was also lots of solo flying under CIC control. Nearly all the night detachment aircraft had radar for their mission and routine navigation. This radar was often used in foul weather to find the blunt-end of the boat and make an ad-hoc CCA approach. The ship was an excellent radar target from any direction, but detecting the ship's wake was necessary to determine the ship's course. A carrier landing was hard on vacuum tubes of that era, so the crewman turned-off the radar at the cut.

> When two ships were operating together at night, it was often difficult to determine which was which. Essex-class ships had a wood deck painted haze-grey and the deck was "brighter" than the surrounding water. Midway-class ships, on the other hand, had a steel deck that looked like a hole in the water. Still, there were planes that landed on the wrong ship.

The straight-deck paddles approach was flat, about 100' altitude on the downwind leg, slowing to 90 knots abeam. The pilot then made a shallow descending turn while gradually slowing to approach speed (about 90 knots in the AD-4N), rolling out over the ship's wake which was usually easy to see. On final, the pilot could see the row of red centerline lights which were only visible from the port-quarter. There was also a red pendulum light in the island structure. If there was a horizon, this light was used to establish the proper final approach altitude, otherwise the pilot had to rely on the radar altimeter.

> There were usually two plane-guard destroyers for night operations. One steamed about 1000-yards astern and the other on the port beam. The ship abeam was supposed to establish the downwind leg, but was seldom exactly on station after one AD, a trifle low, took out the ship's masthead light.

The cut and wave-off were mandatory signals, and there were surprisingly few wave-offs and rare barrier engagements. If a pilot was a little high or fast, he might get an early cut. The difficult part was with a pitching deck when the LSO had to time the cut just right to match the movement of the ship's stern.
At the cut, the pilot pulled off the throttle (even jets), allowed the nose to drop slightly, and then flared to get a three-point attitude on touch-down. Until the cut, the pilot could only see the single row of centerline red lights. A guy in the catwalk turned on the white dust-pan lights at the cut. These gave some dim white light along the deck-edge to help with the flare, but these lights went out again on touch-down.

The dust-pan lights actually resembled a large inverted dustpan, which shielded the light except for the landing area. However, the pilot could never be sure about these lights. Sometimes they didn't come on for various reasons. One rainy night, water caused the circuit breaker to pop at the beginning of the recovery and nobody seemed to know where the electrical panel was located.

The fear in every night pilot after the cut was floating over the barrier and into the pack of parked aircraft on the bow – then the inevitable fire illuminating the deck as pilots and deck crew scramble amongst the jumble of damaged and burning aircraft to reach safety. As a result, some pilots dropped the nose too much and the hard landing usually broke something. Although these hard landings were seldom lethal, it took some time to clear the broken aircraft from the landing area. Meanwhile, the remaining aircraft in the landing pattern got the dreaded DOG signal and watched their fuel gages creep steadily towards zero.

The wave-off was always terrifying, especially in bad weather or no horizon. Full throttle, a little left-wing down and climb with the only illumination coming from the engine's exhaust. The AD was a wonderful airplane, but without visual references the engine torque on a wave-off could easily get the pilot into a steep turn. Using aileron to recover might then cause the left wing to stall. The pilot had to fly instruments, yet one eye always tried to get a reference point from the ship's island. Then it was flying upwind, trying to spot the lights of the last plane in the pattern and take interval without getting vertigo.

Many pilots have stated they would rather take the barrier than wave-off on a really dark night.

After landing, getting from the landing area to the parking area was an interesting event. First off, the AD-4 (and earlier versions) could not retract the tail-hook. On a daylight recover, the pilot would see two guys running out on deck with their "bats" to disengage the hook from the arresting wire and get it back into the release hook. At night, the pilot couldn't see these guys, but had to imagine what was going on behind him. Meanwhile, the pilot had to turn-off the plane's running lights (the switch was not then near the throttle), fold the wings, and raise the flaps.

Finally, the taxi director would give a come-ahead signal. The pilot knew he had to put on some power and get across the barrier so the next plane could land. Yet, in the darkness (no moon lights on ships in those days), the pilot could not accurately judge taxi speed. Anything faster than a turtle-crawl seemed too fast. Finally, the pilot could feel his airplane rumble over the barrier wires lying on deck and could start slowing down.

The next problem was parking next to another aircraft with less-than 6-inches of clearance. The pilot knew there was another aircraft out there, but the darkness and folded-wings precluded seeing how close. Finally, the taxi director gave the hold brakes signal (crossed wands) and the welcome cut engine signal. Then it became a race to get the aircraft secured and climb out of the cockpit before someone behind you in the landing pattern floated over the barrier. Tripping on tie-down cables and bumping into aircraft appendages was almost pleasurable as the pilot headed for the sanctuary of the Island and the comfort of the ready room. Sometimes the Flight Surgeon was waiting in the ready room with a tiny bottle of brandy – it was seldom enough.

The author flew Skyraiders in advanced flight training and received additional all-weather training at Key West flying the F6F-5N Hellcat. Then reported to VC-33 in July 1952, stationed at Atlantic City, N.J., where he flew 12 versions of the AD. He was designated a nuclear delivery pilot after night carrier qualifications aboard USS WASP. His first deployment was with the VAN detachment aboard the straight-deck USS MIDWAY in late 1952.

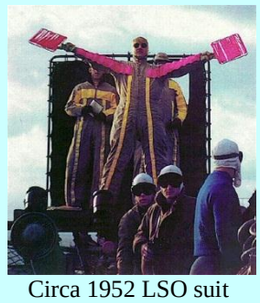
CALL THE BALL

By Scott Smith

Landing aboard an aircraft carrier takes intense concentration and the efforts of more than one person. Soon after the *USS LANGLEY* (CV-1) began landing aircraft, the Landing Signal Officer (LSO) came into being. Radios were undependable in those days, so a set of visual signals to the pilot was developed to assist the pilot in making a correct approach and landing. Without these signals the accident rate would probably have much higher than it was.

Over the years, many other safety procedures were put into practice, including a safety net to catch the LSO when he jumped to avoid a misguided wing-tip. Even today, one person uses binoculars to check each approaching aircraft for wheels and tail hook down, while another is looking up the deck, checking to see when the deck is clear for landing.


WW-II LSO, & home-made paddles


Circa 1952 LSO suit

Night flying operations began in earnest before WW-II. The LSO simply borrowed a pair of flight director wands to replace his paddles. By 1945, he wore a flight suit modified with high-visibility strips. These strips glowed under black (ultra-violet) light. Unfortunately, black light also destroyed the LSO's night vision. The solution was to stand close to the deck-mounted black light and wear a modified duckbill cap under the chin to shield the eyes. Sometimes the LSO forgot and moved out of the black light beam until only one arm and a leg was visible to the pilot.

The black-light system was the standard for many years, but it had serious limitations. Its visibility range was low, such that the LSO could only give two or three signals before the cut. When it rained, the glowing strips on the LSO's suit turned into an orange blob on the windscreen, permitting maybe one signal when the pilot could see past the windscreen with an open canopy. The net result was night qualified pilots received much more training until they could make a near perfect pass without LSO assistance.

In January 1953, the VC-4 LSO aboard *MIDWAY* used the ship's Christmas tree lights to make a lighted LSO suit. It worked beautifully! The only problem was the LSO's arms got tired. If he lowered his arms, pilots flying through the 90° position thought they were getting a low signal. The suit worked great until the first night it rained, when the LSO felt the early symptoms of electrocution.

