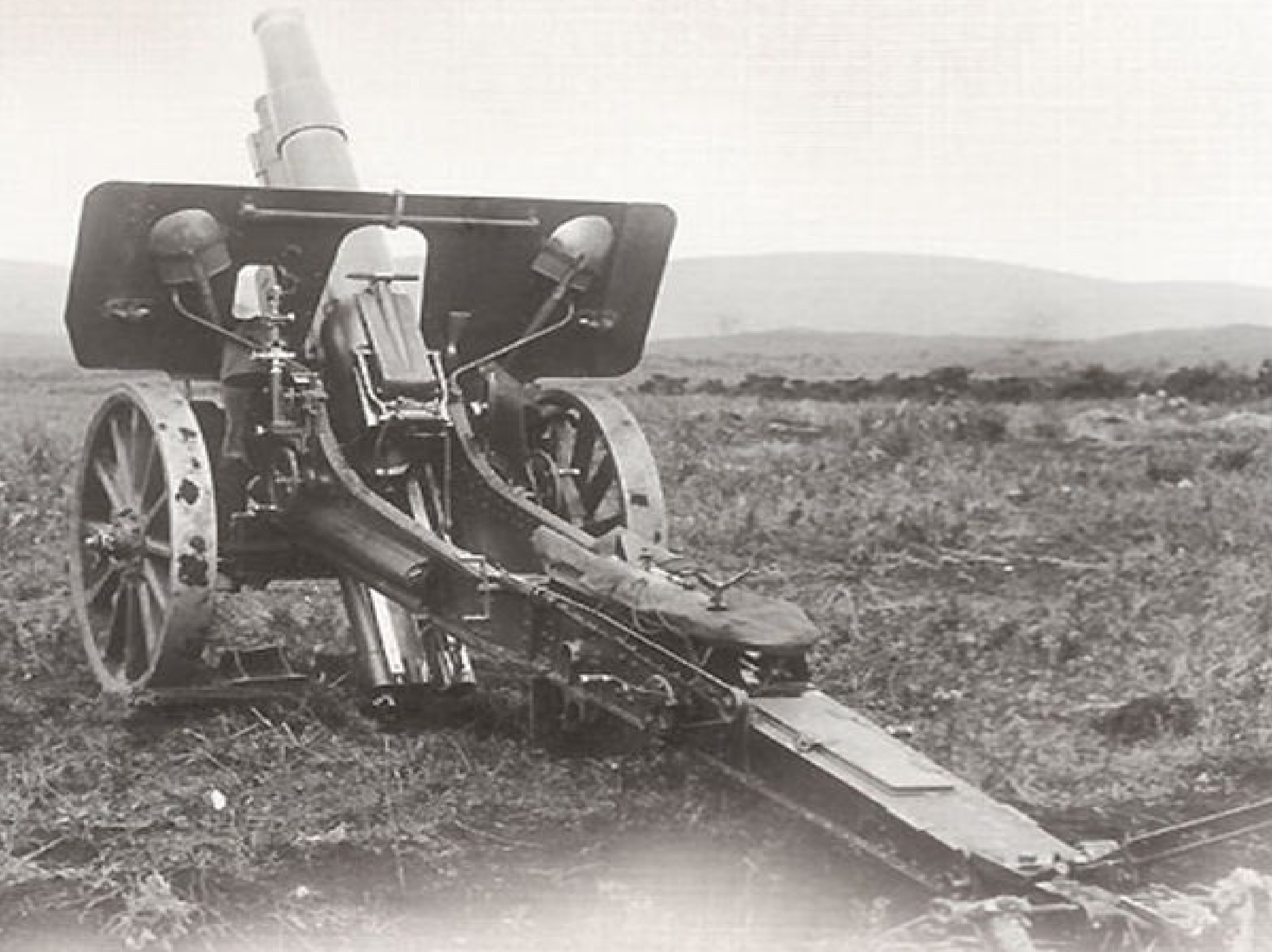
LELAND NESS



# RIKUGUN

## GUIDE TO JAPANESE GROUND FORCES 1937–1945

### VOLUME 2: WEAPONS OF THE IMPERIAL JAPANESE ARMY & NAVY GROUND FORCES

*Rikugun: Guide to Japanese Ground Forces 1937-1945* is the first nuts-and-bolts handbook to utilize both the voluminous raw Allied intelligence documents and post-war Japanese documentation as primary sources. This second volume covers the armament of the ground forces. It takes advantage not only of post-war Japanese research, but also the extensive technical intelligence efforts of the Allies near the end of the war, and the post-war investigations that have heretofore generally been ignored to provide a complete examination of wartime Japanese armament. The book is divided into twenty-three sections covering all categories including not only the standard arms, such as machine guns and coast artillery, but also more esoteric items such as bridging, chemical weapons and assault equipment. Each section provides both production and technical data, as well as a discussion of the unique characteristics of each weapon and its place in the force structure, accompanied by over 300 photographs and numerous data tables.

Leland Ness has been conducting and supervising defense analysis and writing military history for over forty years. He served as director of special projects at DMS/Jane's, published a newsletter on ground ordnance for the defense industry, and has been an editor at Jane's for the last ten years (for *Jane's Ammunition Handbook* and *Jane's Infantry Weapons*). He is also the co-author of the classic *Red Army Handbook*, and the author of the HarperCollins *WWII Tanks and Combat Vehicles*. He has been particularly interested in Asian military history since graduating with a degree in Oriental Studies and Language. During twenty-eight years in the Army Reserve, he served with Headquarters, US Army Intelligence Agency on active duty during Desert Storm.

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## GUIDE TO JAPANESE GROUND FORCES 1937–1945

## Volume 2 Weapons of the Imperial Japanese Army & Navy Ground Forces

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Front cover: A 15cm Type 4 howitzer of the 10th Medium Artillery Regiment awaiting its crew for practice in 1936. Rear cover: A pair of Type 97s being used by SNLF sailors on the China coast near Shantou, July 1939. Note the counterpoise projecting horizontally from the lower radio.

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A Type 2 Mod 1 director.

A latecomer, but by far the most numerous of the AA directors, the Type 2 Model 3.

A 3-meter rangefinder on drill in Tokyo early in the war.

An Army 2-meter heightfinder. It weighed 210 kg and was operated by a crew of four. The 3-meter heightfinder was similar but weighed 41 kg more. Both could be operated as simple rangefinders or, by throwing a lever, introduce cams that accounted for angle of elevation to yield height.

The massive 12cm Type 3 was the best of the Army's heavy AA guns.

A naval crew firing their 8cm 40-cal AA gun from a wet pit in Central China.

A 12cm Type 10 showing the easily-fabricated “spider base” before covering with earth.

The US personnel inspecting a 12cm Type (Taisho) 10 in Korea shows the size of this large, manually-operated weapon.

The size and complexity of the 4.5-meter heightfinder used with the Navy's heavy AA guns can be seen with this example, captured on Saipan.

A twin 12.7cm Type 89 outside Yokosuka.

A Navy Type 2 director manufactured in September 1944 by the Aichi Watch Co, at Kure Navy Base where it controlled a 100mm Type 98 battery.

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Two views of a Type 93 generator/searchlight truck. Note the winch at the front of the cargo bed for loading and unloading the light, with the generator directly below.

Type 93 searchlight control unit.

An Army Type B Fixed Detector (Tachi-6) on Noemfoor Island; on the left the transmitting antenna set in a tree, on the right a receiver antenna.

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A Navy Type 2 Mark 1 Model 1 air warning radar near Nagasaki.

A Type B transportable (Tachi-18) radar antenna.

Two views of A Navy Type 2 Mark 1 Model 2 radar on Moen Island in Truk, the right photo showing the interior of the control cabin.

A Model 13 Navy radar on Moen in the Truk group.

A Tachi-31 radar of the 119th AA Regiment in Niigata prefecture on Honshu.

A Type 90 Small Sound Locator being demonstrated shortly after surrender. Note the plotting table at the top of the tripod.

Type 1 Mobile 150cm searchlight.

A Type 93 searchlight with the shutters removed.

The comparator for the Type 1 searchlight in mobile configurion (above) and static (right).

Two views of a Tachi-2 searchlight control radar. Normally the Tachi-1 and Tachi-2 units were fixed, although in a few cases, such as here, they were mounted on trailers for mobility.

The Tachi-3 receiver. Above, the antenna, right the control unit with stations for three crew.

Two views of the antenna of the Tachi-4.

An L2 (Mark 4 Model 3 Modification 1) searchlight receiver antenna mounted directly on the light, near Nagasaki.

A Tachi-31 fire control radar unit at the AA School.

A Mark 4 Model 2 (S-24) gun fire control radar near Sasebo.

Among the antiques still in service during the war was this, one of two 15cm St Chamond turrets on the Futtsu Peninsula in Tokyo Bay. With its limited elevation it threw its 45 kg shell only to 10 km.

Large numbers of the ancient 280mm coastal mortars remained intact, such as this one on the Ogasawaras, but few were manned.

A Type 89 depression base rangefinder.

15cm Type (Meiji) 45 guns being emplaced (left) and fired (below) pre-war.

Elements of the Type 88 fire control system. On the left the electro-mechanical computer, on the right the rangefinder periscope.

A 10cm Type 92 gun in a concrete shelter in the homeland.

An Armstrong-made 8cm L/40 coastal gun captured at Lae. The sight mechanism is on the ground to the right. For uncertain reasons it was identified as a Japanese-made gun in some US Army publications.

A 12cm Armstrong or Type 41 coastal gun south of Tawui Point at Rabaul.

A captured 12cm Type (Taisho) 3 gun being fired by US troops in the Admiralties. Note the semi-fixed ammunition.

A British-built 15cm L/40 with cruiser-type shield at Kiska.

Above, a 15cm gun in a simple cave on Moen in the Truk group; right, a 15cm gun with broadsides shield behind a concrete embrasure guarding Shubishu Bay in the homeland.

As the lines grew closer to the homeland, and the terrain more rugged, the coast defense guns were more elaborately protected. Here a 15cm naval gun on Kikaiga Shima.

A shielded 14cm gun on Tarawa.

A captured 14cm gun being used by US Marines on New Georgia.

A 20cm battery on Tarawa after the battle; below, a 20cm gun at Pigeon Point on Wake.

Near the end of the war, some of the 10cm Model 2-2 surface fire control radars intended for surface vessels were diverted to shore use in the homeland. Few were so mounted, however, and the lobe-switching used shipboard for fire control was usually not incorporated on the land-based models, leaving them suitable only for surveillance. Here, the exterior and interior of one such unit.

A 76mm Armstrong coastal gun on Tarawa. Note the recoil mechanism below the barrel that differs slightly from another Armstrong original shown earlier.

7cm Army Type (Taisho) 11 Gun.

10cm Army Type (Taisho) 7 Gun.

A 12cm gun, probably an L/40, at the Vickers work in 1907. (Dock Museum 6683)

12cm Navy Type (Taisho) 11.

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A 15cm Type (Meiji) 45 in full recoil during pre-war maneuvers.

An unshielded 14cm Type (Taisho) 3 near Piti Point on Guam. The gun pit has been partially filled in.

15cm Army Type (Taisho) 7 Gun.

An Armstrong 15cm L/40 gun with cruiser-type shield on demonstration in Britain. Note the low pedestal mount that limited elevation and the recoil cylinders below the barrel. (Credit: David Perkins)

A 15cm gun destined for Japan at the Vickers works. Once again the low mounting limited elevation.

A 6” (15cm) L/50 gun at Vickers awaiting installation into the IJN Kongo in 1912. Note the range disk on the left side. (Dock Museum 7195)

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The twin-mount 15.5cm at Yokosuka.

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Camouflage being removed from a 30cm turret on Tsushima.

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GIs examine a Type 97 pole-planting vehicle (top) and wire-laying vehicle (right) in Japan post-war.

The 8-ton Type 95 crane vehicle.

A Type 95 light tank after the battle on Tinian.

The Type 3 gun tank was an effort to provide effective anti-tank firepower to the tank force.

A Type 1 Ho-Ki armored personnel carrier of the 3rd Tank Division in China with side doors open.

A unique, and widely-used vehicle, was the Type 91 armored rail car, produced to protect the long rail lines in Manchuria and, later, China. Here, two are coupled back-to-back for quick maneuver in either direction.

Serving well past its prime – A Type 97 medium tank and its 57mm HE ammunition captured on Iwo Jima in 1945.

A Type 93 armored car.

Tankette, Type 94.

A Type 92 combat car with light machine guns in both positions.

US GI's with a Type 100 in September 1945.

Tankette, Type 97.

Type 95 Light Tank.

A Type 89 parading through Manila in 1942.

A Type 97 Shinhoto Chi-Ha abandoned on Luzon 1945.

An Allied soldier in a Type 97 Chi-Ha tank.

A Type 2 amphibious tank being inspected by a GI on Leyte. The pontoons have been dropped, but the air extension over the engine deck remains in place.

Type 3 Chi-Nu Medium Tank.

The Type 1 SP with 75mm gun.

Type 4 Self-Propelled Howitzer.

Type 4 Self-Propelled Mortar.

A Type 2 Ho-I gun tank.

Type 1 Ho-Ki Armored Personnel Carrier.

Type 1 Ho-Ha Armored Personnel Carrier.

Armored Rail Cars.

Type 4 Amphibious Carrier.

SNLF troops in the battle for Shanghai in 1937 with their Navy Type 97 Model 2 gas masks.

The Type 94 Small smoke candle was small enough to be carried by individual soldiers without encumbrance.

The Type 94 Large smoke candle, which would be called a smoke pot in most western armies.

A frangible smoke grenade A and its carrying box.

A Type 99 self-projecting smoke candle with the spike extended.

A small red candle with the top cover removed.

A 13-kg large red candle.

Type 98 red SP candle.

The 90mm Type 95 red shell with its large burster charge.

The prussic acid frangible grenade and its carrying can.

A cutaway 105mm yellow chemical shell. Note the burster charge tube extending part way down into the body.

A Type 97 decontamination trailer with top removed.

Front and rear shots of the Type 99 gas mask.

A protective cape offered limited protection against aerial spraying.

An Army decontamination suit and gas mask.

A Navy Type 97 gas mask with the diaphragm over the nose, characteristic of all Navy masks, and the supplemental diaphragm to its side.

A Type 97 collective protection chemical filter with manual power.

The detector kit 95A fit into a metal box 21x15x6 cm.

A Type 3 ceramic mine, buried, showing just the fuze, and uncovered.

Sectioned view of a Type 93 mine.

A Type 3 ceramic mine.

The Bar Mine, known to the Allies as the Yardstick Mine; below, disassembled.

A Navy Type 1 beach mine with its single horn removed and laying to the side.

Much more common was the Navy Type 2, with its twin detonator horns.

Artillery projectiles were often converted into mines, usually buried nose-up with pressure plates above. Here, one has been converted by replacing the normal fuze with a pull-type fuze from a pottery mine.

A GI demonstrates the prone coil of the Type 100, although kneeling rather than in the proper position for moving under fire. Note the power pack and control box on his back.

A Type 2 mine detector being operated standing up.

A Type 91 medium pneumatic boat.

A Type 97 floating footbridge.

It looks like these soldiers in China ran out of Type 97 material about halfway from the far bank and, like soldiers everywhere, improvised.

The Type 95 folding boat was the standard river crossing device. GIs unfold one in the top photo, the bottom shows one folded and one ready for use.

A Type B floating bridge in service in China. Note the cables from the bows of the pontoons to the shore to hold them against the current.

The Type B pontoons could, of course, be used for rafts as well as bridges. Here, a pair of Type B pontoons ferrying horses pre-war.

An end section of a Type B pontoon.

A Type 99 raft being assembled, showing the bow section and the three side-by-side mid sections of the pontoon, along with part of the decking.

The Type 100 floating bridge.

A complete Type 98 footbridge, with two end sections and a mid section, being demonstrated by US technicians.

Most dry (non-floating) bridges in the forward areas were built the old-fashioned way, largely without power tools and using local materials.

The results, however, as here in Burma, were usually sufficient for the needs of the relatively lightly-equipped Army.

A Type 86 Mark 5 of the 2nd Medium Artillery Regiment in 1936. Some of these probably remained in service for the start of the war with China.

The Type 94 Mark 6 radio, transceiver on the left and hand generator on the right.

A No.66B radio set.

A US Marine demonstrates the chest-carried Type 96 Mark 7 line-of-sight radio.

The Navy's Type 97 radio. Top (left) – front view of the transceiver; above – the transceiver and generator.

A pair of Type 97s being used by SNLF sailors on the China coast near Shantou, July 1939. Note the counterpoise projecting horizontally from the lower radio.

Type 95 Mark 5 radio. Right – complete set with receiver on left, transmitter in middle and generator on right; below – receiver unit.

The Navy's TM Handy transceiver. Note the morse key fixed to the right side of the pull-down cover that doubled as a writing surface.

A complete Type 94 Mark 3A radio.

HQs above division were provided with the Type 94 Mark 2A radio, a voice/CW set that included a gasoline generator.

The Type 92 telephone with carrier bag.

Wire teams, as this one on maneuvers, were provided not only with reels and chest harnesses for easy unwinding and recovery, but also special forked-tip poles to hang the wires overhead. One soldier here also packs semaphore flags.

A lineman of the 2nd Medium Artillery Regiment reels in medium wire on pre-war maneuvers.

The Type 93 switchboard was not only much lighter and more compact than its US counterpart, but using switches rather than wires to connect phones made it much more suitable for compact spaces, such as foxholes. In fact, technical intelligence of the Burma-India Theater actually recommended American units replace their switchboards with Type 93s if they captured any.

The Type 92 sound-powered.

A 20-line switchboard set up.

A regimental commander checking on training on the Type 92 heliograph.

The receiver portion of a photophone, showing the headphones, amplifier and receiving mirror.

# List of Tables

# List of Acronyms and Abbreviations

| | |
|---|---|
| AA | Anti-Aircraft |
| AP | Armor Piercing |
| Art | Artillery |
| AT | Anti-Tank |
| Att | Attached |
| Bde | Brigade |
| BG | Border Garrison |
| Bty | Battery |
| Cav | Cavalry |
| CD | Coast Defense |
| Co Off | Company Grade Officer |
| DP | Dual Purpose |
| EU | Expeditionary Unit |
| FIU | Fortress Infantry Unit |
| Fld Off | Field Grade Officer |
| GL | Grenade Launcher |
| HE | High Explosive |
| HQ | Headquarters |
| Hvy Art Bn | Heavy Artillery Battalion |
| IGC | Independent Garrison Command |
| IGdU | Independent Guard Unit |
| IGU | Independent Garrison Unit |
| IMB | Independent Mixed Brigade |
| IMR | Independent Mixed Regiment |
| Ind Garr Inf Bn | Independent Garrison Infantry Battalion |
| Ind Inf Bn | Independent Infantry Battalion |
| Inf | Infantry |
| LMG | Light Machine Gun |
| LoC | Line of Communications |
| MG | Machine Gun |
| MSG | Master Sergeant |
| Mtn | Mountain |
| n/a | not available |
| NCO | Non-Commissioned Officer |
| Off | Officer |
| PVT | Private |
| Recon | Reconaissance |
| Regt | Regiment |
| SGT | Sergeant |
| SMG | Submachine Gun |
| SNLF | Special Naval Landing Force |
| SP | Self-Propelled |
| SSD | South Seas Detachment |
| TO&E | Table of Organization & Equipment |

# Introduction

Japanese ground forces fought their war largely with arms that would have been obsolete in many western armies. In fairness, their bolt-action rifles, machine guns and mortars were not much different from foreign models, and their unique grenade dischargers were handy weapons. Larger weapons, however, were a decidedly mixed bag.

The conservatives on the Army staff had restricted development funding in favor of manpower and training into the mid-1930s, which put the Army behind its foreign contemporaries before the war even started. Not only did this cost the Army about a half-generation in weapons development compared to potential adversaries, but it also limited the size and capabilities of the research and development centers.

Subsequently, this shortage of research and development assets, both expert personnel and facilities, prevented the Army from conducting development across a broad range of equipment simultaneously. To an extent this could be ameliorated by purchasing designs from overseas, such as the acquisition of modern field artillery licenses from Schneider in the early 1930s. To a lesser extent more advanced weapons captured on the battlefield could be reverse-engineered and copied, this being the case with 40mm, 75mm and 88mm AA guns, although even here the programs were considerably delayed.

Further, it is unclear to what extent the Army staff appreciated the technological advances being made overseas. The most egregious example was probably heavy antiaircraft guns. By 1940 the US, Britain, Germany, Soviet Union and France had all given up on the 75mm anti-aircraft gun and were in full production of larger (85-95mm) replacements. The IJA, by contrast, had not even begun a development program for a replacement for their 1928-vintage 75mm AA gun, except to the extent of reverse-engineering an elderly, mediocre, static-mounted German naval gun captured in China.

Even once a weapon and its associated equipment was developed production in sufficient quantities was far from certain.

It is often difficult to remember that the innovative and industrial Japan of today is partly a post-war creation. Great strides in industrialization had been made since the Meiji restoration but despite the rise of the zaibatsu conglomerates much manufacturing remained fragmented and inefficient, the exceptions being those few areas, such as textiles and shipbuilding, where the government took a very active interest.

The relatively recent industrialization meant that there was only a very small pool of excess and retired factory workers and engineers, and relatively few civilian-product factories suitable for conversion to the war effort. To the extent that manufacturing was expanded and additional raw materials allocated, wartime increases invariably went to aircraft and shipbuilding. These were not unreasonable priorities, but the limited industrial base meant that little was left for Army munitions expansion.

One way the Army kept production numbers up was to continue building obsolete equipment rather than accept the inevitable, and sometimes substantial, “downtime” of retooling production lines to a new, and invariably larger and more complex, weapon. Examples included the 37mm anti-tank gun and the 75mm anti-aircraft gun, both kept in production long after other nations had abandoned such weapons.

In addition, limited production means often tended to keep cheap, quickly-produced weapons in production even once the more advanced, and complex ones, entered production themselves. For instance, throughout the war the Osaka Arsenal built the ancient 24cm Type (Meiji) 45 howitzer (at ¥90,000 each) in parallel with the much more modern 24cm Type 96 howizer (at ¥400,000 each). This kept production numbers up, but added little to actual combat capabilities.

| Ammunition & Weapons Status | | | | | |
|---|---|---|---|---|---|
| | 1941 | 1942 | 1943 | 1944 | 1945 |
| Weapons (division sets) | | | | | |
| Stock at beginning of year | 95 | 103 | 111 | 123 | 116 |
| Production | 15 | 17 | 24 | 22 | 11 |
| Consumption | 7 | 9 | 11 | 36 | 16 |
| Stock at end of year | 103 | 111 | 123 | 109 | 104 |
| Divisions activated | 49 | 62 | 67 | 92 | 169 |
| Ammunition (*kaisenbun*) | | | | | |
| Stock at beginning of year | 100 | 108 | 103 | 103 | 82 |
| Production | 19 | 25 | 25 | 20 | 8 |
| Consumption | 11 | 30 | 25 | 41 | 16 |
| Stock at end of year | 108 | 103 | 103 | 82 | 74 |

The Army had started the war with a significant stockpile of reserve weapons built up both through excess production in the late 1930s and through retention of older weapons in stockpiles and with second-line troops.[1] This acted as a "cushion" so that shortages of most ground weapons did not become severe until 1945. Unfortunately, little opportunity was taken during the relatively quiet period of late 1942 through 1943 to build up force structure or stocks of weapons. By the time force structure expansion started it was already too late. Raw materials and transport to move them had been dedicated largely to aircraft and ship production, leaving ground ordnance plants operating at considerably less than full capacity during the last 18 months of the war. Further, some production capacity was handed over to other ends, an example being the diversion of small arms production to provide aircraft armament.

Thus, for instance, while ground ordnance represented just slightly under 19% of the Yen value of war production in each of 1941 and 1942, it had fallen to 13% in 1944 and 1945; aircraft production had risen from 21% to 36%. Total Japanese war production continued to increase through September 1944, but for the Army their production of small arms and field artillery peaked in 1943.

In fairness, it should be pointed out that the situation was little different for the Navy. True, their armaments expenditures increased by 50% from FY41 to FY42 but the bulk of that, both as baseline and in increase, was taken up by aircraft production. By the time armaments production was ramped up in early 1943 they were starting to suffer the same problems as the Army; shortages of steel, skilled workers and local transportation. Production of surface-fire guns peaked in 1942, but production of AA guns (primarily the ubiquitous if elderly 12cm) and automatic weapons (mainly the 25mm) did increase dramatically, peaking in mid-1944.

As regards ammunition the picture was already bleak by late 1943. Army production in that year had stagnated, showing no increase from its wartime peak the year before. Combat that year had been relatively light, so they had managed to keep up with demand, but in 1944 the Allies began unleashing their massive offensives and production of ammunition could not even reach half of consumption. Indeed, by the end of the year the IJA actually had fewer *kaisenbun*[2] available than activated divisions. Put another way, they only produced 80 division-combat-months of ammunition that year to support a force structure of 82 divisions. As with ground weaponry, not only were materials and local transport in short supply, but much of the production capacity was turned over to aerial and shipboard ammunition.

Nevertheless, by the end of the war the forces in Japan proper, except the final mobilization waves, were actually somewhat better equipped than those elsewhere. In part this was due to shipping losses en route to overseas formations, but by late 1944 much of the munitions as were produced were being held back for the final defense of the homeland. There were still massive ammunition reserves held, unnecessarily, in Manchuria but almost all new production for the last year had stayed home.

That notwithstanding, by mid-1945, with the war knocking on their doorstep, the divisions in the homeland were still mainly equipped with little 37mm anti-tank guns and the most numerous heavy AA gun was still the 1928-model 75mm.

A great irony is that the Army wound up with the war it did not want, in the jungles to the south, where their obsolescent equipment was actually less of a drawback than it would have been on the plains of Manchuria and Siberia. In any event there was little the Army could have done with their limited development and industrial base to development and industrial base to significantly change the arc of the war in either theater.

1 It should be noted that the figures for weapons in the table above are slightly misleading, since the Army maintained the equivalent of about ten divisions in separate brigades during 1940-43 that really should be counted with the activated divisions.

2 A *kaisenbun* was a calculated mix of ammunition that was supposed to keep a division in combat for four months, assuming 20 days of actual combat per month. The main components were 2.7 million rounds of rifle, 2.8 million rounds of machine gun, 16,800 AT rounds, 27,000 battalion gun rounds, 15,600 rounds of regimental gun, and 48,000 rounds of field gun ammunition. In practice this was found to understate the requirements of heavy combat.

# 1

# Submachine Guns

Surprisingly, given the IJA's focus on offensive infantry action, their attitude towards submachine guns was more that of curiosity than acceptance. A plan for development of a submachine gun had been drafted in 1920, envisioning a comparative trial between an indigenous model, a Thompson model and a Swiss Bergman, but this lead nowhere. The Tokyo Arsenal produced prototypes in 1927 and 1929, but neither was judged effective.

Instead, the IJA purchased 50 Bergman Model 1920 submachine guns from the Swiss firm of SIG, these being delivered in October 1930 as the Model BE, presumably for limited user trials. A second batch of 120 BEs was purchased by the Navy in late 1931 for SFr 50,000 in late 1931. These were handed out to naval special landing forces, particularly in China, before being mostly redistributed to the two naval parachute forces, the Yokosuka 1st and 3rd SNLFs just before the outbreak of the Pacific War.

Chinese-made Bergmans were also captured during the fighting in that country and these were often used by IJA troops. Many of these differed from the original in having a vertical magazine, instead of the standard horizontal one.

A Japanese naval Bergmann used on Guadalcanal.

In the meantime, Kojiro Nambu had also entered the fray and began turning out prototypes of submachine guns based on the Bergman principles. The Model 1 was a bullpup design in 8mm Nambu caliber first shown in 1930, then in modified form in 1934. A Model 2 was shown in 1934, similar to the Model 1 but with more conventional stock and in a special 6.5mm caliber, although this was changed to 8mm in a second version shown in 1937. None of these worked very well in Army trials and the Nambu firm (now Chuo Kogyo) started work again from scratch.

An early model of the Type 100 with bayonet and bipod. It remained in use, being captured in 1945.

The relaunch produced the Model 3, in three variants, all chambered for 8mm Nambu pistol ammunition. Five Pattern A, three Pattern B and three Pattern C weapons were produced and sent for testing in the summer of 1940. The Model 3 Pattern C was judged suitable, accepted for service by the Army as the Type 100 submachine gun, and approved for production in February 1941. There was also a folding-stock model for use by paratroopers, although this weakened the stock to the detriment of handling.

Production entrusted to the Chuo Kogyo firm under the supervision of the Nagoya Arsenal, but was slow to take off, with serial number 5 not coming off the line until August 1942. The number produced is unknown, but was probably quite small, in the hundreds. The weapon was apparently regarded as successful, but was difficult to manufacture. The Army provided funds to design a simpler version and in late 1943 a new version was unveiled. Components were simplified and a longer and stronger recoil spring incorporated that increased the rate of fire to 800 rpm. The rear sight, which had been adjustable from 100 meters to a wildly optimistic 1,500 meters, was replaced by a fixed aperture unit set for 100 meters. The later model is usually known as the Type 100 (1944) to distinguish it from the original, which was retroactively referred to as the Type 100 (1940).

| Type 100 Specifications | | |
|---|---|---|
| | **1940 version** | **1944 version** |
| OA length | 850mm | 900mm |
| Length w/bayonet | 1025mm | 1118mm |
| Barrel length | 229mm | 230mm |
| Weight, loaded | 3.75 kg | 3.92 kg |
| Rate of fire | 450 rpm | 800 rpm |
| Muzzle velocity | 335 m/s | 335 m/s |

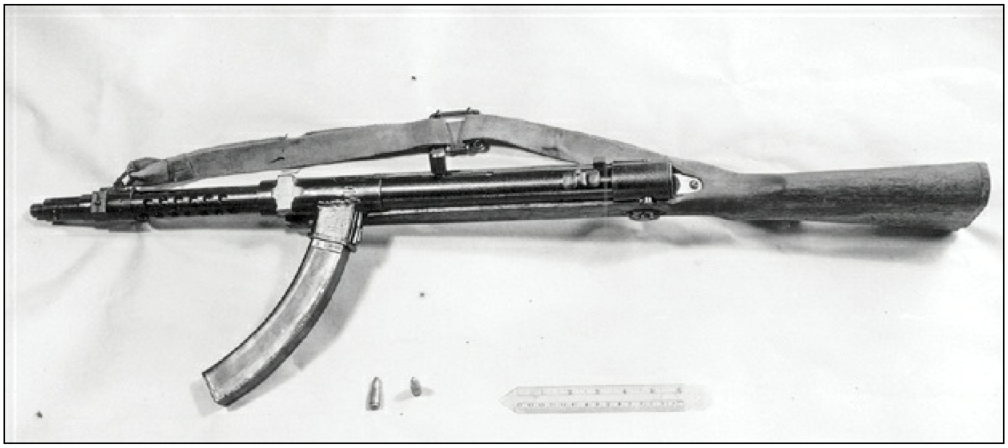
Chuo Kogyo switched over to production of the 1944-pattern in early 1944 but the new design did little to spur output. It appears they only built around 400 by the time they ceased production in August. At that point production was switched to the Nagoya Arsenal’s Toriimatsu factory, which managed to turn them out at around a thousand a month. Production there seems to have totaled about 8,500.

These were issued to the Army’s commando and airborne units, although the Navy seems to have received some as well. The Type 100 had a complex feeding and firing system that made it unreliable in the field, and the 8mm Nambu round was underpowered for the combat role.

The final such weapon was the Italian Beretta MP38/43, 350 of which were ordered by the IJN in June 1943. Only 50 weapons were delivered, later that year, presumably by submarine, and they played little role in the war.

### Type 100 Submachine Gun

The Type 100 was a blow-back operated auto-fire only submachine gun. It utilized a curved, side-carried 30-round magazine, although those for the two models of gun were not interchangeable. Unusual for this type of weapon, the Type 100 included a bayonet lug, and early models had a folding bipod.



Disassembled view and top view of a Type 100 (1944) submachine gun.

# 2

# Rifles

## Rifles

After two centuries of isolation the Japanese began working on a rifled firearm that eventually yielded the Type (Meiji) 13 (=1880), designed by Major Tsuneyoshi Murata. This was a single-shot blackpowder weapon in 11mm, similar to the European weapons of the time. The revolution in rifles heralded by the advent of smokeless powder was noted in Japan, and Major Murata returned to the drawing board. The result was the Type (Meiji) 22 (=1889) rifle, which used 8x52mm smokeless ammunition and featured a tubular magazine holding eight rounds.

A rifle commission was established at the Koishikawa Arsenal in 1895, headed by Colonel Nariaki Arisaka and this yielded the Type (Meiji) 30 rifle in 1897. The most notable feature of this new weapon was its ammunition – a 6.5x50mm semi-rimmed cartridge, a round that was to remain in service to 1945. The ammunition was successful, but the rifle was not. It proved to be complex and susceptible to jams caused by dirt. Nevertheless, about 554,000 rifles and 45,000 of a carbine version were built and were the primary infantry weapons in the Russo-Japanese War of 1905.

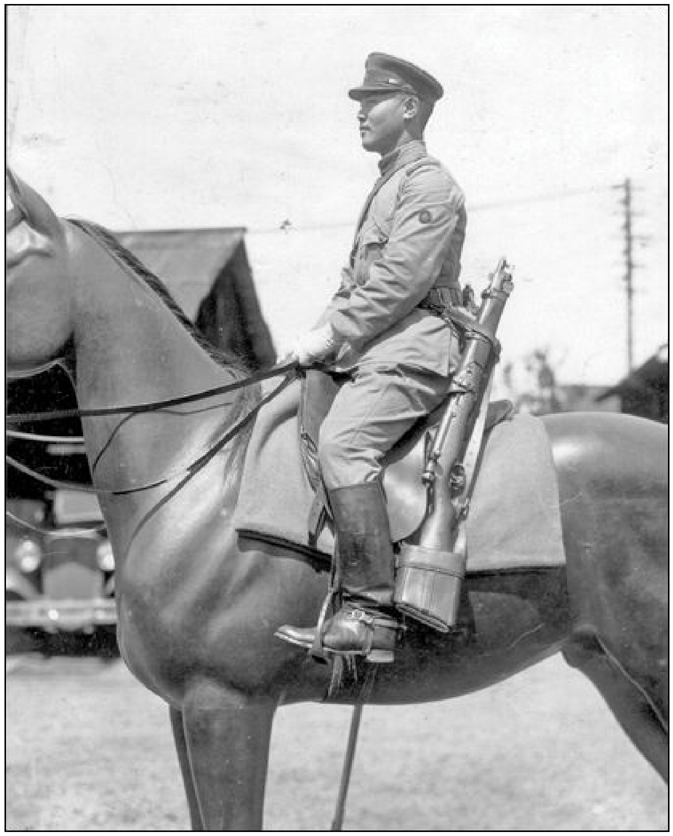
A second rifle commission was convened, also under Colonel Arisaka but here aided by a young Captain Kijiro Nambu. This resulted in the Type (Meiji) 38 rifle, adopted in 1905. It retained the 6.5mm ammunition, but featured a modified Mauser action that proved strong and effective.

Production started at the Koishikawa (Tokyo) Arsenal in 1906 and continued there exclusively into the late 1920. At that time a two-pronged reorganization and expansion of the small arms industry was launched. One part involved moving rifle production from the Koishikawa Arsenal to the Kokura Arsenal starting in 1929. This move was accomplished in phases to minimize breaks in production and was finally completed in March 1935. This line, in the two locations, built around 2,520,000 rifles. The second element involved bringing the Nagoya Arsenal into the production plan production, including the acquisition of new production machinery from Pratt & Whitney in 1927. They built around 313,000. Two overseas arsenals also built smaller numbers: 117,000 at the Mukden Arsenal in Manchuria starting in 1934 and about 12,000 at the Jinsen Arsenal in Korea starting in 1939.

A carbine version of the Type (Meiji) 38 was also produced for cavalry and other special troops. The weapon was shorter and the sling swivels were mounted on the side to facilitate carriage by mounted troops. The sight was graduated to 2,000 meters, instead of the 2,400 meters on the longer-barrel rifle version, a wildly optimistic figure in either case. The Koishikawa and Kokura Arsenals built around 292,000 carbines, while Nagoya built about 206,000 and the Mukden Arsenal about 45,000.

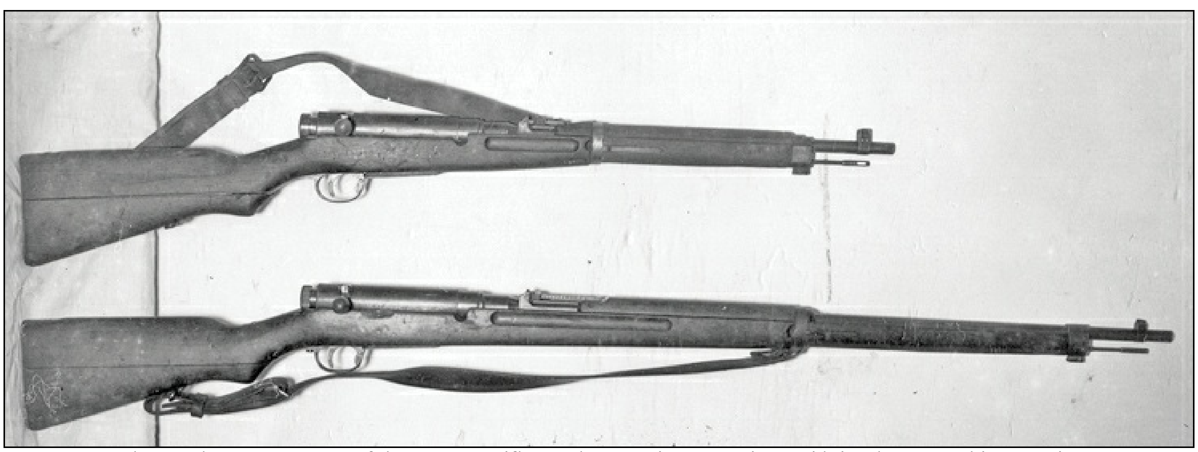
A modified version of the carbine was also adopted as the Type (Meiji) 44 carbine. The main difference between the two carbine models was that the Type (Meiji) 44 had a permanent folding bayonet. The two carbines were produced simultaneously, with the Type (Meiji) 44 having a smaller production run, of about 91,000.

The ungainly length of the basic rifle was also answered by conversion. A new, shorter barrel and a new handguard and shorter stock fitted. The result was the Type (Meiji) 38 cavalry rifle. An unknown, but probably small, number of these cavalry rifles were created by conversion during the war by the Chigusa factory under the auspices of the Nagoya Arsenal. In addition, the Chigusa factory performed repair and rebuilds of Type (Meiji) 38 rifles throughout the war, often integrating later components into earlier weapons.



A cavalry trooper with his Type (Meiji) 44 carbine.

The 6.5mm round was adequate for the short ranges envisioned on the home islands, but it lost power beyond about 200 meters and operations on the Manchurian plains and later in China highlighted its limitations. Indeed, a more powerful 7.7x58mm semirimmed round had already been developed for the new medium machine gun adopted in 1932, and this round was simply modified into the 7.7x58mm rimless (also known as the 7.7x58mm Arisaka) for a new infantry rifle.



The cumbersome nature of the Type 38 rifle can be seen in comparison with its shorter carbine cousin.

In April 1938 the requirement was issued for a new Army rifle family in 7.7mm caliber. The weapon was to weigh no more than 4 kg, have a peep-hole sight graduated out to 1,500 meters, use a lighter stock, be made of readily-available metals, and have simplified construction to speed manufacture.

Four prototypes were submitted for trials. For the infantry rifle the Nagoya Arsenal submitted a Type (Meiji) 38 rifle changed to 7.7mm; while the Kokura Arsenal submitted a modified version of the old rifle with a new breech to simplify manufacture. For a cavalry rifle, there were also two proposals, one a rechambering and reboring of the Type (Meiji) 44 to 7.7mm, and the other the Type (Meiji) 38 carbine converted to the larger round.

The first trials were carried out in October 1938 and those soon reportedly revealed that the short barrels of the carbines yielded excessive recoil with the more powerful ammunition, so those two were dropped immediately. In early 1939 a second set of trials showed that the breech system of the Kokura rifle was not satisfactory, while the Nagoya rifle worked well except for problems with accuracy, that being laid to poor ammunition.

| Army Rifle Production (excl Korea & Japan) | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | FY31 | FY32 | FY33 | FY34 | FY35 | FY36 | FY37 | FY38 | FY39 | FY40 |
| Type 38 Rifle | 2,613 | 960 | 2,262 | 2,677 | 904 | 13,836 | 29,062 | 136,392 | 212,920 | 376,662 |
| Type 38 Carbine | 803 | 0 | 0 | 27 | 1,464 | 5,712 | 8,454 | 25,870 | 30,926 | 59,697 |
| Type 44 Carbine | 200 | 150 | 0 | 102 | 4,617 | 5,867 | 5,238 | 6,007 | 5,773 | 5,281 |
| Type 99 Rifle | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 7,300 |
| | 1941 | | 1942 | | 1943 | | 1944 | | 1945 | |
| | Apr-Jun | Jul-Dec | Jan-Jun | Jul-Dec | Jan-Jun | Jul-Dec | Jan-Jun | Jul-Dec | Jan-Jun | Jul-Aug |
| Type 38 Rifle | 100,000 | 225,000 | 165,000 | 80,000 | 60,000 | 60,000 | 10,000 | 0 | 0 | 0 |
| Type 38 Carbine | 17,500 | 38,500 | 20,935 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Type 44 Carbine | 1,456 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Type 99 Rifle | 3,000 | 47,000 | 160,000 | 125,000 | 180,000 | 255,000 | 390,000 | 420,000 | 369,000 | 55,000 |
| note: figures are those provided in November 1945 by Army Ordnance Bureau. | | | | | | | | | | |

A third set of trials was held in May 1939 that featured improved ammunition used with two varieties of the Nagoya rifle. One was the original full-length rifle and the other was a slightly cut-down version that could be used by cavalry. Both were adopted, as the Type 99 Rifle and the Type 99 Short Rifle, respectively. The ammunition chosen was the 7.7x58mm rimless round, designated the Type 99. The earlier machine gun could fire both the Type 92 and Type 99 7.7mm ammunition, but the later weapons could fire only the Type 99.

| Army Rifle Data | | | | | |
|---|---|---|---|---|---|
| | Ammunition | Weight (kg) | Length (mm) | Barrel Length (mm) | Muzzle Velocity (m/s) |
| Type 38 Rifle | 6.5x50 | 3.95 | 1,280 | 797 | 765 |
| Type 38 Carbine | 6.5x50 | 3.3 | 966 | 487 | 685 |
| Type 44 Carbine | 6.5x50 | 3.3 | 966 | 487 | 685 |
| Type 99 Rifle | 7.7x58 | 3.7 | 1,120 | 657 | 730 |

It quickly became evident that the extreme length of the basic infantry rifle, a holdover from earlier, obsolete concepts, conferred no additional accuracy while making the weapon clumsy and awkward. After only about 38,000 had been built it was dropped from production and the former short rifle was redesignated as the Type 99 Rifle as the new mainstay of IJA forces.[1]

As was the case with the earlier rifles, continual changes were made in the design of the Type 99 and its components. In these cases, however, the changes were mainly driven by the need to conserve scarce resources and simplify production. A major simplification was mandated in 1943 called the Substitute Type 99 Rifle, with this replacing the original Type 99 in production.

As long as the Army remained largely unmobilized there was plenty of capacity for the production of small arms. Once the Army started expanding, however, they soaked up all manufacturing capacity, leaving none for the Navy. The Navy's first response was to place contracts overseas, and they ordered 60,000 rifles from the Terni Royal Arms Factory in Italy, with production to run during 1938/39. These weapons fired the standard Japanese 6.5x50mm ammunition and had the same general appearance, although the barrel was about 12mm shorter than the Type (Meiji) 38 rifle. A significant difference, however, was that they used the Model 1891 Carcano-type action rather than the modified Mauser-type of Japanese rifles. These weapons, referred to in the West as Type I rifles, were issued to naval ground units.

With the outbreak of the war deliveries from overseas became impossible. An arsenal (probably Yokasuka) built a rifle derived from the Type 99, although using cast iron parts for some elements, including the receiver. It seems that about 14,000 of these were built. They seem to have gone through the same simplification process as the Type 99s to save materials and production time. Lacking arsenal markings they are referred to in the West as Naval Special Type 99 Rifles.

## Special Rifles

The Japanese were relative late-comers in the development of sniper rifles. Trials quantities of Type (Meiji) 38 rifles with scopes were built in the 1920s, but nothing seems to have come of them. Interest was renewed when a new version was subjected to tests in 1937. The rifle, fitted with a 2.5-power telescopic sight, showed a 10% improvement in accuracy at 300 meters and 30% at 600 meters. The improvement was presumably due entirely to the use of the scope, since the weapons were standard issue rifles, modified only by the scope attachment points and the use of downturned bolt handle. The weapon was standardized as the Type 97 Sniper Rifle and production initially assigned to the Kokura Arsenal, followed by Nagoya. The former built around 8,000 of these weapons and the latter about 14,000.

The 6.5mm round was never a particularly good long-range round, lacking power and accuracy beyond a few hundred meters, so when the new 7.7mm Type 99 Rifle entered production it was logical to consider it for the sniper role as well. A few original "long" and "short" Type 99 rifles were converted to the sniper configuration in the same way as Type 97 rifles, with 2.5-power optical sights and turned-down bolt handles, and subjected to tests in 1941. The tests showed that both models demonstrated about a 35% improvement in accuracy compared to the basic service rifle, but that there was no significant difference between the long and short rifles. As a result the now-standard short configuration was chosen. The sniper version never received an official designation, being referred to simply as the Type 99 Sniper Rifle. As with the Type 97s, the sniper versions of the Type 99s were purpose-built by the factory, but tolerances were no more demanding. The differences were solely those related to acceptance of the optical sight. Nagoya built around 10,000 Type 99 Sniper Rifles, while Kokura built around 1,000.

The long rifles favored by the Japanese Army made them impractical for paratroopers. Two experimental rifles were developed shortly before the pacific war. The first paratroop rifle was a Type 99 short rifle with an interrupted-screw connection between the barrel and the receiver, enabling the two to be separated and joined with a 90° turn. This, along with a removable bolt handle and a few other minor features, allowed the broken-down rifle to be carried by a descending parachutist. Small quantities of this weapon, unofficially known as the Type 100, probably a few hundred, were acquired by Army and Navy parachute forces from the Nagoya Arsenal. The Type 1 test rifle was a Type (Meiji) 38 carbine with a hinged buttstock such that it could be folded immediately behind the trigger guard. A few hundred appear to have been produced for the IJA parachute force.

Neither type was used by the Army paratroopers dropped on Palembang in February 1942 so that the troops were armed only with pistols, hand grenades and bayonets on landing. Rifles, along with heavier weapons, were dropped separately by canister and many were lost. This provided the impetus for renewed development of special weapons for paratroopers.

A new weapon, similar to the Type 100, was developed in mid-1942 at the 1st Laboratory. The main difference was that the removable barrel was held in place by a tapered wedge rather than the interrupted screw. A first prototype was subjected to tests in October 1942 and after some further tests and tweaking was standardized as the Type 2 paratrooper rifle in May 1943. Production was entrusted to the Toriimatsu factory of the Nagoya Arsenal, which built around 21,500 examples. Some were used in the raids on Leyte but in fact meaningful Japanese parachute operations had ceased by the time the rifle went into production

## Rifle Grenade Launchers

The IJA fielded two rifle-based grenade launchers during WW I. The Type A converted Type 18 rifles into grenade launchers by adding a new stock that rested on the ground, and a new barrel with very long bipod legs to hold the weapon at a 45° angle. That yielded a range of about 320 meters with an iron HE shell. The Type B grenade launcher was similar, but was purpose-built using a modified Type 38 rifle action, rather than being a conversion. Both appear to have fallen out of service by the mid-1930s.

A shortcoming of the Types A and B was that they were single-purpose weapons and once the Type 89 hand held grenade discharger came into use their raison d'etre disappeared. Since the Type 89s were to remain concentrated in a separate squad, however, there still remained the possibility that rifle squads might need their own HE firepower. To this end a spigot adapter was developed that fit over the muzzle of the rifle, hooking around the front sight. There were two types of grenades available that had hollow tail extensions holding fins for stabilization and which fit over the adapter. These were projected by firing a special cartridge with a wooden bullet. The more common of the grenades was simply the standard Type 91 hand grenade, which had a threaded recess at its bottom into which could be screwed either a propellant module for use with the grenade discharger, or a finned tube for use with the spigot-type rifle grenade launcher here.

When fired this way the Type 91 achieved a range of a little over 100 meters with a time of flight of four seconds. Since the grenade had a fuzing time of 7-9 seconds bursts on impact were rare.

Far less common was the smoke grenade with slightly different fuzing. Here the wooden bullet hit a steel plug in the base in the grenade, which ignited a primer that in turn initiated a powder delay train. The sheet steel grenade was 22cm long and 5cm in diameter and carried 269 g of HC smoke filling.

The initial rifle grenadier kit comprised a pouch with five grenade pockets and, left to right at bottom, the spigot adapter, a smoke grenade, and a Type 91 hand grenade with fin attachment.

Accuracy and range were not great with the spigot device and in February 1939 the Army Technical HQ issued a requirement document for a tubed grenade launcher that could be fitted onto a service rifle as needed to fire the now-standard Type 99 offensive grenade. Two prototypes were delivered for testing just three months later, one that utilized regular ball ammunition and the other blank ammunition. To simplify logistics the ball-cartridge version was chosen and further testing conducted in September in Japan and October in Manchuria. The launcher was designated the Type 100 Grenade Launcher, presumably in 1940, but testing and modification continued until full production started in February 1942.

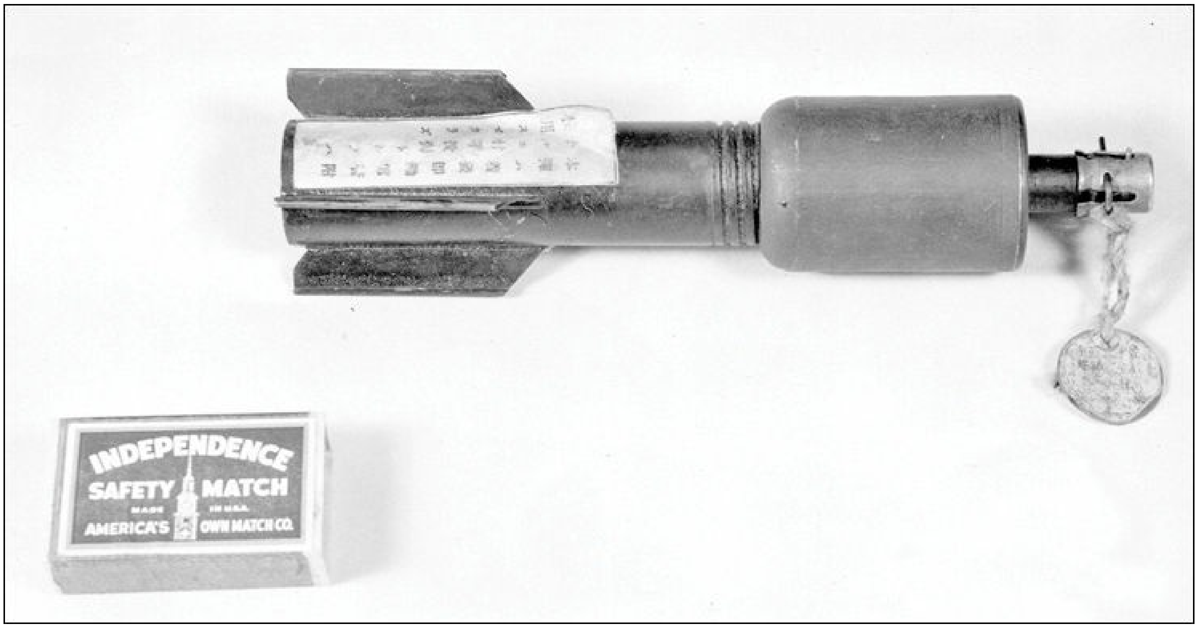
Production was supervised by the Nagoya Army Arsenal, who initially entrusted it to the Toyoda Automatic Loom Works, followed in late 1944 or early 1945 by the Arsenal's Toriimatsu Factory. Post-war experts distinguish between two groups of weapons, each of two types, although it is not clear how, or even if, the Japanese at the time regarded them.

The first 16,000 or so, built by Toyoda in 1942-43, were fixed to the rifle muzzle by means of a retaining pin on the left side of the launcher and have been called the Type A. The remaining 20,000 launchers built from 1943 are called the Type B and feature the retaining pin on the right side, along with a sighting line along the top of the cup. Of more operational significance was a second distinction. The first 5,000 launchers are marked for use with 6.5mm rifles, while those thereafter appear to have been universal launchers, suitable for either 6.5mm or 7.7mm launch cartridges.

The Type 100s were not included in any of the official standard organization tables. Instead, they were issued as supplemental weapons to units deploying. The major groups to benefit were the island defense-type divisions, each receiving 200, and the expeditionary units, each getting 100 to 300. Given the large number produced it seems likely that units in Manchuria and the homeland also received allocations. Navy units also received some late in the war.[2]

Produced and deployed in parallel to the Type 100 grenade launcher was an entirely different weapon, the spigot grenade launcher. The Type 91 hand grenade, a serrated cylindrical device, had been designed from the start to accept a screw-in propellant module in its base for use with the Type (Taisho) 10 and Type 89 hand-held grenade dischargers. The Type 97 grenade was similar but featured a shorter time fuze. Later on it was a fairly simple matter to design a tubular extension with tail fins that would screw into the same threads in the base, converting it to a ballistic projectile. A tubular extension that could be attached to the barrel served as a spigot, over which the tail boom of the grenade would slide. A smoke projectile carrying an HC payload was also designed and produced for the spigot launcher. No estimate of the number of spigot launchers produced has ever been located, but it seems likely to have been substantially lower than those for the Type 100.

Around 1942 the IJN developed its own spigot launcher that was secured to the rifle muzzle by means of a knurled knob that tightened two arms against the rear of the front sight base. These mainly fired the Type 2 and Type 3 Model 1 rifle grenades. Both types were derivatives of the Type 99 hand grenade fitted with a spigot tube with fins, much like the Type 97 and 99 grenades used with the Army spigot launcher. A key difference was that the fuze was modified from a powder-train time model to an impact percussion device. Both fired with a wooden bullet to a maximum range of 205 meters. The Navy also developed a shaped-charge anti-tank grenade for this launcher, capable of penetrating 40mm of armor and having a stated effective range of 50 meters.



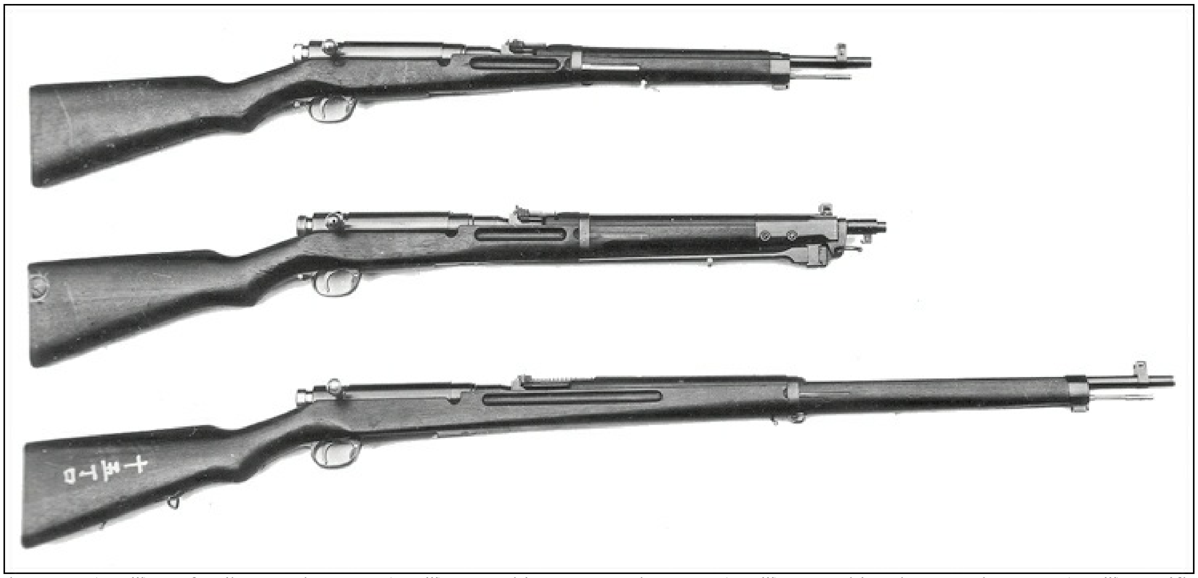
A Navy Type 3 Model 1 rifle grenade.

The cylindrical shape of Japanese hand grenades lent itself to cup-type launchers and numerous extemporized weapons were also designed and fabricated, in this case usually for the Type 91 or Type 97 hand grenades.[3] Invariably, these involved fitting the cup directly to the muzzle of the rifle, rather than using a gas port to bleed gasses off into a parallel but separate cup as in the Type 100. This generally required the use of a blank round or a service round in which the bullet had been removed and replaced with a wooden or cloth plug. The bottom of the hand grenades was too thin to withstand the impact of gas and debris, so the grenades were usually loaded into the cup upside down, with the safety pin still in place. The hot propellant gasses would ignite the powder train of the grenade fuze at the same time they ejected the grenade from the cup. Many of the improvised launchers had gas bleed ports to vary the range, which generally had a maximum value of about 100 meters. Although an official manual was produced in August 1942 detailing how to build one model of an improvised launcher, actual fabrication appears to have been on a small scale.[4]

### Type (Meiji) 38 Rifle & Carbines

The rifle was something of a hybrid, retaining the extreme length and straight bolt-handle characteristic of rifles of the 1890s, while using a fairly modern round, the 6.5x50mm semi-rimmed. The weapon featured an exceptionally strong modified Mauser bolt mechanism that could have handled much more powerful ammunition. A dust cover that fit into two grooves in the top of the receiver, protected the mechanism from dirt and debris. It slid back and forth with the bolt handle, which projected through a hole in the cover. Ammunition was fed from an internal 5-round box magazine that was loaded from stripper clips that held five rounds apiece. The Type (Meiji) 44 carbine used a built-in folding bayonet, the mount of which initially proved too weak until it was modified about two-thirds of the way through the production run.

The design of all three weapons were subject to continual modification during their long production runs. The first million-and-a-half rifles had six rifling grooves, where later rifles had four. A cover was provided for the front blade sight to protect it from damage, probably in the 1930s. Other changes involved the finish of the breech mechanisms, configuration of the rotating safety knob, and a late-war change from a notch rear sight to a peep-type.

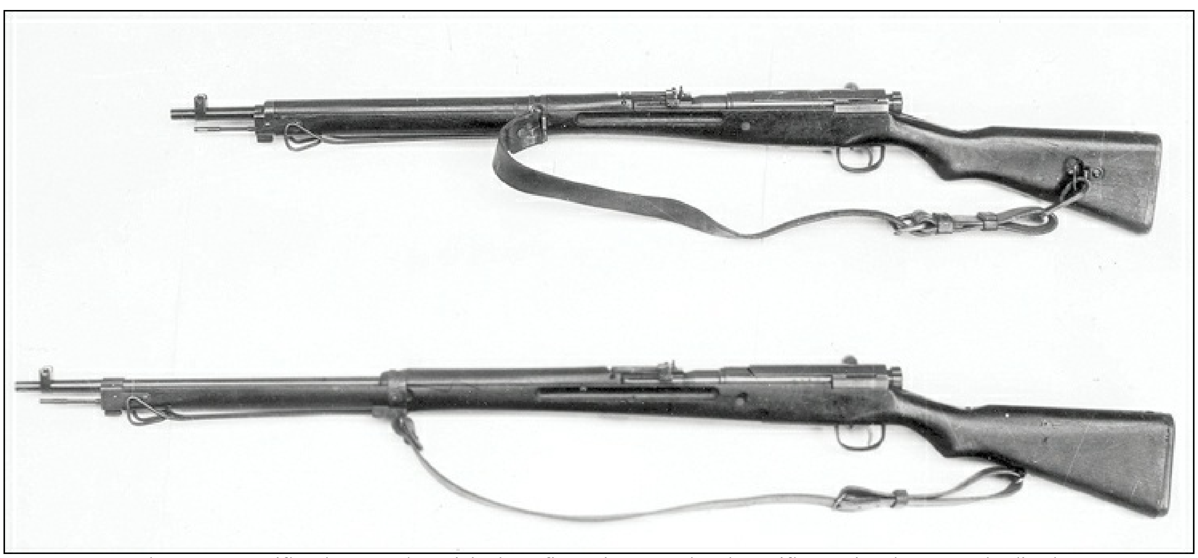


The Type (Meiji) 38 family: top, the Type (Meiji) 38 carbine; center, the Type (Meiji) 44 carbine; bottom, the Type (Meiji) 38 rifle.

### Type 99 Rifle

This was the Type (Meiji) 38 rifle modified and adapted to take the more powerful 7.7mm ammunition. The design retained the bolt mechanism (including dust cover) and five-round staggered internal magazine. Two weapons were actually designated the Type 99, the basic (long) infantry rifle and a short rifle. Experience showed the long rifle to be cumbersome and awkward and it was dropped from production and replaced by the short rifle. The original design of the weapons provided for a wire monopod that swiveled down from the front, and anti-aircraft arms on the sight.

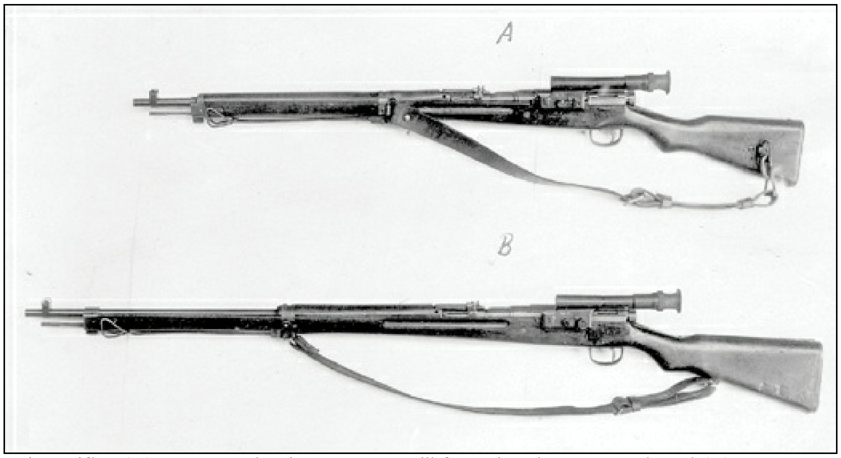
Modifications were made to the rifle during its production run to reduce consumption of scarce materials and reduce production costs, these being cut in at different times at different plants. Over time the monopod and anti-aircraft feature were eliminated, along with the dust cover. The cumulative changes, along with a few others, such as eliminating the chrome plating on the barrel and bolt face, using inferior grades of steel, and a simpler sight graduated out to only 300 meters, were standardized in 1943 as the Substitute Type 99 Rifle. In addition, production standards and tolerances were reduced throughout the war in varying degrees at the different plants, resulting in an almost limitless array of different configurations.[5]



The Type 99 Rifles: bottom, the original configuration; top, the short rifle version, later standardized.

### Sniper Rifles

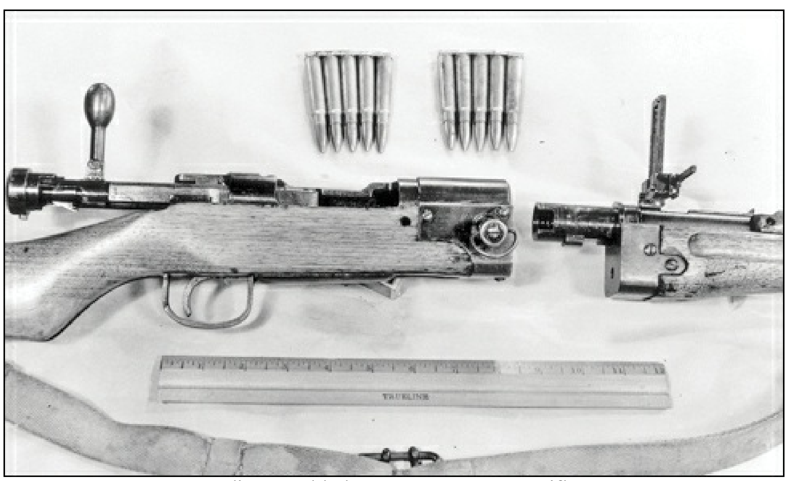
There were two models of sniper rifle in use. The Type 97 was based on the Type (Meiji) 38 rifle, while the Type 99 used the Type 99 Rifle. The basic rifles were little changed, the main visible difference being the bolt handle that bent downward to avoid hitting the scope when open. Both rifles were fitted with a 2.5-power scope that attached to a dovetail joint on the left side of the receiver, although about half of the Type 99s received 4-power scopes in lieu. Attaching and removing the sight was accomplished by throwing a lever. Each sight was set for a specific rifle at the factory and was marked with the rifle's serial number. The sight was not adjustable and the rifleman used reticule marks to compensate for range and drift. Most of the Type 97s had the folding monopod, but the later-produced 97s and all of the 99s lacked this feature.



Sniper rifles (A) a pre-production Type 99 still featuring the monopod, and (B) a Type 97.

**Type 2 Paratrooper Rifle**

This is the (short) Type 99 rifle modified with a quick take-down feature that permitted it to be broken down into two parts, a barrel section 65cm long and a stock section 51cm long. The rear end of the barrel included a large lug on the bottom that fitted into a key hole on the front face of the receiver. Once the barrel had been fully inserted into the receiver a pin that projected from the right side of the receiver was pushed in, in front of the lug, locking the barrel in position. A screw around the pin head was used to lock the pin in position. Taking the rifle down was quick and simple, the soldier simply twisted the pin lock to release it, pulled the pin to the right (it would not come completely out of the rifle) and then pulled the barrel straight forward out of the receiver. Assembly was the reverse. Aside from the take-down feature the rifle was identical to the standard Type 99 rifle. A special Type 1 bayonet, shorter than the standard Type (Meiji) 30, was used with this rifle.


A disassembled Type 2 paratrooper rifle.

**Type 100 Rifle Grenade Launcher**

This was a cup-type launcher that fired standard cylindrical hand grenades by bleeding off gasses from the passage of a round of ball ammunition. The device fitted over the muzzle of the rifle and included a tube that continued the rifle barrel, but with a gas port connecting that tube to a cup set above the tube. As a bullet passed through the tube a portion of its gasses would be diverted into the cup and propel the grenade to a maximum of about 75 meters with the 6.5mm Type 38 rifle and 95 meters with the 7.7mm Type 99 rifle. Varying the range was accomplished by changing the elevation and the use of a gas escape port. Early models were designed for the smaller caliber rifle, while later weapons could be used with either. The grenade thrown was the standard Type 99, which featured a time fuze initiated by the set-back of launch and a delay of 4-5 seconds. There was no impact function for the grenade.

A “universal” model Type 100 grenade launcher with Type 99 grenade and rifle cartridge.

## Spigot Grenade Launcher

This was a simple tubular extension to the rifle barrel, 15cm long and 27mm in outer diameter that could be attached by the soldier to the muzzle of his Type (Meiji) 38 rifle. He would then remove the safety on the Type 91 grenade with tail fin module and slide its tail boom over the spigot extension. A special rifle cartridge with a wooden bullet was used to propel the grenade, achieving effective ranges variously stated to be 90 to 110 meters. The setback of firing initiated the powder train delay fuze, which detonated the grenade 7-8 seconds later. Also available was a smoke grenade specially designed for this launcher, with a body 50mm in diameter filled with a 275 g of a hexachlorethane mixture, and an integral tail boom with fins. This grenade had no fuze, relying instead on the flash of the propellant gasses to initiate an igniter pellet that started the smoke mixture burning, the smoke of which would escape from four holes in the body.

A spigot attached to the rifle barrel and a Type 91 grenade with tail fin extension.

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1 The number of Type 99 rifles manufactured is not entirely clear. The figures in the table are those provided in November 1945 by the IJA Ordnance Bureau. In answer to the same questions the Nagoya Arsenal estimated that they had built 868,000 and the Kokura Arsenal estimated 462,000, on schedules that did not match those of the Ordnance Bureau answers. Analysis of serial numbers by collectors suggests that 2,497,000 Type 99s were built: 1,088,500 by Nagoya Arsenal, 592,000 by Kokura Arsenal, 557,000 by Toyo Kogyo, 98,000 by Tokyo Juki Kogyo, 32,000 by Izawa Jyuku, 32,000 by Howa Jyuko, 94,000 by the Jinsen Arsenal in Korea, and 3,000 by the Mukden Arsenal in Manchuria.

2 The IJA also copied the German anti-tank rifle grenade launcher. See the anti-tank weapons section for details.

3 Note that cup launchers for the older and new hand grenades would not have been interchangeable. The Types 91 and 97 grenades had a diameter of 50mm, while the later Type 99 had a 45mm diameter.

4 Several copies of the manual were recovered by US forces on New Guinea, but there is no record of any such weapon being encountered there. Other types were found in small numbers in Burma.

5 The arsenals and factories assigned serial numbers in blocks of 100,000 which rarely coincided with the changes introduced during the production run. Collectors have spent a lot of time tying serial numbers to changes.

# 3

# Machine Guns

The heavy water-cooled machine guns that made the defense so dominant in the First World War in Europe never impressed the Army much. Instead, they opted to follow the French lead with air-cooled weapons and were world leaders in adopting a bipod-mounted light machine gun for mobile support of the infantry.

Several Gatling guns had been imported from the US in 1867, and some Maxim guns in the early 1890s, but the most significant import was that of Hotchkiss guns in 1897. These were delivered in the Japanese 6.5mm caliber and used a 30-round strip feed mechanism. Impressed with the light weight and portability, the Japanese placed the weapon in production at the Tokyo Arsenal in 1902 as the Type Ho (= Hotchkiss) machine gun, and about a thousand were reportedly built and used in the Russo-Japanese War. The weapon weighed 50 kg and fired the 6.5mm ammunition at a cyclic rate of 450 rounds per minute to a range of 2,000 meters.

Unfortunately, the arsenal was not able to match the machining tolerances of the Hotchkiss facilities and as a result the guns proved unreliable in combat. The internal mechanisms were reworked to allow greater tolerances to yield the new Type (Meiji) 38, standardized in 1905. Externally, the Type Ho and the Type (Meiji) 38 were almost indistinguishable, featuring a pistol grip with safety and sights offset to the left. Placed in production at the Tokyo Arsenal, once again production was modest, probably a total of about a thousand weapons. Hotchkiss soon found out about this and demanded royalty payments. The Japanese resisted, claiming it was a new weapon, but eventually gave in and began making payments in 1909.

The Arsenal also began exporting the Type (Meiji) 38 machine gun to China, although initially in relatively modest numbers. Up to October 1917 a total of 217 of these machine guns were exported to China, but as these weapons were replaced in Japanese service by the successor weapon, stocks were sold off to China to the tune of 464 during November 1917 to November 1918 (of which 92 went to local warlords).

The original modifications to the Type Ho were intended simply to get the mechanism to work but it was clear to Kijiro Nambu, then of the Tokyo Arsenal, that there was room for improvement. Specifically, he made the barrel change quicker and improved the feed mechanism, cooling performance and accuracy. The weapon was adopted in 1914 as the Type (Taisho) 3 machine gun and placed in production at the Tokyo Arsenal. Although produced in large numbers, by peacetime standards, it was destined to share the limelight with a smaller cousin.

Operations in the First World War convinced all participants of the need for a light, portable machine gun that could be carried easily by advancing infantry but few immediately followed through. In Japan, however, responsibility for development of such a weapon was immediately handed off again to Nambu and the result was standardized in 1922 as the Type (Taisho) 11 light machine gun.


A Type (Taisho) 3 machine gun in action near Hankow, China in September 1938.

The Type 11 retained the basic elements of the gas-operated Hotchkiss system, but replaced the feed system with a unique design. A hopper was attached to the left side of the receiver that could hold six rifle clips, each of five rounds of 6.5mm ammunition, laid horizontally one atop the other. Closing the hopper cover smartly drove the rounds from the clips to rest on the platform at the bottom. As the bolt moved forward a feed lever displaced the platform at the bottom of the hopper, allowing a round to fall where it could be engaged by the bolt and driven into the chamber. Unfortunately, the hopper also served to catch dirt and grit, which contributed to the reputation of the weapon for poor reliability.


A light machine gun crew with their Type (Taisho) 11 weapon. Note the ammunition in clips ready to be loaded.

Extraction of the cartridge case after firing was not a smooth, gradual affair, but instead the extractor was at full speed when it pulled the case to the rear. To prevent damaged cases from jamming Nambu placed an oil reservoir over the feed opening such that a spring-loaded lubricator applied a drop of oil via a brush onto each cartridge case.

The advantages to a commonality of ammunition with the infantry rifles had not been lost on the designers, who went so far as to incorporate the rifle five-round strips into their feed system. The riflemen and light machine gunner of a squad could thus share ammunition freely. The Type 3 medium machine gun used the same ammunition, but set into 30-round metal strips.[1]

The Type 11 was placed in production at the Kokura Arsenal (alone and in combination with Hitachi) and the Nagoya Arsenal. The former switched over to the newer Type 96 light machine gun in 1936, but the latter kept it in production until 1940, presumably to avoid a break in deliveries, as the new machine gun was quite different. The Type 11 light machine gun remained in service until the end of the war, both in front-line units in secondary theaters and as an auxiliary weapon in artillery and other non-infantry units in all theaters. Not surprisingly, it was usually deployed hand-in-hand with the Type (Meiji) 38 rifle, which fired the same ammunition.

In the meantime it was becoming clear that the 6.5x50SR cartridge simply lacked the punch for the long-range fire envisioned for medium machine guns. The task of modernizing the Type 3 medium machine gun was entrusted, once again, to Nambu. As it happened, a suitable, more powerful, round, the 7.7x58SR, had already been developed and put in production for the Type 89 (1929) aircraft machine gun. The solution adopted was to slightly enlarge the old Type 3 medium machine gun to this new caliber, retaining the Hotchkiss-type mechanisms.

While the internal operating system remained the same, elements were beefed up a bit to handle the more powerful cartridge. Visually the most distinctive change was the replacement of the spade grips of the Type 3 with a pair of pistol-type grips below the receiver. A difference with operational implications was the provision for mounting optical sights on top of the receiver. Three sights were available. The most common appears to have been the Type 96 telescopic sight, a 4x straight unit that was used for direct aiming of the weapon at targets. The other two, the Type 93 (6x) and Type 94 (5x) were periscope configuration that raised the level of site by 210 or 325mm and were used only for laying of the gun (presumably for indirect fire) and were removed before firing.

The Type 92 was immediately ordered into production at Kokura Arsenal, who subcontracted it to Tokyo Gas, which was later bought by Hitachi. Production ramped up slowly, however, and it never completely replaced the Type 3 in service, particularly in theaters where 6.5mm rifles were still used.

Once the Type 92 was introduced into service, attention turned to the light machine gun. The Type 11 had a poor reputation for reliability, and to remedy that shortcoming the Army turned once again to the Nambu company. Where previously the firm had relied on tinkering with the well-established Hotchkiss design, here they went off in a completely different direction.

A Type 92 medium machine gun being moved in rough terrain. Note the carrying poles projecting from the two front feet.


A Type 92 machine gun in action, showing the ammo strip to the left.

The Czechoslovakian firm of ZB had developed a highly efficient light machine gun in the 1920s that they marketed as the ZB26, and had sold some to the Manchurian warlord Chiang Tso-lin. Presumably some of these would have been captured during the Japanese invasion of that province in 1931, along with others from the various firefights in China during the next few years. Apparently examples of the ZB26 made their way to the IJA laboratories and to the Nambu facility, for the next Japanese light machine gun took some features from that weapon.

The weapon emerged as the Type 96 light machine gun and represented a major improvement over the earlier Type 11. Gone was the dirt-catching ammunition hopper and the need to lubricate the cartridge case at the gun (although cartridges were lightly lubricated before they were loaded into the magazine). Dispensing with the on-gun oiler made possible the incorporation of a quick-change barrel. A unique feature was a Nambu-designed square frame that moved up and down to lock and unlock the barrel.

Each medium MG came with an extension that could raise the firing height of the weapon for anti-aircraft duties and to fire over high obstructions. The rear support piston between the gun and the mount was removed for AA use.

The Type 96 was placed in production at the Kokura Arsenal in 1936. The Ordnance Bureau reconstructed records (as shown in the accompanying table) show no production during fiscal years 1937-39, but it seems likely that there was some low-level output. During 1937-40 both the Type 11 and the Type 96 were concurrently in production, with the latter apparently being phased in, the major shift coming in 1940. Each of the producers of the Type 96 introduced minor changes to the weapon, such as modifications to the flash suppressor, cooling fins, and ejection port cover, without regard to the others, yielding a wide variety of slightly different weapons.

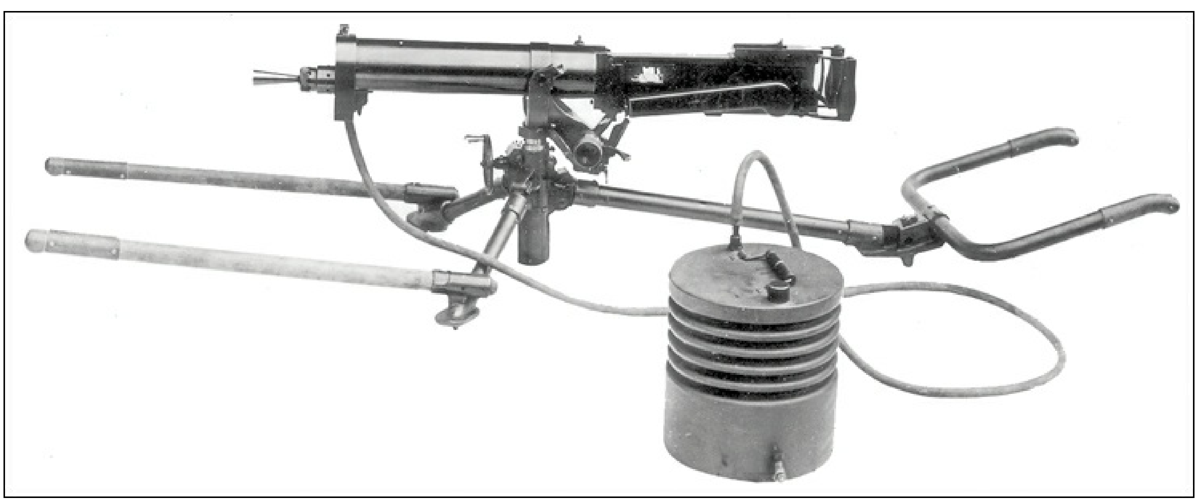
No sooner had production of the Type 96 light machine gun started, however, than a movement to change the caliber of infantry weapons bore fruit. The adoption of the 7.7x58 rimless cartridge for rifles created a requirement to field a light machine gun firing the same ammunition. The requirements specified a weight of no more than 11 kg, a sight graduated between 100 and 1500 meters, and a flash hider.

In response the Nambu factory proposed a version of their Type 96 light machine gun, scaled up to 7.7mm. The Kokura Arsenal and Tokyo Gas proposed weapons based on the mechanisms of the Type 92 medium machine gun, while the Nagoya Arsenal based their proposal on the Type 97 tank machine gun, itself a close copy of the ZB-26 machine gun.

None of the prototype weapons performed very well during trials in June 1938, but the Nambu weapon seemed to have promise and an improved version was tested in November. A third iteration tested in January 1939 eliminated the need to lubricate the ammunition and a fourth improved the quick-change barrel feature. Service tests by the Infantry and Cavalry School in May 1939 confirmed the suitability of the weapon and it was adopted as the Type 99 light machine gun. Simplifying ammunition supply somewhat, the Type 99 light machine gun fired the same 7.7x58 rimless ammunition as the new Type 99 rifle used by the infantry, but it could not fire the 7.7x58SR ammunition initially used by the Type 92 medium machine gun.

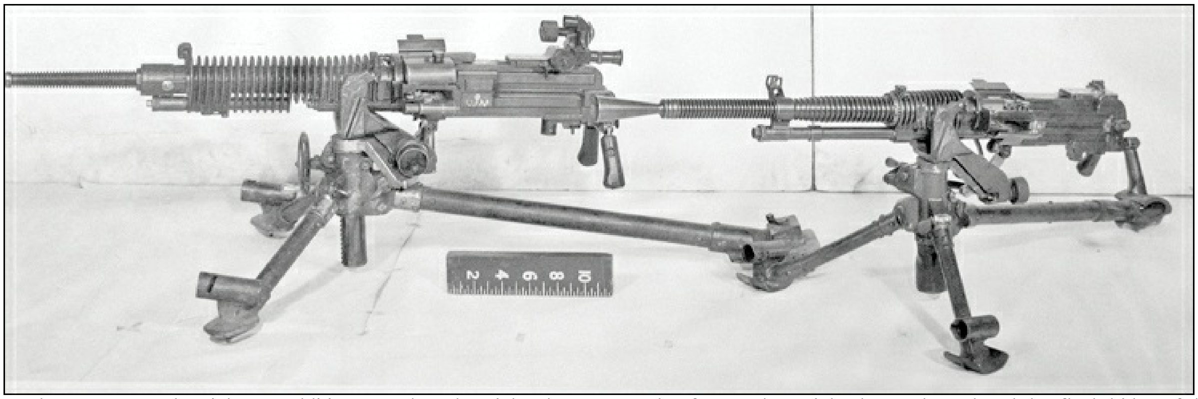
| Army Machine Gun Production | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | FY31 | FY32 | FY33 | FY34 | FY35 | FY36 | FY37 | FY38 | FY39 | FY40 |
| Light MG, Type 11, 6.5mm | 541 | 890 | 2,068 | 1,750 | 1,614 | 1,358 | 862 | 4,872 | 9,662 | 2,946 |
| Light MG, Type 96, 6.5mm | – | – | – | – | – | 50 | – | – | – | 8,530 |
| Light MG, Type 99, 7.7mm | – | – | – | – | – | – | – | – | – | 500 |
| Medium MG, Type 3, 6.5mm | – | 179 | – | – | – | – | – | – | – | – |
| Medium MG, Type 92, 7.7mm | – | – | 816 | 157 | 814 | 503 | 1,418 | 2,054 | 2,695 | 4,036 |
| | 1941 | | 1942 | | 1943 | | 1944 | | 1945 | |
| | Apr-Jun | Jul-Dec | Jan-Jun | Jul-Dec | Jan-Jun | Jul-Dec | Jan-Jun | Jul-Dec | Jan-Jun | Jul-Sep |
| Light MG, Type 96, 6.5mm | 450 | 1,500 | 1,750 | 300 | – | – | – | – | – | – |
| Light MG, Type 99, 7.7mm | 1,300 | 3,900 | 4,900 | 4,920 | 5,100 | 5,400 | 6,200 | 8,100 | 8,128 | 1,608 |
| Medium MG, Type 92, 7.7mm | 250 | 1,300 | 2,350 | 5,300 | 6,000 | 5,600 | 2,096 | 616 | 991 | 349 |

Production began in 1940 at Nambu's firm and in 1941 the Nagoya Arsenal and Hitachi joined in, followed by the Kokura Arsenal. Ease of manufacture had been designed into the weapons, but as had been the case with the Type 96 light machine gun, in practice parts were rarely interchangeable between weapons, each gun being essentially hand-fitted. In addition, each of the four producers had an array of subcontractors, each of whom seems to have felt free to modify designs to simplify production. Further, as the situation in Japan got worse, the firms implemented shortcuts to save high-quality materials and speed production. Many detail changes were made, and by October 1944 the rear monopod had been eliminated and by May 1945 the mounting bracket for the telescopic sight had also been dispensed with.



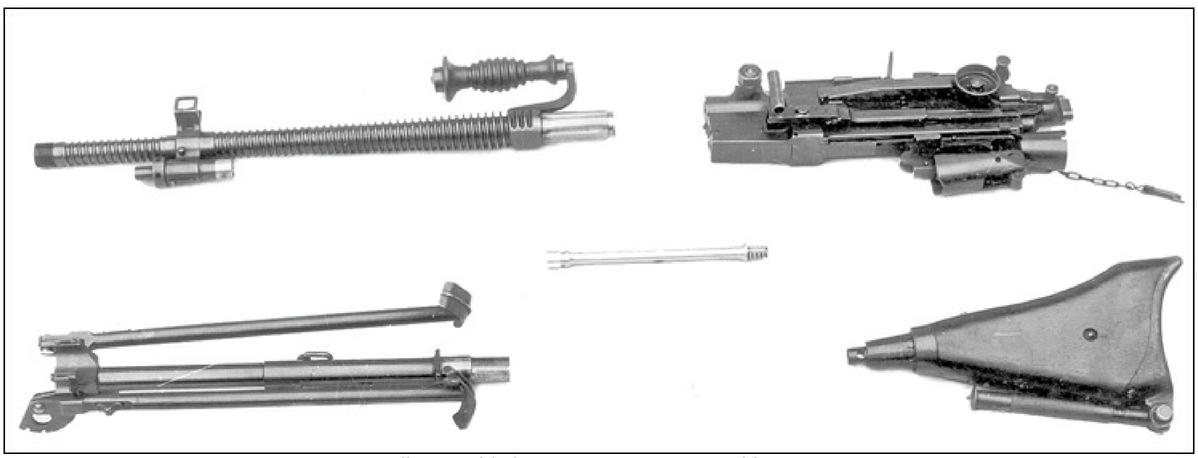
The Type 98 water-cooled machine gun.

In the meantime work had continued on the medium machine gun family, along two separate paths. The Kwantung Army had requested a belt-fed water-cooled machine gun for sustained fire for use from their fortifications on the Soviet border in November 1938. The solution adopted was to take the Type 89 aircraft machine gun (a close copy of the British Vickers) and convert it to a water-cooled configuration as the Type 98 machine gun. This, of course, converted it right back to the water-cooled weapon the Vickers had originated as, albeit quite a bit heavier than the original had been. A small number were apparently built in 1939 and issued to the border units in Manchuria, but were not otherwise used.



A Type 92 on the left and a Type 1 on the right. In addition to reduced weight, the Type 1 also featured a quick-change barrel and the flash hider of the Type 99 light MG.

There had also been a move to reduce the weight of the Type 92 medium machine to improve its man-carried mobility. A requirement was drafted for a weapon with a weight of no more than 40 kg with a sleigh-type carriage that could be carried by two men. A first trial in March 1940 was a failure – the gun was unreliable, the barrel too light and the lightweight mount provided insufficient stability. A second trial, held in June 1940, showed some improvement but the project was then dropped for two years. A third series of tests, in November 1942, showed that a modified version of the second gun combined with a lightened variant of the Type 92 tripod worked satisfactorily. This combination reduced the weight of the gun to 15.2 kg and of the tripod to 16.4 kg, a 40% weight reduction. It was standardized as the Type 1 machine gun, but plans to place it in full production were frustrated by lack of material and, presumably, an unwillingness to sacrifice existing production quotas.[2]



A disassembled Type 99 paratroop machine gun.

The creation of parachute forces led to the development of a more specialized weapon. Research was started in 1938 and the decision was quickly taken to modify the Type 99 light machine gun for this role. The mechanics of the Type 99 remained unchanged. The use of a spring-locked cross-key enabled the user to detach the wooden stock from the receiver, and when the barrel was also removed the longest piece (receiver/gas cylinder) was only 666mm, short enough to fit in the long trouser pouch of a paratrooper. It could be further shortened, if needed, by removing the gas cylinder. Further, the bipod could also be removed for ease of packing. Another feature was the replacement of the wooden pistol grip with a metal one that could be unlocked to rotate forward to envelope and protect the trigger guard.

The prototype was built by Nagoya Arsenal and tests began there in July 1943, followed by further trials at the Futsu proving grounds. It was accepted for service and standardized as the Type 99 paratroop machine gun. A small percentage (probably no more than a few hundred) of the Type 99 light machine guns were built to this specification and they were used in combat by the Army raiding units.

In addition to the purpose-built infantry machine guns, use was also made of other types of machine guns, often on extemporized mountings. The first tank machine gun was the Type 91, which was a Type 11 with the hopper enlarged to hold 60 rounds. It was built in only limited numbers, but some were fitted with bipods while retaining the large optical sights to become rather awkward infantry weapons. It was replaced by the Type 97 tank machine gun, which was a close copy of the

Czechoslovakian ZB-26, but chambered for the 7.7x58mm round in SR and rimless configurations. When the production of this weapon outstripped that of tanks it too was fitted with bipods to yield a rather good weapon.

A GI examines a 12.7mm Type 1 aircraft machine gun on an improvised ground mount on Negros Island.

For aircraft armament the IJA adopted two different weapons at the same time. The Lewis machine gun with its drum magazine in 7.7x58SR caliber was standardized as the Type 89 Flexible Aircraft Machine Gun for hand-held defensive use, while the Vickers air-cooled weapon was chosen as the Type 89 Fixed Aircraft Machine Gun, in the same caliber, as the weapon of choice for fighters. The flexible gun was replaced in aircraft use by the Type 98 Flexible Aircraft Machine Gun, a close copy of the German MG15 machine gun, complete with the adoption of the German 7.92mm ammunition. The heavier weapon was the Type 1 (or Ho-103) machine gun. This was based on the .50cal Browning operation, but utilized the lower-powered 12.7x81SR Italian round. All of these were placed on improvised ground mounts for use by air units that had lost their aircraft.

Some Navy Lewis guns were fitted with butt stocks for use as light machine guns.

The IJN bought one machine gun for surface use, the Lewis gun. Numbers were purchased from BSA in Britain starting in 1925, eventually being designated the Type 92 machine gun for ground, naval and flexible aircraft use. These guns were purchased chambered for the standard British .303 caliber (7.7x56R) cartridge, adding yet another type of small arms ammunition to the already overloaded supply system. Weapons were built by the Toyokawa and Yokosuka naval arsenals, while mounts were made by several other arsenals. Production continued to at least 1942. The one change made by the Japanese was that while the original British weapon had provision for fitting the cocking handle on either side, the Japanese-built version cocked only from the left. Both conventional ground fire tripods and AA tripods with long legs were issued. The Type 92 (Lewis) gun was used by naval ground forces through the war, albeit not in large numbers, as they preferred the Army-type machine guns.

| Machine Gun Data | | | | | | |
|---|---|---|---|---|---|---|
| | Ammunition | Weight (kg) | Barrel Length (mm) | Muzzle velocity (m/s) | Cyclic Rate (rpm) | Effective Rate (rpm) |
| Type 11 Light MG | 6.5x50 | 10.2 | 443 | 730 | 500 | 120 |
| Type 96 Light MG | 6.5x50 | 8.7 | 550 | 735 | 550 | 120 |
| Type 99 Light MG | 7.7x58 | 11.4 | 550 | 670 | 800 | 200 |
| Type 3 Heavy MG | 6.5x50 | 55.0 | 737 | 740 | 450 | 150 |
| Type 92 Heavy MG | 7.7x58SR | 55.3 | 721 | 800 | 450 | 150 |
| Type 1 Heavy MG | 7.7x58 | 31.8 | 589 | 731 | 450 | – |
| Type 92 Lewis MG | 7.7x56R | 11.8[a] | 667 | 731 | 550 | 250 |
| [a] gun only | | | | | | |

While the Lewis guns were the recipients of purpose-designed tripod mounts for ground use, the other naval aircraft machine guns, the 7.7mm Type 97, the 7.92mm Type 1 (similar to the Army's Type 98), the 13mm Type 2 (similar to the German MG131) and the 13.2mm Type 3 all had to do with improvised mountings at local naval airfields.

In addition, of course, the Japanese made considerable use of captured machine guns for their garrison troops in overseas conquests. Of 604 light and 628 medium machine guns held by Japanese forces in eastern and central Java on surrender in 1945, no fewer than 367 light and 548 medium weapons were captured Allied models, mostly Dutch. A small number of Dutch Madsen guns even made their way to Burma. The divisions and brigades of the 35th Army in the southern Philippines in October 1944 were somewhat better provided, having 1,105 Japanese and 409 captured light machine guns and 278 Japanese and 135 captured medium machine guns. No figures are available for Japanese forces in China, but large numbers of Chinese ZB-26s and Maxims were almost certainly in use.

### Type (Taisho) 11 Light Machine Gun

This weapon married the basic operating principles of the gas-operated Hotchkiss with a unique feed system that took standard 6.5mm ammunition in five-round rifle clips and fed them into the receiver via a hopper. An oil reservoir added a drop of oil onto each cartridge as it was fed in to reduce jams. The weapon fired fully-automatic only. A gas valve adjusted the rate of fire, mainly to compensate for fouling of gas passages. The mounting of the extractor on an external pivot was a source of reliability problems.


Type (Taisho) 11 light machine gun.

### Type 96 Light Machine Gun

This was a fairly complete reworking of the light machine gun concept that incorporated some features of the ZB26, in particular the overhead magazine. The ammunition still had to be lubricated, but this function was now carried out when the rounds were loaded into the magazine, and the elimination of the receiver-mounted oiler permitted the incorporation of a quick-change barrel. The Type 96 also used a unique bolt lock, in the form of a square frame that moved up and down. It was provided with both iron sights and a mount for a 2.5x telescopic sight. Only full-auto fire was possible and feed was from a 30-round magazine mounted above the receiver. It fired from the closed bolt position. The Type 96 was better-balanced, easier to handle, and somewhat more reliable than the Type (Taisho) 11.


Type 96 Light Machine Gun.

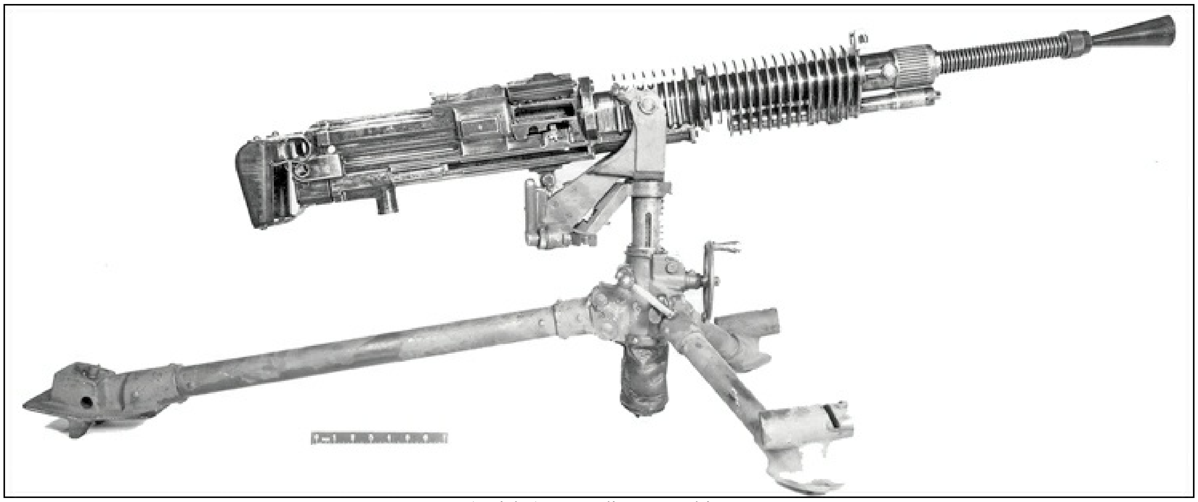
## Type 99 Light Machine Gun

This was a sturdier version of the Type 96, intended for the more powerful 7.7x58 cartridge. The other operationally significant feature of the new weapon was, finally, the elimination of the need to lubricate the rounds before chambering. This was accomplished by changing the extraction mechanism and allowing adjustment of cartridge headspace. Other changes were a modified barrel-locking device and an adjustable monopod on the buttstock.


Type 99 Light Machine Gun.

## Type (Taisho) 3 Medium Machine Gun

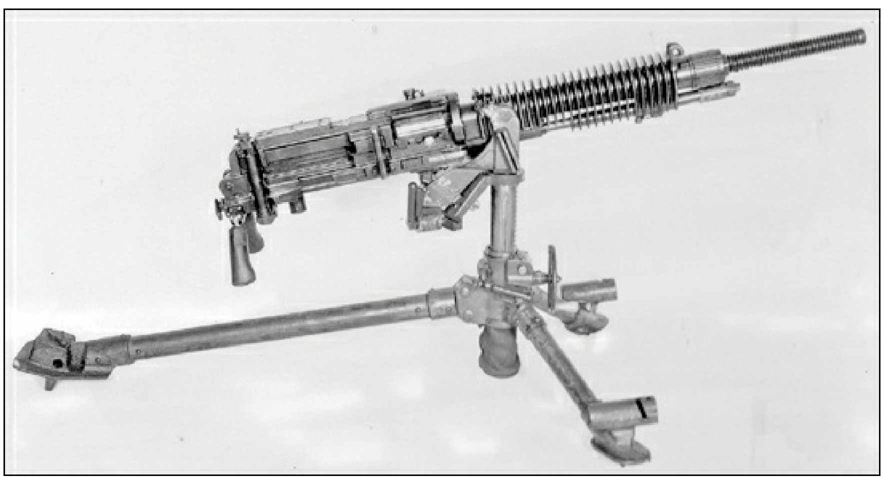
This was a Hotchkiss design slightly adapted for Japanese service. It fired the 6.5x50SR cartridge used by the service rifles of the time, which simplified supply but later proved underpowered for long-range use. Ammunition feed was by 30-round strips fed from the left. An oil reservoir at the top of the receiver lubricated each round during loading to facilitate its subsequent extraction. Aiming was by iron sights, blade in the front and peep in the rear, with ranges graduated from 300 to 2,200 meters. The tripod featured sockets at the base of its two front legs for poles to facilitate carrying the assembly in one piece.



Type (Taisho) 3 Medium Machine Gun.

**Type 92 Medium Machine Gun**

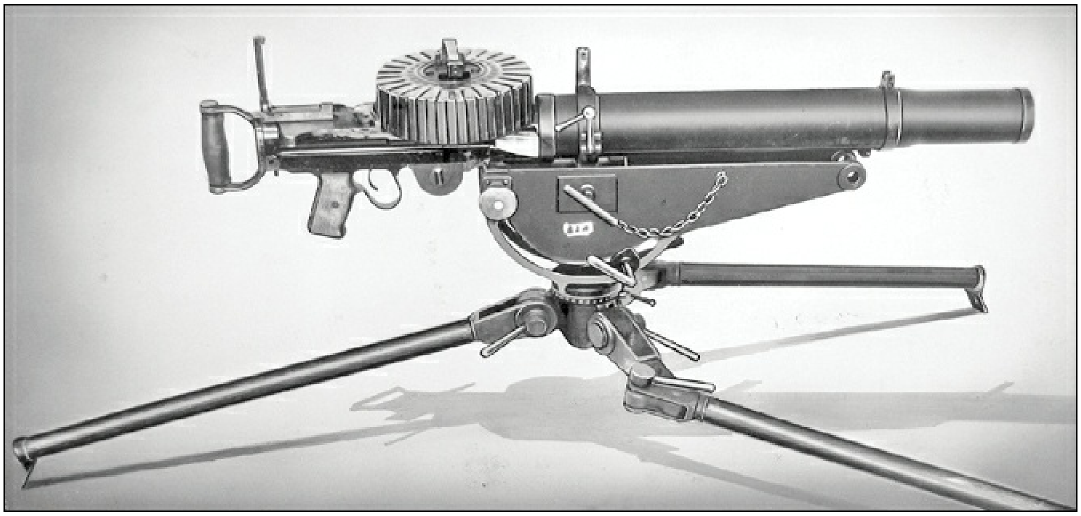
This was the Type 3 modified and enlarged slightly to accommodate the more powerful 7.7mm cartridge. Originally designed to take the 7.7x58SR round developed for aircraft machine guns, it was later found possible to also fire the 7.7x58 rimless round developed for rifles and light machine guns, which simplified front-line supply. The rimless ammunition was available in ball, tracer and AP variants, while the semi-rimmed rounds also included incendiary and HE, although these were primarily meant for aircraft use. The most common configuration for the 30-round hard strip was ball with every fifth round a tracer. A point of recognition is the pair of adjustable grips that replace the spade grips on the (Taisho) 3. The more powerful ammunition made possible firing at longer ranges and to that end an attachment point was provided for magnified optical sights, the most common being a straight 4x telescopic device, although panoramic sights for indirect fire were also provided.



Type 92 Medium Machine Gun.

**Type 92 (Navy) Machine Gun**

This was the standard Lewis machine gun, unique only in that the cocking handle was fixed on the left side. It fired 7.7mm rimmed ammunition, identical with the original British .303” cartridges. It was air cooled, gas operated and was loaded via 47- or 97-round drum magazines. The weapon was well-proven, relatively light weight for a tripod-mounted gun, and reliable, but used a completely non-standard round of ammunition.


Type 92 (Navy) Machine Gun.

1 For some time after the war it was believed that the Type (Taisho) 11 light machine gun needed a less powerful version of the 6.5mm round, one distinguished by the letter “g” in a circle on the cartridge case, but this has turned out not to be so. The actual use of the “g” ammunition, however, remains unclear.

2 A Type 1 machine gun was captured by US forces on Luzon in early 1945, presumably having been sent there for field trials.

# 4

# Grenade Dischargers

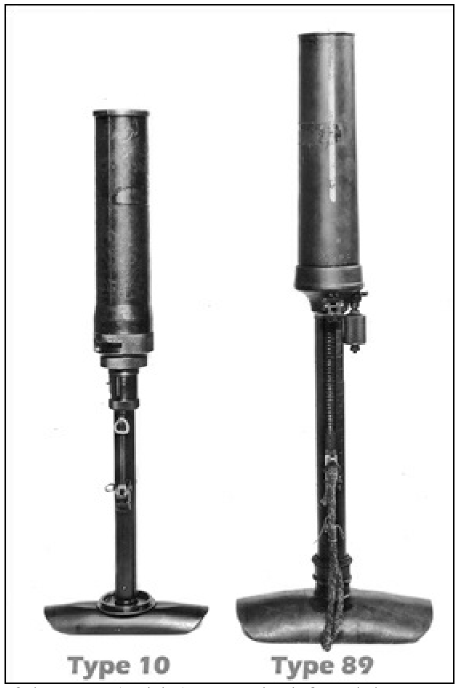
Perhaps the most distinctively characteristic weapon of the Japanese ground forces in World War II started life primarily as a signal flare launching device. The Type (Taisho) 10 grenade discharger was adopted in 1921, along with the Type (Taisho) 10 signal, flare, and high explosive shells, and the Type (Taisho) 11 smoke shell. The Type 10 HE shell was also a hand grenade but a compromise 7-second fuze proved too long for hand-throwing and the charge of 50g of TNT too small. The device functioned well as a signaling device in the era before portable radios, however, and in that role the Type (Taisho) 10 grenade launcher was issued to battalion and regimental headquarters.

Troops demonstrating the use of the Type (Taisho) 10 grenade discharger in pre-war maneuvers. Note the need to hand-hold the weapon in the absence of a bipod.

The problem of providing fire support between the maximum range of the hand grenade and the minimum range of a mortar thus remained and in the late 1920s new approach was tried. The concept of a single munition doing double duty both as a hand grenade and as a projected warhead was still attractive, both from the industrial/supply perspective and in terms of flexibility within the rifle units at the front. It was recognized, however, that the necessary loose fit of a hand grenade (even a cylindrical one) within the barrel and the poor aerodynamic shape severely limited range and did not contribute to accuracy. The new weapon would thus have a rifled barrel and a family of dedicated ammunition rounds while retaining the ability to fire hand grenades as needed.

The Type 89 grenade discharger was accepted for service in 1929 and demonstrated great improvements in performance compared to the Type (Taisho) 10, which would now be colloquially be referred to as the “light grenade discharger” to distinguish it from the new heavy grenade discharger.

The Type 89 was similar in overall appearance to its predecessor, consisting of a barrel on a pedestal attached to a small, curved baseplate, but there were some significant differences. One, already alluded to, was the incorporation of rifling in the barrel as a means of adapting to new, long-range and more efficient projectiles. The second was a new means of varying the range, using a knurled knob to extend or retract the firing pin housing protruding into the base of the barrel. Increasing the chamber volume below the projectile when it was initiated lowered the propellant gas pressure and reduced the range. The trigger was a continuous-pull type similar to that of the light grenade discharger.



A comparison of the Type (Taisho) 10 on the left and the Type 89 on the right.

The new weapon was accompanied by a new family of ammunition specifically designed for it, starting off with the Type 89 HE round. The projectile had a copper rotating band that expanded into the rifling of the barrel when the propellant gasses formed behind it on firing, guaranteeing a tight fit that yielded accuracy and long range. Better design and thinner walls meant that the payload of 153 g of low-grade TNT was triple that of the old Type (Taisho) 10 grenade, not surprising in an “offensive-type” round that stressed blast effect over fragmentation. It was detonated by the Type 88 small instantaneous fuze with set-back safety. At its maximum range of 650 meters the Type 89 HE round had a time-of-flight of 12.5 seconds, reached a maximum ordinate of 194 meters and drifted 21 mils (13 meters) to the right due to spin. At that range the 50% zone (in which 50% of the rounds fired from a fixed weapon would land) was 74 meters long and 11 meters wide. Because of the drop-off in accuracy an SNLF tactical manual put the optimal range of the Type 89 at 200 to 300 meters.

To complement the new grenade discharger a new hand grenade was also developed and introduced, the Type 91 in 1931. This had a heavy serrated case that produced fragmentation but limited the explosive load to 65g, although this was still a 30% increase over the Type (Taisho) 10 grenade. The multi-purpose Type 91 grenade was fitted with a screw-in removable propellant module at the base specifically for use in grenade dischargers, either the Type (Taisho) 10 or the Type 89, and this could be removed for use as a hand grenade or replaced by a finned tail assembly for use with a rifle grenade launcher. An incendiary hand grenade was also available with a propellant module for use with a grenade discharger.

The Type 89 HE round was complemented by a family of more specialized ammunition. The Type 89 incendiary round contained 300g of an incendiary mixture based on potassium nitrate, aluminum and sulphur that was ignited by a powder delay train initiated by the propellant gasses. The Type 95 smoke round used the Type 89 small time fuze, which could be set in ½ second increments between 0 and 20 seconds, to expel and initiate the HC filler, which was contained in a brass can fitted with a steel retarder cup on a cord to slow its descent. Assorted signal and flare rounds were also available. All but the HE appear to have been little used.

The Type 89 was designed to be fired at a 45° angle, with range being changed via the movable firing pin housing. It was possible, however, to fire at lower elevations provided the baseplate could be properly supported.[1] Firing tables were issued for firing at 25° elevation out to 469 meters and 15° out to 317 meters. Of course, range was reduced, as was the vertical fall of the round to engage targets in defilade, but so was time of flight and drift. Thus, where firing at 300 meters range gave a time of flight of 8.3 seconds and a drift of 30 mils (= 9 meters) at the normal 45° elevation, firing at 15° reduced the time of flight to 4.6 seconds and the drift to 4 mils (= 1 meter). A challenge, of course, was achieving the proper elevation with the weapon. Some weapons were issued with a simple bubble level that indicated 45°, others had a weight and quadrant to indicate varying elevations, and other were issued with no such device at all, relying on the training and estimation of the gunner. Pointing the weapon in traverse was accomplished by sighting over a line on the top of the barrel.

The Type 91 hand grenade with propellant module on the left and the Type 89 HE round on the right.

| Grenade Discharge Data | | |
|---|---|---|
| | Type 10 | Type 89 |
| Length (oa) | 508mm | 609mm |
| Length (barrel) | 241mm | 254mm |
| Weight | 2.50 kg | 4.65 kg |
| Range (Type 91) | 160 m | 190 m |
| Range (shell) | n/a | 650 m |
| Grenade Wt | 533 g | 533 g |
| Shell Wt | n/a | 794 g |

The Type 89 could be broken down into three parts by separating the baseplate, pedestal and barrel, but the parachute forces developed a variant of their own that disassembled and reassembled more quickly and for which a special pack was available.

The Type 89 was placed in low-rate production after a few years delay but production remained at a fairly low level until combat in China showed the value of these devices as front-line infantry weapons. Production then dramatically ramped up to fill the new requirements for each rifle platoon in the IJA to have its own grenade discharger squad, peaking in 1940. Indeed, by 1938 the Nagoya, Kokura and Osaka Army Arsenals were all manufacturing the Type 89, either by themselves or via subcontractors. Initial requirements appear to have been filled by late 1940, and thereafter the weapon was produced for replacement of losses and to equip newly-raised unit.

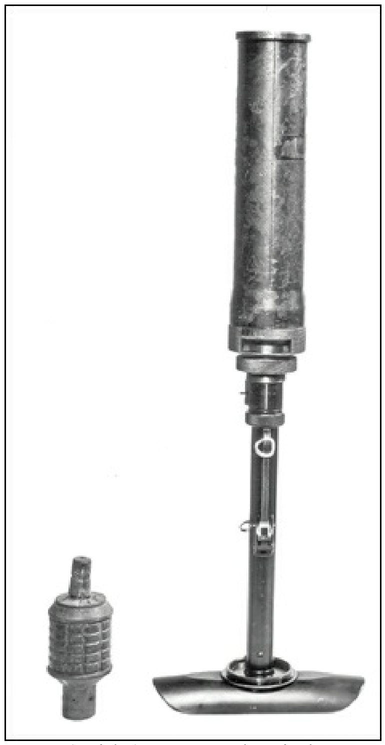
| Production of Grenade Dischargers | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 1931 | 1932 | 1933 | 1934 | 1935 | 1936 | 1937 | 1938 | 1939 | 1940 |
| Type (Taisho) 10 | 300 | 1,027 | 276 | 5 | 0 | 327 | 1,161 | 0 | 0 | 0 |
| Type 89 | 0 | 450 | 3,038 | 1,906 | 1,439 | 1,002 | 2,730 | 5,797 | 17,738 | 21,827 |
| | 1941 | | 1942 | | 1943 | | 1944 | | 1945 | |
| | Apr-Jun | Jul-Dec | Jan-Jun | Jul-Dec | Jan-Jun | Jul-Dec | Jan-Jun | Jul-Dec | Jan-Jun | Jul-Aug |
| Type 89 | 1,800 | 4,200 | 5,100 | 5,200 | 4,900 | 4,100 | 3,500 | 2,420 | 1,680 | 550 |

Units serving in China captured the Chinese Type 27 grenade discharger, which was inspired by the Japanese weapons. These appear to have been used by non-combat units, such as transport and engineer elements, that would normally not have had such weapons at all. When such units were transferred to the Pacific they sometimes took the Type 27s with them and they were encountered in very small numbers by US forces.

The Type 89 proved a very effective weapon, employed in squads of three or four pieces as part of a rifle platoon. The squad was employed as a unit, although the individual weapons often engaged separate targets, with the primary target for the heavy grenade launcher being the enemy's automatic weapons. The light grenade discharger retained its earlier primary role as a signal device at battalion and regimental headquarters.

**Type (Taisho) 10 Grenade Discharger**

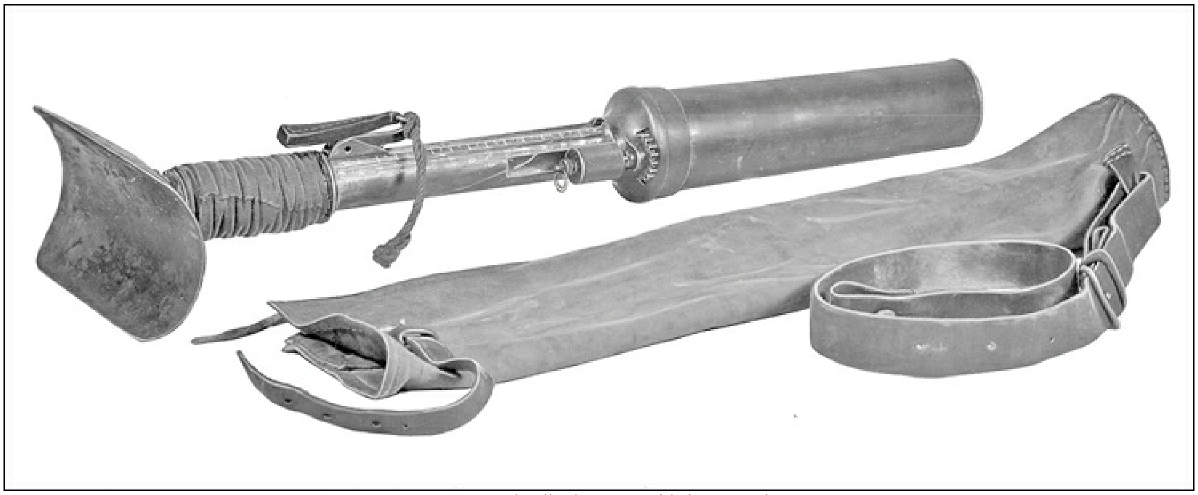
This was a smooth-bore weapon designed to fire pyrotechnics and hand grenades to relatively short distances. It consisted of a barrel mounted on thinner pedestal base, which in turn was set on a small baseplate. Hand grenades were fired by screwing a propellant module into the bottom of the grenade and then dropping the grenade, base first, into the muzzle. A lever in the base pulled the firing pin to the rear, compressing a spring, until a sear reached a detent, which caused the firing pin to be released to leap forward into the primer of the propellant module of the grenade. The weapon was always fired at an elevation of 45° (barring exceptional circumstances) and range was varied by turning knob that varied the opening of a gas port, which would vent a percentage of the propellant gasses out the rear. No sight or elevation mechanism was provided and aiming was accomplished by looking down a longitudinal groove cut into the top side of the barrel.



Type (Taisho) 10 Grenade Discharger.

**Type 89 Grenade Discharger**

This was a much improved version of the prior model. It featured a rifled barrel and a family of purpose-designed spin-stabilized ammunition, in addition to firing the Type 91 hand grenade. It also used a retractable firing pin housing to vary the range. Two range scales were provided for this device, one covering 120 to 650 meters for use with the Type 89 HE shell, and one covering 40 to 190 meters for use with the Type 91 hand grenade. The shell was more useful in offense, with its blast effect, while the grenade, with a fragmenting case, was more suited to defense. In addition, smoke, incendiary, flare and signal rounds were also available.



A Type 89 grenade discharger with its carrying case.

1 Examples captured early in the war were informally called “knee mortars” by US troops because the curved baseplate looked like it could rest on a knee or thigh. Doing that usually resulted in a broken leg and strenuous efforts were made to erase that term from the soldiers’ lexicon.

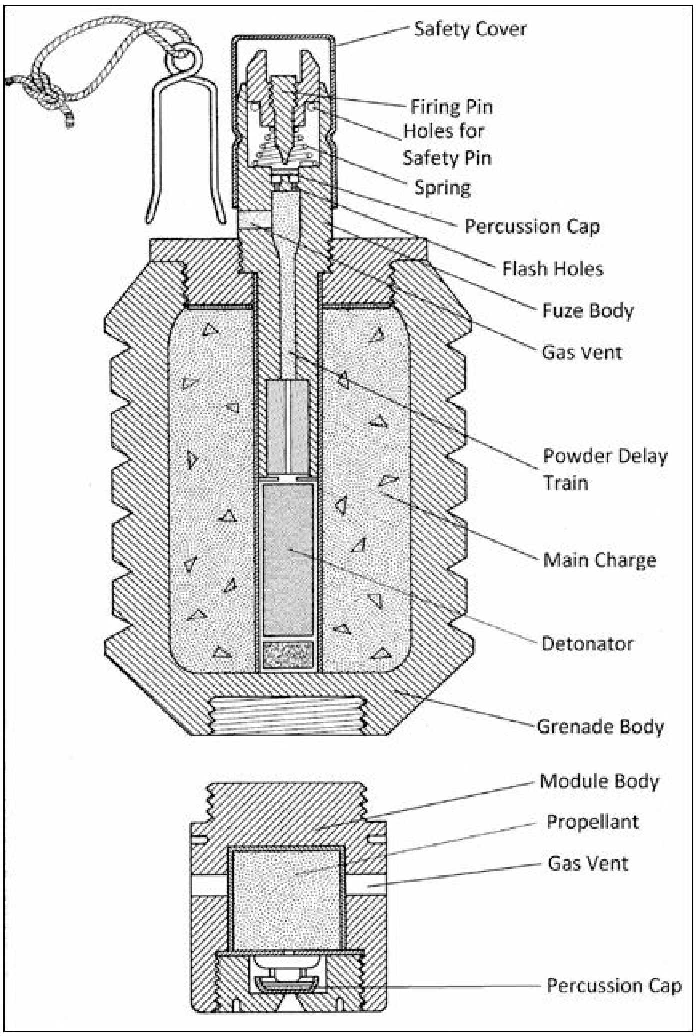
# 5

# Assault Weapons

## Grenades

Japanese grenades were smaller than their western counterparts and, although their blast effect was usually adequate their fragmentation was often ineffective. The fuzes were unreliable and often unsafe, especially as a result of their susceptibility to deterioration from exposure to moisture.

The oldest of the grenades to see service in the war was the Type 91 which encased its charge in a serrated cast iron body for fragmentation effect. It was actually a multi-function grenade, featured a threaded recess in its base that could accommodate a propellant module or a finned extension. The propellant module had a primer at its base so that it could be fired from the Type 10 grenade discharger to give the former signaling device a combat capability. Notably, the fuze had no impact function, just its time delay. It could also be used from the new Type 89 grenade discharger, although the dedicated HE round of that weapon was much more efficient. The extension with fins enabled it to be fired from a spigot rifle grenade launcher, although these were not common.




The Type 91 hand grenade and propellant module.

A multi-function grenade, that could be used as a hand grenade, rifle grenade, or fired from the ubiquitous grenade dischargers was certainly attractive from the logistics perspective and greatly simplified the combat load of the infantry. On the other hand, it was not nearly as effective, in range, accuracy or payload, as the purpose-designed HE rounds for the Type 89 grenade discharger, and rifle grenade launchers had fallen out of favor. Thus, although the Type 91 remained production, albeit at decreasing levels, until 1940 to provide HE for the Type 10 grenade launchers, it was replaced on most of the production lines by the new Type 97 in 1937.

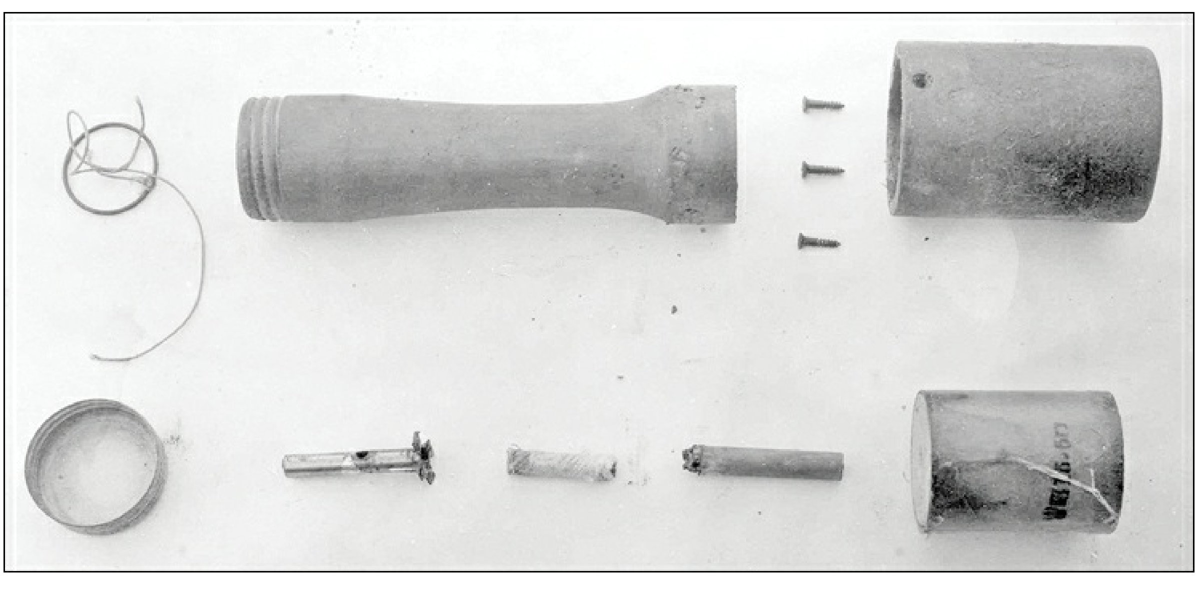
The Type 97 was nothing more than the Type 91 without the base recess, meaning it was a hand-thrown weapon only. One other key change was to the fuze. The fuze of the Type 91 was something of a compromise, as it had to provide 7-9 seconds of delay for use with the grenade discharger, which was far too long for a hand-thrown grenade. Once that requirement had been discarded, the fuze of the Type 97 was cut to a much more practical 4-5 seconds. The Type 97 went into production in 1937 and became the standard hand grenade, such that the 1941 mobilization plan, released in October 1940, specified the Type 97 at an initial allocation of 500 per infantry battalion, with another 500 held as infantry regiment reserve.

The time of the Type 97 was coming to a close, however. It fit the classic definition of a defensive grenade, with a prefragmented metal case to throw off shrapnel. The Army now turned to a new design, smaller with a smooth, thinner cast steel body, closer to the concept of an offensive grenade, relying more on blast than fragmentation. The Type 99 entered production in 1941 as the new standard hand grenade to the end of the war, although existing stocks of Type 91s and Type 97s continued to be issued. In a sense, the Type 99 represented a reversion to the hand-and-launched grenade in that it could be fired from the Type 100 rifle grenade launcher, but that weapon was never standardized in TO&Es, but was rather an additional weapon assigned to units as needed. That the Type 99 was an offensive grenade was demonstrated by a test by the British Army in which a detonated grenade was found to have turned about 75% of its metal casing into dust.

**Army Hand Grenade Production**

| | FY36 | FY37 | FY38 | FY39 | FY40 | FY41 | FY42 | FY43 | FY44 | FY45 |
|---|---|---|---|---|---|---|---|---|---|---|
| Type 97 | 0 | 210,000 | 2,480,000 | 1,780,000 | 3,421,000 | 0 | 0 | 0 | 0 | 0 |
| Type 98 | 0 | 0 | 96,000 | 2,204,000 | 0 | 0 | 0 | 0 | 0 | 0 |
| Type 99 | 0 | 0 | 0 | 0 | 0 | 2,840,000 | 1,200,000 | 1,500,000 | 2,881,000 | 177,000 |
| flame bottles | 0 | 0 | 0 | 0 | ? | 50,000 | 50,000 | 80,000 | 59,000 | ? |
| smoke bottles | 0 | 0 | 0 | 0 | ? | 50,000 | 57,000 | 80,000 | 74,000 | ? |
| ceramic grenades | 0 | 0 | 0 | 0 | 0 | 0 | ? | ? | ? | ? |

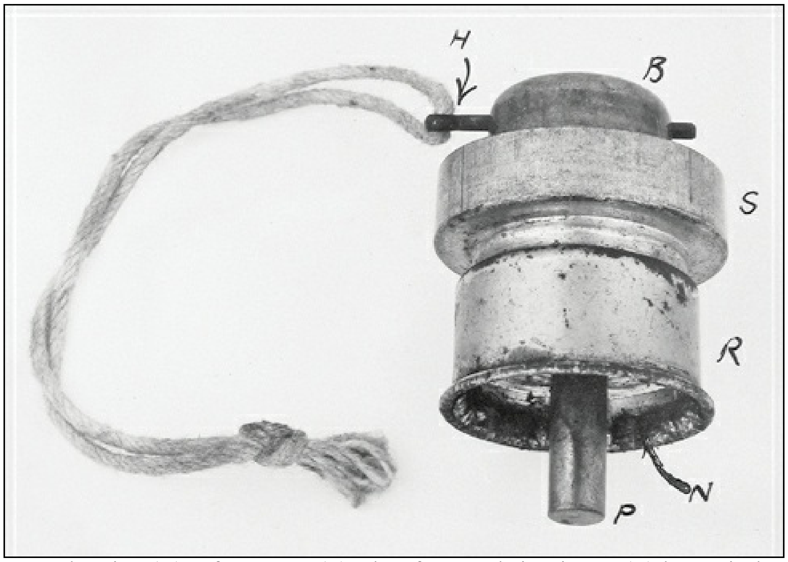
One model of Army hand grenade that fell outside the development narrative was the Type 98 stick grenade. This seemingly adopted the configuration of the German "potato masher" grenade and, although considerably smaller, actually had more fragmentation effect than the original, That was due to the Type 98 having a cast iron warhead body 5 mm thick, where the German original used thin sheet metal for blast effect. In fact, its development and production had been spurred by experience on the receiving end of the Chinese versions in 1937. The Chinese actually varied the designs quite a bit at different arsenals and it is unclear if the Army simply used one of the smaller ones as a starting point or if they, themselves, reduced its size so dramatically, from 365mm length in the German Model 24 to less than 2/3 that.



A Type 89 hand grenade disassembled.

In any event, the order was only for 2.3 million and when that was completed production ceased. Throwing range was improved by the use of the handle, but the Type 98 was about 20% more expensive than the Type 97, while the main factor was probably that the Army was moving from defensive (fragmentation) grenades to offensive (blast) grenades as exemplified by the Type 99.

At about the same time the Army started using glass bottles for specialized grenades. This may have been inspired by the successful use of "molotov cocktails" by the Finns in the Winter War of 1939-40, noticed by many other nations. Whereas the Finns used these as defensive anti-tank weapons, the Army here actually developed two variants for use as assault munitions.



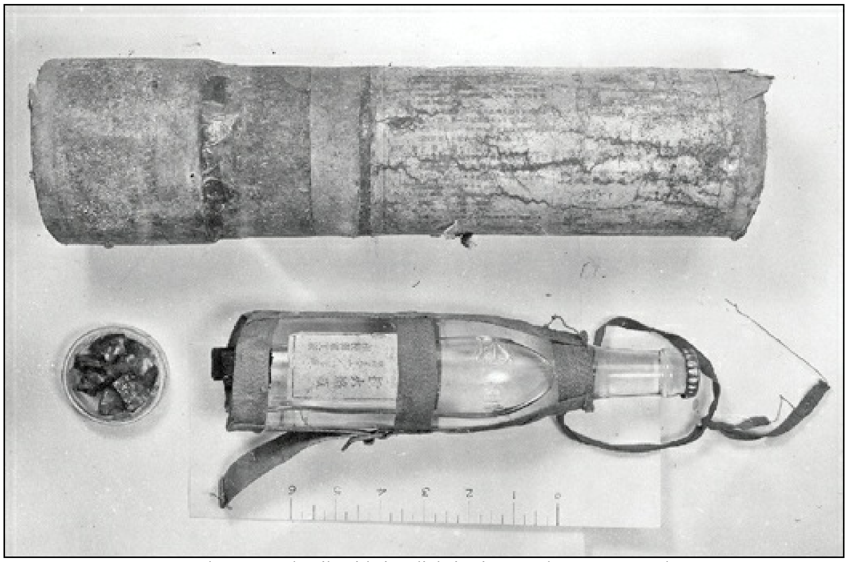
A Molotov Cocktail fuze: (B) upper housing, (H) safety cotter, (P) tube of pyrotechnic mixture, (R) lower tinplate housing, (S) middle housing.

The "flame bottle" was a straightforward glass gasoline grenade, albeit in a number of variants. A unique feature of the primary version was the ignition system. This was a simple "all-ways" fuze in which a firing pin, held in place by a safety cotter prior to use, moved forward against a weak spring into a detonator of mercury fulminate, which in turn ruptured a tin foil diaphragm and ignited a pyrotechnic mixture of barium nitrate and magnesium powder, which then ignited the contents of the 354 ml (12 oz) bottle. The fuzes were shipped separately from the bottles, and, indeed, the bottles were often procured locally as needed. Five soft metal lugs, or arms, bent upwards and inwards from the bottom of the lower tinplate housing so that once the fuze was pushed down over the lip of the bottle it stayed there.

Another type came in a cardboard tube that enclosed the 300 ml bottle and a disk-shaped igniter capsule. In action the tube was opened and the igniter was attached to the bottom of the bottle by means of a rubber harness. The bottle contained a 15% solution of polymethylmethacrylate (an acrylic) in benzene, yielding a thickened fuel that adhered to surfaces. The igniter held 28 g of black phosphorus. On impact, both shattered, with the phosphorus igniting the fuel.

It is not clear when production started, but 3,200 were turned out in April 1941, a figure that increased to 5,000 per month by the end of the year. It climbed to 8,000/month by 1943, but stopped briefly starting in April 1944 before restarting five months later, then stopping again in the spring of 1945.

Of course, these molotov cocktails were fabricated by local units as well, with a predictable diversity of designs and implementations, depending in part on availability of materials. The 11th Division in Manchuria in December 1941, for instance, issued instructions that cider bottles were to be filled with 50 g of sulphuric acid, then the bottle 80% filled with gasoline, and the bottle then plugged with wood or wax. Motor oil could be used to thicken the mixture. The bottle would then be wrapped in paper impregnanted with potassium chlorate and charcoal powder. When the bottle was broken on impact the acid would react with the potassium chlorate and burst into flame. Other improvisations were cruder, including simply using gassoaked rag as the burning fuze.


A molotov cocktail with its disk igniter and transport tube.

The flame bottles were complemented by smoke bottles, or frangible smoke grenades. These used special glass bottles, spherical with a flat bottom with a diameter of 66mm and a neck on top closed by a rubber stopper under an iron cap. The bottle contained 121 ml of a mixture of titanium and silicon tetrachloride, which formed smoke when exposed to the air. It also formed hydrochloric acid, but not in enough density to act as a significant irritant. Their small size meant that they were effective only to screen point targets or if put in front of an enemy pillbox embrasure, or if used in very large numbers.

A different factor came into play later in the war, the need to conserve metals. Both the Army and the Navy turned to the traditional Japanese pottery industry. The result was an array of ceramic grenades, typical of which was the Navy's Type 4. The pottery grenades typically exploded with considerable blast with a sharp report and a cloud of white smoke, but very little fragmentation, the casing having been largely turned to dust. The effective radius was about 15 meters. The grenades had several drawbacks, one being their fragility, being susceptible to breakage either when carried or by hitting a hard object in flight. Another was that the match head strikers were sometimes susceptible to moisure damage, which could cause duds. Pottery grenades were first encountered by the Allies on Leyte in late 1944.

In addition, both Army and Navy ground units frequently improvised hand grenades out of whatever materials were handy. An incendiary stick-type grenade filled with phosphorous-impregnated rubber pellets in carbon disulphide was widely-reported by Allied intelligence, but was actually apparently only encountered once. Much more common were explosive grenades made out of shell casings, pipe, and even wood. The US Navy Bureau of Ordnance summarized these after the war as:

> In general, improvisations were the result of shortage of the manufactured item, and were prepared by inexperienced personnel. Consequently, they were in almost all cases, very ineffective and extremely dangerous to use.[1]

## Flame Throwers

Even before the occupation of Manchuria the IJA had apparently been eying the Soviet fortifications in the far east. A solution, well ahead of its time by world standards, was a dedicated engineer assault vehicle designated the "SS". An initial batch of 13 vehicles, later known as the "Ko" series, was built starting in 1931.The SS-Ko was built on a fully-tracked hull, but did not take advantage of Type 89 tank recently introduced, instead using many unique components, including a suspension system not shared by any other vehicle.

The vehicle had a boxy hull with armor 25mm thick on the front and half that on the sides and could move its 13 tons at 37 km/hr. It carried a folding bridge on top for crossing anti-tank ditches, had a crane at the front left and mounted three flamethrowers, one set in the front and one each side, along with a light machine gun. A second group, known as the Otsu series of 8 vehicles, was built in 1937 in response to concerns about minefields. In this group the crane was abandoned and instead two large rakes were pivot-mounted in the front so that they could drop down and dig up any mines that might be in the path of the tracks. A single third type, the Hei-model, was built at the same time differing only in detail. The Tei group, 20 produced in 1939, was similar, but mounted its two mineclearing rakes on a single pivoting assembly. The final series, the Bo, was the most numerous with production starting in 1940. This differed from the earlier versions in using a one-piece bridge launched via rocket engines and rollers, and also mounted no fewer than five flamethrowers.

Having been designed to 1930 specifications and requirements the SS vehicles were, of course, obsolete by 1941. Their armor was far too thin for assaulting fortifications and they had to close to about 30 meters to operate their only destructive weapons. They still had some use as bridgelayers, and it was for this role that they were kept in service, although their bridge was only about 6 meters long.


A Type SS Model Tei assault vehicle with its scissors bridge after the war.

Another early fruit of this labor was a light, or backpack flamethrower, the Type 93. This was a modern design that, barring a few quirks, worked well. Two fuel tanks were arranged side-by-side and linked top and bottom to create, in effect, a single tank. They had a combined capacity of 13 liters, although only 10.5 of that was usable due to the outlet being a distance up from the bottom. A smaller pressure tank was filled with nitrogen to yield an operating pressure at the wand of 150 g/cm$^2$.


A backpack flamethrower in action in China.

The unit was operated by means of a handle at the rear end of the 1.2-meter wand. The handle performed several functions. First, it actuated a valve right at the rear of the wand that controlled the flow of pressurized fuel towards the nozzle. Second, it caused a rod next to the fuel line to slide forward, and this rotated a revolver-type cylinder containing ten black-powder-filled ignition cartridges to align one with a striker, and then caused the striker to initiate the cartridge.

To engage a target the operator would first open the safety valve by means of a handle on a bowden cable passing over his shoulder. He would then point at the target and turn the wand handle about 60° to get about a second's worth of fuel discharge, then move the handle the rest of the way to the 90° position to initiate the flame. Returning the handle to parallel to the wand shut off the fuel supply.

| Production of Light Flamethrowers | | | | | |
|---|---|---|---|---|---|
| 1935 | 1936 | 1937 | 1938 | 1939 | 1940 |
| 100 | 0 | 50 | 500 | 900 | 1400 |
| 1941 | 1942 | 1943 | 1944 | 1945 | |
| 600 | 400 | 600 | 1200 | 270 | |
| Note: 400 of the 1941 production and all earlier were Type 93s, the others were Type 100s. | | | | | |

The Type 93 was improved to yield the Type 100 in 1940. The wand was made shorter by 30cm, and the cartridge revolver was given a more reliable and durable ratchet system. Even the shorter wand was awkward to operate, however, and the black powder cartridges were not always successful at lighting the fuel the first time.

Production of the light flamethrowers peaked in 1940, and as the likelihood of assaulting Soviet fortifications waned so too did flamethrower production. With only a few exceptions the advancing Japanese faced no substantial fortifications in their drives in China or to the south and through the Pacific. As a result, production ramped back up only slowly, from about 30 per month at the outbreak of the Pacific War to 50 per month in 1943 and then a hundred a month in 1944, before falling again in 1945. Indeed, in the Spring of 1944 the 31st Army, responsible for the central Pacific, requested 300 flamethrowers from the Ordnance Bureau and were told simply that "none are ready".

Flamethrower fuel was mixed in the field from various petroleum products. Gasoline was the favored material, as it gave a quick rise in temperature with rapid combustion and worked well in cold and wet weather. Adding crude oil prolonged the combustion and increased the range. Kerosene gave even greater heat that gasoline. A batch in Burma was a colloidal suspension of 5% unvulcanized rubber and 95% gasoline. The result was a liquid that adhered readily to any surface. Trials showed it burned hot and bright with quite a bit of smoke.

Units that operated flamethrowers were also issued a Type 99 small air compressor that used a two-cycle, one-cylinder gasoline engine to drive a one-stage reciprocating air compressor. The unit could build up 24 atmospheres of pressure (the requisite figure for the flamethrower pressure bottles) in 30 seconds. The compressor and its wooden box weighed 34 kg.

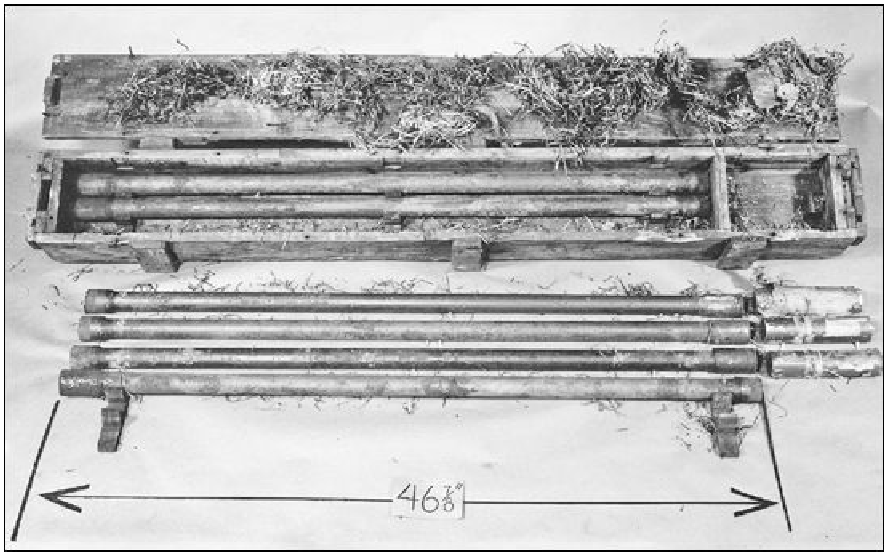
**Counter-Obstacle**

Before closing in on fortifications, of course, troops had to traverse obstructions, usually including barbed wire. A common device, used by almost all armies, was the Bangalore torpedo, consisting of sections of metal tube filled with explosive. Threaded on each end the tubes could be combined to varying lengths. The standard model was the Type 99, and was quite effective both in blast and fragmentation with its high detonation-velocity explosive, but given how simple it was to fabricate inevitably there were many variations and improvisations. The SNLFs at Milne Bay fabricated some by using a split bamboo pole held together by twine, into which were placed five to seven charges, each 15cm long and 7cm in diameter of ammonium perchlorate joined by lengths of safety fuze.

Of course, it was not always possible to get close enough to shove a metal pipe into the barbed wire entanglements, and the solution adopted was a demolition mortar designated the Type 98. It could fire either a special 6.4-kg demolition bomb or a Bangalore torpedo fitted with a special fin attachment. The demolition bomb was shipped unloaded and was filled in the field, normally with 24 of the standard small 50x50x25mm picric acid demolition charges, although any explosive could be used. The bangalore torpedo was 205cm long and consisted of a standard Type 99 section plus an "A section" with three fins and a range setting sprocket. The fuze in the nose was armed in the air and could be set for instantaneous action to destroy wire entanglements or a short delay for use against light shelters. The torpedo, at least, was regarded as highly successful in tests but despite being fully developed in 1942 they were not ordered into full production until 1945. There certainly were uses for the short-ranged little mortar, but they were narrow; a specialized weapon Japan simply could not afford and few were built.

Efforts were also begun by the 3rd Laboratory in March 1941 to develop an obstacle-clearing tank. Three types of vehicles were developed. The first carried two tubes each launching a 4-meter long, 70-kg bangalore torpedo with a range of 30 m, which had to be reloaded in rear areas. The second attached to the turret a cantilevered telescoping arm so that it could rotate

360° and extend to 10 meters to place satchel charges against obstacles. The third used a compressed spring to throw a 30 kg explosive charge a distance of 20 m. GHQ directed the cessation of all these efforts in July 1943, probably due to the lack of envisioned areas of employment and the need to utilize all tank chassis for armored combat roles.



Bangalore torpedo set and box.

### Close-Assault Munitions

There were also devices the Army called “mines”, but which were actually close-assault munitions that played heavily on the penchant for self-sacrifice. The two most common were normally anti-tank weapons, although they could be used in other applications.

The Type 99 anti-tank mine was a disk-shaped charge in a canvas holder with four magnets around its edge. It was to be thrown from 2-3 m away at an enemy tank or vehicle in the hopes that the magnets would cause it to adhere to the vehicle. The tactic involved the soldier hiding by the side of a road and when the enemy vehicle was passing he would pull out the safety pin on the fuze, hit the plunger with a hard object and throw or place it on or against the vehicle. Nine seconds after being struck the fuze would detonate the main charge.

The mine had a flat bottom, so did not have a shaped charge effect, but instead the blast was said by the Army to make a hole 5cm in diameter in 30mm steel plate. It did not appear to cause spalling in thicker plates, presumably due to lack on intimate contact between the explosive and the armor. Tests carried out in Burma by the British using Stuart and Lee tanks showed that the mine was extremely effective against armor 20mm or thinner, typically found on horizontal surfaces, but ineffective against armor 35mm and thicker, usually found on vertical surfaces. Thus, the goal of the user would have been to fling it onto the top of tank, including its engine deck. Of course, it could have been used against any metallic surface, and indeed could serve as a simple satchel charge against any target it could lay on.

The arrival of the shaped-charge concept spawned a new type of personal assault munition, the so called “lunge mine”. The lethal mechanism was a shaped charge 20cm across at the base attached to a wooden handle by means of a push-fuze. The attacker would charge the target and jab it, bayonet-style, causing the shaped charge to detonate, punching a hole in the target wall and, in the process, killing the attacker. It was powerful enough to penetrate the armor of any tank and many fortifications, but it was purely a suicide weapon, as opposed to the Type 99 mine where survival of the attacker was still a possibility. They were first used in combat on Leyte in December 1944.

An outwardly similar munition was the suction-cup mine. In every other respect, however, it was completely different from the lunge-mine. It was not a shaped charge munition, but rather the 110mm-diameter cylindrical warhead body was filled with 2 kg of an explosive 53% RDX and 47% TNT. Two suction cups at the front end of the charge could hold it against a smooth surface. The wooden handle did not itself initiate the charge, but instead included a pull igniter and a fuze for 10-15 seconds of delay. This was a highly-specialized munition intended for raiding units. It could only be used against stationary, highly smooth surfaces to which a rubber suction cup could hold the weight of the charge. Indeed, its only use in action was by raiders who planted them on parked US aircraft on Okinawa, where they did considerable damage.

A later development was a basic shaped-charge warhead that would “simply” be placed on top of enemy tanks and detonated. The munition itself was semi-hemispherical, 23cm across and 19cm high, and contained 5 kg of Type 98 explosive. It was initiated by the same fuze used in the Type 99 anti-tank mine. Production did not start until May 1945 and only about 500 were built before the surrender.

### Types 91 & 97 Hand Grenades

The Type 91 was designed for both hand throwing and firing from the grenade dischargers, with a secondary role of rifle grenade. A cylindrical cast iron body only 50mm in diameter and 95mm long was serrated to create 50 roughly rectangular segments and was filled with 65 g of powdered TNT. The grenade fuze was screwed into the top of the grenade and was initiated by a firing pin with a weight on top that was held towards the top of the grenade by a safety pin and a spring. To use the grenade the soldier would remove the safety pin and hit the top of the fuze with a hard object to drive the firing pin down onto the primer. This initiated a black powder delay element that detonated the main charge after 7-9 seconds. A threaded recess in the base of the grenade could accommodate either a propellant charge or a finned extension. The steel propellant container held a percussion cap at its base and a small charge of nitrocellulose propellant powder. With the propellant charge installed the Type 91 could be fired from the Type 10 or Type 89 grenade launcher. Here, the soldier had only to remove the safety pin as the launch acceleration on firing would drive the fuze firing pin into the primer. The grenade could also be fitted with an pipe-like extension with fins on it in lieu of the propellant container and this converted it into a rifle grenade. The extension fitted over a spigot mounted at the end of the barrel of the rifle and it was projected by means of a special cartridge with a wooden bullet.

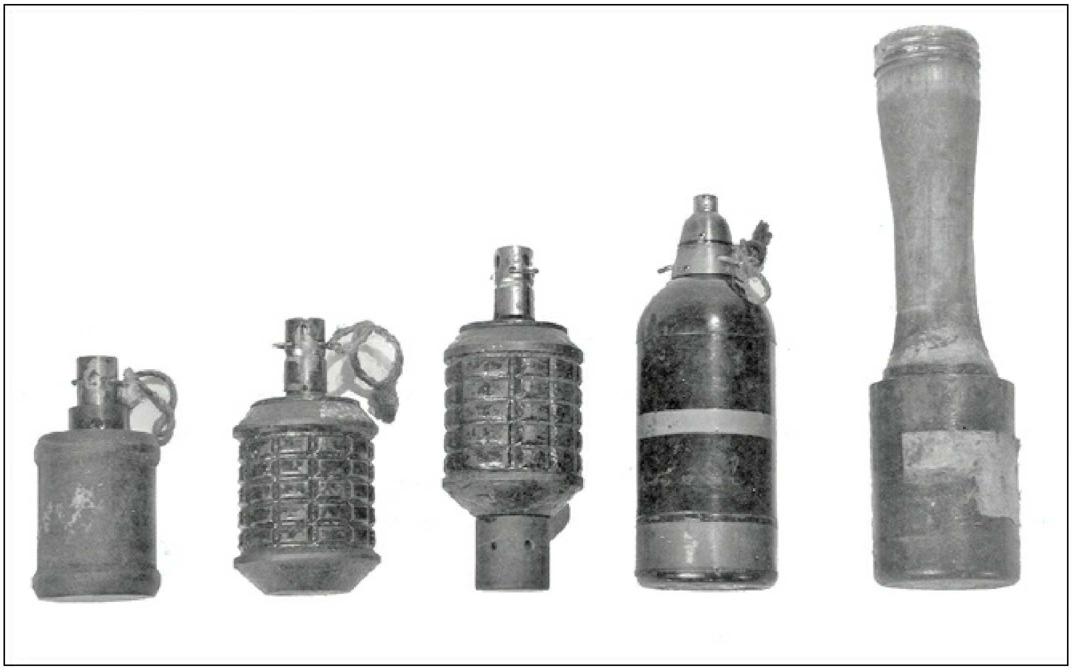
| Army Hand Grenades | | | | |
|---|---|---|---|---|
| | Type 91 | Type 97 | Type 98 | Type 99 |
| Diameter (mm) | 50 | 50 | 32 | 40 |
| Length (mm) | 95 | 102 | 197 | 89 |
| Weight (g) | 534 | 539 | 538 | 363 |
| Explosive Wt (g) | 65 | 65 | 85 | 57 |

The Type 97 was almost identical except that it was a hand grenade only, and to that end it dispensed with the threaded recess at the bottom and the fuze delay was reduced to 4-5 seconds.

### Type 98 Hand Grenade

This followed the overall configuration of the famous German Model 24 stick hand grenade. It was quite a bit smaller and had one significant difference – it was a defensive (fragmentation) grenade, in contrast to the blast-effect of the German version. The castiron body was packed with 75 g of pressed picric acid. The wooden handle was hollow with a sheet metal cap on the base. Behind the screwed-on cap was a pull ring attached to a cord that passed through the handle to an igniter assembly. At the far end of the cord was glued a small sand pellet – pulling the string pulled the sand through a match-type igniter mixture that initiated a safety fuze giving a delay of 4-5 seconds before the main charge was detonated.

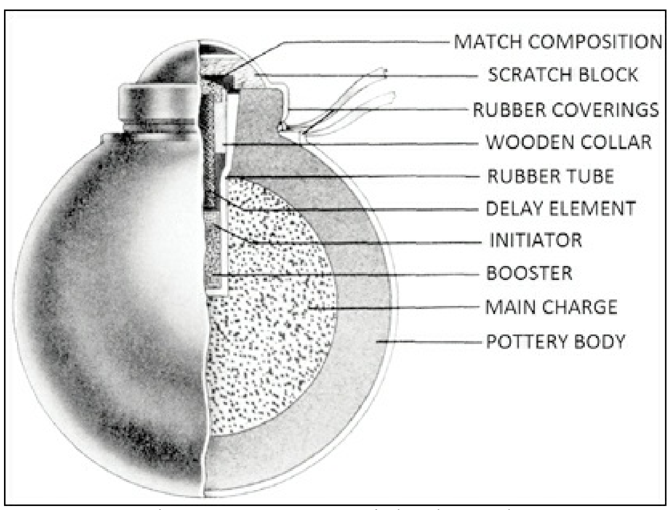
### Type 99 Hand Grenade



Army hand grenades, L to R: Type 99, Type 97, Type 91 (with propellant module), 50mm grenade discharger round for comparison, Type 98.

This was primarily a hand grenade, although it was also the sole round fired from the Type 100 rifle grenade launcher. The body was a cast iron cylinder, with flanges top and bottom, filled with two disks of pressed picric acid. An igniter tube passed down the center of the grenade to the bottom, with detonator material in the lower half and a delay train in the upper half. Attached to the top of the igniter tube was the fuze in which a weighted firing pin was held off a mercury-fulminate percussion cap by a weak spring and a safety fork. For action as a hand grenade the safety fork was removed and the firing pin driven down into the percussion cap by a hard object. This initiated the delay element that gave 4-5 seconds before the main charge detonated. For use as a rifle grenade the fork was removed, but setback on launch moved the firing pin to start the delay element.

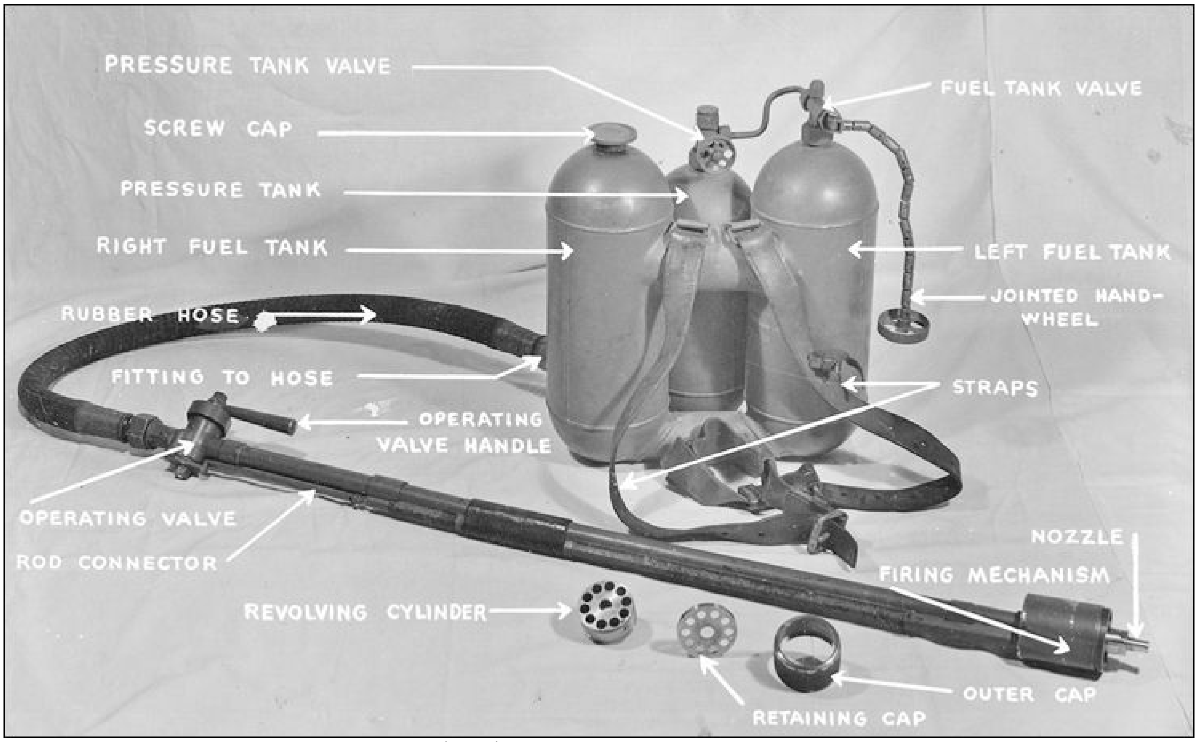
**Pottery Hand Grenades**




The Navy Type 4 ceramic hand grenade.

Pottery hand grenades came in varying sizes and shapes, having been produced by several ceramic firms. The variations, however, tended to be rather small and typical of these grenades was the Navy Type 4. This was sphere-shaped, 75mm in diameter, with a small neck on the top. The case was 12mm thick and contained 100 g of Type 88 explosive, both materials being identical to that used in the Navy's Type 3 ceramic mine. A rubber tube projected down into the explosive to hold the booster that detonated the explosive, the initiator that started the booster, and a delay element to give the user 4-5 seconds before detonation. The whole device was given a thin covering of rubber, a large portion for the main body and a smaller cap for the neck. The neck portion covered a small cap that had a scratch block on its underside and a match head. The user removed the cover and cap and lit the match with block, then threw the grenade.

**Flamethrower Type 93 & Type 100**



Flamethrower Type 93 & Type 100.

This consisted of two interconnected fuel tanks holding a usable 10.5 liters of a 50/50 mixture of gasoline and oil, and a smaller pressure tank of compressed nitrogen. This yielded about ten seconds of flame that could be thrown to a range of about 30 m, although this dropped as pressure in the tanks decreased. The two models differed only in the wand, which was made shorter for the Type 100 and featured a more reliable revolver mechanism for the ignition cartridges. Weight of the Type 100 was 24 kg, the earlier model being about 1 kg lighter, both being relatively comfortable for this type of weapon.

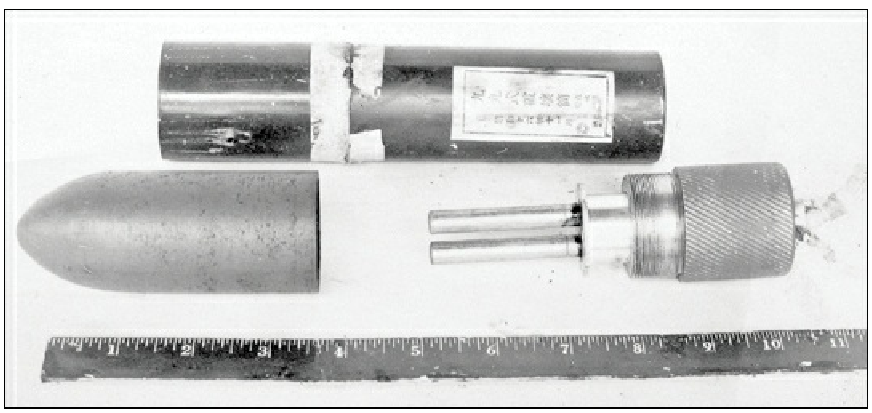
**Type SS Armored Engineer Vehicle**

A multipurpose vehicle that was actually produced in six variants the Type SS served mainly as a trench-crossing bridgelayer. The engine was fitted at the center of the vehicle on the left side, leaving a narrow passage down the right side. Armament consisted of four to six ball mounts set into the hull on the front, sides and corners, each of which could be fitted with a flamethrower or a 7.7mm Type 97 machine gun. A typical configuration placed the driver at the front left, a gunner at the front right with a machine gun and a flamethrower, a side gunner behind the driver with a flamethrower and/or MG, and a rear gunner in the right rear with a flamethrower. The flamethrowers had a range of about 50 meters. Other equipment commonly fitted included forks on the front corners to scoop up mines and clear wire entanglements, a crane, a winch and a 10-meter two-piece bridge on top.

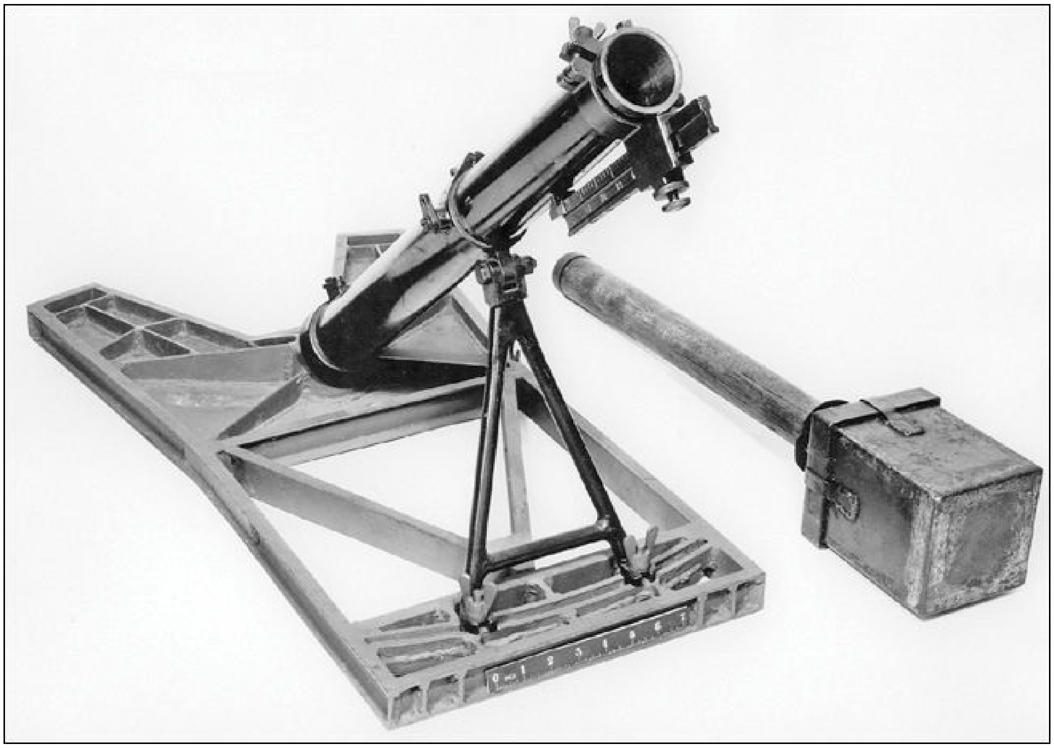

A Type SS-Bo engineer assault vehicle, with mine rakes and bridge rollers, but minus its flame guns and bridge.

### Bangalore Torpedo Type 99

This simple device was built around sections of steel pipe 1.2-m long with a 36mm exterior and 30mm interior diameter. Each section weighed 4.5 kg, of which 1.4 kg was the TNT/RDX or picric acid explosive fill. Each section had an interior thread on one end and an exterior thread on the other, enabling them to be assembled to the required length. A pointed nose piece was threaded onto the forward end of the assembly and an igniter onto the aft end. A 13cm pull from a safe distance on a cord attached to the igniter caused the assembly to blow up after a 7-second delay.


The nose piece and igniter of a Type 99 Bangalore torpedo.

### 50mm Type 98 Small Mortar

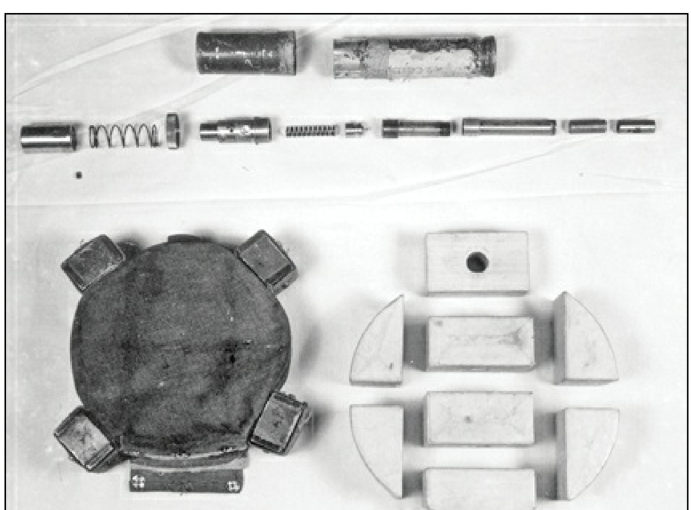


The 50mm Type 98 and demolition munition.

This demolition weapon was intended to create openings in barbed wire obstacles. To that end it threw two types of munitions. The first was a rectangular sheet metal box filled with picric acid demolition charges and fitted with a wooden handle, the whole weighing 6.4 kg. Two holes in opposite sides of the charge accepted pull-type delay initiators. Wires from the initiators attached to the mortar, so that the departure from the barrel pulled the initiators beginning a delay of a few seconds before the bomb was detonated. The second was the standard 1.2 meter bangalore torpedo pole to which was attached an 800mm rear extension with fins, with a total weight of 8.35 kg. The range with the demolition charge was 420 meters and with the bangalore torpedo 290 meters. The minimum range with the torpedo was 90 meters. The barrel was fixed in elevation at 40° and major changes in range were made by varying the propellant charge, with minor adjustments made with a sliding scale mounted below the muzzle that determined how far into the barrel the handle or fin assembly would project.

### Type 99 Anti-Tank Mine

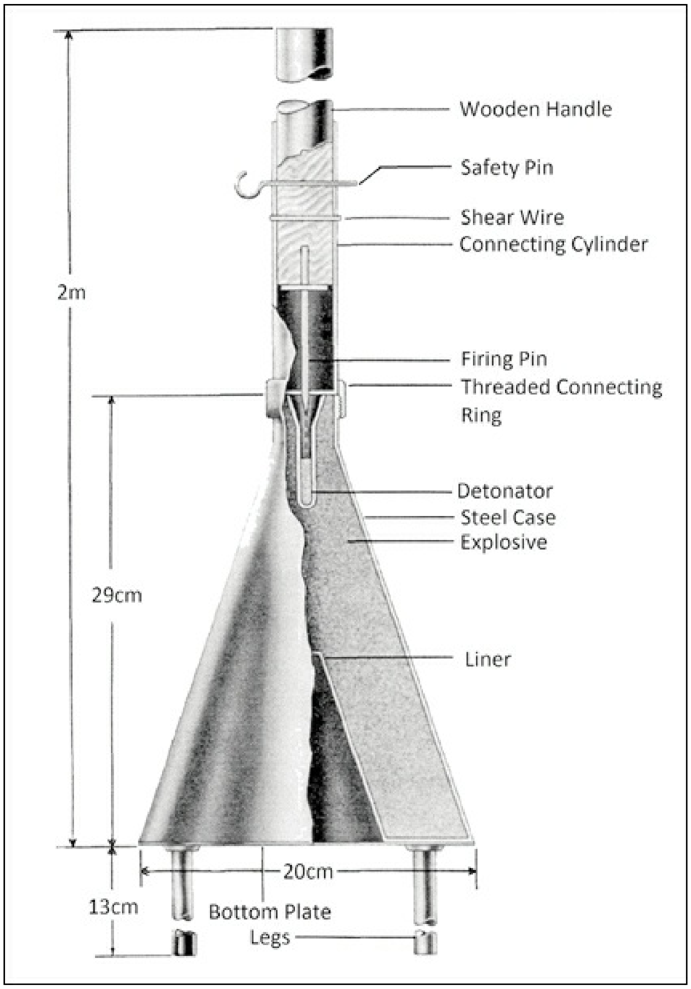
This hand-thrown or placed assault munition consisted of an 8-piece explosive charge assembled into a disk 120mm in diameter and 37mm thick and held in place in a canvas bag. The charge totalled 680 g. Four pockets around the periphery of the bag held rectangular magnets. A non-ferrous layer only 3mm thick on the target would prevent the magnets from adhering to a vertical surface and spacing of about 15cm severely degraded the performance of the mine against armor.



The Type 99 mine disassembled with the canvas bag on the left. The uppermost charge portion has been laid flat to show the hole that allows the fuze (at the top) to pass through the mine.

**Lunge Mine**

This comprised a wooden handle 1.5 m long to which was attached a conical shaped charge 20cm across at the base and 29cm long that was packed with 3.3 kg of crude TNT around a steel liner. Total weight was 6.5 kg. The handle featured a firing pin at its front end and fit into an oversize connecting cylinder. It was kept from sliding forward or back in the cylinder by a safety pin and a thin shear wire. Once the safety pin was removed the device could be pushed forward and if the face of the charge hit an object the handle's forward motion would shear the wire and the firing pin would hit the detonator, initiating the main shaped charge. The legs provided the proper stand-off distance. The charge was said to be capable of penetrating 15cm of steel plate and could be used against tanks, or indeed, any hard wall.



Lunge Mine.

1 USN Bureau of Ordnance, OP 1667, Japanese Explosive Ordnance, 14 June 1946, p.225

# 6

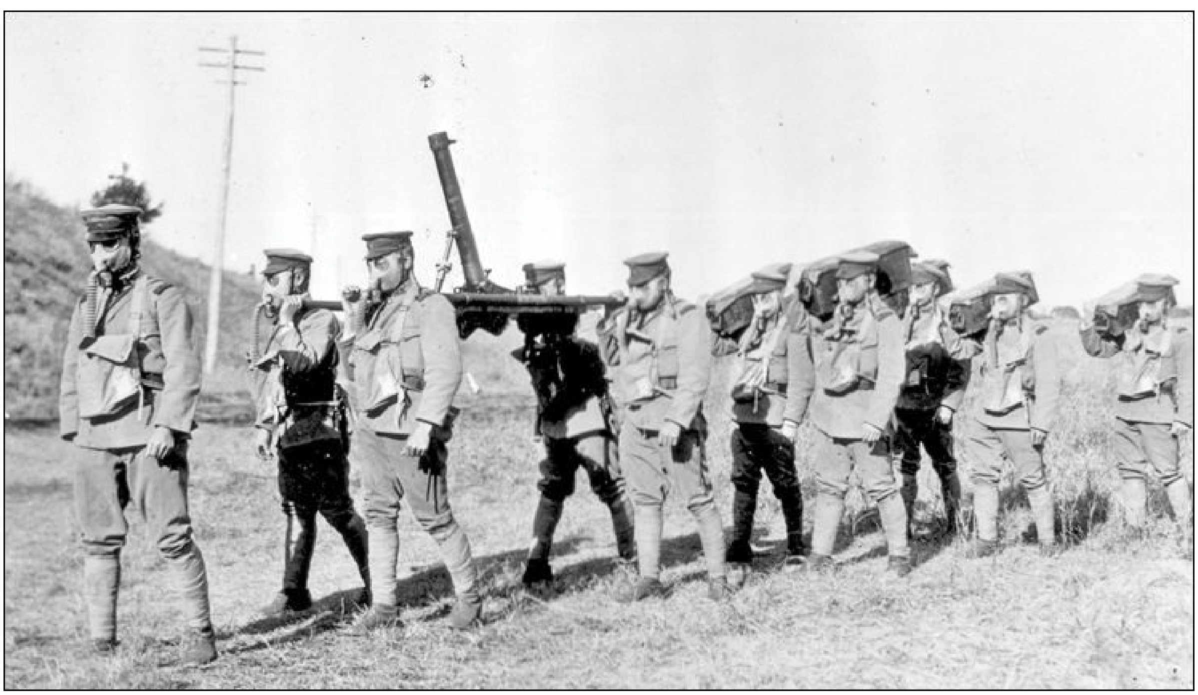
# Mortars

Portable mortars had proven their worth during World War I and all nations, including Japan, rushed to field such weapons. The IJA divided mortars into two categories: infantry mortars (*Kyokusha hoheihō*, literally infantry curved trajectory gun) for use by that branch, trench mortars (*Hakugekiho*) primarily for the chemical troops, and seige mortars (*Kyūhō*) for use by the artillery. The failure to distinguish between the two in western sources has led to some confusion as well as the use of strange designations such as the "90mm light mortar". As any infantry mortarman will testify, a 160 kg mortar is not light, although it is to an artilleryman.

The initial infantry mortar was adopted in 1922 as the 70mm Type (Taisho) 11. It was based on the early mortars common in the war just ended, and featured a large wooden base plate on which the entire mortar was mounted, including the monopod elevating mechanism. It was deployed as a companion piece to the 37mm flat-trajectory infantry gun, with a battalion gun company having one platoon of each type of weapon. The appearance in France in 1927 of Edgar Brandt's rework of mortar design immediately revealed to the world how unnecessarily cumbersome the old style of mortar was and by the mid 1930s the IJA had decided that the days of their old-style weapon were over. The Type (Taisho) 11 served in the early campaigns in China and remained in service with second line units there through much of the war, but was rarely used in combat in the Pacific, and production of ammunition appears to have stopped in 1940.

The Brandt company had sent two of their 81mm mortars, along with 1,000 rounds, to Japan for trials in the Spring of 1932. A year later the IJA inquired about a purchase of 250 more, with a thousand rounds per weapon, but no actual sale was consummated, the decision having been made to replace both the 37mm infantry gun and 70mm mortar with the 70mm Type 92 infantry gun.

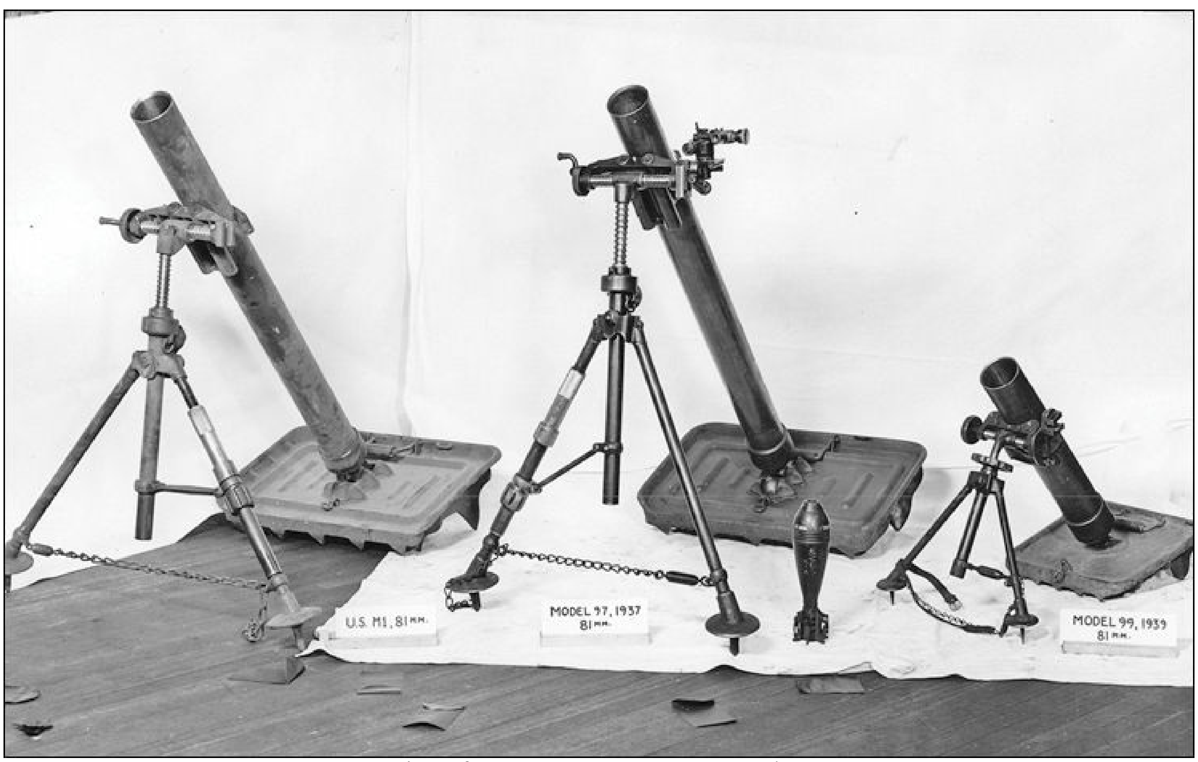
Finally, in February 1936 the Army began negotiations and in May 1937 purchased a production license from Brandt, but did little to actually produce the weapon. Experience against the Chinese Brandt 81mm mortars in 1937, however, opened their eyes to its utility. It was then accepted into service until 1937 and production ramped up rather slowly. Nevertheless, by 1941 it had replaced the 37mm infantry guns and 70mm mortars in all the pack-type infantry regiments. A sound, sturdy weapon, it served through the war, as it was not only lighter and more lethal than the 70mm battalion gun, but also cheaper and less demanding of industrial assets for production.



A mortar section at the Infantry School demonstrates moving and firing the 70mm infantry mortar in 1933.

A lighter version was adopted in 1939 as the Type 99. It was placed in production in 1939 or 1940[1] initially for use with assault troops, and later for parachute units.

The 81mm mortars were used primarily to fire HE ammunition fitted with the Type 93 point detonating fuze. The fuze was extremely quick-acting and effective against troops in the open. When used against earthen bunkers the top of the fuze could be unscrewed, a delay plug inserted, and then closed back up. The Type 100 PD fuze replaced the Type 93 in 1940 and differed in having a simple rotating selector for quick action and delay built in.




Comparison of 81mm mortars, US, Type 97 and Type 99.

Shortages of infantry mortars in the southern regions spurred the 7th Area Army in the Dutch East Indies to attempt local production. The former Dutch Bandoeng Arsenal was rehabilitated and among its products were 250 81mm mortars and 28,000 rounds of ammunition. Apparently quality control was less than satisfactory, for only 18 of the mortars were rated by the Japanese as "good for use". A total of 45 improvised 94mm trench mortars and 4,600 rounds were also manufactured between January and July 1945, but it seems unlikely that these were much better. All of these appear to have been retained on Java. An effort was also made to produce 150mm trench mortars there to compensate for a shortage of artillery, but nothing came of that. In addition, the China Expeditionary Force Field Arsenal in Nanking built 70 mortars of unspecified size, along with 300 rounds of training ammunition, between its opening in December 1944 and July 1945.

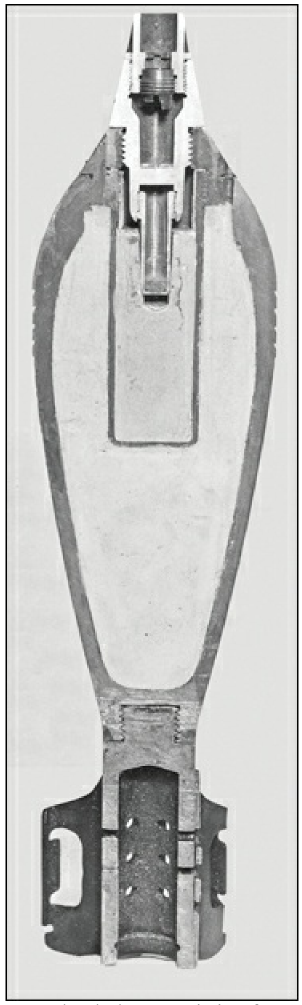
**Army Mortar Production**

| | 1931 | 1932 | 1933 | 1934 | 1935 | 1936 | 1937 | 1938 | 1939 | 1940 |
|---|---|---|---|---|---|---|---|---|---|---|
| Small Mortar, 50mm | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 20 |
| Infantry Mortar, 70mm Type 11 | 28 | 28 | 6 | 0 | 0 | 0 | 4 | 0 | 0 | 0 |
| Infantry Mortar, 81mm Type 97 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 150 | 200 | 300 |
| Infantry Mortar, 81mm short Type 99 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | ? | ? |
| Light Trench Mortar, 90mm Type 94 | 0 | 0 | 0 | 34 | 32 | 128 | 89 | 80 | 97 | 58 |
| Light Trench Mortar, 150mm Type 90 | 0 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Medium Trench Mortar 150mm Type 96 | 0 | 0 | 0 | 0 | 0 | 0 | 3 | 0 | 0 | 9 |
| Medium Trench Mortar 150mm Type 97 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 10 | 30 |
| | | 1941 | | 1942 | | 1943 | | 1944 | | 1945 |
| | Apr-Jun | Jul-Dec | Jan-Jun | Jul-Dec | Jan-Jun | Jul-Dec | Jan-Jun | Jul-Dec | Jan-Jun | Jul-Aug |
| Small Mortar, 50mm | n/a | n/a | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Infantry Mortar, 81mm Type 97 | 175 | 420 | 463 | 525 | 442 | 427 | 328 | 253 | 179 | 30 |
| Infantry Mortar, 81mm short Type 99 | ? | ? | ? | ? | 34 | 107 | 55 | 0 | 0 | 0 |
| Light Trench Mortar, 90mm Type 97 | 0 | 0 | 0 | 0 | 54 | 158 | 160 | 159 | 94 | 0 |
| Medium Trench Mortar, 150mm Type 96 | 2 | 13 | 5 | 9 | 8 | 0 | 0 | 0 | 0 | 0 |
| Medium Trench Mortar, 150mm Type 97 | 6 | 22 | 16 | 23 | 17 | 17 | 11 | 0 | 0 | 0 |
| Trench Mortar, 120mm Type 2 | 0 | 0 | 0 | 0 | 0 | 2 | 17 | 280 | 336 | 60 |
| AS medium trench mort 150mm | 0 | 0 | 0 | 0 | 12 | 53 | 57 | 73 | 57 | 0 |
| AS 12cm mortar | 0 | 0 | 0 | 0 | 0 | 0 | 12 | 55 | 34 | 0 |

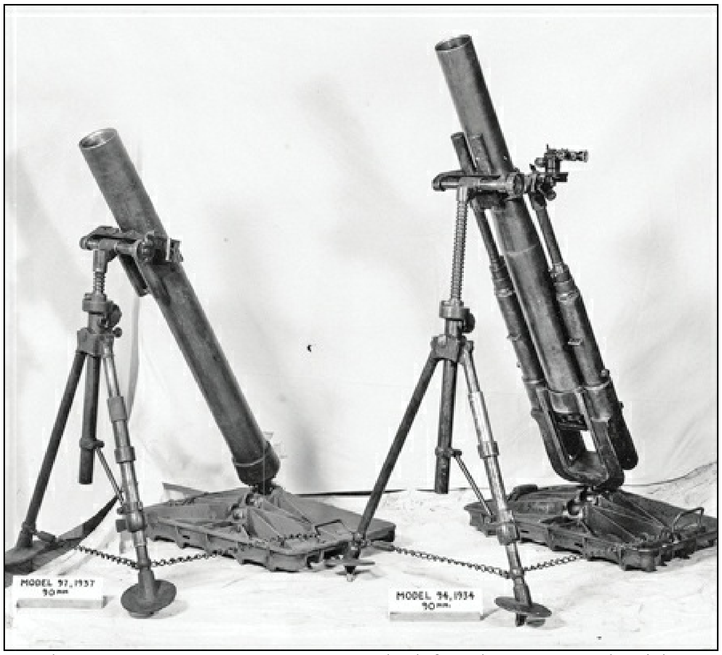
Captured mortars were also used, mostly in secondary theaters. The initial offensive in Burma yielded 130 mortars (mostly British 2" and 3") and additional quantities were captured in Malaya. These were distributed through Burma, Malaya and the Dutch East Indies, so that, for example, at the end of the war there were 18 2" mortars with 3,600 rounds and 58 3" mortars with 19,600 rounds in service on Sumatra. There were also captured mortars that had been locally made in the Dutch East Indies, these consisting of 77 8cm and five 47mm mortars. The former were handed out to Japanese occupation forces on Java as supplemental weapons and the latter disposed of.

The artillery branch began mortar development with a 27cm heavy trench siege mortar and in the early 1920s started showing interest in what they called light trench mortars of 150mm. The 150mm Type 90 light trench mortar was adopted in 1930 but never placed in production.

Instead, efforts began on two types of mortars, 90mm light trench mortars and 150mm medium trench mortars, primarily as chemical-delivery weapons with training under the auspices of the Chemical School at Narashino.[2] The 90mm Type 94 proved initially popular for its light weight (compared to artillery pieces) and its useful HE and hybrid HE/chemical shells and it went into immediate production. The advantages of clumsier 150mm Type 96 were less apparent, and production deferred.



This cutaway 90mm Type 100 HE round shows the thin walls and large payload characteristic of mortar rounds, which do not have to survive the high launch accelerations of artillery.



The two 90mm mortars, Type 97 on the left and Type 94 on the right.

It became clear quite quickly that both models were heavier and more complex than they needed to be, mainly due to the incorporation of unnecessary recoil mechanisms. Work on simpler weapons began almost immediately and yielded two new models, both accepted for service in 1937 as the 90mm Type 97 and the 150mm Type 97. The 150mm Type 97 was placed in production in 1939, apparently replacing the 90mm Type 94 at Osaka Arsenal. Surprisingly, the old, heavy 150mm Type 96 was also placed in production shortly thereafter, with the first coming off the production line in June 1941. It is unclear why both 15cm models were produced, although the earlier model was slightly more stable in firing, yielding marginally greater accuracy.[3] In the event, the 150mm Type 96 was built in only small numbers and was never encountered in combat by US or British troops. An even lighter version of the 150mm, known as the Type 99 experimental short medium trench mortar, was designed with weight reduced to 152 kg and an L/6.2 barrel, but the range fell to only 770 meters, so the project was abandoned. The light version of the 90mm, the Type 97, saw trials batches built for service in China in 1938 and very low rate production thereafter,[4] but was not finally placed in full production until early 1943 and the first of those models came off the production line in May of that year.

The 90mm and 150mm mortars fired primarily HE rounds using the Type 93 and Type 100 PD fuzes and chemical rounds and WP rounds.

| Mortar Data | | | | | | |
|---|---|---|---|---|---|---|
| | Barrel length (cal) | Weight (kg) | Elevation | Traverse | Proj Wt (kg) | Range (m) |
| 50mm Type 98 small mortar | 12.3 | 23 | 40° | 20° | 6.4 | 420 |
| 70mm Type 11 Infantry Mortar | 10.7 | 65 | 43° to 73° | 23° | 2.61 | 1,545 |
| 81mm Type 97 Infantry Mortar | 14.1 | 66 | 45° to 85° | 11° | 3.35 | 2,836 |
| 81mm Type 99 Infantry Mortar | 6.7 | 23 | 45° to 85° | 11° | 3.35 | 2,000 |
| 81mm Navy Type 3 Infantry Mortar | 15.5 | 76 | 45° to 85° | unk | 3.38 | 2,800 |
| 90mm Type 94 Light Trench Mortar | 14.1 | 160 | 45° to 85° | 10° | 5.3 | 3,780 |
| 90mm Type 97 Light Trench Mortar | 14.1 | 105 | 45° to 85° | 25° | 5.3 | 3,780 |
| 120mm Type 2 Trench Mortar | 12.8 | 274 | 40° to 80° | 10° | 12 | 4,180 |
| 150mm Type 96 Medium Trench Mortar | 8.6 | 723 | 45° to 80° | 23° | 25.8 | 3,873 |
| 150mm Type 97 Medium Trench Mortar | 8.6 | 350 | 45° to 80° | 23° | 25.8 | 3,873 |
| 274mm Type 14 Heavy Trench Mortar | 4.9 | 4055 | 45° to 75° | 40° | 135 | 2,390 |
| 305mm Type 96 Heavy Trench Mortar | 8.3 | 19680 | 0° to 75° | 120° | 400 | 2,764 |
| 320mm Type 98 Spigot Mortar | 3.2 | 295 | 45° | 8° | 335 | 1,200 |

Unique among Japanese mortars, the 90mm also had an incendiary round, similar to the HE cartridge, but carrying a 79-g burster charge and a 920-g filler of yellow phosphorous, carbon disulphide, and 40 cylindrical rubber pellets, the latter presumably to spread the effects.

By mid-1941, however, it had been decided that the 90mm caliber was too small for the artillery role, while the 150mm weapons, even the lightened models, simply weighed too much to take advantage of the mortar's generic portability. The resultant efforts yielded the 120mm Type 2 Trench Mortar, a modern and effective design, which was to replace all the previous models. Although standardized in 1942, production was apparently accorded a low priority at Osaka Arsenal and full-rate deliveries did not begin until late 1944. To speed production, Fukushima Manufacturing was brought into the production plan. A few made it to Luzon, but most were held back for the defense of the home islands.

Surprisingly, smoke rounds were developed for only two types of Army mortar. The 70mm Type 11 had a simple base-ejection smoke round with a point-detonating fuze, but that was the last smoke round used by the infantry mortars and appears to have been little used. The 90mm mortar family used the more sophisticated Type 97 smoke round. This used a mechanical time fuze to burst 30-80 meters above the ground and dispense six disk-shaped smoke canisters each containing 300 grams of smoke composition "B" (Hexachlorethane, powdered zinc and zinc oxide). The maximum range for the Type 97 smoke round was 2,200 meters and doctrine called for the use of three rounds to establish a 100-meter long cloud, followed by one round per minute to maintain it, smoke composition B burning slower than WP, but for a longer time.

What westerners would call siege mortars the IJA referred to as heavy trench mortars. The initial model for the artillery was the 274mm Type (Taisho) 14 adopted in 1925, although few were built. It saw little use, although a few dud rounds were recovered in 1945 after having been fired in the Tung-Kuang region of China.

It was succeeded by the Type 96 (1936) 305mm heavy trench mortar, which threw a massive APHE shell for the destruction of fortifications. Although more modern, it was even bigger and clumsier than its predecessor and never went into large-scale production.

A number of specialized mortars were also developed and produced.

A 275mm mortar dud recovered in China in 1945.

The most unusual mortar was the 250/320mm Type 98 spigot mortar. Initially designed to support the assault of fortifications, it was actually used as a fixed weapon emplaced in special gun pits for close-in defense. No record of production has been found, but it must have been substantial. No cranes or other material-handling equipment were available in the gun pits to move the massive ammunition, so the rounds were transported in three main components and assembled on the mortar tube itself for firing. This reduced the rate of fire with a full crew to about one round every 30 minutes. About 4° of traverse each side was possible, but only by loosening the barrel cap screws, moving the barrel by hand, then tightening the cap screws again, a laborious process.

The massive blast of these rounds initially caused some consternation among US troops on Okinawa. They quickly discovered, however, that the huge, slow-moving shells could easily be spotted in flight and this provided plenty of time to take cover. In addition, the almost complete absence of fragmentation effect meant that casualties were actually few.

The Army also developed two anti-submarine mortars for use on their transport ships, one of 150mm and the other of 120mm. It seems likely that stocks of these fixed-mount weapons would have been left on land in late 1945, as they could have fired conventional mortar ammunition in addition to the specialized anti-submarine bombs developed for them.

The Navy developed its own mortar as the 81mm Type 3 (1943).[5] This was placed in production at the Yokosuka Naval Arsenal in two models. The original was a shipboard version with the barrel placed on an arcuate mounting on which it elevated, and a rotating base. An unknown, but probably fairly substantial, number of these were placed on extemporized ground platforms in 1945 for defense of homeland naval bases, although their lack of mobility would have reduced their effectiveness considerably. The second was a field version for ground troops, with the crude bipod and baseplate indicating it was probably an afterthought. These were encountered by the US for the first time in the Marianas. While the ground mount was a rather crude hasty effort, the ammunition had been fully developed for use with the ship-mounted version.

The distinctive Navy 81mm mortar round with 12 fins.

The ammunition available for this mortar was quite diverse, comprising HE (“common”) and incendiary/smoke rounds for land use, and barrage, illuminating, marker and chemical rounds for shipboard, although the HE was the only one widely distributed. The land-use rounds were conventional in design, and in addition the Army Type 100 HE round could also be used. The Type 3 Mortar Fuze was significantly different from that used by the Army, having delayed arming (useful firing out of jungle canopies) and both point-detonating and time function, permitting air burst, a mode not available on Army mortar ammunition. The airburst setting was fairly crude and was intended mainly for AA fire, with a maximum delay of only 22 seconds, while time of flight for full charge varied from 27 to 34 seconds. For this presumably ineffective role the maximum ordinate at full charge was about 1,400 meters (4,600 feet) at a horizontal distance of 900 meters from the mortar.

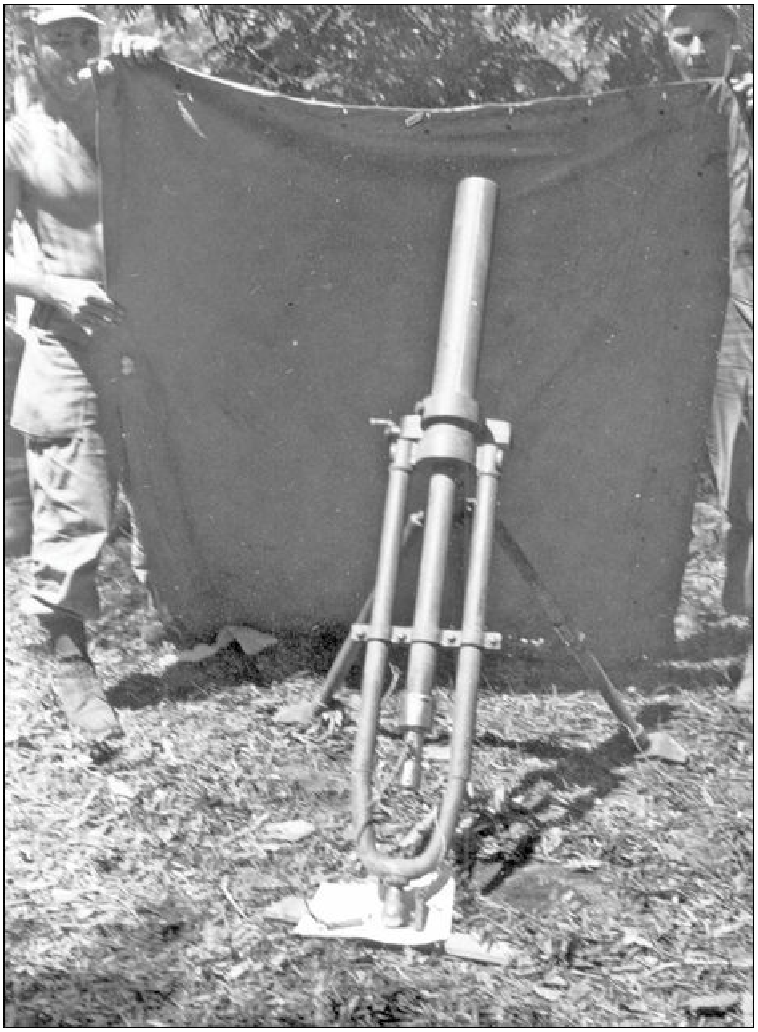
The barrage round was a unique smoke round intended for shipboard defense against torpedo aircraft. Fired at 60° elevation with a preset fuze setting of 13 seconds the projectile would eject a smoke candle suspended from a parachute 1,300 meters out and 1,000 meters up, which would drift down for about 90 seconds, creating a smoke screen to hide the ship. The illumination round had a fixed time setting such that when fired at 50° elevation it ejected its canister about 1,400 meters away and 3,000 meters up and provided 150,000 candlepower for about 50 seconds. The marker round was used to mark the position of submarines with a burst of flame and smoke.

Also produced were fixed-mount 120mm and 150mm mortars as anti-submarine weapons. These were well-made, heavily-built weapons intended to be mounted on shipboard turntables, with the tube mounted in a cylindrical cradle and a variable hydropneumatic recoil system. However, on the ground no such turntables were available so extemporized wooden baseplates were used. No traverse was available for the ground-mounted expedients, and, in the more primitive versions, elevation was fixed at 45°, rendering them of rather questionable utility. Nevertheless the 15cm Type 2 ship-mounted mortar threw a useful 28kg shell to about 4,500 meters.

US Army officers inspect an Army shipboard 15cm mortar in Japan after the war.