The suit went in for immediate modification, replacing the 120-volt tree lights with 24-volt aircraft instrument lights. This modified suit worked equally well, but the first battery cable proved too short when the LSO took a dive into the net. The lighted LSO suits became standard issue, but someone thought they had a better idea.

In January 1954, aboard USS *LAKE CHAMPLAIN*, a civilian contractor had mounted an 8' x 8' panel in the port catwalk. The panel was covered with red and green recognition lights, the kind mounted in the lower fuselage of WW-II aircraft. The LSO had a joystick, and moving the joystick caused the green lights to simulate standard LSO signals. The bomb pickle gave the cut signal and the gun trigger turned on all the red lights for a wave off. At first glance, it was a good idea. The lights could be seen for miles, but the trouble came when the LSO tried to give "sweeten the approach" signals. For instance, LSOs often gave a quick "low dip" signal just before the cut – more a twitch of the wrist than a real signal. However, the panel gave a full-blown low signal and pilots invariably climbed like crazy.

After the first night, the pilots were unanimous in their bad feelings about the panel – it had to go. Talking to the contractor didn't seem to accomplish anything, so the pilots agreed that the first one in the groove on each recovery would force a low wave off. The panel was hinged and held vertical with hydraulic actuators. The wave off signal caused the panel to drop flush with the deck. It dropped with such force that the illuminated lights burned out – all red ones. It then took the contractor an hour or so to replace the light bulbs, only to have the lights burn out again on the next recovery. It took a while, but the contractor finally got the message.


Modern Fresnel lens system


Recent LSOs hard at work

During 1953, the *USS ANTIETAM* was steaming off the East Coast conducting landing operations with an experimental angle-deck. It was abundantly clear that something better than a pair of lighted paddles was necessary. Again a British idea became the solution despite its complexity. The stabilized mirror and its red meatball replaced the paddles, the lighted suit, and that obnoxious lighted panel. The grace and artistry of the LSO and his paddles will be missed, but "calling the ball" is the only way to go with an angle-deck carrier.

A VA-122 carqual cruise aboard *KEARSARGE* in September 1965 preserved on film the artistry of the LSO during day and night paddles landings. This footage was used in the made-for-TV movie, "THE ADMIRAL", about an admiral's son flying in Korea with lots of fake bullet holes in dark blue SPADs. The film crew sprayed blue paint over a dry soap film. Supposedly it would wash right off. It didn't and some of those birds went to overhaul with a streaked blue and gray finish.

FINDING THE BOAT BEFORE TACAN

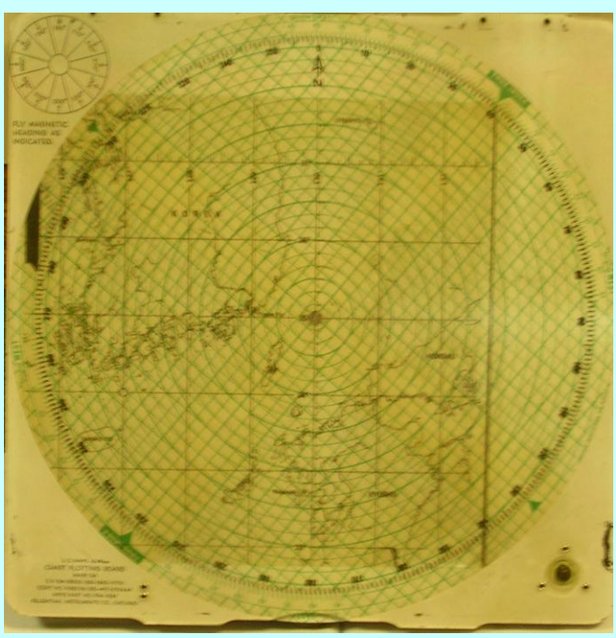
By Scott Smith

TACAN (Tactical Air Navigation) was introduced to the fleet about 1955. Up to that time, finding a moving carrier in the vast ocean required skill in using the few primitive tools available to the Navy pilots of the day.

> The plotting board was installed in early jet aircraft, but deleted in later jets. There are a number of reasons, one being the lack of cockpit space and another being the distance traversed while plotting a position. Besides, it is hard being suave while carrying a plotting board on a windy flight deck.

The primary tool that required considerable skill was the plotting board, a device that was lacking in accuracy and subject to innumerable errors. Of course, student aviators received considerable classroom training, but that is far different from real life situations. The classroom problem is well defined; takeoff from a carrier at a known position; fly a course and speed with a known wind; and return to the carrier that is exactly at its predicted location. In real life, the wind is seldom known; planes must circumvent cloud formations or fly at various altitudes; and the carrier is seldom at its predicted location some hours later. Furthermore, the enemy won't call a "time out" while a pilot updates his navigation.

The plotting board consisted of a clear-plastic compass-rose, backed with a circular disk pivoted in the center. The board was stowed under the instrument panel. In theory, the pilot could fly instruments while up-dating the plotting board, but it wasn't that easy. The plotting board restricted stick movement and flying instruments is a full-time job in most aircraft. At night, the plotting board was poorly illuminated. It became easier with an auto-pilot, but not for the wingman.



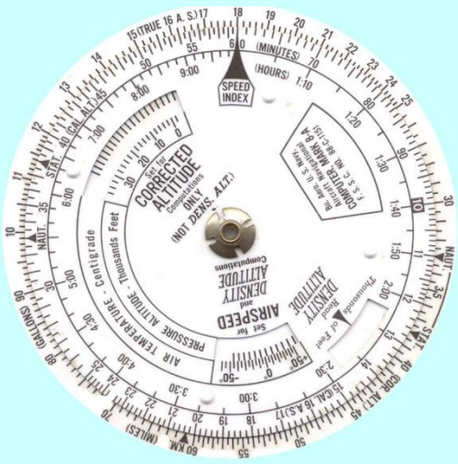
Plotting Board with a transparent chart of Korea and southern Japan

The plotting board was designed for early carrier search aircraft (i.e., SBD), flying sector searches 250 to 300 miles from the ship. If a search plane spotted something, the pilot had to know his position (latitude and longitude) when reporting back to the ship. It was used in the Battle of Midway to navigate to the last known position of the Japanese carriers – kind of a double-error problem.

> The ship could estimate the position of a search plane by knowing its search route and time since launch. This wasn't much help if the search plane was shadowing enemy ships while flying in and out of clouds.