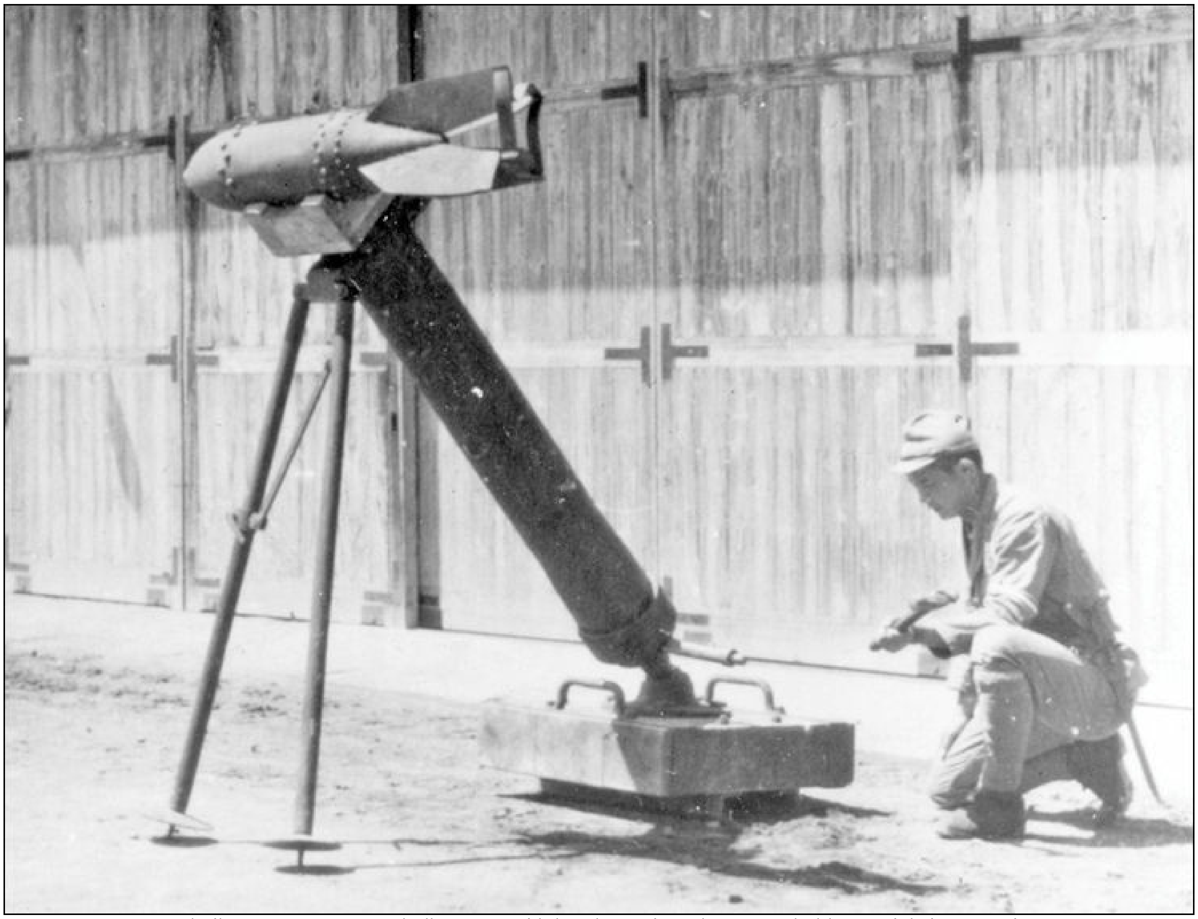
Their limited usefulness notwithstanding production seems to have continued full speed at Yokosuka in spite of the declining need for them as ship production slowed and then halted. Thus, the Navy reported an inventory of no fewer than 4,256 trench mortars at the end of the war, over half of which (2,786) were to be found under the control of the Osaka Navy Yard. The vast majority of these appear to have been fixed anti-submarine mortars held in storage, although some were emplaced as fixed defense weapons. As an example of field use of the more modest numbers of usable mortars the naval inventory report lists 104 at Sasebo Navy Yard, while the actual tally was 20 81mm and 2 150mm mortars in the Sasebo Combined SNLF, along with 20 mortars of unspecified size in each of the Sasebo 12th and 13th SNLFs.

In addition to these weapons, Japanese forces in the Pacific, both Army and Navy, often fabricated improvised mortars for defense. A significant impetus was the presence of significant quantities of artillery ammunition for which there were few weapons. This sometimes resulted from the destruction of the artillery pieces by US forces, and sometimes simply from the difficulty of moving ammunition forward to where the guns were through inhospitable terrain or over water while under attack from US air power. In either event, a logical response was to remove the projectiles from the cartridge cases, fabricate launch tubes of some sort from available materials, modify the fuzes to remove the spin-safety, and package small amounts of propellant for firing. In most cases these were very simple devices, resembling the AA barrage mortars but with crude bipod legs that did not permit elevation or traverse changes. Others were, needlessly, more complex. Army units generally fabricated 75mm mortars and the Navy 127mm mortars, but none were effective. The shells tumbled in the air, showed little regard for where the gunners intended them to fall, and usually failed to detonate.



An unusually complex 75mm improvised mortar captured on Mindanao. It appears that the propellant would be placed in the thinner tube at the bottom and the projectile in the wider tube at the top.

The IJN actually took this process one step further and manufactured very simple mortars at Kure Naval Arsenal starting in early 1944 to launch naval gun ammunition. These were built to launch 8cm, 12cm, 12.7cm and 15cm gun projectiles and were of crude manufacture, machined only where needed. The baseplates were often of wood beams held together by strap iron. The bipods allowed no traverse and usually no changes in elevation. Instead, they were intended to be set in position before an invasion to cover a particular small area. The largest of the weapons was designed primarily to fire the projectiles of the 15cm L/40 to L/50 naval guns, with propellant charges from 60 to 230 g used to give ranges of 300 to 1,000 meters. In addition, a spigot adaptor was also built that could carry a 60-kg aerial bomb sideways at the muzzle. Presumably, once fired the fins of the bomb would cause it to straighten out in flight to a claimed range of up to 500 meters. Rate of fire was 10 rounds/minute with gun projectiles and 4/minute with bombs; the mortar weighed 235 kg, of which 125 was the barrel.


A Kure-built Navy 15cm gun-shell mortar with bomb-carrier adaptor, probably on trials in Japan in 1944.

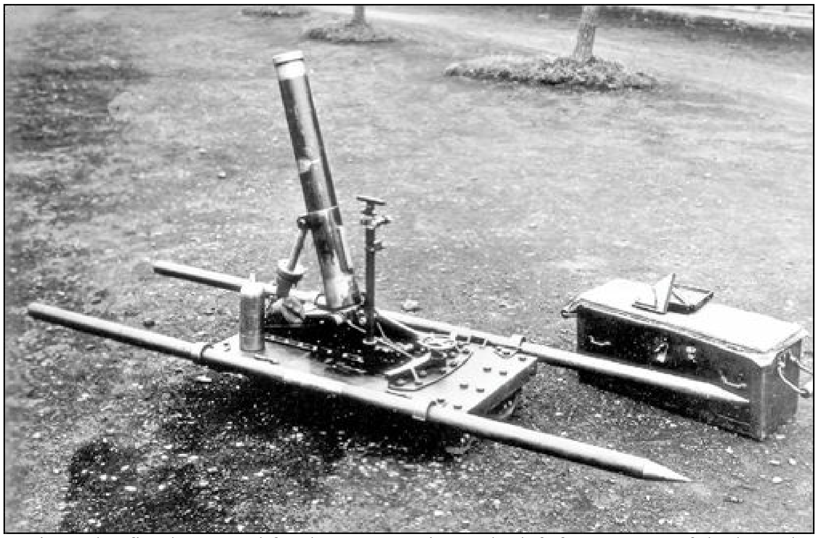
The 12cm version was lighter, at 163 kg (half of which was the cast iron barrel), and was built to fire projectiles of the 12cm L45 Type 10 and L40 Type (Meiji) 41 naval guns. As with the 15cm weapon, range was varied by changing the amount of propellant, here between 50g and 100g, to yield ranges from 350 meters to 900 meters. Officially the mortar was said to have a rate of fire of 15 rounds per minute.

In other cases complete mortar rounds, conventional in appearance if a bit rough in finish, would be fabricated for use in existing stocks of tubes of known dimensions. The 2nd Armored Division Maintenance Unit made 58mm mortar shells that carried 370 g of explosive to a stated range of about 1,000 meters. US Forces captured 30 rounds in their packing and found one dud round that had been fired. Other combinations of tubes and improvised projectiles were also encountered in the Pacific, but were never found to be effective.

Similarly, the 19th Field Air Repair Depot, operating in Burma, Thailand and French Indo China, was directed to fabricate 50 bomb dischargers a month in March 1945, these to consist of crude tubes capable of launching 15kg aerial bombs. It is not known how much progress was actually made in this effort.

**70mm Infantry Mortar Type Taisho 11**

The first of the Japanese infantry mortars, it borrowed extensively from the configurations common in World War I. The entire mortar assembly rested on a large metal-reinforced wooden baseplate 80x44cm featuring rings on the corners, through which poles (which could double as aiming stakes) could be inserted for carrying. The barrel was rifled to fire a spin-stabilized (finless) projectile. A handwheel behind the barrel traversed the assembly about a pivot under the monopod through an arc-shaped metal rail at the rear of the baseplate. Elevation was set by means of a nut on the monopod and a gunner's quadrant was used, since the sight was mounted off-barrel on a stalk and measured only azimuth. HE, smoke and illuminating rounds were available. The weapon was heavy for its caliber and very cumbersome to move, and range was only mediocre. It saw service in China in the late 1930s, but was gradually replaced by the Brandt-type 81mm.


A Type Taisho 11 infantry mortar with carrying poles fitted. A round for the weapon sits on the left front corner of the baseplate, and the sight stalk is to the right of the barrel.

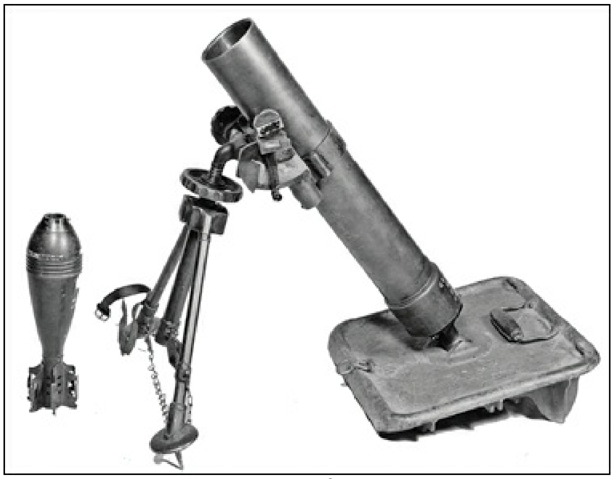
### 81mm Type 97 Infantry Mortar


81mm Type 97 Infantry Mortar.

This, the standard infantry mortar, was essentially a straight copy of the Brandt 81mm mortar with only a few changes. The most notable difference was that the cross-levelling nut was on the right bipod leg, rather than on the left as in the French and US models. US technicians assessed this as making it somewhat more difficult to level, but it does not seem to have bothered the Japanese mortarmen. The main service rounds were the Type 98 HE and, from 1941, the Type 100 HE, both with a base propellant charge and five additional charges. They differed mainly in the fuze used, the Type 93 or the Type 100, both being capable of point-detonating and delay functions. Smoke and illumination rounds do not seem to have been available for this weapon. A sturdy, serviceable weapon, the Type 97 remained in use through the war.

### 81mm Type 99 Infantry Mortar

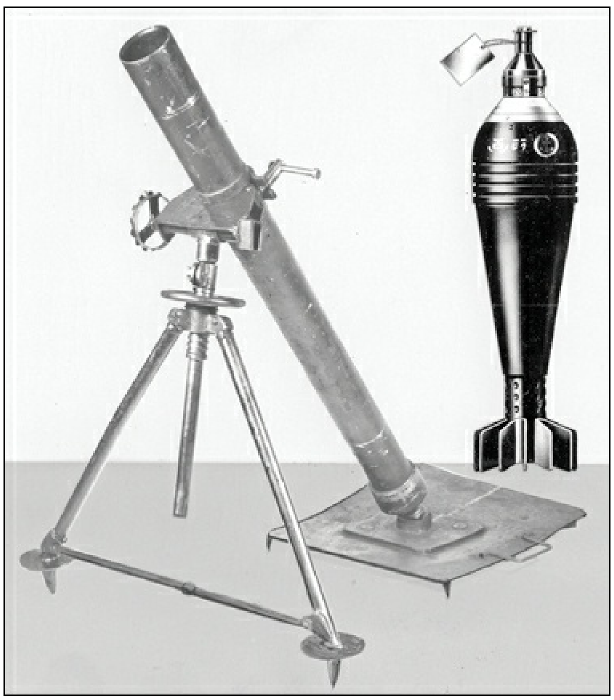
This ingenous weapon resulted from a requirement for an ultra-lightweight medium infantry mortar. The barrel was exceptionally short, so in order to achieve a reasonable range less tolerance was allowed between the shell’s driving band and the interior wall of the barrel. That meant that drop-firing was impractical, so a moveable firing pin, actuated by striking a cam shaft with a mallet, was employed. A simpler sight was also used, which provided an elevation scale but no traverse, which would have slowed down indirect fire. The weapon broke down into three loads, each of which was about 8 kg, so it was easily manportable. It fired the same ammunition as the Type 97 infantry mortar, albeit to shorter ranges.



81mm Type 99 Infantry Mortar.

**81mm Type 3 Navy Mortar**

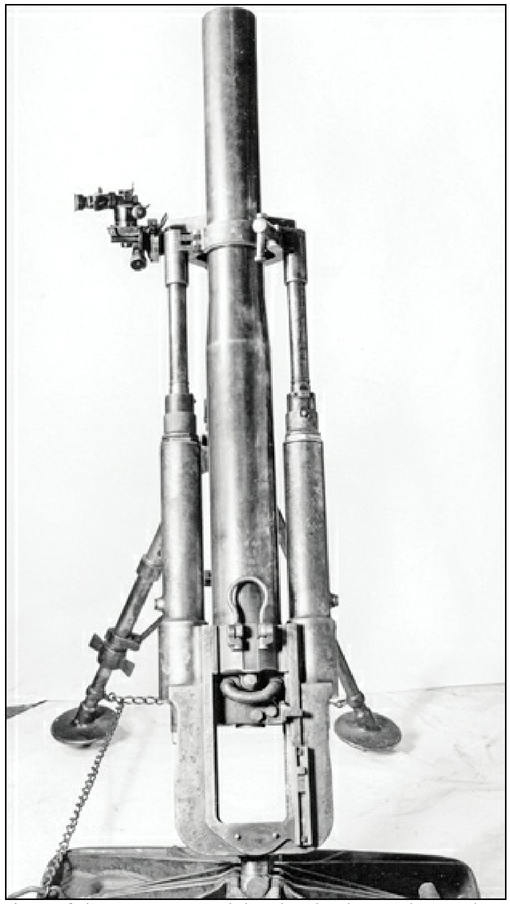
The IJN developed a series of mortars designed for shipboard use, these being mounted on turntables with arc-shaped mounts to regulate elevation. Simply moving these mounts to extemporized platforms for ground use was possible, and indeed such conversions were undertaken in the homeland for naval base defense, but their static nature reduced their usefulness considerably. For more mobile operations, the Navy manufactured crude bipods, incapable of cross-leveling, and baseplates. An unusual feature was the firing pin retraction screw that pulled the pin back 3mm to facilitate safe removal of misfires. The ammunition was quite sophisticated, using ring increments (rather than the Army bag style) and 12 fins (Army rounds had six).



81mm Type 3 Navy Mortar.

**90mm Type 94 Light Trench Mortar**

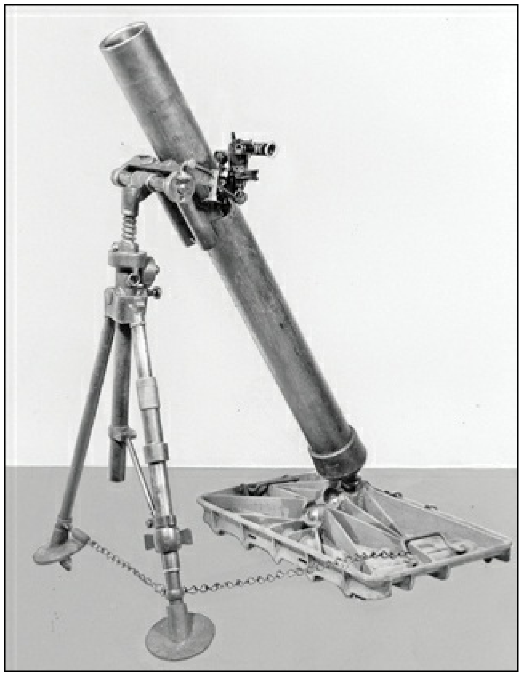
The first of the light/medium trench mortar family, this smooth-bore muzzle-loaded weapon utilized a separate hydro-spring recoil system similar to that of the 150mm Type 96. Spring recoil/recuperator cylinders were fixed at their rear to a U-shaped mount that terminated in a ball-and-socket arrangement on the baseplate. The rods of the cylinders projected forward and were attached to a collar fixed to the barrel near the muzzle. A hydraulic cylinder below the barrel further cushioned recoil, while the springs did dual duty as recuperators. The main service round was the Type 94 HE, although a heavy HE round (11.2 kg with a range of 1445 meters) as well as chemical incendiary and smoke rounds were also available. For transport it was carried in one cart or two pack loads. Although unduly heavy for its caliber, the Type 94 threw a useful shell to a respectable range, and was the standard trench mortar for the first half of the war.



The rear view of the Type 94 at right clearly shows the U-shaped mount.

**90mm Type 97 Light Trench Mortar**

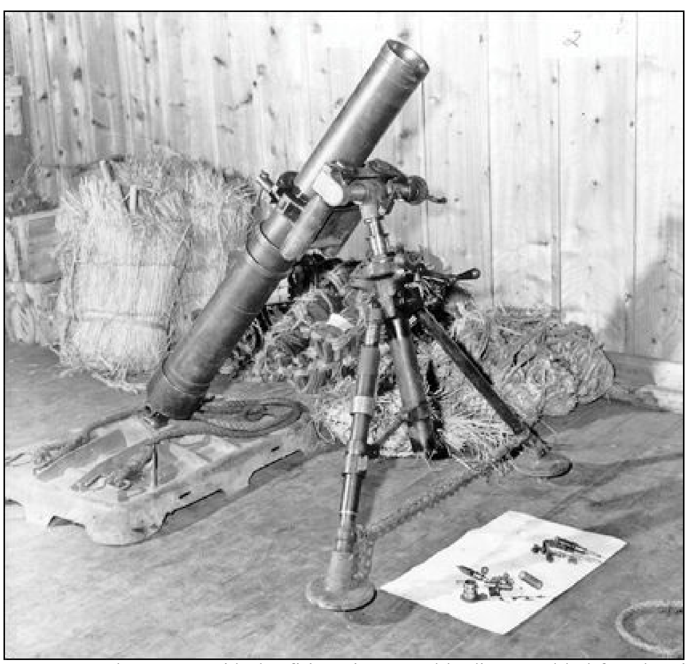
This was essentially the Type 94 trench mortar minus the recoil mechanism and U-shaped frame, using the baseplate and sight of the 81mm Type 97. This reduced weight by a third and also increased the traverse available. It fired the same ammunition with the same ballistic characteristics as the Type 94. It was transported in one cart load or two pack loads, and could be carried short distances by its crew, with the heaviest component being the baseplate at 42 kg. It replaced the more cumbersome Type 94 as the standard trench mortar in 1943, but a year later was itself supplanted by the 120mm Type 2.



90mm Type 97 Light Trench Mortar.

**120mm Type 2 Trench Mortar**

This was the final standardized armament for the trench mortar battalions. It used a new barrel, a variant of the 90mm trench mortar baseplate, and the bipod from the 150mm Type 97 fitted with an adaptor sleeve in the collar. The barrel had a large reinforced section at the very rear and tapered down towards the barrel, with two reinforcing hoops in the middle. The weapon was carried on a single cart or in three pack loads. Only one type of ammunition was produced, the Type 2 HE round with the Type 100 PD/delay fuze. The HE round carried 2.72 kg of explosive fill, a considerable improvement over the 1.07 kg of the 90mm HE round.



A Type 2 trench mortar, with the firing pin assembly disassembled for cleaning.

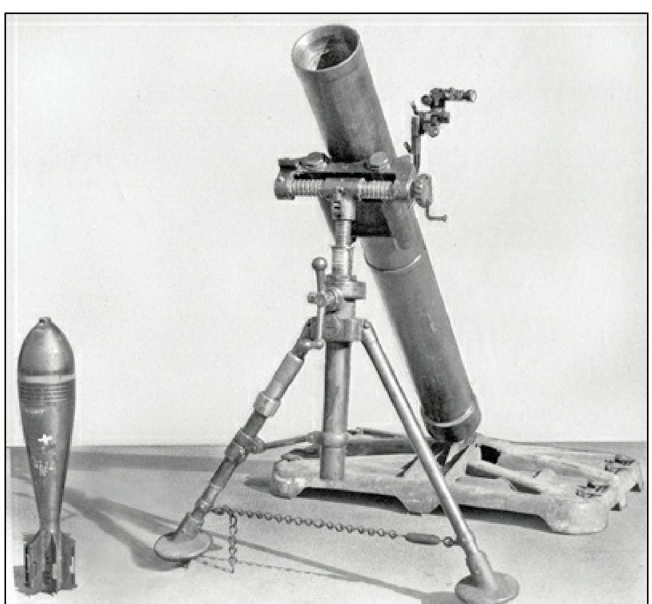
**150mm Type 96 Medium Trench Mortar**

The barrel of this weapon was fitted with spring recoil/recuperator cylinders on each side and this assembly was mounted on a slide within a U-shaped frame so that it could slide to the rear. The frame also included an hydraulic recoil cylinder below the tube. Recoil braking action was secured by the two springs and by the hydraulic recoil piston. The springs returned the tube to firing position after recoil was completed. Traverse was 11.5° each side on the bipod, and 25° each side by moving the bipod. For transport the mortar was broken into two loads, with the baseplate and bipod, totalling 180 kg, in a special cart and the barrel and recoil mechanism carried on a special 2-wheel axle. Normally, each load was drawn by a horse, but they could be pulled short distances by a man.


The 150mm Type 96 at full elevation.

**150mm Type 97 Medium Trench Mortar**

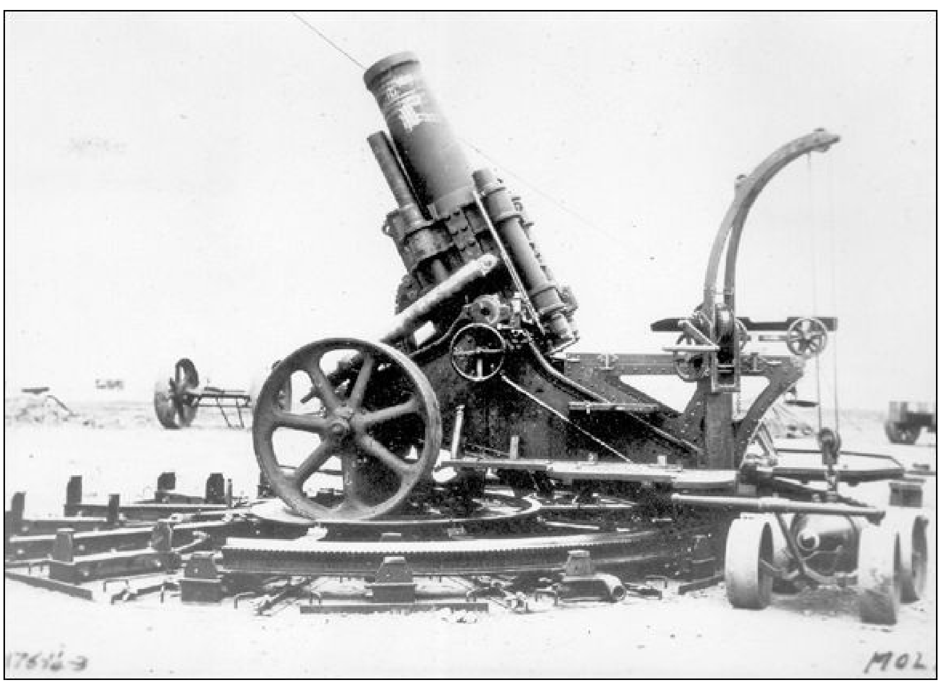
This was essentially the Type 96 but with the recoil mechanism eliminated and a ball-shaped protrusion added to the rear of the tube. This ball sat directly in a socket in the baseplate in the manner normal to mortars. This led to less, but still satisfactory, stability in a weapon that weighed less than half that of the Type 96. It was produced with two barrel lengths: 1.935 m and 1.395 m. The bipod was of conventional design except that the elevating screw was formed as two concentric screws, aiding in stability and overall length. The main components were the baseplate (153 kg), barrel (116 kg for the long) and bipod (79 kg). It could fire the Type 96 HE shell (25.8 kg) as used in the Type 96 mortar with identical range, and was also issued with the lighter Type 99 shell (23.5 kg) and Type 2 shell (23.1 kg), each of which used six increments to vary the range. Only HE ammunition was manufactured for the 150mm trench mortars, the Type 99 being the standard round in production during the war.


The long 150mm Type 97 and Type 96 HE round.

## Heavy Trench Mortars

There were two models of heavy trench mortars, the 274mm Type (Taisho) 14 and the 305mm Type 96. Both were rifled, breech-loaded designs using interrupted-screw breech mechanisms. The Type (Taisho) 14 used a separate hydro-spring recoil mechanism, while the Type 96 utilized a Schneider-type hydropneumatic system. Neither saw combat use.

A Type (Taisho) 14 heavy trench mortar with the barrel rotated to horizontal for loading.

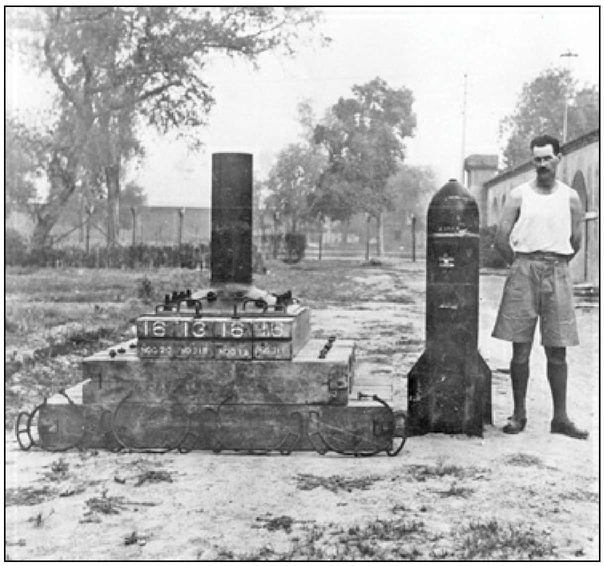


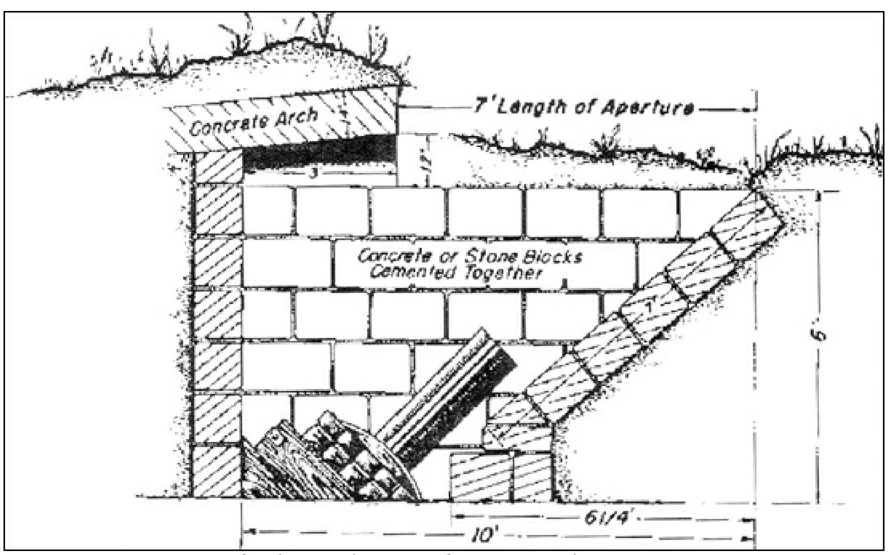
A Type 96 heavy trench mortar in firing position.

## 250/320mm Type 98 Spigot Mortar

This unique weapon consisted of three layers of heavy wooden beams (not included in the weight figure), onto which was mounted a convex steel seating plate, on which sat the cylindrical barrel. The weapon was fixed in elevation at 45° but some traverse was possible by adjusting the mounting bolts. The barrel had an outer diameter of 250mm and an inner diameter of

240mm. The projectile had a diameter of 320mm and had to be assembled from three components: the warhead, the body and the hollow tail that fit over the mortar barrel, this feature enabling the ammunition to be manhandled forward, albeit with difficulty. An igniter screwed into an orifice on the side of the tail assembly to fire the weapon. Although inaccurate and possessed of a short range, the massive projectile, with its 46.8 kg of picric acid explosive, had a devastating effect if it did manage to hit in the area of the target.



Defensive emplacement for a 32cm spigot mortar.

1 Early production of the Type 99 is not known, but serial number 598 was produced in October 1942.

2 Responsibility for the 90mm mortars was transferred from the Chemical School to the infantry on 1 July 1945, and for 150mm mortars to the Artillery School the same date.

3 The difference could not have been that great. A US chemical mortar (4.2") battalion conducted extensive firing tests with a captured 15cm Type 97 and it "was

found to be stable in firing”. They also noted that “the fragmentation of the projectiles appeared to be excellent”.

4 90mm Type 97 serial number 118 came off the Osaka Arsenal production line in 1942. Note the inconsistency with the production table provided by the Ordnance Bureau and Osaka Arsenal and reproduced here. It seems likely that some of the later Type 94s reported as produced were actually Type 97s.

5 It was called the Temporarily Designated Type 3 mortar until April 1944, when the “temporary” modifier was officially removed

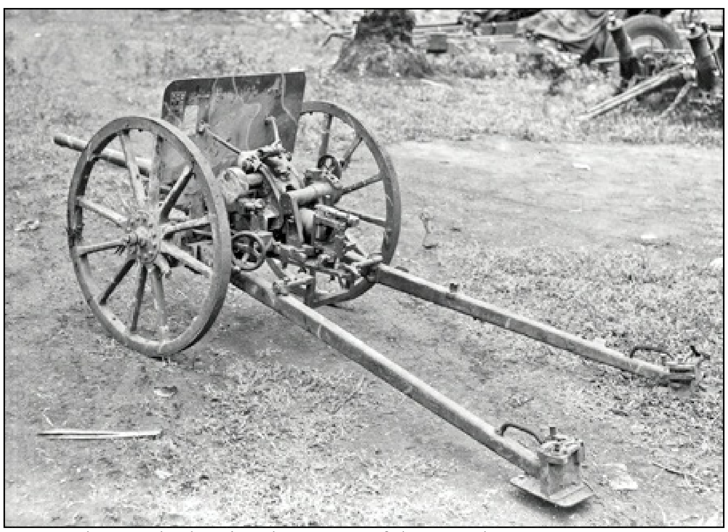
# 7

# Anti-Tank Weapons

The IJA paid little attention to anti-tank warfare until tensions rose with the Soviet Union over Japanese claims to Manchuria in the early 1930s. Then design work was initiated on a modern 37mm anti-tank gun and the weapon was standardized in 1934 as the Type 94 Anti-Tank Gun. Surprisingly, it fired a completely different, and more powerful, cartridge than the parallel 37mm Type 94 tank gun. The Type 94 anti-tank gun owed little to foreign designs and had a number of unusual features, including a semi-automatic rotating breech block and pivoting axle stub. A small 8x telescopic sight was attached to the left side of the gun for the benefit of the gunner, who operated the traversing handwheel with his left hand and the elevation handwheel with his right, firing the weapon by pulling the latter to the rear.

The weapon was quickly placed in production at the Osaka Arsenal, joined by the Nagoya Arsenal in 1941. Production ramped up rather slowly at first, due to the small number required. Lacking separate anti-tank battalions or divisional AT units the IJA line requirements were only 308 for the A-type regiments and 42 for the B-type regiments by the outbreak of the Pacific war in late 1941. Even after allowing for some losses in China, therefore, production actually far exceeded requirements by the late 1930s.

The standard round was the Type 94 APHE-T, which featured a projectile machined from bar steel stock and nose hardened. It contained a small cavity with a volume of 21 ml, but only 13 ml of that was available for the miniscule 8.5 g of picric acid explosive, the rest being taken up by the base fuze. A Type 1 APHE-T improved the hardening process to aid performance at graze angles. Also available was the Type 94 HE, which used the same projectile as that used for the old 37mm infantry gun.



The standard anti-tank weapon of the IJA, the 37mm Type 94.

An effort had been made to improve the performance of the weapon by using a longer cartridge case with more propellant, and this was denominated the Type 97 Anti-Tank Gun, but it does not appear to have progressed past prototype stage. The Type 94 was adequate for its time, but by the outbreak of the Pacific War it was clearly nearing the end of its usefulness.

**Production of Army Anti-Tank Weapons**

| | 1931 | 1932 | 1933 | 1934 | 1935 | 1936 | 1937 | 1938 | 1939 | 1940 |
|---|---|---|---|---|---|---|---|---|---|---|
| 20mm Type 97 AT Rifle | – | – | – | – | – | – | 8 | 50 | 250 | 450 |
| 37mm Type 94 AT Gun | – | – | – | 32 | 192 | 193 | 239 | 234 | 375 | 455 |
| | | | | | | | | | | |
| | 1941 | | 1942 | | 1943 | | 1944 | | 1945 | |
| | Apr-Jun | Jul-Dec | Jan-Jun | Jul-Dec | Jan-Jun | Jul-Dec | Jan-Jun | Jul-Dec | Jan-Jun | Jul-Aug |
| 20mm Type 97 AT Rifle | 150 | 100 | - | - | 100 | – | – | – | – | – |
| 37mm Type 94 AT Gun | 125 | 380 | 247 | 335 | 250 | 180 | 105 | – | – | – |
| 37mm Type 1 Gun[a] | – | – | – | – | 84 | 201 | 151 | 103 | 59 | – |
| 47mm Type 1 AT Gun | – | – | 45 | 250 | 352 | 428 | 380 | 241 | 235 | 30 |
| 7cm rocket launcher | – | – | – | – | – | – | 130 | 1,000 | 2,151 | 259 |

[a] includes both tank and anti-tank guns. About 220 were needed for tank use, the balance were presumably AT weapons

Designed as an anti-tank weapon, actual usage, as reflected in ammunition production, was sometimes rather different. Between mid-1937 and early 1939, facing few armored targets in China, production switched to high explosive rounds for use in the infantry support role. As the Soviet Union re-emerged as a dominant threat, however, production switched back to armor piercing ammunition. By 1943, however, with its utility as an anti-tank gun much reduced, and often replaced in that role by the larger 47mm gun, HE ammunition made something of a comeback before essentially ending in late 1944.

In the meantime, it had been complemented by a lighter weapon, a 20mm AT rifle, which was suitable for man transport and could be allocated down to the battalion level. It was standardized in 1937 as the Type 97 Automatic Cannon pending some further improvements. The cradle, front and rear carriage, and breech mechanism were strengthened and trials in July 1938 showed excellent results. An initial batch of weapons were produced in 1939-40, probably for use against Soviet fortifications rather than against tanks on the open plains of Manchuria and Siberia. Chrome-plating of the barrel was introduced in the summer of 1940, which gave it a life of 5,000 rounds, of which 3,000 rounds gave only a 2% decrease in muzzle velocity. The weapon fired both armor-piercing and explosive rounds, with the latter having a burst radius of about 5 meters. When firing against a stationary target (such as slits in a bunker) a rear monopod was used that reduced the dispersion at 500 meters range somewhat from 0.65x0.70 meters to 0.45x0.67 meters, the improvement coming primarily in the elevation factor. On the other hand traversing the heavy weapon was difficult, which would have reduced its value against moving targets.

**Army Anti-Tank Gun Ammunition Production**

| | | 1931 | 1932 | 1933 | 1934 | 1935 | 1936 | 1937 | 1938 | 1939 | 1940 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 20mm Type 97 | AP-T | – | – | – | – | – | – | – | – | 156 | 297 |
| | TP | – | – | – | – | – | – | – | – | 35 | 364 |
| 37mm Type 94[a] | HE | – | – | – | 16 | 58 | 8 | 192 | 516 | 341 | 483 |
| | AP | – | – | – | 27 | 120 | 16 | 77 | 147 | 558 | 829 |
| | TP | – | – | – | 15 | 64 | 31 | 46 | 71 | 104 | 256 |
| | | | | | | | | | | | |
| | | 1941 | | 1942 | | 1943 | | 1944 | | 1945 | |
| | | Apr-Jun | Jul-Dec | Jan-Jun | Jul-Dec | Jan-Jun | Jul-Dec | Jan-Jun | Jul-Dec | Jan-Jun | Jul-Aug |
| 20mm Type 97 | HE | 36 | 72 | 40 | – | – | – | – | – | – | – |
| | AP-T | – | 200 | 123 | – | – | – | – | – | – | – |
| 37mm Type 94[a] | HE | 72 | 176 | 152 | 101 | 126 | 147 | 132 | 74 | 3 | – |
| | AP | 174 | 448 | 355 | 162 | 214 | 256 | 182 | 49 | – | – |
| | TP | 31 | 159 | 218 | 220 | 162 | 221 | 40 | – | – | – |
| 47mm Type 1[a] | AP | – | 12 | 139 | 290 | 480 | 303 | 279 | 241 | 191 | 14 |
| | HE | – | – | 60 | 149 | 169 | 195 | 146 | 81 | 63 | – |
| 7cm Type 4 RL | HEAT | – | – | – | – | – | – | – | 6 | 43 | 9 |

[a] includes ammunition for tank guns

The most common round for the weapon was the AP-T, initially the Type 97 and later the Type 100, differing in the hardness of the steel used for the projectile. An HE-T round was also available and this appears to have been built when thought was being given to using the weapons almost as a "sniper" weapon against the slits of Soviet pillboxes in the far east. Other types, built for aircraft cannon, including HE-I and HE-T with self-destruct were theoretically available but do not seem to have been issued for this weapon.

It finally went into mass production at the Kokura Arsenal in late 1939, with the first weapon coming off the line in April, but few were built. It was sent to the Pacific in 1942/43 where its light weight recommended it, but it was clearly too weak to deal with the newer generation of Allied tanks and was gradually withdrawn from service. The last models were produced in August 1942.

A two-pronged effort was undertaken to provide more powerful anti-tank weapons. One effort was directed at making the little 37mm more powerful by replacing the L/46 barrel on the Type 94 with an L/50 barrel and enlarging the chamber, a project paralleling that of the tank guns, where the similar Type 94 tank gun was replaced by the Type 1 with the longer barrel. This was to have provided the infantry a slightly more potent weapon for its regimental anti-tank companies. In this case, however, it appears that only nominal quantities of the Type 1 were built, with the Type 94 remaining in production. Presumably the increase in performance, limited as it was, was insufficient to warrant the break in production necessary to change to a new model with different ammunition, especially since so few tanks were built with the analogous new tank gun version. The Type 94 thus soldiered on to the end of the war as the primary Japanese anti-tank gun in all combat theaters.

A special derivative of the 37mm Type 1 was developed for the parachute forces in 1942/43. This featured a smaller shield and lightweight metal wheels to reduce the weapon's weight to 243 kg, but by the time development was complete Japanese parachute forces were largely on the defensive.

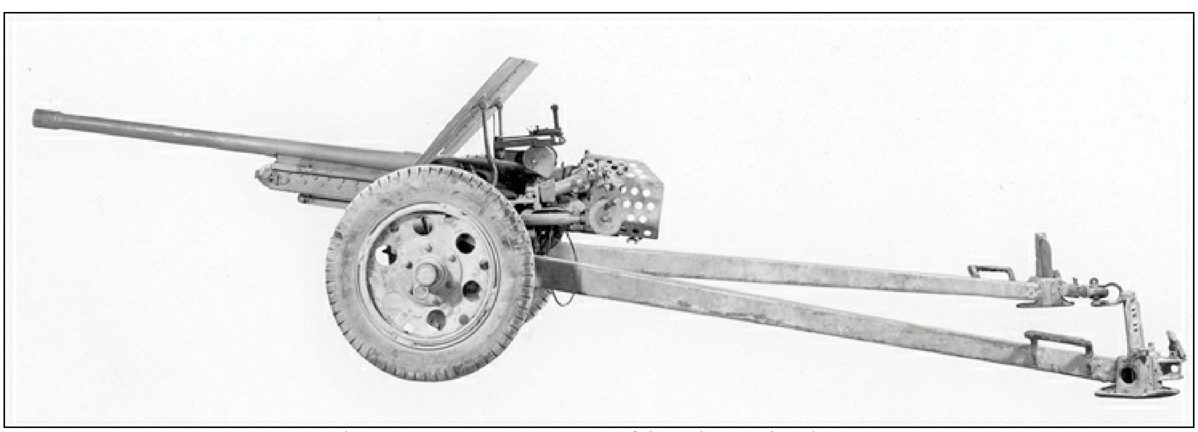
The second effort was directed at providing a heavier, more powerful weapon suitable for motor traction for the separate anti-tank companies and battalions. This yielded the 47mm Type 1 Gun, made by the Osaka Arsenal, with the first being delivered in April 1942. Most of these weapons were retained for the defense of the homeland, although some were shipped to the larger islands of the Pacific, including Luzon and Okinawa.

The goal of almost any anti-tank weapon is to penetrate the armor of an enemy tank and do significant damage on the other side. Predicting the thickness of armor that can be penetrated by a given gun/ammunition combination is always tricky, varying primarily on the type and quality of the armor being attacked, but also on other nonstandard conditions, including ammunition temperature and gun barrel wear. One widely-distributed Japanese table captured by the US gave the following figures:

| Japanese Table of Armor Penetration | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Gun | Projectile | 250m | 500m | 750m | 1000m | 1250m | 1500m | 2000m | 2500m | 3000m |
| 20mm Type 97 | Type 97 AP | 30 | 23 | 18 | 15 | 12 | 10 | 9 | | |
| 37mm Type 94 Tank | Type 94 APHE | 28 | 21 | 15 | 10 | 8 | 7 | 6 | | |
| 37mm Type 94 AT | Type 1 APHE | 46 | 40 | 35 | 30 | 26 | 23 | 19 | | |
| 37mm Type 1 AT | Type 1 APHE | 52 | 44 | 38 | 33 | 28 | 25 | 21 | | |
| 47mm Type 1 AT | Type 1 APHE | 70 | 64 | 58 | 52 | 47 | 41 | 33 | 25 | 19 |
| 57mm Type 1 Experimental | Type 1 APHE | 78 | 70 | 65 | 60 | 56 | 52 | 46 | 40 | 34 |
| 75mm Type 90 Field Gun | Type 1 APHE | 90 | 84 | 78 | 73 | 68 | 63 | 55 | 49 | 45 |
| 105mm Type 91 Howitzer | Type 1 APHE | 75 | 73 | 70 | 68 | 66 | 63 | 59 | 56 | 53 |
| 150mm Type 96 Howitzer | Type 1 APHE | 125 | 120 | 114 | 109 | 102 | 99 | 92 | 87 | 83 |
| Penetration at 0° angle into steel armor (presumably RHA) in mm | | | | | | | | | | |

The small 20mm Type 97 fired a completely inert AP round, but larger weapons used APHE, which added a small explosive charge of picric acid and a short-delay base fuze, presumably at the expense of penetration. Australian intelligence fired APHE rounds out of a Type 94 AT gun against an M3 light tank and at 100 yards and about 0° angle got penetration against the hull side (25mm) and turret (40mm), with detonation inside the tank in both cases. They also got penetration against the side at 20° angle and gouging and spall at 25°. A hit at 350 yards made a hole in the side armor, but not all the way through, while hits on the suspension caused little damage and would not have disabled the tank. Separately, American analysts concluded that the gun would be effective against 25mm face-hardened armor out to about 500 yards.

The 47mm weapon, in tank and anti-tank configurations, was a much more powerful weapon. It fired two types of ammunition, an HE round carrying 87 g of TNT and picric acid and a nose PD/delay fuze, and an APHE round with 18 g of RDX and a base delay fuze. Preliminary firing trials conducted by US Army technical intelligence in the Philippines in 1945 with APHE ammunition from a tank gun showed that “at normal impact at ranges up to 500 yards … the 47mm tank gun will easily penetrate the thickest armor on the US M4A3 medium tank turret” with detonation against the far wall. At higher angles of incidence, 30°-40°, ricochets occurred. Similarly, a Marine Corps afteraction report noted that “the 47mm AP HE projectile penetrated the tank turret of the Sherman at ranges as great as five hundred yards and usually destroyed the tank.” Trials against an M4A6 on Okinawa showed no penetration against the glacis, but consistent penetration against all other parts of the tank at all ranges. Trials conducted at Aberdeen Proving Ground were a bit more reassuring to US troops, these showing the Sherman invulnerable at the glacis and turret front, but vulnerable at all practical ranges at the sides. Penetration almost always resulted in detonation of the projectile charge inside the tank. In some trials, however, the steel used proved brittle, breaking up on contact with face-hardened armor. Unfortunately, US Sherman tanks used homogenous armor rather than face-hardened.



The 47mm Type 1 was a powerful, modern anti-tank gun.

The 47mm also featured an improvement in one other area, the time in flight to 600 meters range was reduced slightly from 1.0 second for the 37mm gun to 0.8 second, making tracking a moving target somewhat easier. On the other hand the 47mm was a little more cumbersome to bring into action. The time required for an average gunner to fire the first shot after occupying the firing position rose from only 10 seconds for the Type 94 to a minute and a half for the 47mm Type 1.

Americans who ran trials with the 47mm noted that the weapon was powerful and the carriage stable in firing but that excessive play in the traverse gear reduced repeatability of shots, extraction of the used casing was unreliable, and the recoil mechanism subject to excessive wear. Also commented on was that firing resulted in a bright orangered ball of muzzle flash about 600mm in diameter a short distance from the muzzle, making concealment difficult and observation of fire by the gunner almost impossible. Also noted was the fact that the range cam (with gradations out to 3,000 m) was set by the assistant gunner, leaving the gunner free to concentrate on aiming.

One other weapon deployed by the IJA was the 37mm Pak 36 from Rheinmetall. During the offensives of 1937/38 some 46 of these, along with substantial stocks of ammunition, were captured from the Chinese Army and they were used to equip one AT battalion that was sent to the Dutch East Indies and one separate company sent to Guadalcanal. The German 37x250mm ammunition was similar to the 37x251mm ammunition used in the Type 1 tank and anti-tank guns, but was not interchangeable due to different contours. Subsequently, 30 of the Soviet copies, the obr.30, were also captured from the Chinese and were probably used locally.

Overall, IJA kinetic-energy type anti-tank weapons lagged behind the rest of the world throughout the war, although they got off to a respectable start. The 37mm Type 94 was as good as any other anti-tank weapon at the time of its introduction, and the 47mm Type 1 was only about six to twelve months behind European weaponry. A high-velocity 57mm experimental gun was developed, but was not placed in production as the increase in performance was considered insufficient for the effort involved.

**Anti-Tank Gun Data**

| | 20mm Type 97 | 37mm Type 94 | 37mm Type 1 | 47mm Type 1 | 57mm Exper |
|---|---|---|---|---|---|
| Barrel Length (cal) | 60 | 46 | 50 | 54 | 57 |
| Proj Wt (AP)(kg) | 0.16 | 1 | 1 | 2 | 3 |
| Complete Rd (AP)(kg) | 0.32 | 1 | 2 | 3 | n/a |
| Muzzle velocity (m/s) | 792 | 697 | 797 | 827 | 845 |
| Traverse (deg) | n/a | 60 | 60 | 58 | 57 |
| Elevation (deg) | n/a | -10 to +25 | -10 to +25 | -10 to +18 | -10 to +18 |
| Height of tube from ground (mm) | 400 | 523 | 523 | 658 | 800 |
| Avg Recoil Length (mm) | ? | 391 | 500 | 391 | 695 |
| Recoil Pull (kg) | ? | 623 | 764 | 1,760 | 1,710 |
| Weight in Firing Position (kg) | 68 | 330 | 336 | 805 | 1,086 |

The revolution in Japanese anti-tank weaponry started in May 1942, when Col. Paul Niemüller and Maj. Walter Merkel of the German Heereswaffenamt arrived in Japan via a blockade runner with documentation and samples of the German 30mm and 40mm shaped-charge anti-tank rifle grenades and *schiessbecher* launchers. By the summer of 1943 copies of both the 30mm and 40mm grenades were in production in Japan and work was underway on hollow-charge rounds for artillery weapons.

The German grenades and launcher were copied as the Type 2 Rifle Grenade Launcher. Production appears to have begun in August 1942 and it was encountered on Guadalcanal as early as mid-October. It is not certain, but seems likely that about 17,000 launchers were built through the end of 1942, and another 32,000 in 1943 before production terminated. The grenades were manufactured by the Osaka and Tokyo 1st Army Arsenals. Production of grenades ran at least through March 1944. Both the 30mm and 40mm grenades were produced, with the larger apparently being more numerous.

US Army trials of 30mm Type 2 grenades captured on Leyte and Luzon in 1944-45 showed:

> that the grenade will penetrate nearly 2½ inches of armor. The grenade is stable in flight, and it was found quite easy to strike a target one yard square with this grenade at a range of 50 yards. In this respect, the 30mm grenade is superior to the 40mm grenade, which is somewhat unstable in flight. A total of eighteen grenades were fired in the test, of which ten failed to explode…. [T]his was due to faulty construction of the grenades.

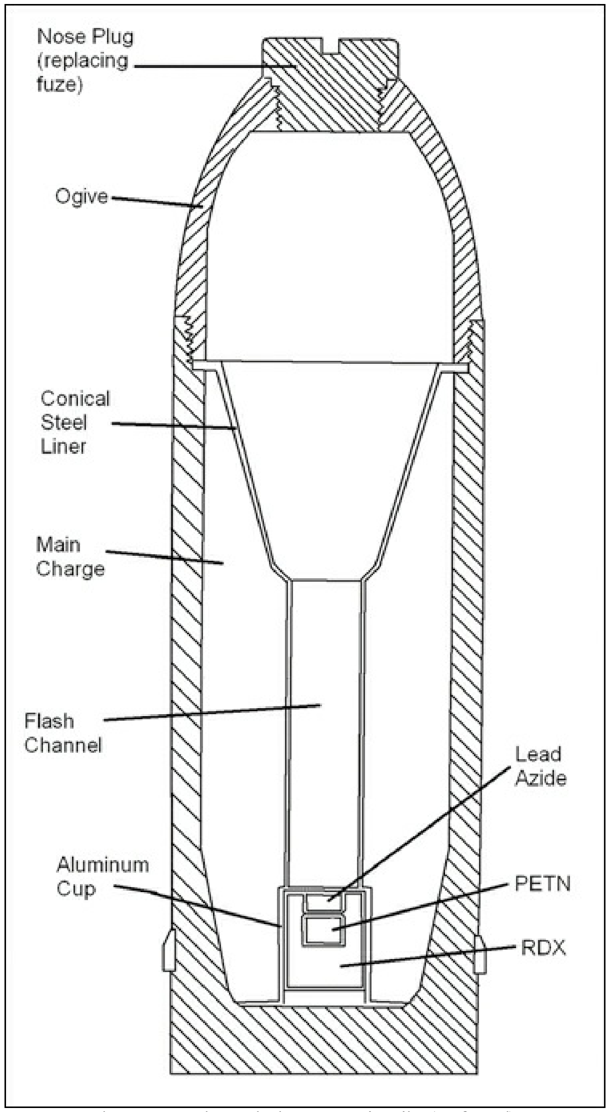
The problem with the rounds encountered in the Philippines was an excess of "play" to the firing pin in its cylindrical sleeve. Instead of sliding straight forward into the primer on impact, the pin would wobble and ballot on its way forward and fail to find the opening at the forward end. Early firing trials in Japan had noted a high percentage of duds, but this was initially ascribed to impact at an oblique angle.

The Type 2 grenade launcher was never incorporated into any list of organizational equipment and were, instead, issued as "additional" equipment, so tracking usage is difficult. The Expeditionary Units dispatched to the central Pacific received them. The 50th Infantry Regiment on Tinian, an island defense-type belonging to the 29th Division, got 35 of them as well, but it is not clear if other elements of the division did. While the 1st Expeditionary Unit (later 47th IMB) on Saipan got them quite quickly, the 43rd Division on the same island did not get its allocation (100 Type 2, along with 300 Type 100) until mid-1944. The 52nd Division, another island defense-type, did not get any. As of October 1944 the divisions and brigades of the 35th Army in the central and southern Philippines had not received any.


A 37mm AT gun (here with the pressed steel wheels) with the overcaliber shaped charge round.

Another application for the hollow-charge principle was artillery ammunition, which were of two varieties. For the small 37mm AT gun a spigot design was adopted, in which the fin-stabilized overcaliber round was fitted over the muzzle. The round had a warhead diameter of 80mm and carried 0.675 kg of explosive behind a steel liner 3mm thick. The range is unknown, but with a muzzle velocity of only 90 m/s is unlikely to have been great, and effective range was probably only about 100-200 meters. It was capable of penetrating 100mm of armor. In any event, mass production never materialized. An experimental overcaliber round, similar to that used with the 37mm AT gun, was designed for the 75mm Type 41 mountain gun with a 200mm diameter capable of penetrating 300mm of armor, but it too was not produced.

For larger pieces the rounds were more conventional and loaded through the breech. Known as "TA ammunition" to the Japanese, these shaped charge rounds were produced for the 57mm tank gun, the 70mm Type 92 infantry (battalion) gun, 75mm Type 41 mountain (regimental) gun, 75mm Type 94 mountain gun, the 105mm Type 91 howitzer, the 120mm Type 38 howitzer, and the 150mm Type 4 howitzer. TA rounds were also developed for the Type 38 field gun and the Type 99 105mm mountain howitzer, but it is not clear if these entered production. The 57mm round was said to be able to penetrate 55mm of armor, the 70mm round 90mm, the 75mm rounds 100mm, the 105mm round 120mm, the 120mm round 140mm, and the 150mm round 150mm. US tests with 70mm HEAT rounds captured in the Philippines showed penetration of an M4A3 Sherman turret most of the time, with penetration rated at "at least 70mm". It was noted of the battalion howitzer that "[t]hese tests indicated that the use of HEAT ammunition in this weapon makes it a formidable anti-tank weapon", although it should be noted that these were static tests of the ammunition only and no attempt was made to hit a the target with the low-velocity gun itself.



The 75mm shaped charge projectile (unfuzed).

The most common of the shaped-charge projectiles was the 75mm. The projectile body housed the main charge, made of 60% TNT and 40% RDX (then known as cyclonite). A liner of steel formed a conical indentation in the front face to take advantage of the focusing effects of the Munroe Principle. An unusual feature of the design was the retention of the conventional Type 88 impact fuze in the nose. A shaped charge warhead has to be initiated from the base of the main charge in order to be effective, and most nations accomplished this by using a base fuze consisting of a sliding weight that moved forward on impact to initiate a primer charge. The Japanese felt that such a fuze took too long to operate. The base fuzes used in their rifle grenades had a delay of .005 seconds, acceptable for munitions moving at 50 m/s, while the Type 88 instantaneous nose fuze had a delay of one-fifth that and, even with the need to transit the length of the projectile, were better suited to faster gun-launched rounds. Thus, here a conventional fuze in the nose sent the flame from a booster charge rearward through a flash channel defined by the steel liner, until it hit a lead azide pellet, that ignited a PETN pellet, that in turn ignited the RDX primer that initiated the main charge. The fact that they used a relatively hard variety of steel for the liner and the loss of the central part of the cone and its share of the explosive reduced the effectiveness of these rounds compared to international standards, although they would usually still be lethal against M4 Shermans.

The 75mm shaped charge round had a complete round weight (less fuze) of 4.82 kg, a projectile weight (less fuze) of 3.57 kg, and outer diameter of 75mm, a charge diameter of 61mm, and 2mm-thick liner with a front diameter of 49mm and a rear diameter of 27mm, representing an angle of 25°. The Japanese claimed that the optimal impact velocity for the hollow-charge rounds was 250 m/s, and that at 350 m/s and above there was a “marked decline” in its penetration power. As a result, these rounds were fired with reduced propellant loads that, in turn, gave them a curved trajectory that limited accuracy at longer ranges.

While the penetration of the HEAT rounds would have been sufficient to destroy many tanks, most of the weapons that fired them had very narrow traverse ranges that greatly limited their usefulness against mobile targets. This was true of two of the most common weapons, the 75mm Type 41 regimental gun and the Type (Meiji) 38 field gun, which had only 6°-7° of traverse available, meaning they would have had to predict, with a fair degree of specificity, where enemy tanks would appear when setting up.

Postwar GIs show firing and carrying positions for the Army 7cm AT rocket launcher.

Another effort involved tying the shaped charge principle to the rocket concepts under development. The most fruitful result was the Army 7cm anti-tank rocket launcher. Development had been begun by the 1st Army Laboratory in 1943 and the design of the simple (if heavy) launcher had been completed by mid-1944 and it was placed in production. Production of the rockets was a more complicated affair, however. Changes to design and manufacturing difficulties meant that mass production did not begin until April 1944. By July production had risen to 2,000 per month, still a negligible figure compared to the number of launchers already produced and any expected consumption rate in combat in the home islands. These shortages presumably also severely restricted training with the new weapon. The laboratory also developed a similar 90mm rocket and launcher, but this was never placed in production.

Distribution of these rocket launchers to units at the end of the war, according to the IJA Ordnance Bureau, was:

| 7cm AT Rocket Launcher Distribution at end of war (according to Ordnance Bureau) | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | 5th Area Army | 11th Area Army | 12th Area Army | 13th Area Army | 15th Area Army | 59th Army | 55th Army | 16th Area Army |
| Launchers | 0 | 100 | 484 | 103 | 960 | 75 | 38 | unk |
| Rockets | 0 | 0 | 3204 | 287 | 0 | 0 | 611 | 3824 |

Given the chaotic state of administration in mid-1945 and the destruction of records it seems likely that the numbers are not completely accurate, but overall it is clear that the priority was given to the 12th Area Army on the Kanto Plain around Tokyo, the 15th Area Army in southern Honshu and the 16th Area Army on Kyushu.

The Navy developed their own anti-tank rocket launcher, roughly similar to the Army's 7cm launcher. It utilized the Army's shaped charge concept of a front-mounted fuze with the central flash channel. Relatively few appear to have been made, for at the end of the war the IJN ordnance bureau counted only 173 on hand, the bulk of which, 149, were at the Sasebo Naval Base. Anti-tank rockets in 10cm and 12cm were also under development at the end of the war but none had apparently been built.

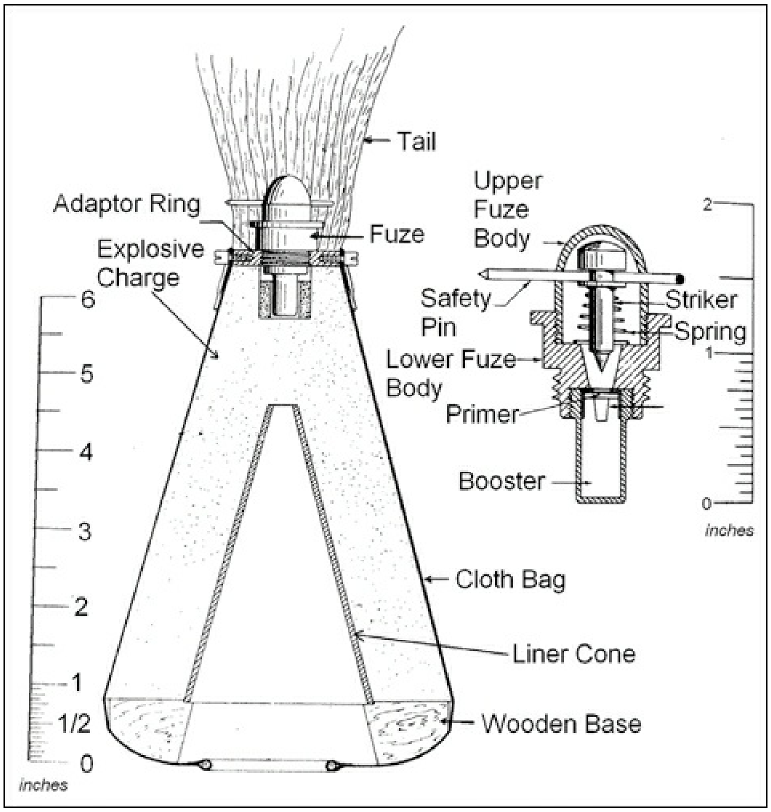
The final effort to develop a personal anti-tank weapon was the 45mm Type 5 recoilless gun, a handheld tube that launched an 80mm spigot-loaded shaped-charge warhead to an effective range of about 30 meters. An advantage this had over the 7cm rocket launcher was that it was much lighter, making it easier to carry and eliminating the need for bipod support for firing. Production of this weapon had just begun when the war ended.

A demonstration of the kneeling firing position for the 45mm Type 5 recoilless AT weapon.

Another application of the shaped charge principle, and an ideal once since it does not rely on projectile velocity for penetration, was to hand grenades. Three models were developed, all with the same configuration. The conical explosive charge was provided with a thin steel or aluminum cone and wrapped in a silk bag and attached to a ring-shaped wooden base. At the top of the charge was attached an adaptor ring, which served as a mount for the fuze and a tail. The fuze body was usually made of two pieces threaded together and housed a striker pin with a weight on top. A weak spring held the pin in the up position, as did a removable safety pin. A tail of hemp strands provided stability and proper orientation in flight. Once the safety pin was removed impact by the base on a hard surface at 10 m/s velocity caused the striker pin to move forward against the spring, initiating the lead azide primer, which would set off the RDX booster, which would, in turn, explode the main charge of TNT & PETN.

The three models developed had cone diameters of 50mm, 60mm and 75mm. The largest appears never to have left the development stage. The smallest was built in trials quantities as the Type 1, and was even encountered by US forces on Leyte but quantities appear to have been small. The 60mm model was chosen based on comparative tests against steel plate 50mm thick and standardized as the Type 3 Anti-Tank Grenade and was ordered into full production, but in fact it was not until July 1944 that the first units came off the production line, with production peaking at about 20,000 per month later that year, before dropping to about 7,000/month in late 1945, for a total production of about 230,000. The Japanese claimed that the Type 3 would penetrate 70mm of armor and could be thrown 10 meters.

A related, but earlier, device was the Type 99 magnetic anti-tank mine, although it was not a mine in the sense that active participation by a soldier was required. This is covered in more detail in the assault weapons chapter, as it was suitable for other targets as well.



Type 3 Anti-Tank Grenade.

**20mm Type 97 Anti-Tank Rifle**

Unique among anti-tank rifles, this weapon was fired semi-automatic from its 7-round overhead magazine. An unusual feature was that it included an 8mm thick shield just forward of the bipod, although this was often removed by the troops to save weight. The gas-operated weapon operated from the open bolt position. It was fired from a front bipod and rear monopod, and was carried by handles that attached forward and rear for carriage by four men, although it could be carried by two. It fired HE, HE-T, HEI, HEI-T and AP-T ammunition in 20x124mm rounds that were common to the Japanese 20mm aircraft cannon, but not to the 20mm Type 98 AA gun. The AP was rated as able to penetrate 30mm of armor at 250 meters at 0° angle.


Type 97 AT Rifle with front carrying handles and shield fitted.

**37mm Type 94 Anti-Tank Gun**

The standard infantry anti-tank gun during the war, the Type 94 was obsolete by 1942 but remained in service in part for its light weight and low silhouette. The weapon had a number of unusual features, including driven spades. These driven spades made repositioning the gun an awkward task, so the left stub axle was provided with a knuckle that permitted the left wheel to be turned 30° outward at the rear to improve on-carriage traverse without hitting that wheel. A spring-loaded locking arm held the axle in either the normal or rotated position. The weapon could be pack-carried by four horses, pulled by one horse or, for short distances, manhandled by pulling or carrying. Two types of wheels were used, wooden spoke and pressed steel. It fired

37x166mm ammunition in HE and APHE configurations.

a Type 94 in firing position;

the low height of the barrel above the ground can be appreciated in this photo of a GI examining a captured weapon with wooden wheels.

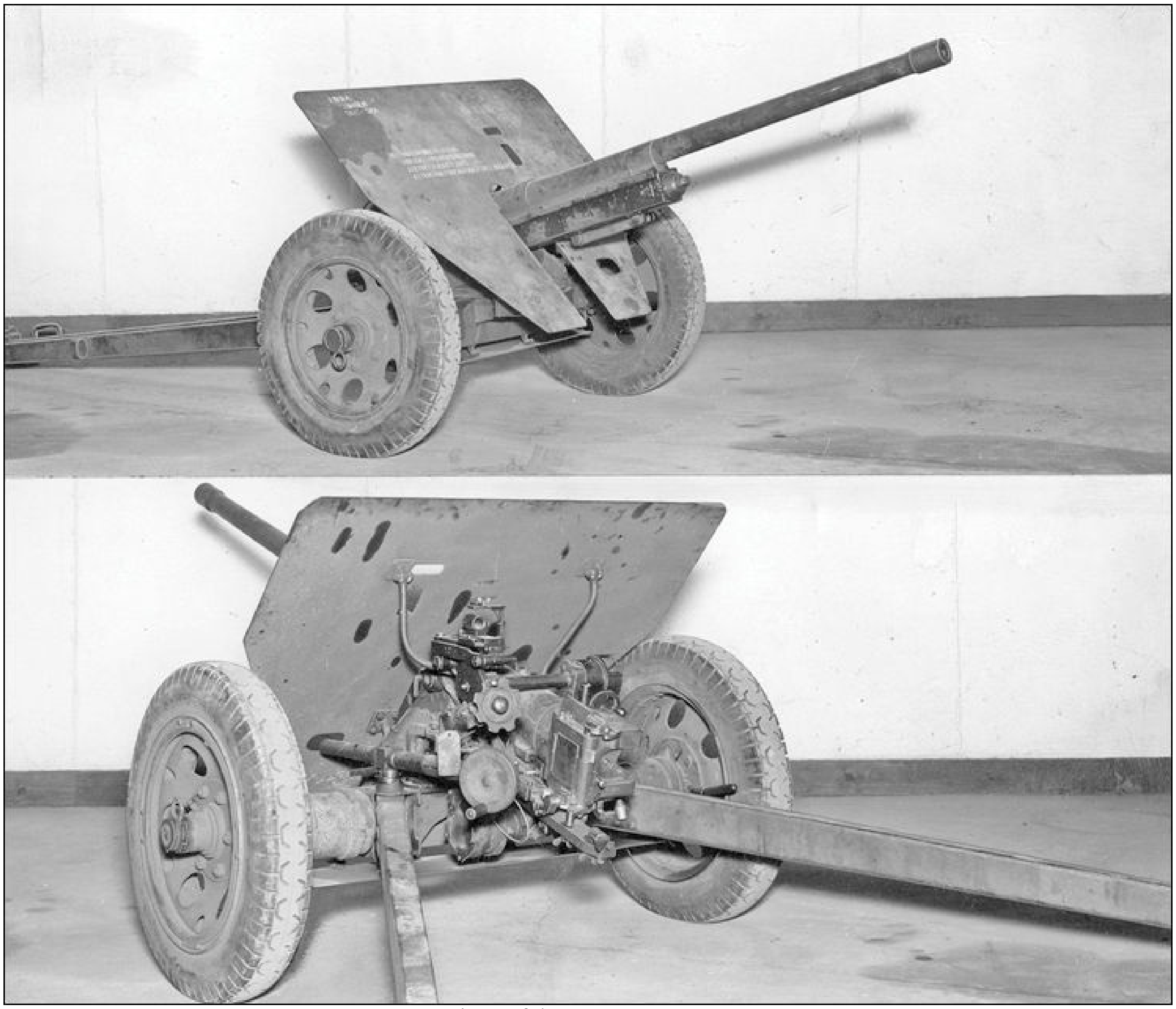
### 37mm Type 1 Anti-Tank Gun

This was an improved version of the Type 94 with the longer barrel and larger chamber of the Type 1 tank gun. It fired the more powerful 37x251mm cartridge, although the HE and APHE projectiles used were the same. Penetration was rated at 25mm or 33mm at 1,000 meters range at 0° angle, depending on the source and test. It would appear that few were made.

The Type 1 37mm gun showing the driven spades inherited from the Type 94.

## 47mm Type 1 Anti-Tank Gun

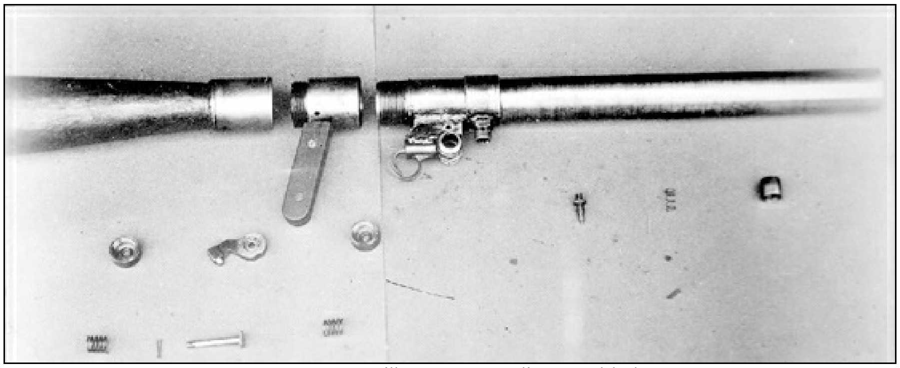
Starting in 1941 this was the standard weapon for the separate anti-tank companies and battalions. Unlike other Japanese anti-tank guns, it was optimized for truck-drawn operation with steel wheels and sponge-rubber-filled tires. It had a semi-automatic horizontal sliding breechblock, in which the breech was automatically opened and the spent casing ejected as the gun returned to forward after firing and the breech was held open until a new round was inserted, which triggered a lug that closed the breech. The trails were held in place for firing by driven spades. The sight bracket carried a range drum calibrated in 100-meter increments out to 1,700 meters. A modern weapon for 1941/42, it was obsolescent by 1945. Armor penetration was 70mm at 450 meters and 40mm at 1,350 meters at 0° angle.



Two views of the 47mm Type 1 AT gun.

## 45mm Type 5 Recoilless Anti-Tank Weapon

This was a simple tube open at the rear that fired an overcaliber 80mm shaped charge round. The steel barrel (forward of the trigger) was 600mm long and had walls 4mm thick. The rocket looked like a stick grenade, with an 80mm diameter head that accommodated the shaped charge, and a 700mm long cartridge case that was inserted down the front of the barrel. A cut-down 7.7mm rifle cartridge contained 1 g of fine black powder to initiate the 0.1 kg of propellant in the cartridge case. To fire, a hammer in the trigger mechanism was manually cocked into a horizontal position, the safety cleared, and the trigger pulled. The round left the barrel at only 40 m/s, so that even at 45° elevation, range was only about 150 meters. Effective range was much less, about 30 meters. The warhead was said to penetrate 100mm of armor, making a 25mm diameter hole. A round with a conical front was under development to increase standoff but had not entered production. Production of the 45mm recoilless gun and its ammunition had only just begun in August 1945.



A 45mm recoilless weapon disassembled.

**8cm Navy Anti-Tank Rocket Launcher**

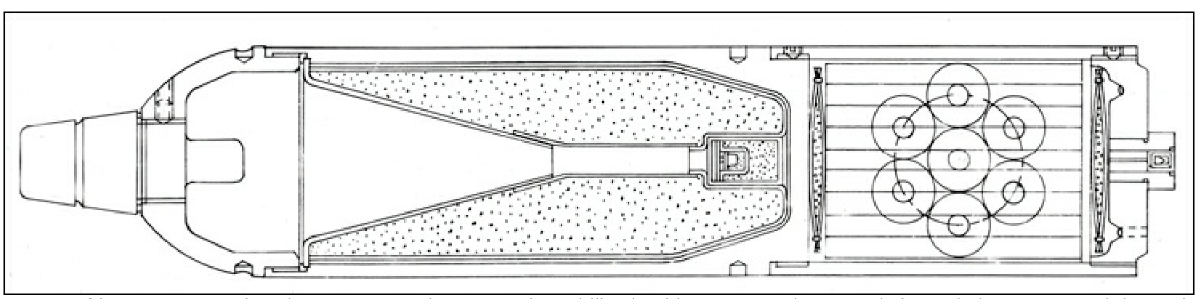
This featured a hexagonal barrel with riders in the lower portion for the rocket. Sighting was via an open peep at the rear and a circle with cross-hairs at the front. The weapon was 1.5 meters long with a tube width of 170mm. The 5.9-kg rocket had a motor and warhead diameter of 8cm and was provided with six angled nozzles for spin stabilization. The motor burned for only 0.4 seconds, probably about the time it took to leave the tube. The shaped charge was made from 530 g of RDX to give a penetration of 58mm against RHA. Theoretical maximum range was 1,200 meters, but practical anti-tank range was probably only about 75-150 meters.

A US sailor demonstrates the IJN anti-tank rocket launcher after the war.

**7cm Army Anti-Tank Rocket Launcher**

This 70mm weapon was to be the standard light AT weapon for the defense of the homeland. The launcher was much heavier than the equivalent US and German designs, and as a result was provided with a bipod at the front. The tube was broken down into two pieces for man carrying and a small, flat sack of hay was provided to cushion the load. The two halves were clamped together by means of three adjustable bolts, hinged at the base of the front half, which overlapped into hooks on the rear half. Due to manufacturing variances the parts of different launchers were not interchangeable. A folding bipod was attached about 20cm from the rear of the front half. On the rear half were a pistol-type grip, a percussion-type firing mechanism, a protective frame, a burlap shoulder rest, and a loop used in steadying the piece. The firing mechanism was cocked manually and released by means of a pull cable which extended forward of the pistol grip. The sight consisted of an open peep and two blade signed aligned vertically. The spin-stabilized rocket weighed 4.1 kg, including 0.26 kg of propellant and 0.71 kg explosive charge behind a conical steel liner. It had a nominal range of 750 meters, although the effective range was probably about 50-100 meters. The round was said to penetrate 100mm of armor.

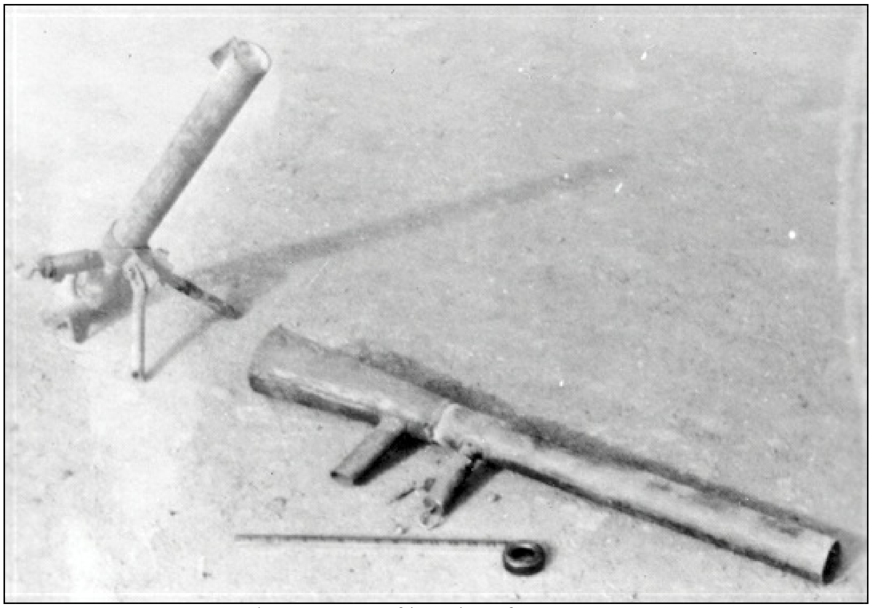
An Army 7cm AT rocket launcher with the cushioning sack in the foreground.



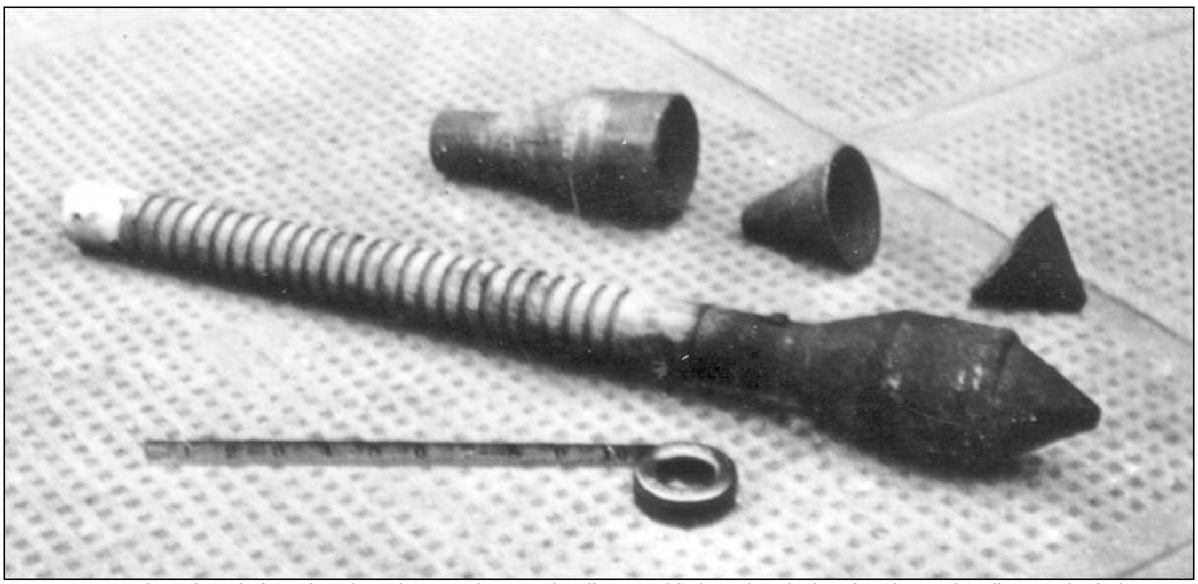
Unlike most of its contemporaries, the 7cm AT rocket was spin stabilized, with one central vent and six angled vents around the periphery.

## China Type Rocket Launchers

A sample with sketches of the 7cm Army anti-tank rocket was provided to several local arsenals in China and each built an approximation of the sample, allowing for the availability of materials and machinery in the area. Two types of launcher were built in Canton, one with a closed breech and bipod to act as a mortar, the other more closely approximating the standard Army 7cm launcher. Two factories in Shanghai built AT rockets; the TOA Iron Works and the Ai-kung Iron Works The Ai-kung launcher used a steel tube 1 meter long with two peep sights for 30 and 50 meters, and a notch sight for 70 meters range. Other rockets and launchers were made at Tientsin and Nanking. All the launchers except the mortar-type from Canton generally approximated the Army 7cm launcher.



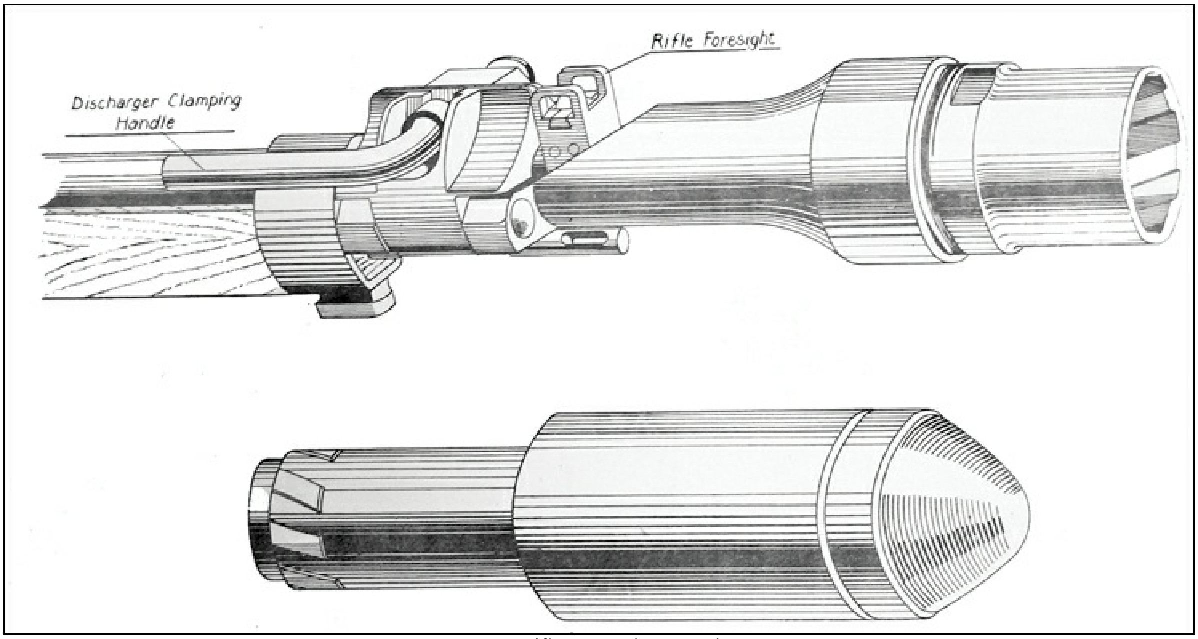
The two types of launchers from Canton.



TOA Iron Works (Shanghai) anti-tank rocket. At the top, the disassembled warhead, showing the casing, liner and windscreen.

### Type 2 Rifle Grenade Launcher

This was a direct copy of the German anti-tank rifle grenades and launcher. The grenades were produced in both original German sizes, 30mm and 40mm warhead diameter, with the launcher able to fire both. The launcher used an extension that fit over the front end of the barrel, with a clamping handle to hold it in place on either side of the rifle foresight. The launcher cup featured pronounced rifling, matched by raised angled vanes on the tail of the grenades. The grenade was inserted into the cup and a special rifle round with a wooden bullet fired to propel the grenade to a range of 250 meters. The 30mm grenade weighed 260g, of which 46g was the TNT/RDX main charge, while the 40mm version weighed 370g, including 100g of main charge. The base-mounted fuze was armed by the setback of launch and initiated by impact. Penetration into steel was 30mm with a 12mm diameter for the 30mm grenade, and 50mm with a 15mm diameter hole for the 40mm grenade. US Army technicians noted that the 30mm grenade imparted no more "kick" to the mounting rifle than normal service ammunition and that an experienced gunner should be able to hit a tank at 90m range, although the maximum ordinate at that range was about 3.5 meters. If the tank were moving things would be trickier, as the time in flight to 100m was 2.0 seconds. The 40mm grenade produced more kick and Japanese manuals indicated that firing from the shoulder in kneeling or standing position was not possible.



Type 2 Rifle Grenade Launcher.

# 8

# Infantry Guns

The lessons derived from the combat of the First World War in Europe persuaded the IJA to adopt the French system of infantry fire support. That system comprised a complementary mix of high-angle mortars for area targets and those in defilade, and flat-trajectory 37mm infantry guns for point-type targets, particularly machine guns. The mortar chosen was an indigenous design, the 70mm Type (Taisho) 11, but the infantry gun actually began life earlier.

The Osaka Arsenal had developed an accompanying infantry gun in 1918 known as the *Sogekiho* (flat trajectory weapon) that featured a wheeled mount and rotating shield, a manually-operated sliding breech and a unique 37x133 cartridge, considerably more powerful than the 37x93 round used in the French original. Only a small number were built before it was realized that the weapon was too heavy and ungainly for the small round it threw. They were used in the Allied intervention in Siberia and maneuvers in the 1920s, but discarded shortly thereafter.

For a replacement the Army turned once again to the Osaka Arsenal and was rewarded with a new weapon adopted as the 37mm Type (Taisho) 11 in 1922. It used a slightly less powerful cartridge, at 37x112, but was much lighter and more easily handled. It featured a vertical sliding breech that incorporated a cam that automatically closed the breech when a cartridge was loaded, and opened the breech and ejected the case after firing, a significant improvement over earlier infantry guns, increasing the rate of fire. It utilized a hydrospring recoil system, in which a piston in a liquid-filled tube with grooves on the inside was forced slowly rearward by recoil, compressing a spring that moved the barrel back into firing position after recoil was halted.

A demonstration of a Type (Taisho) 11 infantry gun between the wars.

The 37mm was a standard part of the infantry armament through the 1920s and was only gradually displaced after that. The HE round carried only 58 g of TNT and picric acid, a respectable load for such a small round but at the expense of thin shell walls that minimized fragmentation. As a result US intelligence assessed the projectile, shared with tank and anti-tank guns, as "not considered dangerous except at the point of impact or a small inclosure directly penetrated".[1] It remained in service with second-line infantry units in China to the end of the war, and indeed, a further small quantity were manufactured in 1937 to fill up unit quotas.

**Production of Infantry Guns**

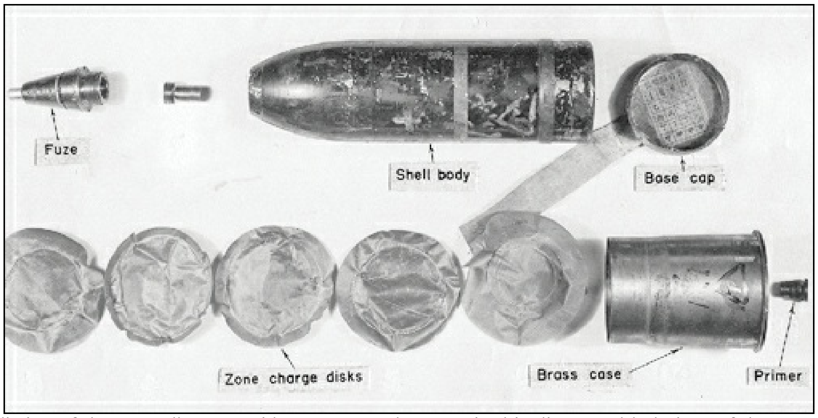
| | FY31 | FY32 | FY33 | FY34 | FY35 | FY36 | FY37 | FY38 | FY39 | FY40 |
|---|---|---|---|---|---|---|---|---|---|---|
| 37mm Type Taisho 11 | – | 1 | 30 | – | – | – | 40 | – | – | – |
| 70mm Type 92 | – | 171 | 384 | 4 | – | 37 | 96 | 248 | 363 | 624 |
| 75mm Type Meiji 41 | 22 | 42 | – | 8 | – | 77 | 31 | 159 | 256 | 339 |
| | | | | | | | | | | |
| | 1941 | | 1942 | | 1943 | | 1944 | | 1945 | |
| | Apr-Jun | Jul-Dec | Jan-Jun | Jul-Dec | Jan-Jun | Jul-Dec | Jan-Jun | Jul-Dec | Jan-Jun | Jul-Sep |
| 70mm Type 92 | 80 | 179 | 158 | 192 | 147 | 89 | 61 | 26 | 11 | 6 |
| 75mm Type Meiji 41 | 12 | 60 | 58 | 52 | 45 | 53 | 35 | 11 | 6 | – |

By the late 1920s the French and the two armies that copied them, the American and Japanese, had concluded that the mix of 37mm gun and mortar was wasteful and inefficient. The obvious solution was to adopt a single weapon that could perform the range of missions required. For the French, and the Americans later, that weapon was the Brandt 81mm mortar. The Japanese, however, took a very different tack. They developed a unique weapon, the 70mm Type 92 infantry gun, to replace the two earlier weapons. Designed to support the infantry as an organic part of the battalion, it was unofficially known as the "battalion gun".

A battalion gun in action in Shanghai in 1937.

The Type 92 was a very clever and versatile weapon, a miniature artillery piece that could fire in the direct-fire mode in its low elevation range and with plunging fire like a mortar in the high range. Compared to a medium mortar it had the advantage that it could deliver accurate and effective direct fire against point targets. On the other hand, compared to that same mortar, it was considerably heavier, more demanding of manufacturing assets to make, and had a slower rate of fire with shells containing less explosive. They were an integral part of the initial Japanese operations in China and the Pacific. Even by 1940, however, doubts about its utility relative to its cost had begun to surface and by April 1941 the Osaka Arsenal, sole producer of both weapons, was turning out only 20 Type 92s compared to 50 81mm Type 97 mortars per month. Nevertheless, the large numbers already produced, the fact that it was never completely taken out of production, and its limited utility as an anti-tank weapon once the HEAT round had been introduced meant that it remained in front-line service to the end of the war.

Ammunition production figures show that even in the early phase of the war in China the new generation of battalion support weapons (Type 92 gun and Type 97 mortar) were replacing the old family (Type 11 gun and mortar) in operational use.



The small size of the propellant cartridge case can be seen in this disassembled view of the 70mm round.

| Pre-war Ammunition Production – Battalion Support Weapons | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | FY31 | FY32 | FY33 | FY34 | FY35 | FY36 | FY37 | FY38 | FY39 | FY40 |
| 37mm Type 11 Infantry Gun | | | | | | | | | | |
| HE | 15,000 | 10,000 | 49,930 | 4,289 | 7,500 | 2,000 | 47,000 | 315,250 | 316,410 | 233,530 |
| training | 16,000 | 8,000 | 10,000 | 1,500 | 1,500 | 3,600 | 3,600 | 6,800 | 20,000 | 0 |
| blank | 380 | 130 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 40,000 |
| 70mm Type 11 Mortar | | | | | | | | | | |
| HE | 31,000 | 9,400 | 7,550 | 12,010 | 0 | 5,800 | 116,200 | 377,080 | 454,854 | 180,680 |
| training | 17,500 | 8,000 | 17,660 | 8,000 | 6,000 | 706 | 0 | 0 | 21,700 | 46,000 |
| blank | 11,380 | 10,400 | 10,000 | 0 | 0 | 3,890 | 0 | 0 | 8,000 | 58,040 |
| 70mm Type 92 Infantry Gun | | | | | | | | | | |
| HE | 0 | 100,800 | 107,900 | 16,050 | 17,300 | 22,400 | 233,950 | 735,550 | 862,740 | 1,270,520 |
| cast iron HE | 0 | 0 | 0 | 0 | 0 | 0 | 20,000 | 170,000 | 36,430 | 16,000 |
| training | 0 | 0 | 20,600 | 51,130 | 35,980 | 22,220 | 17,600 | 80,600 | 175,740 | 125,660 |
| blank | 0 | 0 | 10,600 | 0 | 28,100 | 24,620 | 0 | 86,620 | 117,470 | 141,440 |
| 81mm Type 97 Mortar | | | | | | | | | | |
| HE | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 7,560 | 224,720 | 498,140 |

The initial 70x101R ammunition for that gun was the Type 92 HE, filled with 600 g of TNT or RDX, later supplemented by the Type 92 Substitute, which used black powder as the explosive. Both could be fitted with either the Type 88 instantaneous or Type 88 short-delay fuze. These were followed by the little-used Type 95 illuminating (with a 20-second flare) and Type 95 APHE, which reduced the explosive fill to 170 g to accommodate a thicker nose section, and incorporated a Type 95 small base fuze. Finally, a hollow-charge shell entered production in April 1943, but the weapon's curved trajectory made engagements at other than close range difficult, and in any event by this time many 70mm infantry guns had been replaced with 81mm mortars.

The largest of the infantry guns were hand-me-down items. When the artillery branch replaced their Type (Meiji) 41 mountain guns with the new Type 94s, the older weapons were turned over to the infantry. The infantry replaced the old, over-the-wheels shield with a narrower version (although they often discarded the heavy shield completely) and added a handle to the axle to facilitate manporting the weapon. Not only were old artillery-branch weapons converted, but new ones were built, initially by the Osaka Arsenal, joined by the Nagoya Arsenal in early 1941, while the Mukden Arsenal in Manchuria turned out their hundredth gun in January 1943.

The Type (Meiji) 41 was light and handy, and easily moved, and was usually assigned at a four-gun company per infantry regiment, earning the name "regimental gun". It could be assembled and ready to fire from its broken-down pack state in 15 minutes. It had significant drawbacks, however. The most important of these was that it fired fixed ammunition, which made plunging fire all but impossible. In fact, anything other than flat, open terrain often would have limited the weapon to direct fire, where the gunners could actually see the target. The unusual trail configuration was strong enough to absorb the recoil of firing, but was weak laterally and often broke with rough handling. In spite of its aged design and limitations, nothing was available to replace it, and it too remained in production to the end of the war.


Loading a Type (Meiji) 41 regimental gun.

The relatively low density of dedicated anti-tank guns in the IJA meant that the Type (Meiji) 41 was sometimes forced into the role of defending against tanks. For this it was notably ill-equipped. The small amount of traverse available meant tracking moving targets was often impossible, as well as restricting the amount of front that such a weapon could cover against quickly-appearing foes. Further, the HE shell they threw had very little utility in such a role. Trials carried out in May 1939 involving live firing against Type 97 medium and Soviet T-26 tanks showed that direct hits with HE rounds usually had no effect on the tank. A Type 1 AP shell was developed and produced, but apparently was not very successful and built only in relatively small numbers. Instead, the regimental gun received priority for the new hollow-charge ammunition being introduced via German technicians, with initial firing tests in July 1942 and it became the first weapon to receive the new type of ammunition. Second priority for the new ammunition was the 70mm Type 92 battalion gun, which followed shortly behind. Both started coming off the production line in May 1943, although only the 75mm version was deployed to the Pacific.


The light weight and portability of the regimental gun was to prove invaluable, especially in rough terrain in China and Burma, where it was manhandled, and even more so in New Guinea, where it was broken down and man-carried.

The AP-HE rounds of the infantry guns were ineffective largely because they were velocity-dependent. The AP-HE from the Type (Meiji) 41 could penetrate 35mm of armor at 0° at 500 meters, while that of the battalion gun was said to penetrate 25mm, with the latter figure appearing suspiciously optimistic. The hollow-charge ammunition, on the other hand, could penetrate 75mm in the case of the regimental gun and 100mm in the battalion gun.

Theoretically the shaped charge round could have been issued as a universal round, but the reduced explosive loading meant that the effective burst radius of a 75mm projectile fell from 22 meters to 13 meters compared to an HE round, and for the 70mm from 20 meters to 13 meters and this, together with the poor ballistics and higher manufacturing costs, meant that the hollow charge rounds were reserved for anti-tank work.