The beauty of the plotting board was its simplicity – only one moving part. Any errors in navigation were induced by the pilot, but most errors still brought the pilot (in his plodding piston-engine aircraft) back to a position within visual range of the carrier. The board could be used for a geographic plot or a relative plot:

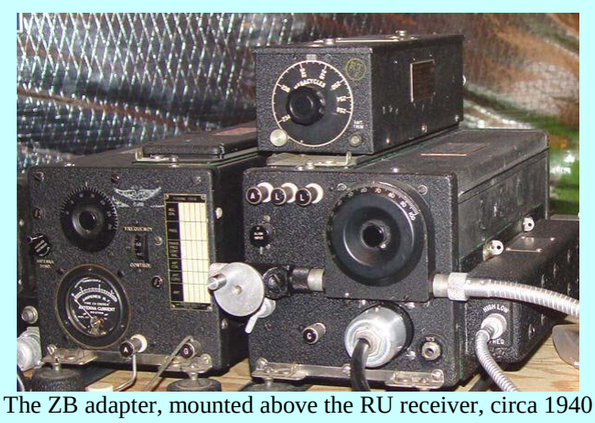
> The geographic plot used latitude and longitude, like a small-area plotting sheet. The pilot plotted the launch, target, and recovery positions. In flight, the pilot rotated the circular grid to determine course to target, corrected for variation and wind, while chugging along towards the target. Accuracy was always a problem because the width of a pencil-mark could be a mile or more.
>
> The relative plot assumed the ship was in the center of the board. The pilot plotted the various courses and distances flown after takeoff until it was time to return to the ship. A bearing from the last plot was the course to return. Although easier and quicker, this method couldn't provide a latitude and longitude position. This method worked well at night when the pilot couldn't turn up the lights bright enough to see latitude and longitude markings.



The plotting board came with a circular slide-rule, like above (25% full size), and formatted to solve time-distance calculations. It was also used to determine true airspeed, an essential calculation when flying at high altitude.

HAYRAKE

Long before 7 December 1941, the Navy recognized the problems with plotting board navigation, but it took a decade for technology to offer a viable solution. The idea was for a short-range homing receiver to help locate the carrier during the last 50-miles. The first such attempt was the ZB adapter, basically a UHF converter connected to the existing communications

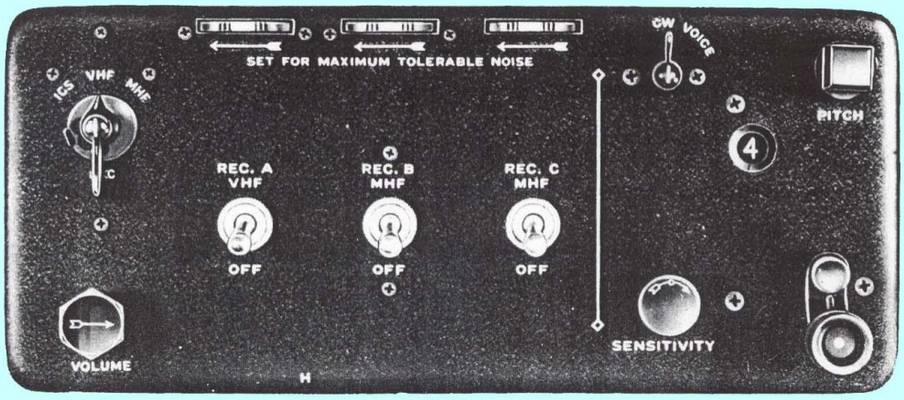


The ZB adapter, mounted above the RU receiver, circa 1940

> Of course the carriers could have used a LF homing beacon (low trout) and installed ADF equipment like the airlines were using. However, these beacon signals were detectable from considerable distance and even further at night. Clearly, that would make it too easy for a potential enemy.

This system became known as the YE/ZB receiver. YE stations were fixed stations located ashore. The ZB stations were installed aboard aircraft carriers. The transmitter used a double-modulated signal. The ship transmitted a line-of-sight UHF signal (234-258 MHz) carrying a LF signal (800-1000 KHz) that was tone modulated with Morse code letters. The UHF frequency was occasionally changed, but all the ships and shore stations in a region area used the same frequency.

> A UHF signal was used because it was line-of-sight (short range) and making a receiver for these frequencies was "challenging" with 1930 technology.

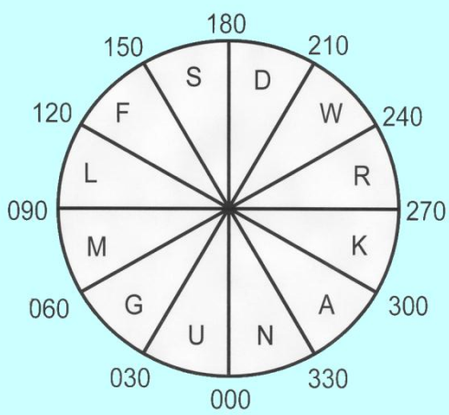


The ARC-5 control panel, with the ARR-2 receiver controls on the right, circa 1944

By 1942, carrier aircraft were using the ZBX, a separate receiver later called the ARR-1. This evolved into the ARR-2 by 1943, which had six channels for different ships in the same formation. The carrier's ZB transmitter was set to one of six different channels. All shore station YE transmitters used the same channel. During the Korean War, piston-engine aircraft were still equipped with the ARR-2A.

A holiday flag flown on VJ-day with ZB antenna at the masthead

The ship's ZB transmitter antenna was at the mast head and looked like a small radar antenna, but connected to a gyro repeater. The transmitter sequentially switched between sector letters as the antenna rotated. The YE equipment ashore was similar and usually located near or on the tower.



YE/ZB HOMER

This is the shore-based letter sequence. A blank pattern was located on one corner of the plotting board. The pilot printed the letters into the sectors prior to each flight.

The shore-based stations used the same system except the sectors were always assigned the same letters. Pilots recalled the letter sequence using the following ditty:

Did **W**illie **R**eally **K**ill **A** **N**asty **U**gly **G**erman **M**an **L**ast **F**riday or **S**aturday.

Operation of the system was simple. Turn on the receiver, select the ship's channel, and turn up the volume to full. Somewhere between 50 and 100-miles, depending on altitude, the pilot would hear a very weak Morse-Code signal. The signal should get louder if the aircraft was closing on the ship.

The sector letter determined the course to the ship. In the above example, if the pilot received the letter "A", he would steer a course of 315° to close the ship. While closing, the pilot might receive a letter from one of the adjacent sectors (N or K) and the pilot would make a small turn away to stay in the A-sector. Over the ship, the pilot would receive a whole bunch of different letters, finally settling on the letter "F" as the aircraft proceeded away from the ship, and the signal would then start getting weaker.

During WW-II, pilots were sometimes instructed to return using a specific sector. This was a nice idea, but combat damage often involved the radio and pilots didn't always have sufficient fuel to return via some indirect route.

Of course things don't always work according to plan. Aboard the straight-deck *MIDWAY* in 1953, pilots often heard a whole bunch of different letters while still closing the ship because the gyro-repeater couldn't keep up with the ship's rate-of-turn. Most often, the signal was so weak it was barely heard from 25-miles away. That wasn't much bother since most night pilots flew planes equipped with radar, which was used even in good visibility to find and make a carrier approach.

Apparently, the Japanese never developed a device to home on the Hayrack's UHF signal. They probably didn't need to, since they could easily follow one of our returning strike groups. Besides, the carriers only turned on the system when our aircraft were returning.

Finding the ship wasn't a pilot's only worry during WW-II. Friendly gun-crews relied on visual recognition, but some of those gunners wore glasses and seldom had time to clean them during GQ. At night, friendly aircraft relied on a set of colored recognition lights installed on the lower fuselage. The pilot turned on the appropriate recognition lights for the code-of-the-day and hoped the jittery gun crews weren't also color-blind.

The prayers of once lost carrier pilots were answered with the introduction of TACAN in 1955.

At about the same time, instrument training programs switched from the SNB to various tandem cockpit aircraft (TF-9J and T-28). The new generation of instrument instructors found devious ways of using TACAN, some of which required mental trigonometry solutions. Mathematically, it is possible to determine a course to fly directly from point A to point B located anywhere on the same TACAN station. Except most old-timers were still trying to understand the TACAN's To-From flag.

Now carrier aircraft have TACAN and Global Positioning System (GPS), yet pilots still get flight pay.

THE CARRIER READY ROOM

By Scott Smith

The carrier ready room has served the same purpose since the beginning of carrier aviation. The original intention was a briefing space for pilots preparing for launch, but it has become much more – a virtual living room and clubhouse for flight crews.

The original Essex-Class carrier ready rooms were on the 02-Level, immediately below the flight deck. Since the early carriers had wood flight decks, there wasn't much protection for the flight crews, so three ready rooms were moved to the second deck, immediately below the armored hangar deck. Modernized Essex-Class carriers had an escalator to carry the flight crews between the hangar deck and flight deck. Perhaps leaving the fighter pilots (in RR #1) exposed below the flight deck gave them more incentive to protect their carrier from attack.

Ready rooms were back on the 02-Level on Midway-Class carriers that had armored flight and hangar decks. In latter-day carriers, the ready rooms were on the 03-Level, but still just below the armored flight deck.

Typical Essex-Class carrier ready room, circa 1943-44, with original style chairs. Pilots are wearing wash-khaki uniforms and street shoes (or loafers), with WW-II style life vests and cloth helmets, and writing on cockpit plotting boards.

Tommy Booth, author of *Wildcats Over Casablanca,* stated; "The funny thing about a ready room is that you get attached to the hole. As much as you are attached to the ship. It's more than sentiment. It's an urge for protection. The loneliest feeling in the whole of a carrier pilot's world is when he's at sea with the gas running low, and he can't see his carrier. You think of the ready room then, and the noisy guys who make it the most desirable place in the world. It's your office, you live in it, it's a big thing in your life, […] You sweat and worry in it, and grouse and argue, and get mad at it when you can't hear yourself speak because everyone is yelling at once, but you're deeply attached to the place."

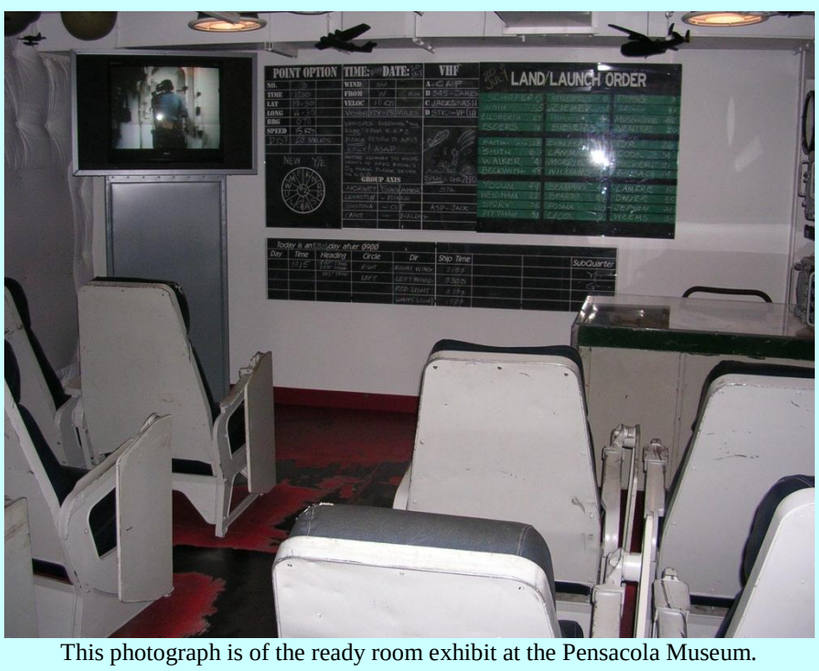
Typical VA-25 ready room aboard *RANGER*, circa 1970, larger and with new style chairs. Pilots are wearing Nomex flight suits and combat boots, but haven't yet donned G-suit and integral flight harness and life belt. Smoking was permitted in those days.

Some changes appeared in ready rooms of the first angled-deck carriers. A Pilot Landing Aid Television (PLAT) monitor was mounted in the overhead above the briefing board. The PLAT had a camera mounted flush on the flight deck centerline, allowing everyone in the ready room to watch each landing. Things got very quiet in the ready room when an aircraft strayed too far from the glide-slope cross-hairs. A manually operated video camera was also mounted in the Island structure to watch the catapult launch and movement of aircraft on flight deck.

Of course, these cameras were recorded on video tape for play-back after recover, if nothing more than bolster the LSO's long-list of derogatory comments about a particular approach.

The earlier straight deck carriers usually had a photographer in the island structure to capture still-photos of daytime accidents. Unfortunately, camera equipment was unable to capture night incidents, since flash-bulbs would have been destructive to night vision.

By the Vietnam War, most carriers were equipped with a closed-circuit television cable system. The PLAT system became one of the channels



This photograph is of the ready room exhibit at the Pensacola Museum.

The above photograph is illustrative, but not accurate in size and many details. For instance, the Teletype Machine screen has a TV set in-lieu of the real display screen and the seats are a recent vintage. WW-II versions were welded steel with wood tables, and were more easily battered. The briefing board on the wall is from the 1943-44 period. These boards were changed frequently over the years as briefing needs changed. The aircraft recognition models are (far L. to R.) the SO3C seaplane, the PBY seaplane, and the PBM seaplane.

THE TELETYPE MACHINE

In the early days, the Air Boss personally briefed the pilots, but this had to give way to mechanization as the carriers became larger and missions became more diverse. It is uncertain when the teletype machine first appeared in a ready-room, but the device was a combination of several technologies:

The automated typing machine was used by the stock market beginning in 1870. These early ticker-tape machines only printed upper-case letters and numbers on a narrow strip of paper about a half-inch wide. Western Union Telegraph used a similar machine, permitting the message strip to be glued to a standard message sheet with minimum effort. These ticker-tape machines were made famous by New York's "ticker-tape" parades. The ready room machines had the tape that came out the side, where it was torn off by the Squadron Duty Officer, and then copied to the Ready Room briefing board.

The teletype machine (TTY) came into use in 1910 and was used in 1914 by Associated Press wire service. About 200,000 of these machines were installed in every Navy Communication Station during WW-II, although radio operators still copied some message traffic on a standard typewriter.

Basically, these Read Only (RO) teletype machines are similar to an electric typewriter with a remote keyboard. Electric pulses were sent from the keyboard by wire or radio using what was known as Baudot code. These machines printed on 8"-wide continuous roll of paper. The ready room machines were identical, but printed on rolls of transparent cellophane.

The overhead projector is a device used in classrooms to display previous prepared graphics. As the teletype machine printed its upper-case characters on cellophane, the words appeared on the overhead projector screen, complete with misspellings and typos. The projector bulb even had a red lens for night operations.

These three devices were all combined inside the ready room Teletype Machine and turned on each day by the Squadron Duty Officer prior to briefing for the first flight of the day. These machines had to be serviced with regularity – replacing ticker-tape spools, cellophane rolls, type-writer ribbons, and projector bulbs. A door on the front of the machine provided service access.