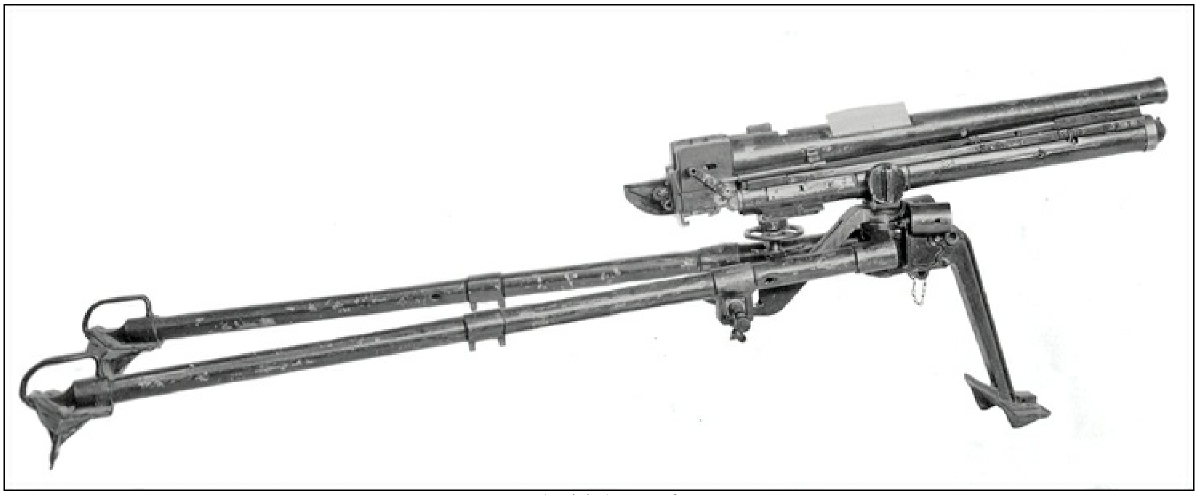
| Infantry Gun Data | | | |
|---|---|---|---|
| | 37mm Type 11 | 70mm Type 92 | 75mm Type 41 |
| barrel length (cal) | 25 | 11 | 18 |
| elevation | -5° to +14° | -11° to +70° | -18° to +40° |
| traverse | 30° | 45° | 6° |
| Wt (fir posn)(kg) | 91 | 213 | 535 |
| MV (m/s) | 451 | 198 | 354 |
| Range (m) | | 2,800 | 6,400 |
| Proj Wt (kg) | 0.68 | 3.8 | 6.01 |

Of the three infantry guns, only the Type 92 can be regarded as successful. It was certainly an ingenious design and well thought-out, but it can be questioned whether the limited advantages over a conventional mortar were worth the extra weight and production resources.

In the meantime work had began on recoilless guns in March 1944 with an 81mm weapon in both breech-loaded and muzzle-loaded configurations, neither of which proved practical. Receipt of drawings of the German 75mm recoilless gun led to a derivative design in 105mm in early 1945. This last weapon, mounted on a simple wheeled carriage and using a horizontal sliding breechblock, proved satisfactory in test firings in May 1945, but the project was then placed in abeyance, and no further work was carried out. The 105mm gun had a weight of 310 kg, a traverse of 60° and an elevation of 22°. The primary round would have been a Type 3 shaped charge anti-tank round, so the weapon presumably would have served as a dual purpose infantry/AT gun had it entered production.

**37mm Type (Taisho) 11 Infantry Gun**

Inspired by the French 37mm TR16 infantry gun, it improved on it in several respects. The barrel and breech ring were formed from a single piece. The breech was a vertical sliding device that could be operated manually or semi-automatically (e.g., automatically closing when a cartridge was inserted and automatically opening and ejecting the case on recoil). Recoil was controlled by a hydro-spring tube arrangement under the barrel. The mount was a tripod with two long legs to the rear and a short leg in the front. Mounting holes in the front leg allowed the attachment of two hand spikes that projected out each side to allow easy carriage by four men (one on each handspike, one on each rear leg). The initial family of ammunition was the Types 12 and 13 HE, later replaced by the Type 94 HE and APHE rounds.



37mm Type (Taisho) 11 Infantry Gun.

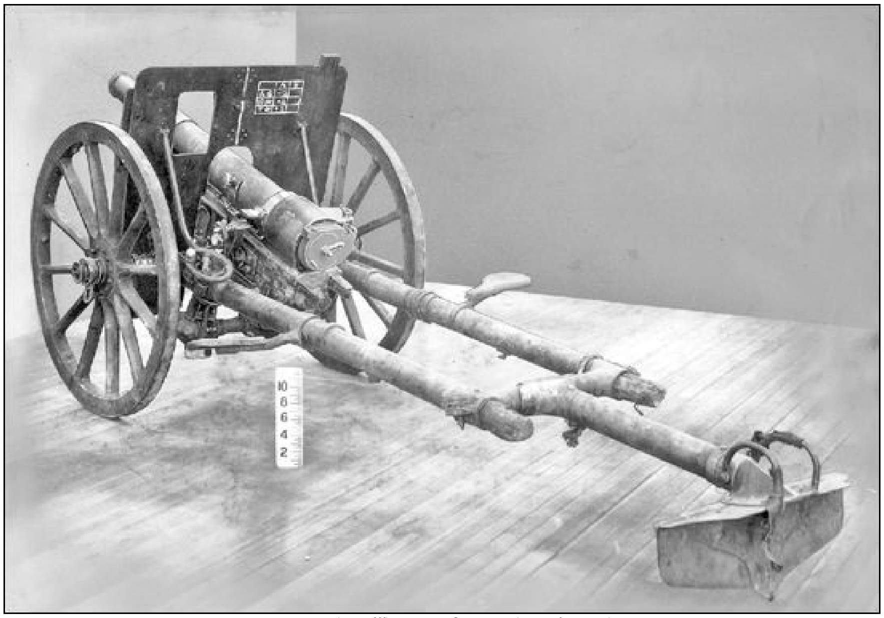
**70mm Type 92 Infantry (Battalion) Gun**

This was configured like a miniature artillery piece, and featured a barrel, breech ring and top sleigh of a single forging. It used an interrupted-screw breech mechanism, hinged at the bottom. The high elevation range and the use of semi-fixed ammunition with four propelling charges gave the weapon a great deal of flexibility in delivering plunging fire at various ranges. It used the standard field artillery sight. HE, smoke and illumination rounds were initially provided, later supplemented by a shaped-charge anti-tank round. It was built with pressed-steel wheels in two varieties, and with wooden spoked wheels.

A 70mm battalion gun with steel wheels captured on Guadalcanal, at full elevation.

**75mm Type (Meiji) 41 Infantry (Regiment) Gun**

This was an old mountain gun slightly modified for use by the infantry. The weapon employed cross-axle traverse and was trunnioned at the point of balance, thus eliminating equilibrators. The elevation handwheel was on the left side of the carriage and the traverse handwheel on the right. The single spade at the end of the twin-boom trail could be removed and replaced with two poles for horse draft. The gun fired the standard family of 75mm projectiles, mainly the Types 90 and 94 HE, Type 95 APHE and (from 1943) Type 2 hollow-charge ammunition, all with a short fixed cartridge.



75mm Type (Meiji) 41 Infantry (Regiment) Gun.

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1 Japanese Infantry Weapons, MID Special Series No.19, December 1943, pp201-202.

# 9

# Pack Artillery

The decision to acquire a pack artillery piece in 1894 led to a competition in 1895 that pitted designs from Armstrong, Canet, Krupp, St. Chamond and Schneider against each other, with each firm delivering a gun and 200 rounds of ammunition. A late arrival, the following year, was an indigenous weapon designed by Colonels Arisaka and Akimoto. In 1898 the Japanese weapon was chosen and standardized as the 75mm Type Meiji 31 mountain gun. With a weight of only 290 kg that could be broken down into four pack loads, it was certainly portable. However, the range of 4,300 meters was rather short and the lack of any recoil mechanism or on-carriage traverse severely limited accuracy and rate of fire. A few survived into the 1930s, mainly with naval landing units, but it had been phased out of front-line service by the time the war began.[1]

The replacement came from the same source as the rest of the pre-WW I artillery modernization package, Krupp. The weapon adopted was the 75mm L/14 mountain gun, but significant changes were made to the design before production. The breech was changed from the standard Krupp sliding-type to an interrupted screw, and the trail from a simple box to a unique fixed twin pole design, the latter increasing elevation from 25° to 40°, thus extending the range somewhat. It was placed in production as the 75mm Type (Meiji) 41 Mountain gun.

A battery of pack artillery with Type 41 weapons. Note the full-width shield that was replaced when they were converted to regimental guns. (Courtesy: Alvin Segelman)

The shortcomings of this elderly weapon led to a replacement design effort in the early 1930s. As it was displaced from the mountain artillery units it was modified slightly and reassigned as an infantry gun (*q.v.*), although some units retained their Type 41s for quite a while, such as the 3rd Independent Mountain Artillery Regiment in the Philippine campaign in 1942, and the 37th Mountain Artillery Regiment of the 37th Division in China, into late-1944 at least.

| Production of Mountain Artillery in Japan | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| 75mm Type 94 Mountain Gun | 0 | 0 | 0 | 15 | 165 | 221 | 60 | 171 | 228 | 198 |
| 105mm Type 99 Mountain Howitzer | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 17 |
| | 1941 | | 1942 | | 1943 | | 1944 | | 1945 | |
| | Apr-Jun | Jul-Dec | Jan-Jun | Jul-Dec | Jan-Jun | Jul-Dec | Jan-Jun | Jul-Dec | Jan-Jun | Jul-Sep |
| 75mm Type 94 Mountain Gun | 4 | 20 | 25 | 35 | 52 | 152 | 85 | 51 | 45 | 30 |
| 105mm Type 99 Mountain Howitzer | 5 | 30 | 28 | 28 | 20 | 15 | 6 | 0 | 0 | 0 |

The replacement weapon, adopted in 1934 and known as the 75mm Type 94 Mountain Gun, remedied some archaic elements of the Type Meiji 41 but inexplicably not all. The most obvious area of improvement was the replacement of the open pole trail by split trails, dramatically improving on-carriage traverse. The inefficient hydrospring recoil system was replaced by a modern Schneider-type hydropneumatic system, smoothing the recoil and permitting the use of ammunition with more propellant, yielding an increased range.

A Type 94 Mountain Gun in action in China in 1937/38. Note the low silhouette and fixed ammunition.

Surprisingly, while artillery designers world-wide were introducing separate-loading ammunition for their mountain pieces starting in the 1920s, the Army here opted not to. The disadvantage to their fixed round was that it always fired at maximum charge, thus making it difficult to engage in high-angle plunging fire, a feature much needed in mountains and jungles. This is less important if the intended employment is the direct-fire or modified direct-fire mode, but it still reduces flexibility considerably.

The Type 94 Mountain Gun was placed in production through the Osaka Arsenal in late 1934 as the standard weapon of the mountain artillery, and production peaked in 1939. The Mukden Arsenal began production shortly after Osaka and built them at 1-2 per month through 1942, then increasing their numbers.[2] Deliveries continued throughout the war (with Nagoya Arsenal joining in for small numbers in late 1944), but priority was given to field artillery in the first part of the war and by the time attention shifted back to mountain artillery in mid-1943 restrictions on raw materials reduced output. Nevertheless, the Type 94 remained in widespread service except in Manchuria, and was encountered almost everywhere the Allies fought the IJA.

If need be, the Type 94 could be manhandled, as seen here in China.

The Type 94 could be carried by 22 men – four each for the trail segments, barrel, cradle, carriage, and wheels, and one each for the shield and sight mount. This was a common method of transport in the south Pacific jungles, such as New Guinea and the Solomons.

To simplify production, all Japanese 75mm field and mountain artillery ammunition used the same projectiles. There were three different lengths of cartridge cases, however, the shortest being 184mm long and used only by the Type (Meiji) 41 mountain/regimental gun. The most common was 292mm long and was used in the Type (Meiji) 38 field gun and as the Type 94 mountain gun. The ammunition was not interchangeable, however, as the cartridges for the field gun contained up to 50% more propellant than those for the more lightly-built mountain gun. The most widely-used round of ammunition for the Type 94 was the Type 94 HE round, which utilized the standard Type 94 HE projectile with PD fuze. Other rounds available were the Type 90 HE, Type 90 shrapnel with powder time/PD fuze, and Type 90 smoke with a small load of WP. Also available were the Type 95 APHE round and the Type 1 AP round.[3] In 1943 the Type 2 hollow-charge shell was introduced, which could penetrate 100mm of armor at all ranges, leaving a hole 25-30mm in diameter, and this was distributed to the central Pacific starting in early 1944. Also near completion of development at the end of the war was a 200mm spigot-launched overcaliber shaped-charge round for the Type 94 but this had not progressed beyond the prototype stage. The Type 90 illuminating round could have been mated to the 292mm cartridge case with reduced charge, but it is not clear if this was actually done.

The new ammunition notwithstanding, a 75mm projectile still had only limited lethality and an effort was launched almost immediately to develop a larger companion piece for the mountain artillery units. The result was the 105mm Type 99 Mountain Howitzer, accepted for service in 1938 and placed in production at Osaka Arsenal in 1940. The light weight of the Type 99 came with a price, it had to use a special light HE projectile, the Type 100, and a small three-part propellant charge with a full weight of 0.4 kg, compared to 1.13 kg for the 105mm Type 91 howitzer. Although highly portable, the Type 99 suffered from a very short range and was never widely distributed.

Projects to replace both the 75mm Type 94 and 105mm Type 99 were launched in early 1940, with designations as Type 1. Neither offered any real improvement in weight or range over the models they would have replaced and they did not progress beyond the prototype stage.

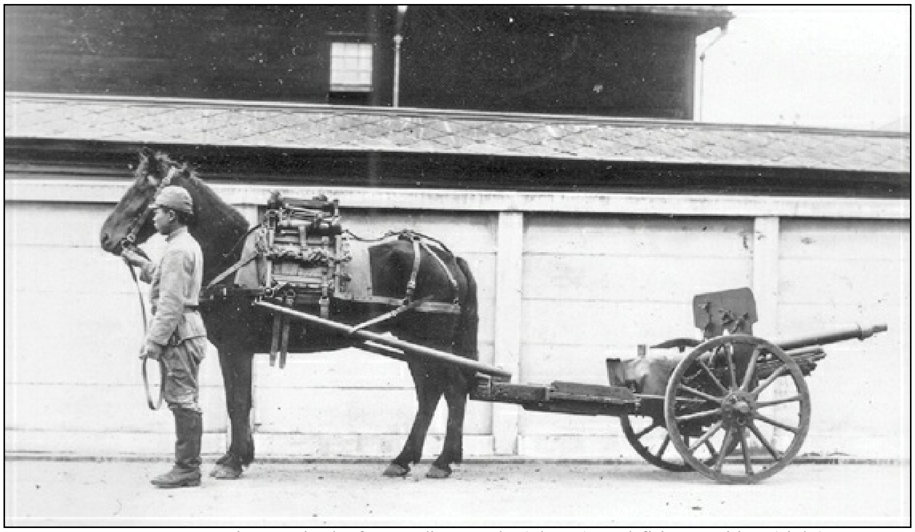
**Mountain Artillery Data**

| | **75mm Type 94** | **105mm Type 99** |
|---|---|---|
| Barrel Length (cal) | 20.8 | 17.3 |
| MV (m/s) | 383 | 330 |
| Pressure (MPa) | 174 | 176 |
| Proj Wt (kg) | 6.4 | 12.6 |
| Max Propellant (g) | 380 | 280 |
| Piston Rod Pull (kg) | 2,780 | 5,035 |
| Avg Recoil Length (cm) | 90 | 80 |
| Elevation (deg) | -10 to +45 | -3 to +42 |
| Traverse (deg) | 40 | 7 |
| Tread width (m) | 1.35 | n/a |
| Barrel height (cm) | 74 | 80 |
| Wt in Firing Posn (kg) | 536 | 804 |
| Max Range (m) | 8,270 | 5,546 |

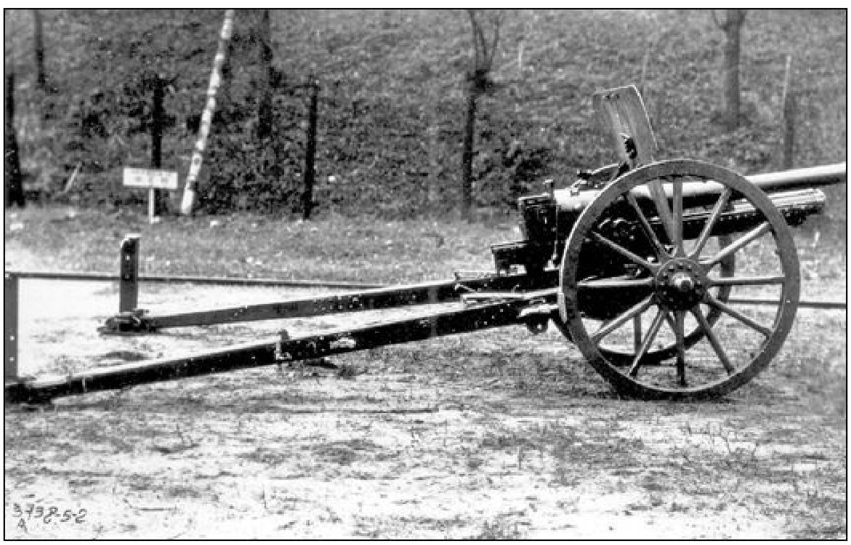
In addition to the standard pieces, the IJA also picked up a disparate collection mountain guns during its campaigning in China. The 20th Independent Mountain Artillery Battalion used captured Bofors 75mm mountain guns during the assault on Hong Kong in December 1941. The 104th Division’s field artillery regiment supplemented the field guns in its first battalion with a dozen captured German 75mm light infantry guns, while its 2nd battalion used ex-Chinnese old Krupp-style 75mm mountain guns, and both types were used extensively in its operations in south China in 1940-42. Other units almost certainly impressed captured Chinese pack artillery into their inventory, at least until ammunition ran out.

**75mm Type 94 Mountain Gun**

This sturdy, light weapon broke down into 11 sections (the heaviest 95 kg) for short-distance manpacking or six pack loads for animals. It could also be towed by a single horse. The split-trail design, utilizing driven spades, gave good elevation and traverse. The weapon featured a removable breech ring and, in a departure from the preceeding Type Meiji 41, a horizontal sliding breech block. It used the same Type 90 HE projectile as the Type 38 Field Gun, but with about 40% less propellant in the fixed cartridge case.

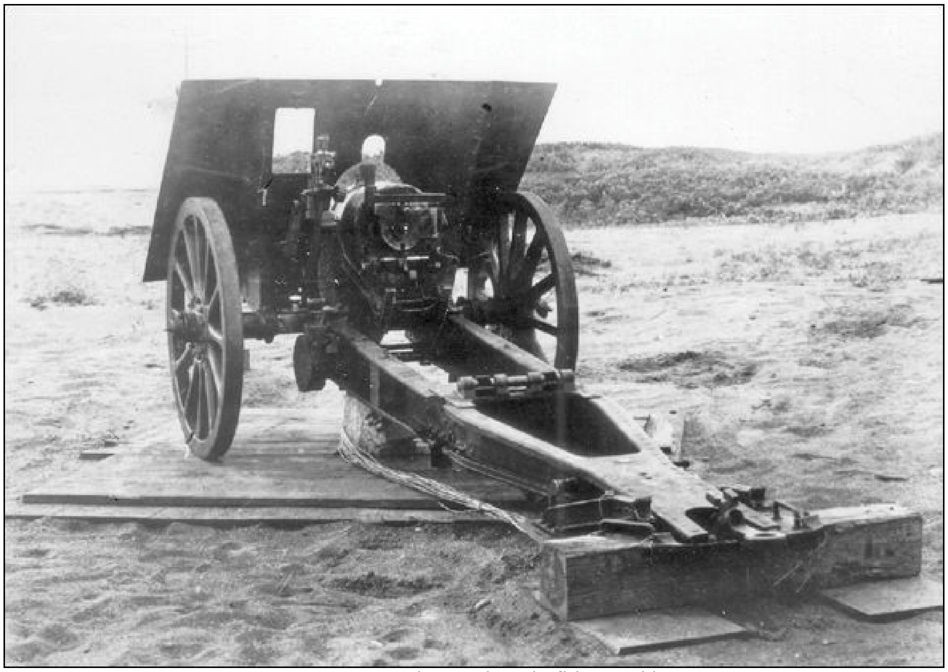


Type 94 Mountain Gun in draft traveling mode (above) and firing position (right).



**105mm Type 99 Mountain Howitzer**

Of generally conventional design, this weapon traded off range for reduced weight. It was normally broken down into seven pack loads, but could be further broken down into ten if needed. It could also be drawn by a two-horse team. It reverted to the open box trail and interrupted screw breech system and was one of few Japanese artillery weapons employing a gas check pad. A significant improvement over the Type 94 Mountain Gun was the use of a bagged charge with three increments to vary trajectories.



Type 99 Mountain Howitzer in firing position.

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1 Three weapons were somehow acquired by the 15th Division in Burma, apparently prized for their portability in the jungle, and used in the Imphal operation.

2 The Mukden Arsenal had a rated capacity of 600 mountain guns per year, and during the last quarter of 1944 actually built 131. This was presumably a mixture of Type (Meiji) 41 regimental guns and Type 94s, with the former probably predominating.

3 Apparently it was possible to fire field gun ammunition from the Type 94 in an emergency. British ordnance personnel in Burma fired what was clearly field gun AP ammunition (heavier load of strip propellant) from a Type 94 and found that it increased the muzzle velocity from 366 m/s to 450 m/s and penetration at 300 yards range at normal impact from 58mm to 72mm.

# 10

# Light Artillery

Little could have demonstrated the lack of modern development and production facilities in Japan more clearly than the evolution of IJA field artillery. Lacking an established industrial base, they purchased Krupp designs in the period up to the First World War, and Schneider designs thereafter.

Within a few months of the start of the Russo-Japanese War of 1904-05 artillery had proven its worth. The large number of modern (recoiling, breech-loaded, rifled) pieces used by both sides marked it as the first war fought in which massed artillery fire was the dominant force on the battlefield. Even before the war had begun the Japanese had appreciated the value of indirect fire, and then placed small contracts with Krupp for field howitzers in 1903 (24 12cm L/12 and 20 15cm L/12 howitzers), followed by the larger October 1904 contract that purchased, among others, 400 75mm L/31 field guns.

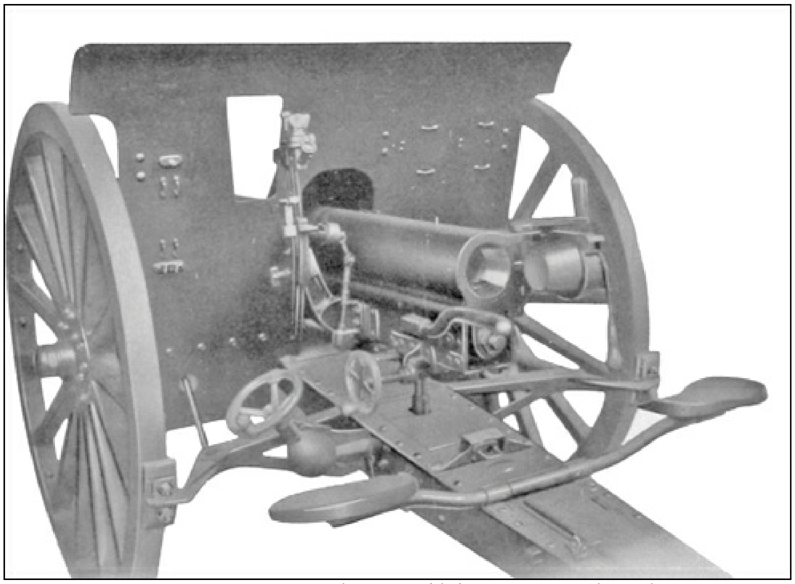
This insight notwithstanding, however, the demonstrated usefulness of howitzers using indirect fire tended to be overlooked, both in Japan and overseas. Instead, the Japanese decided field guns, often pushed forward and used in the direct-fire role, were a higher priority, and chose the 75mm Krupp L/31 as their main field piece. An initial contract resulted in the production of 400 of these weapons for Japan by Krupp in 1904.

Local production, however, was the ultimate aim. All three Krupp weapons were placed in production at the Osaka Arsenal with the designation Type (Meiji) 38 (1905). To speed acquisition the components for the field guns were purchased from Krupp, with 1,435 sets being acquired between 1905 and 1912. The howitzers, needed in smaller numbers, were built entirely locally.

Loading a 75mm Type 38 field gun pre-war. Note the solid box trail that limits the elevation of the gun.

The Type (Meiji) 38 field gun was little different from the Krupp original, and suffered from the same limitations as other field guns of that period. Having been designed with an eye towards forward deployment and direct-fire operation, it possessed very limited elevation and fired a fixed propellant charge, yielding a flat trajectory unsuitable for the indirect fire methods that came to the fore later. The 12cm howitzer was capable of plunging fire but suffered from a fairly short range.

To support the cavalry a different weapon was adopted, the 75mm Type (Meiji) 41 (1908) cavalry gun for the horse artillery. The weapon was distinctive for utilizing an interrupted screw breech mechanism, in contrast to the sliding breech used on other 75mm guns, but was built only in small numbers. Presumably because of the need for hasty emplacement, the cavalry gun also had more traverse available than the field artillery weapons. These may have been used in China in 1937-45, but their only known combat use was by the 135th Division’s artillery (who had apparently inherited them from the disbanded 3rd Cavalry Brigade) in Manchuria in 1945.


A 75mm Type 41 cavalry gun with its screw-type breech.

Drawing on the lessons of WW I the IJA launched a comprehensive field artillery modernization program in the mid-1920s. The goal was to come up with a family of light field guns and field howitzers that could complement each other. Many other countries had come to the same conclusions, but unlike those the Japanese were not burdened with huge excess stocks of existing weapons.

They did have significant numbers of Type (Meiji) 38 field guns, probably around 2,000, and as a stopgap measure a technologically undemanding upgrade program was immediately launched with the goal of increasing the elevation and, hence, range. They moved the trunnions further to the rear on the trough, added two spring-and-cable equilibrators to compensate for the now out-of-balance ordnance, replaced the recoil system with a variable resistance unit, and replaced the former single-arm trail with an open box-type that permitted the breech to pass through at higher elevations. The resultant weapon was called the 75mm Type (Meiji) 38 Improved Field Gun and it quickly became the standard field artillery weapon of the IJA. A small number were built new, but the majority of them were conversions undertaken by the Osaka Arsenal between 1926 and 1935. Small additional quantities may have been converted in 1941/42. The percentage of 75mm Type (Meiji) 38s upgraded is not known, but is likely to have been substantial.

The resultant mix of semi-modernized field guns for range and ancient 120mm field howitzers for plunging fire was only an interim step in the re-equipping of Army field artillery. A completely new and modern family of field artillery was given high priority.

Much of the effort centered around the clear benefits of using the autofrettage manufacturing method for the fabrication of artillery barrels. This involved manufacturing the steel barrel with a bore slightly narrower than the specifications called for, and then, with brute force, either ramming an oversize billet of tungsten carbide down the barrel or sealing sections of the bore off and subjecting it to great hydraulic pressure. After the billet had passed or the pressure was released the barrel would shrink back down again, but not all the way, leaving a bore the proper size for final machining and in a constant state of compression, thus imparting extra strength to resist high-pressure propellant loadings

A leading practitioner of the autofrettage method was the Schneider company of France and in 1925 both the IJA and IJN went to that firm and purchased the license for this process as described by various patents acquired by the company in the early 1920s.[1] Autofrettage is a tricky process, however, and in early 1927 the IJA had to place two additional orders, one for plant equipment to facilitate manufacture, and the other for trials batches of the Schneider commercial model 75mm field gun and 105mm field howitzer.


A Type (Meiji) 38 improved field gun being readied for movement.

Schneider had initially developed these weapons as part of the French Army 1922 re-equipment program before walking away from that effort as too unlikely to lead to sales. The 75mm field gun was a modern weapon with split trails and high elevation, had a range of 12,000 meters and weighed 1,635 kg in firing position.

In the meantime, Colonel Saigo of the Technical Department's artillery office had developed an indigenous 75mm field gun in cooperation with the Osaka Arsenal, which built a prototype. This weapon, a 1,450-kg gun with split trails and hydro-pneumatic recoil mechanisms, was to throw a 7.5 kg projectile to a range of 13,000 meters.

Comparative trials between the two guns were held in April 1927 yielding mixed results and some discord. The Technical Department denigrated the Schneider weapon on the basis that it was far too heavy for useful employment under Japanese conditions, although it was within the weight limits set by the original Japanese specifications. The Ordnance Bureau, on the other hand, pointed to a number of failures of the Saigo model, apparently including the recuperator and spades, mostly due to its light construction. The result was a compromise.

**Production of Light Artillery**

| | FY31 | FY32 | FY33 | FY34 | FY35 | FY36 | FY37 | FY38 | FY39 | FY40 |
|---|---|---|---|---|---|---|---|---|---|---|
| 75mm Type 41 Cavalry Gun | – | – | – | – | – | 2 | – | – | – | – |
| 75mm Type 38 Impr Field Gun | – | – | 12 | 43 | – | 34 | – | – | – | – |
| 75mm Type 38 Impr Field Gun[a] | 100 | 120 | 100 | 70 | 30 | – | – | – | – | – |
| 75mm Type 90 Field Gun | 2 | 26 | 19 | 143 | 31 | – | – | – | – | – |
| 75mm Type 90 Field Gun (mot) | – | – | – | – | 4 | 17 | – | – | – | – |
| 75mm Type 95 Field Gun | – | – | – | – | – | – | 27 | 75 | 91 | 68 |
| 105mm Type 91 Howitzer | – | 2 | 4 | 4 | 24 | 65 | 57 | 106 | 143 | 222 |
| 105mm Type 14 Howitzer[a] | – | – | – | – | – | – | – | 30 | 30 | – |
| | | | | | | | | | | |
| | 1941 | | 1942 | | 1943 | | 1944 | | 1945 | |
| | Apr-Jun | Jul-Dec | Jan-Jun | Jul-Dec | Jan-Jun | Jul-Dec | Jan-Jun | Jul-Dec | Jan-Jun | Jul-Sep |
| | | | | | | | | | | |
| 75mm Type 90 Field Gun (mot) | 40 | 121 | 111 | 131 | 100 | 25 | 16 | – | – | – |
| 105mm Type 91 Howitzer | 50 | 99 | 85 | 96 | 98 | 62 | 12 | – | – | – |
| 105mm Type 91 Howitzer (mot) | 7 | 20 | 18 | 21 | 21 | 19 | 14 | – | – | – |

[a] conversions

The IJA purchased license rights from Schneider for some components, presumably including the barrel and breech, while working on reducing the weight of other components. The result of this new collaboration was the 75mm Type 90 (1930) field gun, which retained the look of a Schneider weapon. The weapon included many modern features, including split trails, a hydro-pneumatic recoil system, a long barrel with a muzzle brake and high elevation range. The IJA elected to retain the Krupp-type horizontal sliding breechblock that they were familiar with, apparently believing it yielded a high rate of fire, rather than adopting the Schneider interrupted-screw type breech. To stabilize the weapon after reducing its carriage weight Schneider and the IJA opted to use driven spade plates at the far end of the trails, a feature that was to become common with Japanese weapons designed for light weight.

The use of an autofrettaged barrel yielded an ordnance able to accept pressures higher than in any other Japanese-built artillery weapon built prior to 1945, including AA guns. To take advantage of this a larger chamber accommodated longer cartridge cases with more propellant. The standard family of 75mm artillery projectiles, however, lacked the structural strength to withstand greater launch acceleration, so they were fired with a reduced propellant load that yielded performance almost identical to that of the old Type (Meiji) 38 guns. Thus, a new projectile with thicker walls was designed, the Type 90 long pointed HE and this was paired with a greatly increased propellant load to yield significantly longer range. This same barrel strength would later prove useful for anti-tank work as well.

The gun was trunnioned well to the rear, but even so a pit had to be dug to accommodate recoil at high elevations. Hand-cranked jacks were provided that extended downwards to rest the gun directly on the axle, taking the springs out of action and contributing to stability in firing. Seats were fitted on the front of the shield for two crew members, one of whom operated individual wheel brakes during towing. This was a common feature on horse-drawn guns and probably worked, even if barely, on the motorized version behind the slow tracked tractors the IJA used, but would have been challenging should high-speed towing behind trucks been attempted.

The Type 90 would prove useful in flat or gently rolling terrain, but the continued reliance on fixed ammunition reduced its utility in the indirect fire mode in more broken or forested terrain. An initial batch of a little over 200 guns was built in the early 1930s, before production switched to a version with pneumatic tires and spring suspension suitable for towing behind a tractor or truck.

The fact that the Type 90 had entered production did not end the debate over whether such a heavy weapon was suitable. Indeed, the proponents of a light field gun marshaled their forces and, armed with the fact that the modification program had only shaved 200 kg from the original weight of the Schneider gun, continued to press their case. To demonstrate an alternative, they took a modified version of the old Saigo gun, replaced the barrel and breech with that of the old Type 38, which placed less stress on carriage, and proposed that as a lightweight, if less capable, replacement for the Type 90.

A motorized version of the Type 90 field gun in action. Note the driven spade plate on the right.

The tides turned against the Type 90 in 1935 and production was halted after only a single battalion's worth of the motorized version had been built, in favor of the proposed lightweight field gun.

The new weapon was designated as the Type 95. It reverted to the ordnance and ammunition of the Type 38, but adopted a split trail design that increased traverse. Produced in relatively small numbers, the Type 95 was not a success, with operations in Manchuria clearly demonstrating the need for the longer range of the Type 90, and in early 1940 production reverted to the Type 90 in its motorized configuration. The Type 90 remained in production until artillery production ceased in early 1944, although it never completely replaced the Type (Meiji) 38 Improved. Indeed, although the Type 90 was used in the Malaya campaign of 1941/42, it was not seen again by the Allies until it was encountered on Luzon in 1945.

Although all the 75mm weapons used fixed ammunition, the Army matched up a standard set of projectiles with different propellant loads as needed for the different guns. Several HE projectiles were produced, the most common being the Type 94 HE, although others were also developed, many to take advantage of lower grades of steel available. The Type 90 long pointed HE projectile, featuring dual rotating bands to accept higher pressure loads behind it, in contrast to the single band of the Type 94, was also produced, both for use with the Type 88 AA gun (in the ground role) and the Type 90 field gun. The thicker walls of the long pointed projectile allowed it to survive greater launch accelerations without deforming, but at the cost of payload, which fell from 810 g of TNT or RDX in the standard Type 94 HE to 490 g in the long pointed version. Both were usually fitted with Type 88 instantaneous or delay fuzes. Old shrapnel projectiles with powder time fuzes were also available, but these obsolete designs were rarely used.

Also produced was a Type 90 WP/smoke projectile that featured a 100-g burster charge and 700 g of white phosphorus. This was said to create a cloud 20 meters high and wide, for one to two minutes. This was available for the regimental, mountain and field guns. Also available for all guns was an illumination round that used a 30-second Type 89 powder train fuze and provided 90,000 candlepower for 20 seconds.

APHE projectiles were also available, but production tended to drop off during the war due to shortages of alloying materials for the hard steel needed. As a result, priority was given to those for use with the regimental guns, which were forward-deployed, and the high-velocity Type 90 field gun, which made best use of them. Hollow-charge projectiles were introduced in 1942, this time with priority going to the regimental gun and the Type 38 and Type 95 field guns.

The projectiles were married at the factory with cartridge cases of varying lengths and propellant loadings for the different types of guns. A summary of the cases and exemplary loadings is shown as:

| 75mm Ammunition Family | | | | | | |
|---|---|---|---|---|---|---|
| | Type 41 | Type 94 | Type 38 | Type 41 | Type 95 | Type 90 |
| | Regt Gun | Mtn Gun | Fld Gun | Cav Gun | Fld Gun | Fld Gun |
| Cartridge Case | 184mm | 294mm | 294mm | 294mm | 294mm | 424mm |
| Propellant for Type 94 HE | 265 g | 318 g | 600 g | 600 g | 600 g | 655 g |
| Propellant for long HE | – | 378 g | – | – | – | 1,100 g |

As can be seen there was a wide variety of propellant loadings used with the same projectiles for the assorted 75mm guns in service, resulting in different ballistic performance.

To complement the flat-trajectory 75mm field guns the Army looked to the German experience in WW I with their 105mm howitzers. Thus, the 1927 trials also looked at weapons in that class. Once again a Japanese design competed against a Schneider design, both 105mm howitzers. Here the local weapon proved a complete failure and the decision was an easy one. The Ordnance Bureau insisted that Schneider reduce the weight of the howitzer by 200 kg and once this was done the decision was made in 1928 to standardize on this weapon, although the actual classification was delayed a few years.

The new weapon was to be the 105mm Type 91 (1931) howitzer. For some reason, possibly because priority was given to the 75mm Type 90 gun, production of the 105mm howitzer was slow to start. As a result, orders were placed with Schneider for initial batches of the weapon. The original Japanese requirement was for 90 imported weapons, but orders were placed slowly. An initial order for about 30 was placed in 1930, followed by two orders of 10 and 24, in 1931. Six more were ordered in mid-1933 (but apparently cancelled shortly thereafter) and then a final 13 in June of 1934. Each howitzer was accompanied by a limber and two sights. The 1931 orders were not delivered until 1934 and the last order was not delivered until late 1935. By that time production of the Type 91 field howitzer was finally coming up to speed. According to figures provided post-war by the Ordnance Bureau (see table) production was never great.[2]

Unlike the field gun, the howitzer had a great deal of ballistic flexibility, having available four bagged charges within the brass cartridge case to yield plunging fire at all ranges. The projectiles and cases were supplied separately, and prepared and assembled at the gun position for firing. As with the Type 90 field gun, to which it was the companion piece, the howitzer was originally built for horse draft, with a modified version for truck or tractor use being added later. Unlike its companion 75mm gun, the Type 91 howitzer was little changed from the Schneider original, including retaining the interrupted-screw breech mechanism. The Schneider engineers had opted for a long recoil stroke, resulting in a prominent long trough behind the breech, but this enabled them to reduce the weight of the piece considerably, so that in its horse-drawn version it weighed in at only 70% of the weight of its German counterpart, with the same range; and in the motorized configuration only 77% of the weight of the US M2, albeit with a loss of about 5% of range.

A 105mm Type 91 field howitzer in action in Shantung Province, China in 1938. Note the separate-loaded projectile being held in the foreground.

Production of the 105mm Type 91, together with continuing reliance on field guns, meant that the old 120mm howitzers were generally handed over for scrapping. A small number were incorporated into the fortress artillery of the Bonins, Rashin in Korea and Soya in the home islands, where they were provided with both APHE and HE ammunition, but otherwise appear to have been mostly discarded. Their sole combat use seems to have fallen to two weapons on Iwo Jima. The 10cm Type 91, on the other hand, served extensively in Manchuria, the Philippines and China.

The final field artillery piece was a 105mm howitzer modified from the Chinese Type 14 10cm field howitzer. About 60 of these weapons were captured during the takeover of Manchuria and were modified in 1938-39 by rechambering the ordnance to accept the ammunition of the Japanese Type 91 field howitzer but with less propellant in the cartridge case. They were issued to troops in Korea, and possibly in China and Manchuria.

**Regimental, Mountain & Field Artillery Ammunition Production Pre-War (by fiscal year)**

| | 1931 | 1932 | 1933 | 1934 | 1935 | 1936 | 1937 | 1938 | 1939 | 1940 |
|---|---|---|---|---|---|---|---|---|---|---|
| for 75mm mountain & field guns | | | | | | | | | | |
| HE | 52,070 | 46,200 | 79,700 | 271,880 | 172,970 | 115,950 | 338,900 | 2,461,770 | 3,722,420 | 3,626,640 |
| HE pointed | 0 | 10,600 | 34,000 | 35,500 | 95,000 | 27,000 | 48,480 | 105,000 | 5,500 | 114,400 |
| iron HE | 6,500 | 4,500 | 500 | 4,450 | 700 | 0 | 0 | 420,000 | 1,914,630 | 567,000 |
| shrapnel | 0 | 0 | 2,500 | 34,500 | 0 | 2,160 | 0 | 0 | 0 | 0 |
| illumination | 3,700 | 5,800 | 19,220 | 8,180 | 500 | 870 | 1,400 | 7,200 | 2,380 | 0 |
| WP/smoke | 9,720 | 21,600 | 1,790 | 23,020 | 500 | 6,060 | 21,000 | 0 | 0 | 0 |
| training | 61,550 | 55,900 | 12,100 | 70,390 | 80,500 | 163,210 | 125,600 | 63,320 | 53,320 | 463,660 |
| for 105mm howitzers | | | | | | | | | | |
| HE | 0 | 0 | 0 | 12,000 | 250 | 750 | 2,000 | 160,790 | 548,310 | 764,150 |
| HE pointed | 0 | 24,000 | 0 | 1,500 | 58,150 | 35,480 | 26,570 | 261,930 | 345,180 | 410,910 |
| training | 0 | 0 | 0 | 3,800 | 5,000 | 6,280 | 6,000 | 7,380 | 86,120 | 142,340 |
| for 120mm howitzers | | | | | | | | | | |
| APHE | 0 | 0 | 0 | 0 | 0 | 0 | 10,000 | 0 | 0 | 0 |
| training | 0 | 0 | 0 | 4,000 | 2,000 | 0 | 0 | 0 | 0 | 0 |

Special ammunition, white phosphorus/smoke and illumination, were available only for the 75mm gun. Even there production was never great, and ended before the war started, excepting only a small run of 20,000 rounds of WP in 1944. Surprisingly, the only service ammunition produced for the 105mm howitzer was HE, long pointed HE, and chemical. The former, loaded with 2.3 kg of picric acid or TNT was more common, fitted with either the Type 88 instantaneous or short delay fuze. In this case the "long pointed" HE round was simply longer and had a more pointed nose profile than the regular HE round, using the same propellant load and packing the same weight of explosive but here it was a mixture of ammonium nitrate, RDX and guanadine nitrate.

| Wartime Production of Mountain & Field Artillery Ammunition | | | | | |
|---|---|---|---|---|---|
| | 1941 | 1942 | 1943 | 1944 | 1945 |
| For Type 41 regimental & mountain guns | | | | | |
| Type 94 HE | 386,000 | 2,123,100 | 20,000 | 169,000 | 37,000 |
| Type 99 iron HE | 113,600 | 125,600 | 100,000 | 0 | 0 |
| M1 AP | 37,840 | 416,000 | 34,000 | 0 | 0 |
| Type 2 HEAT | 0 | 0 | 475,000 | 152,000 | 55,000 |
| Type 90 training | 142,000 | 0 | 13,750 | 0 | 0 |
| For Type 94 mountain guns[1] | | | | | |
| Type 2 HEAT | 0 | 0 | 0 | 37000 | 0 |
| Type 90 WP/smoke | 0 | 0 | 0 | 8000 | 0 |
| Type 90 training | 86,000 | 102,000 | 86,000 | 0 | 0 |
| For Type 99 mountain howitzers | | | | | |
| Type 100 HE pointed | 0 | 0 | 0 | 56,000 | 0 |
| For Type 38 & Type 95 field guns | | | | | |
| Type 94 HE | 0 | 0 | 855,000 | 0 | 0 |
| Type 90 pointed HE | 122,240 | 67,000 | 87,000 | 0 | 0 |
| Type 97 iron HE | 0 | 133,000 | 152,000 | 0 | 0 |
| Type 90 AP for Type 38 | 0 | 431,000 | 0 | 0 | 0 |
| M1 AP | 40,330 | 47,000 | 36,000 | 0 | 0 |
| Type 90 WP/smoke | 0 | 0 | 0 | 12,000 | 0 |
| Type 90 training | 0 | 78,000 | 346,000 | 0 | 0 |
| For Type 90 field guns | | | | | |
| M1 AP | 40,000 | 0 | 600,000 | 0 | 0 |
| M4 AP | 0 | 0 | 0 | 0 | 3,200 |
| Type 90 pointed HE | 72,100 | 0 | 69,000 | 71,000 | 0 |
| Type 94 HE | 23,300 | 0 | 21,000 | 0 | 0 |
| For 105mm howitzers | | | | | |
| Type 91 HE | 381,970 | 367,200 | 144,000 | 18,000 | 0 |
| Type 91 HE pointed for Type 91 how | 339,770 | 300,000 | 100,000 | 7,000 | 0 |
| Type 3 HEAT | 0 | 0 | 0 | 4500 | 13400 |
| Type 14 training | 80,140 | 17,800 | 102,900 | 0 | 0 |

[1] HE may be included in Type 41 ammunition

Despite its direct-fire origins, defeat of tanks was not a high priority for the field artillery until late in the war. Shaped charge rounds were known, but priority was given to the battalion and regimental guns that deployed on the front lines. Since the Type (Meiji) 38 and Type 95 field guns already had marginal anti-tank capability with their APHE rounds, and the Type 90 field gun had excellent performance in that role, the first field artillery weapon to receive a HEAT round was the Type 91 field howitzer. Production of these rounds, however, did not begin until January 1945 and totaled only about 15,000 to the end of the war. Production of similar rounds for the field guns does not appear to have started until about mid-year.

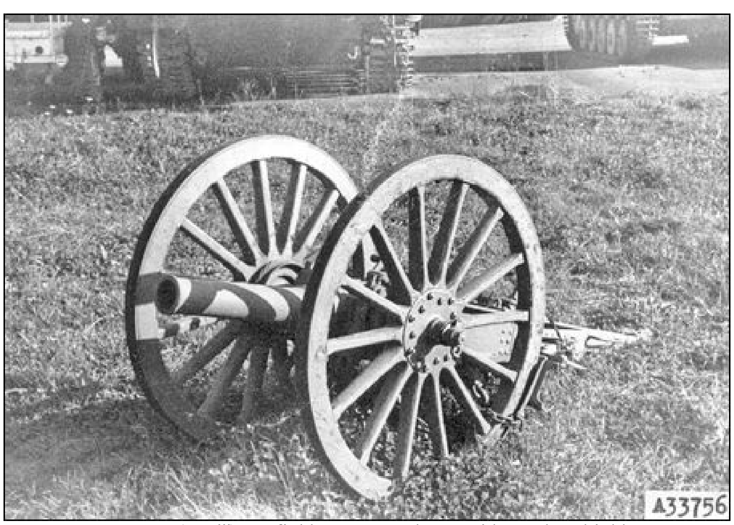
Chemical projectiles were available for almost all the field artillery weapons, “yellow” for blister agents, “red” for vomiting agents, and “blue and white” for choking gas and smoke. All were designated the Type 92 shell of that color, and in April of 1934 these were authorized for use with the 10cm Type 91 howitzer, 75mm Type (Meiji) 38 gun and Type 95 field guns, the cavalry gun, and the Type 41 mountain gun; followed in March 1935 by the 75mm Type 90 field gun, and in January 1937 for the 75mm Type 94 mountain gun. Although chemical rounds were fired from 90mm mortars in China, it is not known if the field artillery chemical rounds were used in combat.

The failure of IJA artillery to support their infantry during the war can partly be traced to inappropriate equipment. The primary field artillery weapon through the war remained the 75mm field gun, and while the Type 90 was an excellent example of that type, by the time production ramped up to acceptable levels, that type of weapon had been abandoned by most other armies as too inflexible in trajectory and too small of projectile for indirect fire support. The Type 91 field howitzer was an adequate weapon, but was never more than a supplement to the field gun and the problem of trying to fire support missions in jungle or hilly terrain with a flat-trajectory weapon remained.

| Characteristics of Light Artillery | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | 75mm (Meiji) 38 gun | 75mm (Meiji) 38 imp Gun | 75mm (Meiji) 41 Cav Gun | 75mm Type 90 field gun | 75mm Type 95 field gun | 105mm Type 14 mod howitzer | 105mm Type 91 howitzer | 120mm Type 38 howitzer |
| Barrel length (cal) | 31 | 31 | 30 | 38 | 31 | n/a | 20 | 12 |
| Muzzle Vel (m/s) | 518 | 518 | 518 | 675 | 518 | 451 | 451 | 290 |
| Pressure (MPa) | 245 | 245 | 245 | 290 | 245 | n/a | 250 | 192 |
| Proj wt (kg) | 6.4 | 6.4 | 6.4 | 6.4 | 6.4 | 16 | 16 | 20 |
| Propellant wt (g) | 599 | 599 | 603 | 655 | 603 | 1139 | 1139 | 300 |
| Piston Rod Pull (kg) | 1560 | 1560 | 1841 | 3275 | 1560 | n/a | 7892 | 6668 |
| Avg Recoil Length (cm) | 125 | 120 | 100 | 98 | 120 | n/a | 120 | 83 |
| Elevation (deg) | -8 to +16 | -8 to +43 | -8 to +16 | -8 to +43 | -8 to +43 | -10 to +42 | -5 to +45 | -5 to +43 |
| Traverse (deg) | 7 | 7 | 12 | 50 | 50 | 6 | 40 | 2 |
| Tread width (m) | 1.4 | 1.4 | 1.4 | 1.5 (1.7) | 1.5 | n/a | 1.6 (1.7) | 1.4 |
| Barrel height (cm) | 99 | 101 | 99 | 108 (1020 | 94 | n/a | 113 (119) | 104 |
| Wt in Firing Posn (kg) | 948 | 1134 | 916 | 1402 (1601) | 1111 | n/a | 1406 (1751) | 1261 |
| Max Range (m) | 8200 | 9450 | 8380 | 13900 | 9450 | 10730 | 10730 | 5669 |
| Note: figures in parenthesis are for motor-drawn version if different from horse-drawn | | | | | | | | |

### 75mm Type (Meiji) 31 Field Gun

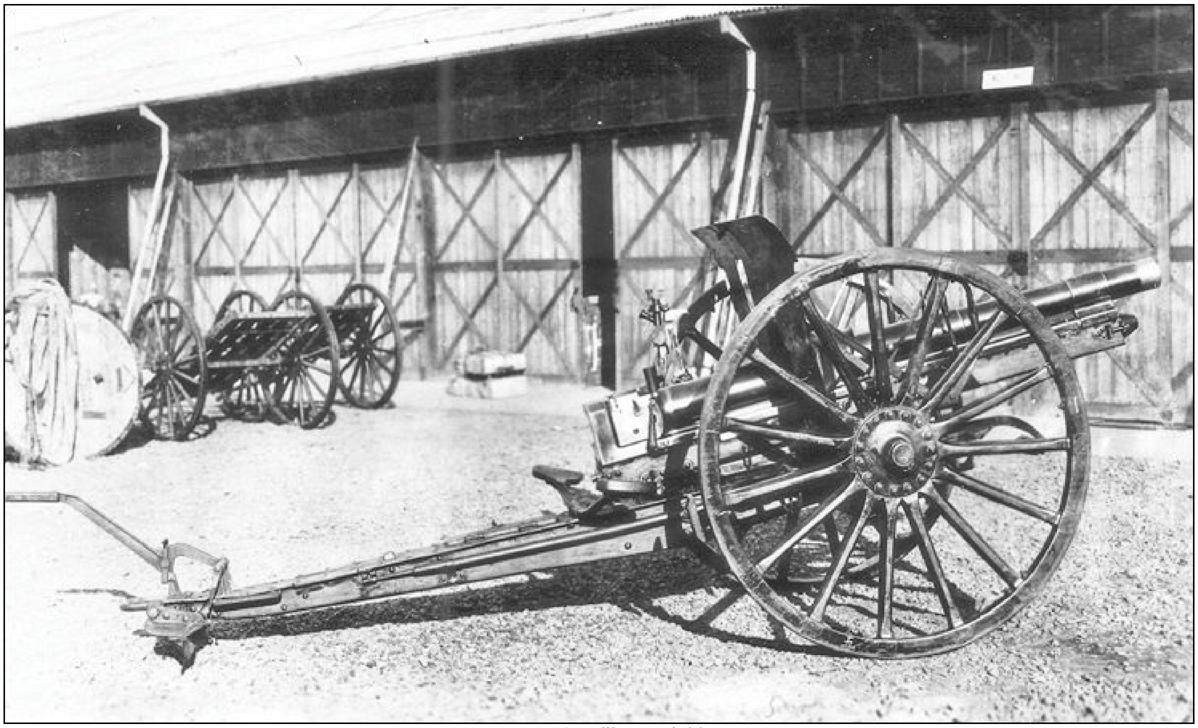
This was an early weapon (1898) developed by Colonel Arisaka. It had a steel barrel and was breech loading, but had no recoil mechanism or on-carriage traverse. A small shield was added during the Russo-Japanese War, but this appears to have been later removed by some users. The weapon was held in reserve during the war, and was only encountered by the US forces during the post-surrender occupation of Korea.



A Type (Meiji) 31 field gun, seen here without the shield.

**75mm Type (Meiji) 38 Field Gun**

This was the Japanese-produced version of the Krupp L/30 field gun. The gun trough was trunnioned to the upper carriage at the point of balance, so no equilibrators were needed. The gun used a horizontal sliding breechblock and a hydrospring recoil mechanism. A single closed-box trail was used that limited elevation, and hence range. HE, APHE, shrapnel and (later in the war) shaped charge rounds were fired.



75mm Type (Meiji) 38 Field Gun.

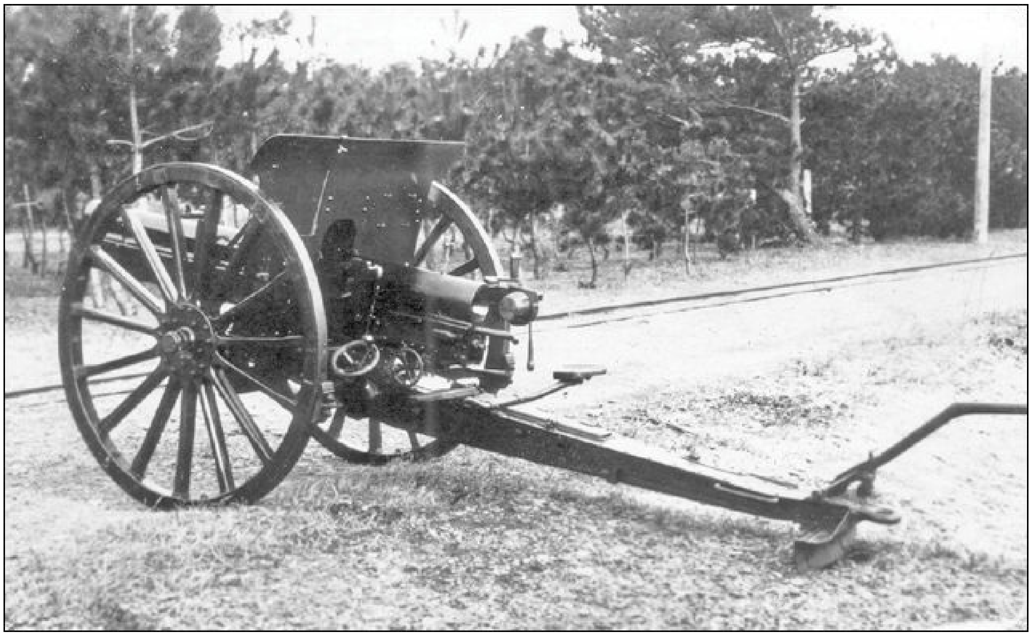
**75mm Type (Meiji) 38 Improved Field Gun**

This was the Type (Meiji) 38 modified to give a higher maximum elevation in order to increase the range. To accomplish this the trail was replaced by an open box-type that permitted the breech to recoil through it, the trunnions were moved towards the rear (and two spring and cable equilibrators added) and the recoil mechanism modified to a variable-resistance type. These also served to increase the rate of fire from 8-10 rounds per minute to 10-12. It was the standard Japanese field piece in China and the Pacific.

75mm Type (Meiji) 38 Improved Field Gun.

**75mm Type (Meiji) 41 Cavalry Gun**

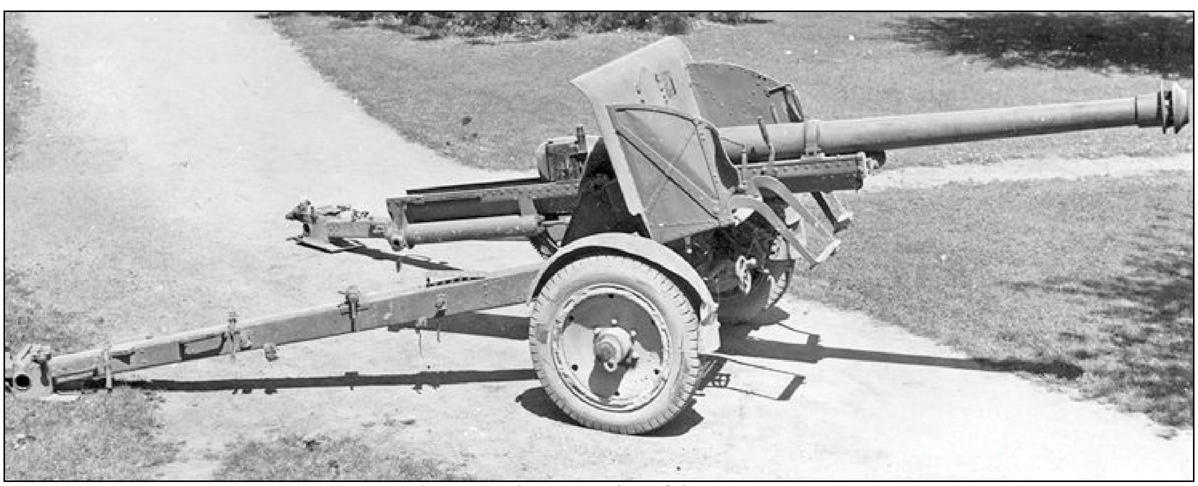
This was a unique design that owed little to other Japanese 75mm weapons. It had an interrupted screw-type breech, although it fired the same ammunition as the Type (Meiji) 38 field guns, with slightly more propellant. As with the Type (Meiji) 38 field gun, it used a single box trail that limited elevation and used the same kind of recoil gear as well, a combined hydrospring arrangement with variable holes in the piston. Operationally it differed from the field gun in having a slightly wider traverse. It appears that only a few dozen of these weapons were ever built, and they were not encountered by the western Allies.



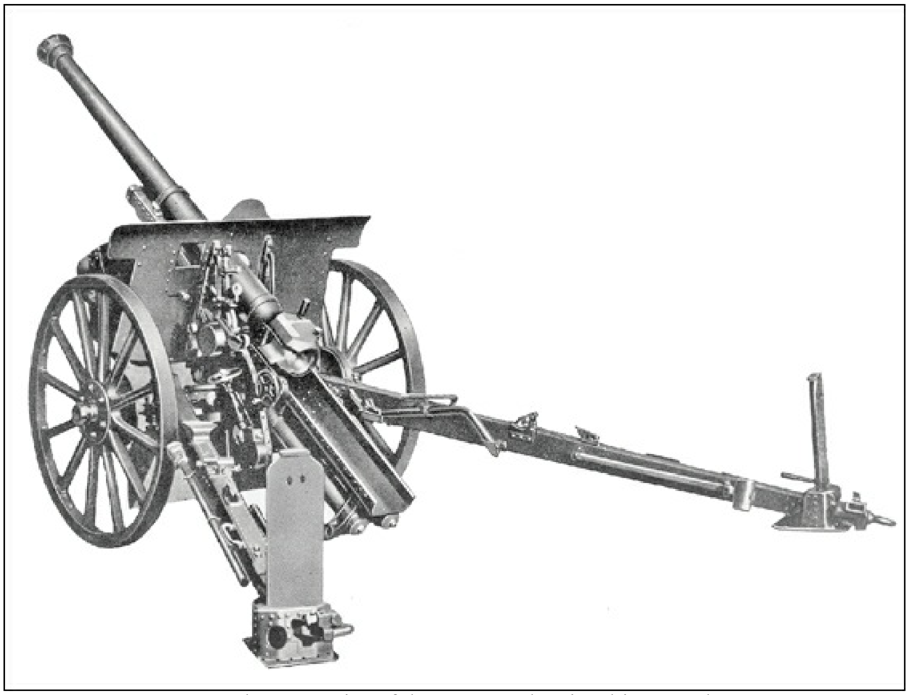
75mm Type (Meiji) 41 Cavalry Gun.

### 75mm Type 90 Field Gun

This modern weapon featured a barrel not only longer than the predecessor 75mm guns, but also stronger as a result of the introduction of the autofrettage process. Consequently, the gun could withstand 20% more pressure than the earlier guns, which permitted the use of a more powerful cartridge. It had a split trail with spades that were driven into the ground for stability, the latter made necessary by the fact that it had over twice the recoil pull, and a shorter stroke, than the old Type 38. The horse-drawn version was unsprung, while on the motorized version small screw jacks served to lock the elliptical suspension springs out for firing. The standard range of HE and shrapnel projectiles were fired, along with the Type 94 and Type 1 APHE rounds, which were effective rounds from this high-velocity weapon. Because the APHE was effective, no shaped-charge ammunition was produced.



The motor-drawn version of the Type 90.


Horse-drawn version of the Type 90 showing driven spades.

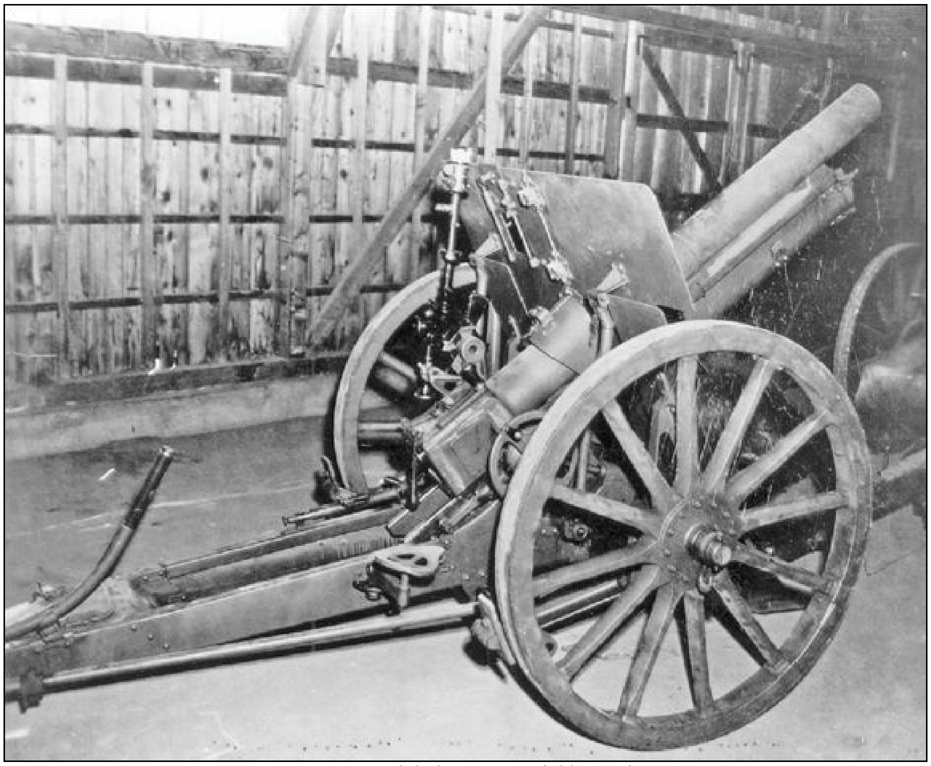
### 75mm Type 95 Field Gun

This was essentially the ordnance (and ammunition family) of the Type 38 placed on a new carriage with split trails and the Schneider-type recoil system as used on the Type 95. The barrel was slightly lower than on preceding models. Like the other field guns, it was drawn by six horses.


75mm Type 95 Field Gun.

### 105mm Remodeled Type 14 Field Howitzer

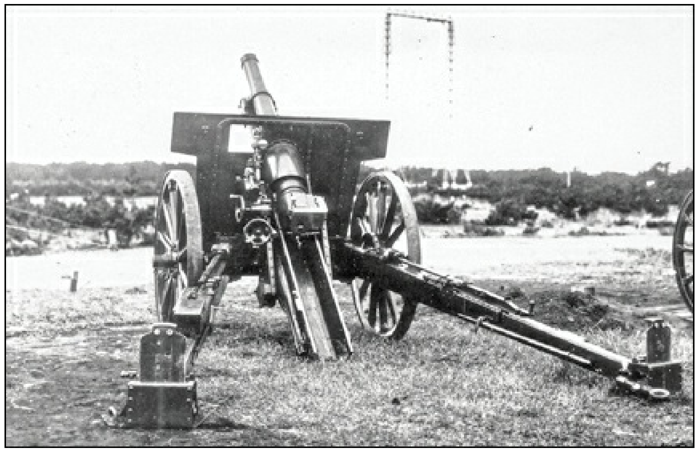
This was the Manchurian/Chinese Type 14 (1925) 10cm field howitzer rechambered to fire the ammunition of the Type 91 field howitzer. It used an open box trail and cross-axle traverse, with hydro-spring recoil system and spring equilibrators. The original German-made panoramic sight was retained, with a new gunner's quadrant with several scales for different charges. The range figure was set directly onto the quadrant, which moved an index arm through an angle equal to the required elevation angle. The maximum range calibrated on the quadrant was 7,800 meters. A separate level vial accepted compensation for angle of site.


105mm Remodeled Type 14 Field Howitzer.

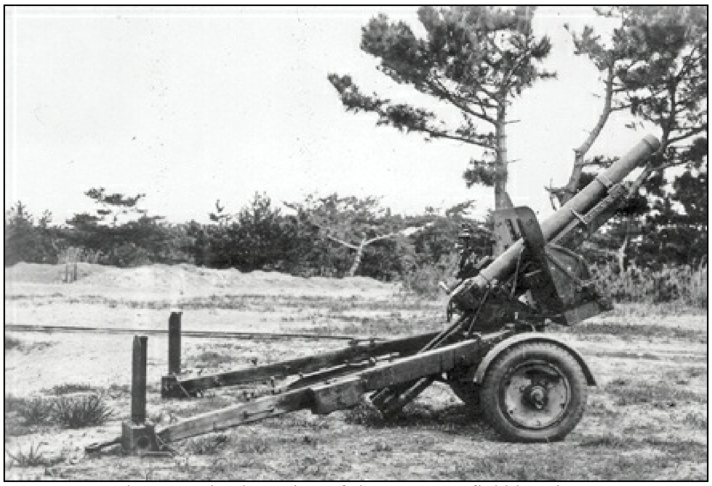
## 105mm Type 91 Field Howitzer

This Schneider design was distinctive for its trough that projected well to the rear. It used an interrupted-thread breech and a hydropneumatic recoil system housed in the long trough. The carriage was designed for rapid disassembly and reassembly, which added mobility in rough terrain. A motorized version, with a carriage similar to that of the Type 90 field gun, was produced in smaller numbers. It fired separate-loading ammunition with four charges and had a rate of fire of 6-8 rounds per minute. HE, APHE, shrapnel and incendiary projectiles were available, the most common being the Type 91 long pointed HE also used by 105mm field guns. A shaped-charge round capable of penetrating 120mm of steel was also produced late in the war. The basic version was drawn by six horses, the motorized version by 9- or 13-ton tractor. The Type 91 had adequate performance for its time, similar to that of its contemporaries elsewhere, and was probably the best of the Japanese field artillery pieces for general fire support.


A Type 91 howitzer with its limber.



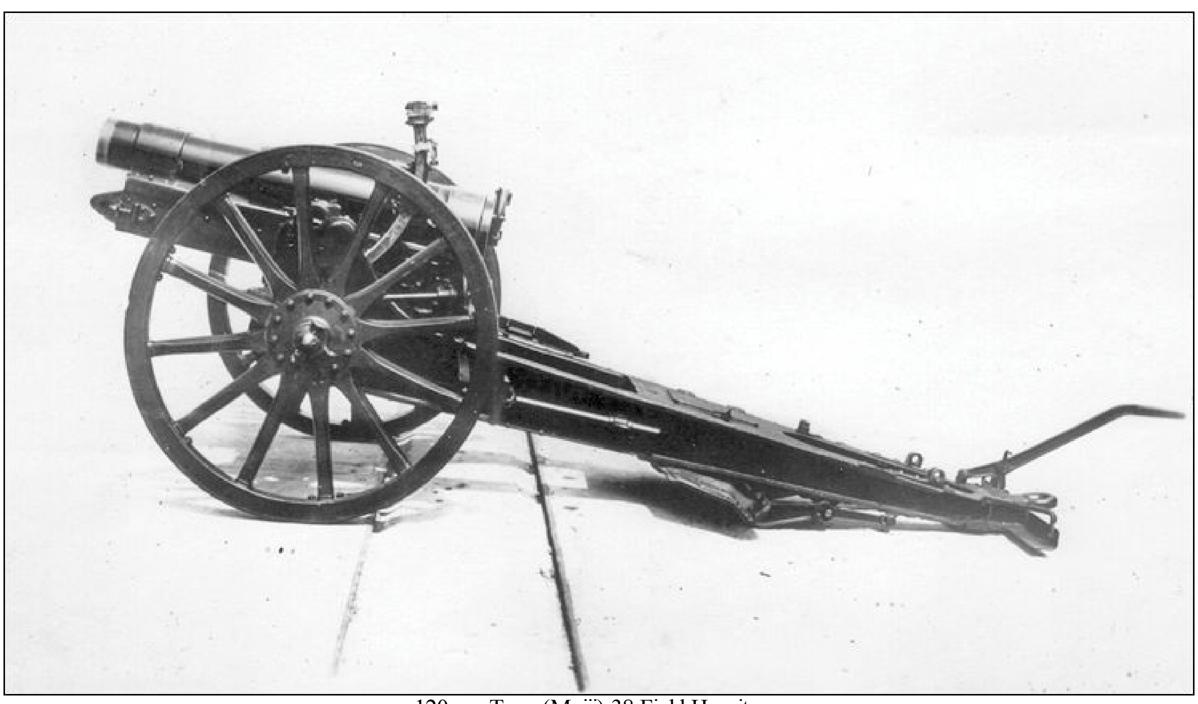
A Type 91 in firing position. Note the long trough that contacts the ground at maximum elevation.



The motorized version of the Type 91 field howitzer.

### 120mm Type (Meiji) 38 Field Howitzer

This was the Japanese version of the Krupp L/12 field howitzer of pre-WW I vintage. It used an interrupted-screw breech mechanism with a combined hydrospring recoil/recuperator system with tapered grooves. It fired separate loading ammunition with HE, APHE and shrapnel projectiles. Late in the war a shaped charge round, able to penetrate 140mm of steel, was also produced. The weapon was drawn by a team of six horses. The limited traverse and short range rendered it obsolescent, and it served only with second-line units.



120mm Type (Meiji) 38 Field Howitzer.

1 The Schneider patents of the 1920s all utilized hydraulic pressure, usually applied to the bore in sections, with decreasing pressure applied closer to the muzzle where less strength was required.

2 However, the US captured weapons with serial numbers 1125 to 1594 made at the Osaka Arsenal in 1942, indicating the Ordnance Bureau estimates may be low.

# Medium Artillery

That the Army's medium (or field heavy) artillery contributed little to Japan's war effort cannot be blamed on the weapons. The first and third generation weapons, introduced in 1903 and the 1930s, were European designs fully modern at the time, while the intervening indigenous Type (Taisho) 4 howitzer responded to Japanese conditions with ease of portability.

The first modern piece of heavy field, or medium, artillery acquired by Japan was the 15cm L/12 howitzer from Krupp, 20 of which were ordered in 1903 and a further 16 the following year. The companion piece, the 10.5cm L/30 gun, was purchased at the same time, 20 being ordered in 1904. None arrived in time for service in the Russo-Japanese War. The howitzer was built under license with only minor changes as the 15cm Type (Meiji) 38 field howitzer, while the field gun was more extensively modified to yield the 10cm Type (Meiji) 38 field gun.

The howitzer was an adequate weapon at the time of its introduction, but advances elsewhere soon outstripped it in muzzle velocity, and consequently range. The extremely short range, of less than 6,000 meters, made replacement a high priority and work on a new weapon was quickly begun at the Osaka Arsenal. Nevertheless, although clearly obsolete, the 15cm Type (Meiji) 38 howitzer remained in service with two regiments into 1940, seeing some service in the early campaigns in China.


15cm Type (Meiji) 38 howitzers on pre-war maneuvers.

The result of the replacement effort was standardized in 1915 as the 15cm Type (Taisho) 4 howitzer, and 280 were built. This weapon had a slightly longer barrel than its predecessor, but the main difference came from the heavier construction, which allowed it to fire the same projectiles, but with more than twice the propellant load (2.25 kg vs 0.83 kg), yielding an increase in range. The price to be paid, however, was a great increase in weight to the point where it was felt impractical to move it in one load by horse draft. Instead, for movement the barrel was removed and placed on a separate axle, along with the rear half of the trail and drawn behind a limber. The carriage and recoil mechanisms were carried on a separate axle and limber. Thus it used two 6-horse teams to move the weapon in two loads, rather than the one 8-horse team used by the Type (Meiji) 38 howitzer. This, of course, slowed down the time into and out of action. The weapon also marked a switch from the interrupted-screw breech mechanism of the Type (Meiji) 38 to a vertical sliding type.

The crew of a 15cm Type (Taisho) 4 pull and push the barrel to the rear out of the cradle and onto its separate axle in preparation for movement.

The barrel portion and its limber of a 15cm Type 4 left behind in Burma, 1944.

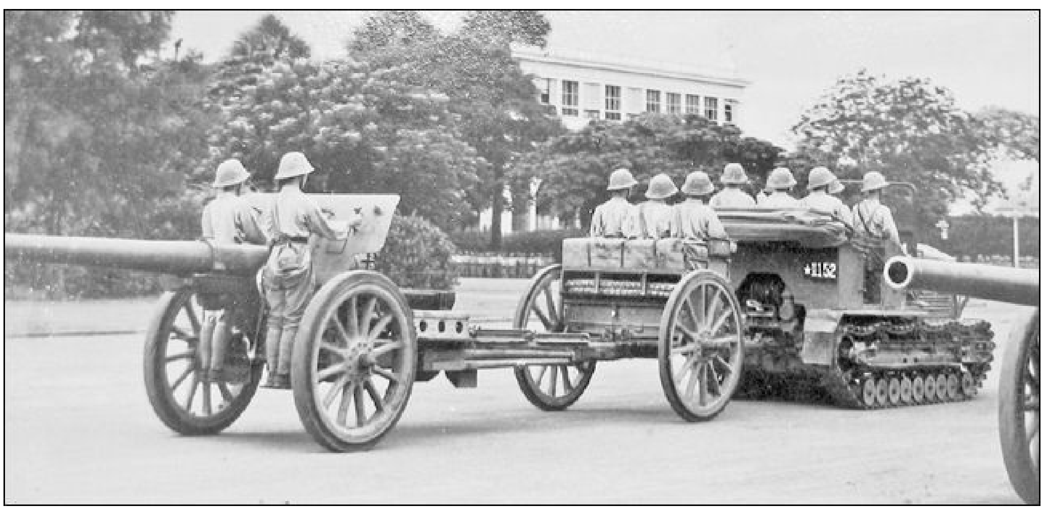
The Type (Taisho) 4 howitzer can be regarded as the first of two attempts at indigenous development of modern artillery, the other being the Type Taisho 14 field gun. Both succeeded the Krupp designs of the 1905 family, but were found wanting, forcing a return to European designs.

The Japanese designers were working under constraints that did not plague their European and American counterparts, the most significant being a limited industrial development base and strict limits on the maximum single-load weight of weapons. The latter, presumably reflecting Japan's frail bridges, resulted in the 15cm Type (Taisho) 4 being broken down into two loads for transport, an awkward expedient not required of European or American designs.

Having come up with an indigenous replacement for the 15cm howitzer, the Japanese now turned their attention to the companion 10cm gun. The result was the Type (Taisho) 14 field gun, introduced in 1925. By the time WW I ended, the older Type (Meiji) 38 weapon had no more range than the newer 105mm howitzers in west, so a major driver was the need to increase the "reach" of the piece. The closed trail was replaced by a split type that permitted the breech to drop through for firing, while the breech and barrel were strengthened to permit the use of 50% more propellant. Notably, the ten years since the adoption of the Type (Taisho) 4 howitzer saw the introduction of motorized tractors, and this, together with decreased concerns about roads, enabled the Army to do away with the requirement that weapons of that weight be moved in two loads, so the Type (Taisho) 14 gun was towed as a single unit by a tractor.

A 105mm Type (Taisho) 14 field gun in action in China.

Neither of the indigenous pieces, the 15cm Type (Taisho) 4 nor the 10cm Type (Taisho) 14 was regarded as entirely successful. The range of the 15cm howitzer was short by international standards, and the need to disassemble and reassemble it for movement was a tactical shortcoming. The saving graces of the howitzer were that it could be moved by horses in light loads and it had an unusually high elevation angle, permitting plunging fire in rough terrain. The 10cm gun required the use of tractors to move, but was still not in the same league as western weapons, particularly those of France, in terms of performance. In fact, production of the 10cm Type (Taisho) 14 gun was terminated after only 60 had been built.



105mm Type 92 guns in parade in 1942.

As a result the contracts with Schneider in 1927 included one example each of their 105mm field gun and 155mm howitzer. Priority was accorded the former and it was accepted for service with only minor changes as the 105mm Type 92 Field Gun in 1932.

The Type 92 Field Gun incorporated all the modern features of the time, so that even by 1945 its only anachronistic element was the lack of provision for high-speed motor towing by trucks. As with the earlier 105mm guns, the Type 92 combined an interrupted-screw breech mechanism with a metal cartridge case for sealing. The brass cartridge case was considerably longer than that used in the Type (Taisho) 14 gun, 736mm as opposed to 460mm, enabling 4 kg of propellant to be utilized, compared to only 2.53 kg in the older gun. In addition, the propellant was now divided into charges, one of 1.5 kg and the other of 2.5 kg to facilitate the use of plunging fire at varying ranges, a useful feature. Early production guns suffered from weaknesses in the sealing of the recoil system, which prevented the firing of the weapon at full charge, essentially limiting the range to about 13 km, but this was apparently remedied in 1939/40. The Type 92 was placed in production at the Osaka Arsenal, but was never produced in large numbers. This conformed with the experiences of other armies, that the 105mm field gun category of weapon was simply not that useful, that a 150mm-class howitzer of the same weight provided much more lethality at the same level of mobility.

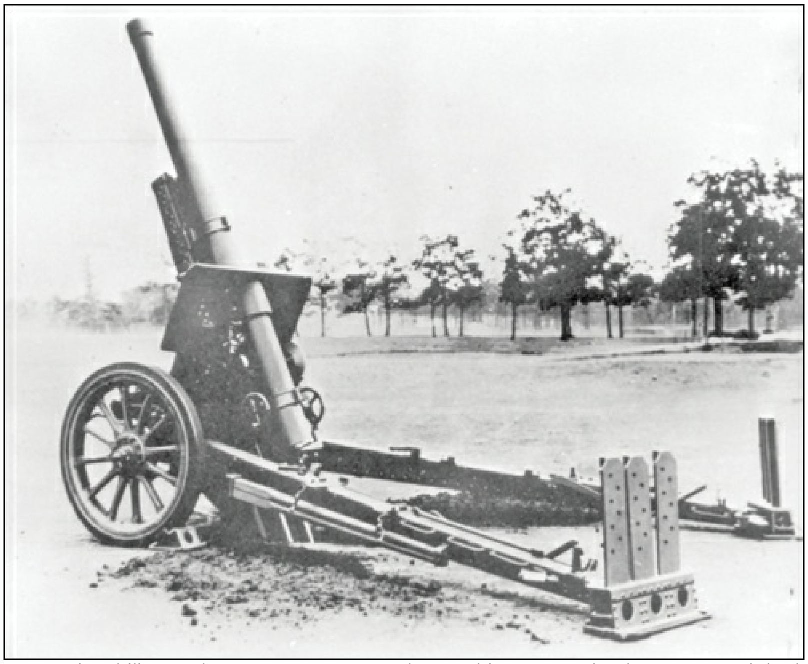
As it happened the inability to fire at full charge, both because of problems with recoil system sealing and lack of long-range facilities in the homeland, concealed a dangerous weakness in the trails. These were exposed in the fighting at Nomonhan, when trails broke in combat. Promises of a fix were a low priority and trails broke again on Guadalcanal. They were finally remedied in the later production weapons.

The next weapon to be scheduled for replacement was the 150mm Type (Taisho) 4 howitzer. Production of this weapon ceased in 1928, by which time no fewer than 340 had been built. Perhaps some had worn out, for further batches were built in the mid- and late-1930s. The Type (Taisho) 4 was quite light for the projectile it threw, and the fact that it could be further broken down into two for transport, while slowing the time into and out of action, also made it uniquely suitable for marginal terrain and locales with poor roads and weak bridges. The weapon thus remained in low-level production through the war, despite the introduction of a much more modern piece.

**Production of Medium Artillery**

| | FY31 | FY32 | FY33 | FY34 | FY35 | FY36 | FY37 | FY38 | FY39 | FY40 |
|---|---|---|---|---|---|---|---|---|---|---|
| 105mm Type 92 Gun | 0 | 0 | 18 | 24 | 0 | 0 | 4 | 18 | 29 | 22 |
| 150mm Taisho 4 Howitzer | 0 | 0 | 0 | 24 | 0 | 8 | 16 | 0 | 11 | 0 |
| 150mm Type 96 Howitzer | 0 | 0 | 0 | 0 | 0 | 6 | 24 | 29 | 40 | 105 |
| | | | | | | | | | | |
| | 1941 | | 1942 | | 1943 | | 1944 | | 1945 | |
| | Apr-Jun | Jul-Dec | Jan-Jun | Jul-Dec | Jan-Jun | Jul-Dec | Jan-Jun | Jul-Dec | Jan-Jun | Jul-Sep |
| 105mm Type 92 Gun | 0 | 25 | 16 | 20 | 18 | 8 | 0 | 0 | 0 | 0 |
| 150mm Taisho 4 Howitzer | 6 | 11 | 7 | 12 | 6 | 5 | 5 | 0 | 0 | 0 |
| 150mm Type 96 Howitzer | 30 | 105 | 68 | 65 | 51 | 47 | 34 | 0 | 0 | 0 |

Only partially replacing the 15cm Type (Taisho) 4 howitzer was the new 15cm Type 96 howitzer, based on a Schneider design, but modified locally, adopted in 1936. Once again, this was a sound, modern design, although notable more for its light weight than its mediocre range. The Type 96 was placed in production at the Osaka Arsenal and by late 1940 was specified as the armament for five heavy field (medium) artillery regiments, each of two battalions.



A truly remarkable feature of the Type 96 was its ability to elevate to 70°, as seen here. This was no simple matter: a pit had to be dug to accommodate the recoiling breech at elevations over 45°, but it did allow the howitzer to fire missions almost as a mortar if needed.

The primary round of ammunition was the HE, although for longer range the special long pointed HE projectile could be used, which increased the reach from 10.4 km to 11.9 km. An APHE round was also deployed, presumably for use against concrete fortifications, featuring a base fuze with delays of .05 to 2 seconds and thicker walls and nose, although this reduced the explosive payload from 5 kg to 2.3 kg. Also available were shrapnel and WP/smoke projectiles, all little used.

Notably, the transition to motor transport initially involved the use of 22 km/hr, fully-tracked tractors rather than trucks. These were replaced by the Type 98 6-ton tractor, which could tow at 30 km/.hr. In any event towing speeds remained limited by the wooden wheels used, albeit with rubber rims. Thus, where US intelligence credited the horse-drawn 15cm Type Taisho 4 howitzer with a daily range of 65 km on good roads, early Japanese doctrine called for road speeds of only 13 km/hr for the tractors, yielding comparable ranges of 80 to 100 km for the tractor-drawn Type 92 and Type 96 weapons on roads; an improvement, but hardly the breakthrough to be achieved if trucks were used instead. Of course, the trucks of the 1930s did not have great cross-country mobility and Japan did not devrelop the heavy cross-country wheeled vehicles that the US did, so there was little incentive to develop medium artillery suitable for high-speed towing.

A 15cm Type 96 howitzer on the move in China.

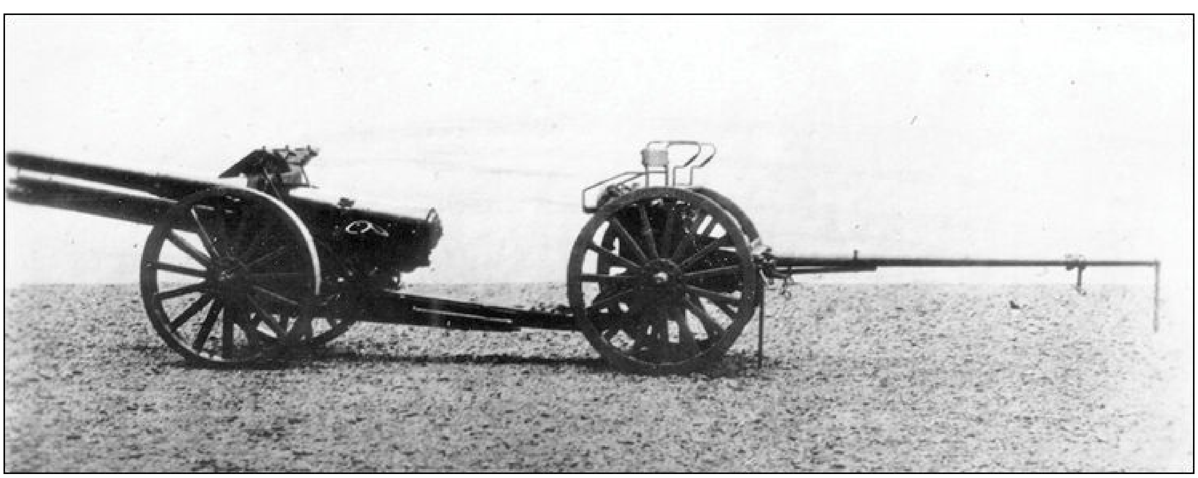
The Schneider 15cm was initially modified by reducing the bore to 149.1mm, changing the 8-segment breechblock to a 6-segment, reducing the trail spread from 65° to 60°, enclosing the elevating arc and pionion and some details. About 90 of these preproduction weapons were produced before switching to the full production version, with changes mainly to speed production and conserve high-value materials at the expense of weight, such as the use of heavier, bolted trailed in lieu of the earlier lighter, welded ones.

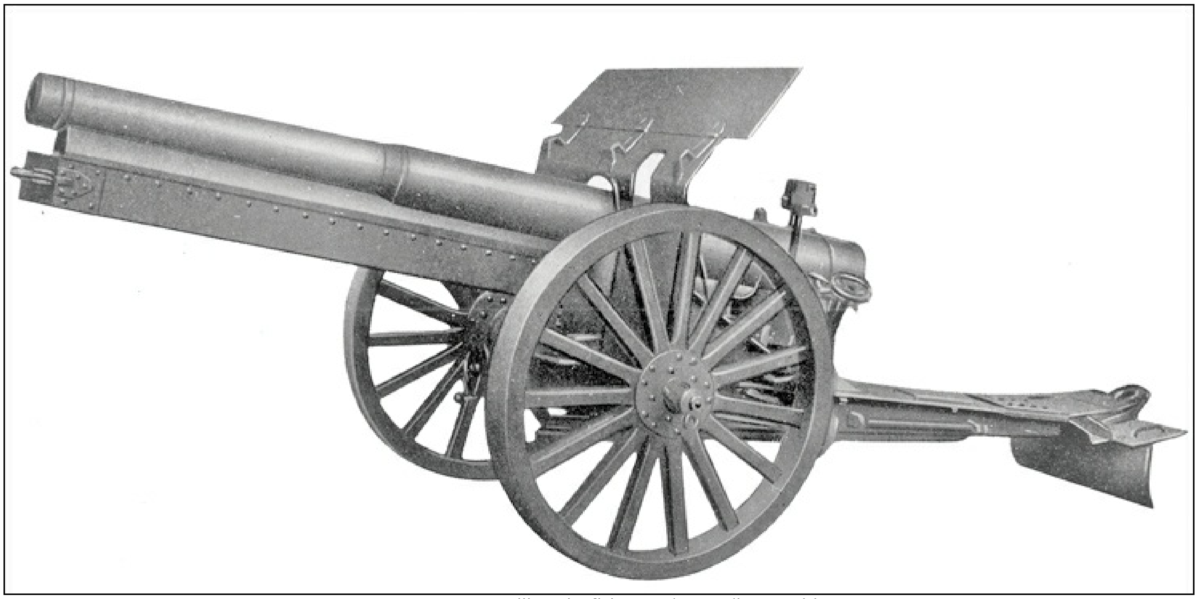
| Medium Artillery Specifications | | | | | | |
|---|---|---|---|---|---|---|
| | 105mm Type (Meiji) 38 gun | 105mm Type (Taisho) 14 gun | 105mm Type 92 gun | 150mm Type (Meiji) 38 How | 150mm Type (Taisho) 4 How | 150mm Type 96 How |
| Barrel length (cal) | 32 | 34 | 45 | 12 | 15 | 24 |
| Muzzle Vel (m/s) | 570 | 640 | 765 | 276 | 400 | 546 |
| Pressure (MPa) | 265 | 226 | 268 | 201 | 194 | 245 |
| Proj Wt (kg) | 16 | 16 | 16 | 36 | 36 | 36 |
| Propellant (g) | 1,740 | 2,535 | 4,000 | 825 | 2,260 | 2,930 |
| Piston Rod Pull (kg) | 13,925 | 12,110 | 10,250 | 11,610 | 12,745 | 13,520 |
| Avg Recoil Length (cm) | 160 | 150 | 100 | 60 | 130 | 100 |
| Elevation (deg) | -2 to +16 | -5 to +43 | -5 to +45 | 0 to +43 | -5 to +65 | -5 to +70 |
| Traverse (deg) | 3 | 30 | 36 | 4 | 6 | 30 |
| Tread width (m) | 1.4 | 1.5 | 1.5 | 1.5 | 1.5 | 1.6 |
| Barrel height (cm) | 120 | 123 | 139 | 109 | 130 | 139 |
| Wt in Firing Posn (kg) | 2,600 | 3,120 | 3,742 | 2,091 | 2,803 | 4,146 |
| Max range (m) | 10,790 | 15,270 | 18,200 | 5,915 | 8,780 | 11,890 |

Overall, the medium artillery did not play a major role in the Japanese war effort. Presumably the modern Schneiders were bought with an eye towards the Soviet threat to Manchuria, but they were never procured in enough numbers to have made a difference there. Medium artillery was only intermittently useful in China, where the more mobile field artillery performed just as well, and found little employment in the jungles or small islands of the Pacific. Where it might have proven useful, in the Philippines or Okinawa, it was neutralized by American air supremacy. Carefully hidden, it may have inflicted casualties on Americans invading the Japanese homeland, but that probably would have been a short-term success.

**105mm Type (Meiji) 38 Gun**

This was a much-modified version of the original Krupp L/30 field gun. Its single trail restricted elevation (and hence range) considerably. The most characteristic feature of the weapon was the trough that extended forward almost as far as the muzzle. It utilized a combined hydrospring recoil/recuperator system and an interrupted screw breech mechanism. HE, APHE and shrapnel projectiles were available, fired with semi-fixed cartridge case ammunition. The weapon was obsolete, and held only in reserve in the homeland.

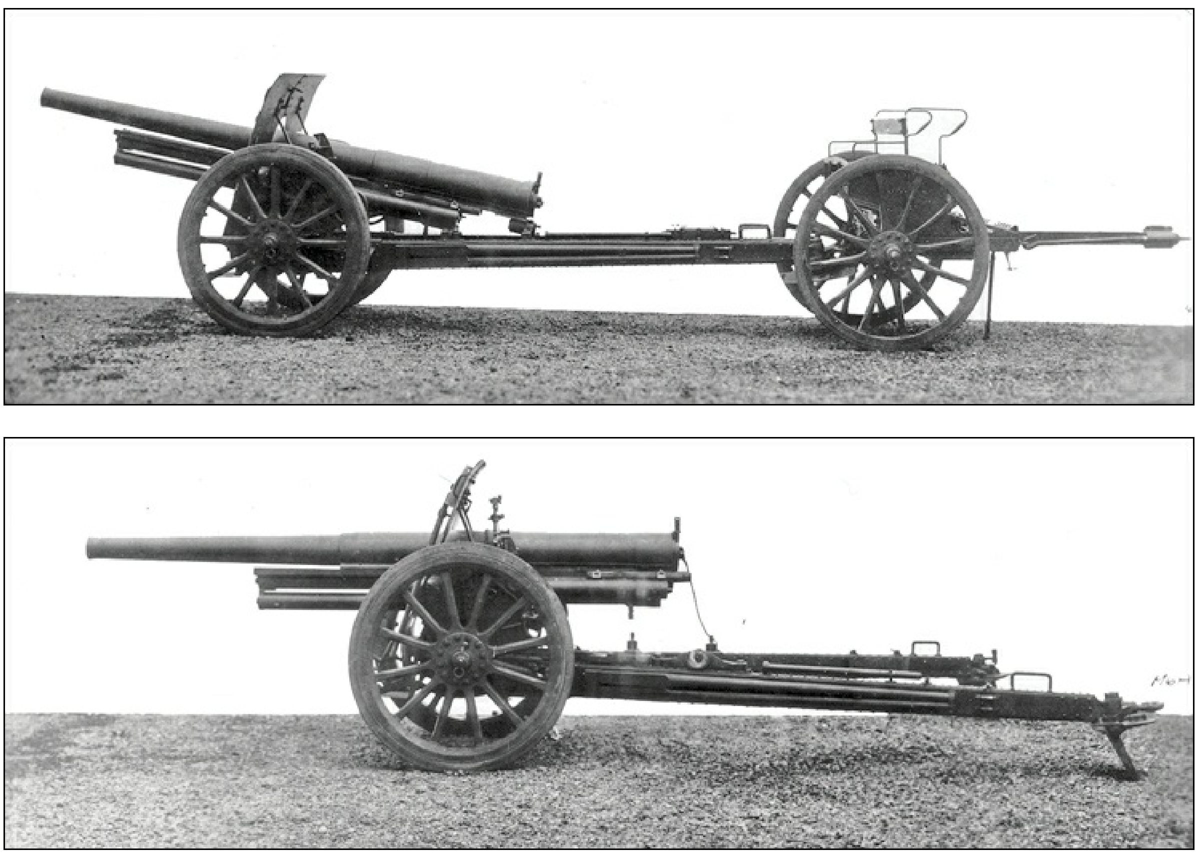




A 10cm Type Meiji 38 in firing and traveling position.

**105mm Type (Taisho) 14 Gun**

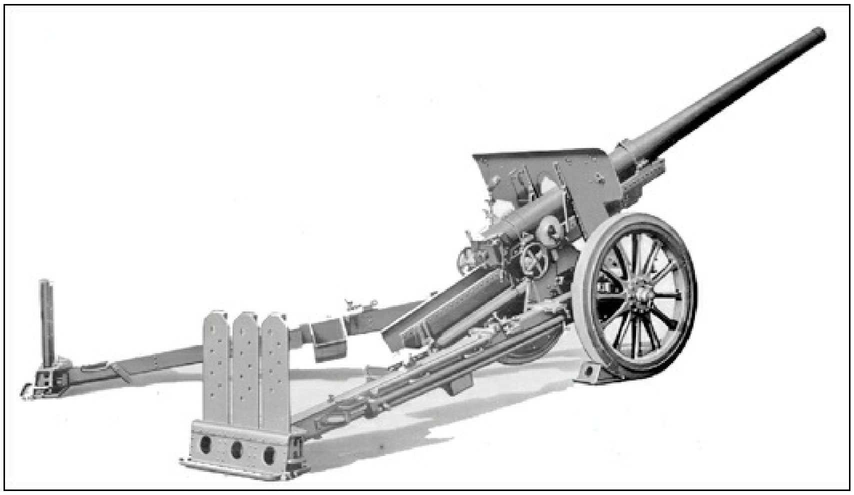
This was an indigenous development aimed at increasing muzzle velocity and elevation (for greater range) and incorporation of a more advanced hydropneumatic recoil system. The muzzle velocity increase was accomplished through a slightly longer barrel (necessitating a spring equilibrator) and increased propellant. The elevation increase was achieved through the adoption of a split trail design. The gun was originally drawn by horses, but later by 13-ton tractors.



The 10cm Type Taisho 14 gun in firing and traveling position.

**105mm Type 92 Gun**

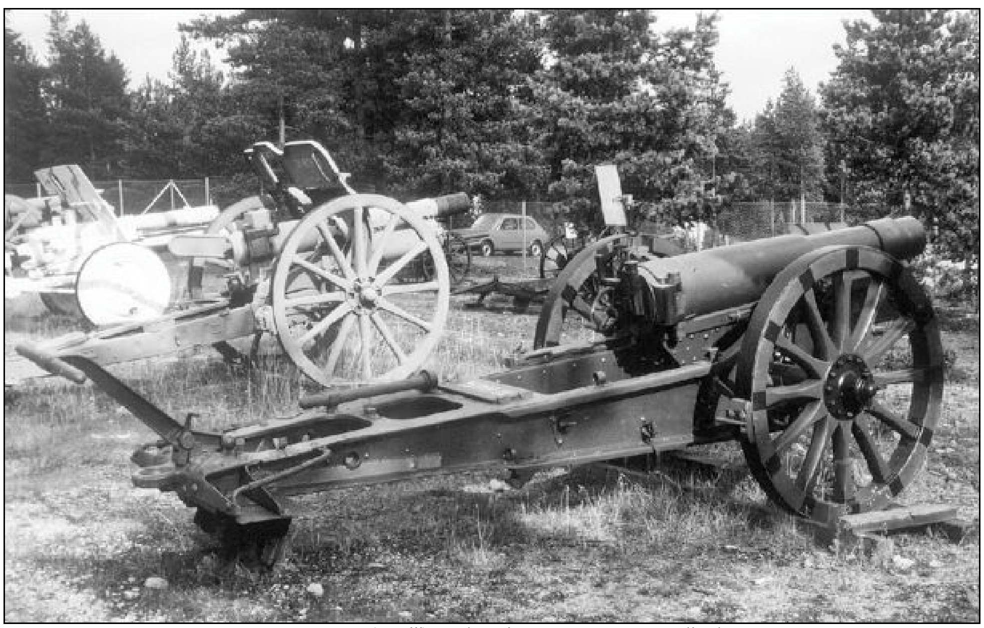
This thoroughly modern weapon featured a very long, thin barrel and long split trails with driven spade plates. Not only did modern, autofrettage construction allow the use of more propellant, yielding increased range, but the semi-fixed ammunition utilized two propellant charges that provided flexibility in trajectories. For transport the long barrel was pulled back by winch into the recoiled position. The most common projectile was the Type 91 HE with instantaneous or short-delay fuze, also used by every other Japanese 105mm weapon. Due to the high recoil load the trail ends incorporated three spade plates in each that had to be driven down into the earth, and removed to displace the gun.



105mm Type 92 Gun.

### 150mm Type (Meiji) 38 Howitzer

This was Japanese copy of the original Krupp L/12 howitzer. It had an open box trail and interrupted screw breech. The opening in the trail gave respectable elevation, but traverse was almost nil. The small propelling charge gave a short range, but also made for a light weight weapon and permitted the use of the relatively simply hydro-spring recoil mechanism.



A 15cm Type (Meiji) 38 howitzer at a museum display.

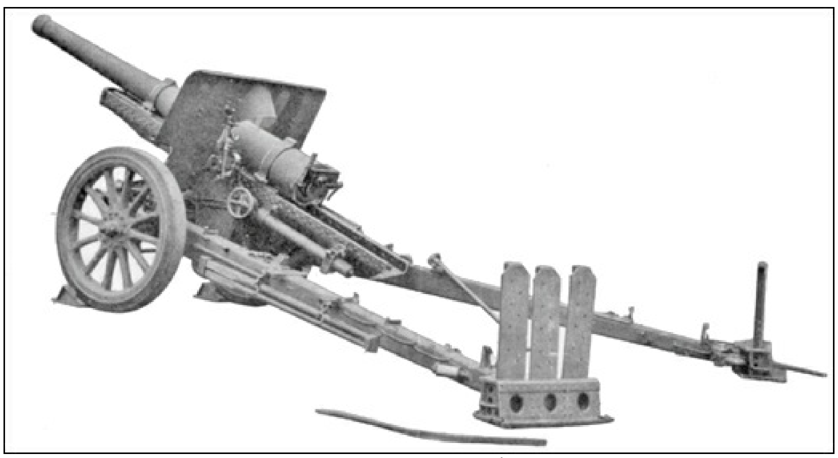
### 150mm Type (Taisho) 4 Howitzer

This was an indigenous design that accepted a greater gun weight to remedy the extremely short range of the Type (Meiji) 38 howitzer that preceded it. In order to retain mobility in rough terrain and poor roads, the weapon had to be disassembled into two loads for movement, with the barrel being winched back out of the trough onto a platform on the back part of the box trail, and that was then detached from the front half of the trail and placed on a separate axle and wheel arrangement. Each of these loads weighed about 2,175 kg. The weapon used a hydropneumatic recoil system and vertical sliding breech mechanism, obturation being by means of the brass cartridge case that contained five propelling charges. The weapon could elevate to 65°, a useful feature in irregular terrain. The two equilibrators acted through wire ropes attached to the elevating arc.


150mm Type (Taisho) 4 Howitzer.

**150mm Type 96 Howitzer**

This was a modern piece featuring the standard Japanese combination of interrupted-screw breech and metal cartridge case for sealing. The cartridge case, at 320mm, was longer than the 260mm of the Type (Taisho) 4, and held more propellant. The projectiles, however, were the same, the most common being the Type 92 HE with instantaneous or short-delay fuze. Shrapnel, APHE and smoke rounds were also available. A major change from the Type (Taisho) 4 was that it was moved in a single unit on solid-rubber tired wooden wheels, towed by a tracked tractor. The high elevation limit and provision of five propelling charges gave the weapon excellent trajectory coverage over its entire range.


150mm Type 96 Howitzer.

# 12

# Heavy Artillery

The advent of heavy, or siege, artillery in the modern Japanese Army can be traced to the successful employment of ten 28cm Italian howitzers removed from coastal positions for use against Port Arthur in the Russo-Japanese War. Their resounding success in that operation led to a major effort to develop a family of siege weapons, all of which came to fruition in 1912.

Two of the new weapons were howitzers, a 20cm and a 24cm as Type (Meiji) 45 howitzers, but only the latter was built in quantity. The family was completed by a 15cm gun, also the Type (Meiji) 45, but this was a pedestal-mounted weapon that was difficult to emplace and used primarily as a coastal weapon. The 24cm Type (Meiji) 45 was the first indigenous design of a heavy artillery piece and reflected the times. It utilized a below-ground array of struts and plates that required the excavation of a substantial pit, not only to mount the weapon but also to provide a depression into which the breech could recoil at high elevations through 360° of traverse. The entire process took a crew of 50 men two days to install the weapon, with the aid of a 10-ton crane that formed part of the battery equipment. By the 1930s it was clearly obsolete, but continued as the armament of the three permanent heavy artillery regiments of the IJA's force structure, even firing against Bataan and Corregidor in 1942, to the end of the war.

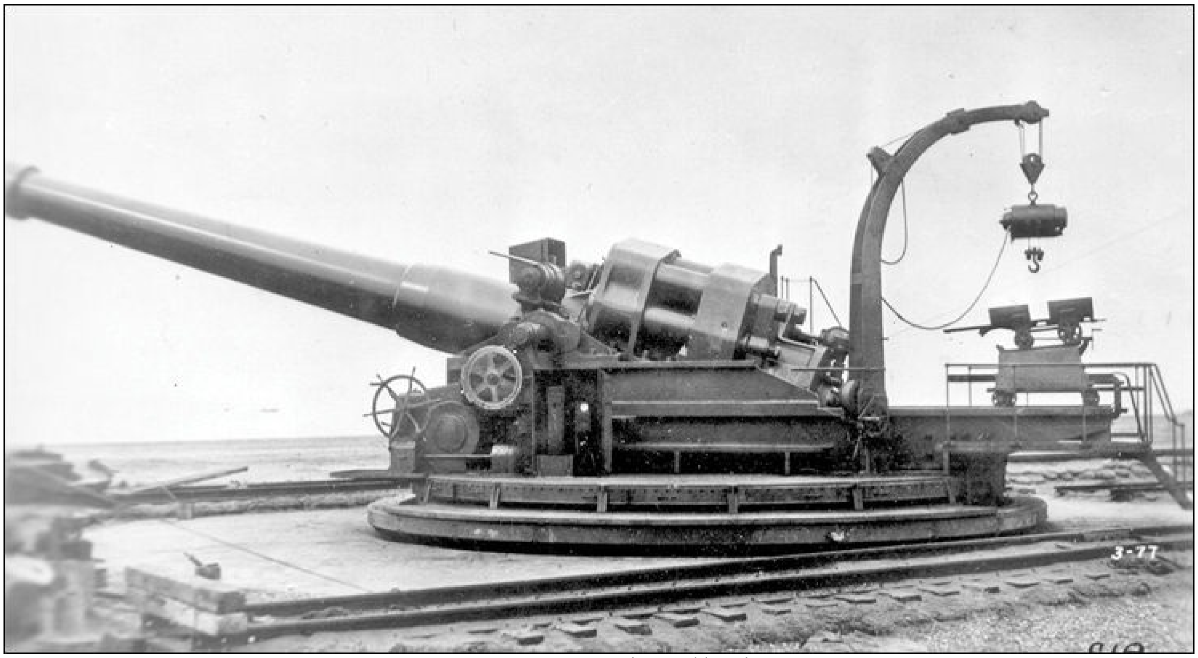
A 24cm Type 45 howitzer on maneuvers around 1930.

An even heavier weapon, the 30cm Type (Taisho) 7 was adopted in 1918 in short barrel configuration and four years later in a long barrel version. It fired a 300-kg projectile using a semi-fixed brass cartridge case with three propellant charges. The only projectiles available were APHE type with a solid metal nose that extended almost halfway to the rear leaving a filling of only 22 kg of explosive. The weapons were ungainly to move, a 2-gun battery of short 30cm howitzers fielding no less than 23 Type 95 low-speed 13-ton tractors and 22 tracked trailers for gun components. The mount was a truncated steel cone embedded in concrete about 2 meters below the ground. The gun carriage was a rectangular steel frame a little under 6 meters long and a meter and a half wide that spun atop the mount, with a vertical shaft attached to a worm gear on the lower end and a handwheel on the top providing rotation.

A total of ten short-barrel and twenty-four long-barrel weapons were built, with production continuing, at very low levels, through the war at the Osaka Arsenal. These formed the armament of about half of the separate heavy artillery battalions of the Army's permanent force structure, stationed mainly in Manchuria, although one battalion was shipped to the Philippines in 1944, with what end in mind is unknown.

That seems to have satisfied the Army's requirements for super-heavy (28cm and higher) models, or at least the payoff was regarded as insufficient for the development efforts required, because no further weapons of that type were made it to full production. One more super-heavy was built, the 410mm experimental howitzer. The single example was probably built around 1940-41, and it was shipped to Manchuria for possible use against the Soviets. It stayed there throughout the war. Development of a follow-on Type 100 was started but never completed.

Instead, development concentrated on two slightly more mobile weapons, a 15cm gun and a 24cm howitzer.



410mm Type 100 experimental howitzer.

**Production of Heavy Artillery**

| | FY31 | FY32 | FY33 | FY34 | FY35 | FY36 | FY37 | FY38 | FY39 | FY40 |
|---|---|---|---|---|---|---|---|---|---|---|
| 150mm Type 45 gun | 2 | – | – | – | 4 | 7 | 15 | – | – | 4 |
| 150mm Type 89 Gun | 1 | 3 | – | 6 | 4 | 9 | 5 | – | 8 | 19 |
| 240mm Type 45 Howitzer | 2 | 2 | – | 1 | – | 1 | – | – | – | – |
| 300mm Type 7 (long) howitzer | – | – | – | – | – | 1 | 1 | – | – | 3 |
| 300mm Type 7 (short) howitzer | 1 | – | – | – | – | – | – | – | – | 1 |
| | 1941 | | 1942 | | 1943 | | 1944 | | 1945 | |
| | Apr-Jun | Jul-Dec | Jan-Jun | Jul-Dec | Jan-Jun | Jul-Dec | Jan-Jun | Jul-Dec | Jan-Jun | Jul-Sep |
| 150mm Type 89 Gun | 3 | 6 | 5 | 6 | 5 | 3 | – | – | – | – |
| 150mm Type 96 Gun | 3 | 6 | 2 | 7 | 5 | 5 | – | – | – | – |
| 240mm Type 45 Howitzer | 3 | 12 | 6 | 12 | 7 | 3 | 2 | – | – | – |
| 240mm Type 96 Howitzer | – | 1 | 3 | 1 | 1 | 2 | – | – | – | – |
| 300mm Type 7 (long) Howitzer | – | 1 | – | 1 | 1 | 1 | 1 | – | – | – |
| 305mm SP Mortar | – | – | – | – | – | – | – | 2 | 1 | – |

The initial result of the gun project was the 15cm Type 89, adopted in 1929. It was apparently spurred by the success of the French 155mm GPF in creating a mobile 6-inch category gun. It was significantly lighter and easier to move and set up than the earlier static 15cm Type (Taisho) 45 gun, but only at the cost of range and firepower. It was drawn by a pair of 8-ton Type 92 tractors, one for the carriage and the other for the barrel on a special wagon. The range was modest, and varied from 13,589 meters for the basic Type (Taisho) 13 HE round to 14,700 meters for the APHE projectile, and up to 18,700 for the Type

(Taisho) 13 long pointed HE shell.

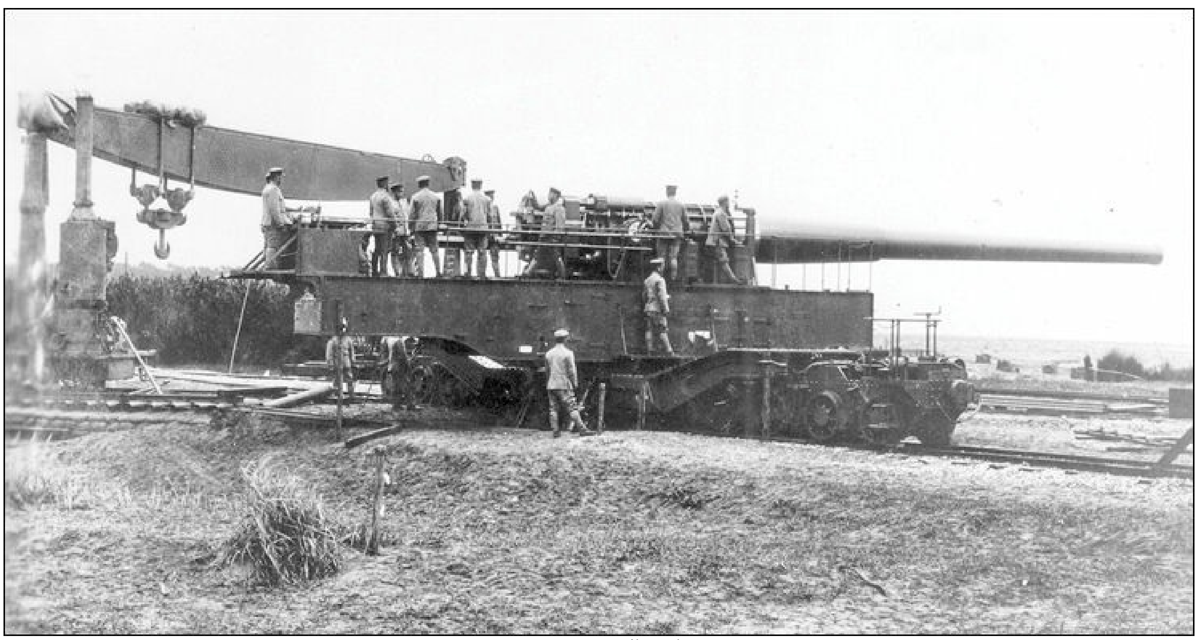
Limitations notwithstanding, it was economical to make and much easier to move than the heavier guns and remained in production into 1943.

Work continued on the 15cm caliber in an attempt to remedy the shortcomings of the Type 89, and this resulted in the 15cm Type 96 gun, adopted in 1936. Here, they went to the other extreme. The result was a weapon that threw a powerful projectile to an exceptional range, but was a massive device that required a lot of time and effort to set up. As a result, the Type 89 and Type 96 were kept in production simultaneously both in small numbers.

The largest modern piece to placed in production by the IJA was the 24cm Type 96 howitzer. It was adopted at the same time as the 15cm Type 96 gun, and shared many of the same basic concepts. It threw a massive shell but to an indifferent range. It did not enter service until early 1942, and was built only in insignificant numbers.

**Heavy Artillery Data**

| | Guns | | | Howitzers | | | | |
|---|---|---|---|---|---|---|---|---|
| | 150mm | 150mm | 240mm | 240mm | 240mm | 305mm | 305mm | 410mm |
| | Type 89 | Type 96 | Rail | Type 45 | Type 96 | Type 7 short | Type 7 long | Type 100 |
| Barrel length (cal) | 40 | 53 | 53 | 16 | 24 | 16 | 24 | 33 |
| Muzzle Vel (m/s) | 735 | 860 | 1050 | 387 | 500 | 402 | 500 | 580 |
| Pressure (MPa) | 245 | 265 | 354 | 255 | 231 | 205 | 223 | 245 |
| Proj Wt (kg) | 40 | 46 | 166 | 200 | 199 | 399 | 399 | 1,270 |
| Piston Rod Pull (kg) | 43,045 | 36,290 | 110,220 | 63,050 | 101,150 | 122,015 | 166,470 | 334,750 |
| Max elevation | 43° | 45° | 50° | 62° | 65° | 73° | 73° | 73° |
| Traverse | 40° | 360° | 0° | 360° | 360° | 360° | 360° | 360° |
| Wt in Firing Posn (kg) | 10,430 | 24,990 | 136,080 | 33,110 | 37,650 | 76,880 | 122,920 | 319,780 |
| Max range (m) | 18,010 | 26,060 | 49,925 | 10,515 | 13,625 | 12,620 | 15,180 | 20,025 |

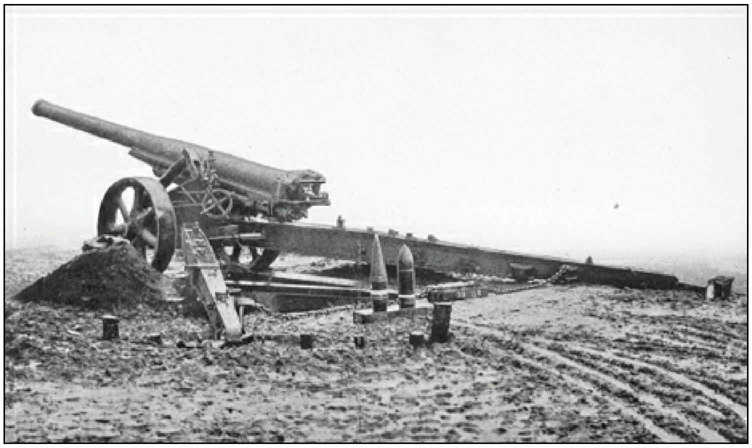


24cm Type 90 railroad gun.

The Japanese were not believers in railroad artillery and only purchased and fielded a single weapon. A single 240mm railroad gun was delivered from France by Schneider in 1928 and subjected to trials in November. The results were satisfactory, demonstrating exceptional range, and the gun paid for and retained as the Type 90. The gun was pointed by moving it along curved track, using two electric motors on the carriage. It was shipped to Manchuria for possible use there, but no further weapons were ordered.

### 15cm Type 89 Gun

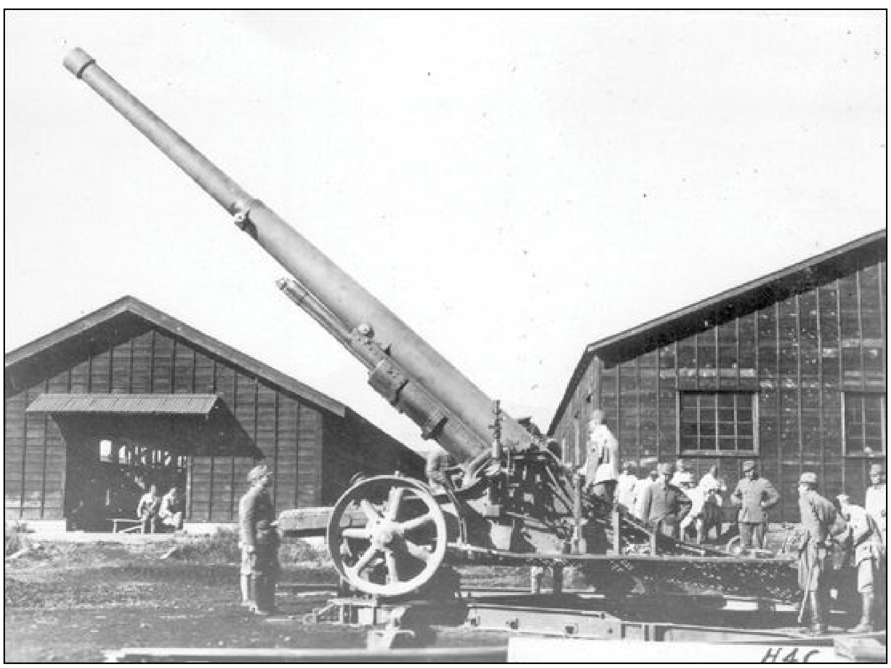
This was a conventional design utilizing a split trail and a single-axle carriage. It was transported in two pieces, the barrel being removed for transit. It utilized an interrupted-screw type breech, Puteaux-type hydro-pneumatic recoil control and compressed air recuperator. For travel the barrel retracted onto a separate 4-wheel carriage. The main round of ammunition was the Type 93 HE projectile with 4.8 kg of explosive and fitted with the Type 90 PD/delay fuze, although the older Type (Taisho) 13 HE rounds were also commonly used.



15cm Type 89 Gun.

**15cm Type 96 Gun**

This was a heavy, high-performance weapon that fired from a complex steel base. The use of the base yielded 360° traverse and gave stability even against heavy recoil, but added considerably to the time needed to bring the weapon into action and made the weapon overall heavy and difficult to transport, requiring 28-ton tractors and many trucks. The heaviest load in transport was 13,300 kg. Since it pivoted on the base it required only a single trail. It utilized a Schneider-type hydropneumatic recoil system and a compressed air recuperator. Indicative of the power of this weapon, it used more than twice as much propellant (21 kg vs 9.7 kg) as the older Type 89 gun, plus fired a heavier (Type 96) HE projectile.



15cm Type 96 Gun.

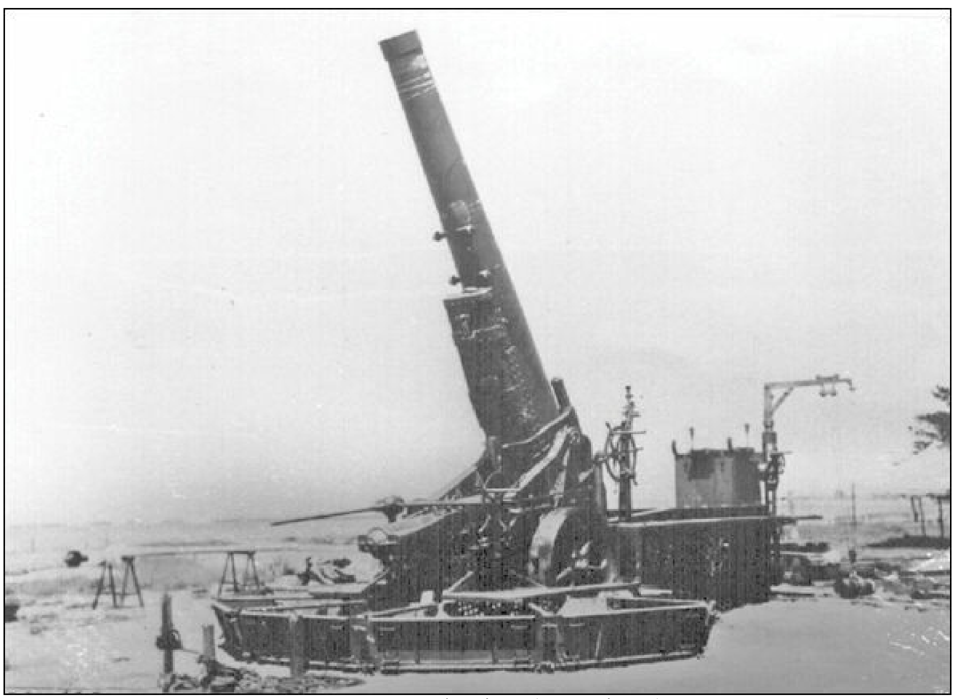
**24cm Type (Meiji) 45 Howitzer**

This elderly siege weapon broke down into four large tractor-drawn loads (the heaviest 6 tonnes) and about a dozen truck loads for transport. It used a hydro-pneumatic tapered-groove recoil system and a compressed air recuperator. It was balanced such that it did not need an equilibrator. Although obsolete, with short range and time-consuming set-up, these weapons remained in service to the end of the war in Marchuria.

24cm Type (Meiji) 45 Howitzer.

**24cm Type 96 Howitzer**

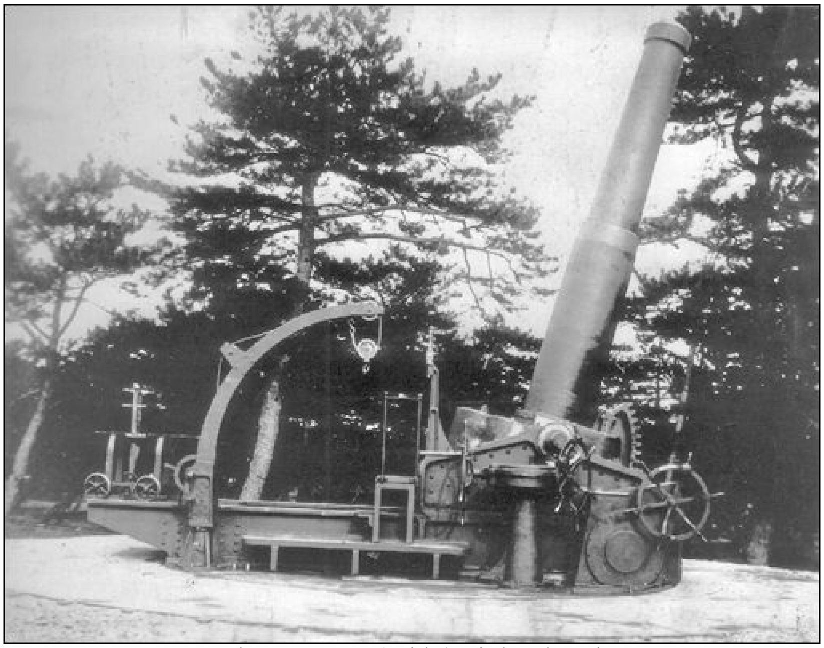
This shared the same concept as the Type 96 gun, being tractor-drawn in four main pieces, one a circular plate that was heavily staked into the ground for firing. It had a single massive trail that permitted it to be rotated (although not easily) around a pivot in the center of the plate. It had dual separate Schneider-type tapered-groove hydropneumatic recoil systems and a gun-charged compressed air recuperator. It used an interrupted-screw breech and separately-loaded ammunition.

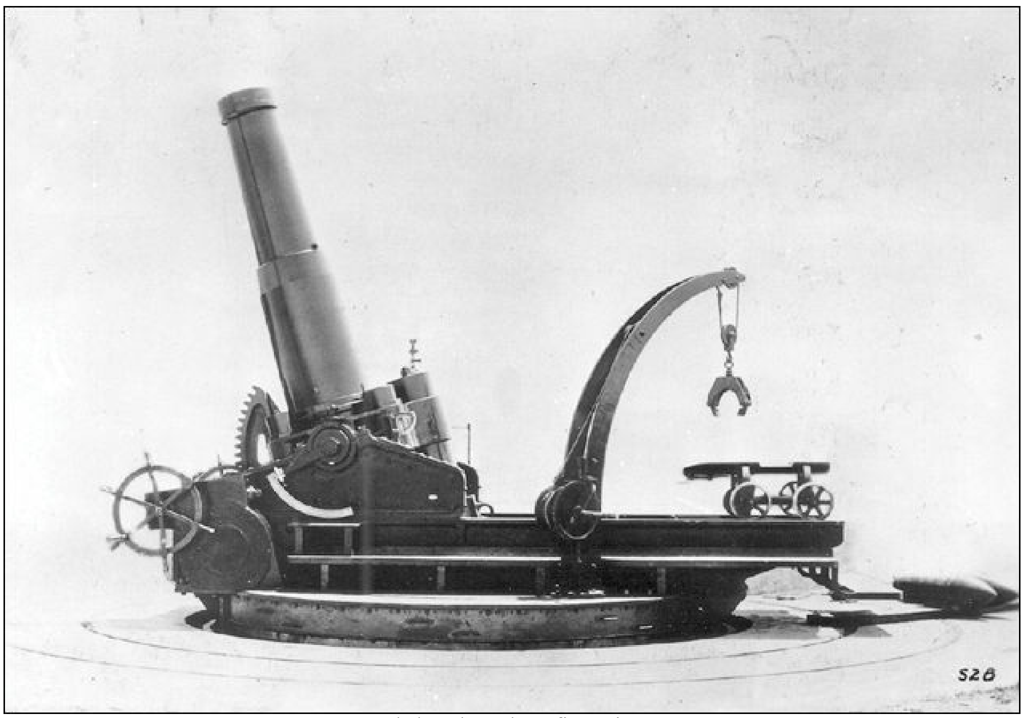


A 24cm Type 96 howitzer (Y. Kunimoto).

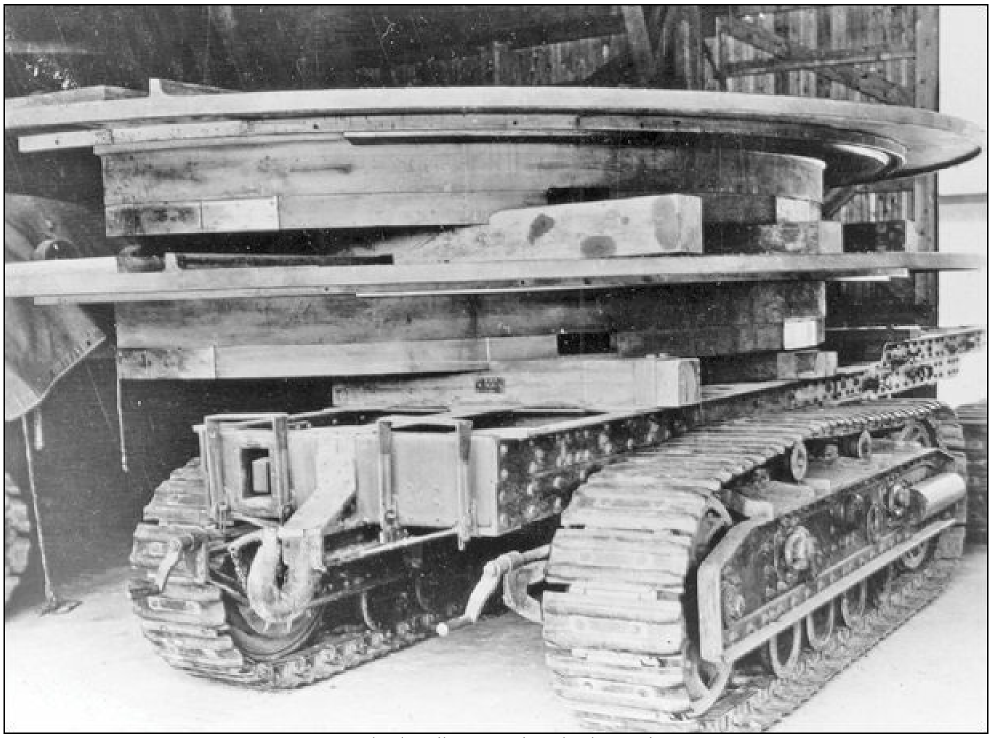
**30.5cm Type (Taisho) 7 Howitzer**

This was the standard heavy siege weapon of the IJA and came in two varieties: a short barrel (L/16.4) and a long barrel (L/23.7) model, with the latter more common. A circular rail rested on a truncated steel cone that was embedded in the ground, sometimes in concrete. The carriage base rested on, and rotated by manual gears around, the rail. The hydropneumatic recoil and compressed air recuperator cylinders were above the barrel and the equilibrator tubes below it. It utilized an interrupted-screw breech system with a percussion hammer firing device and utilized a short cartridge case for obturation. Two air flasks on the carriage were used to blow out the tube after firing.


The 30cm Type (Taisho) 7 in long barrel



and short barrel configurations.


A tracked trailer carrying the base ring.

# 13

# Artillery Rockets

## Army Rockets

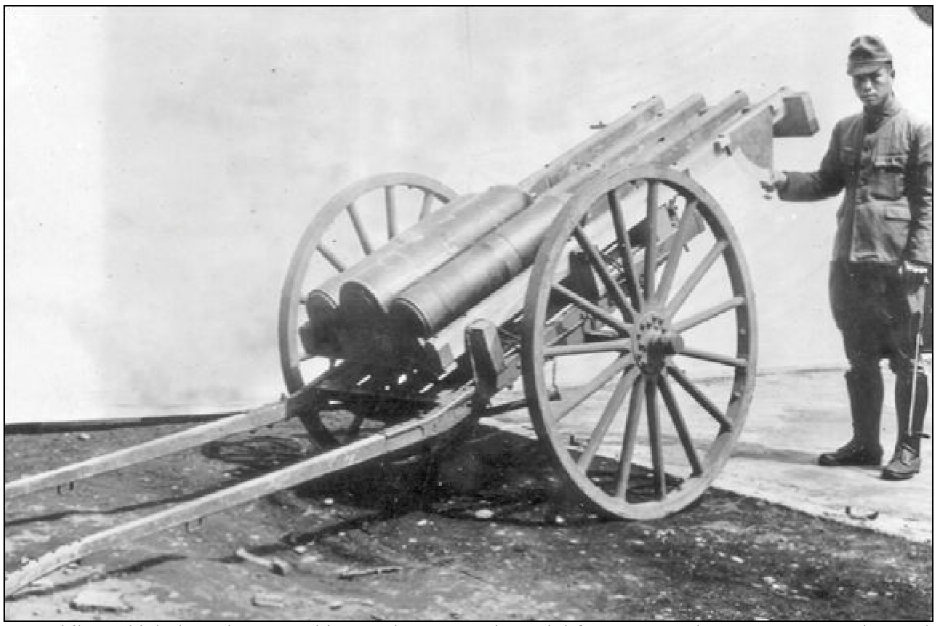
There had been no study of rocket motors in Japan prior to 1930, when investigations began by the 1st Army Laboratory, with the first experiments a year later. Efforts continued at a leisurely pace but by 1941 the 7th Army Laboratory had developed three prototype fin-stabilized rockets using single-grain motors, known as the 7cm, 10cm and 13cm rockets (their actual rocket motor diameters were 8.6cm, 11.8cm and 15cm, respectively). The two smaller models had a range of 1 km and the largest 3 km. In spite of the short ranges, dispersion was great, which was blamed on the large fins that made them susceptible to cross-winds. In early 1942 work on fin-stablized rockets was discontinued.

Attention then turned to spin-stabilized rockets. The first was an 81mm model with a range of 1,600 meters. Accuracy was much improved over the fin-stabilized rockets, but it was rejected for production by the Ordnance Bureau as providing no advantages over the 81mm infantry mortar. The second effort was an enlarged version of 20cm with a 7-grain propellant charge and six 15mm nozzles angled at 25° to provide spin.

20cm Type 4 launchers lined up after the surrender on Saishu Island.

At this point the Ordnance Bureau restructured the rocket program, transferring most development back to the 1st Army Laboratory, leaving the 7th Army Laboratory to undertake basic research efforts. The 1st Army Lab responded by modifying the 20cm rocket, mainly by replacing the electric squib igniter with a friction igniter, which eliminated the need for batteries in the field. The modified 20cm rocket and a similar 24cm rocket were submitted for trials at the Field Artillery School in 1943, and the 20cm was accepted for service late that year and placed in production at the Osaka Arsenal. The launcher for this rocket resembled a mortar, with traverse and elevation gears, rather than the multiple launchers developed by the Soviets and Germans for saturation fire, which would seem to have negated much of their potential value. In fact, the Type 4 appears to have been regarded simply as an eight-inch mortar. Deliveries of the rockets began in August 1944, with 2,900 delivered by the end of the year and another 6,900 in 1945. Production of launchers is unknown, but probably totaled somewhat less than 1,800. They were the only model of Army rocket used in combat, being deployed to Luzon with the 3rd Rocket Artillery Battalion. Large numbers were deployed for the defense of the homeland.

A 20cm rocket being fired in Japan in 1945.

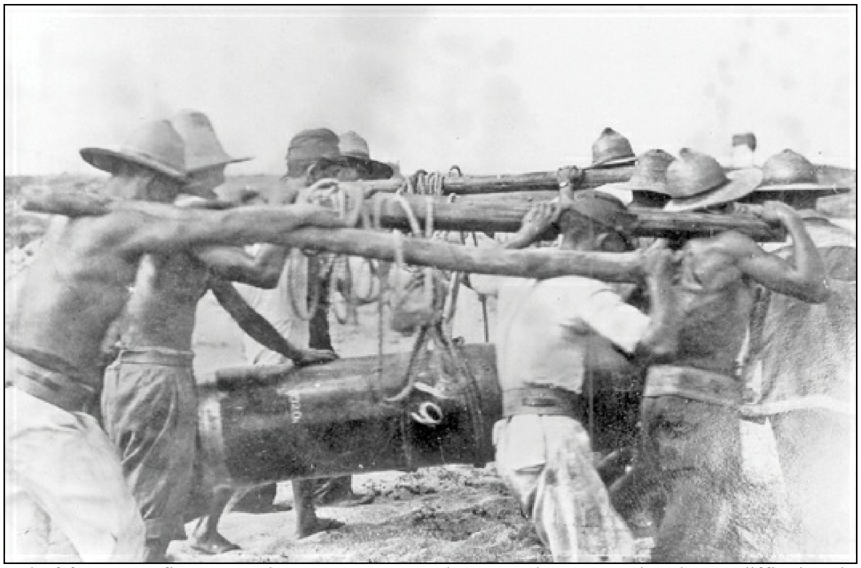


The only IJA attempt at a mobile multiple launcher was this wooden 3-trough model for 20cm rockets. It never got beyond the experimental stage.

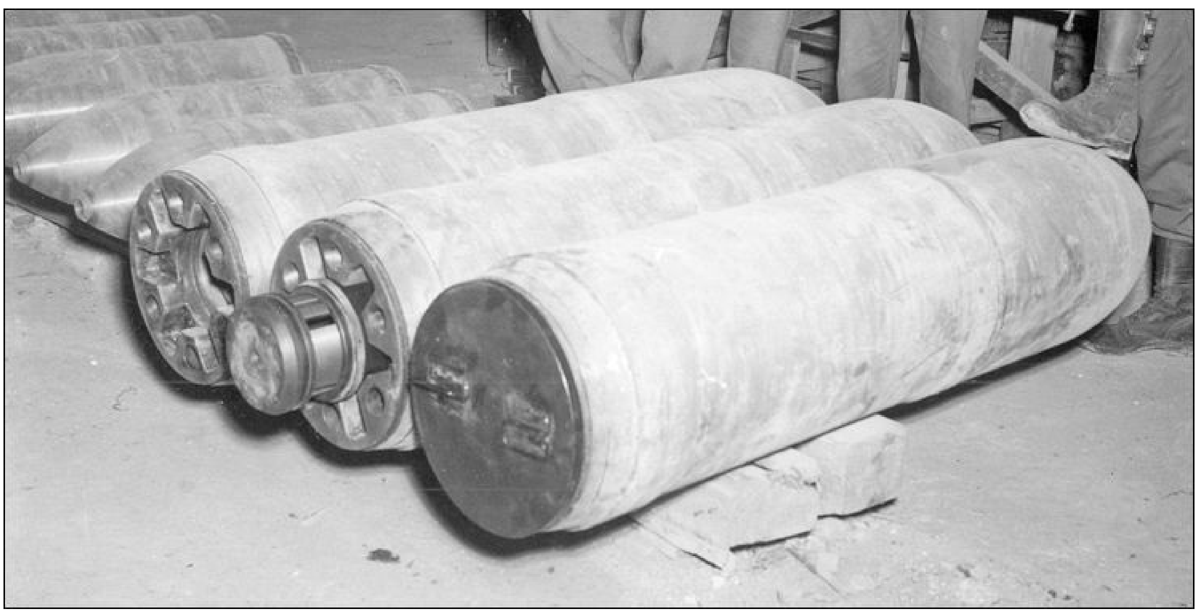
The 20cm Type 4 rocket and its launcher were well-regarded by the US Army. The technical intelligence assessment was that the launcher was a “simple, sturdy, mobile device, capable of fine adjustment for accurate fire” and that the rockets were “quite accurate, probably having less dispersion than most types of mortars”. Indeed, US Army units used captured launchers and rockets themselves.[1] On ignition the rocket gave off a blast of flame 6-9 meters long, which it maintained for about 100 meters of travel. There was no smoke, but a lot of dust was kicked up. The rocket was audible in flight to personnel on the receiving end.

Following the success of the 20cm the 7th Laboratory began work on a much heavier weapon, the 40cm variable-range rocket. It differed significantly from the earlier model in several respects. First, it used wooden troughs for firing rather than steel tubes. This was done to save scarce raw materials and production facilities, and apparently in the belief that the inherent accuracy of this rocket was not sufficiently great that this would make much difference. In fact, many of the launchers were not even manufactured by the arsenals, but instead plans for making the wooden structures were sent out to the troops along with rockets, with directions to make their own launchers.

The second difference was that these launchers were fixed in elevation, meaning some other method had to be found to vary the range. This was accomplished by a variable bleeding of propellant gasses to the side.


Although possessed of fearsome firepower, the Army 40cm rocket was short-ranged and very difficult to load, as seen here.

Given the simplicity of the wooden launchers it is not surprising that the arsenals were able to build about 1,700 wooden launchers for the 40cm rocket, all in 1945. An unknown number were presumably also built by local units. A steel tube launcher was designed for the 40cm and designated the Type 4, but never placed in series production. Production of the rockets was more complex and never exceeded 50 per month, starting in May 1945, so there were actually considerably more launchers built than rockets. All the rockets and launchers were deployed for the defense of Japan proper.



Massive 40cm rockets being examined after the war in Kyoto.

To increase the short range of the artillery rocket force the 7th Laboratory designed a 9cm gliding rocket with wings to reach 10,000 meters. Trials in 1944 were a failure due to instability and the project was started again as a 25cm rocket with a gyrostabilizer. This proved little better and it was also dropped. A number of other projects were underway at war's end at the 7th Laboratory, including a 60cm variable-range rocket capable of reaching 9,000 meters, but none reached even the prototype stage.

### Navy Rockets

The Navy trailed the Army in the development of rockets as weapons and it was not until about the end of 1943 that a naval delegation witnessed the test firing of an Army 20cm rocket and launched an immediate crash program to develop a similar weapon for their own land forces. The solid propellant for the rocket motors was developed and manufactured at the 2nd Naval Powder Factory at Hiratsuka, while the design and manufacture of metal parts and launchers was carried out at the Kure

Navy Yard. Three experimental 20cm rockets were fabricated, with weights ranging from 83.3 to 93.5 kg and ranges from 2,100 to 2,300 meters. Eventually the "Type C" was chosen, which was both the lightest and the shortest-ranged. This entered production in March of 1944.

The 20cm was followed shortly by the 45cm Heavy Rocket in April. An initial hasty production batch of the latter were rushed to Luzon on the battleship Ise, along with Commander Hanamizu, in charge of rocket development at the Kure Navy Yard, who was to instruct the sailors in their use.

**Artillery Rocket Data**

| Type | Diameter | Length | Weight (kg) | Range (m) | Explosive charge (kg) |
|---|---|---|---|---|---|
| Army 20cm Type 4 | 202mm | 980mm | 92 | 2,500 | 16.5 |
| Navy 20cm | 210mm | 1,020mm | 90 | 1,800 | 17.5 |
| Navy 20cm Mod 1 | 210mm | 1,020mm | 85 | 4,500 | 11.7 |
| Army 40cm | 400mm | | 510 | 3,800 | 98.3 |
| Navy 45cm | 450mm | 1,715mm | 660 | 1,600 | 181.9 |

In terms of field use the 20cm was a more practical weapon and these were shipped out to the Pacific in mid-1944. While the rockets were standard items, the launchers were not, and indeed most appear to have been locally-made. Launchers captured on Leyte were based on a steel trough two meters long with two sets of bipods made of 25mm pipe, which could be adjusted to vary the elevation, but not azimuth. On Luzon the launchers were simple wooden rail, sometimes single units, other times joined together to form triple launchers. The front bipods were adjustable in height to vary elevation. A plumb bob and arc scale were provided below the front of the trough/rails to show elevation.

A conventional rocket launcher with a 2-meter long launch tube was developed and manufactured, in two configurations. One used a simple bipod in the front and was suitable for pack transport, and the other had a pair of wheels for draft transport. In the pack mode one horse carried the bipod and baseplate (95 kg), one carried the rear end of the tube (98 kg), and one carried the front end of the tube (51 kg) and accessories (56 kg). In addition, an ammunition horse was required for each rocket. The bipod version had elevation ranges of 18° to 65°, accomplished by moving the legs to the front and back. In trials it used the same panoramic sight as the Type 96 medium mortar, but it is unclear if these were actually provided to field units. The wheeled version, weighing 236 kg, could be towed and was accompanied by a wheeled cart that carried two rockets, and was deployed to Saipan. It had an elevation arc and wingnut on the left side that went up to 75°, but was fixed in azimuth. It could be disassembled for portage if needed.


A US technician reassembles the propellant sticks in an Army 20cm rocket.

In either case the tube had to be raised to nearly level to load, at which point two men would use a pair of large lifting tongs to move the rocket to the barrel and push it forward until it was fully in. They would then take a position about 5 meters to the side of the gun and fire it by pulling a lanyard. A limitation of the weapon was that the barrel became extremely hot after two or three rounds had fired, necessitating a pause of almost an hour before it was safe to load a rocket again. Maximum range of 1,778 meters was accomplished at 49° elevation.

As with all of the spin-stabilized rockets there was a pronounced drift when fired, with the drift increasing as the "flip" at the apogee became more pronounced. As a result a median value for all ranges was chosen as compensation built into the nominal firing direction. When pointed thus at 30° firing elevation a range of 1,450 meters was achieved, but with a drift to the left of 36 mils; while at 50° a range of 1,790 meters resulted with a drift to the right of 34 mils, and at 60° the range was 1,600 meters and the drift had increased to 88 mils (= 140 meters) to the right. Since these values were known they could be compensated for, but it is not clear if this was actually done given the primitive sighting equipment used.

The rocket had a length of 588mm, a diameter of 210mm and a weight of 49.9 kg, of which 17.5 kg was the trinitroanisol explosive fill that had been cast directly into the lacquered interior. The high loading was made possible by the fact that the walls could be made only 12mm thick due to the low acceleration forces experienced compared to gun projectiles. The rocket motor was a straight cylinder accommodating a central stick and six identical sticks arranged around the outside. The rear plate had six nozzles offset at 25° to induce spin. The warhead was initiated by a nose-mounted centrifugally armed point detonating fuze.

A major drawback of the Navy 20cm rocket was its rather short range and by early 1945 a way had been found to supplement the original seven sticks of Nitroglycerine 30%, Nitrocellulose 65% propellant (each 292mm long and 57mm in diameter) by squeezing in an additional ten sticks 12mm in diameter. This had a dramatic effect on range and the improved "Mod 1" was placed in production in January 1945 and used in action on Luzon.

It is unclear how many 20cm rocket launchers were built by the Navy in all, but 226 were in Japan at the surrender, the bulk of the at Kure and Sasebo.

The 45cm was the Navy's analog to the Army 40cm, but sacrificed range for a much larger explosive payload. Production does not appear to have been large.

The massive 45cm rocket were deployed to Luzon, but do not appear to have been used in significant numbers, many being captured by US forces outside Manila. The rockets were crudely made and large-scale production does not appear to have been achieved.

The Navy also used 12cm rockets for anti-aircraft defense utilizing multiple launch mounts, but only in small numbers. A ground artillery version of the 12cm rocket with an HE warhead and a range of 4,750 meters had also been developed, but appears to have been produced only in trials quantities.

A more primitive series of devices was concocted to take advantage of the large number of aerial bombs in storage at airfields that no longer had operational aircraft. The thought was to use a simple metal trough 6 meters long with a pair of legs at one end to provide elevation, and launch a bomb downrange with a rocket motor. The initial, and most widely distributed, device was the Model 10 Rocket. This was a simple rocket motor with a wooden boss in front with grooves to match the pattern of the tail fins of a bomb. Launchers were fabricated, these consisting of a long lower trough, a short cover for the rear of the trough, and a simple bipod at the front, although local improvisations were also common. The rocket motor weighed about 18 kg, of which 5.7 kg was propellant, and had a single venturi and fins. The bombs were the Navy 60 kg Type 97 bombs or 63 kg GP bombs with A3 nose impact fuzes. The two units, rocket motor and bomb, were not connected, instead the motor was just placed behind the bomb in the trough and ignited. It thereupon pushed the bomb up the trough before falling away, leaving the bomb to travel about 1,200 meters before impacting the ground. As can be imagined, accuracy was poor.

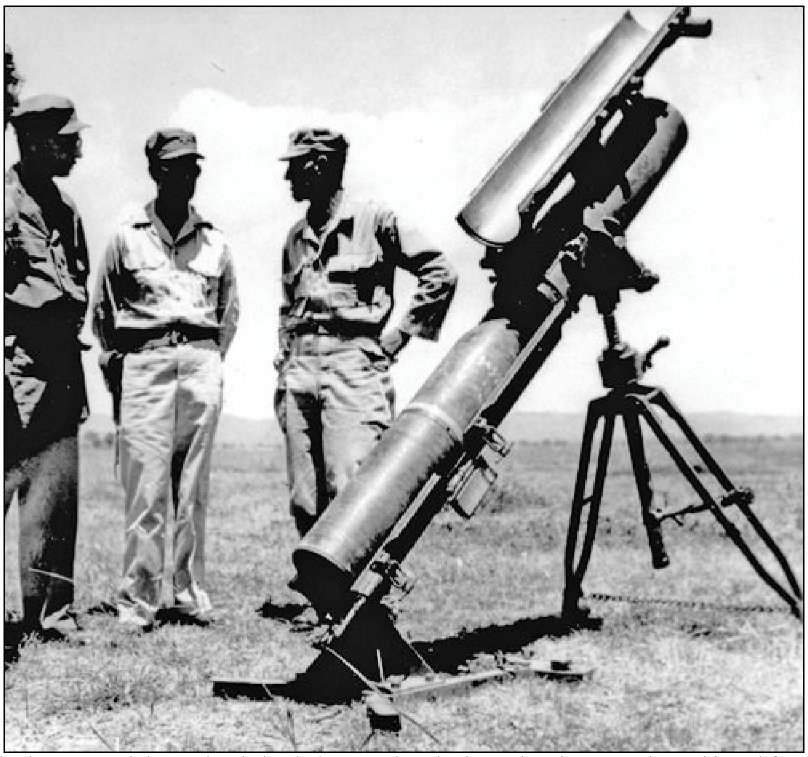
A captured improved first-generation bomb thrower. Above, the launcher with rocket motor and bomb. On the right, a disassembled rocket motor with 60 kg bomb behind it.

Later versions used shorter launchers, with rails of hardwood rather than metal and a monopod, and a longer, more powerful rocket motor. This presumably increased the range, probably by around 50%, but not the accuracy.

A second generation of bomb thrower integrated the rocket motor and bomb into a single unit. This was accomplished by providing a sleeve that replaced the fin assembly on the bomb and to which was attached the rocket motor, creating a single long unit. The scale here was much larger than the earlier versions, with a 190-kg rocket motor attached to a 250-kg bomb, with the latter carrying 99 kg of explosive. The assembled unit was loaded into and fired from a metal trough, supported at its front end by a pair of tubular legs. A Japanese manual gave this combination a range of 10,000 meters, but US intelligence gave the “maximum recorded range” as 6,750 meters, at which range accuracy was “very poor”, and post-war questioning of Japanese engineers gave a figure of only 5,000 meters. In any event, only 71 bomb rocket launchers were in the homeland at the end of the war, most of them at Sasebo.

### 20cm Army Type 4 Rocket and Launcher

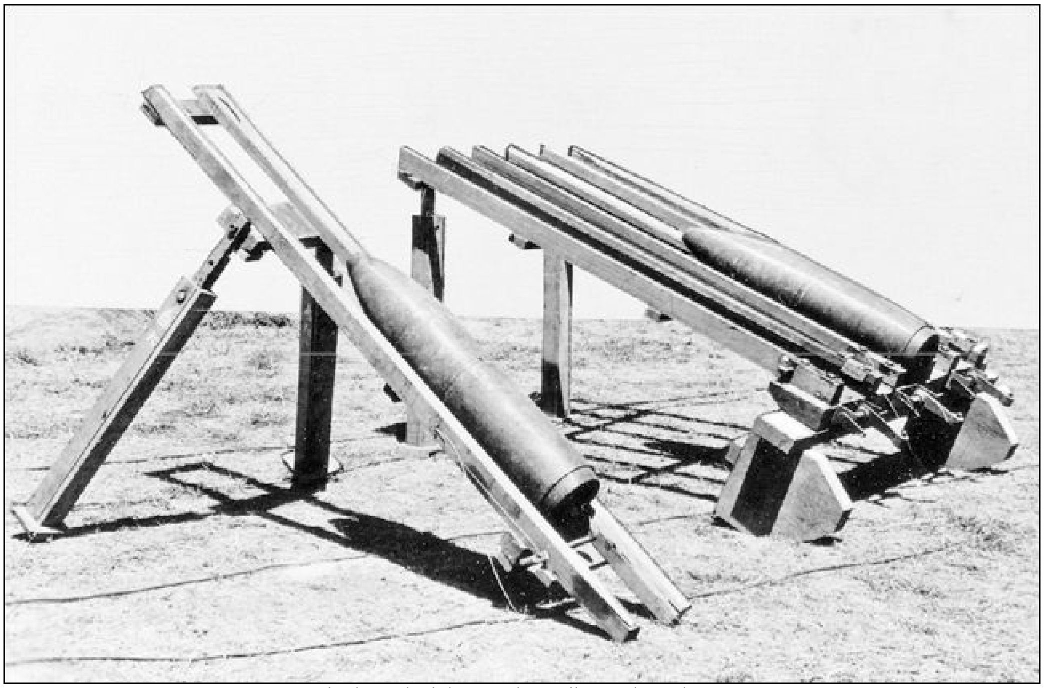
The launcher closely resembled a conventional mortar, with a baseplate, barrel and bipod with elevation and traverse mechanisms. The main difference were that the rear half of the barrel was longitudinally split, with a hinge at the front to enable the upper half of the rear to swing upwards for loading and, of course, the open back of the tube. Once the rocket was in place the upper half was pulled down and secured in place by two quick-release latches on each side. The baseplate incorporated driven spades at its front and this kept the launcher steady during firing, deviations of only about 1 mil being noticed in azimuth after firing. Aiming was by standard mortar sight. The rocket was in two parts, the forward warhead and the rear rocket motor, that screwed together. The propellant was formed into seven sticks, one in the center and six arranged in a circle outside of it. The rear plate had six venturis angled to spin the rocket in flight. When US technical intelligence fired a weapon captured on Luzon they found it "surprisingly accurate", noting that six rounds, fired at a range of 2,700 meters, landed within an area 91 m long by 82 m wide, following a flight of 25 seconds. The rockets were fitted with Type 100 mortar fuzes that could be set for either instantaneous or delay action.



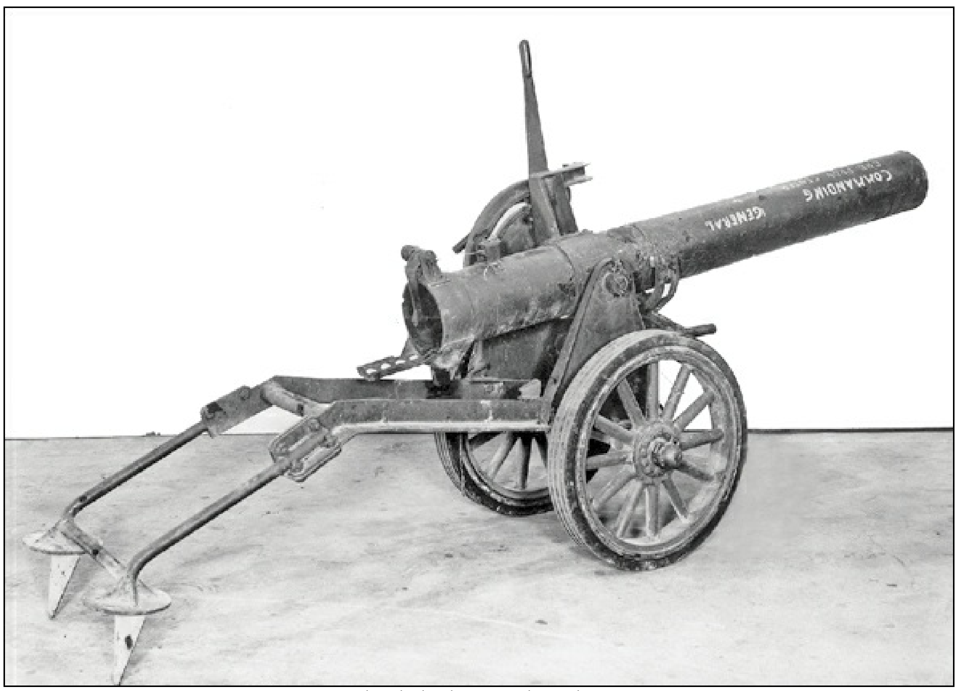
A captured 20cm Type 4 launcher. The tube is open and the rocket is loaded. Note that the baseplate is correctly positioned for firing, extending forward; it is often placed backwards in technical illustrations.

### 20cm Navy Rocket and Launcher

A variety of launchers were used with the standard Navy 20cm (actually 210.5mm) rocket, the most common by far being a pair of wooden rails set on an adjustable wooden bipod. The original version had seven sticks of propellant weighing a total of 8.3 kg. An improved version, the Mod 1, reduced the bursting charge from 16.7 kg to 11.7 kg, and added propellant to increase the range substantially, from 1,800 meters to 3,000 meters. In both dispersion in both planes was about 10% of range. As with all other Japanese unitary artillery rockets, the munition was spin-stabilized, rotating at 3,600 rpm from the six nozzles angled at 25°.



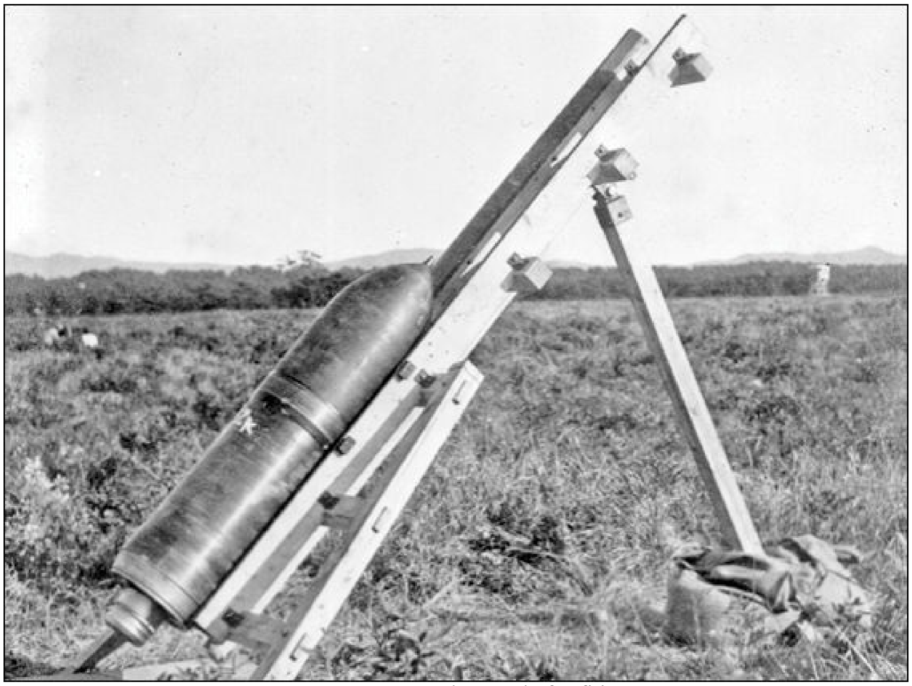
single and triple wooden rail-type launchers,

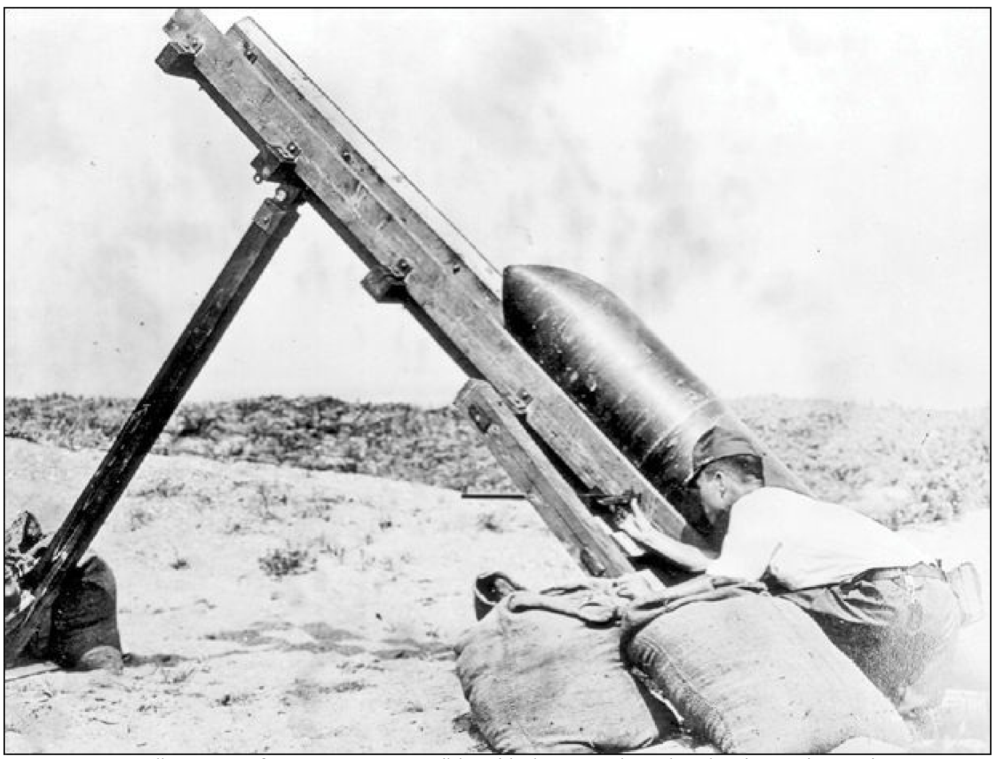



wheeled tube-type launcher.

**Army 40cm Variable-Range Rocket**

This unique design was fired from a crude wooden trough launcher fixed in elevation (at angles between 45° and 60°). Range was varied by bleeding off a portion of the propellant gasses. This was done by placing an array of anular holes around the rear of the rocket to vent out gasses perpendicular to the direction of flight. A rotating ring controlled the size of the openings. This permitted the range (at 45° elevation) to be varied from 2,000 meters to 4,000 meters.


A 40cm Army rocket ready for firing.


A small amount of traverse was possible with the 40cm launcher, but it was imprecise.

**Navy 45cm Rocket**

This massive rocket consisted of a short ogive at the nose and two sheet metal cylinders, the forward containing the HE warhead and the latter the 37 sticks of rocket propellant each 58mm in diameter with a 10mm central core hole. It was spin stabilized in flight, rotating at about 3,000 rpm. The warhead and ogive weighed 424 kg, of which 168 kg was the HE charge. It could use either the Navy fuze found with their 20cm rocket or, with an adapter, the Army Type 100 PD/delay fuze. Accuracy in both azimuth and range was said to be 10% of range, but no tests were conducted to verify this. The launcher was a simple wooden trough on two solid wood wheels, resembling an oxcart, and it was a one-time device, being destroyed by the firing. US tests yielded craters 2.5 meters deep and 6 meters in diameter, with fires being started 100 meters from the impact by hot metal fragments. The fragments varied in weight from a few grams to over 4 kg.


A naval 45cm rocket on an extemporized launcher built by US forces for trials.

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1 In April 1945 the US Technical Intelligence Company in the theater reported that they had trained a rocket platoon on Luzon made up of personnel from the AT company of an infantry regiment and that the platoon had fired 100 rounds of Japanese 20cm Type 4 rockets on the former owners with impressive accuracy. Other platoons appear to have been formed without formal training. Presumably, shortages of ammunition would have limited their usefulness and longevity.

# 14

# Light Anti-Aircraft Weapons

Japanese low-level air defense efforts proved insufficient for their tasks throughout the war. Postwar Japanese anti-aircraft specialists claimed that this was due to a mistaken belief that the main threat would come from high-flying bombers, although the state of Japanese heavy anti-aircraft equipment (which was just as bad) calls this into question.

The problems stemmed primarily from the fact that Japan came late to the recognition that the 20-25mm caliber simply did not possess the lethality or range needed. While other nations developed new standard weapons in the 37-40mm caliber the Army and Navy both hesitated. The capture of Bofors 40mm guns in Singapore finally sounded the wake-up call, but by then it was too late.

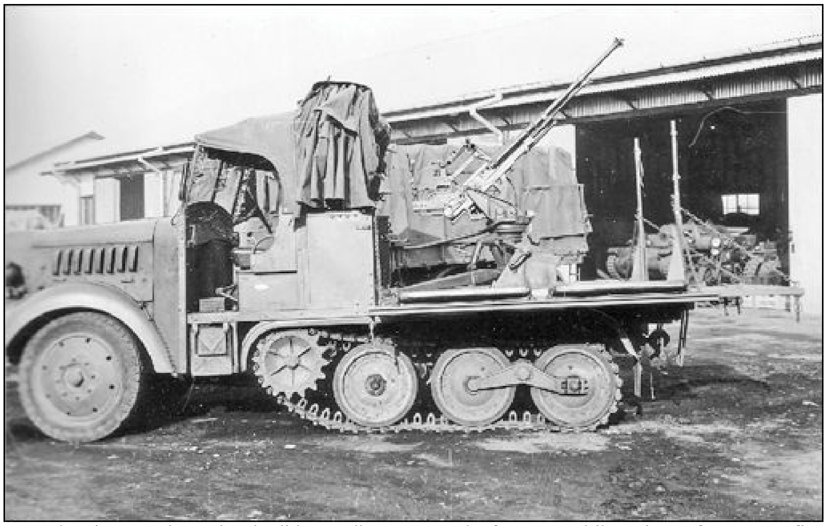
### Army Weapons

Through most of the 1930s the IJA relied on high-angle tripod mounts for the Type 92 medium machine gun for low-level air defense. In 1932 Oerlikon delivered four JLaS 20mm weapons and offered to sell license production rights, but this went nowhere, although the IJN did buy the rights to the Oerlikon F aircraft gun. Early efforts to develop a 20mm weapon yielded the Type 94 20mm AA gun, which did not enter series production and work continued, primarily directed towards improving the mount. The result was the Type 98, which was accepted for service in 1938 and entered production in 1939. The initial production rate was low, with only 37 being built that first year and 142 in fiscal year 1940. Most production was carried out by the Kokura Army Arsenal, supplemented beginning in 1942 by Hitachi Seisakusho.

A unit training on the 20mm Type 98 Gun. Note the 1-m rangefinder in the background.

The Type 98 was powerful for its caliber and light and easily portable. The trade-off for the light weight was that stability, and hence accuracy, suffered somewhat, but initially this was not considered a great problem. The Type 98 was the only light AA weapon in widespread use by the IJA and was encountered by the Allies almost everywhere they met the Army.

The gunner sat on the left side and traversed the piece by “walking” it around with his feet and elevated it via a handwheel on his left. The trigger was at his right hand. Loaders kept the gun fed with magazines, replaced as needed. At Palembang the Type 98s opened fire at 1,500 meters range and fired in six-round bursts. In other areas fire discipline may not have been as good.



One problem with the 20mm Type 98 was that its wooden wheels did not allow motor draft. For mobile units, a few were fitted on the beds of trucks or halftracks.

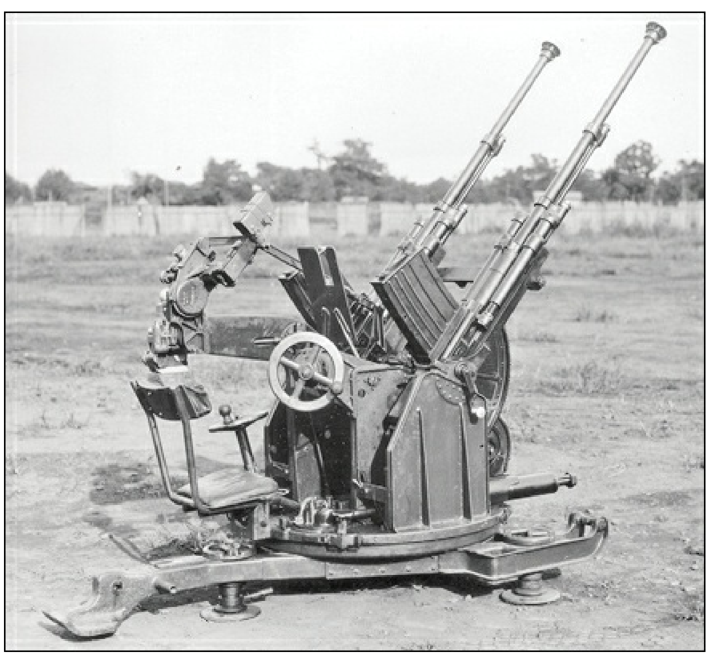
The limitations of the tall, free-pivoting Type 98 with its relatively slow hand-cranked elevation rate in countering fast-moving targets was apparent even before the Pacific War began. The solution adopted was a fully remotely-controlled mount on which to mount the existing ordnance of the Type 98. In the resultant Type 2 AA gun a single director would control all six guns of a battery, aiming and firing them. The guns fired in parallel axes as there was no correction for parallax. Unfortunately, the system, in particular the Type 2 director, was far more complex than industry could mass produce and just barely enough guns for two batteries were completed, with one battery being deployed to defend the Palembang refineries and the other battery remaining in the homeland.

British experts who examined the battery at Palembang concluded that:

> The guns and instruments are exceptionally well finished and beautifully machined. The whole unit is extremely mobile and easy to handle. It is estimated that the gun could be brought into action at gun control in under a minute; the operation to set up remote control would take longer due to the necessity of accurate siting, leveling and lining up. A company with this equipment would be ideal for operating with forward troops and constitute a formidable AA defense against low-level attacks.[1]

Nevertheless, it can still be questioned whether the investment in fire control equipment would be repaid by 20mm weapons, a caliber discarded as insufficiently powerful by most other nations.

Two efforts were launched to increase the firepower of the little 20mm by the simple expedient of switching to twin mounts. This resulted in two very different weapons, each designated the Type 4. The initial version used a mount similar to that of the Type 2, but without the provision for remote control and with two guns mounted side-by-side. The resultant weapon proved to be too heavy and cumbersome for the anticipated effectiveness, and it was canceled.



The twin-mount 20mm that never saw service.

The requirement for greater firepower remained, and a simpler solution was adopted. This was to mount two Type 98 cannon side-by-side on a simple pedestal. The resultant weapon was too heavy to swing around to engage and then aim against fast-moving aircraft, and but its primary role was actually to counter tanks and landing craft, although its usefulness against the former must be questioned. The revised project was begun in November 1943 and the first trial model, known as the So-Ki IV was delivered by the Kokura Arsenal in April 1944. It was regarded as successful and mass production began immediately. In fact, it never had to face Allied tanks or boats, but it did see action in its secondary role as an anti-aircraft weapon in the homeland.

| Wartime Army Production of Light AA Guns | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 1941 | | 1942 | | 1943 | | 1944 | | 1945 | |
| | Apr-Jun | Jul-Dec | Jan-Jun | Jul-Dec | Jan-Jun | Jul-Dec | Jan-Jun | Jul-Dec | Jan-Jun | Jul-Aug |
| 20mm Type 98 | 42 | 145 | 326 | 310 | 435 | 520 | 445 | 346 | – | – |
| 20mm Type 2 | – | – | – | – | – | – | 3 | 10 | 3 | – |
| 20mm Type 4 | – | – | – | – | – | – | – | 151 | 325 | 140 |

In all cases these weapons used the 20x142mm cartridge, which provided a hefty 56 g of propellant for a very respectable muzzle velocity. The main round was initially the Type 98 HE-T, and in common with similar 20mm rounds around the world the need to provide a fuze in the nose and a 2.2 g tracer element in the base left little room for the HE fill, in this case 4.2 g of RDX. This was replaced on the production line in 1941 by the Type 100 self-destroying HE-T round, in which a tiny charge of gun powder connected the tracer to the HE fill such that when the tracer burned to its front face it initiated the HE destroying the projectile in flight. There was also an HE-I round that combined 4.3 g of PETN with 8.8 g of incendiary mixture, this being made possible by the replacement of the Type 93 small PD fuze with a soft brass head, using the PETN for detonation on impact. An HE-I round was also produced that included the Type 93 small fuze, but at the expense of the explosive, which was reduced to near nothing. There was also an AP-T round made of solid hardened steel.

The need for a heavier weapon than the 20mm had not been completely overlooked, although efforts in that direction were accorded a low priority. The capture of a German 37mm Flak 18 in China provided a starting point and the 1st Section of the Army Technical Research Institute, together with the Kokura Arsenal, began work on a Japanese version. Two trial models were built and were subjected to testing in the summer of 1942 at Futsu. Results were disappointing, and the ejector, bolt cylinder and equilibrator springs were redesigned, with the new model being tested in December 1942. This proved satisfactory, and after the magazine design was changed to the box type and the springs changed yet again it was accepted for service as the 37mm Type 1 anti-aircraft gun. Two types of mounts were envisioned, the Saki I with manual controls and the Saki II with electrical controls, both with pneumatic tires for motor draft. By this time, however, the superiority of the Bofors design had become apparent and the 37mm Type 1 was not placed in series production.

The fall of Singapore netted 69 Bofors 40mm guns (not counting 7 that had to be scrapped due to damage) plus 51 spare barrels and 89,600 rounds of ammunition; while in Java a further 34 Bofors guns (mostly needing repair) were captured, plus some more on outlying islands. All the directors for them in Singapore had been destroyed, and only two were captured on Java. The bulk of the guns were issued to local anti-aircraft units where they were used with ring sights, but a few were sent back to Japan for study by both the Army and the Navy in mid-1942. At the end of the war there were still 40 Bofors guns in IJA service on Java, 28 on Sumatra, 15 in Burma, and probably about two dozen in Singapore.

A Type 94 one-meter rangefinder being demonstrated.

The Army attempted to reverse-engineer the Bofors, using the spare barrels captured in Singapore, and the first trials gun was tested in 1943. The test was a complete failure and the Army, in what must have been a humiliating effort, asked the Navy for its drawings and ordered the gun into production at the Kokura Arsenal. The only change they made was to retain the Bofors L60 barrel, where the Navy had adopted a longer one. To save scare raw materials, much of the carriage was to be made of wood. Production was begun in December 1944 and the first two guns were completed in July. They were given a quick test, which proved satisfactory, but by then the war was almost over. A total of only six guns were built, none of them seeing service.

The most common sight for Army light AA guns was a simple ring sight with 60-, 180-, and 300-mile per hour rings. A semi-computing sight with a telescopic optic was developed for the Type 98. It mounted on the left side of the gun and provided offset for deflection and elevation by amounts calculated by the sight based on manually input target speed, course angle and slant range. Ranges of up to 2,000 meters and speeds up to 486 m/hr could be set in. In operation, the gunner sighted the weapon through the telescope, traversing it by shoulder pressure and elevating it by means of the handwheel. The first assistant gunner set the course angle and target speed on the sight, while the second assistant gunner listened for the range as yelled out by the rangefinder operator, and set that into the sight. It proved difficult to use, and was generally discarded in the field in favor of a ring sight.

Range data was provided by a 1-meter base optical rangefinder assigned to each battery. An old Type Taisho 8 (1919) coincidence rangefinder mounted on a tripod was sometimes used, but more common was its replacement, the stereoscopic Type 94. The Type 94 incorporated a shoulder yoke and was calibrated for 250 to 7,500 meters and had 8x magnification and a 4.5° vertical and 5° horizontal spread.

There was no central control of the guns except in the case of the Type 2.

**Naval Weapons**

The first automatic light AA gun adopted by the IJN for close-in defense of its ships was the British Vickers Mk VIII 2pdr (40mm) “pom-pom”, selected in 1925. About 500 guns and 200 single mountings were imported from the UK during 1925-1935. The balance of the guns were incorporated into twin mounts designed and built by the Maizuru Navy Arsenal, and later by the Kure Navy Arsenal. With their short barrels and consequent low muzzle velocities, these weapons had become obsolescent by the late 1930s and were replaced by the 25mm Type 96. Some of the guns removed from ships were placed in storage until the outbreak of the war, when they were used in the defense of Pacific islands, sometimes with brand new Kure-built twin mounts. The Navy also used 75 of these weapons in the homeland for defense of naval bases, these apparently being part of the 200 mounts reported as having been used during the war by the IJN. Although the Navy had introduced time-fuzed ammunition, ranged for a surprisingly high 1,030 meters to a wildly optimistic 4,815 meters, the weapon was obsolete and relatively ineffective.

The search for a light AA weapon led the Navy in the late 1920s to the Hotchkiss firm of France. There they saw two weapons that could complement each other for defense against low-level attacks from the aircraft of the day. The first was the 13.2mm heavy machine gun and initial demonstrations were followed by an order for 20 guns, 10 mounts and 250,000 rounds of ammunition in early 1932. These apparently proved satisfactory for late that year the IJN placed an order for 121 more guns (with deliveries completed in February 1933). The next year the gun was standardized as the Type 93 heavy machine gun, and an additional 26 guns and 700,000 rounds of ammunition were ordered from Hotchkiss. The final order to Hotchkiss, for 130,500 rounds, came in January 1934, after which Japanese production was sufficient to meet the IJN's requirements.[2]

The Type 93 was a gas-operated weapon firing at an adjustable 425-475 rounds per minute. The barrels screwed into the receiver, which should have made for quick changes, but gas cylinder connections also had to be connected and disconnected, and as result it took two men five minutes to complete an exchange. The single mount was a simple pedestal, while the twin mount was bolted to a base on which it could rotate, yielding great stability. The gunner there sat on a seat directly behind the guns and fired them by foot pedals.

For the twin mount an assistant gunner stood to the side manipulating the sight linkages to input range (to apply superelevation and compensate for time-of-flight), bearing and speed (up to 500 km/hr). The gunner then simply traversed and elevated the gun to keep the cross hairs of his telescopic sight on the target.

The weapon used essentially the same ammunition as the 12.7x99mm American .50cal heavy machine gun but with a slightly larger projectile. This yielded, predictably, a an 18% heavier heavier bullet with a concomitant drop in velocity. The weapon fired ball, ball-T, AP and incendiary ammunition. The ball ammunition used copper-jacketed mild steel with a long ogive and boat-tail base. The ball-T round was similar but was drilled in the base for a 8-second orange tracer. The AP round used a hardened steel core and lead cap. The incendiary projectile put a tiny 0.7g charge of PETN in the nose to act as an impact detonator for the 1.6 g of incendiary mixture.

**IJN Production of Light Anti-Aircraft Weapons**

| | 1931 | 1932 | 1933 | 1934 | 1935 | 1936 | 1937 | 1938 | 1939 | 1940 |
|---|---|---|---|---|---|---|---|---|---|---|
| 13.2mm MG | – | – | 20 | 40 | 100 | 200 | 300 | 300 | 400 | 400 |
| 25mm Gun | – | – | 10[a] | 20[a] | 50[a] | 100 | 100 | 100 | 200 | 300 |
| | 1941 | | 1942 | | 1943 | | 1944 | | 1945 | |
| | Apr-Jun | Jul-Dec | Jan-Jun | Jul-Dec | Jan-Jun | Jul-Dec | Jan-Jun | Jul-Dec | Jan-Jun | Jul-Aug |
| 13.2mm MG | 105 | 245 | 300 | 325 | 575 | 1,100 | 3,000 | 4,300 | 2,400 | 280 |
| 25mm Guns | 90 | 245 | 330 | 335 | 900 | 3,200 | 7,700 | 12,200 | 6,000 | 500 |

Note: figures are for individual guns (i.e., barrels) and include shipboard weapons
[a] These figures are those provided by the IJN Gunnery Dept after the war. They are suspect in that the weapon was not adopted until 1936.

The 13.2mm Type 93 was placed in production at the Toyokawa and Yokosuka naval arsenals. Both arsenals built mounts, a single pintle-mount and a twin-mount with seats. Production did not ramp up to high rate until late 1943, by which time its obsolescence as an anti-aircraft weapon against modern aircraft had become painfully obvious.

The second Hotchkiss weapon was the 25mm automatic cannon. About a dozen had been purchased for evaluation during 1932-34 and in early 1935 the decision was reached to standardize on this weapon to replace the obsolete 2pdr (40mm) Vickers guns in service. The IJN approached Hotchkiss for a production license for a slightly modified version and that firm asked the French Navy for permission, which was granted in May 1935 on the basis that the French considered the weapon too light for shipboard air defense. In mid-1935 the Navy placed an order with Hotchkiss for 48 25mm Model J weapons and 60,800 rounds of ammunition, followed in March 1936 by a second order for 80 weapons. At that time the Navy officially adopted the 25mm as the Type 96 and began its own production,[3] although a further 44 guns were bought from Hotchkiss in 1936/37. Shipboard installations began in 1936, using manual-drive twin mounts, both French and Japanese. It was produced at fairly low rates by the Toyokawa and Yokosuka naval arsenals in twin mounts through the early 1940s. In early 1943 production was greatly expanded at the Toyokawa Naval Arsenal, so that production at that facility ramped up to no fewer than 12,000 in the second half of 1944. The Japanese gun was almost identical to the French version, the major change being a switch from forgings to castings of some breech parts, including the receiver itself. During the war the IJN also switched from the simple conical flash hider of the Hotchkiss original to a more effective Rheinmetall design. The German device was also intended to serve as a muzzle brake, but its actual usefulness in this role proved minimal.


A twin 25mm prior to emplacement, showing the lower mount.

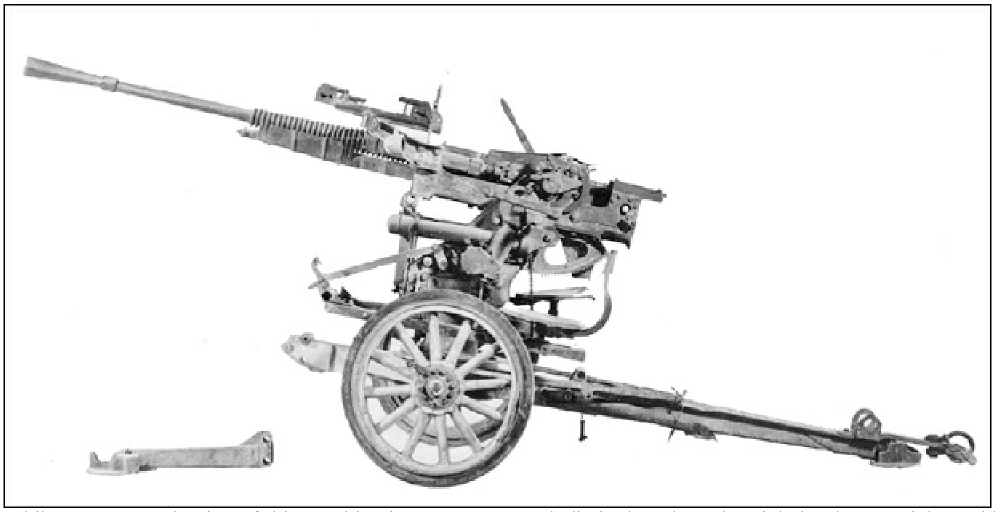
The main rounds used were HE and HE-I, both with and without tracer elements, fitted with a percussion fuze. The former held 17 g of TNT, while the latter carried 6 g of TNT and 13 g of white phosphorus. Later in the war the Model 1 fuze was replaced by the Model 4, a more compact design that enabled the amount of explosive in the HE round to be increased to 19 g, while that in the incendiary round rose to 7.6 g. In either event the rounds gave a maximum ceiling, at 80° gun elevation, of 5,000 meters; but at a more common elevation of 50° the maximum ordinate was about 3,200 meters, which was reached about 4,000 meters horizontally out and after 20 seconds of flight. An AP round, the Model 8, was also produced. This was said by Japanese testers to “almost” penetrate 60mm of mild steel at 1,000 meters range at 90°, but featured a steel cartridge case that tended to jam when the weapon was fired in bursts. Surprisingly, the projectile was made of a rather soft steel, so penetration against armor plate presumably would have been significantly less.

The mounts, initially twin gun units designed for shipboard use, were manufactured by four private firms. When this proved insufficient in early 1943 the Toyokawa Naval Arsenal was brought into the production scheme along with two other private producers. All the Japanese-made mounts were designated the Type 96, with the Model 1, in twin and triple versions being the most common, the latter having been introduced in 1941.

The manually-powered twin and triple mounts were well suited to expeditionary warfare in that they could be lightered ashore and emplaced in a pit in about a day. In naval use the mount was simply bolted to the deck, but for land use a lower mount was added below that and the gun lowered into a hole in the ground such that filling the hole in (preferably with concrete, but dirt and sand would do) covered the lower mount. Further recommending them for hasty base defense was that they did not require electrical power, although inevitably this slowed their traverse rate to the detriment of ability to engage fast-crossing targets.

The twin- and triple-mounts each had a crew consisting of two seated gunners (for traverse on the right and elevation on the left), a sight setter to input the range and other data, and two loaders per gun.

For all their apparent benefits, however, they were not well suited for mobile war requiring frequent moves. In 1942 development began of a simple pedestal mount for a single gun that could be used both on land and to fit into small corners of warships for extra AA firepower. The pedestal mount entered production at the Maizuru Naval Arsenal, with the first coming off the production line in May 1943. The Toyokawa Naval Arsenal produced its first single mount in January 1944, joined by the Sasebo Naval Arsenal in April. By the second half of 1944 the single mount was the dominant one, with over 4,000 being built, compared to about 1,000 twin mounts and 500 triple mounts. For shipboard use this was the Type 96 Model 3, while for land use with a two-wheel carriage it was designated the Type 96 Models 6 and 8. It will be noted that by this time gun production was outstripping that of mounts, resulting in the use of a variety of extemporized mounts for the excess guns.



A 25mm Type 96 Mod 6 or 8 mobile mount. Production of this combination was apparently limited, and used mainly by the Special Machine Cannon Units raised by the Army in 1944-45, a rare example of Army-Navy cooperation.

The use of the 25mm as a land-based weapon appears to have begun in late 1942, and they were deployed in considerable numbers to naval guard units in the Pacific, with some even handed over to the Army for their use. As shipbuilding slowed down, it proved possible to divert large numbers to land use, and by the end of the war the IJN had deployed about 3,500 of these weapons in defense of naval bases in the homeland.

Both the 13.2mm and 25mm weapons were essentially static devices once employed on land, emplaced once and left there. There were a few extemporized mounts on sledges and carts, but these were uncommon, and production of the wheeled 25mm mount probably did not exceed a few hundred.

The 25mm Type 96 proved a powerful weapon for its class. It could not fill the gap left by the absence of a modern 37-40mm weapon, but it was not designed for that. For its caliber it was accurate and hard-hitting. Its one vice was the weakness of the firing pin, causing frequent stoppages. Indeed, a staff officer with the 54th Guard Unit at Palau reported to his HQ that during a 10-hour marathon air raid his 32 25mm guns broke 80 firing pins, and at one point 60% of the guns were out of action for that reason, largely due to the need to extemporize replacements. The ordnance bureau was aware of this problem and eventually redesigned the firing pin, increasing its thickness at the front, which improved service life from 250 rounds to 4,000.

The Navy had received an example of the Bofors 40mm gun from stocks captured in Singapore and immediately begun a reverse-engineering effort. Although work proceeded more slowly than the parallel Army effort, it was more successful. The main differences were that the Navy used a slightly longer barrel than the original, and simplified the carriage so that instead of releasing the wheels to deploy the weapon to firing position, it was jacked up off them. Ballistics were generally similar to those of the Bofors original, with a muzzle velocity of 803 m/s. It was ordered into production at the Toyokawa Naval Arsenal, but only a handful had been completed by war’s end it is unlikely they saw service.

Fire control for the 25mm guns differed little from the Army’s procedures. They received their range data verbally from a 1-meter base coincidence range finder set on a tripod. This was a 12x unit with range graduations from 200 to 10,000 meters. The piece was accurate (for its size) and well-made.

Like the Army, the Navy did not use off-carriage fire control for its light AA guns. The Hotchkiss 25mm guns purchased from France had come with sights that had so impressed the IJN officials that they ordered into production a family of similar sights known as the “LPR” series. The operator manually input the target range (provided by voice from the battery’s 1-meter rangefinder operator), estimated speed and course angle, and this operated a series of cams and linkages that offset the telescopic sight by the required amount. The slant range scale was calibrated for ranges from 500 to 4,000 meters, while the target speed input was calibrated for 0 to 400 km/hr. Effective early in the war, as airplanes got faster the speed input limitations proved a problem. In addition, it proved impossible to manufacture them in the quantities needed and such production as was delivered was reserved almost entirely for shipboard mounts.

The initial replacement for the LPR sights for the 25mm was a simple speed ring, with the front element consisting of three concentric oval rings representing target speeds of 200, 300 and 400 knots. The rear peep could be slid forward and back along the base to accommodate the range, with graduations between 500 and 2,000 meters. The speed ring for the 13.2mm machine gun was similar, but had only two rings.

| Light AA Gun Data | | | | |
|---|---|---|---|---|
| | 13.2mm | 20mm | 25mm | 40mm |
| | Type 93 | Type 98 | Type 96 | Vickers |
| Ammunition | 13.2x99mm | 20x142mm | 25x163mm | 40x158mm |
| Weight (single)(kg) | 380 | 450 | 970 | 1,410 |
| Weight (twin)(kg) | 772 | | 1,364 | 3,070 |
| Barrel Length (cal) | 109 | 70 | 60 | 40 |
| Proj wt (g) | 50 | 136 | 275 | 772 |
| Muzzle Vel (m/s) | 794 | 944 | 894 | 596 |
| Max ceiling (m) | 4,150 | 4,500 | 5,210 | 3,960 |
| Effective ceiling (m) | 910 | 1,700 | 1,981 | 1,515 |
| Cyclic rate of fire | 450 | 300 | 230 | 200 |
| Practical rate of fire | 250 | 100 | 120 | 100 |

In early 1945 the speed ring was replaced by a course ring, based on target approach angle rather than speed. In this device the front rings were circles rather than ovals and represented approach angles of 15°, 30° and 70°, while the rear sight was adjustable for speed. Range was treated as a constant, a figure of 1,500 meters being built in. By the end of the war the course ring sight was the standard and had been installed on the majority of Navy 13.2mm and 25mm guns in the homeland.

In late 1944 a central director version of the LPR sight was tried with the hopes of controlling two or more 25mm guns, but this project was abandoned.

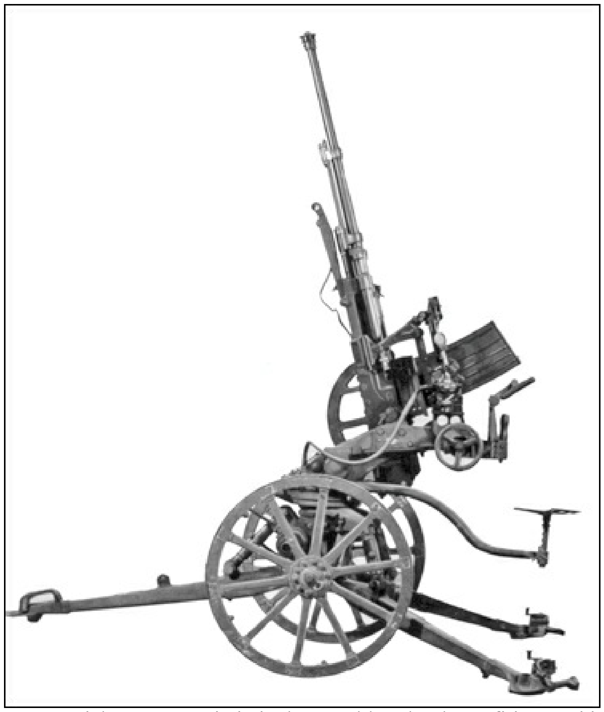
### 13.2mm Navy Type 93 Heavy Machine Gun

This was the standard Hotchkiss heavy machine gun, license built in Japan, fitted to indigenously-designed single and twin mounts. It was gas-operated, somewhat unusual for a weapon this size, but its distinctive feature was the use of a top-feeding 30-round box magazine. The cyclic rate of fire was somewhat low to begin with, and reduced even further by the need to change magazines. It had cooling fins along the length of the barrel, larger ones to the rear, smaller towards the front, which aided cooling but added to manufacturing costs. The twin mount was a large, bulky affair, while two single-mounts were available, one a tripod for ground use, and the other a pedestal for AA use.

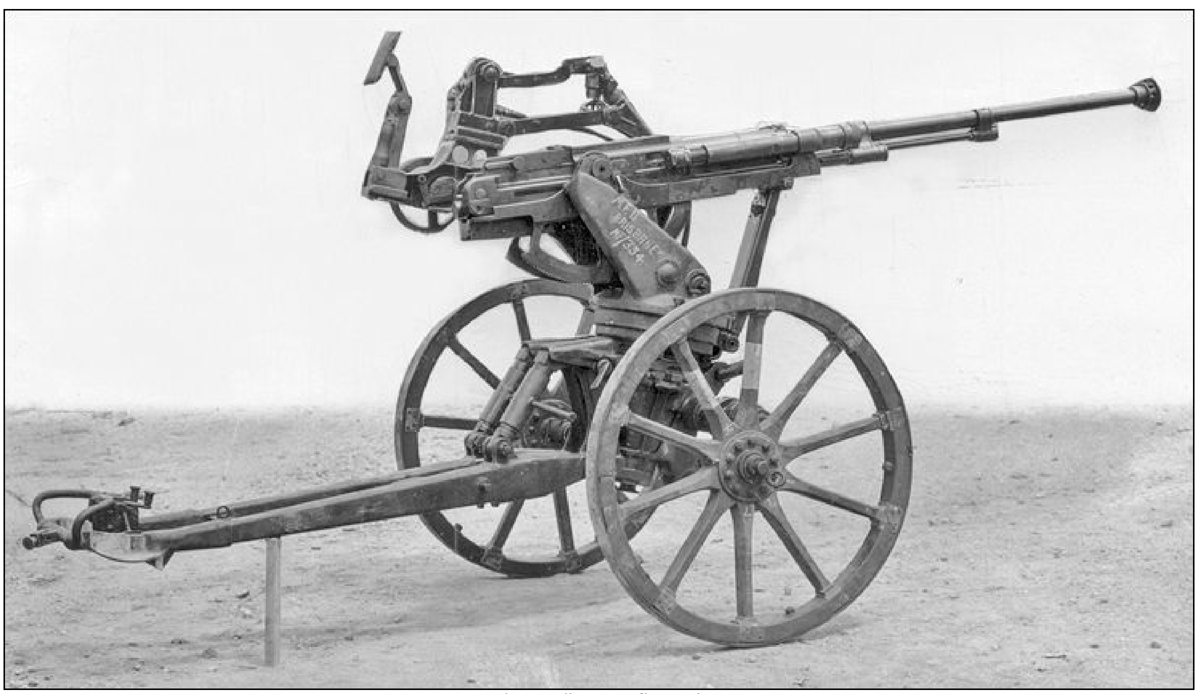
A twin 13.2mm with LPR computing sight but without magazines in place.