The teletype printer and overhead projector were located at the bottom of the machine, with the projector focused on a mirror mounted on the back-side of the display screen. The ticker-tape printer was mounted in one corner of the machine so it spewed out the tape onto the ready room deck unless immediately intercepted by the duty officer. The whole machine was mounted in one corner of the ready room, usually opposite from the Squadron Duty Officer desk.

All the ready room machines were controlled from one keyboard in Air Operations. These machines were the largest and most prominent object in the ready-room, but most of its interior was empty space.

As the briefing process began, the machine would spring to life with a clatter of keys printing out information from Air Operations pertaining to the day's operations. Sometimes Air Ops printed other things, such as poems, jokes, and occasionally libelous comments about some friend of the Air Ops Officer. However, men with typing skills were in high demand during WW-II, and few good typists were assigned to Air Operations.

Air Operations had one very important source of information that it shared with the ready rooms. This was the Dead Reckoning Tracer (DRT), a device that was connected to the ship's gyro compass and underwater log through several gears and motors. If everything was working and adjusted correctly, the DRT bug moved under a light-table to shine a spot of light on a chart taped to the light-table – the ship's position. The DRT was handy, but could not predict where the ship might be heading in the near future. This highly dubious information came only from the Bridge. It was called the ship's Point of Intended Movement (PIM) or Point Option and could change without prior notice.

Not all briefing information came over the teletype machine. Some came by way the ready-room sound-powered phone talker (2JG) from Flight Deck Control, such as where planes were spotted on the flight deck. Other information came in printed form, usually related to security codes, code words of the day, frequencies, and the YE/ZB sector letters.

Other information came by way of the ready room squawk box, a standard intercom device that was built to withstand the rigors of war (i.e. very expensive). Operation was simple; select the station you want to talk with and press the Call switch. Unfortunately, the design failed to consider human nature. People failed to deselect the station when finished talking. The next person to call the ready room also talked to all the other selected stations. There was no expectation of privacy!

Most of the information coming over the Teletype Machine involved navigation information. The ship's projected launch position, of course, was critical. Also important was the ships Point of Intended Movement (PIM) or Point Option – where the ship hoped (and pilots prayed) to be for recovery.

The ready rooms also had a dial telephone and the ship was wired to an automated switchboard. The Essex and Midway-Class carriers had a three-digit rotary dial. Latter-day carriers had to expand to a four-digit system. This telephone system had an executive override feature. Certain telephones could cut into an on-going conversation instead of getting a busy signal. These phones were on the Bridge, the Quarterdeck, Prifly, Air Operations, and probably a few other places. The two people talking had no warning that a third person was on the line, unless of course, that third person said something – usually in a very loud voice.

The ready rooms were also exposed to the ship's announcing system. Of course, the 1MC circuit could be heard everywhere on the ship. Those speakers in the ready room were also connected to the 3MC circuit, which typically announced "Pilots man your planes." Sometimes, this call came instead by the intercom system, since not all ready rooms might be on the schedule for a particular launch.

ENTERTAINMENT

For years, shipboard entertainment consisted largely of 16mm films that were passed from ship to ship during each replenishment. The ship scheduled movies on the hangar deck and in the wardroom. Thus, officers could attend either of the two movie titles. At least the hangar deck was out of the rain, a feature not enjoyed by the crew aboard destroyers.

Eventually, the Navy acquired enough 16mm projectors so each ready room had one. However, there were only a limited number of Cinemascope lenses. There were lots of Cinemascope movies being produced in the 1960s and sometimes more Cinemascope movies arrived than lenses. Thus, sometimes a ready room had to watch a movie in what we called skinny scope. Some movies were more entertaining in skinny scope. Other times, watching PLAT reruns was more entertaining than watching the assigned movie and wild claims were made to swap movies with another ready room.

In the years immediately prior to the Vietnam War, carriers were busy installing a closed circuit TV system. This was basically a cable TV circuit that provided anyone with a TV set access to a few dozen channels, mostly with pre-recorded programming. Someone back in San Diego recorded network programs for viewing aboard ship a week later.

Now, it is all … different. Only the Knee-Knockers are the same.

The PROXIMITY FUSE

This brief history of the proximity fuse is digested from Captain Linwood S. Howeth's **History of Communications-Electronics in the United Sates Navy**, *published in 1963. This book chronicles the early decades of the 20th century and the numerous technical advancements that changed our daily lives and even the conduct of war. This entire volume is available on-line at* **http://earlyradiohistory.us/1963hw.htm**

During the early days of WW-II, Anti-Aircraft Artillery (AAA) on both sides used an adjustable time-delay fuse, set to detonate at the altitude flown by enemy bombers. The bursts of flack left puffy little clouds, but with an expanding ring of shell fragments radiating outward towards the bombers. However, the AAA gunners had to know details about the bomber's flight path to set the fuse timer before firing.

The Japanese added color to their bursts of flack to help gunners adjust lead and fuse settings properly.

Determining the proper setting was complex. It might take 10-20 seconds for the shell to reach the bomber's altitude; meanwhile the bomber was moving horizontally at about 500 feet per second. Not only must the gun be aimed so the shell intercepted the bomber's flight path, but the shell must explode near the aircraft's altitude. All the while, the diagonal bearing and distance from the gun-barrel to the aircraft was changing, as did the shell's ballistic trajectory. Fortunately for the flight crews, all these variables meant that the odds of one gun shooting down a bomber were small – it took lots of guns firing lots of shells to increase the odds, but there were also lots of bombers.

In the Pacific, the problem was even more complex because dive-bombers constantly changed heading, speed and altitude approaching the target, while the enemy ship (gun platform) was radically maneuvering. Our ships used analog computers to aim the guns and automatically set the time-delay fuses.

Early in the war, fire-control radar was added and accuracy improved, but so did aircraft tactics. Coordinated attacks resulted in a dozen dive-bombers and torpedo aircraft attacking a ship at the same time – splitting the available gunfire between them.

Long before Pearl Harbor, every major country recognized the problem and had people working on a solution.

In the United States, development began during the summer of 1940, shortly after the formation of the National Defense Research Committee (NRDC). By the spring of 1941, the radio-type fuse appeared to hold the most promise. The first proximity fuse was the Mk 32, designed for the Navy 5"/38 – the gun in common use aboard navy ships during that period. However, development was not easy!

Tests in early 1941 involved firing THOUSANDS of rounds vertically over a farmer's field with parachute recoveries to see which, if any, of the fragile electronic components survived. By April 1941, a complete oscillator circuit was test fired and its signal was detected throughout the flight. A complete fuse was test fired in 5"/38 projectiles at the Dahlgren Naval Proving Grounds in September 1941, but with many premature

failures. The Sylvania Company, a vacuum tube manufacturer, was brought in to reduce tube failures. By January 1942, tests gave slightly better than 50% success.

During these Dahlgren tests, the care-taker's dog ran into the river with each shot. It took several weeks before the dog realized these hunters were really bad shots.

In April 1942, tests were moved to Parris Island, N.C., firing at full-size aircraft targets suspended beneath a balloon to get the timing right. A satisfactory safety clock was also developed to prevent premature detonations before tests moved to sea.

In August 1942, test firings against remote-controlled drones were conducted from *USS CLEVELAND* (CL-55) which proved satisfactory, with two drones promptly shot down. Full-scale production was initiated by the Crosley Corporation.

Ironically, these early tests were conducted about 100 miles from where, 20 years earlier, General Billy Mitchell thought he had proven surface ships were obsolete and AAA fire would be ineffective against air power.