### 20mm Army Type 98 Light AA Gun

The standard light AA gun of the IJA, this was a gas-operated, air-cooled weapon with ammunition provided by a 20-round box magazine on top of the receiver. The powerful ammunition, unique to this weapon, was available in both HE-T and AP-T configurations. The two-wheeled mount was simple and lightweight and was easily broken down for pack transport. The gun was free-handled, being traversed by the gunner pushing around the mount and could be fired on or off the wheels. The gun was originally aimed by means of a telescopic sight, which was offset in deflection and elevation by amounts calculated to allow for lead angle. This proved difficult to use, however, and in practice it was usually discarded in favor of a more practical ring sight.



Type 98 Light AA Gun, in in its less-stable wheels-on firing position

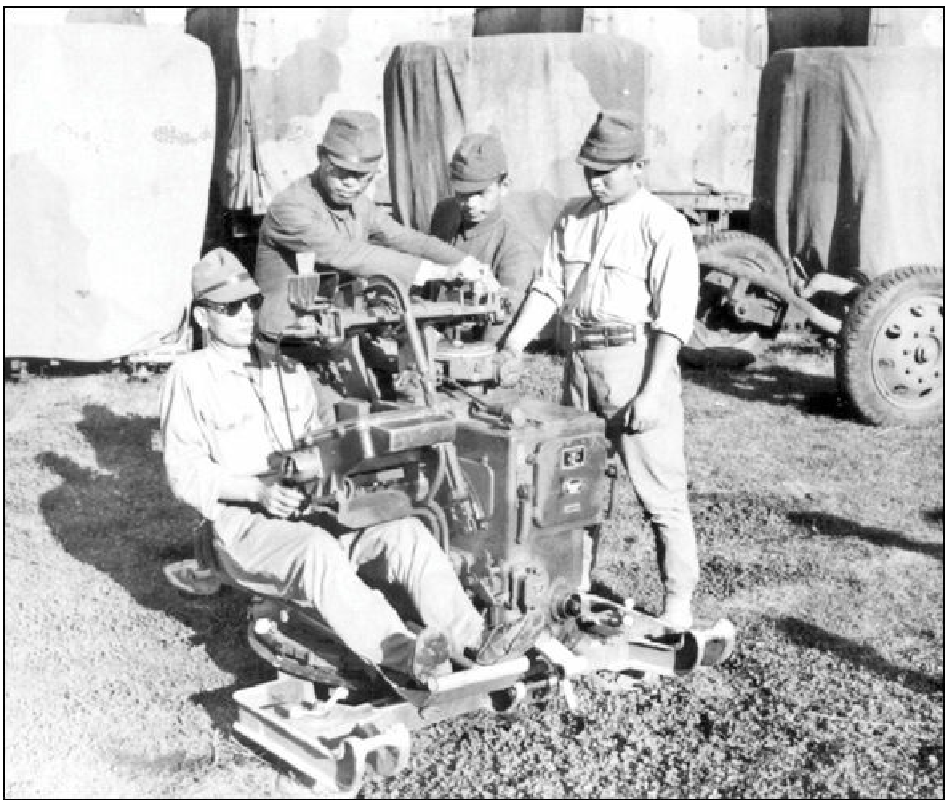


and traveling configuration

**20mm Army Type 2 "Ke-Ki" Light AA Gun**

This used the same gun as the Type 98, but with an entirely new mount, possibly influenced by the Solothurn and Oerlikon weapons captured in China. The trunnions were moved to the rear, under the back of the gun, permitting it to be mounted close to the ground, improving stability. The most radical departure from prior practice, however, was that it was driven by electric motors, taking their power from a generator trailer. The six guns in a battery were elevated, traversed and fired by remote control from the Type 2 fire control system. Local manual control of each gun was also possible.

A Type 2 gun showing local control.



The director for the Type 2 light AA gun.

**20mm Army Type 4 Twin Light AA Gun**

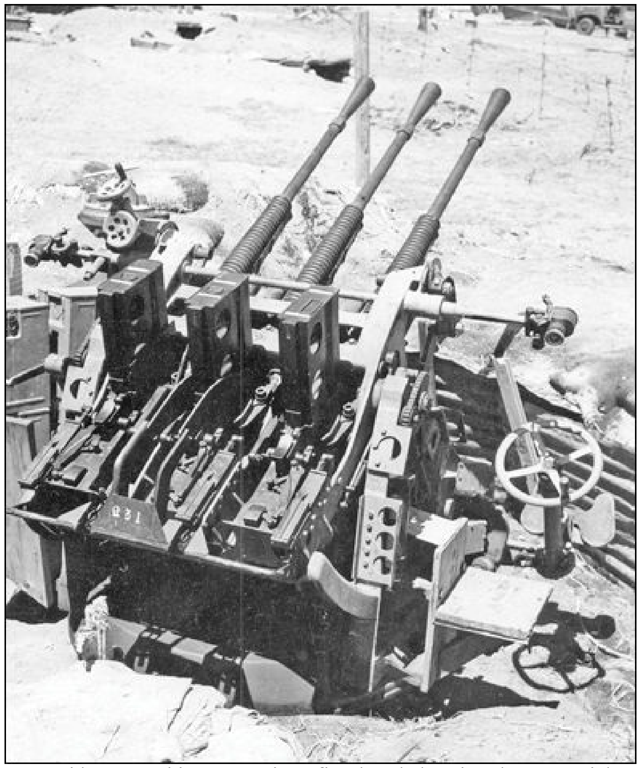
The Type 4 was little more than two Type 98 cannon set side-by-side and pintle-mounted on a pedestal. It used a simple speed-ring sight. It was designed primarily to engage ground targets, but in fact was only used in the anti-aircraft role. For that, it was really too heavy to be brought to bear quickly on a target and track it, but it did put up more firepower than the Type 98. It was a purely static weapon.

20mm Army Type 4 Twin Light AA Gun.

## 25mm Navy Type 96 Light AA Gun

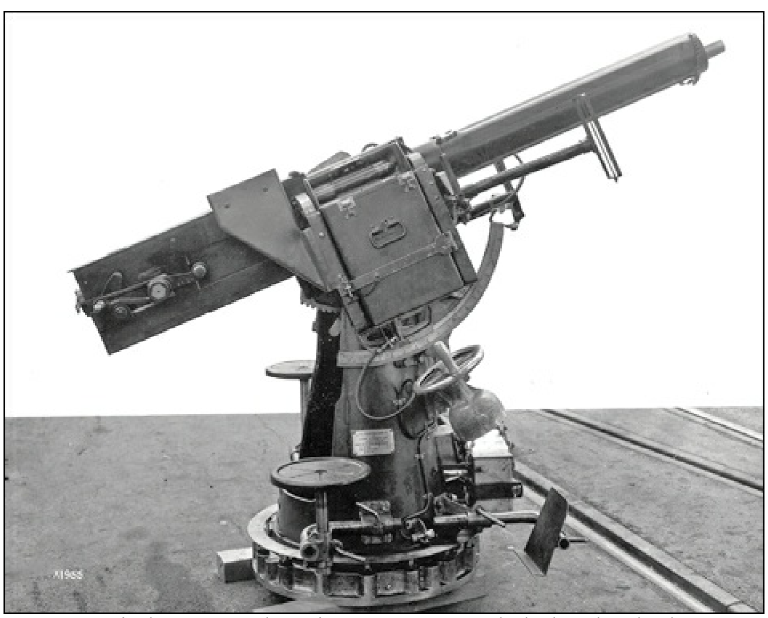
This was the Hotchkiss 25mm AA gun on a series of Japanese-designed mounts, initially twin and triple types. Designed for naval use, they were out of their element when emplaced on land, being heavy, cumbersome and incapable of movement. Even on ships the multiple mountings were not popular, having slow rates of elevation and traverse (the latter 13°/sec) due to the lack of power controls, and the tendency to vibrate. It had a nominal rate of fire of 230 rounds per minute per barrel, but the practical rate was only half that due the need to change the 15-round magazines and allow the air-cooled barrels to cool down periodically. HE-T ammunition with 15 g of explosive and PD fuze was the most common, but HEI-T and AP-T were also available. A self-destruct fuze, with a 10-13 second delay, was fielded late in the war. The tracer element changed from blue to red at about 1,500 meters, aiding range estimation. Partially in an effort to provide some mobility, however limited, the IJN introduced simple pedestal mounts for single guns in early 1943.

A single-mount 25mm on an improvised sledge for mobility.


A triple-mount with ammunition magazines fitted and showing the LPR sight on the left.

### 40mm Navy Autocannon

The Type AN (for Armstrong) 4cm was the Vickers 2pdr Mk VIII gun fitted to Vickers single mounts and Japanese-designed manual twin mounts. It was a recoil-operated, water-cooled, belt-fed weapon with a short barrel, a weakly-propelled round, and consequent low velocity and short range. The twin mount added firepower, but the manually-powered traverse rate was only 10°/second, slow for engaging fast aircraft. Both types of mounts were of the naval variety with no provision made for mobility once landed. The main type of ammunition was an HE round with 70 g of cast TNT and a powder-based time fuze (with no impact function). A crewmember set the estimated range on the fuze cutter dial and this device twisted the fuze rings to the appropriate delay as the round was fed into the gun. A complex system of gears, cams and linkages compensated for elevation and lead on the twin mount sights. Since the HE round had no tracer element, it could be supplemented by an inert tracer round. An APHE round was also available, but was probably little used.


A single-mount and a twin-mount 40mm 2pdr deployed on land.

1 Survey of Japanese A.A. Defences of Singapore and Palembang, prepared by INT/12 Air Command South East Asia, for MI 15, War Office, 22nd November 1945, in PRO WO208/1553; p.45.

2 Although old stocks continued to be used; US troops discovered a stock of Hotchkiss-manufactured 13.2mm ammunition on New Georgia in 1943.

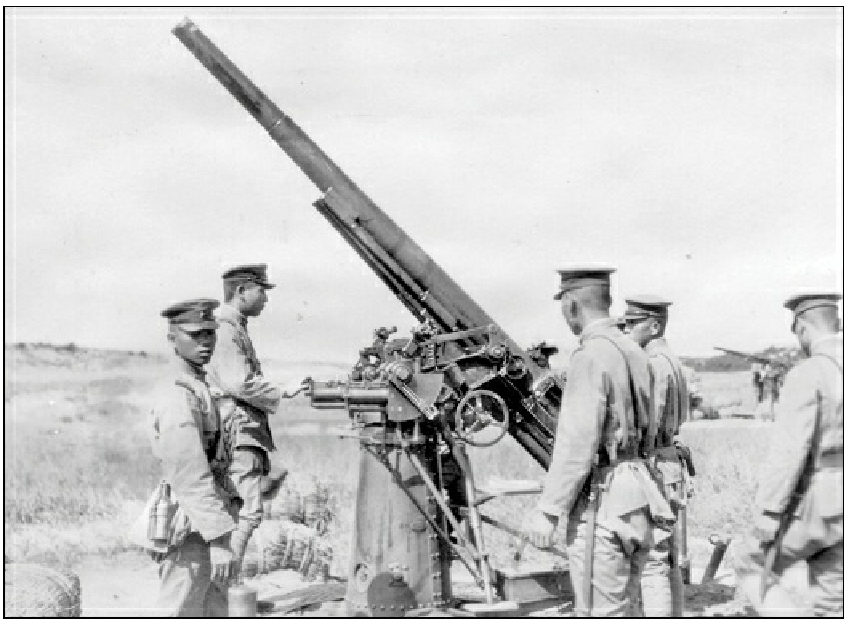
3 The French-made guns were designated Type 94 and Type 95.

# 15

# Heavy Anti-Aircraft Weapons

### IJA Anti-Aircraft Weapons

The use of aircraft during World War I had been noted in Japan and design work on a purpose-built anti-aircraft gun was started almost immediately. The result was the 75mm Type (Taisho) 11 gun, which, not surprisingly, drew heavily from the Type Meiji 38 field gun. It had a longer barrel, which gave it slightly higher muzzle velocity, and was mounted on a pedestal for high-angle firing, but was chambered for the same ammunition and featured many of the same mechanical components. Some were fitted to mobile carriages with spoked wheels, while others were set in semi-permanent emplacements. The number built is uncertain, but is unlikely to have exceeded four or five dozen, starting in 1922, all at the Osaka Arsenal. They remained in the homeland except for a single battery in the Chichijima Fortress. Inefficient, they had been relegated to training duties by the start of the war, although they were probably fired in anger in 1944-45. They were originally supplied with the Type (Taisho) 11 fire control system, but these were supplanted by later models before the war began.



A 75mm battery with Type 11 guns on pre-war maneuvers.

A companion heavier piece was introduced in 1925 as the 10.5cm Type (Taisho) 14. It was little more than a scaled-up version of the Type (Taisho) 11 and did not prove popular. Few were built, probably only about two dozen, and they remained in the homeland, seeing little active service. Eighteen were pulled from training duties for operational employment late in the war, including at least one battery deployed on static mounts around Nagasaki.

Advances in aircraft design spurred many nations to develop new and improved models of their 75mm/3-inch AA guns during the 1920s, and Japan was no exception. The result of their efforts was the 75mm Type 88 AA gun, introduced in 1928. In fact, the Type 88 differed little from the (Taisho) 11 in its mechanics except for a longer barrel, the fact that it was now carried on a single-axle device with rubber tires to speed road travel, and a breech that was completely semi-automatic. The latter meant that pushing the cartridge into the breech triggered the closing of the breechblock, and during the recoil the breech was again opened and the now-empty cartridge case ejected. Most importantly, it was chambered for a more powerful round, using a cartridge case 489mm long, instead of the 292mm version inherited by the (Taisho) 11 from the field artillery. An adequate, if unexceptional, gun for its time it remained at a fairly low rate of production through the 1930s. Initial production came from the Osaka Army Arsenal, with the Hiroshima plant of Nippon Seikōsho (Japan Steel Co.) joining in production in 1933. Output picked up starting in 1940 and increased thereafter with the introduction of subcontractors for various components, and the Type 88 remained the standard field AA gun for the IJA through the war, being encountered by the Allies in all theaters.

10cm Type 14 AA guns collected at the end of the war, still on their original low-speed carriages.

A 75mm Type 88 AA gun in a typical homeland emplacement, featuring concrete base and magazine roof, outside Nagasaki.

The main round of ammunition for the Type 88 was the Type 90 long pointed HE-AA projectile, filled with 385 g of TNT and usually fitted with the 30-second Type 89 powder time fuze. The complete round had the longest cartridge case and greatest propellant load of all the Japanese 75mm rounds almost to the end of the war, and the projectile featured two rotating bands to seal the pressure behind it. The Type 89 fuze had good, consistent performance at rest, but suffered from several shortcomings, most notable of which was a failure in the design phase to take sufficient account of the decreasing oxygen content and atmospheric pressure at high altitudes. As a result, the burning of the powder train became slightly erratic and unreliable when used against high-flying targets, even extinguishing in some cases, leading to duds. Inadequacies in Japanese fire control seem to have masked this problem for some time, but eventually it was replaced by the Type 2 powder and impact fuze, which improved the burn characteristics and added an impact function, turning it into a dual-purpose fuze.[1]

These guns were also provided with Type 94 HE and Type 90 long pointed HE projectiles fitted to the long cartridge case for use against ground targets. In this case Type 88 PD or delay fuzes would be fitted. Production appears to have been slight, as the HE-AA round could be used in this role if fitted with Type 88 fuzes. The Type 95 APHE projectile used with the standard 75mm field guns was also mated to the cartridge case of the Type 88 to create a respectable anti-tank round, this entering production in July 1941. This round was issued to units on Luzon, but was not encountered elsewhere by the western Allies, and was probably intended for Manchuria and the homeland.[2] A training round was also produced that ejected a puff of smoke from peripheral gas ports when the fuze went off, before falling to earth as a single unit, trailing smoke as it fell.

By the mid 1930s most nations had decided that the 75mm/3-inch caliber had reached the limits of its effectiveness. The coefficient of ballistics of the projectile in that caliber simply drained too much velocity away to reach a useful altitude in a reasonable amount of time. This realization was delayed in reaching Japan, however, and the IJA was to remain one step behind AA gun development in other nations. While other nations were fielding high-velocity 85-94mm weapons the IJA continued to rely on its 1920's vintage 75mm guns for field air defense.

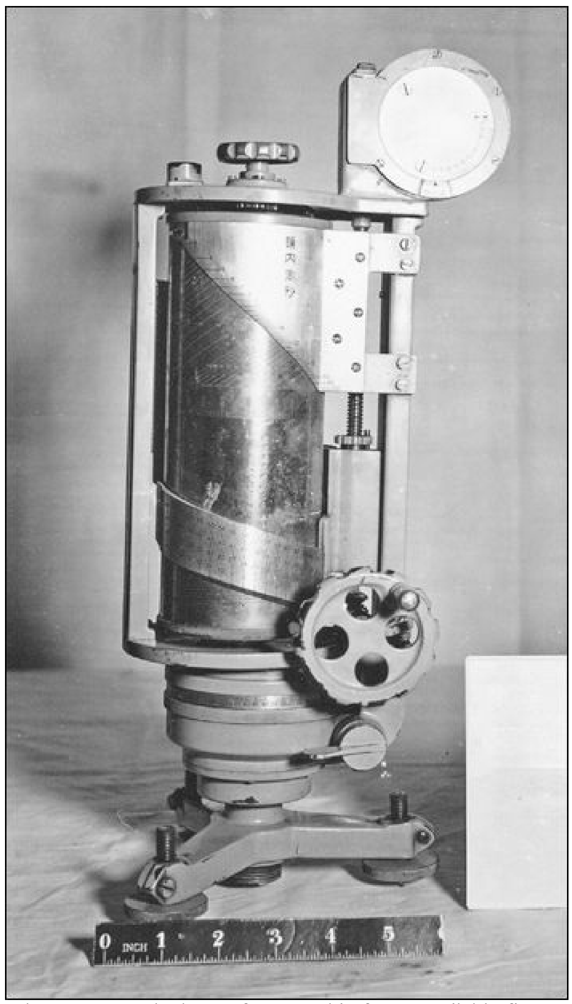
An underpowered gun, one that takes a long time to get a projectile up to where the enemy aircraft are flying, places a premium on accurate fire control. The longer the time lag between when the order to fire is given and when the shell reaches the proper altitude, the more critical the precise measurements and estimations of the fire control apparatus. In the case of the Type 88 gun firing the Type 90 AA pointed shell, when engaging a bomber flying at an altitude of 6,000 meters, at a horizontal range of 4,000 meters out, the time in flight would be 19.4 seconds, at which time the shell's velocity would have fallen to 225 m/s. The 50% burst zone (the area in which half of the rounds fired at that data would actually burst) for the gun at that range was 93 meters in horizontal range and 156 meters in height, even assuming perfect firing data.[3] As if an obsolescent gun were not enough, the Army fared even worse at developing fire control for it.

**Production of Army Anti-Aircraft Guns**

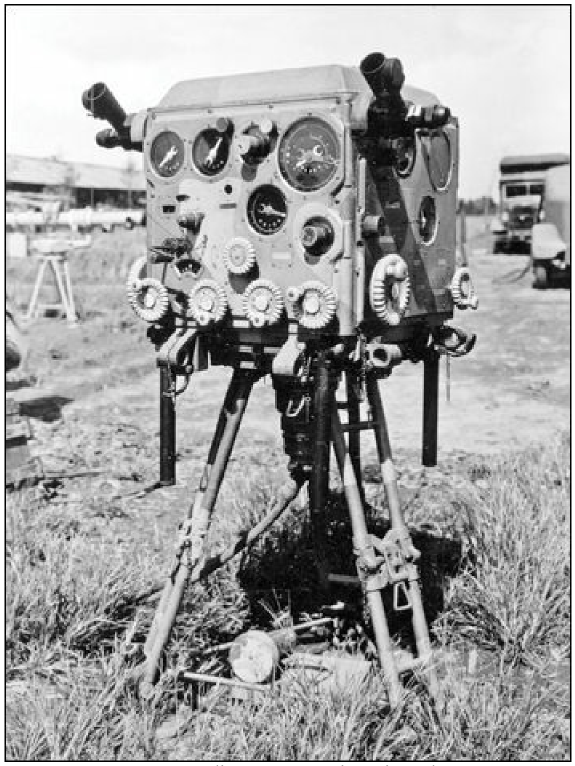
| | 1931 | 1932 | 1933 | 1934 | 1935 | 1936 | 1937 | 1938 | 1939 | 1940 |
|---|---|---|---|---|---|---|---|---|---|---|
| 20mm Type 98 AA Gun | – | – | – | – | – | – | – | 42 | 254 | 534 |
| 75mm Type 88 AA Gun | 32 | 19 | 170 | 73 | 72 | 112 | 165 | 127 | 142 | 293 |
| | 1941 | | 1942 | | 1943 | | 1944 | | 1945 | |
| | Apr-Jun | Jul-Dec | Jan-Jun | Jul-Dec | Jan-Jun | Jul-Dec | Jan-Jun | Jul-Dec | Jan-Jun | Jul-Aug |
| 20mm Type 98 AA Gun | 42 | 145 | 320 | 310 | 435 | 530 | 453 | 176 | – | – |
| 20mm Type 98 mod AA Gun | – | – | – | – | – | – | – | 170 | – | – |
| 20mm Type 2 AA Gun | – | – | – | – | – | – | 3 | 10 | 3 | – |
| 20mm Type 4 Twin AA Gun | – | – | – | – | – | – | – | 83 | 325 | 140 |
| 40mm Type 5 AA Gun | – | – | – | – | – | – | – | – | 2 | – |
| 75mm Type 88 AA Gun | 130 | 275 | 222 | 304 | 417 | 520 | 403 | 252 | 138 | 9 |
| 75mm Type 4 AA Gun | – | – | – | – | – | – | – | 12 | 50 | 2 |
| 88mm Type 99 AA Gun | – | – | 2 | 21 | 96 | 200 | 223 | 200 | 188 | 16 |
| 120mm Type 3 AA Gun | – | – | – | – | 8 | 11 | 16 | 51 | 68 | 3 |
| 150mm AA Gun | – | – | – | – | – | – | – | – | 2 | – |

The first fire control system planned for the Type 88 gun was the Type 88 Director, but this program was halted before it entered production. It was replaced by the Type 90 Director, which used slip-rings and a Wheatstone Bridge-type transmitter, tied to the Type 90 course-angle speed computer. The unit weighed 220 kg and had a nominal (computing) accuracy of ±10 mils in azimuth and elevation. However, it needed nine men to operate it, and this lowered the actual accuracy to ±90 mils and resulted in a computing time of 30 seconds. Production of the Type 90 was cancelled after about 60 had been built, and none remained in service at the end of the war.

With the cancellation of the Type 90 director fire control fell to what had been intended as a back-up system, the Type 90 target speed and course angle calculator. This much simpler device featured an elbow telescope on a small rotating drum, that telescope having a cross-hairs inside an oval. An operator tracked the plane with the crosshairs and when the fire control chief was certain that the plane was flying level and straight he yelled stop and began his stopwatch, and the operator stopped tracking. When the plane crossed into the oval on the telescope the operator yelled again and the chief stopped his watch. Using the plane's altitude and range (from the optical rangefinder) and the direction of flight (taken from where in the oval it crossed) and the time taken to cross a given angle the chief could yell out commands that the gun crew would put on their on-carriage instruments to allow for lead in time and direction. Range data was taken directly from the rangefinder for the fuze setters and was assumed to remain constant during the computation and firing. This latter was not a straightforward operation, since the burn rate of the powder train in the fuze varied with altitude, so that the old Type 89 fuze, for instance, had a limit of 19 seconds when fired at a 15° quadrant elevation, but 35 seconds at 75°, and this differential had to be accounted for in the fuze setting. The whole system was fairly quick and simple, but not very accurate, with accuracy of the target speed and course angle calculator said to be ±50 mils in course angle and ±10% in speed.



The target speed & course calculator often stood in for unavailable fire control directors.


A Type 97 director at Koiwa, in Tokyo.

Work on a replacement director was begun in 1933, influenced heavily by the American M2 and M3 directors by Sperry. The result entered service as the Type 97 director and was their first attempt at mechanical computation, rather than manual drum-matching process. A myriad of variable speed drives, three-dimensional ballistic cams, quadrant switching devices, follow-up motors and other devices raised the weight to 400 kg but speeded up the prediction time to 5 seconds. Accuracy was said to be ±5 mils in azimuth and 3 mils in elevation. The 98 Correction Device, which computed the corrections needed for changes in ambient temperature, wind, atmospheric pressure and projectile weight, also fed data into the director if available.

The performance was a great improvement, although the prediction time was still a little too long by Western standards, but it was a very complex piece of precision equipment. The need for precision machining meant that the AA branch had to compete with many other branches and services clamoring for similar efforts in the very limited Japanese industrial base, and as a result the first Type 97 director did not actually come off the production line until October 1941. It should have been possible to marry the director with different weapons by swapping out cams, but in practice this proved almost impossible and the Type 97 was suitable only for use with the 75mm Type 88 gun.

In the meantime, the IJA made a very interesting discovery, capturing several batteries of German 88mm AA guns that had been sold to China. These were not the famous 88mm Flak guns developed for the Luftwaffe, but instead the 88mm SKC/30 naval dual purpose model. These weapons had shorter barrels than the more well-known 88mm's and, in fact, were simply naval guns, complete with shields, set in concrete to support coastal defenses. All 20 Chinese guns were captured early in the war and were relocated by the Japanese to serve new masters. In addition, the weapon was reverse-engineered and accepted for service as the 8.8cm Type 99 AA gun.[4] The only round provided was the Type 100 long-pointed HE shell, carrying 900 g of TNT. The Army took advantage of the larger projectile and specified the new Type 100 mechanical time/PD fuze, essentially repackaging the components of the Navy's Type 91 and adding a point-detonating feature, although the PD element was often disabled in the field for fear of in-bore bursts. The adoption of mechanical timing, it was hoped, would reduce the magnitude of the powder-train fuze problems that afflicted the shells of the smaller 75mm guns.[5] The Type 100 was also retroactively specified for the old 105mm Type 14 AA gun.

The 88mm Type 99 with its shield, in Tokyo.

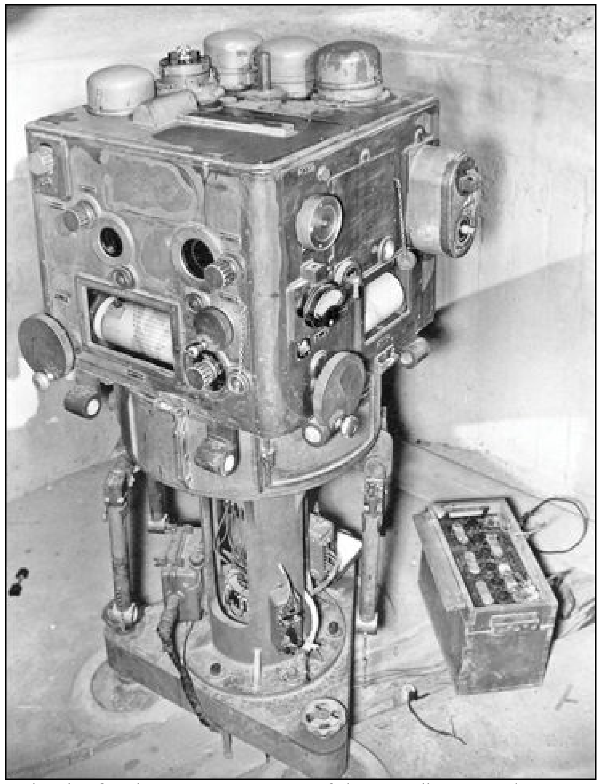
| Wartime Production of AA Fire Control | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 1941 | | 1942 | | 1943 | | 1944 | | 1945 | |
| | Apr-Jun | Jul-Dec | Jan-Jun | Jul-Dec | Jan-Jun | Jul-Dec | Jan-Jun | Jul-Dec | Jan-Jun | Jul-Aug |
| AA observation car, Type 94 | 10 | 15 | 27 | 8 | 16 | 34 | 24 | | | |
| Director, Type 97 | – | 7 | 9 | 5 | 8 | 29 | 24 | – | – | – |
| Director, Type 2 Mod1 | – | – | – | – | 14 | 35 | – | – | - | - |
| Director, Type 2 Mod3 | – | – | – | – | – | 16 | 73 | 242 | 140 | 23 |
| 3-meter heightfinder Type 90 | – | 30 | >31 | n.a | >55 | 143 | 102 | – | – | – |
| 2-meter heightfinder Type 93 | 25 | 72 | 63 | 55 | 77 | 119 | 71 | – | – | – |
| Fire Control Radar, Type 1 | – | – | – | – | 12 | 38 | – | – | – | – |
| Fire Control Radar, Type 2 | – | – | – | – | 13 | 50 | 7 | – | – | – |
| Fire Control Radar, Type 3 | – | – | – | – | – | 19 | 38 | 10 | – | – |
| Fire Control Radar, Type 4 | – | – | – | – | – | – | 49 | 29 | – | – |
| Fire Control Radar, Type 4 mod | – | – | – | – | – | – | – | 22 | 38 | 24 |

The 88mm Type 99 was essentially a manually-operated shipboard weapon, complete with shield, with a base suitable for embedding in concrete for land use. It is, perhaps, a measure of the desperation with which the Japanese faced aerial threats in the late 1930s they were reduced to copying a mediocre static gun. The SKC/30 was an outdated, relatively short-barrelled weapon with sub-par performance by the late-30s, and suitable only for static defense duties. An archaic feature was the absence of a slip-ring, so that the mount could only make two complete turns in azimuth before the cables carrying the firing data prevented further movement. Although accepted for service in 1939 as the Type 99, the first weapon did not come off the production line until June 1942. Since they were suitable only for fixed emplacement they all remained in the homeland, except for about a half-dozen sent to Rangoon and eight to Singapore.

By the time the Type 99 AA gun was coming into service it had become clear that Japanese precision manufacturing, already strained to breaking, would simply not be capable of producing the Type 97 director in adequate numbers. They were not even able to provide directors to all the AA units in the active combat theaters. The 50th Independent AA Battalion, for instance, sailed for Rabaul in December 1942 with only the old Type 90 target speed and course angle calculators and on-carriage devices for fire control, and that was what they used in the south Pacific.


A Type 2 Mod 1 director.

In desperation they went back to the Type 90 director, but with some modifications. The first iteration, designated the Type 2 Model 1, added a fuze time calculator and transmitter, a target speed and course angle measuring unit, receivers for data from radar units, and replacement of the spring drive with an electric motor. It was still basically a drum-matching device and the accuracy of the data remained the same as the old Type 90. Surprisingly, the Type 2 Model 1 did not include a slip ring, so it could complete only about 5 full revolutions before the crew had to spin it around to “unwind” its cabling. The Type 2 Model 1 could be used with the 75mm Type 88 and 88mm Type 99 guns by using interchangeable cams, but in fact they appear to have been used almost exclusively with the 75mm.


A latecomer, but by far the most numerous of the AA directors, the Type 2 Model 3.

The changes made to the original Type 90 defeated the purpose of simplification, so after only a few Model 1 directors were built production switched to the Type 2 Model 2 and then almost immediately the Model 3. This replaced the folding tripod with a pedestal, eliminated the altitude converter used with radar, decreased the vertical deflection limits and eliminated the target speed solving mechanism. Accuracy, at ±10 mils in deflection and elevation and ±0.1 seconds in fuze time, remained the same, but production was simplified. The one specification to see improvement was in the settling prediction time, which fell from 30 seconds in the Type 90 to 10 seconds in the Type 2 models, although this was still long by international standards. Although the nominal mechanical accuracy figures were in the acceptable range, in practice the need for nine men to crowd around the machine and turn hand wheels and track curved lines on the rotating drums introduced additional sources of error. The Model 2 was used with 75mm Type 88, 88mm Type 99 and 120mm guns; while the Model 3 was used with the experimental 15cm AA gun as well.


A 3-meter rangefinder on drill in Tokyo early in the war.

Height determination for the directors was usually performed by stereoscopic optical heightfinders that also measured both slant range and angle of elevation (from which altitude could be computed). The Army used eight different models of heightfinders, but the two most common were the 2-meter base Type 90 and the 3-meter base Type 93. The 3-meter unit had an inherent error rating of 105 meters at 10,000 meters range, compared to 140 meters in the 2-meter model, but at the cost of weight and portability. The other types were generally 4.5-meter base units, often based on Navy designs.

An Army 2-meter heightfinder. It weighed 210 kg and was operated by a crew of four. The 3-meter heightfinder was similar but weighed 41 kg more. Both could be operated as simple rangefinders or, by throwing a lever, introduce cams that accounted for angle of elevation to yield height.

A 6-meter heightfinder was developed for the 120mm AA gun and was planned for the 150mm gun, but few of these beasts were actually built.

Before the war the AA batteries did practice two-station height finding with angular measuring devices 800 or 2,000 meters apart with a telephone link between them. This may have remained a practice in the homeland but does not appear to have been used overseas. In either event, with a single instrument or a two-station arrangement, the measured range was read off verbally to the battery commander and the director crew.

| Effective Range at Target Heights | | | | |
|---|---|---|---|---|
| Height (m) | Effective Range (m) | | | |
| | 150mm AA | 120mm AA | 88mm AA | 75mm AA |
| 15,000 | 11,800 | | | |
| 12,000 | 13,900 | 8,500 | | |
| 8,000 | 14,800 | 11,300 | 7,100 | 4,400 |
| 6,000 | 14,300 | 11,400 | 8,300 | 6,600 |
| 4,000 | 13,300 | 10,700 | 8,400 | 6,900 |
| 2,000 | 11,000 | 9,100 | 7,200 | 5,700 |
| 100 | 3,700 | 3,000 | 2,400 | 1,800 |

Fire control of a battery involved multiple steps, each with an opportunity for error. A director had separate vertical and horizontal sights that were kept on the target aircraft by turning the device and elevating the sight. This automatically provided present vertical angle and azimuth. Voice commands provided height (from the heightfinder), target speed (often estimated) and direction, with these being input manually into the director. The director computed solutions and transmitted future azimuth and future elevation by cables to the gun positions, where they were displayed by moving pointers that the gunners copied. The voice command of height was also used by the fuze setters at the guns by using a fuze range disk. A burst of five or six rounds was fired, then the commander would visually observe the burst pattern relative to the target and estimate the changes needed to bring the bursts onto target – a very challenging process.

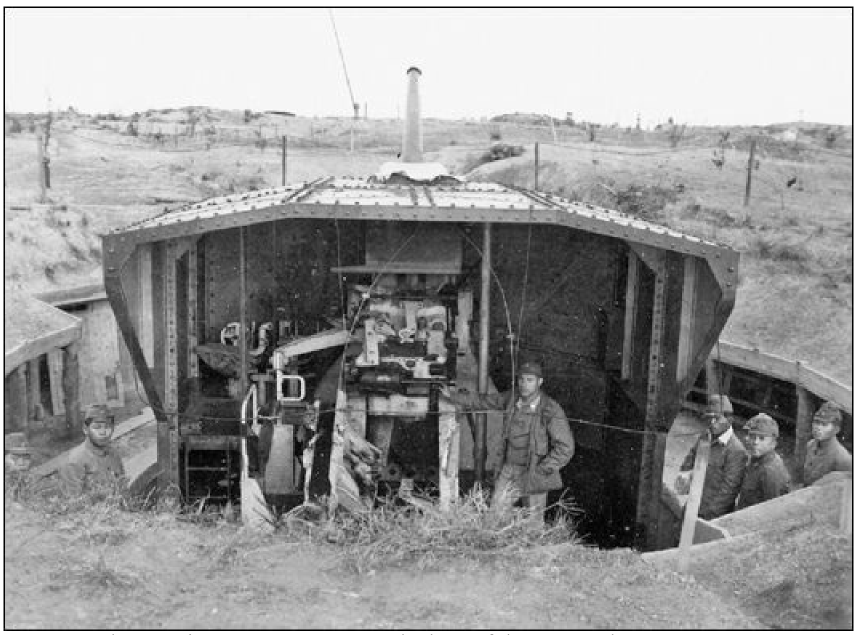
Certainly, none of these changes to the directors did anything to improve the very poor accuracy of IJA anti-aircraft artillery through the war. Each of the directors (except the Type 97) required an external source of information for the initial setting of target speed and course angle before computations could begin. The original adjunct device, the Type 90 Target Speed & Course Angle Calculator was to have become obsolete with the introduction of the Type 97 director. The Type 2s did include devices for the measurement of target speed and course angle, but their accuracy was poor, so the old Type 90 Target Speed and Course Angle Calculator was pressed into service again. This added to the "dead time" in the calculation process and inserted another possible source of error.[6]

A post-war assessment of Japanese anti-aircraft artillery by US air defense officers noted that:

> Japanese fire-control procedures, markedly inferior to those followed by the western nations, required the use of an excessive number of separate instruments. This resulted in a maximum opportunity for personnel and transmission errors and large time lags, all of which comprised the factors most largely responsible for the very low effectiveness of Japanese antiaircraft artillery.

In the meantime, efforts had continued to develop more effective heavy AA guns. This was probably spurred by the appearance of modern bombers in Europe in 1939/40. The reaction from the IJA was the development of a modern 120mm AA gun. The resultant weapon, the 12cm Type 3, was the only IJA AA gun to enter regular service to have power controls and utilized a power ramming and semi-automated fuze setting on the loading tray similar to that of the Navy's 10cm Type 98 gun. It was a modern weapon and was by far the best heavy AA gun of the Army, although employment was limited by the need for large concrete mounts, limiting use to the home islands.

Fearful of very high altitude attacks from B-29s, the Army began design efforts to scale-up the 12cm Type 3 with the primary requirement being an effective ceiling of 20,000 meters. Working backwards from that requirement they calculated they would need a 15cm weapon, and design work on the 15cm AA weapon began in May 1944. Surprisingly, the weapon used fixed ammunition, a complete round weighing 84 kg and needing two men to carry it to the gun's loading tray. Even so, the rate of fire would have been slower than the 120mm and, of course, the smaller guns, but their calculations indicated that the lethal volume of each shell burst would more than compensate.



The massive 12cm Type 3 was the best of the Army's heavy AA guns.

When it became apparent that the 12cm Type 3 gun had the reach to engage B-29s planned production of the 15cm was reduced to just 6 guns and no complete fire control was finished. In any event, only two of these were actually completed before the war ended, these being emplaced just west of Tokyo. Barrel life was estimated to be short, at about 300-400 rounds, but other than that the Japanese pronounced themselves satisfied with the weapon.

**Japanese Homeland AA Effectiveness Figures**

| | 75mm T88 | 75mm T4 | 88mm | 120mm | 150mm |
|---|---|---|---|---|---|
| Maximum Height (m) | 9,000 | 10,000 | 10,000 | 15,000 | 20,000 |
| Effective Height (m) | 7,000 | 8,000 | 8,000 | 12,000 | 16,000 |
| Burst Radius (m) | 5 | 5 | 7 | 15 | 30 |
| Burst Volume ($m^3$) | 125 | 125 | 343 | 3,375 | 27,000 |

The AA School taught that it was possible to use fire control radar to control the heavy guns, but it is not clear how often this was implemented. The radars were not terribly accurate, and the usual allocation was only one per battalion. So the battery colocated with the radar would get the vertical angle, azimuth and altitude delivered by selsyn to the director, but more distant batteries would receive the information by phone and have to plot the data on a contangent chart to account for parallax.

The emphasis on static heavy guns apparently precluded work on a mobile replacement for the elderly 75mm Type 88, and in the end the only solution the Ordnance Bureau could come up with was another copy of a weapon captured in China, this time the Bofors 75mm M.1930. Such improvement over the Type 88 as it offered was largely due to the use of a longer cartridge case holding about 50% more propellant than its predecessor.

The Bofors was a good weapon for its time, the early and mid-1930s, but by 1940 almost every nation's air defense forces had realized they needed a larger, more ballistically efficient gun. Thus, while the US was fielding 90mm guns, the Germans 88mm and the British 94mm, the IJA was initially doing nothing for its field air defense units, and then finally they were reduced to reverse-engineering a weapon only slightly better than their own Type 88. In any event, they were so late off the mark that the new weapon was not standardized until 1944, as the Type 4, and only 62 were built before the war ended, all staying in the homeland.

In addition, the IJA also used small numbers of captured weapons. They employed six 3" 20cwt and twelve 3.7" British AA guns in Singapore, the latter modified to accept Japanese on-carriage fire control devices in the absence of any functional British units. Some Dutch guns were probably also used in the defense of the East Indies.

### IJN Anti-Aircraft Weapons

The Japanese Navy used shipboard weapons adapted to ground mounts for their land defense almost exclusively, the only exception being the purchase of a small number of 75mm Type 88 guns from the Army near the end of the war.

A naval crew firing their 8cm 40-cal AA gun from a wet pit in Central China.

One of the most common was an elderly 3-inch (76mm) design given a variety of designations, including the 8cm Type (Taisho) 3 and the 8cm 40-caliber dual-purpose gun. Regardless of the designation it was an obsolete design dating back to 1914. Despite its obvious limitations, the production line to build it was in place and it was kept in production at the Muroran plant of Nippon Seikosho (Japan Steel), which delivered 50-70 per year during 1931 to 1944, including those for ship use. They were quite common in the Pacific, where their light weight (relative to other naval AA guns) made them easy to deploy onto the isolated islands and the fact that they did not require electrical power to operate made them attractive. They were less common in the home islands, but by the end of the war there were 116 of these weapons deployed on land in the homeland, representing about 12% of the naval AA weapons there. In spite of its long production run only one variant was introduced, the Type 88, which differed only in having a slightly heavier barrel and shorter recoil length, presumably for more compact shipboard applications.

| IJN wartime AA Gun Production | | | | | |
|---|---|---|---|---|---|
| | 1941 | 1942 | 1943 | 1944 | 1945 |
| 76mm Taisho 3 | 50 | 70 | 60 | 60 | 10 |
| 76mm Type 98 | 4 | 8 | 4 | 1 | 0 |
| 100m Type 98 | 10 | 40 | 70 | 40 | 10 |
| 120mm Taisho 10 | 0 | 35 | 500 | 1600 | 185 |
| 127mm Type 89 | 95 | 150 | 300 | 300 | 50 |
| Note: most are for shipboard use | | | | | |


A 12cm Type 10 showing the easily-fabricated “spider base” before covering with earth.

The 8cm L/40 fired a different family of ammunition from the low-angle 8cm coastal guns, using a fixed round of ammunition to speed the rate of fire, while the low-angle guns used semi-fixed ammunition. A slightly longer cartridge case carried 927 g of propellant, compared to 900 g for the surface gun. Nevertheless, it was severely underpowered even by the early 1930s, and its long time-of-flight usually made engagement of fast aircraft unprofitable. The most common round used the Mk3 Mod1 HE projectile carrying 408 g of picric acid and fitted with either an Army Type 89 powder time fuze or a Navy Type 3 powder time/PD fuze, the latter yielding a maximum fuze ceiling of 6,700 meters, well above the effective range of this elderly piece. The Navy Type 5 PD fuze could also be used against surface targets. An APHE round was also available, this with 186 g of trinitroanisole explosive initiated by a Type 1 short-delay impact fuze, and a thicker nose section, should a suitable surface target present itself.

For reach beyond that afforded by the little 8cm gun the Navy developed the 12cm Type (Taisho) 10 (1921) dual-purpose gun for shipboard use. It was developed at roughly the same time as the various flat-trajectory 12cm naval guns, the Types AN, (Taisho) 3 and (Taisho) 11, and shared some components, but it did not fire the same ammunition. For land use the pedestal’s ring was simply sunk in concrete or attached to an earthfilled crib of timbers. The guns were usually controlled by a fire control director, but they were also provided with an on-carriage speed ring sight for use if the director was non-functional or not yet installed. These had rings for 200, 300 and 400 knots of target speed and range cams set by a handwheel on the lft out to 12,400 meters. Each gun was accompanied by a Type 89 fuze-setter, a massive 215-kg wheeled unit that received data electrically from the battery director and displayed it so that the crew could place the round on the mechanism and rotate a handwheel an appropriate amount to turn the fuze ring. The round was then removed from the setter and loaded. The immobility of the fuze setter in field conditions probably introduced considerable, and variable, lag times as the guns were traversed, and in mid-1944 the Type 89 Model 5 was introduced that reduced the weight somewhat to 156 kg, probably enabling the crew to move the device as needed within the gun pit.

Splinter-proof (10mm) three-sided gun shields were available for these weapons but were only rarely used on land.


The US personnel inspecting a 12cm Type (Taisho) 10 in Korea shows the size of this large, manually-operated weapon.

Some features of the gun revealed the age of the design: the traverse and elevation were manual, and with such a large gun that translated to a rate of traverse of only 10°/sec and elevation of 6.5°/sec. Although the reciprocation action in recoil ejected the empty shell case and latched the breech block open, it lacked any mechanical loading assist, so the rate of fire was mediocre. The muzzle velocity, good when the weapon was introduced, had been outpaced by newer weapons and, more importantly, by faster airplanes. On the other hand, it threw a powerful shell and was simple to operate and manufacture, so it remained in production until the end of the war. In fact, production was ramped up considerably during the war, so that no fewer than 500 were built by the Kure Naval Arsenal in 1943 (these including ship mounts as well). In 1944 the Hikari Naval Arsenal was brought in to help Kure. The 12cm Type (Taisho) 10 was widely used throughout the Pacific since it was relatively simple to emplace and did not require external power, and by the end of the war 40% of the naval AA units in homeland were equipped with this weapon as well.[7]


The size and complexity of the 4.5-meter heightfinder used with the Navy's heavy AA guns can be seen with this example, captured on Saipan.

The ammunition for the Type 10 was fixed, in contrast to the semi-fixed type used by the low-angle 12cm naval guns, and was also longer to hold 5.5 kg of propellant for greater velocity. Two HE rounds carrying charges of picric acid were used, the Common Mk 1 with 1.8 kg cast directly in the projectile body, and the Common Mk 2 carrying 1.6 kg bagged and sealed with parafin. These were fitted with Type 88 PD fuze for ground targets and Type 91 MT fuze for aerial targets. Also available was an incendiary shrapnel round that carried 48 small iron cylinders 37mm long by 22mm diameter filled with WP and expelled in mid-air by the Type 91 fuze. Although designed for AA barrage fire, they were used with great effect in the shelling of Manila in February 1945 when the cylinders proved capable of penetrating roofs to set buildings afire from within.

Design work on a 12.7cm L/50 weapon had begun in 1914 but was shelved until the mid-1920s when it formed the basis for the 12.7cm Type (Taisho) 3 dual-purpose gun in single and twin turrets. This weapon provided the main armament for most Japanese destroyers during the war and about 700 were built, but none appear to have been installed on land. Thought was certainly given to that near the end of the war, however, for a new Type 3 AA fire control system in development was envisioned in both shipboard and land configurations. No shipboard units had been completed, but a single experimental land version had been completed.

Apparently it was felt that battleships and cruisers did not need such a powerful weapon, or such a heavy one to add to top-weight, resulting in the 127mm Type 89, adopted in 1929 as secondary armament for cruisers and battleships. Somewhat lighter, 24.5 tons for a twin-mount, compared to 32 tons for the Type (Taisho) 3, it dispensed with the full turret and used a shorter barrel that reduced muzzle velocity from 910 m/s to 725 m/s with the same projectiles. It was the standard such weapon from 1930 through the war years.

A twin 12.7cm Type 89 outside Yokosuka.

The weapon was advanced for its time, featuring power operation and a weather and splinter-proof gun house for the gun crew. Sliding loading trays and power ammunition ramming, using springs compressed during recoil, gave a firing rate of 8-10 rounds/min per tube. A number of compromises had been made in the design, however. One was the use of small, compact motors that had the power to rotate the mount only at about 6°/sec in the land mounting, less than half that of the equivalent American 5"/38 twin, and not quickly enough to engage the aerial targets of the late 1930s.[8] Another was the adoption of a relatively short L/40 barrel, resulting in mediocre ballistic performance. Thus, the weapon had trouble tracking targets at low and medium altitudes, and, according to CINCPAC intelligence in 1945 "Hits above 20,000 feet (6070 m) have not been recorded from this gun" due to the low projectile velocity. Nevertheless, it did throw a powerful projectile and it remained in production through 1945 for both shipboard and land use.

It was used in the Pacific in those instances where the complex bases and power needed could be provided, usually pre-war or early-war installations, and on coral atolls it often served as dual-purpose weapons in batteries of two twin-mounts. Later, it comprised about 32% of the strength of the naval heavy AA defenses of the homeland.

It threw both HE and Incendiary projectiles, both characterized by a long ogive and short body, fixed to brass cartridge cases. The HE round carried 1.79 kg of picric acid explosive, while the less-common incendiary round had 162 grams of picric acid to expel 43 steel pellets each 50mm long and 20mm in diameter filled with a dry incendiary mix of magnesium and barium dioxide. The HE projectile could be fuzed for time or point detonating, while the incendiary round used the Type 91 mechanical time fuze exclusively.

Because the IJN had so little early involvement in land-based air defense they neglected non-shipboard fire control almost completely. They did eventually take the then-new Type 94 fire control system intended for use aboard warships and adapt it for land use as the Type 95 (1935) for use with 8cm Type (Taisho) 3 and 12.7cm Type 89 guns. The result was large, heavy and complex, but it was accurate and permitted tracking targets with speeds up to 700 km/hr (originally only 450, but later increased), including those diving and climbing. Unfortunately, external data (such as height) had to be entered manually after verbal receipt from another instrument, which slowed the process and added an opportunity for error. It had a crew of 8, plus 5 on the height finder. About 120 were built by the Aichi Clock Company and Nippon Optical Company. It was not until 1940 that they Navy established the Hikari and Toyokawa Arsenals to mass produce fire control systems.

A Navy Type 2 director manufactured in September 1944 by the Aichi Watch Co, at Kure Navy Base where it controlled a 100mm Type 98 battery.

Late in the war the IJN built a single Type 5 “Raiun” fire control complex, designed to provide the maximum concentration of aerial bursts in the smallest three-dimensional space. A single Type 5 fire control system ran five heavy batteries around the Kure Navy Yard, each battery with three twin-mount 12.7cm Type 89s.[9] Radar data was input and a firing unit specified the fuze settings for each battery and then gave the fire order when the target’s anticipated position meant that all the shells would burst at the same place and time. The Kure unit was the only such installation, however, and never had all of its planned components.

The most modern of the Japanese naval AA guns were designed in the mid- to late-1930s and adopted in 1938 as the 8cm Type 98 and the 10cm Type 98. The 8cm (76mm) Type 98 was a very good weapon for its caliber, but was optimized for shipboard use. As a result, only two twin-mounts were emplaced on land, for the defense of Maizuru.

The 10cm Type 98 is widely regarded as Japan’s finest anti-aircraft weapon. It was powerful, rapid-firing and could track fast-moving targets. The high muzzle velocity and rapid rate of fire tended to burn out barrels quickly, but that was the only defect noted to the gun itself. Dials for pointer-matching of azimuth, elevation and fuze displayed data from the Type 2 director. The sole round of service ammunition was a fixed HE cartridge with 5.7 kg of double-base propellant for a 13.2 kg projectile that carried a 1.4 kg block of TNT and a Type 98 MT fuze, although the Type 88 PD fuze could also be issued for shipboard use against surface targets.

When used as a land-based weapon, of course, it suffered from needing considerable construction work in preparation for emplacement, which limited its usefulness to static defense. Nevertheless, 32 mounts were deployed for defense of the homeland, and another three on Iwo Jima, along with two more at Balikpapan.

The new weapons apparently did not spur any efforts to replace the Type 95 fire control system, but the capture of a Vickers angular-travel director in Singapore did. The Vickers was completely reworked to yield the Type 2 (1942) Director, which was to become the standard late-war naval anti-aircraft fire control system, with about 500 being built, seemingly starting in March 1944. Like the other naval directors, it took present azimuth, angular height and slant range as input and output firing azimuth, quadrant elevation and fuze setting. It gave a maximum computation ceiling of 6,000 meters for the old 8cm gun, 7,000 meters for the new 8cm gun, and 9,000 meters for the 12cm and 12.7cm guns. Surprisingly, it did not work well with the 10cm gun. It was efficient against targets in straight, level flight but tracking targets that changed altitude was almost impossible. Its settling time of ten seconds, although better than the 15 seconds of the Type 95, was still too long. It could, however, continuously receive present data from an outside source, such as a tracker or radar. Range drums were available for several weapons, from the Army 75mm Type 88 (with an altitude limit of 7,000 meters) to the Navy 12cm Type (Taisho) 10 (with a limit of 9,000 meters) and the 12.7cm Type 89.

The Type 2 was subjected to modifications during its production run, mostly intended to speed manufacture. The major change came in the summer of 1944 with the switch to the Type 2 Model 2 Modification 3, which eliminated the wind correction feature, to the slight detriment of accuracy. The altitude converter, which converted slant range/elevation into an altitude, was also removed and its place presumably taken by a paired optical height finder.

At the other extreme the Type 4 Simplified Short Range Director system was placed in production as both a supplement to and replacement for the more complex Type 2. The name notwithstanding, it was provided with range drums for 10cm, 12cm and 12.7cm DP guns, and it was suitable for use against both aerial and surface targets. It was a (relatively) small pedestal mounted unit that was turned by pressure from the main operator's body and worked in elevation by a handwheel. The computations were accurate, but only if good external sources of target speed and heading were available. Once the information was set the operator traversed and elevated the device to point his telescopic sight at the target and the resultant data is transmitted to the guns. The device had an effective altitude of 8,000 meters and could correct for a velocity up to 400 knots.

Since naval AA units were relatively static their height finders tended to be larger than the mobile units favored by the Army. The two main height finders in use were both 4.5 meter base units, the Type 94 and Type 98, both of conventional design.

**Anti-Aircraft Guns**

| | Mount | Bore | Length | Wt (fir posn) | MV | Eff Ceiling (m) | | Proj Wt | Elev | rds/ min |
|---|---|---|---|---|---|---|---|---|---|---|
| | Type | | cal | kg | m/s | Allied | Japan | kg | deg | |
| | | | | Army Guns | | | | | | |
| 7cm Type 11 | field | 75mm | 33 | 2,040 | 524 | | | 8.35 | 0 to +85 | 12 |
| 7cm Type 88 | field | 75mm | 44 | 2,450 | 720 | 7,180 | 5,000 | 6.53 | 0 to +85 | 20 |
| 7cm Type 4 | field | 75mm | 56 | 3,400 | 853 | | | 6.44 | -5 to +85 | 12 |
| 8cm Type 99 | static | 88mm | 45 | 6,514 | 777 | 7,600 | | 9.07 | -11 to +80 | |
| 10cm Type 14 | field | 105mm | 40 | 5,190 | 700 | 7,315 | | 16.01 | 0 to +85 | 10 |
| 12cm Type 3 | static | 120mm | 56 | 19,870 | 853 | | | 23.36 | -5 to +85 | 8-12 |
| 15cm Type 5 | static | 149mm | 60 | 45,130 | 930 | | | 44.41 | 0 to +85 | 15-20 |
| | | | | Navy Guns | | | | | | |
| 8cm Type 3 | static | 76mm | 40 | 2,900 | 677 | 5,760 | 5,000 | 5.99 | -5 to +75 | 18 |
| 8cm Type 98 | twin static | 76mm | 60 | | 929 | | | 13.02 | unk to +90 | |
| 10cm Type 98 | twin static | 100mm | 65 | 22,680 | 1,009 | 11,610 | 9,000 | 13.02 | -10 to +90 | 15a |
| 12cm Type 10 | static | 120mm | 45 | 7,710 | 823 | 8,900 | 7,000 | 20.73 | -10 to +75 | 10-12 |
| 12cm short | static | 120mm | 12 | | 290 | | | 13.52 | -15 to +75 | 10 |
| 12.7cm Type 89 | twin static | 127mm | 40 | 22,950 | 720 | 7,680 | 6,000 | 23.04 | -8 to +90 | 12-15[a] |
| 20cm short | static | 200mm | 12 | | 310 | | | 47.17 | -15 to +65 | 4 |

[a] Rounds per barrel

Note: "effective ceiling" is the arbitrary calculation used for comparisons. Actual figure was always lower. Japanese figure represents 20 seconds of engagement time against 300-knot target. Allied estimate was more lenient.

About mid-1942 it was decided that future efforts should focus on a large, complex and accurate fire control system, with a small, simple auxiliary director as back-up. The result was the huge Type 3 fire control system and the much smaller Type 4. The former was never completed, and the latter proved too inaccurate for use except in an emergency, although 300 were built starting in March 1945 by the Tokokawa Naval Arsenal.

Dealing with limited industrial resources the Navy developed three short naval guns about 1944 for use on merchantmen, although only the larger two appear to have seen use. They had very short barrels, almost mortar-length, which presumably did not place demands on the limited long-barrel manufacturing base. They were nominally dual-purpose weapons, useful against both aircraft and submarines.

The basic round of ammunition for both the 120mm and 200mm short guns was the HE, fixed in the case of the smaller weapon, semi-fixed in the larger. Little propellant was used, 0.5 kg in the case of the 12cm, compared to 5.4 kg for the 12cm L/45 coastal guns, giving a very curved trajectory. The 20cm round actually had two charges in the cartridge case to facilitate plunging fire. This was critical, as one of the roles of these guns was the destruction of submarines. To that end these HE rounds could be fitted with a special anti-submarine fuze with settings of instantaneous for a target on the surface, or a five-second delay that would, according to plans, go about 25 meters into the water before exploding, assuming it did not ricochet. These rounds could also be fitted with a Type 88 point detonating fuze for surface targets or a Type 100 mechanical time fuze for AA use, the latter being a modification of the Type 91 MT fuze with a weaker spring to permit arming with less setback. The low muzzle velocity of these guns meant that the walls of the shells could be made quite thin at 12mm, which permitted the loading of a lot of explosive fill, 2.5 kg as compared to 1.6 kg for the HE shell of the 12cm L/45 coastal gun.[10]

A GI demonstrates loading the stubby projectiles on the short 20cm gun.

The primary round for air defense for these short guns used a barrage projectile. This utilized a Type 100 time fuze to initiate an expulsion charge that deployed an explosive and incendiary munition below a pair of parachutes. The munition descended at 5 m/s and incorporated a self-destruct fuze that activated after 80 seconds. Neither was actually an effective air defense weapon, with either the HE round or the barrage round. Starting in 1944 they were emplaced on land where they could be used both in the anti-aircraft and coast defense roles, and for the latter they had ranges of 5300 m for the 12cm and 6350 m for the 20cm.

Deliveries of the short weapons in began August 1943, although formal acceptance for service did not come until 1 September, and ran at about 50 per month through late 1944, when deliveries dropped to half that until the end of the year, and then all but ceased, for a total of about 800 weapons, most of which were mounted on ships. At the end of the war there were 34 8cm, 163 12cm and 39 20cm short guns in the homeland. Additional 12cm and 20cm guns had been emplaced on the Bonins and Ryukyus.

### Army 75mm Type (Taisho) 11 Anti-Aircraft Gun

This weapon used a semiautomatic horizontal-sliding breechblock that was manually closed but opened and ejected the cartridge case automatically after firing. Leveling of the gun was accomplished through a ball-and-socket mount at the top of pedestal that could be adjusted by means of a wrench. A spring equilibrator was housed in the pedestal and operated via a cable that passed over two rollers to the rear of the trough. There were two short hydro-pneumatic cylinders, one for recoil and one a recuperator. The fuze-setter and the sight offset device were both connected to a range input handwheel. The round was twisted by hand to cut the fuze. Rate of fire was officially 15 rounds per minute, although this may have been difficult to achieve.

Army 75mm Type (Taisho) 11 Anti-Aircraft Gun.

**Army 75mm Type 88 Anti-Aircraft Gun**

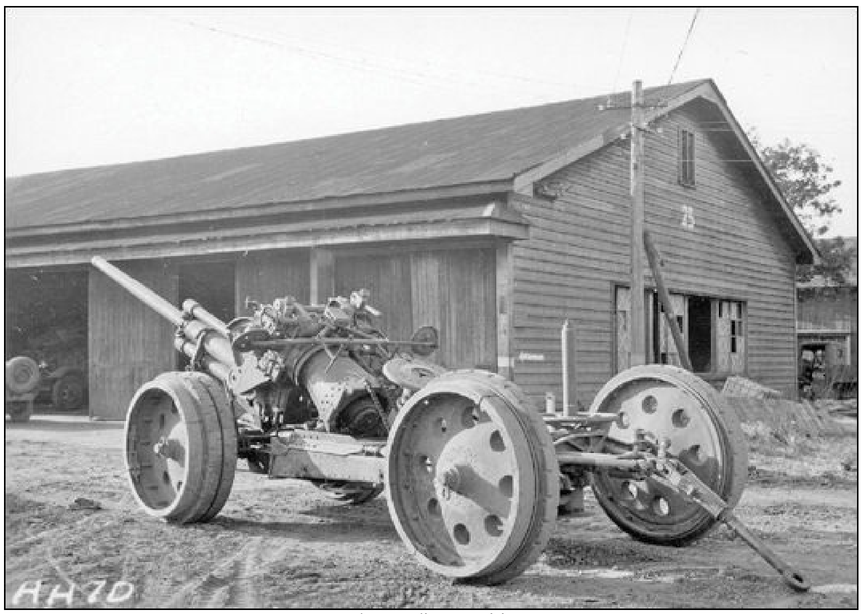
The standard heavy AA gun of the IJA during the war, the Type 88 was mechanically and visually almost identical to the (Taisho) 11, differing mainly in having a longer barrel and a longer chamber to accommodate more powerful ammunition cartridges. The projectiles, however, were the same for the two guns, mainly the Type 89 pointed AA HE projectile, which weighed 6.5 kg, of which 380 grams was the TNT charge. The weapon was stabilized by five outriggers in the field configuration, or set in concrete for fixed defense. The weapon had a theoretical effective ceiling of 7,200 meters, but US forces in the Pacific (CINCPAC) noted that they had not experienced accurate fire above 4,850 m, and SWPA reckoned the effective ceiling to actually be even lower, at 3,640 m. On the other hand, it was relatively light and portable, and quickly brought into and out of action.

A 75mm Type 88 AA gun on Tinian after the battle. Note the outriggers are almost completely buried.

**Army 75mm Type 4 Anti-Aircraft Gun**

This was a copy of the Bofors 75mm AA gun, examples of which had been captured in China in 1938. It featured a semi-automatic horizontal sliding breechblock and a hydropneumatic recoil system with the recuperator above the barrel and the recoil cylinder below. The barrel recoiled in a sleeve-type cradle, to which were fixed the recoil and recuperator cylinders and the elevation arcs. The top carriage included the fuze setter (which could set three fuzes simultaneously), elements of the Type 2 director, the elevating handwheel on the left and the traversing handwheel on the right, along with two seats for the gunners. The steel wheels had solid rubber tires 75mm thick for motor draft, although not at high speed. For traveling the barrel was pointed in the direction of the pintle, cranked up to maximum elevation, then forced down to the position shown in the photograph. It fired the new Type 4 HE projectile, unique to that weapon, with the Type 2 powder time/PD fuze.


The Type 4 AA gun in firing position



and traveling position.

**Navy 76mm Type (Taisho) 3 Dual Purpose Gun**

This was an elderly shipboard design mounted on a fixed conical pedestal which was bolted to a base ring that was set in concrete or fixed to timber bracing. A very large recoil cylinder was set above the barrel. The massive hand-operated breech assembly utilized a sliding breechblock set at a 45° angle. The barrel was of built-up construction and recoiled inside a cylindrical cradle. The short barrel length limited muzzle velocity. Using the arbitrary Allied standard the weapon had an effective ceiling of 5,760 m, but the Japanese themselves rated it at 5,000 m, and US intelligence stated that accurate fire could not be expected above 3,660 m.


Navy 76mm Type (Taisho) 3 Dual Purpose Gun.

**Army 88mm Type 99 Anti-Aircraft Gun**

This was a copy of the German 88mm SKC/30 naval gun, examples of which had been captured in China. It differed from other IJA pieces most notably in having a vertical, instead of horizontal, sliding breechblock. It featured a shield 10-15mm thick covering all but the rear, although this was not always present. The pedestal was bolted to a baseplate, which was embedded in concrete or supported by a timber base. Elevation and traverse were manual. It used a hydro-spring recoil system with a spring recuperator. The ordnance was balanced, eliminating the need for an equilibrator. Some units added a wood and steel platform that allowed the crew to rotate with the gun.


A Type 88 AA gun without a shield.

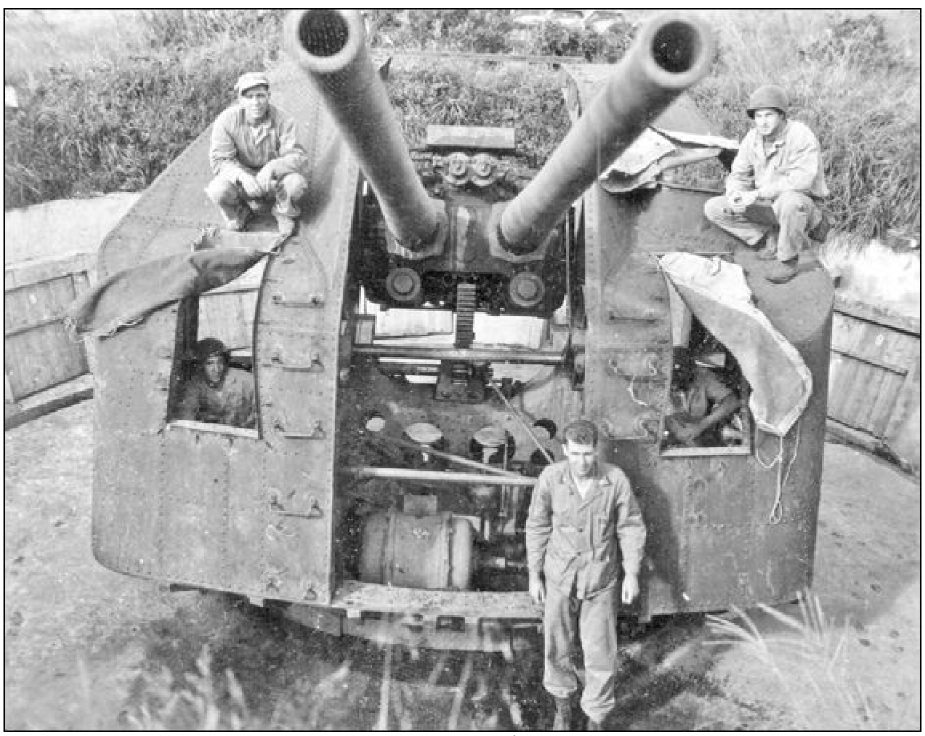
**Army 10cm Type (Taisho) 14 Anti-Aircraft Gun**

The (Taisho) 14 followed on from the earlier 75mm (Taisho) 11 weapon and also used a horizontally-sliding wedge breechblock, here one that gave considerable trouble due to jamming. The main complaint, however, was that it was simply mounted too high for its base, making it top-heavy on the move and unstable on firing. It also used the same means of leveling as the (Taisho) 11, but a different equilibrator system, with two external cylinders projecting forward from the upper carriage.


Army 10cm Type (Taisho) 14 Anti-Aircraft Gun.

**Navy 10cm Type 98 Dual-Purpose Gun**

This was a thoroughly modern and powerful gun designed for use on destroyers and cruisers. The configuration was similar to the 12.7cm Type 89, but it had large armored shields on both sides of the guns instead of the just the left side, and it lacked the long recoil cylinders of the larger weapon. The lighter weight of the mount and guns, combined with larger motors, give a much better tracking rate. It utilized a horizontal sliding breech block and an automatic rammer and fuze setter.


Navy 10cm Type 98 Dual-Purpose Gun.

**Navy 120mm Type (Taisho) 10 Dual-Purpose Gun**

This weapon followed the general practice of other Japanese 12cm naval guns of the time, with the trunnions mounted on a cylindrical sleeve, through which the barrel recoiled. Three cylinders rested on the top of the sleeve, attached at their front to the sleeve and the pistons to the rear connected to the breech ring. Two large cylinders on each side were spring recoil cylinders, while the smaller one in the center was the hydropneumatic recuperator unit. The gun featured a semi-automatic horizontally-sliding breechblock and fired fixed ammunition. The elevating handwheel was on the right side of the gun, the traverse handwheel to the left, although an auxiliary handwheel on the left permitted one man to operate both. Push-type equilibrators below the gun made it unusually easy to elevate. The most widely used round was the common projectile round with a Type 91 time fuze for AA use, a Type 88 fuze for use ground targets, or a Type 4 time fuze for both. The fuze-setter was separate from the gun and carried on a small dolly.

Navy 120mm Type (Taisho) 10 Dual-Purpose Gun.

### Army 120mm Type 3 Anti-Aircraft Gun

This was a permanently-emplaced heavy AA gun with a shield covering three sides and metal floor plates. It had an elevation motor on the mount and a 10-hp traverse motor below the ground level. The initial Model I of this gun had an elevation range of –8° to +90°, but this was replaced by the Model 2, which lowered the trunnion mounts to reduce the strain on the mount, reducing the elevation range. A loading tray cut the fuze as the round was swung into position behind the breech, identical to the Navy 100mm Type 98. Two large recoil cylinders were located above the barrel and recuperators below it. Azimuth, elevation and fuze data were received electrically from the fire control director and the gun crew zeroed a lagmotor to point the gun.

Army 120mm Type 3 Anti-Aircraft Gun.

### Navy 127mm Type 89 Dual-Purpose Gun

This weapon appeared in single- and twin-mounts, with the latter far more common in land applications. The mount had electric traverse and elevation, both of barely adequate speed, and a recoil-set spring automatic rammer and a fuze setter. Loading into the trays was manual, and an interesting feature was the platform for each loader suspended from the breech, raising and lowering as the guns moved in elevation. The guns were fitted with horizontal sliding breech blocks. The fuze setter cabinet was at the right side, with a control rod passing through the trunnion to actuate the left-side unit for continuous corrections. A curved sheet-metal shield covered the front and sides of the cabin for the two gunners on the left side of the mount. It fired fixed ammunition, with the service round having the common projectile, which could be fitted with the Type 88 fuze for surface targets and the Type 91 time fuze for AA fire.

A 12.7cm Type 89 mount. Note the loader's platform for the right-hand gun in the foreground.

**Navy Short Defense Guns**

There were two models of short-barrel guns intended for arming merchantmen, a 12cm weapon and a 20cm weapon. In both cases the barrel had to be depressed to about 15° elevation before loading, and this slowed the rate of fire considerably. The effective ceilings of these weapons is not known, but their maximum ceilings were only 3,090 m for the 120mm and 3,490 m for the 200mm. The 20cm gun had a massive breech that apparently acted in part as a counterweight. The 12cm gun used an arc and gear elevation mechanism, while the larger gun used telescoping steel rods that acted on the barrel forward of the trunnions. In both cases, elevation was quite easy.

Short 20cm gun above and short 12cm gun on the right, both post-war in Japan.

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1 Neither the Army nor the Navy made serious efforts to harden proximity fuzes for gun use. Thus, time fuzes remained the standard device for AA munitions.

2 A similar round was created in Burma by simply mating the 75mm APHE projectile with a standard AA cartridge case.

3 In addition each tenth of a second change in the fuze time changed the horizontal range 26 meters, and the height 24 meters.

4 The caliber of the weapon and rumors of their provenance confounded Allied intelligence officials through the war. Even after a few Type 99 guns were captured in 1945 in Burma intelligence officials declared the controversies settled – the guns were not copies of the German 88. They arrived at this faulty conclusion because they were comparing them, of course, to the more famous Luftwaffe 88mm Flak, not the German Navy's 3.5-inch dual purpose guns.

5 The MT fuzes were themselves not without problems and the Army estimated that the powder-train fuzes were actually more accurate up to about 5,000 meters height, beyond which their accuracy dropped rapidly.

6 The Army did develop fire control radars, but these proved ineffective in that role and are thus covered in the AA Detection chapter.

7 In August 1945 the US Military Intelligence Division estimated that some 750 Type (Taisho) 10s had been built between the start of production in 1923 and the end of 1942, followed by 250 in 1943 and 1,100 in 1944, based on analysis of serial numbers. They stated that "at least 1,300" of the weapons had been emplaced on land as dual-purpose weapons.

8 There was a Type 89 Model B which dispensed with the shield and added a larger, more powerful set of motors, but this does not appear to have been used for the land-mounted guns.

9 The guns involved used a different round of ammunition, with a heavier (27 kg) projectile and new propellant so that muzzle velocity dropped only slightly.

10 Or, in other words, the cavity of the 12cm short projectile represented 54% of the total projectile volume and that of the 20cm projectile no less than 66% of projectile volume, compared with normal values of 25-30% for standard HE projectiles.

# Anti-Aircraft Devices

## Barrage Balloons

Balloons for the defense of targets against low-level air attacks had been procured since the early 1930s, but on a very limited scale. The British use of these devices during the Blitz spurred interest and in 1941 a directive from the IJA Chief of Staff set requirements for balloon defense. Balloons would be used for the defense of factories, airfields, and other similar targets in Tokyo, Osaka and northern Kyushu against low-flying aircraft. Even these relatively modest goals were never met, however, due to the shortage of hydrogen and cloth.

One company, Fujikura Kogyo, manufactured all the barrage balloons for the Army and the Navy. An initial version, the Type 93, began development in 1933 but apparently was not placed in production until 1939. Development of an improved model began in 1941. This had a few detail changes that permitted it to operate at higher altitude, but the most important change from the Japanese perspective was the replacement of the cotton balloon material with silk. Cotton was preferred but with war mobilization and the need to manufacture uniforms and other cloth items, became hard to acquire. As a result, starting in 1943 the Type 93 and the new Type 1 were both produced in parallel, with the mix depending on the availability of cotton.

**Barrage Balloon Characteristics**

| | Type 93 | Type 1 | Type 2 | Type 4 |
|---|---|---|---|---|
| Capacity (m3) | 450 | 550 | 400 | 240 |
| Length (m) | 21.6 | 20.6 | 18.6 | 15.6 |
| Diameter (m) | 5.7 | 7.8 | 7 | 5.9 |
| L/D | 3.69 | 2.65 | 2.65 | 2.65 |
| Balloon Weight (kg) | 180 | 220 | 200 | 110 |
| Altitude (m) | 2,300 | 3,000 | 2,000 | 720 |
| Max Wind (m/s) | 25 | 25 | 25 | 25 |
| Rate of Ascent (m/s) | 2.5 | 2.5 | 2.5 | 2.5 |
| Angle of Attack (deg) | +5 | +5 | +5 | +5 |

The Type 2 was a smaller version of the Type 1 but designed for use by civilian air defense personnel.

All were generally similar, made up of four sections separated by three transverse seams. They were made of fabric coated with five layers of lacquer. The balloons were secured to the ground with hemp and steel cables with a breaking strength of 1,900 kg. No lethal devices of any kind were fitted to the balloons or cables.

The balloon winches were initially powered, with separate trailer-mounted or stationary winch and engine units to enable a single engine to mechanically drive several winches sequentially. The engine was a 4-cylinder unit putting out 20 hp that provided power to a heavy winch with a haul-in speed of 85 m/min and a pay-out rate of 240 m/min. After about a thousand powered units had been built they were replaced in production in 1944 by a hand-operated model for the Type 4 balloon to save materials. Each balloon had a crew of 20 men to handle it. A balloon took about 15 minutes to raise and about 30 minutes (with a snatch block and full crew) or 90 minutes (with a mooring device and half crew) to lower.

The service life of the balloons was six months in the summer or twelve months of winter weather. The three types remained in production into 1944, with 100 Type 93, 120 Type 1 and 200 Type 2 having been built, with most production after 1941. In 1944 a new version, the Type 4, was introduced to reduce labor and costs. About 500 of these were built, although it is not clear how many were actually delivered and deployed.

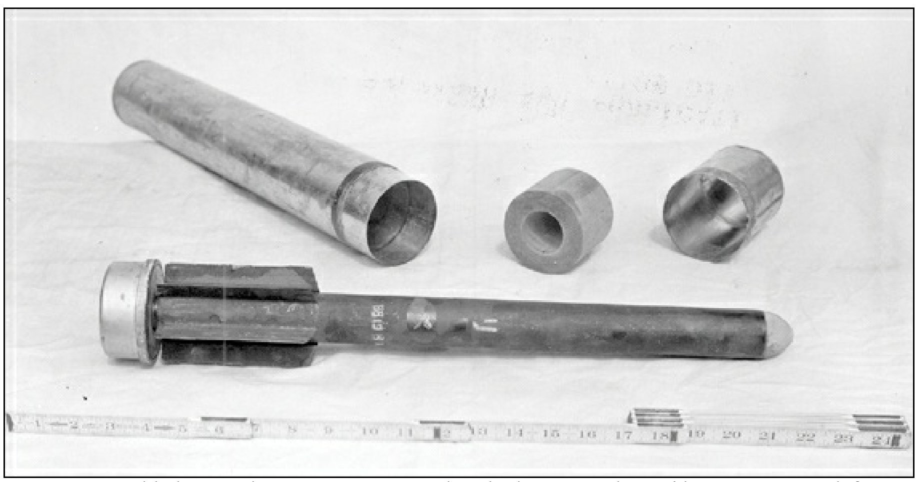
In operation the balloons were placed in small numbers 500 to 1,000 meters from the target being protected and about 4,000 meters apart to prevent entanglement. The Army deployed balloons not only in the homeland, but also to Manila and Palembang. The overseas balloon units were provided with hydrogen generators, at a ratio of about three balloons per generator, but these devices could only produce gas at 7 cubic meters per hour, so filling a Type 2 balloon took a while.

The IJN began buying balloons in 1944 for defense of their larger bases in the homeland, and seem to have procured a couple of hundred of the Army's Type 4 balloons, along with Army accessories to include cable and winches. The Navy also deployed 39 of the Type 4s to the Philippines to guard Manila harbor and Subic Bay. The hydrogen produced in Japan was 98% pure, but none of that was shipped with these balloons, instead they relied on high pressure hydrogen generators that worked by electrically decomposing liquid ammonia. These devices could only generate 75% pure hydrogen, which reduced the maximum ceiling of the Type 4 balloons from 1,000 meters to 800 meters. Further, the Navy generators could produce only 24 cubic meters per hour, thus requiring 10 hours to inflate the 240-cubic-meter Type 4 balloon.

### Barrage Mortars

An ingenious, if not particularly successful, solution to the problem of defense against low-flying attack aircraft was the barrage mortar. This was a simple tube with a fixed firing pin, a wooden block for a baseplate, and spike projecting downward for stability. Ammunition consisted of a cylindrical projectile and a propellant charge. The mortar was set so that it was pointed straight up, or nearly so, and when fired the projectile would reach an altitude of about 515 meters before an 8-second powder time fuze would open the projectile body and deploy submunitions.

There were two models, a 70mm and an 81mm, presumably to take advantage of existing mortar barrel production facilities. The 70mm mortar was placed in production in 1942 at the Tokyo No.1 Army Arsenal. For that weapon the ammunition's cargo consisted of seven explosive charges, each with its own parachute attached by a 2-meter long cord. The small charges would drift down, taking about two and a half minutes to reach the ground. A friction igniter attached to the parachute cord would detonate the charge if pulled with a force of about 8 kg. Thus, if an airplane flew into a cord it would set off the charge. The inert shell case was also provided with a parachute, presumably to avoid injury to friendly troops on the ground. The 70mm barrage mortars were widely distributed as secondary weapons, being noted by US forces from the Aleutians to the Solomons. Massed fire, however, was not practiced. In May 1944 US technical intelligence noted:



An assembled 81mm barrage mortar round at the bottom and cartridge components left.

> Although no instance has ever been reported of our aircraft being damaged by this weapon, it would appear that this weapon might be very effective against low flying aircraft if used in sufficient quantity. A small number of mortars could maintain a dangerous "barrage" of floating bomb tubes in the air if fired at the maximum rate. To date, there is no evidence that any such method is being tried, and only occasional rounds have been observed.

A high-volume barrage, of course, would expend a lot of ammunition to defend a relatively small area, and Japanese supply difficulties may explain the absence of such tactics. Success with the weapon was so scanty that no record has survived of the lethality of the little bombs carried, or of the actual likelihood of hitting one in a barrage.


A GI with a captured 70mm barrage mortar and round.

The 81mm mortar was built by the Nagoya Army Arsenal, which produced 6,000 of them starting in April 1944 and ending four months later. This unique round had a subcaliber main body only 38mm in diameter, apparently relying on the long fins for stability in the barrel. This used only a single 113 g charge that was supported by two parachutes via a 1- and 9-meter cords. The ejection altitude for this round was 1,000 meters and, unlike the 70mm rounds, it had a self-destruct feature that operated after 40 seconds to detonate the munition in the air to avoid the problem of duds on friendly ground.

Both weapons were cheap and simple to manufacture, especially inasmuch as the tubes were smooth-bore, and used few precious raw materials. Each individual weapon was hopelessly inaccurate, so success depended on massing weapons directly underneath a likely flight path and firing a barrage of submunitions that planes would have to fly through. The obvious limitations of this system ruled out forming units dedicated to manning the barrage mortars, and instead they were issued to ground troops to operate when possible.

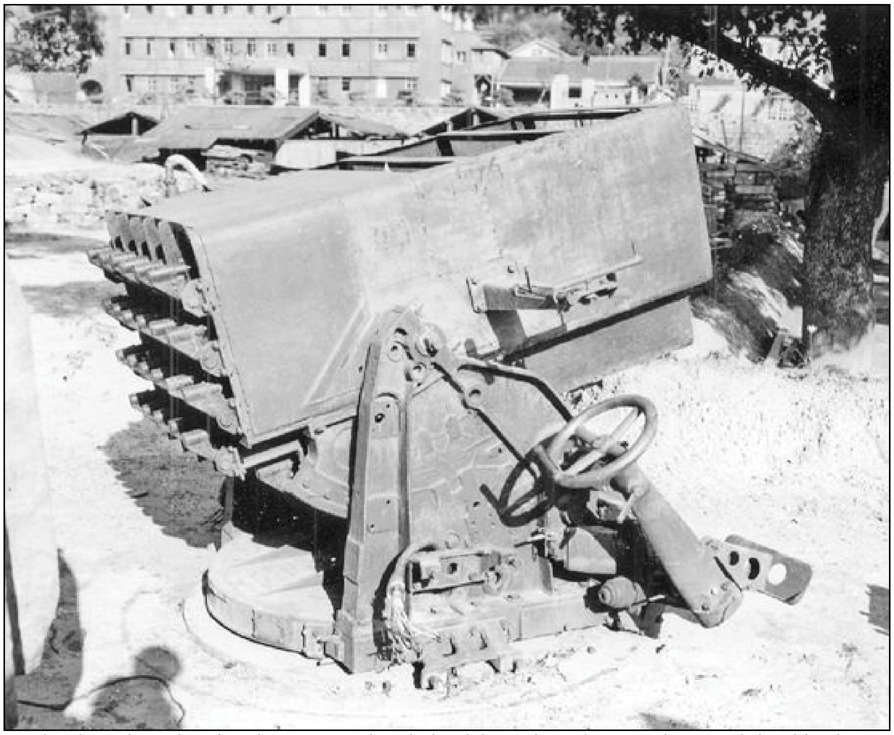
An example was the improvised barrage mortar platoon formed within the 4th Battery of the 12th Medium Artillery Regiment in the Philippines in April 1945. It consisted of a platoon leader, a 5-man HQ squad, and five mortar squads, each of five men with a barrage mortar. The platoon thus had 31 men, 5 barrage mortars, 15 rifles, 10 shovels and 5 picks and was to be commanded in action personally by the battery commander.

**Anti-Aircraft Rockets**

The Navy developed a 12cm AA rocket launcher and deployed it on aircraft carriers and battleships, seeing its first action in October 1944. They also, apparently in desperation, emplaced a few at Kure Navy Yard. Under pressure of time the designers adapted the 25mm triple AA mount by replacing the ordnance with a box with 28 launching troughs, three upper layers each of 6 and two lower layers of 5. It was mounted on a rotary pedestal with a seat on each side. The gunner sat on the left and operated the elevation handwheel and firing mechanism foot pedals. The assistant gunner sat on the right, operating the traverse wheel. Both had simple metal bar sights. The two tracked the target and when within range the gunner pressed the pedal, which pulled an electrical trigger that fired all 28 rockets in sequence.

The first rocket to be developed was an incendiary-shrapnel spin-stabilized model weighing 23.9 kg and fitted with a Type 5 Model 2 combination fuze with 5.5 to 8.5 second time. The IS warhead was similar to those used on shipboard AA guns. Steel pipe 20mm in diameter with a wall thickness of 3mm was painted with coal tar, then an incendiary agent was forced into the tube, leaving a perforated center for a quick burning igniter. The filled pipe was then cut to about 25mm lengths to yield incendiary pellets. The main components of the incendiary mix were 40% barium nitrate, 45% magnesium, 9% organic polysulfides, and 5% rubber. The warhead held 60 of these pellets.

The Type 5 fuze would cause the rockets to burst at about 600 m altitude, and a 28-rocket ripple salvo would create a cloud of these burning pellets. The Navy regarded this weapon as effective both for its visible effect and as being particularly useful against dive bombers.



A Navy 12cm AA rocket launcher, showing the traverse handwheel, but minus the seat there and the thin sheet-metal flame shield.

The IS-warhead rockets were also fitted one each side to some suicide boats, apparently to suppress Allied shipboard guns. In that case a simple powder fuze gave a range of 2,000 to 3,000 meters before burst. Thought was also given to using them as ground weapons, and to that end an HE warhead with 1.6 kg of explosive was developed to complement the IS round. For that application the Type 5 PD fuze was used, giving a range of 4,800 m, although the simple powder time fuze was retained when used on suicide boats.

# 17

# Anti-Aircraft Detection Equipment

Engaging enemy aircraft at night or in periods of reduced visibility proved difficult for everyone until an effective radar system came on the scene. The initial means of night firing, adopted by all combatants of World War I, was the large searchlight that could illuminate enemy aircraft in the sky, thus permitting aiming of the guns. Initially, the IJA bought about two dozen 60-inch diameter searchlights from the Sperry company with Duplex generators for this task.

Of course, the searchlights could not just randomly swing their beams around in the dark, they needed at least a rough indication of where to point. That was the job of the sound locators. The sound locators had horns that magnified the sound coming from a particular direction and the operators could traverse and elevate the sound locator to point it towards the source of the sound. Generally a sound locator would have four “horns”, two for the azimuth operator and two for the elevation operator. In each case the output from the horns fed into different ears of the operator to aid in binaural sensing of the sound.

Early efforts appear to have utilized both the bistatic and monostatic modes. The bistatic mode used two sound detectors at known locations that telephoned their data to a central plotting team that calculated the intersection of the two vectors. This was the more accurate of the two methods, but required a network of fixed sound locators, relegating it mostly to fixed defenses, and was slow in operation. The more common method was the monostatic, which involved estimating the azimuth and angular elevation from a single machine. Sound locators were initially purchased from the US and France. The first Japanese machines, the Types 87, 88 and 89, were large and cumbersome and built only in trials numbers.

An early sound locator, a Type 90 Large, on maneuvers.

For use in the field a smaller, more portable unit was needed and this requirement led to the development of two versions of the Type 90 Sound Locator, introduced in 1930. One was a small version and the other a larger one, still with four horns apiece, two each for the elevation and azimuth operators.

Of course, simply pointing the horns at the apparent noise source did not locate the target. Unlike the electronic waves used in later radar devices, sound waves move at a leisurely pace through the atmosphere. When a radar device was pointed at the source of the strongest signal it was, for all practical purposes, also pointed at a moving aircraft. A sound locator, however, was always pointed some distance behind the plane, identifying where it had been when it made the sounds that had finally made it to the horns of the device. Thus, if the target aircraft is 3,000 meters (9,900 feet) away the sound will take about 8 seconds to reach the sound locator on the ground. A plane traveling at 500 km/hr will have gone over a kilometer in that time. Any calculation based on the sound locator's sensing must compensate for that lag, which is further complicated by the fact that this compensation presupposes the accurate ranging needed to determine just how much lag to compensate for. Further complications are that wind can change the apparent direction of the noise, while varying air densities and humidity can affect the speed of sound.

It should have been fairly obvious that sufficient accuracy to point guns could never be achieved with sound locators, but that did not stop the IJA (and other armies) from trying in the early 1930s. Of course, the results were disappointing and aside from trials during maneuvers, the sound locators appear to have been relegated completely to searchlight assistance. In that mode, where they could provide a general direction that the lights could probe, they were able to provide some useful service.

The four-man crew of a Type 90 Small Sound Locator on pre-war maneuvers.

The small Type 90 was not only smaller and more portable than the earlier models, but performed some of the calculations right on the machine. The device was mounted on a tripod with adjustable legs to permit leveling. A circular disk was fitted to the head of the tripod and the rest of the apparatus revolved around that fixed disk. A table carried the horns and formed a horizontal surface that revolved around the disk, this table being fitted with two long rollers, one on each side. These were rotated together by the elevation handwheel. They thus imparted a motion, perpendicular to the edge of the table, to a ruler that lay flat on the disk with a lug on each end that engaged the grooves in the rollers. At the center of one edge of the ruler was a pen. In operation, elevating the horns traced a radial line on the on this disk, while traversing traced a circle on the disk with its center at the center of the disk and its radius corresponding to the vertical setting. The third crewman, the plotter, used a small strip that pivoted on the pen to read a predicted azimuth and elevation. These settings were announced by voice to the searchlight crew.

The Type 90 was such an improvement over the earlier models in terms of mobility and usefulness that it was immediately placed in (relatively) mass production and 21 had been built by the end of 1930, enough for the sole AA regiment and school use. Apparently benefits were still expected from separating the horns further apart and a large version of the Type 90 was also built, mainly for static homeland defense. A revised version, with a more complex plotting system, was apparently also known as Type 95 Sound Locator. This featured a plotting device that projected a beam of light upwards onto a glass cotangent board. A pointer was then manually positioned along this plot, this activating mechanical linkages that worked selsyn transmitters, with the data being transmitted electrically to the Type 93 or Type 1 searchlight control unit. The Type 95 does not appear to have been a success, however, and those that were built were eventually decommissioned, leaving the Type 90 Small as the standard sound locator for all applications through the end of the war.

The Type 90 sound locators were initially used with 60-inch (150cm) US-built Sperry searchlights. An indigenous replacement, a close copy of the Sperry, was developed and standardized as the 150cm Type 93 searchlight in 1933, but apparently full scale production did not start until 1940.

The Type 93 searchlight differed from the Sperry in only two respects. First, it lacked the exhaust fan of the American light, and second it incorporated vertical shutters just behind the lens operated either manually at the light or remotely from the control unit. These could be used for rapid black out or for signaling. Arc control was semi-automatic, with adjustment for burn rate, but no thermostat or other means of maintaining the position of the positive carbon. Traverse, elevation, opening and closing of the shutters, and beam spread were all controlled remotely from the control unit.

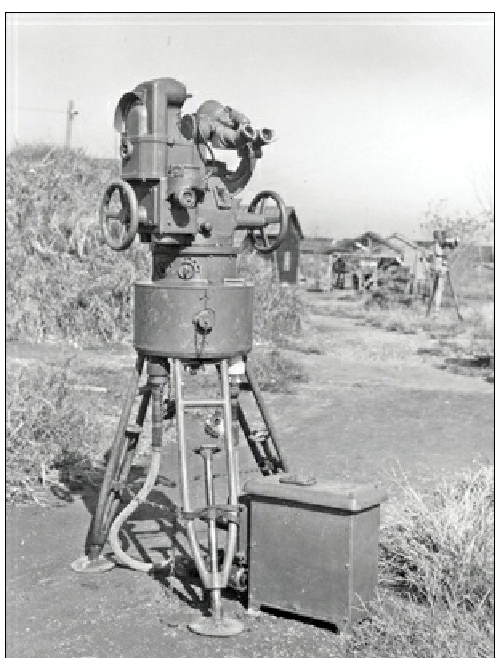
The light was carried on a mount with small wheels that were used to move it across ramps on and off the bed of the generator truck. In action the light would be unloaded from the truck and set up within the 200 meters of cable that carried power from the truck to the light. The control unit would also be set up, within the 100 meters of cable that connected that unit to the light. A telephone line would run from the sound locator to the control unit to carry oral information, unless the Type 95 sound locator was in use, in which case a 70-meter cable carried the requisite electrical signals directly. The power for the light was provided by a generator in the front of the truck body, which was run by a power-take-off from the 39-hp water-cooled gasoline truck engine.

The Type 93 Control Unit (or comparator) had a twin eyepiece, with a right ocular that served as a tracking telescope with 10x optics. The left eyepiece had a line of sight that turned left 90° to look at an arc-shaped reading window through which two pointers indicating the relative orientations of the tracking telescope (and the searchlight) and the data from the sound locator could be checked for coincidence. A pair of handwheels elevated the telescope and also, via electrical commands, the searchlight. The upper portion of the comparator rotated freely and its rotation was also applied, electrically, to the searchlight. Also on the comparator were electrical controls to open and close the shutters and widen and narrow the beam.

Two views of a Type 93 generator/searchlight truck. Note the winch at the front of the cargo bed for loading and unloading the light, with the generator directly below.

In action, the searchlight commander would initially lay the control unit and searchlight on the elevation and azimuth data of the sound locator, and then search the sky with the light via the telescope on the control unit. Once he illuminated a target he would track it with the telescope, which would also keep the searchlight on it. The two pointers on the comparator would be checked to ensure that the light was properly following the telescope movements.

The Type 96 searchlight was a Type 93 with minor improvements and continued to use the Type 93 control unit. Where this combination was used with the rare Type 95 sound locator, data could be automatically transmitted from the sound locator to the comparator, although the effectiveness of this arrangement in practice is unknown.



Type 93 searchlight control unit.

**Army Searchlight Characteristics**

| **Searchlight** | **Type 93** | **Type 1** | **Type 3** |
|---|---|---|---|
| weight (kg) | 700 | 1000 | 3175 |
| reflector dia (cm) | 150 | 150 | 200 |
| candlepower at source | 1.7 x 105 | 2 x 105 | 2.5 x $10^5$ |
| candlepower reflected | 6 x 108 | 10 x 108 | 20 x $10^8$ |
| nominal range (km) | 6 | 8 | 12 |
| arc voltage (v) | 78 | 90 | 90 |
| arc current (amp) | 150 | 250 | 305 |
| positive rod dia x l (mm) | 16 x 560 | 17 x 800 | 17 x 800 |
| negative rod diz x l (mm) | 11 x 305 | 16 x 420 | 16 x 420 |
| consumption mm/hr, pos rod | 280 | 900 | 1400 |
| consumption mm/hr, neg rod | 120 | 90 | 100 |
| **Generator** | | | |
| weight (kg) | 3000 | 3000 | 2000 |
| capacity (kw) | 18 | 32 | 35 |
| generated voltage | 105 | 115 | 115 |
| current rating (amp) | 150 | 267 | 305 |
| **Controller** | | | |
| weight (kg) | 150 | 500 | 500 |
| max vertical speed, secs/90° | 10 | 5 | 6 |
| max horiz speed, sec/360° | 140 | 20 | 23 |

Initial efforts to further improve the basic Type 93 searchlight concentrated on increasing the beam power. To this end they incorporated larger carbons and higher arc current and voltage – to 90 volt 250 amp – that yielded one billion candlepower illumination. The increased capacity of the generator needed mandated a significant change in configuration – it would now have its own 6-cylinder air-cooled diesel engine. The generator with its diesel engine was placed on a trailer with small wheels, similar to that of the Type 93 searchlight, and would now be carried in the bed of the truck for most moves. The searchlight was now placed on a conventional, if somewhat top-heavy, trailer with pneumatic tires to be towed behind the truck.