For security reasons, the proximity fuse was called the VT-fuse, meaning Variable Time-delay. Actually, the fuse was a miniature radar circuit that detonated the shell when it came within a lethal distance (about 70 yards) of an aircraft. However, the fuse operation and circuitry remained a closely guarded secret during the war. The early fuses were not allowed in Occupied Europe during 1944 for fear the Germans would find a dud and replicate the circuit.

The VT-fuse principle is still used in anti-aircraft missiles today, but the circuit is more complex because the WW-II fuse would have been easily defeated if anyone had tried electronic jamming.

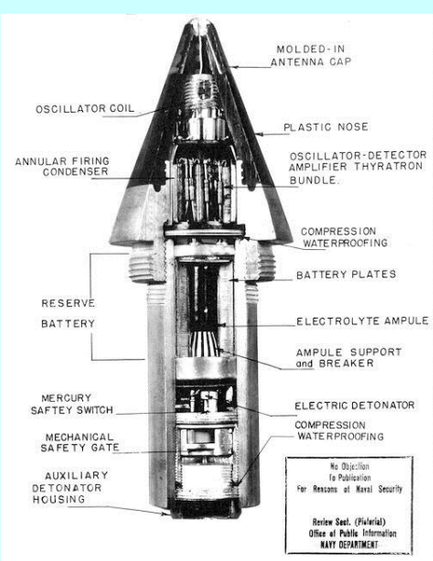
Some called the VT-Fuse a miracle weapon, but the miracle was not the idea, but its development during an age of glass vacuum tubes, thumb-size capacitors, and other components that must fit into a tiny fuse that could be held in the palm of your hand.

Indeed, early development focused on finding vacuum tubes that could survive the high accelerations as the artillery shell was blown out the barrel, spun by the rifling, exposed to high temperatures and super-sonic speeds, not to speak of rough handling by ground crews and exposure to salt-air and long idle periods during shipping and storage.

The first Mk-32 fuses were delivered to the fleet in November 1942. The first Japanese plane was shot down by the second salvo of VT-fused shells from *USS HELENA* (CL-50) on 5 January 1943. During 1943, about 25% of the total rounds fired had VT-fuses, yet 52% of the hits on enemy planes were credited to VT-fuses.

However, there were still problems. VT-fuse storage life was too short because batteries deteriorated while in storage under hot, tropical conditions. The early Mk-32 fuses also detonated prematurely when fired at low-angle trajectories against torpedo aircraft, because of reflections from the water.

Almost 2-million VT-fuses were delivered by the end of 1943, and deliveries increased to 40,000 per day. Each VT-fuse cost $742 in 1942, but per unit cost had decreased to $18 by 1945. By May 1944, improved Mk-32 fuses were delivered to the fleet. Production of the Mk-53 fuse, replacing the Mk-32, commenced in November 1944. Over 22-million fuses were purchased by the end of the war.



Also in May 1944, the Mk-45 fuse was delivered for use in the 3"/50 used on smaller ships, but was discontinued and replaced by the Mk-58 fuse in November 1944. VT-fuses for other allied weapons were produced during this period.

The first V-1 "Buzz Bomb" fell on London on 12 June 1944, and continued for the next 80-days. During that first week, only 24% of these flying-bombs were destroyed. More AAA guns were moved to the coastal areas and began using VT-fuses by the second week, while the rate steadily increased to 79% destroyed. Finally, the launch site was overrun by Allied troops.

VT-fuses were cleared for use in Europe in December 1944 during the Battle of the Bulge. VT-fuses were used in ordinary artillery shells against German ground units. The high-angle fire caused the shells to burst with devastating effectiveness above German soldiers in their foxholes.

Still, some enemy aircraft got through and caused horrific casualties! Remember *USS FRANKLIN* (CV-13) on 19 March 1945 and *USS BUNKER HILL* (CV-17) on 11 April 1945 – both hit by Japanese Kamikaze aircraft while operating off Okinawa. It could have been much worse without the VT-fuse!

Finally, the proximity fuse circuitry produced a more devastating air-burst with FAT MAN, the 21 kiloton atomic weapon used on Nagasaki.

JAPANESE AIRCRAFT CARRIERS

By Scott Smith

It is difficult to compare the World War Two American and Japanese carriers. One difference was the Japanese didn't use catapults, which reduced the number of aircraft their ships could operate. The Americans standardized new construction with the Essex and Independence Class carriers. The Japanese had over a dozen different class ships, each with different characteristics. However, the most significant difference was between the American and Japanese carrier training programs. The Japanese were clearly unprepared and unable to replace their 1942 flight crew losses. The Americans began expanding flight training programs even before the war started. After all, war or not, the new Essex Class carriers were under construction.

> For comparison, the original Essex-Class carriers were 27,100 tons, carrying 91 aircraft (late WW-II types) and could make almost 33 knots. The Independence-Class light carriers were cruiser-hull conversions of 11,000-tons that carried 33 aircraft and could make 32 knots. The Kaiser-built Casablanca-Class escort carriers were 10,902-tons that normally carried 27 aircraft and could make 19 knots. Of course the little CVE was more vulnerable than the highly compartmented CV and CVL.

In December 1941, the Japanese had six fleet-carriers, each with two or three hangar-decks (stacked). They also had four light-carriers and one escort-carrier:

HOSHO This 7,470-ton light-carrier was commissioned on 27 December 1922 as the first aircraft carrier designed and built from scratch. She could carry about 19 aircraft, could make 25 knots and was equipped with gyro-stabilization. She operated with scout-aircraft (biplanes) at Pearl Harbor and for the main body (battleships) during the Battle of Midway. She served as a training carrier during the latter part of the war. She was damaged by air strikes at Kure on July 1944, but survived the war and entered special transport service before being scrapped in 1947.

> After the war, special transport service ships were fitted with bunks on the hangar deck and sent to return by-passed Japanese troops home.

AKAGI This 36,500-ton fleet-carrier was commissioned on 25 March 1927, converted from a battle-cruiser. She carried about 91 aircraft and made 31 knots. One of Japan's largest carriers, her aircraft attacked Pearl Harbor and she was severely damaged on June 4, 1942 by *USS ENTERPRISE* aircraft during the Battle of Midway before being sunk the next morning by Japanese destroyers.

KAGA This 38,200-ton fleet-carrier was commissioned in 1928, converted from a battleship. She carried about 90 aircraft and made 28 knots. A sister ship to AKAGI, her aircraft attacked Pearl Harbor and she was set on fire and severally damaged on June 4, 1942 by *USS ENTERPRISE* aircraft during the Battle of Midway. In the afternoon, she was torpedoed by USS Nautilus, but the torpedo failed to detonate. In the early evening, she exploded and sank.

RYUJO (not RYUHO) This 10,600-ton light-carrier was commissioned in 1931. She carried about 38 aircraft and made 29 knots. Her aircraft participated in air strikes against the Philippines in December 1941 and she was part of the Northern Force that attacked Dutch Harbor during the Battle of Midway. She was sunk on August 24, 1942 at the Battle of the Eastern Solomons by *USS SARATOGA* aircraft.