This new searchlight/generator combination was designated the Type 1, but it was not placed into production immediately because a new controller was taking longer to perfect than anticipated. The new controller, much heavier and on its own trailer in the mobile version, increased the engagement speed of the searchlight considerably, and was now to be compatible with radar hand-off. The new Type 1 searchlight, instead of using “step-by-step” motors that were found in the Type 93 used selsyn-type motors that paralleled similar motors on the controller. The control unit was a powered system capable of receiving selsyn data from a remote source, such as a Type 95 sound locator or, more significantly, a radar. The data appeared graphically as an icon within concentric rings and centering the rings around the icon brought the searchlight into line with the received data. The comparator operator could also control the light directly using a pair of 15x binoculars incorporated on the top of the unit.

**Army Production of Sound Locators & Searchlights**

| | 1931 | 1932 | 1933 | 1934 | 1935 | 1936 | 1937 | 1938 | 1939 | 1940 |
|---|---|---|---|---|---|---|---|---|---|---|
| Sound Locator, Type 90 Large | 12 | 11 | 6 | 7 | 8 | 8 | 2 | 0 | 0 | 0 |
| Sound Locator, Type 90 Small | 27 | 28 | 37 | 28 | 20 | 36 | 8 | 0 | 0 | 224 |
| Searchlight, Type 93 | 10 | 10 | 10 | 10 | 20 | 20 | 40 | 0 | 7 | 150 |
| | 1941 | | 1942 | | 1943 | | 1944 | | 1945 | |
| | Apr-Jun | Jul-Dec | Jan-Jun | Jul-Dec | Jan-Jun | Jul-Dec | Jan-Jun | Jul-Dec | Jan-Jun | Jul-Aug |
| Sound Locator, Type 90 Small | 46 | 101 | 88 | 90 | 96 | 99 | 50 | 0 | 0 | 0 |
| Searchlight, Type 93 | 24 | 54 | 30 | 43 | 30 | 24 | 18 | 0 | 0 | 0 |
| Searchlight, Type 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 20 | 20 | 0 |

This additional requirement both delayed development and increased production requirements from 1,250 man-days to 1,377, and it was not until July of 1944 that the Ordnance Bureau switched from issuing Type 93s to the new Type 1s. Even then they made it clear that it would be quite a while before all existing units could expect replacements. Indeed, only 40 Type 1s were issued to field units to supplement the 1,300 Type 93s used.[1]

The final step in the IJA's searchlight development path was to enlarge the prior 150cm lights to 200cm as the Type 3 Searchlight. It was essentially a scaled-up version of the Type 1 with a 90 volt 300 amp consumption that reportedly yielded 2 billion candlepower. The control unit and generator were derived from the Type 1 units. In the event, only four Type 3s were built and served only for field trials.

The Navy had a wide variety of searchlights designed and built for shipboard applications, and made use of those for the land-based air defense role. The two most common were both introduced in 1936, the 110cm Type 96 and the 150cm Type 96 searchlights. They were almost identical except for the mirror diameter. Both had identical arc arrangements consuming 85 volts and 200 amps of current to yield 1,300 million candle power. The main differences were that the 110cm had a weight of 1.6 tons and was manually controlled, whereas the 150cm weighed 2.1 tons and used selsyn motors controlled from the Type 96 comparator. A total of 60 of the smaller lights were built, while production of the larger Type 96 ran at about 4 per month through the war. There were also small numbers of manually-controlled 90cm Type 92 and Sperry lights used, with intensities of 1200 and 900 million candlepower, respectively.

The Type 96 control unit (comparator) came in two varieties, both power operated with a maximum traverse speed of 16°/sec. The Type 96 Mark I weighed 580 kg and could elevate from –10° to +90°, while the Type 96 Mark II was slightly lighter at 465 kg and could elevate from –10° to +100°.

The Navy had three models of sound locators. The Type 90 was a lightweight unit similar to the Army's Type 90, while the Type 97 was a much heavier unit, for which they claimed a maximum pickup range of 17.8 km, while the later Type E had a claimed pickup range of 29.8 km. In any event, the Navy had little faith in sound locators, possibly in part because they had no shipboard experience with them, and only rarely actually used them.

The use of radio waves, rather than sound waves, for aircraft detection and location presented obvious advantages, in particular that of essentially real-time information without a time lag, and the ability to determine range. Putting that into practice, however, was considerably more difficult.

Along with many others at the same time, the Japanese had noted that an airplane passing between a transmitter and a receiver, particularly at certain frequencies, disrupted the signal due to the Doppler effect. They were slower off the mark, however, than the Germans, British and US. In early 1941 the Army directed the development of a bistatic radar that would become designated the Type A Bistatic Doppler Interference Detector. This used a transmitter and an omnidirectional antenna and two or more satellite receivers placed tens, or even hundreds, of kilometers distant. A receiver could tell if an airplane passed between it and the transmitter, but little else. Lacking any but the crudest of location information its usefulness was extremely limited, but initially it was all they had, and it did provide some benefit in China, where air traffic was light, and around the home islands. As a result it was ordered into production and the first set came out in November 1941. Eventually

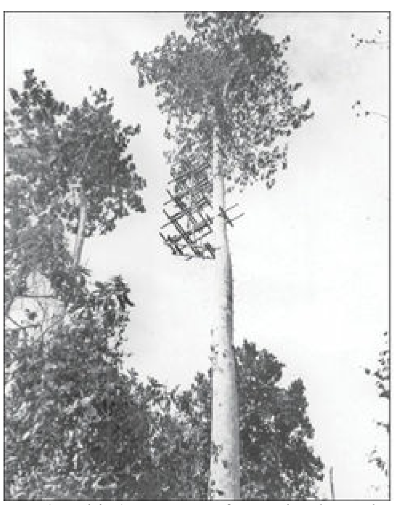
400 to 500 of these sets were built by NEC and Toshiba. The longest “link” was between Shanghai and Taiwan, a distance of 650 km.

This Type A detector used a continuous wave at frequencies of 40 to 60 MHz with variable power settings of 10, 20, 100 and 400 W. These yielded ranges of 80, 120, 200 and 350 km. Presentation of information was in the form of a panel at each receiver with colored lights to indicate when a plane had passed between the transmitter and that receiver and an aural signal that led the operators to nick name it the “bow wow set”.

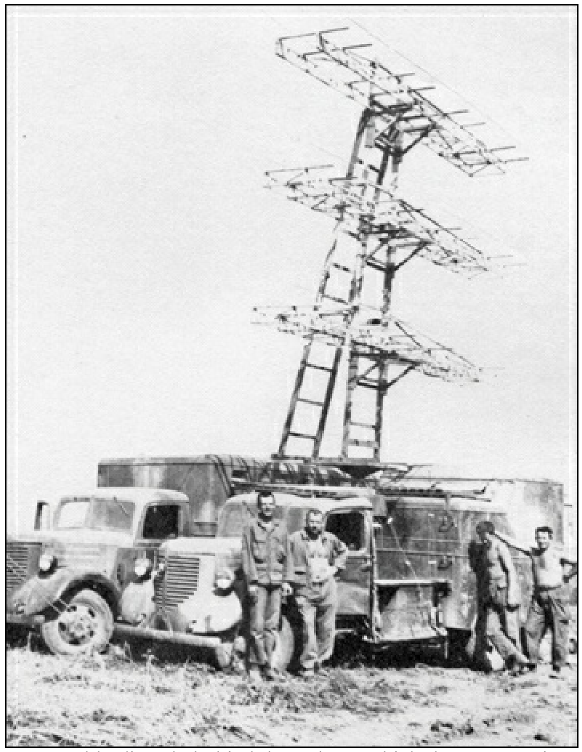
The Doolittle Raid of April 1942, although hardly noted by the civilian populace, was a professional humiliation for the Army and the Navy. Efforts on air warning developments were stepped up, and before too long the Japanese had captured Allied radars. Examination of the British GL (gun laying) Mk II and SLC (searchlight control) radars captured in Singapore and the US SCR-268 fire control radar and SCR-270 early warning radars on Corregidor quickly disabused the Japanese, both Army and Navy, that their radar efforts were on the same level as their enemies. British and US radars were quickly shipped to the Army’s 5th Technical Institute for study.

Suddenly work on a replacement for the Type A Detector had some priority. The result was the Type B Fixed Early Warning Device (later Tachi-6).[2] This was similar to the Type A in being a bistatic device, with a transmitter and several remote receivers, but there the similarities ended. The Type B used pulsed waves, rather than continuous. Initially the antenna was omnidirectional box, but later a crossed-dipole version radiating over 90-120° was substituted. The transmitter could select an output of 68, 72, 76 or 80 MHz and had a peak power of 50 kW. The pulse repetition rate was 500 or 1,000 Hz. The key improvement was that the receivers had narrowly directional antennas that could be traversed by hand. An A-scope in the receiver control would indicate when, during the movement of the antenna, the signal was strongest, thus providing an azimuth to the target. The nominal range of the set was 200-300 km and it went into service in 1942, with 350 eventually being built by NEC, JRC and Matsushita.

The next step forward for the Army resulted in the Type B Mobile Early Warning Device (later Tachi-7). The frequency was increased and fixed at 100 MHz and the pulse repetition rate set at 750 Hz, while peak power remained the same. The main change, and a very important one, was that it operated as a single tactical unit that transmitted and received on a single antenna. The light wooden antenna rotated by power in the search mode, but could be manually traversed back and forth for fine searching and tracking. This permitted it to not only measure azimuth to the target, but also range to within 5 km, since time to signal return could be measured. It still, however, used an A-scope to display the information. A unit had four trucks, one each for the transmitter electronics, the receiver electronics, the generator and spare parts and accessories. Production was assigned to Iwasaki Communications Co. and the first set delivered in 1943, but only 60 were built.



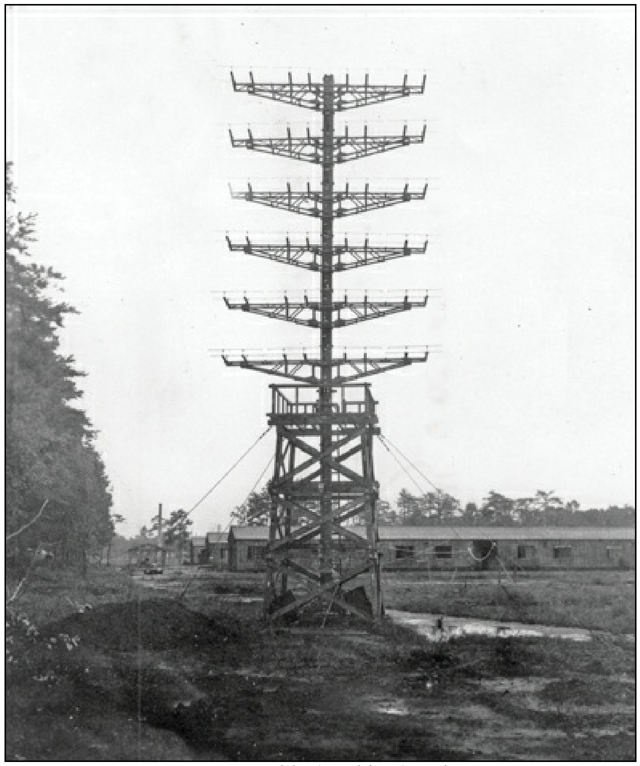

An Army Type B Fixed Detector (Tachi-6) on Noemfoor Island; on the left the transmitting antenna set in a tree, on the right a receiver antenna.



The receiver truck of the Tachi-7 in the foreground has a turntable directly behind the cab on which the antenna is assembled for use once in position. The transmitter truck is behind.

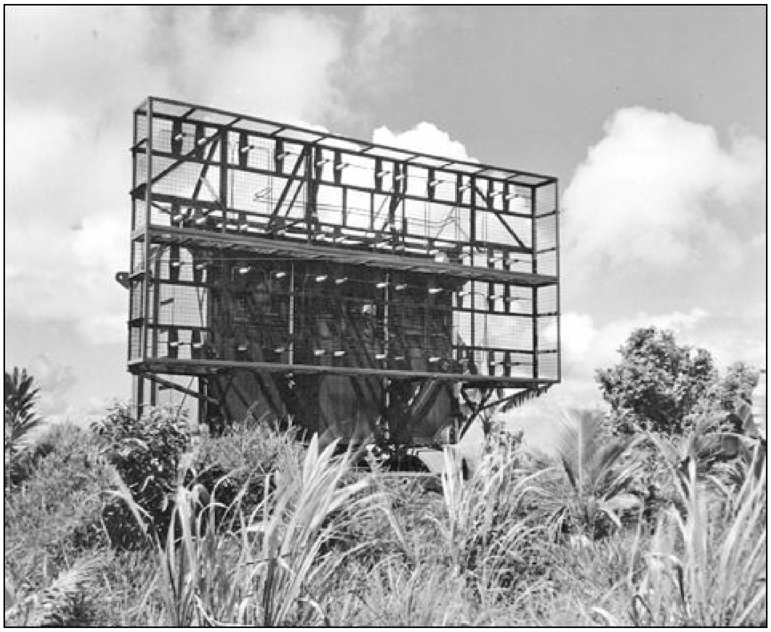
That was replaced, in turn, by the Type B Transportable Early Warning Device (later Tachi-18), based on the captured SCR-270. The result was a much lighter unit, 4 tons as compared to the 18 tons of the Tachi-7 with roughly similar performance. Both had a stated range of 200 km achieved with 50 kW of peak power. Frequency could be set at 94, 98, 102 or 106 MHz, generally the same, but the pulse repetition rate was dropped to 375 Hz. Production was entrusted to Toshiba and Iwasaki, with the first production unit coming off the line in 1944 and a total of 400 being built, all of which apparently stayed in the home islands. Theoretically the unit could be disassembled and moved in trucks, but in practice they tended to stay in one place once set up.

A weakness of all these sets, although a relatively minor one given the dire straights Japan found itself in, was that none could give altitude data, only azimuth in the Type B Fixed or azimuth and range in the later versions. To remedy that the Tachi-20 height finder was developed that operated as a receiver in conjuction with the Tachi-6 to provide altitude ±500 m. Only 30 were built but they were used for ground control interception with fighter aircraft rather than land-based air defense.

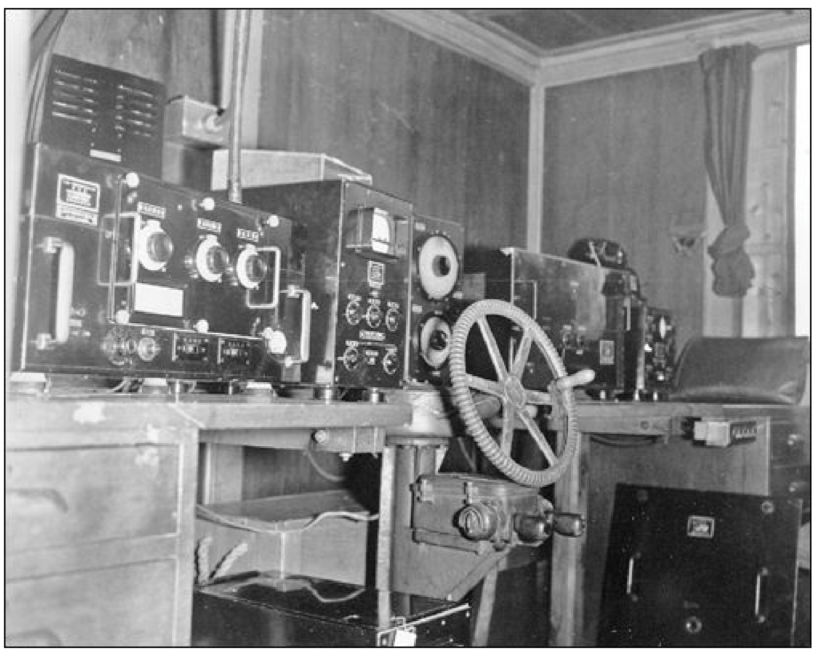

A Type B transportable (Tachi-18) radar antenna.


A Navy Type 2 Mark 1 Model 1 air warning radar near Nagasaki.

The Navy had also been relatively inactive, and like the Army it took the Doolittle Raid to get things moving in earnest. A dual-track approach was taken to air warning radars. One model, designated the Type 2 Mark 1, was intended for fixed shore use to protect naval bases, while another, the Type 2 Mark 2, was for use on ships. Development of the Type 2 Mark 1 Model 1 began in April 1941 and was completed in March 1942 in its initial version.[3] The first two versions (Modifications 0 and 1) were low power, but work on Modification 2 started shortly after the Doolittle Raid and completed in May 1943, followed by Modification 3 in August. Like the original version, these latter two operated at 100 MHz, but the power had been increased from 5 kW to 40 kW, while the pulse repetition rate was cut in half to 500 Hz. The Type 2 Mark 1 Model 1 had two antennas mounted side-by-side on the same large wooden mattress frame. This frame was fixed to the front of a wooden control shed, and the whole thing mounted on a turntable. Maximum echo as the unit traversed provided azimuth, while timing provides range. The higher-powered versions could detect a single plane at 130 km and a formation at 250 km. It is not clear how many of the first two were built, although a Type 2 Mark 1 Model 1 Modification 0 was captured on Guadalcanal. In the event, only 30 of the Modifications 2 and 3 were built.



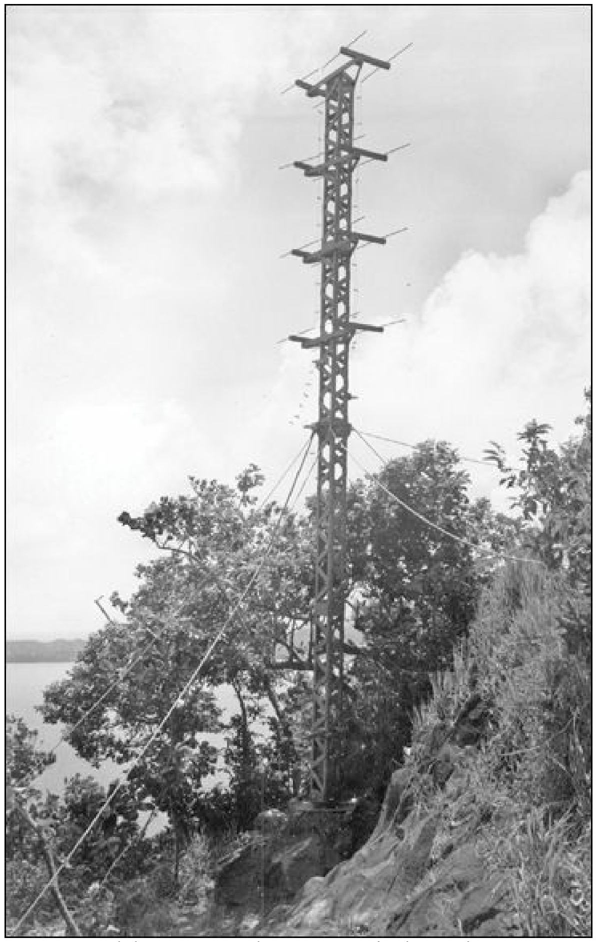
Two views of A Navy Type 2 Mark 1 Model 2 radar on Moen Island in Truk, the right photo showing the interior of the control cabin.



These were replaced in production, at Toshiba and Nihon Onkyo, by the Type 2 Mark 1 Model 2 series, which began development in April 1942 and completed it a mere eight months later. These were lighter units, although using a similar antenna, and lower powered, with the air of making them transportable. They shared some components with the Type 2 Mark 2 Mod 1 shipboard radar. The antennas were mounted on cabins that were carried on trailers. They operated at 150 MHz with only 5 kW of peak power. They went through three modifications (0, 2 and 3), but all retained a range of 50 km against a single plane and 100 km against a formation of planes. Modification 3 involved two distinct antennas mounted on the trailer cabin, with development turning around quickly, running from December 1943 to January 1944. A total of 50 "Model 12's" off all modifications were built with production commencing in December 1942.

The most numerous naval air warning radar was the Type 3 Mark 1 Model 3 (also known as the Model 13) The antenna was made up of a stack of dipoles mounted on a rotating vertical mast set on or next to the control shack and supported by guy wires. It worked at 150 MHz (i.e., 2 meter wave length) with 10 kW peak power and a pulse rate of 500 Hz. The range was 50 km against a small plane and 100 km against a formation. Range resolution was about 3 km and bearing accuracy was about +/- 10°. Development was begun in April 1943 and completed that August. About a thousand were built by Toshiba and Anritsu.

The final Navy air warning radar to see major service was the Type 3 Mark 1 Model 1 (also known as the 11-K, to distinguish it from the earlier Model 11) which, confusingly, actually followed the Type 3 Mark 1 Model 3, with development starting in May 1943 and completed in October. It was similar in appearance to the Model 11.



A Model 13 Navy radar on Moen in the Truk group.

The performance of the Navy's air warning radars apparently varied greatly, probably due to varying local abilities to compensate for the poor quality control that plagued all Japanese radar efforts, as well as siting problems. Rabaul, for instance, had two Model 11s and nine Model 12s, and the Navy's Chief Signal Officer there stated that both had ranges of 96 km against a single plane, 100-115 km against a flight of three planes, and 135-145 km against more than three. The low-lying Marshall Islands received unspecified Type 2 radars (probably Model 11s), but in all cases these were said to give ranges of only 40-80 km (due at least in part to their low elevations), yielding only five to ten minutes' warning. Truk received Model 12s and Model 13s. Here it was possible to place them on high hills and the Truk command reported they achieved ranges of 300 km with both models, this remarkable figure probably referring to use against large formations.

Following the Doolittle Raid the Army ordered the development of searchlight control radars and in June 1942 contracts were placed with NEC and Toshiba for competing designs operating on 1.5 m wavelength with 5 kW power. The prototypes were delivered in December, only six months later, an initial examination was favorable, with nine more of each being ordered for further trials. These were delivered in January 1943. Both types proved fragile in service, operational only a few hours each day, which restricted them to use in the homeland. As a result, only 35 of each were ever built. The NEC product was designated the Tachi-1 and the Toshiba unit the Tachi-2.

In the meantime two types of British radar had been shipped back to Japan from Singapore, an SLC searchlight radar and a GL Mark II gun control radar. NEC took the GL Mk II and incorporated some elements from their Tachi-1 to create a new 3-meter set and, by dint of extraordinary labor, turned out a prototype in December 1942. Tests demonstrated its superiority over the Tachi-1 and –2 models and it was quickly ordered into production as the Ta Type 3, later Tachi-3. Estimates of the number built vary greatly, from a low of 67 immediately after the war to a high of 150 in a much later study.[4] In either case, it was one of the more widely used of such radars.

**Production of Army AA Fire Control Radars**

| | 1943 | | | | | 1944 | | | | | | 1945 | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Mar-Apr | May-Jun | Jul-Aug | Sep-Oct | Nov-Dec | Jan-Feb | Mar-Apr | May-Jun | Jul-Aug | Sept-Oct | Nov-Dec | Jan-Feb | Mar-Apr | May-Jun | Jul-Aug |
| Tachi-1 | 3 | 9 | 15 | 16 | 7 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Tachi-2 | 2 | 11 | 12 | 22 | 16 | 7 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Tachi-3 | 0 | 0 | 0 | 0 | 19 | 16 | 12 | 10 | 7 | 3 | 0 | 0 | 0 | 0 | 0 |
| Tachi-4 | 0 | 0 | 0 | 0 | 0 | 20 | 23 | 6 | 17 | 12 | 0 | 0 | 0 | 0 | 0 |
| Tachi-4 mod | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 5 | 12 | 16 | 27 | 1 | 24 | 0 |

Almost simultaneously, Toshiba examined the British SLC and began combining its features with those of its own Tachi-2. The result was the Tachi-4, a 1.5-meter gun-laying radar. Initial American efforts to blind the Tachi-1 to -4 series with "window" were successful, but training of the operators could reduce its effectiveness by about 80%. Jamming proved more successful, especially at shorter ranges.

None of these first four efforts was sufficiently accurate to permit gun pointing. Such a unit was available, however. When Japan entered the war Germany decided to share the technology of their Würzburg radar and Japan sent a submarine to pick up an example and documentation. The submarine almost made it, hitting a British mine in October 1942 after leaving Penang. Two Italian submarines made a second effort the next year and one made it, carrying most of the radar and a German technician. This resulted in a two-pronged approach. The German worked on building the Würzburg in Japan with Japanese materials and practices, while a Japanese team set about developing a hybrid of Toshiba's Tachi-2 and the Würzburg.

The effort to build a Japanese Würzburg failed. It proved impossible to find components built to the same demanding specifications as used in Germany and the first prototype, delivered in December 1944 as the Tachi-24, failed to operate at all. Frantic efforts to rebuild the set to working order resulted in a single unit that was shipped to the 15cm AA battery outside Tokyo, but it served only as a surveillance set.

The other effort was more successful. Initially Tachi-2/Würzburg hybrid was known as the Type 4 Modified, but it was subsequently given its own designation as the Tachi-31. There was some difficulty in mating the Tachi antenna to the display of the Würzburg, but eventually it yielded the best of the Army's fire control radars. That, however, is faint praise indeed. They never did come very close to the accuracy figures of the Würzburg – 40 meters in range and 2 mils in azimuth and elevation.

The Army did develop a data distribution system that would transmit firing data over radio frequencies from a single radar to up to six battery positions. An operator at the radar site could turn a handle to dial in numeric data and this would be transmitted to and repeated on dials on the remote receivers. Only seven units had been sent to the field by the war's end, however, all still on trials, so its efficiency remains unknown.

The Navy pursued two tracks in precision radar – one, less demanding, for searchlight control and the other for gun fire control. The initial effort in designing a searchlight control radar using the captured British SLC model resulted in the Mark 4 Model 3 Modification 0, also known as the L-1, and was a failure. A redesign that also simplified production was the Modification 1, also known as the L-2.

The L-2 used the same key feature as its earlier incarnation – a bistatic configuration with a transmitter and antenna mounted on the searchlight controller and the receiving antenna on the searchlight itself. The L-3 was similar to the L-2 but further simplified to speed production. Very few of the L-1s were built, about 120 L-2s, and 70 L-3s, although almost all of those last-mentioned were destroyed in a bombing of the factory.


A Tachi-31 radar of the 119th AA Regiment in Niigata prefecture on Honshu.

Where the Army had chosen to base their fire control radars on British designs, the Navy took the American SCR-268 as a starting point. They attempted a copy as the Mark 4 Model 1, also known as the S-3, with research starting in August 1942 and completing a year later. A total of 50 were built by NEC, but these appear to have suffered from teething problems An early S-3 sent to Rabaul and set up with a two-turret 127mm battery proved so unreliable that it was disassembled and stored after repeated attempts to get it to work failed. A simpler model, to speed manufacture, started development in January 1943 and this was completed in October 1944. This, the Model 2, also known as the S-24, also proved to be slightly more accurate than the S-3 and probably somewhat more reliable. In the end the IJN regarded the S-24 as the best Japanese fire control radar and the accuracy figures, although still well short of western standards, seem to bear that out.

In the event, neither the Army nor the Navy managed to come up with a fire control radar system that was sufficiently accurate for the firing of guns. In addition, shortages of raw materials late in the war and the lack of an advanced electronics industrial base resulted in small production numbers and poor reliability of produced sets. It has been argued, however, that the wartime radar effort was a major contributor to post-war Japanese commercial success in consumer electronics.

**Type 90 Small Sound Locator**

This was the standard IJA sound locator throughout the war. It featured two horns for the azimuth operator and two for the elevation operator, with each horn having a diameter of 50cm at the bell and 3cm at the throat. The elevation horns were separated by 1.7 m vertically and the azimuth horns by 1.8 m horizontally. The unit weighed 260 kg, was worked by a crew of four, had 360° traverse, and could elevate from –5° to +90°. Japanese manuals gave it a fair weather range of 7 kilometers and an accuracy to a fixed source of 1°, although other sources say 1° in elevation and 4° in azimuth. A plotting board and cotangent chart accounted for time lag due to the slow speed of sound. The only external data required for the data solution was target ground speed, which was usually assumed. The data was read off the board and announced orally to the searchlight control unit, there being no data transmission system.


A Type 90 Small Sound Locator being demonstrated shortly after surrender. Note the plotting table at the top of the tripod.

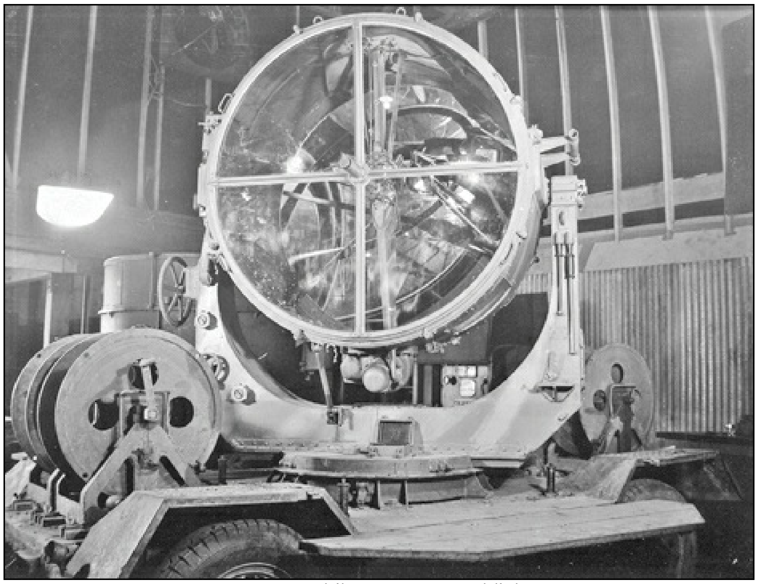
**Type 93 150cm Searchlight**

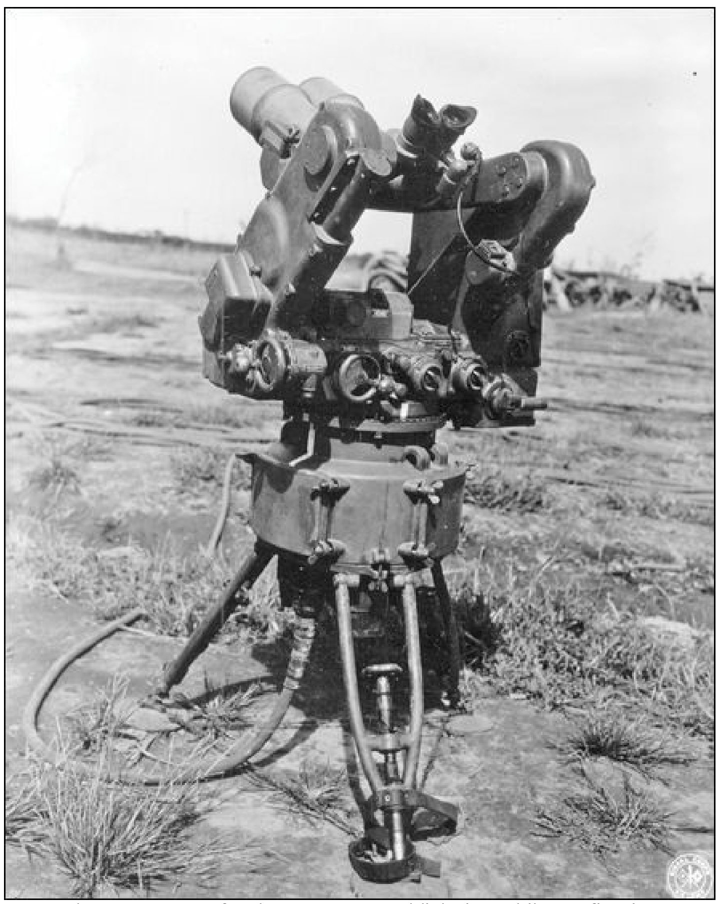
This unit developed 600 million candlepower out of 78 volt-150 amp power consumption. It utilized a parabolic glass reflector 1.4cm thick, with an outer diameter of 156cm and a focal distance of 65cm. The searchlight itself weighed 1,000 kg, and the control unit 125.5 kg. The searchlight was mounted on a small-wheeled carriage that was rolled on and off the generator truck for movement. The truck itself weighed 5,800 kg, yielding a total system weight (with accessories) of 7,432 kg. The beam spread of 1°, 4° and 6°, along with traverse, elevation and shutter operation, was controlled by the off-carriage control unit. Japanese manuals gave it a range of 8 kilometers.

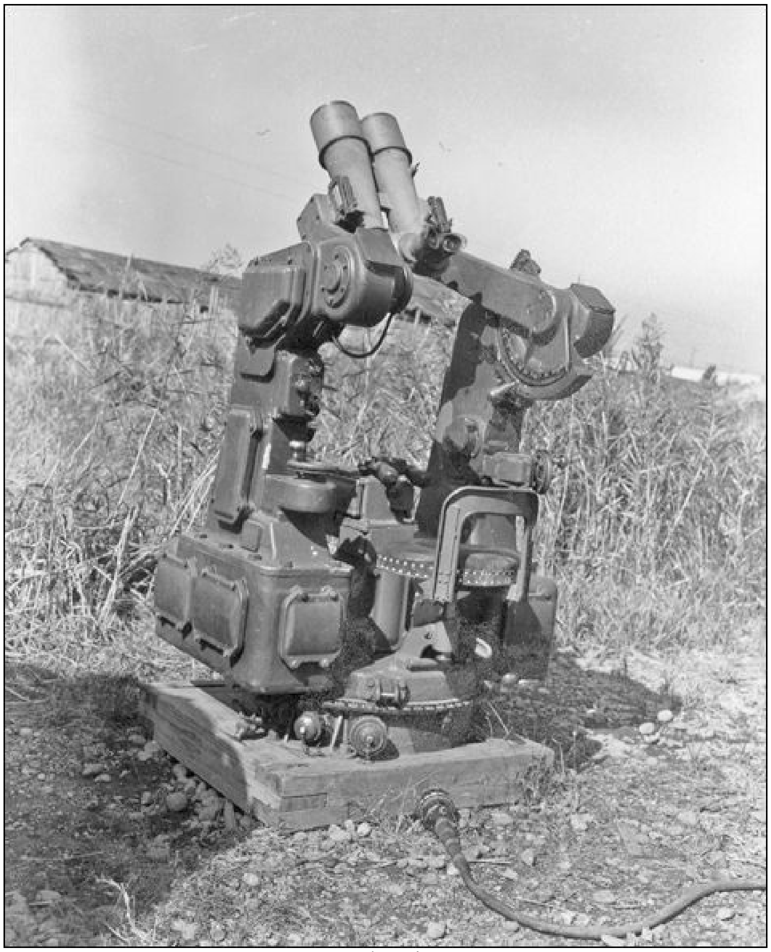

A Type 93 searchlight with the shutters removed.

**Type 1 150cm Searchlight**

This was an improved version of the Type 93, of the same diameter but drawing 90 volt-250 amp power to provide one billion candlepower. There were two models, static and mobile. The static model had no thermostat, and shutters and beam spread were controlled manually at the light. The mobile model had a thermostat for positioning the positive carbon, and the arc strike, shutters and beam spread were controlled from the comparator. The comparator was power-operated, with the operator riding on a seat on the unit in the static version.


Type 1 Mobile 150cm searchlight.


The comparator for the Type 1 searchlight in mobile configurion

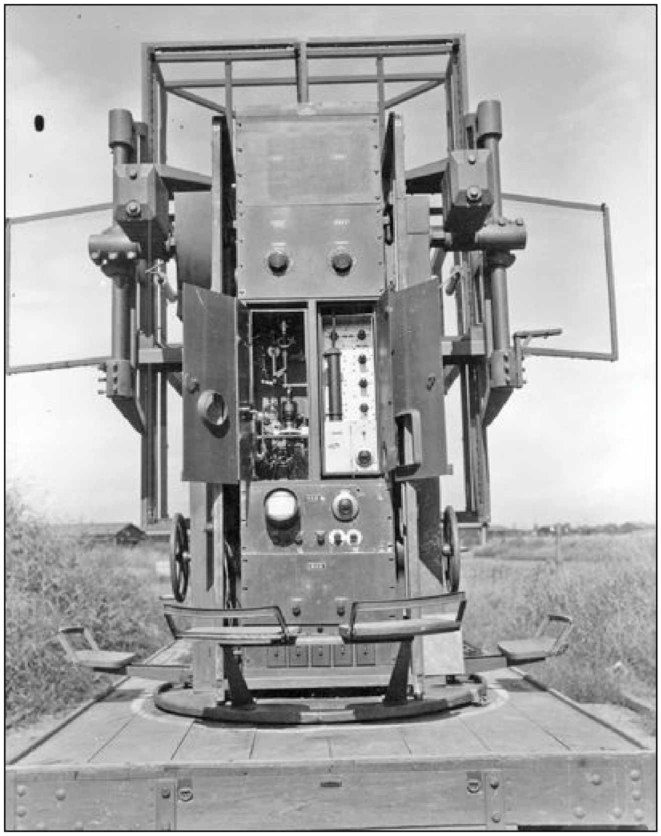


and static

**Tachi-1 & Tachi-2 Searchlight Radars**

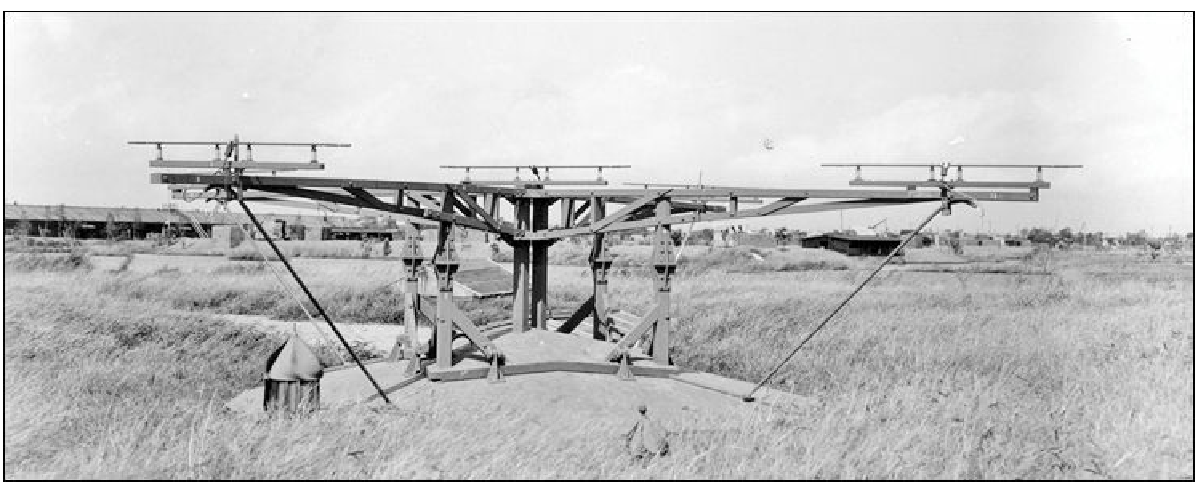
Two models of searchlight control radars that were, in fact, almost identical in appearance and performance. Both operated at 200 MHz with a pulse repetition rate of 1,000 Hz. Peak power was 10 kW. The transmitter antenna was a central dipole. The receiving antenna, on the same frame, had four dipoles in a diamond shape that fed through a capacitive phase ring to conical scanning. The frame was mounted on a yoke on a turntable, so that it could be rotated in azimuth and swung in elevation. Data was displayed on three oscilloscopes, one each for azimuth, elevation and range. The Tachi-1 had a rated range of 15-20 km, while the Tachi-2 had a nominal range of 20-40 km. The Tachi-1 was notoriously poor at elevation accuracy, with the Tachi-2 being somewhat better (18 mils compared to 35-52).

Two views of a Tachi-2 searchlight control radar. Normally the Tachi-1 and Tachi-2 units were fixed, although in a few cases, such as here, they were mounted on trailers for mobility.

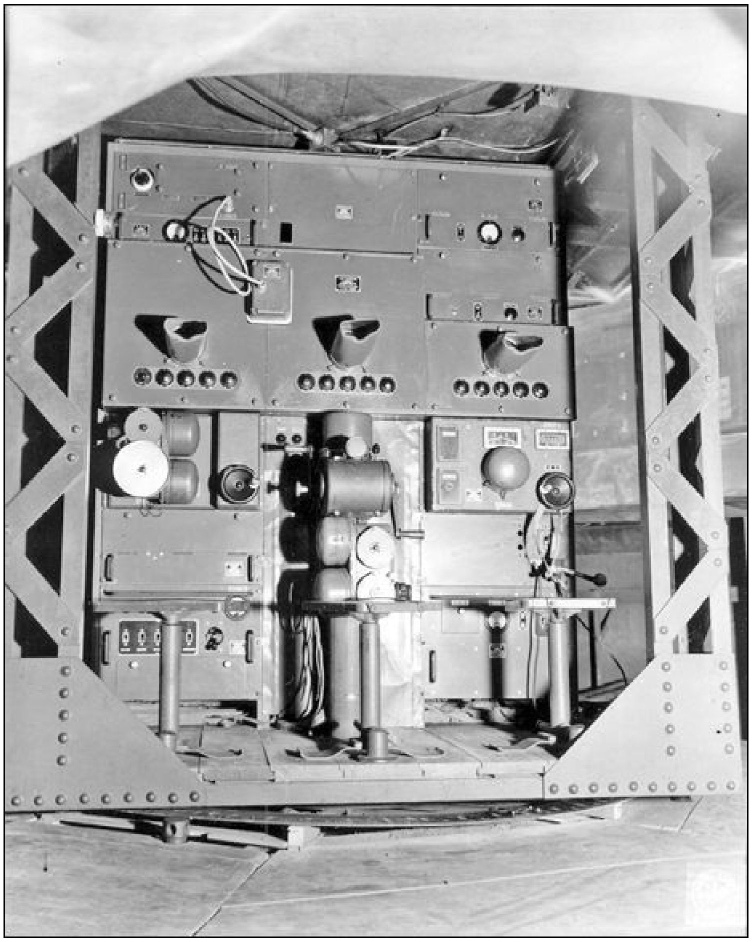


**Tachi-3 Fire Control Radar**

Probably the most numerous of the IJA fire control radars, the Tachi-3 was a three-meter unit that combined features of the Tachi-1 and the British GL Mk II. The transmitter and receiver had separate antennas, about 75 meters apart, and projecting just above ground level from underground control units. Both could rotate in azimuth, but neither could mechanically elevate. Instead, elevation angle was determined by means of a goniometer. They operated at 78 MHz with a peak power of 50 kW and a pulse repetition rate of 1,875 Hz. The stated range was 40 km. Accuracy was said to be 300 meters in range, and 18 mils each in azimuth and elevation.



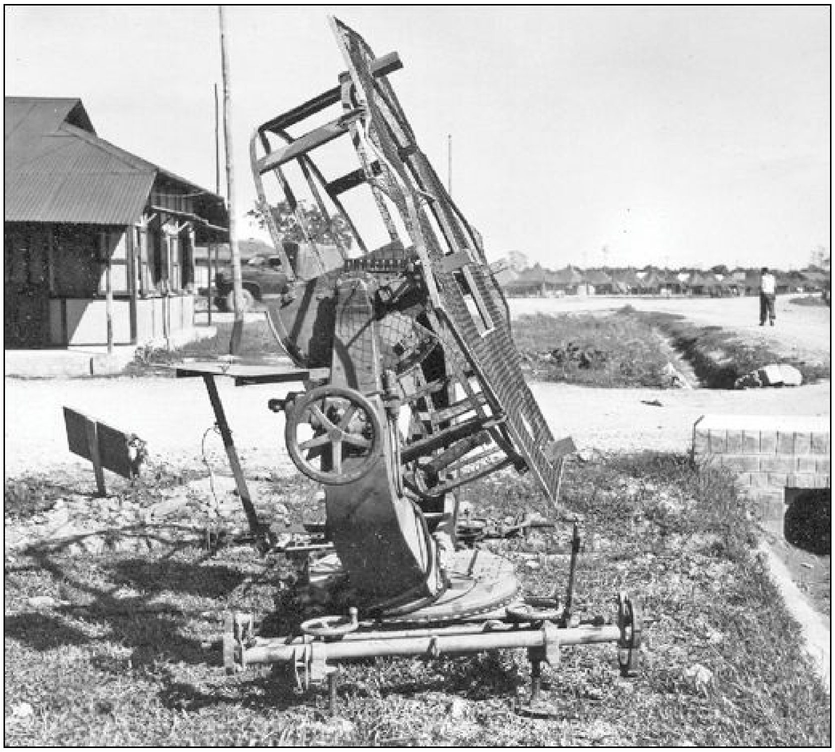
The Tachi-3 receiver. Above, the antenna, right the control unit with stations for three crew.



**Tachi-4 Fire Control Radar**

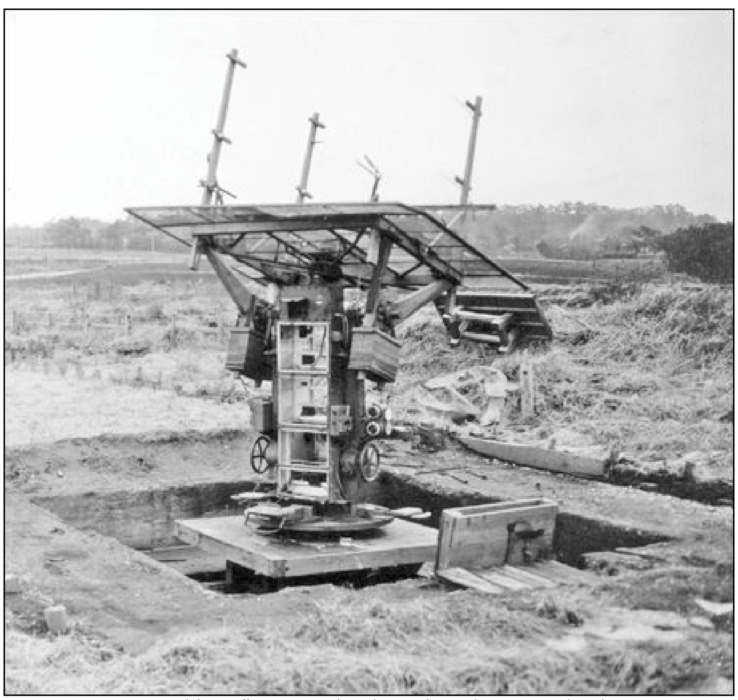
This unit combined features of the British SLC and the Japanese Tachi-2 radars. The number of operator scopes was reduced to two by combining the azimuth and elevation readings into one. A circular antenna frame carried four Yagi dipole arrays switched consecutively by a phasing motor for receiving and one for transmitting. It operated at 200 MHz at a peak power of 10 kW with a pulse rate of 1,000 Hz. The stated range was 40 km. Azimuth and elevation accuracy was the same as the Tachi-3, but range accuracy was improved to 100 meters.

Two views of the antenna of the Tachi-4.



**Tachi-31 Fire Control Radar**

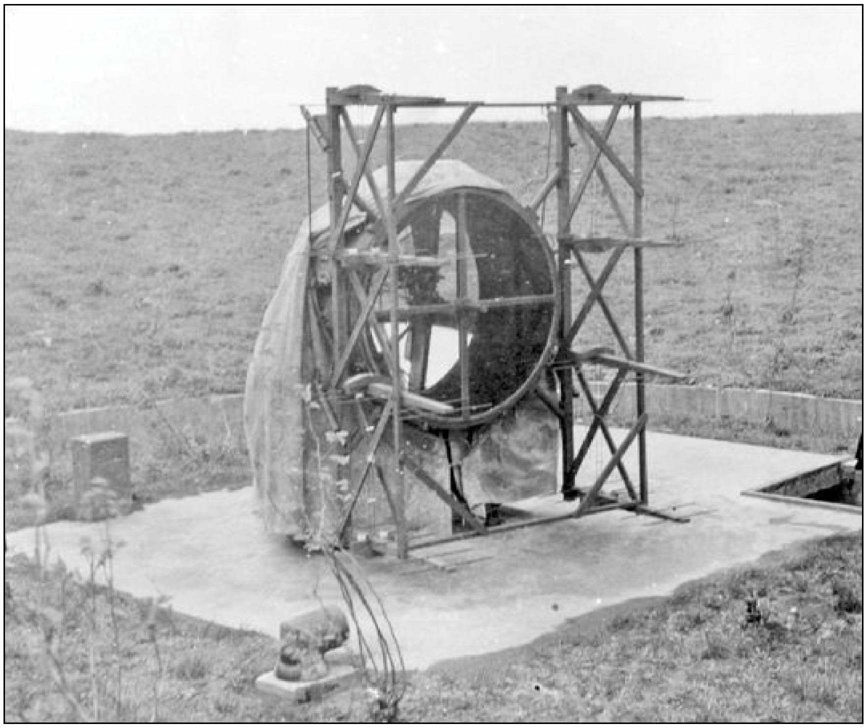
Originally known as the Tachi-4 Modified radar, this set borrowed heavily from the Würzburg technology delivered in 1943. It operated at the same frequency and peak power as the Tachi-4 but had an increased pulse rate of 3,750 Hz. It used one antenna for transmitting and receiving and had a stated range of 18-25 km. Range accuracy was 100m, while azimuth and elevation was 12 mils.



A Tachi-31 fire control radar unit at the AA School.

**Mark 4 Model 3 Searchlight Radar**

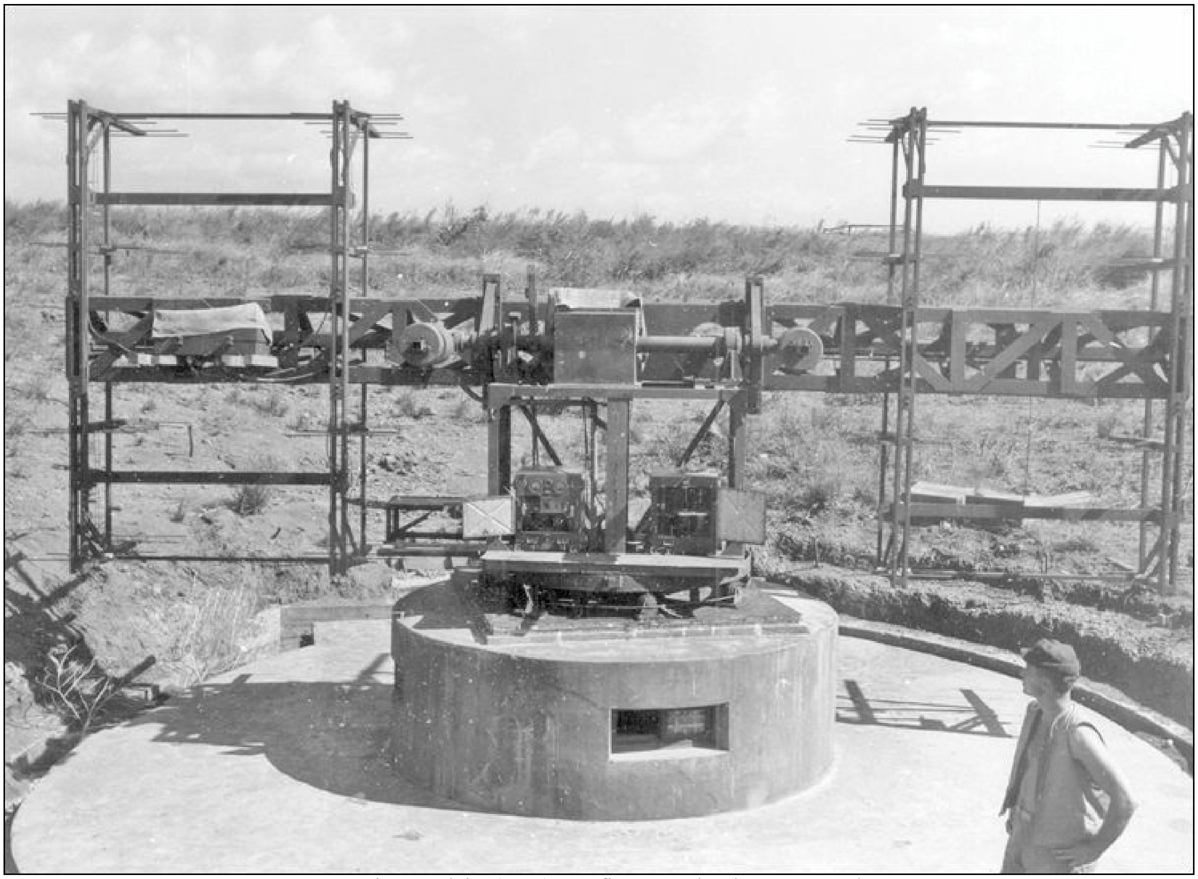
This Navy unit was an unusual device in that the transmitter antenna was mounted on the searchlight controller, along with the bearing and elevation indicators, while the receiving antenna and transmitter power supply were mounted on the searchlight itself. The searchlight was operated remotely from the controller, which received its information from the radar. Azimuth and elevation were displayed as an echo spot, which the operator brought to the center of the oscilloscope. The unit had a range accuracy of 150 meters and a bearing accuracy of about 25 mils. Maximum range was 22 km.



An L2 (Mark 4 Model 3 Modification 1) searchlight receiver antenna mounted directly on the light, near Nagasaki.

### Mark 4 Models 1 & 2 Fire Control Radar

The original Model 1 (S-3) was a close copy of the US SCR-268. The Model 2 (S-24) was similar but with a different antenna arrangement. Where the Model 1 had three antennas (one each for transmitting, elevation and bearing), the Model 2 had two by combining the receiving antennas into one. Both operated at 200 MHz with a peak power of 13 kW and a pulse rate of 1,000 Hz. Range was said to be 20 km against a single plane and 40 km against a formation. Accuracy in range was claimed at 50 meters and in bearing plus or minus 18 mils. The Model 2 had four scope operators who sat around a narrow shelf viewing their scopes: one each for range, azimuth, elevation and target selection. The IJN considered this the best of the Japanese fire control radars.


A Mark 4 Model 2 (S-24) gun fire control radar near Sasebo.

1 The quantities of Type 93 searchlights built as shown in the table are almost certainly too low, but are those reported after the war by the Ordnance Bureau, Tokyo 1st Arsenal and Fuji Denki Seizo, the leading manufacturer. The figure of 1,300 comes from the post-war AFPAC study of Japanese AA defenses of the homeland and may, itself, be a little high.

2 In July 1943 the IJA established the Tama Technical Research Institute under the direct control of Prime Minister and War Minister Tojo to unify the radio efforts of the Army Scientific Research Lab, the Army 5th Research Institute and two other institutions. Thereafter, Army radars were given a two-syllable designation starting with "Ta" (for Tama Technical Research Institute) then "chi" for land-based, "ki" for airborne, or "se" for ship-borne. The units under discussion here are thus all Tachi (ground-based AA) radars.

3 The Navy taxonomy for radars was *shiki-go-kata*, usually translated as type-mark-model, with a final *kai* or "modification" if needed. Confusingly, they were often given alternative designations that simply abbreviated the portion after the "type". Thus, the Type 2 Mark 1 Model 1 was often known as the Model 11, the Type 2 Mark 1 Model 2 as the Model 12, etc.

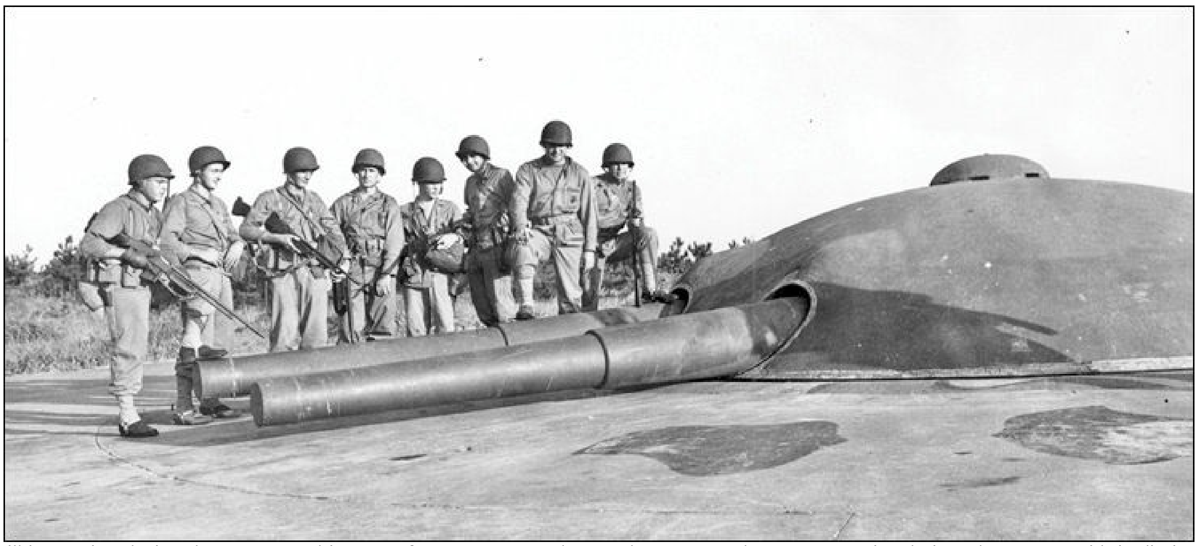
4 The table is taken from Survey of Japanese Antiaircraft Artillery, GHQ USAFPAC, February 1946. The figure of 150 total produced is from Nakagawa.

# Coastal Artillery

The arrival of better-armed western warships off the Japanese coast in the 1800s precipitated many dramatic changes to Japanese governance. From a military perspective one of the more significant was a major effort to develop coast defenses in hopes of keeping the barbarians at bay. Initially this was the responsibility of the Army.

## Army Coast Artillery Guns

In 1886 a seacoast modernization board established the 28cm coastal mortar as the principal coastal weapon, to be supplemented by smaller numbers of 24cm L/23 guns, both to be manufactured in Japan. Pending the development of manufacturing capacity, however, the purchase of a wide variety of foreign guns, including 15cm Krupp Model 1890 and St. Chamond Model 1890, and 27cm Schneider-Crusot Model 1894, was authorized. The foreign weapons had been placed in storage by the start of Wolrd War II and appear not to have been returned to service, except for a few St Chamond turrets.



Among the antiques still in service during the war was this, one of two 15cm St Chamond turrets on the Futtsu Peninsula in Tokyo Bay. With its limited elevation it threw its 45 kg shell only to 10 km.

The 28cm mortars on the other hand, 110 of which had been built during 1887-1892 based on an Italian design, remained in service through the end of the war. Since their near-vertical plunging fire made precise ranging a prerequisite, they were sited to fire into channels and passages that could be registered in advance. The vulnerability of these large short-range weapons in their open pits was recognized during during the 1930s, however, and their masonry emplacements had been allowed to deteriorate over the years. Although many were still in place at the end of the war, most had had their crews pulled away to man other, less vulnerable and more useful, weapons.


Large numbers of the ancient 280mm coastal mortars remained intact, such as this one on the Ogasawaras, but few were manned.

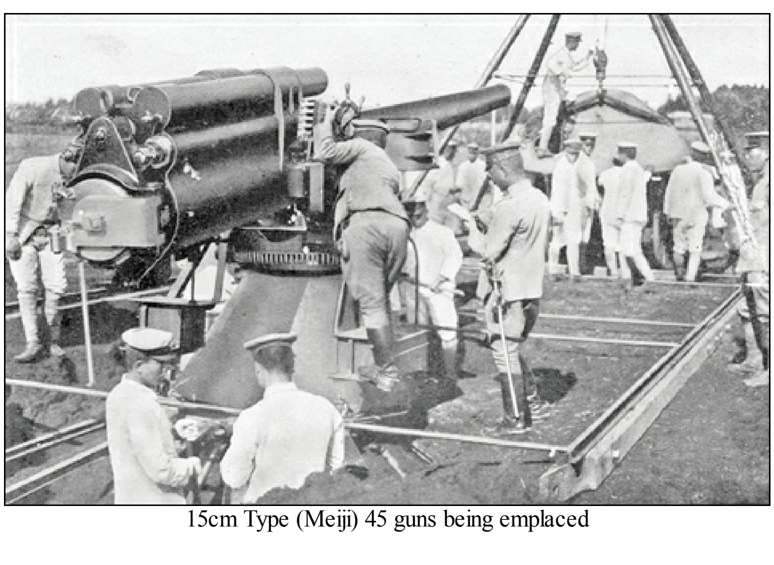
The Army launched a modest second effort early in the century to develop a new generation of coast artillery weapons. This resulted in the adoption of the 15cm Type (Meiji) 45 gun in 1912, a dual-function weapon. Nominally it was a heavy artillery piece, but emplacing this pedestal-mounted weapon required much engineer preparation and the pouring of concrete, so in fact it served almost exclusively as a static coast defense weapon. Once set up it rarely moved. The 15cm Type (Taisho) 7 used the ordnance of the Type (Meiji) 45 heavy gun but placed it in a new mount with a deeper naval-type shield.

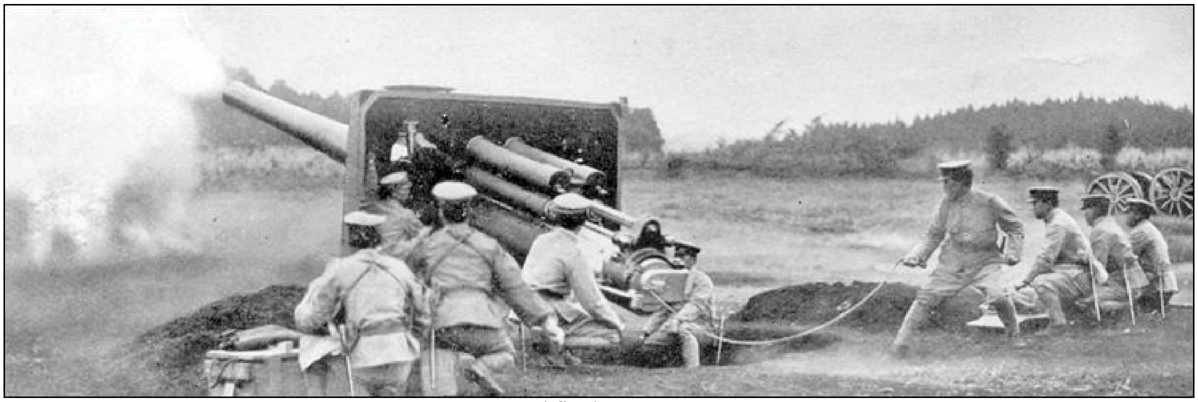
Despite the appearance of the 15cm Type 7, the older 15cm Type 45, slightly less immobile, remained in production, albeit at low levels. Production ran at 1-2 per year through the 1920s, and totaled about 40 overall. The main limitation of both 15cm coastal guns was the limited elevation of 30°. In 1934 a modification program was undertaken on the Type 45s that increased their maximum elevation to 43°, and hence their range. This modification was not applied to Type 7 guns.

The 10cm Type (Taisho) 7 was the medium-caliber complement to the 15cm weapon. Like the 15cm weapons, these were built in only modest numbers and were not deployed outside the homeland.

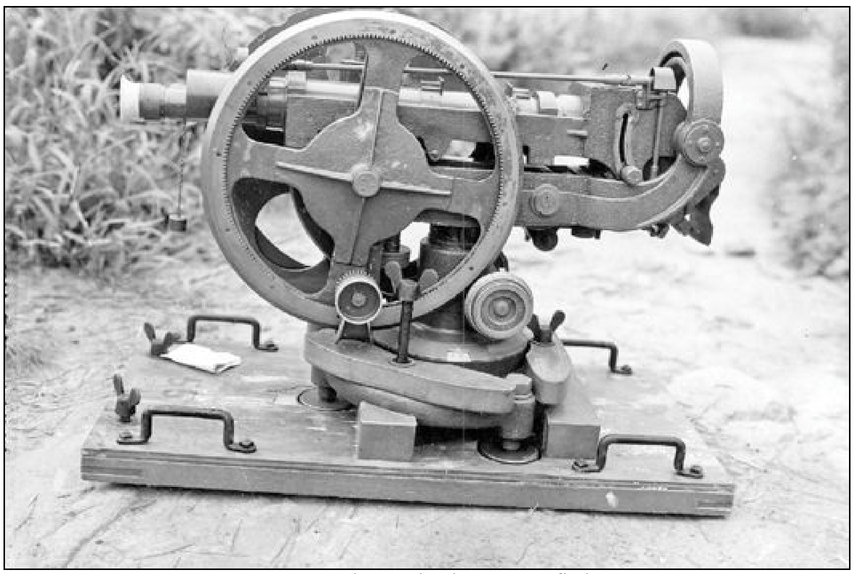
A light coastal gun, the 7cm Type (Taisho) 11 was introduced in 1922 with some secondary anti-aircraft capability, but it proved unsuccessful, being too small for the coastal role and its muzzle velocity too low for the anti-aircraft role. Once again, few appear to have been built.

The old weapons and the new 10cm and 7cm guns were deployed with only the simplest of fire control instruments. The only rangefinders used by the Army coastal artillery were of the depression-base type, in which an instrument on a hilltop at a known height above sea level measured the negative elevation to a target on the water. With a known height and angle it was a simple matter to solve for the range. The most common of the rangefinders was the Type 89, which replaced the earlier Brachalini-type units for all but the 28cm howitzers. Depression-based rangefinding worked well on the hilly Japanese homeland, but would have been next to useless on many of the flat Pacific islands. In the event, IJA coastal artillery never left Japan, Korea and Taiwan.


15cm Type (Meiji) 45 guns being emplaced


and fired pre-war.

For at least some of the 15cm weapons a simpler version of the Type 88 fire control system used with the heavy turret guns (see below) was developed and fielded as the Type 98A. The rangefinder used two periscopes side-by-side, one to track azimuth and the other to determine range through measuring the angle of depression. This data was transferred mechanically by gears to an azimuth/range transmitter that used cams to factor in ballistic corrections and the resultant data was transferred electrically to azimuth and elevation pointers on the guns. An even simpler version, the Type 98B, did away with the mechanical computer of the azimuth/range transmitter and required manual input of data from the rangefinder. Due to limited ability to compensate for parallax, the Type 98 had to be located within 200 meters of the guns.

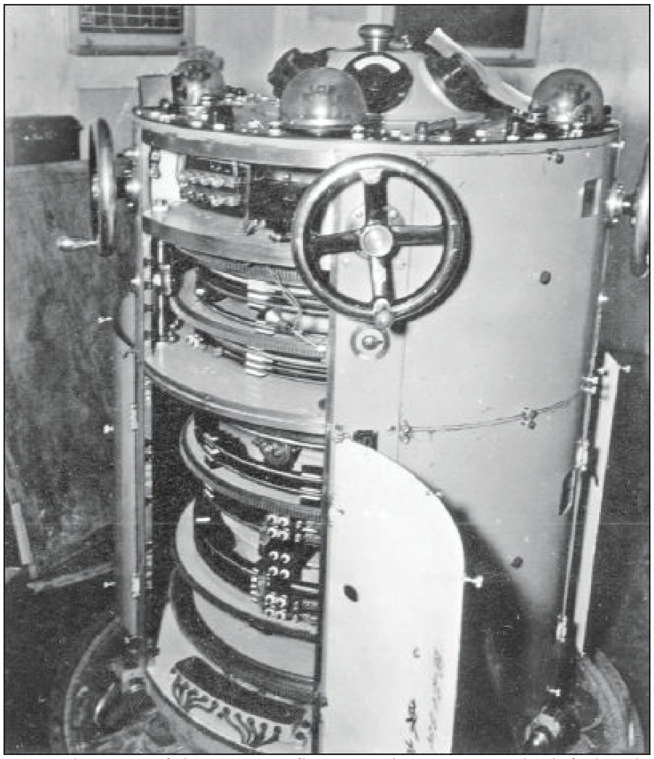
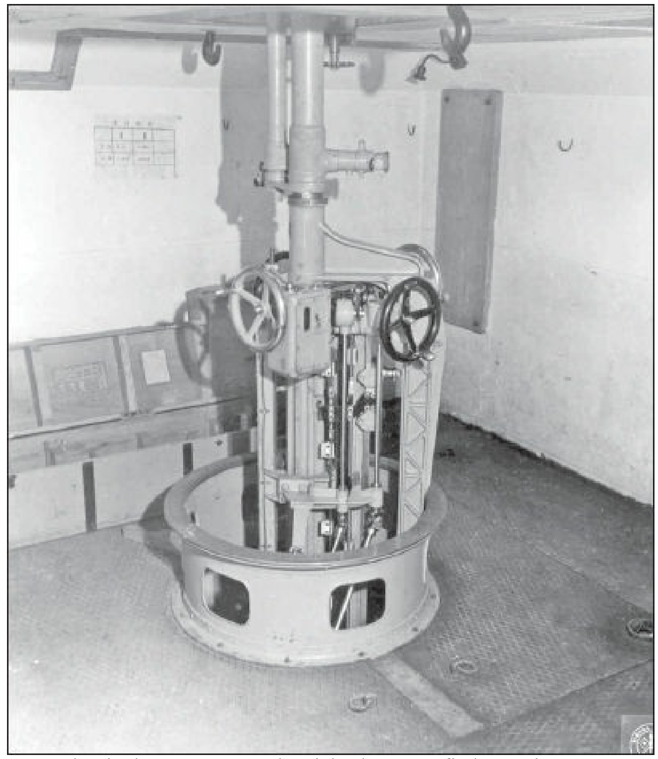

A Type 89 depression base rangefinder.

With the advent of the Washington Naval Treaty, and the consequent scrapping of many old warships, large numbers of naval guns came available and in the face of this embarrassment of riches the Army coastal artillery gun development program was halted.

| Naval Turrets Used by Army | | | | | |
|---|---|---|---|---|---|
| **Turrets** | **Source** | **Total** | **Modified** | **Emplaced** | **Location (fortress)** |
| 40cm L/45 | Tosa & Akagi | 6 | 4 | 3 | Tsushima, Pusan & Iki |
| 30cm L/50 | Settsu | 2 | 2 | 2 | Tsushima (2) |
| 30cm L/45 | Kashima, Ibuki, Ikoma, Settsu, Katori & Kurama | 14 | 6 | 5 | Tokyo Bay (2), Iki, Tsugaru & Houyo |
| 25cm L/45 | Aki | 2 | 2 | 2 | Tokyo Bay (2) |
| 20cm L/45 | Kurama & ibuki | 8 | 2 | 2 | Tokyo Bay (2) |

As a result of the need to disarm old ships and halt construction of new ones the IJN offered the Army no fewer than 62 turrets from 15 battleships for use as coast defense weapons. This was not entirely unprecedented. An ex-battleship turret had already been emplaced to protect the fleet anchorage at Saeki in 1918, but in 1923 it suffered an explosion during practice firing of its 12” guns that resulted in its complete destruction.

Notwithstanding this unfortunate precedent, in the end the Army accepted 40 turrets with 10” to 16” guns (with 22,352 projectiles and 548 tons of propellant), of which 14 were modified for land use. The unmodified turrets were kept in storage until 1943 when they were scrapped. Of the 14 modified battleship turrets, 12 were actually emplaced with the other two remaining in reserve to the end of the war. In addition, two 8” turrets were also modified and emplaced. It would appear that none of these weapons was fired in anger.

Elements of the Type 88 fire control system. On the left the electro-mechanical computer, on the right the rangefinder periscope.

The long range of the weapons called for a more complex fire control system, and the Type 88 was developed for these heavy turret guns. The main fire control station was set up in a concrete underground facility about 400 meters from the turret. The Type 88 rangefinder consisted of two periscopic telescopes yoked together with eyepieces 90° apart. An electrical contact on the rotating base moved over an electrical potentiometer such that rotating the periscope sent a variable voltage to the computer indicating present azimuth. Similarly, adjusting the eyepiece vertically to tilt the line of sight up and down moved an arc-shaped arm that also slid across a potentiometer, which sent the vertical angle down to the target to the computer.

The computer was a manually operated electrical bridge instrument wherein computations and data transmission were made by positioning potentiometers. Measurements of target movement over a period equal to the estimated time-of-flight of the projectile were made and applied to predict the future position of the target. This data was transferred electronically to the turret, where the guns were laid on a follow-the-pointer device. The battery commander had a separate OP with its own periscope and a set of potentiometers for adjusting the fire of the guns based on observed fall of shot.

These heavy gun systems never got a chance to try their mettle in combat. The US Navy, however, was not terribly worried, at least by those that covered the entrances to the Sea of Japan. Their plan was to simply cover the straits with smoke, blinding the optically-based Japanese fire control, and sail through. A seacoast fire control system based on radar, of course, would have negated this tactic, but such devices were simply not available.

Once the heavy turrets were in place the Army cut back on its coast defense efforts. By 1945, however, the need for additional coastal artillery had become obvious, and field and medium artillery pieces were pressed into service. The most common weapons were the 75mm Type 38 improved gun, the 105mm Type 92 gun, and the 15cm Type 89 gun. For the Type 89 a special emplacement was designed, analogous to the US “Panama mount”, that placed the base on a pivot and provided a circular track in which the spades rested.


A 10cm Type 92 gun in a concrete shelter in the homeland.

## Navy Coast Artillery Guns

The story of the IJN's coastal artillery is inextricably bound up with the naval expansion program launched over forty years earlier, following the Sino-Japanese War of 1895. With the Royal Navy ruling the seas it was logical to turn to Britain for the latest ships, and indeed that had started a few years earlier, albeit on a smaller scale.

Two battleships were laid down in Britain for Japan in 1894, the Fuji and the Yashima. Following the practice of the time each ship carried not only four main guns in turrets, but also ten 6" (15cm) L/40 guns as broadsides weapons.

Within a few years the Armstrong family of weapons had been adopted as standard by the IJN, comprising 8-inch (20cm), 6-inch (15cm), 4.7-inch (12cm) and 3-inch/12 pounder (8cm). The design philosophy was carried through on all the weapons, merely scaled up or down. All had their recoil and recuperator cylinders set under the barrel to yield a compact, if somewhat difficult to access, weapon. All, except the 8cm, had the mount's trunnion bearings very low down, apparently to reduce the required deck height (or turret height in the case of the 8"). This also severely limited elevation and hence range, although with the fire control of the time this was not the disadvantage that it might seem.

The Armstrong engineers also favored the newly-introduced cartridge cases as a means of carrying the propellant and sealing the breech, but retained the interrupted screw breech mechanism. A cartridge case was impractical for the big 20cm gun, but was used for all the others, semifixed even though the propellant load was not adjustable.

Japan placed massive orders with British yards for battleships, cruisers and destroyers starting in 1895, with most of the deliveries completing by about 1906. Not counting those of the battleship Kongo, which was still in service for World War II, the European-built and British-armed warships carried 32 20cm guns, 196 15cm guns, 32 12cm guns and 280 8cm guns.[1] Initially most of the weapons, and all of the 20cm and 8cm guns, were medium-length weapons with L/40 barrels.

The majority of the British guns came from Armstrong (and its Italian subsidiary Stabilamento Armstrong), with smaller quantities from Vickers. Demands for increased performance led to the adoption of longer barrels by Armstrong, initially L/45 for the 12cm and 15cm, and eventually L/50 for the latter. Concurrently, the firm adopted bag charges for the L/45 and L/50 versions of the 15cm.

Not willing to rely on foreign suppliers, the Navy quickly began production of warships and their guns themselves. To simplify logistics they decided to license-build the same Armstrong guns for their first generation of modern indigenous warships.

The Kure Naval Arsenal had some limited production capacity, but not enough for the surge the IJN required. Thus, in 1907 the Japanese Navy invited foreign firms to participate in the set-up of an ordnance facility. A team of Vickers and Armstrong were selected and thus was born Nihon Seiko Sho (Japan Steel Works), owned 25% each by Vickers and Armstrong and the remaining 50% by Japanese interests. The company was successful, building and selling Armstrong guns, along with the Kure Naval Arsenal. Expansion diluted British ownership to a total of 25%, however it did lock in Armstrong guns as the preferred weapon for the IJN well into the 1920s.

They built very few of the 20cm guns, but the 8cm L/40, 12cm L/40 and L/45, and 15cm L/40, L/45 and L/50 were all placed in series production as the Type AN (= Armstrong) and, slightly modified, as the Type (Meiji) 41 series of guns.[2]

Most of the old vessels were broken up during the 1920s as a result of the Washington Naval Treaty, but the guns were not scrapped. Instead, they were put in storage, probably as a stockpile from which to arm merchant vessels and auxiliaries in time of war.

When the decision was made in the late 1930s to arm the Mandated Pacific Islands, the choice logically fell to the older guns in light of the steadfast refusal of the fleet to divert weapons from new production. Although elderly, their very age made them suitable, in that these old broadsides guns were manually-operated pedestal-mount weapons that required no external power or complicated mount bases.

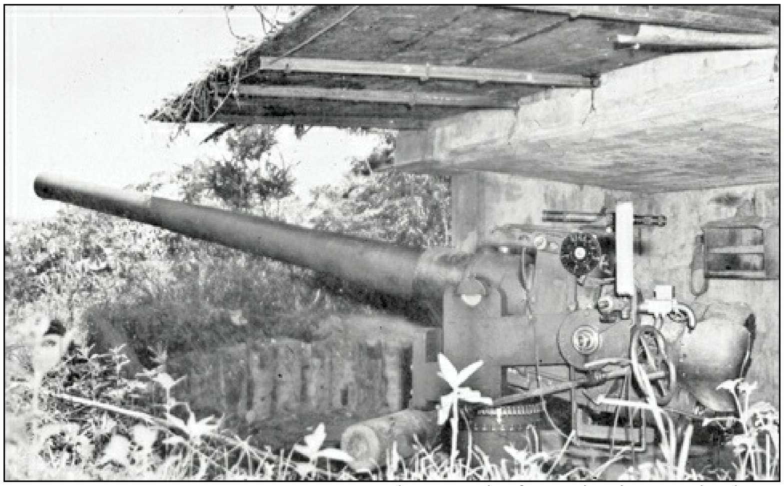
Not surprisingly, then, the first increment of coast defense guns for the Pacific Islands were the 15cm weapons, 32 L/40 Armstrong models to Saipan, Palau, Truk and Ponape in 1938, although not mounted until later. A total of 6 12cm and 14 8cm coastal guns accompanied the larger weapons. A second batch of 15cm guns was modified for land use in November 1941 and sent to the Marshall Islands. This was to prove but a small first installment in the movement of old naval guns to the islands of the Pacific.

An Armstrong-made 8cm L/40 coastal gun captured at Lae. The sight mechanism is on the ground to the right. For uncertain reasons it was identified as a Japanese-made gun in some US Army publications.

The most numerous of the weapons was what Armstrong called the 12pdr, a pedestal-mounted 3” (76.2mm) gun with a barrel 40 calibers long. They were fitted in considerable numbers to the torpedo boats, cruisers and battleships built in Britain for the IJN through about 1907. After that they were built under license for locally-built ships until production ceased around 1919. The British-built guns exhibited some visual differences among themselves and the Japanese built eight models as the Type AN and the Type 41 with slight changes in rifling and details of appearance, but none altered the ballistics or performance. As these vessels aged and were decommissioned in the 1920s and 1930s they yielded up 226 of these weapons from foreign-built boats and ships and 180 from Japanese-built vessels. Presumably most of these were put in storage and then available for coast defense use.

Although short-ranged and possessed of limited terminal effectiveness, the 8cm guns were simple to emplace, being relatively light and requiring only a small foundation for the base. None apparently had shields. Significant numbers were encountered by the Allies throughout the Pacific.

Another weapon acquired in large quantities was the 12cm Armstrong. The British firm offered the 12cm in two varieties. One used an L/40 barrel paired with a 4.9-liter chamber, and other a longer L/45 barrel with a larger chamber. Japan acquired mostly L/40 weapons with a few L/45s, and although relatively few were bought with the British-built vessels others were built under license as the 12cm Types AN and (Meiji) 41 naval gun. Over a hundred L/40s were built locally, mostly as broadsides weapons for battleships and armored cruisers, along with a small number of L/45 Type 41s. The various ordnance elements were given the model numbers I through VI, but all were virtually identical. This was the end of development for the 12cm L/40, although the large numbers built guaranteed that it would be encountered by the Allies on dozens of islands in the Pacific.



A 12cm Armstrong or Type 41 coastal gun south of Tawui Point at Rabaul.

A captured 12cm Type (Taisho) 3 gun being fired by US troops in the Admiralties. Note the semi-fixed ammunition.

The original Armstrong 12cm L/45 was simply an enlarged version of the L/40, with a slightly longer barrel and an 8.3-liter chamber. The IJN bought a few of these and designated the ordnance the 12cm L/45 Model I, complemented a little later by the Model IIs, which were taken from captured Russian warships following the Russo-Japanese war. The Model III was experimental, and the Model IV was an Armstrong weapon not purchased in quantity, but which did intrigue the Japanese designers by moving the recoil system above the barrel, which significantly increased the maximum elevation and lengthened the recoil travel to yield a smoother firing. None of these, however, entered widespread service.

Instead, an improvement program was launched to locally build a 12cm L/45 weapon that mated the recoil configuration of the Model IV along with an enlarged chamber volume of 10.44 liters. This was adopted as the Model V ordnance in 1914, giving it the full weapon designation of Type (Taisho) 3. Subsequent changes to the rifling yielded the Models VI and VII barrels, while keeping the Type 3 type designation.

The increase in elevation and propellant charge combined to extend the maximum range of the piece by 50% compared to the previous standard L/40, although usable, effective, range was probably little changed due to the limitations of the fire control available.

The fire control of the 12cm Type 3 is illustrative of most Navy coastal guns. The traverse gunner was placed on the right side of the gun and the elevation gunner on the left, both on platforms attached to the upper carriage, rotating with the weapon. The traverse gunner had a horizontal handwheel turning a vertical shaft that rotated the gun through 360° via a gear at the bottom. Both gunners had speaking tubes for communication with each other and the gun commander. Each had an open iron sight for initial target acquisition and a 15x 4° optical sight for fine laying. The azimuth sight was adjustable for deflection for use against crossing targets, while the elevation sight was depressed by operation of a range cam by a range setting crewman. Range information was provided by an optical rangefinder, usually located a few tens of meters from the guns. The gun used direct-lay, with the gunners aiming at the target, and firing usually being done by the elevation gunner via a handle near his handwheel. Subsequent corrections were passed by the observer or gun commander to the range operator and gunners.

While the Type 3 was a more capable weapon there was still room for improvement. Indeed, the Japanese built over 600 generally similar weapons for Britain during WW I but the British accepted them only reluctantly, for lack of anything else. The problem was that although the ammunition utilized a metal cartridge case the weapon retained the cumbersome screw-type breech system. In the meantime British and other gun designers had perfected the sliding breechblock mechanism, quicker to operate, although 12cm would remain about the upper limit for such devices.

Replacing the screw-type breech with a horizontal sliding mechanism yielded the new Model X ordnance,[3] adopted in 1922 as the basis of the Type (Taisho) 11 gun. Since the tube and chamber were unchanged, ballistics were identical to those of the Type 3. One other change was to the mount, which on the earlier weapons was a fixed pedestal on which was pivot mounted the upper carriage. For the Type 11 the entire pedestal rotated, with this probably providing greater stability.

A British-built 15cm L/40 with cruiser-type shield at Kiska.

The 12cm L/45 weapons all had the 10.44-liter chamber and fired the same semifixed ammunition with straight-sided cartridge case 549mm long carrying 5.4 kg of unperforated cylindrical propellant. Several reduced charges were also available, but not often used. The standard projectile was the Mk 3 Common with 1.7 kg of picric acid explosive and fitted with a Type 5 PD fuze. The Mk 3 Mod 1 shell was similar, but had a wider fuze well that could accommodate either the Type 5 or Type 88 PD fuzes. There was also a common projectile with a Type 3 Mk 1 base fuze for penetrating thin armor, although there was no AP projectile *per se*. A starshell projectile was also available, which contained ten small cylinders of illuminant. A powder time fuze, settable up to 30 seconds in 1/5-second increments, ejected and ignited the cylinders, which tumbled to earth without parachutes. No illuminating projectile was produced.

A weapon that particularly impressed the admirals was the Armstrong 15cm (6”) gun in the L/40 and L/45 configurations. The initial model was the L/40 and almost 200 were incorporated into the British- and Italian-built warships. These weapons were built by the Elswick works of Armstrong (later Vickers-Armstrong) and Stabilimento Armstrong Puzzuoli of Italy. The Kure Naval Arsenal built the L/40 model as the Type AN and Type (Meiji) 41, but mainly for sale back to Britain during WW I and few seem to have been built for the IJN.

The L/40 was a lightweight model, featuring not only the shortest barrel of the 15cm family, but also a relatively small chamber for propellant. The vast majority of the barrels, the Models I, II, III, VI and VII (for “Type AN” guns) and Model V (for Type 41 guns) all featured a cartridge-type charge that fitted into a 15.3-liter chamber. A smaller number of barrels featured an enlarged chamber of 18.9 liters that enabled them to fire the Mark 4 common projectile,[4] these being the Model IV with a bag charge for Type 41 guns and Model VI-2 and VI-3 with cartridge charges for AN guns, but these do not seem to have been deployed to coastal positions.

Above, a 15cm gun in a simple cave on Moen in the Truk group; right, a 15cm gun with broadsides shield behind a concrete embrasure guarding Shubishu Bay in the homeland.

The L/45 model was also adopted as a standard weapon for locally-built ships and placed in production, also as the Type AN, Type VI (Vickers) and Type (Meiji) 41 (1908).[5] All used bag propellant charges. The Type AN weapons used Model V barrels with 31.4-liter chamber; the Type VI weapons used Model VI barrels with 24.5 liter chambers or Model VII barrels with 31.2 liter chambers; and the Type (Meiji) 41 guns used both Model VIII barrels with the larger chambers or IX and X barrels with the smaller chambers.[6] Most, if not all, of the weapons emplaced for coastal defense appear to have used the larger chamber, but only a portion (of all types) had their chambers modified to permit the firing of the Common Mark 4 projectile.

For the battlecruisers of the Kongo class Armstrong supplied a new weapon, the 6” (15cm) L/50 gun. The British provided the guns for the first vessel, and the Japanese copied them for the other three, and later the Fuso-class, designated the Type AN, Type VI, Type (Meiji) 41 and Type (Taisho) 3. All utilized a 26.1-liter chamber for bagged charge and were ballistically identical. During the 1930s the ships were modernized, with the elevation of the guns increased from 15° to 30° and two guns on each ship removed. It is not known if the twelve removed guns had their elevation increased.

The 15cm guns were quite numerous in the Pacific coastal defenses. They did not require power and were thus fairly easy to emplace. They were generally set on “spider bases”, which looked like large wagon wheels with spokes radiating out from the pedestal mount. The most common were the old L/40s, with a smaller number of L/45 and a few L/50s, the latter only on Guam.

The Navy appears to have shipped out the oldest guns first. This was certainly the pattern for the 28 15cm guns sent to the

Marshalls.[7] In another example, the defenses of Truk included nineteen 15cm L/40 guns, comprising 4 Japanese-built Type 41s, and 15 Type Armstrong (only one of which was British built, the rest Italian-built) and four 15cm L/45 guns (2 Vickers-built and two Japanese-built). Almost all were mounted in caves, with maximum elevations of 14° to 20°. That the cave arrangement did not reduce elevation much is demonstrated by the one 15cm gun mounted in the open, an Italian-made L/40, which also had a maximum elevation of 20°. The Japanese on Truk estimated the effective ranges of the L/45 guns to be 14,000 meters and of the L/40 guns to vary from 8,000 to 13,000 meters, depending primarily on presence or absence, and size, of an associated range-finder.

As the lines grew closer to the homeland, and the terrain more rugged, the coast defense guns were more elaborately protected. Here a 15cm naval gun on Kikaiga Shima.

The 15cm L/40 and L/45 guns were deployed in a wide variety of configurations. Where time and geography permitted they were often placed in caves. In some cases they were placed in concrete emplacements. Most of the time they were placed in the open, sometimes with no protection, sometimes with shields of varying shapes, including angular cruiser-type and a semi-circular type that appears to have been taken from broadsides mounts. The shields were sometimes up to 10cm thick at the front, but were more commonly quite a bit thinner. Because of the low trunnion height the open emplacements were not sunk much below ground level.

The 15cm L/50 guns had been built as broadsides armament, sixteen for each of one British-built and five Japanese-built battlecruisers before the First World War. In any event, only three guns were deployed to the Pacific, to Guam. A few more were emplaced around the homeland.

Similarly, Armstrong built a number of 20cm (8”) guns in single turret mounts for use on Japanese cruisers between 1896 and 1901. Vickers also built smaller numbers, as did the Kure Naval Arsenal, all in the L/40 configuration. The total number of 20cm L/40s appears to have been around 30. About a dozen improved versions, with L/45 barrels, were built around 1905-10, as the 20cm L/45 Type (Meiji) 38 naval gun.

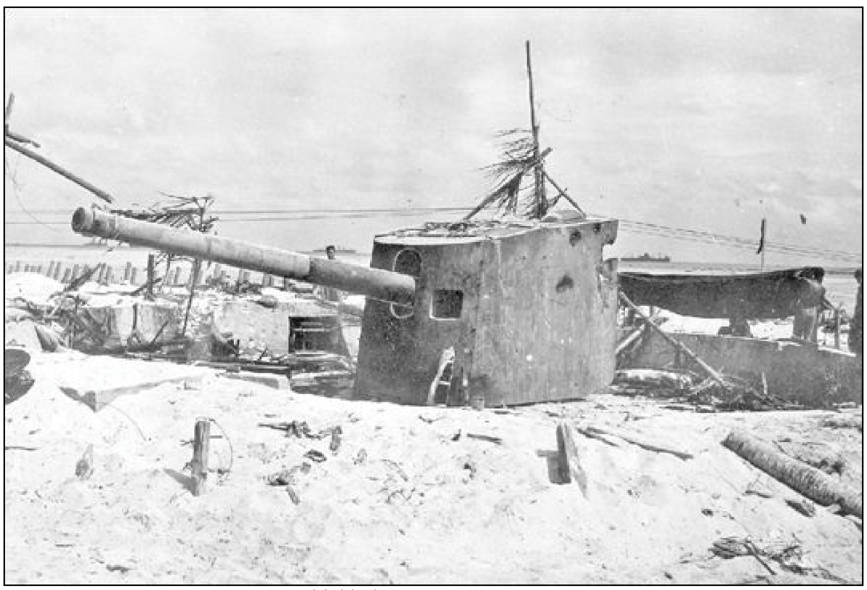
The 20cm guns were used only in the central Pacific, as even Rabaul had only 15cm guns. A four-gun battery was deployed to Moen Island in the Truk group, two 2-gun batteries to Betio Islet at Tarawa and two more 2-gun batteries to Wake Island. The Moen guns were Italian-made L/40 Armstrong weapons that used a 4.5-meter rangefinder and had 28° of elevation that gave what the local Japanese figured a maximum effective range of 18,000 meters. The guns on Wake and Tarawa were L/45s (British-built on the latter island), with roughly the same performance. They were used with a wide variety of turrets and shields that appear to have been manufactured in segments in Japan and shipped out to the gun positions for local assembly.

Although it would appear that Vickers had the naval gun spectrum well covered, the Navy decided that they needed an intermediate caliber weapon, larger than the 12cm, but with lighter, easier-to-handle ammunition than the 15cm. In response the Kure Navy Arsenal took the 12cm Type (Taisho) 3 gun and scaled it up slightly to 14cm.[8] This L/50 weapon was identical in all major regards to the concurrently-produced 12cm except for the larger chamber and barrel and formed the primary armament for a large number of the early Japanese light cruisers, along with secondary weapons for battleships. On land they were emplaced with no shield, with a cruiser-type shield or a circular broadsides-type shield.

In common with pre-1930 naval armament around the world the 14cm Type (Taisho) 3 was beset by demands for ever-increasing range. As was also common, the problem was not the ballistics of the weapon and ammunition, but rather the limited elevation possible. Thus the weapon went through several improvements, with the Model II having an elevation of 15°, then the

Model III-C with 20° and the Model III-D and Model IV with 25°, and then the Model III-2 with 30°. Of these, the Model III-D was the most common on coastal platforms. The bore length and chamber were identical on all these models and if unlimited elevation had been possible the standard Model 2 HE capped round would have traveled 22,000 meters with an elevation of 47°. As it was the range was limited to 17,000 meters at the elevation of the Model III-2.

A captured 14cm gun being used by US Marines on New Georgia.


A shielded 14cm gun on Tarawa.

A massive program of shipping ex-naval guns to the Pacific began in early 1943. For the Marshalls that meant additional guns, including 20cm Armstrongs that were heavier and needed electrical power. For the South Pacific it meant almost any gun that could be found, mostly 15cm, 14cm, 12cm and 8cm.

In all cases these old guns, with their limited ranges, used direct fire. A battery of 2-4 guns normally included a 1.5-meter or 2-meter base optical rangefinder (or 3-meter or larger in the case of the 8" guns), the data from which would be verbally given to the guns for sight adjustment. Estimated crossing speed would also be sent from the command post to the guns, where that value would be applied to the sights as offset, or lead, angle.

Indeed, naval fire control was sufficiently imprecise and the trajectories so curved at longer ranges that the maximum range of the guns seldom mattered. The Yokosuka Naval Gunnery School issued guidance in 1944 giving two practical ranges for the main types of naval coast defense guns: a maximum effective range, beyond which, presumably, fire would not be attempted, and an accurate range at which results against large ships "are reasonably certain". Both were highly subjective figures, but in no case did the effective range even approximate the maximum range of the weapons.

A 20cm battery on Tarawa after the battle; below, a 20cm gun at Pigeon Point on Wake.

| Tateyama School Ranges | | |
|---|---|---|
| | **Accurate Range** | **Max Eff Range** |
| 20cm Armstrong type | 8,000 m | 10,000 m |
| 14cm & 15cm L40 & L45 | 6,000 m | 8,000 m |
| 12cm L40 & L45 | 5,000 m | 7,000 m |
| 8cm L40 | 4,000 m | 6,000 m |

| Coast Defense Gun Data | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Bore (mm) | Length (cal) | Elevation (deg) | Traverse (deg) | Weight (fir posn) (kg) | Proj Weight (kg) | Muzzle Velocity (m/s) | Range (m) |
| 7cm Army Type (Taisho) 11 | 75 | 50 | -7 to +80 | 360 | 6,500 | 6.0 | 715 | 11,550 |
| 8cm Navy L/40 | 76 | 40 | -5 to +20 | 360 | 1,700 | 5.7 | 680 | 9,800 |
| 10cm Army Type (Taisho) 7 | 105 | 45 | 0 to +20 | 360 | 8,360 | 18.1 | 696 | 9,100 |
| 12cm Navy L/40 | 120 | 40 | -4 to +20 | 360 | | 20.4 | 658 | 10,000 |
| 12cm Navy L/45 Type (Meiji) 41 | 120 | 45 | -4 to +20 | 360 | | 20.4 | 825 | 14,000 |
| 12cm Navy L/45 Type (Taisho) 3 | 120 | 45 | -5 to +35 | 360 | | 20.4 | 825 | 15,000 |
| 12cm Navy L/45 Type (Taisho) 11 | 120 | 45 | -10 to +50 | 360 | | 20.4 | 825 | |
| 14cm Navy L/50 Type (Taisho) 3 | 140 | 50 | -7 to +25 | 360 | | 38.4 | 850 | 17,000 |
| 15cm Army Type (Meiji) 45 | 150 | 50 | -8 to +43 | 360 | 22,900 | 40.9 | 860 | 22,550 |
| 15cm Army Type (Taisho) 7 | 150 | 50 | -8 to +30 | 360 | 20,450 | 40.9 | 860 | 16,000 |
| 15cm Navy L/40 | 152 | 40 | -5 to +20 | 360 | | 44.5 | 701 | 9,950 |
| 15cm Navy L/45 | 152 | 45 | -5 to +20 | 360 | | 44.5 | 820 | 15,400 |
| 15cm Navy L/50 | 152 | 50 | -5 to +15 | 360 | | 44.5 | 850 | 14,500 |
| 15.5cm Navy Type (Taisho) 3 | 155 | 60 | -7 to +55 | 360 | | 55.9 | 925 | 27,400 |
| 20cm Navy L/45 | 206 | 45 | -5 to +24 | 360 | 190,100 | 113.4 | 760 | 17,000 |
| 28cm Army howitzer | 280 | | -10 to +68 | 360 | 10,758 | 217.0 | 314 | 7,800 |

Few new weapons were deployed outside the home islands. One small exception came when the Navy found itself with a surplus of 15.5cm after having removed them from the Mogami-class cruisers. These weapons were designated the Type (Taisho) 3, or Model 1914, in recognition of their design start, but in fact full design was not undertaken until 1928 and production in 1934. Five of these weapons were shipped to Okinawa where they were emplaced in single mounts as two batteries in covered emplacements while another two formed a single battery in caves for the defense of Tokyo Bay. Triple-mount turrets were set up at Kaburasaki and Kure, and a twin-mount at Yokosuka, although these appear to have been intended as much for their marginal AA capabilities as for coast defense. Three guns in single shielded mounts were set up on Uman Island in the Truk group, where they used direct fire telescopic sights and a 3.5 meter rangefinder, although these probably would not have sufficed to provide accuracy at its maximum range of 27,000 meters.