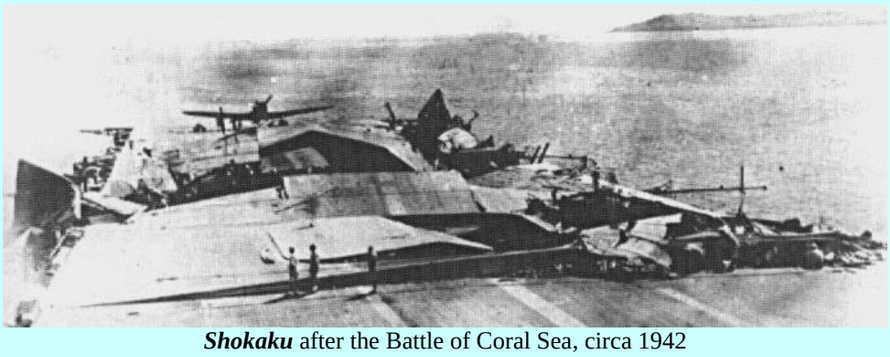
HIRYU This 20,250-ton fleet-carrier was commissioned in 1937. She carried about 71 aircraft and made 34 knots. She was a sister ship to SORYU, but had a port-side island structure. Her aircraft attacked Pearl Harbor and Wake Island in December 1941. She was set afire and severely damaged on June 4, 1942 during the Battle of Midway by American carrier aircraft. She was sunk the following morning by a torpedo from a Japanese destroyer.

SORYU This 18,800-ton fleet-carrier was commissioned in 1937. She carried about 71 aircraft and made 34 knots. She was a sister ship to HIRYU, but with a starboard-side island structure. Her aircraft attacked Pearl Harbor and Wake Island. She was sunk on June 4, 1942 during the Battle of Midway by *USS YORKTOWN* aircraft.

ZUIHO This 14,200-ton light-carrier was a converted sub-tender and commissioned on 27 Dec 1940. She carried about 30 aircraft and made 28 knots. She was damaged on 26 October 1942, during the Battle of Santa Cruz. She was attacked repeatedly and finally sunk on 25 October 1944 off Cape Engano (Battle of Leyte Gulf).

The lighthouse at Cape Engano is on Palaui Island, just north of Escarpada Point, Luzon Island. The Battle of Leyte Gulf involved four separate engagements: Sibuyan Sea, Surigao Strait, Samar, and Cape Engano. The first two were major surface ship engagements. Four Japanese carriers were sunk about 150-miles east of Cape Engano. The Battle of Samar is a breath-taking story of a few American escort-carriers (Taffy Three) against a major force of Japanese battleships and cruisers.

SHOKAKU This 25,675-ton fleet-carrier was commissioned on 8 August 1941. She carried about 84 aircraft and made 34 knots. She was the sister ship to ZYIKAKU and her aircraft attacked Pearl Harbor. She was severely damaged on 8 May 1942, during the Battle of Coral Sea, requiring a 50-day repair period. She was damaged again on 26 October 1942, during the Battle of Santa Cruz, requiring a 144-day repair period. She was finally sunk by the submarine *USS Cavalla* on 19 June 1944.



Shokaku after the Battle of Coral Sea, circa 1942

TAIYO (not TAIHO) This 20,000-ton escort-carrier was converted from an ocean liner and commissioned on 2 Sept 1941. She could carry about 27 aircraft and made 21 knots. She normally served as an aircraft ferry to Japan's far-flung island bases. She was damaged by *USS Trout* on 28 September 1942, by *USS Tunny* on 9 April 1943, and by *USS Cabrilla* on 24 September 1943. She was finally sunk on 18 August 1944 by *USS Rasher* off Cape Bolinao, Luzon.

Cape Bolinao is the headland northwest of the beaches of Lingayen Gulf, on Luzon Island, where the Japanese landed in 1942 and the American forces went ashore in 1945.

ZYIKAKU This 25,675-ton fleet-carrier was commissioned on 25 Sept 1941. She carried about 84 aircraft and made 34 knots. She was the sister ship to SHOKAKU and her aircraft attacked Pearl Harbor. Although undamaged on 8 May 1942, at the Battle of Coral Sea, she lost most of her Air Group. She was slightly damaged on 20 June 1944 by American carrier aircraft, but was able to return to Japan. She was sunk by seven torpedoes and nine bombs on 25 October, 1944, during the Battle of Cape Engano (Battle of Leyte Gulf), by American carrier aircraft.

SHOHO This 11,262 light-carrier was a converted sub-tender and commissioned on 30 Nov 1941. She carried about 30 aircraft and made 30 knots. She was sunk during the Battle of Coral Sea on 7 May 1942 by American carrier aircraft.

Japan lost four fleet-carriers and one light-carrier during the first half of 1942. Of the six survivors, two were fleet-carriers (SHOKAKU and ZYIKOKU) and three were light carriers (RYUJO, ZUIHO, and HOSHO). The HOSHO and escort-carrier TAIYO were not much of a threat. The Japanese also commissioned the following ships after Pearl Harbor:

JUNYO (also DYUNYO) This 24,500-ton fleet-carrier was an ocean liner conversion and commissioned on 3 May 1942. A sister ship to HIYO, she carried about 53 aircraft and made 25 knots. She was part of the Northern Force that attacked Dutch Harbor on 3 June 1942, during the Battle of Midway. She was damaged on 5 November 1943 by *USS Halibut* in the Bungo Strait, but managed to get back to Kure for repairs. She was hit by two bombs on 20 June 1944, during the Battle of the Marinas, but returned to Japan for repairs. She was hit by three torpedoes from an American submarine wolf pack on 9 December 1944, but she made Sasebo still listing to starboard. Repairs were never completed due to lack of materials. JUNYO survived the war, but judged too expensive to repair and was ordered scrapped on 8 October 1945.

The Bungo Strait is the southeastern entrance to Japan's Inland Sea, between Shikoku and Kyushu Islands. The wolf pack consisted of *USS Sea Devil*, *Plaice*, and *Redfish*.

UNYO This 20,000-ton TAIYO-Class escort carrier was a cargo-ship conversion and commissioned on 25 November 1942. She carried about 27 aircraft and made 21 knots. She normally ferried aircraft to Japan's far-flung island bases. She was torpedoed on 19 January 1944 by *USS HADDACK*, but managed to limp into Saipan for repairs. She was torpedoed again and sunk on 17 September 1944 by *USS BARB*.

HIYO This 26,949-ton fleet-carrier was an ocean liner conversion and commissioned on 31 July 1942. She was a sister ship to JUNYO and carried about 53 aircraft, but made only 21 knots. She was damaged by *USS Trigger* on 10 June 1943. She was finally sunk on 20 June 1944, during the Battle of Marianas, by a single torpedo launched by *USS BELLEAU WOOD* pilot **Ltjg George Brown**, who died in the attack.

CHUYO This 20,000-ton TAIYO-Class ship was a cargo-ship conversion and commissioned on 25 Nov 1942. She carried about 27 aircraft and made 21 knots. She normally ferried aircraft to Japan's far-flung island bases. She was sunk on 4 December 1943 by *USS Sailfish*. The CHUYO carried 20 American POWs on this voyage, but only one survived.

RYUHO (not RYUJO) This 13,360-ton fleet-carrier was a conversion and commissioned on 30 November 1942. She carried about 31 aircraft and made 25.6 knots. She was slightly damaged on 18 April 1942, while being converted in Yokosuka by Lt McEroy's #13 B-25 of Doolittle's raiders from *USS HORNET*. She was slightly damaged on 13 December 1942 by a torpedo from *USS DRUM*. Her first combat mission was on 19 June 1944, with air strikes against the American TF 58. She was slightly damaged the following day by aircraft from *USS ENTERPRISE* and severely damaged on 19 March 1945 off Yoshiro Point (Kure Bay) by American carrier aircraft. She was judged inoperable after the last attack.

By the end of 1942, these six conversions gave the Japanese a numerical advantage of nine carriers against SARATOGA and ENTERPRISE (the *USS RANGER* operated in the Atlantic). However, the Japanese had lost most of their experienced aviators at Coral Sea, Midway, and Santa Cruz. The Japanese aviator training program could not produce sufficient trained flight crews to use this advantage. It was too late for the Japanese by the end of 1943.

The following Japanese ships were commissioned later in the war:

CHITOSE This 11,190-ton light-carrier was a conversion and commissioned on 14 April 1943. A sister ship to CHIYODO, she carried about 30 aircraft and made 29 knots. She was sunk on 25 October 1944 off Cape Engano (Battle of Leyte Gulf) by American carrier aircraft.

SHINYO This 17,500-ton escort-carrier was a conversion and commissioned on 1 Nov 1943. She carried about 27 aircraft and made 21 knots. She was normally assigned convoy escort duty. She was sunk on 17 November 1944 by *USS Spadefish* during a night attack on a convoy near Shanghai.

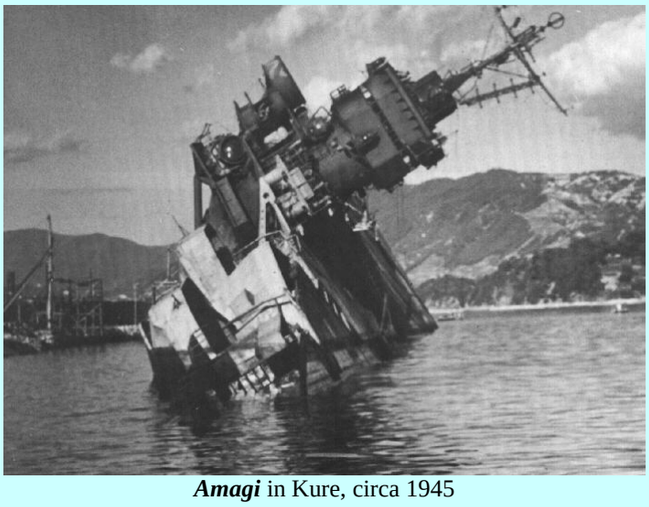
CHIYODO This 11,190-ton light-carrier was a conversion and commissioned on 21 Dec 1943. A sister ship to CHITOSE, she carried about 30 aircraft and made 29 knots. She was struck by a bomb on 20 June 1944, but made port in Japan for repairs. Crippled by bombs on 25 October 1944, she was sunk by naval gunfire from American cruisers and destroyers off Cape Engano (Battle of Leyte Gulf).

TAIHO (not TAIYO) This 29,300-ton fleet-carrier was new construction and commissioned on 7 Mar 1944. She carried about 60 aircraft and made 33 knots. She was sunk by *USS Albacore* on July 19, 1944, during Battle of the Marianas.

UNRYU This 17,150-ton fleet-carrier, similar to HIRYU Class, was new construction and commissioned on 6 Aug 1944. She carried about 65 aircraft and made 34 knots. She was sunk on 19 December 1944 by *USS Redfish* while transporting 30 Ohka suicide rockets to Manila.

The poor state of Japanese aviator training is apparent when *UNRYU* was used as a transport and her two sister ships were laid up in camouflage. Three other Unryu-Class fleet carriers were under construction at the end of the war.

AMAGI This 17,150-ton UNRYU-Class fleet carrier was commissioned in August 1944. She was designed to carry about 65 aircraft and made 34 knots. She was attacked by American aircraft on 19 March 1945, while in Kure, but with only minor damage. By 13 April she was moved to semi-permanent camouflaged mooring off Mitsuko-Jima, about 5-miles from Kure. She was heavily damaged from bombing on 24 July 1945 and then bombed again on 28 July before capsizing on 29 July.



Amagi in Kure, circa 1945

KATSURAGI This 17,150-ton UNRYU-Class fleet-carrier was commissioned on 15 Oct 1944. She was designed to carry about 65 aircraft and made 34 knots. She was slightly damaged in an air attack on 19 March 1945. By 25 March 1945, she was moved to semi-permanent camouflaged mooring off Mitsuko-Jima, about 5-miles from Kure. She was slightly damaged from aerial bombing on 24 July 1945 and bombed again on 28 July. Although severely damaged she was still seaworthy. She was converted for special transport duty after the war and departed on 18 December 1945 to return Japanese troops home.

SHINANO This 64,800-ton battleship conversion was commissioned on 19 November 1944. She was designed to carry about 50 aircraft and made 27 knots. This huge carrier started out as a Yamato-Class battleship and would have been the largest carrier in the world at the time. The Japanese knew she had been photographed by a B-29 on 1 November. Thus, she prematurely departed Yokosuka for Kure on 28 November. She was sunk by *USS Archerfish* the following day while steaming due south of Nagoya, about half-way to her destination.

> ***Shinano*** was still missing many internal hatches and lacked water-tight integrity. Even if completed, it is doubtful the Japanese Navy had enough pilots, aircraft or fuel to pose much of a threat to the United States Navy of 1945.

Of all the Japanese carriers only three (HOSHO, KATSUAGI, and JUNYO) survived the war. HOSHO and KATSURAGI served as troop transports during the months following Japan's surrender.

In contrast, the United States Navy had 16 Essex and Independence Class carriers operating off the coast of Japan at the end of the war. All of them full of fight and with more such ships and crews on the way.

The following Japanese ships have limited historical records:

KAIYO This 13,600-ton light-carrier was a conversion and commissioned 23 November 1943. She carried about 24 aircraft, but made only 23 knots. She was damaged on 14 July 1945 by British carrier aircraft. She made it back to Japan, but was too seriously damaged and ordered scrapped at the end of the war.

AKITSU Maru This 11,800-ton Army transport was a conversion and entered service on 30 January 1942. She carried about 20 aircraft and made 20 knots. She was torpedoed and sunk on 12 January 1944 by *USS HAKE*.

NIGICU Maru This 11,980-ton Army transport was a conversion and entered service in March 1943. She carried about 20 aircraft and made 20 knots. She was torpedoed and sunk in November 1944 by *USS QUEENFISH*.

SHIMANANE This 11,800-ton tanker conversion and entered service on 28 February 1945, but never became operational. She was to carry about 12 aircraft and make 18.5 knots. She was sunk at Takamatsu, Skikoku Island on 24 July 1945 by American carrier aircraft.

YAMASHIRO This 15,864-ton tanker conversion entered service 27 December 1944, but never became operational. She was to carry about 8 aircraft and make 15 knots. She was sunk on 17 February 1945 while still in Yokosuka Harbor.

IBUKI This light-carrier was a cruiser-hull conversion, under construction and never completed. She was to carry about 27 aircraft and make 29 knots.

In addition, there were three unnamed cargo/tanker conversions to escort-carriers that were never completed.

There is an important lesson here! Ships, without trained crews, do not make a Navy.

Back to Home Page