The Navy’s coast defense guns deployed to the Pacific used HE rounds almost exclusively. The most recent design of AP projectiles was the Type 91 family, introduced in 1931 and produced at the Kure Naval Arsenal, but they ranged in size from 18 inch to no smaller than 15.5cm, leaving the 15cm and lesser guns to rely on a small quantity of old-generation AP rounds or HE rounds, some of which had thick noses (at the expense of explosive fill) and base fuzes, the so-called “HE capped” projectiles.

The smallest of these AP rounds, the 15.5cm, featured a windscreen to cover a blunt, thick nose that reduced the explosive fill slightly to 3.1 kg, and a base fuze, compared to 3.4 kg in the common projectile.

The 14cm and 15.5cm gun also had available illumination rounds using a candle of barium nitrate and magnesium suspended by a parachute, ejected by a Type 91 MT fuze and ejection charge.

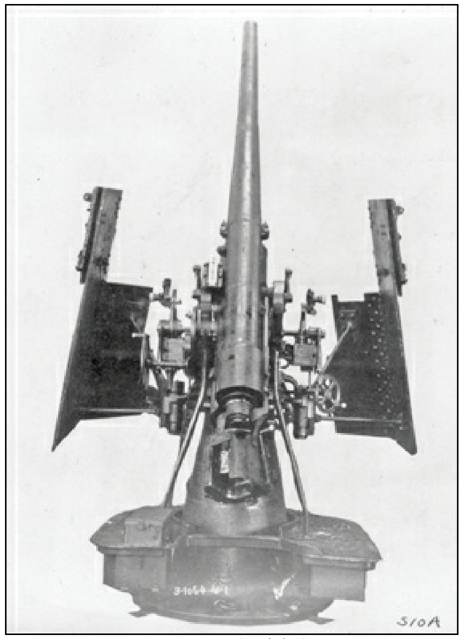
In addition, incendiary shrapnel rounds were available for the 14cm and 12cm guns similar to those described for the 12.7cm AA gun, having a payload of small iron cylinders filled with rubber and barium nitrate or phosphorus, although these were rarely used.

In the event, neither Army nor Navy coastal defense guns did much damage to US ships. The US surplus of old, slow battleships meant that most opposed landings would be supported by massive firepower against which even the rare open mounted 8” guns were no match.

Near the end of the war, some of the 10cm Model 2-2 surface fire control radars intended for surface vessels were diverted to shore use in the homeland. Few were so mounted, however, and the lobe-switching used shipboard for fire control was usually not incorporated on the land-based models, leaving them suitable only for surveillance. Here, the exterior and interior of one such unit.

**7cm Army Type (Taisho) 11 Gun**

This weapon, a nominal coast/anti-aircraft gun, featured a hydro-spring recoil system with a spring recuperator. The trunnions were set near the center of gravity, so no equilibrator was needed. The breech mechanism was a sliding block, set at 45°. It used separately-loaded ammunition, firing the Type 94 HE and Type 90 AA projectiles propelled by 1.54 kg of Mk 3 strip propellant. An inefficient weapon, few were built and none left the homeland.



7cm Army Type (Taisho) 11 Gun.

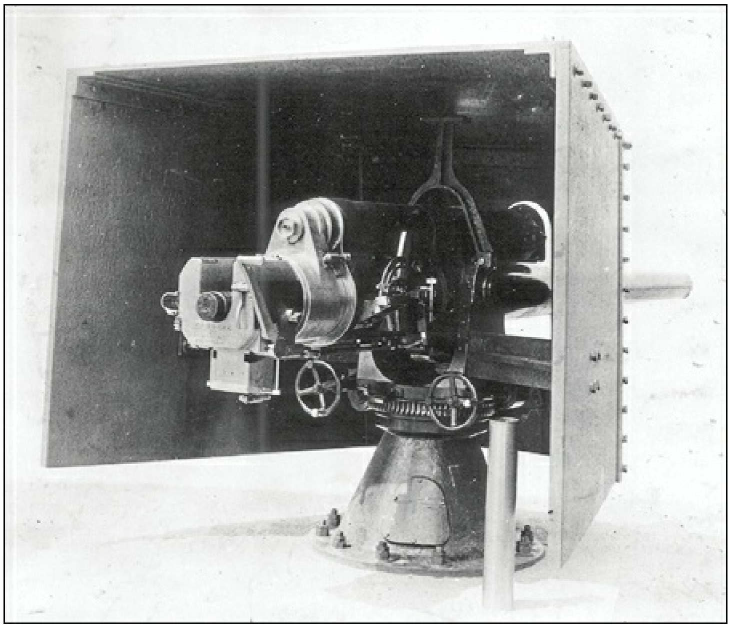
## 8cm Navy L/40 Guns

These comprised two models, essentially identical. The Armstrong-Type was the original British-built gun and its Japanese copy, while the Type (Meiji) 41 used a slightly different breech and very slightly increased rifling. The weapon was pedestal-mounted set on a steel spider or a concrete base. The trunnions were fitted to the elevated mass at the point of balance, eliminating the need for equilibrators. The hydrospring recoil mechanism was below the barrel, and the breech mechanism was of the two-step-interrupted-screw type. The gunner pointed the gun in both traverse and elevation using a telescopic sight, while another crewman set the range and deflection indices. A significant weakness of the weapon was its low maximum elevation, which restricted its range. It fired semi-fixed ammunition with a single propellant charge bag. The most widely-used projectile was the Type 2 Mod 2 HE carrying a single block of cast picric acid weighing 322 grams and a PD fuze. The ammunition was not interchangeable with that of the Navy's 8cm AA guns, which used a sliding breech and fixed cartridge case system.


A 76mm Armstrong coastal gun on Tarawa. Note the recoil mechanism below the barrel that differs slightly from another Armstrong original shown earlier.

## 10cm Army Type (Taisho) 7 Gun

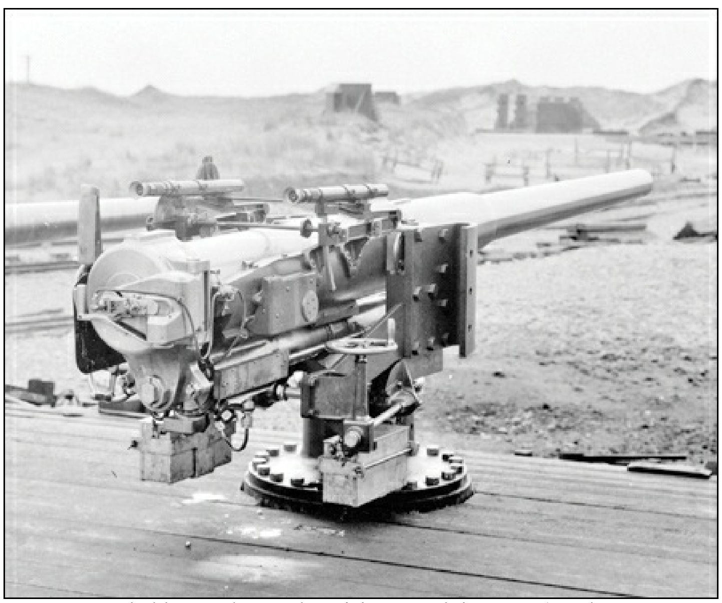
This weapon was fitted to a barbette pedestal mount usually emplaced in a shallow concrete pit, with a shield protecting the gun pointer and range setter. It used a hydro-spring recoil system and a semi-automatic sliding breechblock. Fire control consisted of a panoramic sight and a range scale, with estimated range being obtained from a separate rangefinder. It fired HE and APHE semi-fixed ammunition at a rate of 12 rounds per minute. Like most guns of its period, range was limited by a relatively low elevation.



10cm Army Type (Taisho) 7 Gun.

### 12cm Navy L/40 guns

These Armstrong-designed weapons were lightweight pieces with medium-length barrel and a relatively small chamber for propellant. The Japanese used both Armstrongproduced guns ("Type AN") and Japanese-built (Type 41). All were essentially identical in ballistics and configuration. The gunner, who sat on the left, operated both the azimuth and elevation wheels, while an assistant gunner set the range and lead-angle on scales that displaced the gunner's telescopic sight. The gun used an interrupted-thread breech mechanism and fired semi-fixed ammunition in HE and illuminating types. It was mounted on a pedestal and was not fitted with a shield in coast-defense applications.



A 12cm gun, probably an L/40, at the Vickers work in 1907. (Dock Museum 6683)

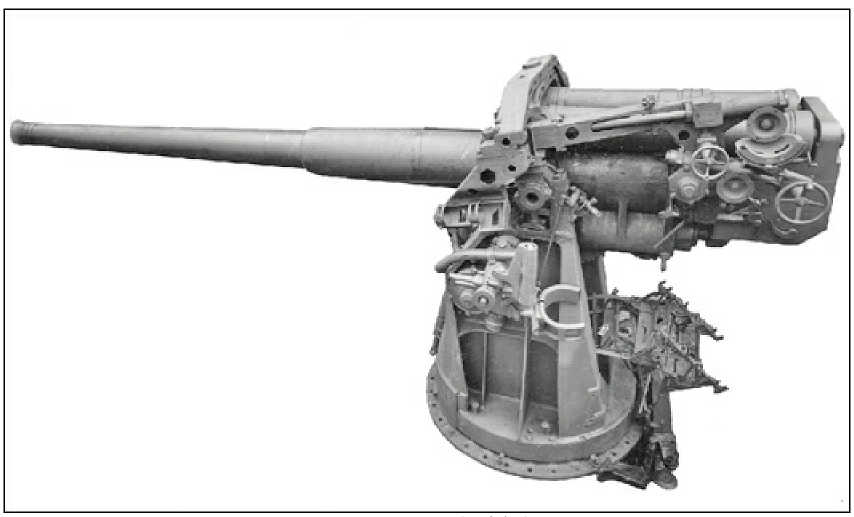
### 12cm Navy Type (Taisho) 3

This was a modification and improvement on the L/45 Armstrong type, moving the recoil mechanism, a three-spring hydrospring unit, above the barrel where it benefitted from a longer throw, although it retained the screw-type breech. The gunner duties were split, with the elevation crewman on the left and the azimuth crewman on the right, with a speaking tube between them. The third gunner set the range and lead-angle, which caused the sights to displace. The guns were pedestal mounted, both with and without shields fitted. The propellant load was considerably larger than in the L/40 models, 5.2 kg as opposed to 2.7 kg and this resulted not only in higher velocities but also the need for projectiles with thicker walls to withstand the acceleration, these being the Model 3 and Model 4 HE.

The 12cm Type (Taisho) 3 gun shown on page 244 moved to a display area on Manus Is.

## 12cm Navy Type (Taisho) 11

This was a further evolution of the 120mm L/45 gun, differing from the Type 3 in that it incorporated a horizontal sliding breechblock, reconfigured the recoil arrangement as two cylinders above the barrel and one below, and used a different type of pedestal mount. On the Type 3 the pedestal was fixed, with the gun rotating at the top, whereas on the Type 11 the two-armed pedestal itself rotated with the gun on the baseplate. Another difference was that the range and deflection scales were moved from in front of (and above) the elevation gunner, to his rear near the breechring.



12cm Navy Type (Taisho) 11.

## 14cm Navy Type (Taisho) 3

This was a conventional manually-operated pedestal-mounted weapon that initially utilized a wire-wound barrel (Model II) then transitioned to a built-up type (Model III) that saved about 500 kg in weight. It was almost identical in appearance, construction and operation to the 12cm Type 3 Navy gun. It used an interrupted-screw breech and fired separate-loading ammunition with a choice of four propellant charges in silk bags. The standard projectile was the HE type, which carried 2.6 kg of picric acid explosive to a range of 17,000 meters from the Model III-2 variant of the gun with 30° elevation. There was no AP round, although an HE capped projectile, which sacrificed 600 g of explosive for a thicker nose section, was available. Both were base-fuzed. A starshell/illuminating projectile with a 30-second time fuze and a range of 18,000 meters for a 700-meter height of burst was also produced. Guns were emplaced with thin cruiser-type shields, thicker casemate-type shields taken from their battleship mountings, and with no shield at all.


An unshielded 14cm Type (Taisho) 3 near Piti Point on Guam. The gun pit has been partially filled in.

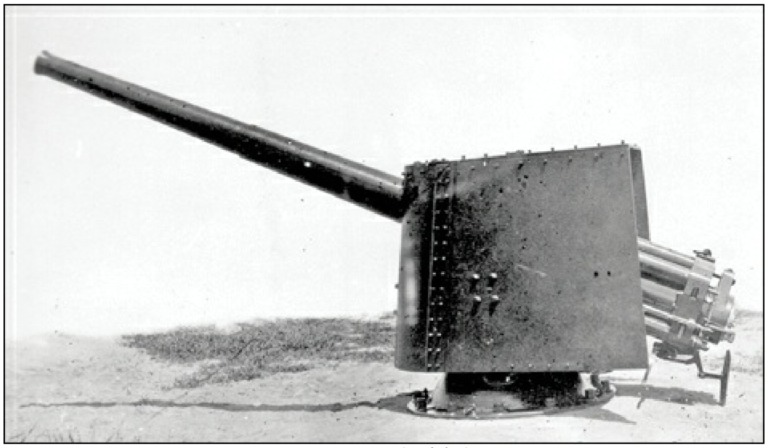
## 15cm Army Type (Meiji) 45 Gun

This was a pedestal-mounted weapon with an interrupted-screw breech block, hydropneumatic recoil mechanism and compressed air recuperator. It fired HE and AP rounds, the former with the Type 90 combination fuze and the latter with the Type 88 base fuze, both with separate cartridge case. Ramming was by hand from a hinged tray. The weapons were modified in 1934 by increasing the height of the pedestal and raising the trunnion seats to increase elevation, and hence range. Azimuth and elevation receiver dials were fitted to receive data from a Type 98 director, but a panoramic sight and range scale were also provided for local control.


A 15cm Type (Meiji) 45 in full recoil during pre-war maneuvers.

## 15cm Army Type (Taisho) 7 Gun

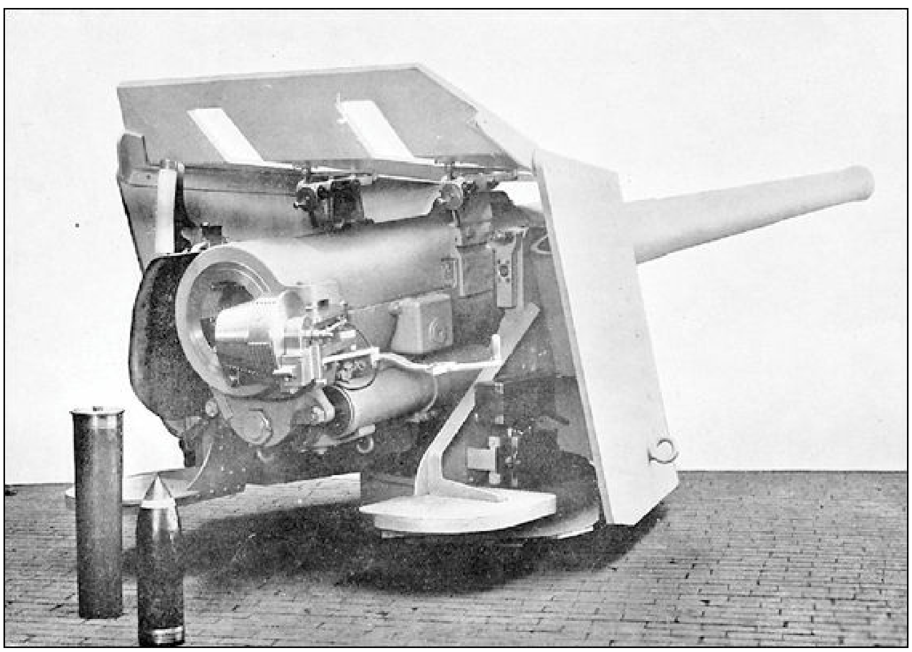
This used the ordnance of the Type 45, but incorporated a semi-automatic sliding breechblock. Other improvements included a shield that projected further to the rear, and a reduced weight to save on materials. Elevation, on the other hand, was reduced to the detriment of range.



15cm Army Type (Taisho) 7 Gun.

## 15cm L/40 Navy Gun

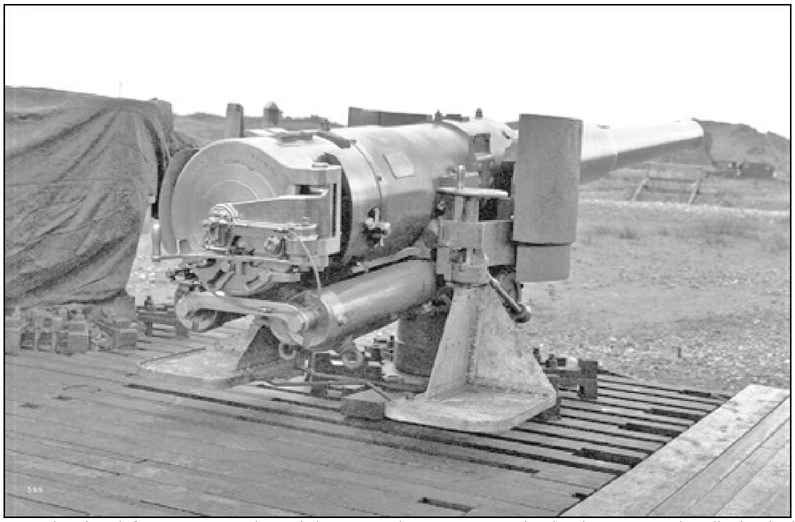
The older guns were Armstrongs built in 1890-1905 in various marks with only minor differences. The Kure Navy Arsenal built copies of these guns through WW I. The weapon was mounted on a fixed pedestal and could be fitted with a cruiser-type shield, a casemate-type partial shield, or no shield at all. The gunner, sitting to the left of the breech, elevated the gun with a handwheel and traversed it with bicycle-type pedals. An assistant gunner stood in front of him, setting the range and crossing speed adjustments. This data was received by voice from the battery CP. The gun fired five types of HE projectiles and an illumination shell. One of the HE rounds, the Model 4, was a “capped” variety that reduced the HE fill from 3.1 kg to 2.7 kg in exchange for a thicker nose section and base fuze to aid penetration, but it may not have been suitable for coastal guns and there was no AP round. Range was limited by the low elevation limits.



An Armstrong 15cm L/40 gun with cruiser-type shield on demonstration in Britain. Note the low pedestal mount that limited elevation and the recoil cylinders below the barrel. (Credit: David Perkins)

## 15cm L/45 Navy Gun

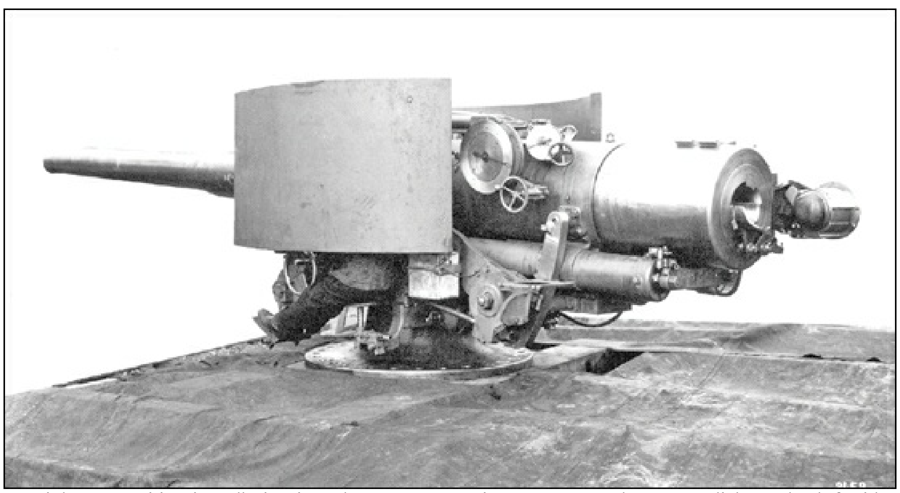
Once again, these older guns were built by the British and the Kure Arsenal. Visually similar to the L/40 guns the featured a longer barrel and larger chamber. They used an interrupted-thread screw-type breech, but in this case it used a deBange-type mushroom obturator with the propellant in silk bags, where on the L/40 guns a brass cartridge case provided the sealing. As part of the deployment to coast defense duties at least the Type (Meiji) 41s were modernized, increasing the maximum elevation from the prior 23° and providing separate gunner stations for traverse and elevation. Projectiles were the same as for the L/40 gun.



A 15cm gun destined for Japan at the Vickers works. Once again the low mounting limited elevation.

### 15cm L/50 Navy Gun

An initial batch of 16 were built by Vickers for use as casemate guns for the battle-cruiser Kongo, and three sister ships were fitted with similar Japanese-made guns. When the guns were removed most were reused in light cruisers, but a small number were utilized as coastal guns on Guam. The British-made guns were of wire-wound construction and designated the Mk 2, while the Japanese-made guns were of three-layer built-up construction. The initial Japanese copies were designated the Type (Meiji) 41, these being succeeded by the Type (Taisho) 3. They differed only in detail and were of conventional Vickers overall design with interrupted-screw type breech mechanisms and utilized unpowered mounts, which made them suitable for simple emplacement on land. Projectiles were the same as for the L/40 gun, but bagged charges were used.



A 6” (15cm) L/50 gun at Vickers awaiting installation into the IJN Kongo in 1912. Note the range disk on the left side. (Dock Museum 7195)

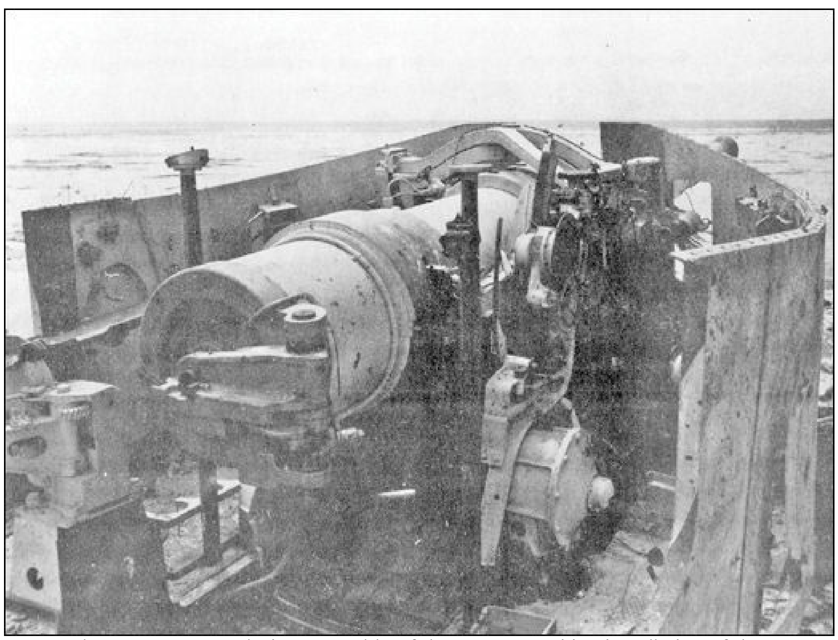
### 15.5cm Type (Taisho) 3 Navy Gun

These weapons were the most modern of the IJN’s coastal guns. They utilized bag charges, which necessitated interrupted-screw breech mechanisms with deBange obturating pads. With a 55° elevation in the original triple turret mounts they were theoretically capable of anti-aircraft fire, but proved inefficient in that role. Available projectiles were AP (1.15 kg bursting charge), HE (3.1 kg) and illumination, the latter having a range of 21,600 meters. For the coast defense role the HE rounds were fitted with the Type 88 PD fuze, but a time fuze was available for AA fire. The three weapons at Truk were fitted to shielded single pedestal mounts with an elevation of +60°.

The twin-mount 15.5cm at Yokosuka.

## 20cm L/40 & L/45 Navy Gun

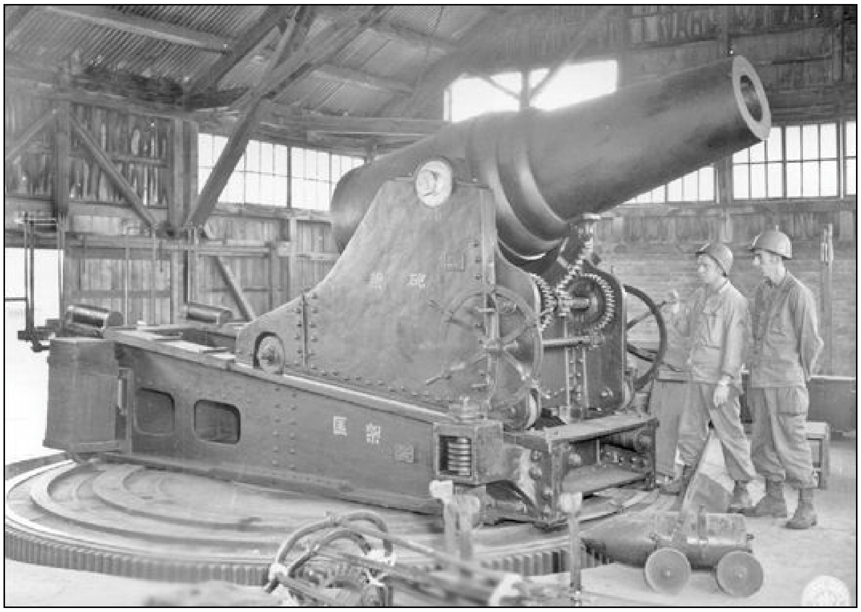
These were original Armstrong guns (including some made by their Italian subsidiary) and Japanese copies of the L/45 weapons. The mounts used on Truk had elevation of -5° to +28°, yielding a maximum range of 18,000 meters with their L/40 weapons. The guns fired HE projectiles with semi-fixed ammunition. Traverse and elevation was by hydraulic mechanism powered by electric pumps fitted to a pit below the turret, although manual back-up was available. Several types of turrets were used, all of which appear to have had frontal armor that seems to have been 50-75mm thick, and side armor 25mm thick. The turrets on Truk were completely enclosed, while the others were open at the rear, covered by canvas on Tarawa and a wooden structure on Wake.



A 20cm coastal gun on Tarawa during assembly of the turret, awaiting installation of the armored roof.

## 28cm Army Coastal Mortar

Also known as a howitzer, It was officially introduced in 1892 (although in production earlier) it featured a horizontally-swinging screw breechblock with a gas check pad for the bagged charges. The trunions were fixed to the upper carriage, which in turn rested on four small double-flanged wheels. The wheels rode on tracks on the ramp-shaped lower carriage. Recoil was absorbed when the upper carriage was pushed rearward up the inclined ramp and against a recoil cylinder below until it hit stops at the end. With the recoil spent, the upper carriage rolled down the ramp and back into firing position. The lower carriage could rotate 360° on the platform that rested on the ground.


28cm Army Coastal Mortar.

### Heavy Turret Guns

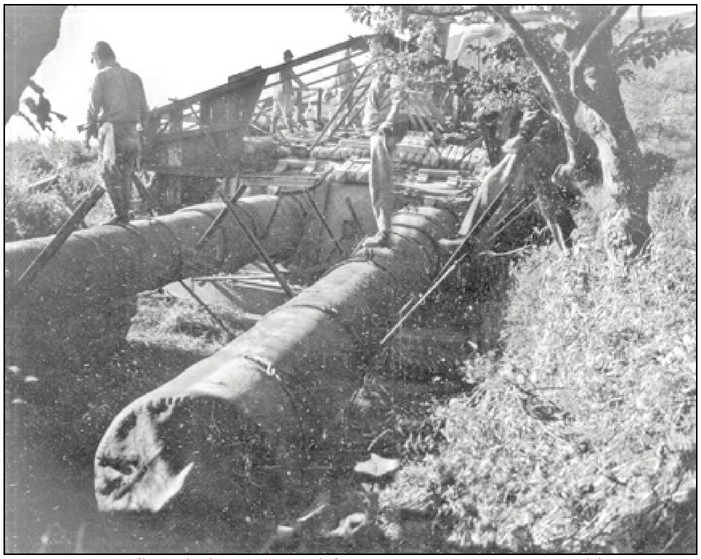
These weapons, transferred from the Navy in 1923-24, ranged in size from the relatively modest 20cm (8”) turrets to the massive 40cm (16”) weapons They were of two main types, the heavy turret for the 30cm and 40cm weapons, and the light turret for the 20cm and 25cm weapons. All were twin-gun designs.

| Heavy Turret Gun Data | | | | | |
|---|---|---|---|---|---|
| | **40cm** | **30cm L/45** | **30cm L/50** | **25cm** | **20cm** |
| Bore (mm) | 410 | 305 | 305 | 254 | 206 |
| Length (cal) | 45 | 45 | 50 | 47 | 47 |
| Elevation | -2° to +35° | 0° to 33° | 0° to 33° | -5° to +35° | 0° to 30° |
| Traverse | 270° | 270° | 270° | 360° | 360° |
| Muzzle Vel (m/s) | 760 | 800 | 850 | 800 | 760 |
| Range (m) | 29,800 | 27,300 | 29,300 | 24,500 | 18,200 |

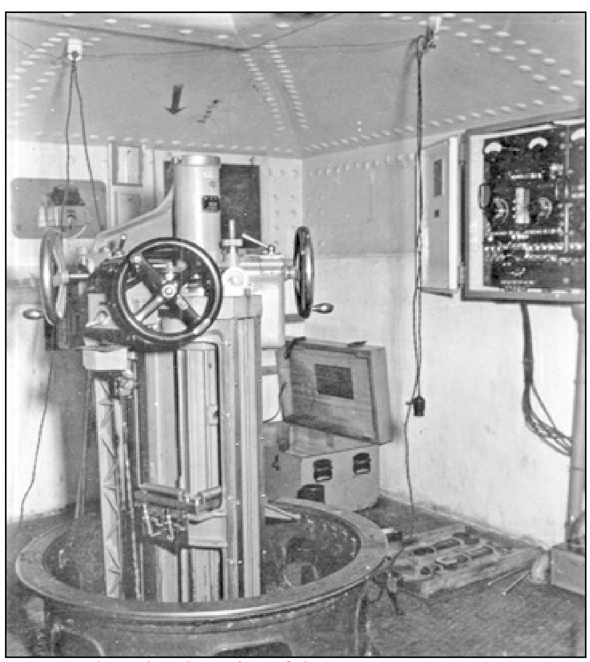
The heavy turrets utilized hydraulic power for turret traverse, elevation, breech operation, ammunition delivery from underground magazines, and ramming. In the case of the 40cm turret the frontal armor was 30cm thick on the front and sides, and 10cm thick on the roof. In the 30cm turret the front and side armor was 20-25cm thick, while the roof was 5cm thick.

A central shaft ran vertically down from the turret about 15 meters to the underground facilities below the turret. These included the magazine, diesel engines powering hydraulic pumps and generators, the ammunition lift that ran through the central shaft, tool rooms, living quarters, latrines, etc. The rate of fire was one round per minute per gun for the 40cm weapons, and double that for the 30cm weapons.

The light turrets were much simpler affairs, with manual traverse and elevation, and no underground facilities. Ammunition was supplied via doors in the rear of the turret. Front and side armor was 8-15cm thick on the 25cm turret, and 5-10cm on the 20cm turret, while the roof of both types was only about 2cm thick. Additional top protection was provided by a 15cm layer of concrete and 30cm of earth, the latter also functioning as camouflage. Both fired at two rounds per minute per gun.


Camouflage being removed from a 30cm turret on Tsushima.


The 40cm turret at Pusan in Korea.


The azimuth station of the Pusan 40cm turret.

1 These do not include the 8cm L/28 guns that were scrapped in the 1920s and 1930s.

2 As a result the IJN used their own distinctive designation system for the larger ordnance pieces. They were designated primarily by bore diameter and caliber length, for instance 15cm L/40. The various ordnance units (barrel and breech combinations) were designated by a Model number (in roman numerals); while a combination of ordnance and mount yielded a Type designation. Thus, for example, the 12cm L/45 Type (Taisho) 3 gun could have either the Model V or VII ordnance, while the Type (Taisho) 11 had the Model X ordnance.

3 The Model VIII was a test barrel and the Model IX was used with the 12cm Type (Taisho) 10 AA gun discussed elsewhere.

4 The Mark 4 Common was actually close to an APHE round with a thicker nose section and a base fuze. This reduced the explosive fill from 3.08 kg in the normal Mark 0 common with its nose fuze to 2.68 kg.

5 The ships scrapped or decommissioned by the IJN prior to World War II would have yielded up 197 L/40 weapons (184 from foreign-built vessels and 13 from Japanese-built vessels) and 70 L/45 weapons (24 from British-built vessels and 46 from Japanese-built). Presumably the bulk of these would have been placed in storage and then made available for coastal defense use, although some may have been fitted to auxiliaries.

6 Surviving Japanese records do not indicate what the L/45 Models I through V were, presumably they were trials guns or acquired only in very small numbers.

7 Of those weapons, Spennemann managed to identify nine by breech numbers, all nine being British-built between 1898 and 1905. These were carried on a variety of types of mounts, including at least two British P II/Mk II on Maloelap, with a maximum elevation of only 10°.

8 Interestingly, the Greek Navy had reached the exact same conclusion about ten years earlier and had commissioned Vickers rival Coventry Ordnance Works to design a 5.5” (140mm) gun. The result was very similar to the Kure Arsenal weapon, but with a slightly larger chamber.

# 19

# Armored Vehicles

It did not escape Japanese notice that tanks had clearly proven themselves as valuable weapons during World War I. Trials of a number of foreign models were undertaken near the end of the war, but the only purchases were about a half-dozen British Whippet tanks and about 22 FT-17 tanks in 1919. A few were shipped to Vladivostok for the Allied intervention and all were utilized in maneuvers during the 1920s with infantry and cavalry units. The FTs were rearmed with Japanese machine guns and 37mm infantry guns, but both models proved dead-ends in Japanese evolution. A third type, in the form of 17 Renault NC tanks, was ordered in 1927 pending the introduction of an indigenous tank. Reinforced by six more ordered later they served in the Shanghai battles of 1932, but these were intended merely as an interim measure. All the foreign vehicles had been removed from service by the start of the war in 1937.

To replace these foreign vehicles the Army began developing its own armored vehicles, including both tanks and armored cars, at the 4th Military Laboratory. The first product was a medium tank, accepted for service in 1929 and thus designated the Type 89 medium tank, with production undertaken at the Osaka Arsenal.

Inevitably, the Type 89 suffered from the shortcomings of any first-of-a-kind product. Development of a main gun ran slightly behind that of the rest of the vehicle, so the first few were armed with the 37mm Sogekiho infantry gun until the 57mm Type 90 tank gun could be placed into production. Many other changes were made as experience was gained, some minor and some significant. The most imortant was replacement of the gasoline engine with a diesel model, resulting in a new set of designations, the Type 89A for the early version and Type 89B for the diesel model. At about the same time the positions of the driver and gunner were switched, with the former moving from the left side of the hull to the right. Other changes were introduced incrementally, including eliminating a vertical portion of the hull front, adding a tail to facilitate trench-crossing, and adding fireproofing to reduce the dangers from backfires.

The diesel engine was developed by Mitsubishi and was the first such powerplant to be used in a tank anywhere in the world. The engine proved reliable under all conditions and was subsequently used to power the Type 95 light tank, and provided the basis for later tank engines.

Production of the Type 89 medium appears to have been executed outside of any real framework. The Sagami Arsenal was given responsibility for production of the Type 89 and farmed out production of both components and complete tanks to subcontractors. The Kokura Arsenal began building diesel engines for the tanks in 1933 and in 1935 they also started building complete tanks, although they built only 13 Type 89A and 8 Type 89B before switching to other models. Production was slow to take off and apparently rather confused, and as a result there was little standardization among the Type 89 fleet.

Apparently undaunted by the difficulties of getting the Type 89 medium into production, the Army turned its attention next to a heavy tank, and accepted the Type 91 into service for that role in 1931. This, however, proved a failure even after several modifications and was aborted after only 7 had been built.

The next effort, apparently run approximately concurrently, was at the light end of the spectrum, and was intended to provide a fast tank for the cavalry. Developed by the Ishikawajima Motor Company, the resultant vehicle, the Type 92 combat car, produced a fast, turreted tracked vehicle at a time when the only other such vehicles were the light tanks from the Vickers firm. The early models used a pair of 6.5mm Type 91 tank machine guns (based on the Type 11 infantry machine gun) for armament, but 80 copies of the Hotchkiss 13.2mm machine gun were produced by the Army in 1933-36, and presumably at least most of these were used to replace the hull gun in some vehicles. They were built only in small numbers for use by the tank units of the cavalry brigades, were obsolete even by 1937, and with the possible exception of a few in North China early in the war, were not sent into combat. They had been withdrawn from service by 1940.


Field maintenance on an early Type 89, with the driver on the left.

Thus, of these initial forays into tank production only the Type 89 actually saw combat, for the most part being used in China through about 1942 where anti-tank weaponry was scarce. In addition, one regiment was sent to the Philippines in 1942. The tanks were left there when the regiment re-equipped and they were hurriedly re-issued in 1944 to new independent tank companies, only to be quickly and effortlessly destroyed in the subsequent American reconquest.

In terms of design, all three models proved dead-ends, their obsolete features contributing little to subsequent Japanese efforts. One exception was the diesel engine in the Type 89B which proved its value in terms of reliability, fuel economy and, perhaps most importantly, independence from high-quality gasoline that could be scarce in a war.

**Tankettes**

The early attempts to design and produce tanks having proven largely disappointing, the Army turned its attention to the lightest of vehicles, generally called in the west a “tankette”. These were light, two-man armored vehicles usually armed with a single machine gun and designed primarily to tow a tracked trailer in the battlefield resupply role. They were initially intended for a role akin to that of the Renault UE tractor in the French Army, where the problems of supplying front-line troops across ground covered by enemy machine guns and artillery fire had proven so difficult in the First World War.

Unlike the UEs, which were unarmed, the Japanese solution to the problem incorporated a turret-mounted machine gun for the tractor vehicle. In some ways this made the Japanese vehicles more useful in that they were capable of self-defense if needed. On the other hand a hidden danger lurked, in that the temptation to employ them as combat vehicles proved well-nigh irresistible. Indeed, during development the type was known as the TK (special tractor) vehicle, but when it entered production the general staff ordered it renamed as a light armored car (translated universally as “tankette”). They were often pushed into the scouting role, for which their lack of a radio, poor vision and overworked commander/gunner position made them unsuitable, or even into the infantry support role, which worked sometimes in China but which was suicidal against a foe with even rudimentary anti-tank weapons.

The first of these was the Type 94, with a turret-mounted machine gun. By the time of the outbreak of war in China in 1937 it was by far the most numerous Japanese armored vehicle and it saw widespread service in that theater. The shortcomings that showed up in operations, such as the use of a gasoline engine, a tendency to shed tracks on tight turns, short ground contact for the tracks, and difficulty in accessing the engine for maintenance, had all been anticipated and design of a successor was well underway when the war broke out. Indeed, late-production Type 94s utilized a trailing idler, pressing on the ground, to reduce specific ground pressure and lengthen the track contact for a smoother cross-country ride.

Its successor, the Type 97 tankette entered production in late 1937 and remedied many of the problems noted. In addition, provision was made for replacing the 7.7mm machine gun with the rather underpowered 37mm Type 94 tank gun.

| Combat Vehicle Data | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | Wt (kg) | Length (m) | Width (m) | Height (m) | front armor (mm) | side armor (mm) | Engine HP | Road Speed (km/hr) | ground pressure (kg/m²) |
| Tankette Type 94 | 3,200 | 3.08 | 1.62 | 1.62 | 12 | 10 | 35 | 40 | 31.7 |
| Tankette Type 97 | 4,200 | 3.70 | 1.90 | 1.79 | 12 | 10 | 65 | 40 | n/a |
| Light Tank Type 95 | 6,700 | 4.30 | 2.07 | 2.28 | 12 | 12 | 120 | 40 | 41.5 |
| Light Tank Type 98 | 6,200 | 4.11 | 2.12 | 1.82 | 16 | 16 | 130 | 50 | 36.6 |
| Medium Tank Type 89 | 11,800 | 5.75 | 2.18 | 2.56 | 17 | 17 | 118 | 25 | 36.1 |
| Medium Tank Type 97 | 14,300 | 5.55 | 2.33 | 2.23 | 25 | 25 | 170 | 38 | 44.9 |
| Medium Tank Type 1 | 15,200 | 5.73 | 2.33 | 2.38 | 50 | 25 | 240 | 44 | 49.3 |
| Medium Tank Type 3 | 18,000 | 5.73 | 2.33 | 2.61 | 50 | 25 | 240 | 39 | 55.6 |
| Amphibian Tank Type 2 | 9,150 | 4.80 | 2.80 | 2.30 | 12 | 12 | 115 | 37 | 33.1 |
| SP Artillery Type 1 | 14,700 | 5.55 | 2.33 | 2.39 | 50 | 25 | 170 | 38 | 47.1 |
| APC Half-Track Type 1 | 7,000 | 6.10 | 2.10 | 2.00 | 8 | 6 | 100 | 50 | n/a |
| APC Tracked Type 1 | 6,500 | 4.78 | 2.19 | 2.58 | 6 | 6 | 134 | 42 | 26.4 |
| Engineer Vehicle Type SS | 13,600 | 4.86 | 2.52 | 2.08 | 20 | 15 | 145 | 37 | 35.6 |

Other shortcomings remained. The Type 97 tankette still had very thin armor, a two-man crew, and no radio. Nevertheless, it replaced the Type 94 in full-scale production during 1938-40. By the latter date, however, its limited utility was finally becoming clear and production tapered off dramatically. The chassis of the tankettes, on the other hand, had been adapted to a wide range of small specialized vehicles, and these continued to be built almost to the end of the war.

The first variants were designed to lay telephone wire through rough terrain. The Type 97 pole-planter was intended to carry short telephone poles on side-mounted brackets. It is unclear what equipment was carried in the cargo bay in the rear, but it may have included a powered auger to dig the holes for the poles. The Type 97 wire vehicle carried reels of wire and an arm on the right side to string wire from one pole to the next. Both were based on the chassis of the late-production version of the Type 94 tankette, with the trailing idler but still with the outside track guides.


GIs examine a Type 97 pole-planting vehicle (top) and wire-laying vehicle (right) in Japan post-war.

A front-line vehicle was developed for the artillery using the automotive components of the Type 97 tankette. Each artillery battery headquarters would send a detachment forward to observe fire and ensure liaison with the supported infantry. In the horse-drawn artillery this detachment, which included the battery commander, forward observers and signalmen, would be provided with a horse-drawn observation wagon. During the 1930s the motorized (tractor-drawn) artillery utilized 6x4 trucks for this purpose. The trucks were fast on the road, but since the guns themselves were tractor-drawn at about 10 km/hr, this was less of an advantage than might be thought. Instead, the artillery demanded a tracked vehicle with good cross-country mobility, moderate road speed and at least nominal armor to carry a forward observation party to the front while laying wire to the gun position as it went. The result was the Type 100 Observation Vehicle, which went into production at the Hino facility in 1942.

The Type 94 tankette was also used for chemical warfare. Two tracked trailers were developed for the specialized role, the Type 94 gas dispensing vehicle dispersed mustard gas in a cloud 8 meters wide, while the Type 94 disinfecting vehicle scattered bleach powder to neutralize many agents.

### Engineer Vehicles

The need to support engineers in forward areas was appreciated early by the IJA. The first concrete result was the Type 95 “Ri-Ki” engineer crane vehicle. This small vehicle was provided with a thinly-armored (8mm) cab for two men and a 3-ton multipurpose 4.5-meter crane. It was primarily meant to aid bridge construction and the crane was operated from the open outside. The running gear was unique, sharing nothing with other AFVs.

The 8-ton Type 95 crane vehicle.

Developed at about the same time was a very interesting vehicle, the Type SS armored engineer vehicle. It was originally intended to support the assault on Soviet fortifications, but eventually evolved into a multifunction jack-of-all trades, none of which it did particularly well. The armor was far too thin for the assault role, the range of the flamethrowers was rather short, and there were numerous blind spots. The fact that they did not share components with the tanks developed later presumably made support difficult. They were, however, useful as bridge layers for crossing narrow obstacles.

In 1944 MHI was given a contract for 200 dozer blades for Type 97 medium tanks but only delivered about 50 before the war ended. These were not front-line combat engineer vehicles, since the blade operator worked outside the vehicle, behind the turret. Rather, they were mainly intended for airfield construction and once threatened, as in the Philippines, the blades could be removed and the tanks restored to combat duties.

**The Next-Generation Tanks**

The next foray into armored vehicle development was far more conventional – a 7-ton light tank. Design began in 1933 for vehicle with an armor basis of 12mm, armed with a 37mm gun and using the diesel engine of the Type 89B medium tank. The prototype contract was awarded to Mitsubishi Heavy Industries (MHI) in 1933 and the vehicle turned over to the Army in June 1934. The Cavalry School liked the tank, but the Infantry thought the armor too thin and the gun too weak. A second prototype was completed in November 1935 and, misgivings notwithstanding, it was accepted for service as the Type 95 “Ha-Go” Light Tank. Although obsolete by world standards by 1940 it would soldier on as the most numerous Japanese tank to the end of the war.

Up to this point production of armored vehicles had been entrusted to MHI. In 1935 Kokura Army Arsenal completed their first tank, a Type 89. Kokura was never a major producer, however, and finally stepped out of the tank business in 1943. Osaka Arsenal began production in 1936, building Type 89s, Type 95 lights and Type 94 tankettes, this continuing to 1940.


A Type 95 light tank after the battle on Tinian.

The arsenals built a few tanks themselves, instead about 90% of the tracked vehicles built for the Army were subcontracted to civilian firms. There was, however, only one major producer of tanks, MHI.[1] Much of the rest was contracted out to firms who built small numbers of tanks as a sideline to their normal business.

The Army Technical Bureau had begun looking at a new medium tank to replace the Type 89s in 1935, but had received little backing from the conservative general staff. Nevertheless, they placed contracts for two different prototypes, a heavier one with 2-man turret from MHI and a lighter (and cheaper) one with 1-man turret from Osaka Army Arsenal. The ascendancy of the progressives in the Army hierarchy in 1936 and the freeing of the budget that resulted from the outbreak of the China war finally broke the logjam and in late 1937 the MHI prototype, modified somewhat, was adopted as the Type 97 “Chi-Ha” medium tank. MHI launched full production shortly thereafter, and the arsenals joined in as well, with Kokura turning out 5 and Osaka 4 in 1938, although that was Osaka’s only production of that vehicle.

Tank production was a complex undertaking, particularly so as the number of models proliferated. In 1938 the Tokyo Army Arsenal opened a subsidiary facility at Sagami to supervise the production of armored vehicles. They began by assembling a few Type 97 mediums from components delivered by MHI in 1939 and in early 1941 turned out the first Chi-Ha built in the factory, by now designated the Sagami Army Arsenal and responsible for the production of all combat vehicle, although Kokura continued to build tanks in small numbers until August 1943.

Although committed to action in China, the scarcity of effective anti-tank measures by the opponents meant that the only things really being tested on the IJA’s tanks were mobility and reliability. That the tanks passed both of these tests probably lulled the general staff into a dangerous complacency. That was shattered in the battles at Nomonhan.

A key discovery was that Soviet high-velocity tank 45mm guns were far more effective against armored targets than the Japanese 57mm guns. Two approaches were then taken. One was improve the existing 57mm tank gun, the other was to develop a variant of the 47mm anti-tank gun that the infantry was itself developing as a result of Nomonhan. The latter was finally chosen for reasons of standardization and a new turret developed to mount the weapon. The new turret could drop onto the hull of the Type 97, resulting in the Type 97 Shinhoto Chi-Ha medium tank. Deliveries of the Shinhoto Chi-Ha began in early 1942, and all subsequent vehicles used the new turret. In addition, small numbers of original Chi-Has were retrofitted with the new turret.

| Armored Vehicle Production & Conversion | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | FY31 | FY32 | FY33 | FY34 | FY35 | FY36 | FY37 | FY38 | FY39 | FY40 |
| Combat Car, Type 92 | – | – | 42 | 49 | 44 | 32 | – | – | – | – |
| Tankette, Type 94 | – | – | – | – | 300 | 246 | 200 | 70 | 5 | 2 |
| Tankette, Type 97 | – | – | – | – | – | – | 1 | 56 | 217 | 284 |
| Wire Laying Vehicle, Type 97 | – | – | – | – | – | – | – | – | – | 40 |
| Pole-Planting Vehicle, Type 97 | – | – | – | – | – | – | – | – | – | 30 |
| Chemical Trailers, Types 94&97 | – | – | – | ? | ? | ? | ? | ? | ? | 33 |
| Light Tank, Type 95 | – | – | – | – | – | 31 | 80 | 53 | 115 | 422 |
| Medium Tank, Type 89 | 12 | 20 | 69 | 121 | 58 | 51 | 44 | 19 | 20 | – |
| Medium Tank, Type 97 | – | – | – | – | – | – | – | 110 | 202 | 315 |
| Heavy Tank, Type 91 | – | 1 | 1 | 1 | 1 | – | – | – | 3 | – |
| Armored Engineer Vehicle, Type 96 SS | – | – | – | – | – | 40 | | | | 11 |
| Armored Railway Car, Type 95 | – | – | – | – | 1 | 10 | 22 | 9 | 8 | 34 |
| | 1941 | | 1942 | | 1943 | | 1944 | | 1945 | |
| | Apr-Jun | Jul-Dec | Jan-Jun | Jul-Dec | Jan-Jun | Jul-Dec | Jan-Jun | Jul-Dec | Jan-Jun | Jul-Aug |
| | Production | | | | | | | | | |
| Tankette, Type 97 | – | – | 8 | 30 | – | – | – | – | – | – |
| Wire Laying Vehicle, Type 97 | 30 | 10 | – | – | – | – | 5 | 43 | 12 | – |
| Pole-Planting Vehicle, Type 97 | 10 | 30 | 20 | – | 15 | 30 | 30 | 20 | – | – |
| Chemical Trailers, Types 94&97 | 20 | 60 | 54 | 73 | 35 | 22 | 10 | – | – | – |
| Armored Observation Vehicle, Type 100 | – | – | 5 | 49 | 33 | 42 | 21 | – | – | – |
| Light Tank, Type 95 | 160 | 410 | 226 | 326 | 366 | 106 | – | – | – | – |
| Light Tank, Type 98 | – | – | 5 | 15 | 21 | 35 | 37 | – | – | – |
| Light Tank, Type 2 | – | – | – | – | – | – | – | 20 | 9 | – |
| Medium Tank, Type 97 | 100 | 262 | 271 | 301 | 284 | 281 | 143 | – | – | – |
| Medium Tank, Type 1 | – | – | – | – | – | – | 100 | 55 | 15 | – |
| Medium Tank, Type 3 | – | – | – | – | – | – | – | 10 | 91 | 65 |
| Gun Tank, Type 2 | – | – | – | – | – | – | – | 30 | – | – |
| Gun Tank, Type 3 | – | – | – | – | – | – | – | 10 | 21 | 10 |
| SP Gun, 75mm, Type 1 | 1 | 17 | 17 | 14 | 7 | – | – | – | – | – |
| SP Howitzer, 105mm, Type 1 | – | – | – | 10 | 8 | 18 | 13 | 13 | 8 | – |
| SP 12cm Howitzer | – | – | – | – | – | – | – | 4 | 12 | – |
| Amphibious Tank, Type 2 | – | – | – | – | 22 | 60 | 61 | 39 | – | – |
| Amphibious Tank, Type 3 | – | – | – | – | – | – | 4 | 8 | – | – |
| Amphibious Vehicle, Type 4 | – | – | – | – | – | – | 18 | 21 | 11 | – |
| Armored Engineer Vehicle, Type 96 SS | – | 8 | 23 | 9 | 5 | 15 | 14 | 6 | – | – |
| Tree-clearing Vehicle Ho-K | – | – | 2 | 2 | 15 | – | – | 15 | 6 | – |

Concurrently, a slightly more comprehensive approach to modernizing the Type 97 was also undertaken. In addition to the new turret, it also proved possible to replace the engine with a more powerful model, increase frontal armor thickness and utilize welding for much of the armor joining. The result was the Type 1 Chi-He medium tank.

### The Wartime Efforts

With the Type 1 not that different from the Shinhoto Chi-Ha, it seems the Ordnance Bureau was unwilling to sacrifice production quantities with a switchover. Finally, MHI was told to start building the Type 1 and the switchover from Shinhoto Chi-Ha to Type 1 came with the February 1944 output. The concerns were not ungrounded, as production at the facility dropped from a steady 30 Shinhoto Chi-Has a month to an average of 20 Type 1s through August, when production was switched to Type 3s.

In the meantime, work continued on a medium tank that could be armed with a 75mm gun. Once again, they chose to make few changes to the hull and automotive elements, presumably to minimize disruption of manufacturing. The result was the Type 3 Chi-Nu medium tank. This featured a new, 3-man turret with a 75mm gun derived from the Type 90 field gun, mounted on a modified hull of the Type 1 Chi-He.

The Type 3 represented a major step forward in terms of firepower, but production did not prove simple. Mitsubishi had been told to switch from Type 1s to Type 3s with the September 1944 output, and they did that, but they only built 5 in the next three months, presumably due to shortages, probably of guns. Pending resolution of the problems the firm began building both Type 1s and Type 3s concurrently, both in small numbers, until March 1945 when the Type 1 was finally dropped from production for good.

A complete redesign of the medium tank would have to wait for the Type 4, which utilized a larger chassis and would mount the 75mm Type 5 tank gun, based on the 75mm Type 4 AA gun. Production was assigned to MHI (20/mo) and Kobe Seiko (5/month), but was not scheduled to start until August 1945. An even larger Type 5 medium tank was also designed, but was not ordered into production in order to concentrate on the Type 4.

For lighter tanks it had been recognized that the one-man turret, with a single crewman acting as commander, gunner and loader, was inefficient. Two designs were proffered, one from Hino Motors and the other from MHI. The Hino model was chosen and designated the Type 98 light tank, but not immediately ordered into production. The tank was lower and faster than the Type 95, and had slightly thicker armor at 16mm. The turret mounted a 37mm Type 100 gun and a coaxial MG. It is thought that a lack of complaints from the field about the Type 95 until after the Malaya operation led the Army staff to defer production, and the first Type 98 did not come off the line until June 1942 at the Hino facility, followed three months later by the first MHI-built vehicle, and then in March 1943 by the final producer, Kobe Seiko. There was clearly little commitment to the new vehicle and production never exceeded ten in a month from all firms combined. A roomier turret resulted in the Type 2 Light Tank, produced only in very small numbers, and then a series of prototypes as the Types 3, 4 and 5 light tanks. Thus, after much work the Army ended the war using the same light tank they started it with, the obsolete Type 95.

Another failure noticed at Nomonhan was the inability of Japanese artillery to deploy quickly in tactical order across unimproved ground. To remedy this a pair of self-propelled artillery pieces were developed, designated the Type 1, one for the 75mm Type 90 field gun (Ho-Ni I) and the other for the 105mm Type 91 howitzer (Ho-Ni II).

The Type 1 was clearly an artillery piece for indirect, or at least long-range, fire. The shield was low and did not go far back, and the absence of any mantlet for the gun would have made the crew vulnerable to small arms fire even from the front of the vehicle. The Ho-Ni I gun would have been effective as an anti-tank weapon, but only in areas where the vehicle could stay out of machine gun range. Being an artillery weapon fabrication of the Ho-Ni was entrusted to the Osaka Army Arsenal, which was responsible for most artillery production. They started with an initial batch of 30 Ho-Ni I turned out between June 1941 and March 1942. For the next fiscal year, ending in March 1943, they produced 26 Ho-Ni I and 14 Ho-Ni II. Thereafter production continued to run at a relatively low level, surprisingly all of the 105mm Ho-Ni II version. The last Ho-Ni II was turned out March 1945.

The successor to the Ho-Ni at Osaka Arsenal was the 15cm Type 4 Ho-Ro SP Howitzer. This was essentially identical to the Ho-Ni models, but substituted the old 15cm Type (Meiji) 38 howitzer for the earlier weapons. The requirements for the vehicle appear to have been somewhat muddled by the pressures near the end of the war. It was fitted only with a fixed telescopic sight, so was not usable for indirect fire without using the commander’s sight. On the other hand it suffered from the same inadequate protection scheme as the Ho-Ni vehicles, so would have been too vulnerable for the assault gun role. A few were hurriedly shipped to Luzon in 1945 where they were quickly lost. A companion vehicle, but much lighter, was the Ho-To, which mated the old 12cm Type (Meiji) 38 howitzer with the chassis of the Type 95 light tank. Unlike the others, which were Osaka products, the Ho-To was built by Mitsubishi, although only in a single very small batch.

The heaviest of the SP artillery was the 300mm Type 4 Ha-To mortar. It was regarded as successful and with its 170 kg projectile it was certainly powerful, but by 1945 the need for such assault weapons had passed. Further, rocket weapons were favored as being far easier to produce, so only four were built.

Related to the SP guns were the so-called “gun tanks”. These were developed by the armor branch to supplement the firepower of the Shinhoto Chi-Ha medium tanks in the tank regiments. Initially the concern was that by switching from the low-velocity 57mm to the high-velocity 47mm too much had been sacrificed in high-explosive firepower. As an expedient original Type 97s were retained for the gun tank role, but a more powerful HE-throwing weapon was clearly desirable.

The initial effort resulted in the 75mm Type 99 tank gun, a short-barrel L/24 weapon that resembled a scaled-up 57mm. This was mounted in a new turret and placed on the chassis of the Type 97 medium tank. Production of the guns was undertaken by the Osaka Arsenal, and the finished vehicles were turned out by MHI in July 1944. Few were built and none saw combat, apparently a recognition that with the appearance of M4 Shermans in significant numbers on the battlefield, AP performance was more important than the HE firepower provided by the short Type 99 guns.

The Type 2 was replaced in funding by the Type 3 "Ho-Ni III" gun tank. This was essentially the Ho-Ni I concept adapted by the armor force by extending the gun shield to completely enclose the fighting compartment, sides, rear and top. This vehicle was intended as a tank destroyer to counter the M4 Sherman and various Soviet tanks that the IJA undoubtedly would have heard about. It was placed in production by Hitachi, which received a small order for 57 and turned them out at a low rate to the end of the war.

In sum, the gun tank concept sprang from the Japanese inability to produce enough tanks to keep their armored force current. Initially, in each regiment of Type 97's one company would be equipped with Shinhoto Chi-Ha's to provide a measure of anti-tank capability. Later, when most regiments were equipped with Shinhoto Chi-Ha's or Type 1 mediums, a gun tank company could have original Type 97s or Type 2 gun tanks for HE support, or Type 3 gun tanks for improved anti-tank capabilities.

At the very light end of the spectrum the Japanese were not believers in the value of armored cars for their homeland. They did buy about a dozen Vickers Crossley armored cars around 1930 for use by the IJA and the Navy, These were heavily used in Manchuria and during the 1932 Shanghai battles. It is not clear if they were still in service at the start of the war, but they would have been pretty tired by that point.

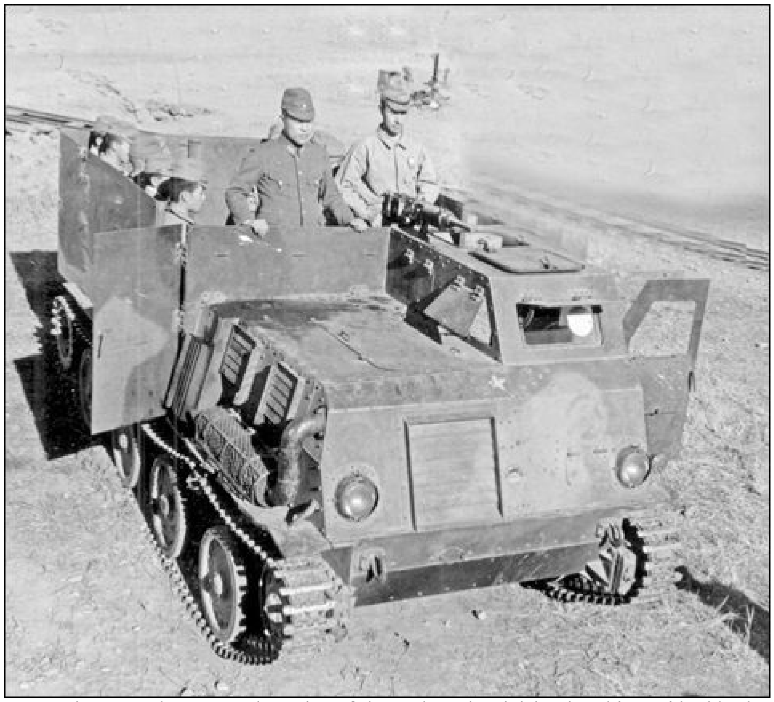
For indigenous production they chose the 6x4 configuration common to larger armored cars around the world at the time. One or two hundred Chiyoda armored cars were built in the late 1920s and many used the Jehol operations of 1932, but all appear to have been withdrawn from service by 1937. The successor was the more modern Type 93, built by the Ishikawajima Motor Company in 1933-34, probably using imported chassis. It was more modern, but was built in smaller numbers. It was used by the SNLF during the 1937 fighting in Shanghai.

It is unclear when the IJA began its development of armored personnel carriers, but two had been sufficiently advanced by 1941 to be accepted for service in that year as the Type 1 APC. The half-track vehicle was known as the Ho-Ha, while a full-track vehicle was called the Ho-Ki. Both appear to have been built by Hino, the Ho-Ki in considerably larger numbers.

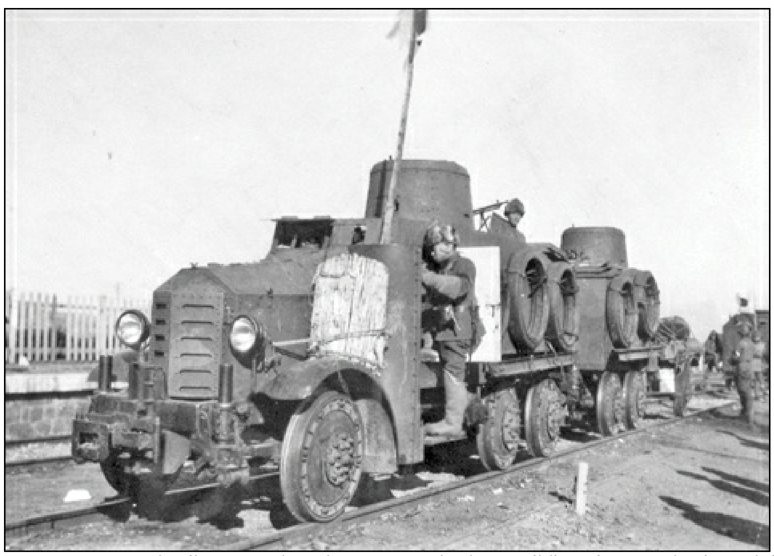
The Type 3 gun tank was an effort to provide effective antitank firepower to the tank force.

The concept of the Ho-Ha, with the long tracks and unpowered front axle, may have been influenced by German half-tracks, but the execution was Japanese. The suspension components were those of the light tanks and the engine a standard Japanese diesel. It does not appear to have been deployed outside the homeland. The Ho-Ki, on the other hand, was an integral component of the armored divisions and was encountered by US forces on Leyte and Luzon.

A more specialized set of vehicles were those designed to patrol the long rail lines of Manchuria. The initial model was the Type 91 So-Mo, which was little more than a conventional 6x4 truck adapted to run on rails and fitted with a thinly-armored body. They had no built-in armament and their main role seems to have been to carry about a half-dozen infantrymen in its open rear compartment. They were produced in large numbers[2] and widely used along Manchurian and later Chinese rail lines. The second was the Type 95 So-Ki, a tracked vehicle produced in much smaller numbers. It could move to the railroad mode in 3 minutes and back to the cross-country mode in 1 minute. Like the Type 91, however, it had no armament. The convertible running gear of the So-Ki was also used as the basis of an unarmored rail/track crane vehicle. These vehicles were used in Manchuria, China and Burma.



A Type 1 Ho-Ki armored personnel carrier of the 3rd Tank Division in China with side doors open.



A unique, and widely-used vehicle, was the Type 91 armored rail car, produced to protect the long rail lines in Manchuria and, later, China. Here, two are coupled back-to-back for quick maneuver in either direction.

**Amphibious Vehicles**

The Navy had also been an early adopter of armored vehicles. They had used Type 89 mediums, Carden-Loyd tankettes and various armored cars in the fighting in Shanghai in 1932. None of these, however, had been adapted for landing purposes. The Army did experiment, in the 1930s, with several designs for amphibious tanks, all relatively light vehicles, but none came to fruition.

Efforts on behalf of the Navy followed a different tack and were more successful, although their requirements were actually more demanding. The Navy envisioned launching raids from submarines and had decided that accompanying tanks would make such raids much more effective. In addition, this would facilitate covert reinforcement of Pacific islands. To that end they demanded a tank that was not only amphibious, but could be carried submerged on the deck of a submarine.

The first, and most numerous, of the resultant line of vehicles was the Type 2 “Ka-Mi” amphibious tank. This utilized large front and rear pontoons that could be released from inside the tank once it reached land. Nevertheless the tank’s armor inevitably was thin, even by the standards of a light tank. The tank could be carried on the deck of a submarine, but since it was not pressured the engine and electrical components had to be packed inside the submarine and reinstalled on the surface, which took about a half-hour. No such operations were undertaken.

The Type 2 amphibian was placed in production at Mitsubishi, with deliveries starting in April 1943, too late to take part in the offensives in the Pacific. They were added to the defenses of Kwajelein and Saipan, but the only assault from the water they seem to have undertaken, and that an inadvertent one, was at Ormoc Bay on Leyte. In all cases the thin-skinned tanks were destroyed with little difficulty.

A larger version, with thicker frontal armor and a 47mm main gun, was developed as the Type 3 "Ka-Chi" amphibian tank. As with the Type 2 it could be carried as deck cargo by a submerged submarine, perhaps as a means of reinforcing isolated island garrisons.[3] In any event, very few were built and the vehicle was never deployed outside the home islands.

The next vehicle in the family was not a tank at all, but an amphibious carrier. Designed at the Kure Navy Yard, it was once again, a Mitsubishi product and the first vehicles were not delivered until January 1944, far too late to be of use in Japan's early-war expansion. The vehicle traveled at 8 km/hr in the water via its two propellers, and had a water-borne range of 160 km. They could be carried submerged on the deck of a suitable submarine and were originally designed to carry torpedos, but could also have been useful for resupply of isolated garrisons, but any cargo would have had to have been specially sealed, because only the engine compartment was kept dry during such travels. With only small hatches above the cargo compartments they were not optimized for either cargo or troop carriage. It fact, they proved underpowered and the engine compartments were prone to leakage when carried by a submerged submarine.

### Tank Guns

The first Japanese-designed tank gun was the 57mm Type 90, intended for the new Type 89 medium tank. It was a low-velocity weapon with a vertical-sliding breech and hydrospring recoil system firing a short 57x121R cartridge in two varieties: HE with 250 g of TNT and an APHE with 100 g of picric acid and TNT. An experimental 7cm Type 94 gun was not a success and instead detail changes were made to the existing weapon to yield the 57mm Type 97 for use on the Type 97 medium tank. The 57mm Type 97 gun served on to the end of the war in non-modernized Type 97 mediums.[4]

**Tank Gun Data**

| | Barrel Length (cal) | Muzzle Vel (AP)(m/s) | Proj Wt (AP) (kg) | Recoil Length (cm) | Recoil pull (kg) | Gun Weight (kg) |
|---|---|---|---|---|---|---|
| 37mm Type 94 | 37 | 600 | 0.46 | n/a | n/a | 138 |
| 37mm Type 98 | 37 | 700 | 0.46 | n/a | n/a | n/a |
| 37mm Type 1 | 46 | 800 | 0.46 | n/a | n/a | n/a |
| 47mm Type 1 | 48 | 810 | 1.38 | 29 | 2500 | 410 |
| 57mm Type 97 | 19 | 420 | 2.58 | 25 | 2380 | 150 |
| 75mm Type 99 | 24 | 445 | 6.14 | 48 | 4625 | 603 |
| 75mm Type 3 | 38 | 667 | 6.14 | 66 | 5000 | 1301 |

For the lighter vehicles the 37mm caliber was chosen. The first weapon was the 37mm Type 94 tank gun, possibly intended as one of the two armament choices for the tankette, although this was not implemented until the Type 97 tankette. Surprisingly, this was not the same weapon as the concurrent Type 94 anti-tank gun, but instead a sort of intermediate weapon somewhere between the old Type 11 infantry gun and the new anti-tank gun. All three weapons used the same projectiles, in HE and APHE configurations, but where the infantry gun used a 111mm cartridge case with 51 g of propellant, and the anti-tank gun a 165mm case with 121 g, the Type 94 tank gun used a 133mm case filled with 80 g of propellant. The projectiles were identical with all the other 37mm tank and anti-tank guns, but the reduced propellant load generated a muzzle velocity of only 600 m/s, compared to 700 m/s for the AT gun or the later Type 98 tank gun.

The gun was set in a gimbal mount that permitted not only elevation changes, but limited traverse independent of the turret. It was controlled by a shoulder stock at the rear, with a pistol grip and telescopic sight on the left. The weapon was briefly used by the first batches of Type 95 light tanks, and also served in some of the Type 97 tankettes.

It was soon apparent that the muzzle velocity of the 37mm Type 94 was insufficient to enable the APHE projectile to penetrate enemy tank armor at useful ranges. The solution adopted was to enlarge the chamber to accept the more powerful 37x166R cartridge designed for the Type 94 anti-tank gun, which increased the amount of propellant. The rest of the gun remained the same, as did the projectiles fired, although by virtue of its shorter barrel the tank gun did not achieve the same performance as the anti-tank gun. The new weapon, designated the Type 98 tank gun, was finally placed in production at the Osaka Arsenal in late 1940 and fitted to Type 95 light tanks starting in early 1941.

Detail changes resulted in the Type 100 tank gun, used in the Type 98 light tank, followed by a complete rework, the Type 1 tank gun intended for the Type 2 light tank and Type 2 amphibious tank. The Type 1 not only featured a longer barrel, but also adopted the 37x251R cartridge with 142 g of propellant. Surprisingly, the Type 1's ammunition retained the same APHE projectile as the original Type 94, only the cartridge case changing. A new HE projectile, however, was provided, with thicker walls to withstand the greater acceleration loads. The Type 1 was an improvement, but by the time it entered service in late 1943 most other nations were abandoning the 37-40mm caliber for tank weapons.

The tanks Japan brought to the Nomonhan battles were tankettes and light tanks with 37mm Type 94 guns and medium tanks with 57mm Type 90 and Type 97 guns. Both weapons were hopelessly inadequate against enemy tanks. For the light tanks a solution was already in progress, which would yield the 37mm Type 98 tank gun. For the medium tanks work had already begun on a short-barrel 75mm that was standardized as the Type 99 tank gun, but this was designed to optimize HE performance with a big, slow shell, and that was clearly not the direction the Army needed to move.[5]

Serving well past its prime – A Type 97 medium tank and its 57mm HE ammunition captured on Iwo Jima in 1945.

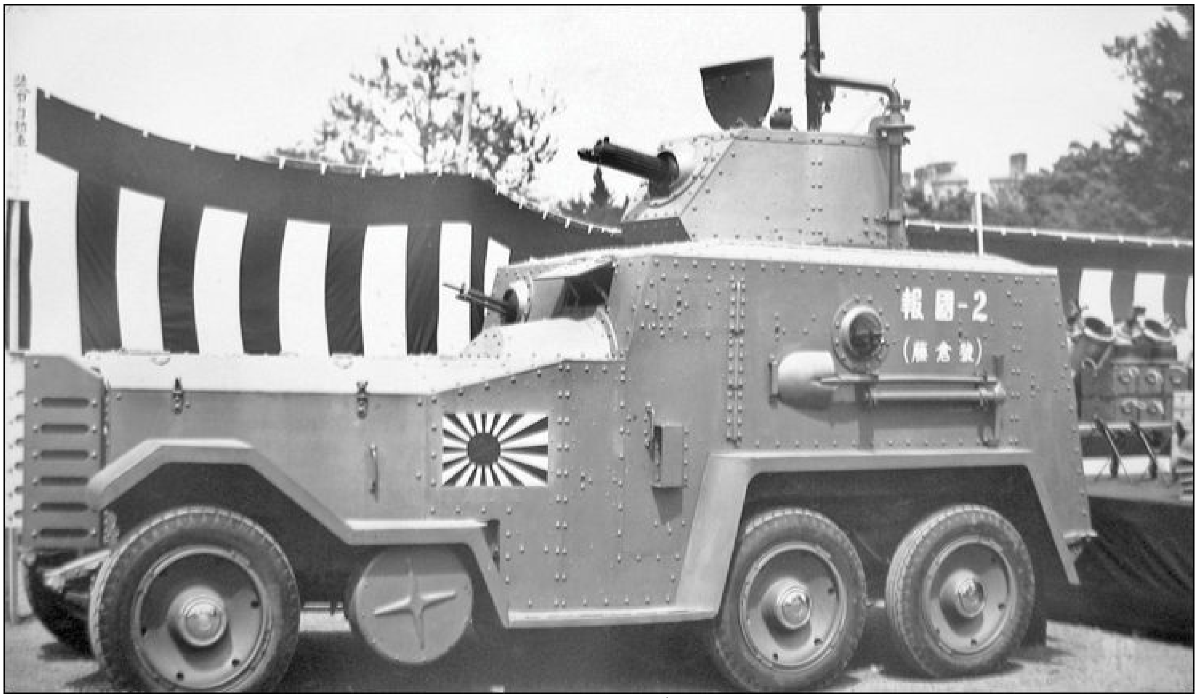
Instead, work was launched on two fronts, one an effort to increase the muzzle velocity of the 57mm by enlarging the chamber, the other to create an entirely new weapon, a high-velocity 47mm gun. The latter route was chosen, at least in part to standardize with the infantry, which were developing a 47mm anti-tank gun. The 47mm tank and anti-tank guns were almost identical, the major change being the horizontal sliding breech on the AT gun and the vertical type on the tank gun. They fired the same HE and APHE ammunition, and received the designations as Type 1. The 47mm Type 1 tank gun was fitted to a new turret and used in modernized Type 97 medium tanks, as well as the later Type 1 medium tank. As with the 37mm guns, the 47mm Type 1 had limited traverse within the turret mount. A sound weapon in terms of design, it was once again obsolescent by the time it reached combat.

The emergence of the M4 Sherman with its 75mm gun as the main US tank, as well as the appearance of the Soviet T-34 quickly brought home the need for a more powerful tank armament. A quick solution was to adapt the 75mm Type 90 field gun to tank use. The Type 90 had already been mounted on the Ho-Ni SP artillery vehicle but for tank use fitted to a turret a few changes were needed. These were relatively minor, however, and since an ammunition family was already in service it could be standardized as the Type 3 tank gun fairly quickly. The first weapons were not turned out by the Osaka Arsenal until May 1944, but this was still about five months ahead of the first Type 3 medium tank that was to carry it at Mitsubishi. The guns and tanks never saw combat. This gun was also used in the Type 3 gun tank, but this was even later into production.

A high-velocity 75mm tank gun was developed as the Type 5, but the Osaka Arsenal reported building only two of these before the war ended.

## Armored Cars

Japan undertook the indigenous production of two armored cars, both 6x4 designs based on truck chassis. The Chiyoda incorporated a number of archaic features, including solid rubber tires, and appears to have been removed from the inventory by the start of the war. It was followed by the Navy's Type 93, using pneumatic tires and a somewhat more modern configuration. It had the unusual armament of one 7.7mm Vickers machine gun in a turret and three 6.5mm Type 11 machine guns in the hull.



A Type 93 armored car.

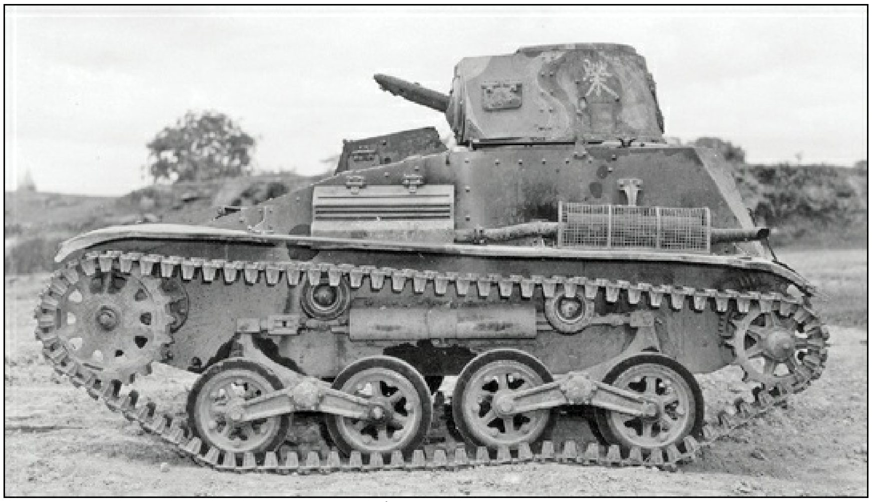
## Combat Car, Type 92

This was developed to support the cavalry in mobile operations in 1930 and by the outbreak of the war was understandably obsolete. It had a crew of three, comprising a driver and a machine gunner in the hull and a machine gunner/commander in a small turret. In most cases both machine guns were 6.5mm Type 91 models, but in a few later vehicles the hull gun was a 13.2mm with both ball and AP ammunition available. It was geared for a high road speed, but the archaic suspension was weak and unsuited to fast cross-country movement. The 6mm armor made it a deathtrap in combat, while the lack of a radio except in command vehicles severely reduced its usefulness for scouting. It was never committed to combat against the Western allies.


A Type 92 combat car with light machine guns in both positions.

## Tankette, Type 94

This was a small vehicle with the engine in front and a crew door in the rear face of the hull. Crew consisted of the driver in the right hull front, with the engine to his left, and the gunner/commander in a small turret with a single machine gun as armament. The machine gun was originally the 6.5mm Type 91, but later the 7.7mm Type 97, for which 2,000 rounds were supplied. Unusually for a Japanese vehicle, the track used outside guides, rather than center guides, and this resulted in a tendency to throw the track in hard turns. US examinations showed penetration of the hull rear by .30cal AP ammunition at up to 270 meters, and .50cal ammunition could penetrate all over at up to 550 meters range. In addition, none of the vision devices had protection against bullet splash.



Tankette, Type 94.

**Tankette, Type 97**

This was an improved version of the Type 94, with center-guide tracks, a diesel engine moved to the rear, a trailing idler at the back to increase ground contact, along with a variety of detail changes. Like the Type 94 it used a 4F1R transmission and clutch-and-brake steering. A noticeable change was the provision for alternative armaments – the vehicle could be armed with the usual 7.7mm machine gun or the low-power 37mm Type 94 tank gun.

Tankette, Type 97.

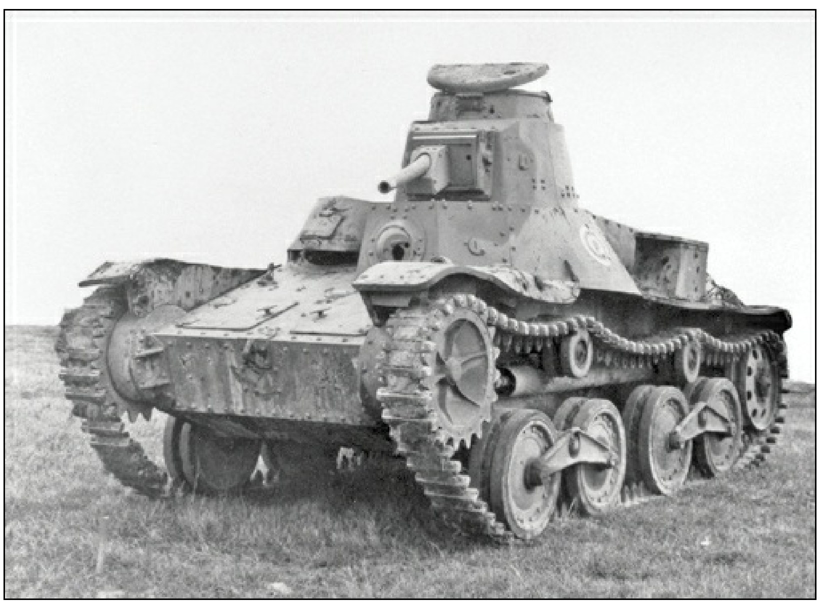
**Observation Vehicle, Type 100 ("Te-Re")**

This artillery vehicle used the suspension and engine of the Type 97 tankette, but reconfigured the vehicle to place the engine at the front, next to the driver. It could carry six passengers with storage space behind the seats for observation equipment. The rear door was equipped with reels for laying telephone wire. It was unarmed and overall armor thickness was 8mm, probably sufficient for protection from splinters but little else. It weighed 3 tons, had a road speed of 40 km/hr, and a cruising range of 200 km or 6 hours. The driver's position had a hood with observation slits, but the rest of the vehicle was open-topped.


US GI's with a Type 100 in September 1945.

**Type 95 Light Tank**

This showed conventional configuration for its time, the engine in the rear, a two-man hull crew and one man in the turret. The driver sat on the right and machine gunner on the left with his 7.7mm weapon in a ball mount. The turret featured a 37mm gun facing forward and a 7.7mm machine gun in a ball mount pointed rearward. The air-cooled diesel proved to be a good choice, reliable in both tropical environments and Manchurian winters. The main gun was originally the Type 94, firing a short round of ammunition, but was changed for the visually identical but slightly more powerful Type 98 gun in later vehicles.


Type 95 Light Tank.

**Type 89 Medium Tank**

The first Japanese attempt at designing a tank featured a tall, slab-sided hull and an irregularly-shaped turret. Production was farmed out to many facilities and improvements cut into production frequently, so that there were many variations in features. The most common distinguishing element was the engine, either gasoline (Type 89A) or diesel (Type 89B). In some vehicles the driver was on the left and the gunner on the right, in others that was reversed. In all vehicles the main armament was the low velocity 57mm Type 90 gun, supplemented by two machine guns in ball mounts, one in the turret rear the other in the hull front.

A Type 89 parading through Manila in 1942.

**Type 97 Medium Tank**

This vehicle had six roadwheels on each side, the first and last being independently sprung and the others on two 2-wheel bogies using horizontal coil springs, and three return rollers, the middle one supporting only the inner half of the track. Power was from a V-12 air-cooled diesel and moved through the 4F1R transmission to the front-mounted sprocket. The crew comprised the driver at the right front and machine gunner at the left front of the hull, and a commander/loader and a gunner in the turret. The turret was irregularly shaped and manually traversed, and was offset to the right of the hull. It was fitted with a 57mm low-velocity Type 97 gun in the front and a machine gun facing almost rear at 170°. A second machine gun was fitted to the hull front. Internal communications was handled by a panel of 12 buttons at the commander's station and 12 lights and a buzzer at the driver's.


An Allied soldier in a Type 97 Chi-Ha tank.

**Type 97 Shinhoto Chi-Ha & Type 1 Medium Tanks**

The Shinhoto Chi-Ha was simply the basic Type 97 fitted with a new turret mounting the 47mm Type 1 high-velocity tank gun. This retained, however, the anachronistic arrangement of placing the turret MG at the rear, rather than coaxial with the main gun. The Type 1 was a further modernization featuring a new engine providing a 35% increase in horsepower, and additional armor on the front that doubled its thickness. Starting in 1943 a third turret crewman was added to serve as a loader in many vehicles, but this must have made the vehicle extremely cramped.

A Type 97 Shinhoto Chi-Ha abandoned on Luzon 1945.

### Type 3 Chi-Nu Medium Tank

Once again, this retained much of the automotive and hull components of the Type 1, which was borrowed heavily from the Type 97, but here they were used to carry a new, large turret with a 75mm L/38 gun based on the Type 90 field gun. The powerful gun, plus the addition of a third crew member in the turret, forced the abandonment of the turret machine gun. The Type 97 machine gun in the hull was retained for use by the radio operator seated to the left of the driver.

Type 3 Chi-Nu Medium Tank.

### Type 2 Amphibious Tank

Developed for the Navy, this tank could be carried on the deck of a submarine, although undoing it to prepare for action was a laborious process. For floatation the vehicle was fitted with front and rear buoyancy pontoons made of 3mm soft steel that could be unhooked and dropped from within the tank. Extensions above the engine deck and turret provided air and visibility for the commander. The vehicle featured a commander and gunner in the turret, a driver and a hull machine gunner in the hull front, and an engineer behind them. A unique feature among Japanese tanks to this point, the turret machine gun was coaxially mounted with the 37mm Type 1 main gun, improving its usefulness. A second MG was mounted in the hull front. Mobility in water was by means of two propellers and a rudder yielding a water speed of 10 km/hr.


A Type 2 amphibious tank being inspected by a GI on Leyte. The pontoons have been dropped, but the air extension over the engine deck remains in place.

### Type 1 Self-Propelled Artillery

This was a straightforward adaptation of the Type 97 medium tank as a chassis for artillery. There were two versions: the Ho-Ni I with the 75mm Type 90 field gun and the Ho-Ni II with the 105mm Type 91 field howitzer. The field gun was modified slightly for this use by having a reinforcing ring in lieu of the muzzle brake, and using a slightly smaller breech assembly. Aside from armament the two vehicles were similar, with 25mm armor shields front and sides, but no top or rear protection. The hull machine gun and crewman's position were sacrificed to provide ammunition stowage, which comprised 54 rounds of 75mm or 20 rounds of 105mm. The Ho-Ni I had an elevation range of -5° to +25°, which presumably would have limited range, but it was provided with range drums out to 12,000 meters.


The Type 1 SP with 75mm gun.

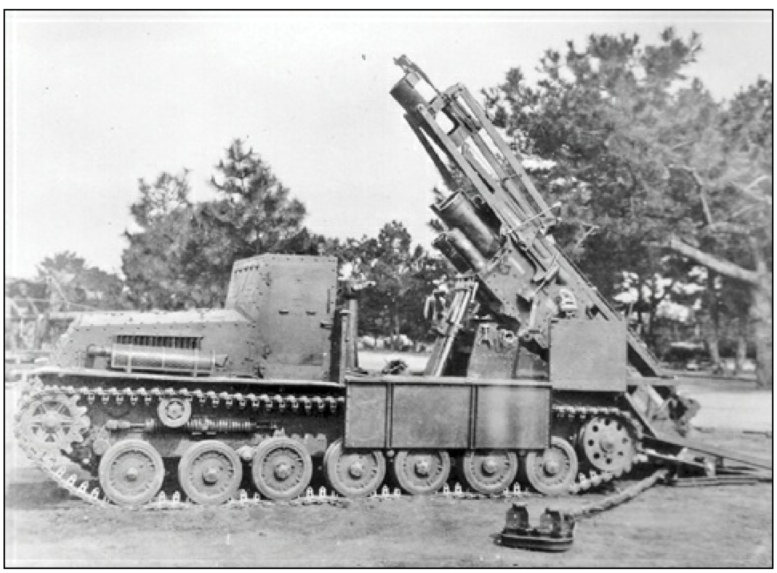
### Type 4 Self-Propelled Howitzer

This was the Type 1 Ho-Ni vehicle rearmed with the 15cm Type (Meiji) 38 howitzer, for which 28 rounds were carried, many in metal boxes on the rear deck. The crew was six, comprising a driver, a commander and four gun crew. It utilized a fixed telescopic sight with no range drum, but the commander did have a traversing sight. The elevation of the main gun was from -10° to +20°, which probably would have limited range to about 3,000 meters.


Type 4 Self-Propelled Howitzer.

### Type 4 Self-Propelled Mortar

This used a lightly-armored tractor chassis to carry and fire the 30cm Type 3 heavy mortar. The weapon was unusual in that it had a short barrel, probably about L/7, to reduce its visual signature, and counted on its mobility to survive in spite of its consequently short range of 3,150 meters. It was unique in that the weapon had a fixed elevation of 50° and the range was varied entirely by finessing the propellant charge. The absence of an elevation mechanism simplified production and reduced weight considerably. For travel the barrel was laid almost horizontal on the bed, and for firing the rear and baseplate were dropped down onto the ground. Set above the barrel was a metal frame and sliding tray that could carry the ammunition up and beyond the muzzle for loading.


Type 4 Self-Propelled Mortar.

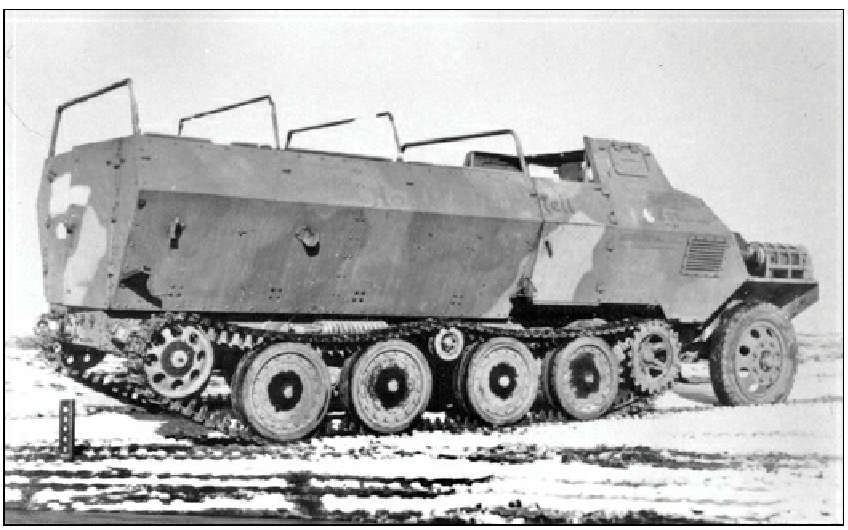
### Gun Tanks

There were two vehicles designated as "gun tanks" by the IJA. The Type 2 Ho-I gun tank placed the short-barrel 75mm Type 99 tank gun in a rotating turret on the hull of the Type 1 medium. The hull machine gun was the only such weapon on the vehicle, which must have limited its usefulness in the planned close-support role. The Type 3 Ho-Ni III gun tank was the Type 1 Ho-Ni I SP gun but with two hinged rear plates and a roof to create an enclosed fighting compartment. The main gun on this vehicle was the 75mm Type 3, derived from the Type 90 field gun.


A Type 2 Ho-I gun tank.

### Type 1 Ho-Ha Armored Personnel Carrier

This half-track had an unpowered front axle, with steering accomplished both via knuckle-steering of the front wheels and clutch-brake controlled differential on the drive sprockets. The engine used the basic components of that used in the Type 98 and Type 2 light tanks. The vehicle carried a crew of 3 plus 12 troops, who were seated facing inwards on benches that ran the length of the side walls. Access was by means of a door on each side at the forward end of the troop compartment and a pair of doors at the rear. The vehicle was provided with three pintle mounts for 7.7mm machine guns.


Type 1 Ho-Ha Armored Personnel Carrier.

### Type 1 Ho-Ki Armored Personnel Carrier

This full-tracked APC borrowed automotive components from the family of light tanks. The roadwheels were common to the light tanks, although the suspension itself was different, each wheel being independently sprung. The engine was that used in the Type 98 and Type 2 light, with preheating to speed starting and a semi-automatic valve rocker arm. The vehicle carried a driver in the front left and twelve passengers on seats facing inwards, plus up to twelve more standing in the center. Sockets for four machine gun pintle mounts were provided for the two mounts carried. The vehicle was automotively well thought-out and provided good mobility over rough terrain, although its face-hardened armor could be penetrated by .50cal ammunition out to 450 meters.

Type 1 Ho-Ki Armored Personnel Carrier.

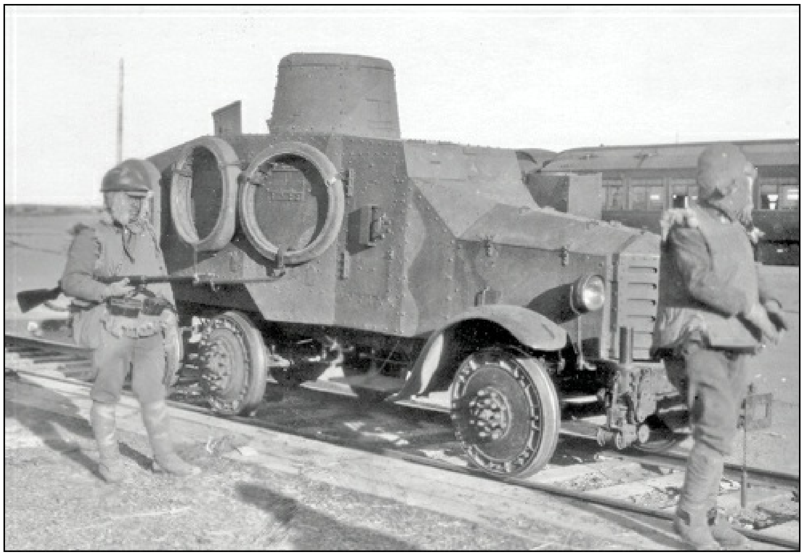
### Type 4 Amphibious Carrier

This was a large, thinly-armored amphibious carrier propelled in the water by two retractable propellers. The engine was mounted in a waterproof compartment in the center of the hull, with cargo compartments fore and aft of it. The cargo compartments were accessed by relatively small hatches in the roof of the vehicle and did not contain any cargo-handling equipment or seats. A small pilot house was provided above the driving compartment for marine navigation. The vehicle was unarmed.

Type 4 Amphibious Carrier.

### Armored Rail Cars

The Type 91 armored rail car was simply a 6x4 truck onto which a thinly-armored body had been fitted. The wheels were replaced by solid flanged units that fit onto railroad tracks. Solid rubber tires were carried so that the vehicle could be easily converted to road use. The armor was only 6mm thick and the vehicle carried no weapons, relying on the arms of infantry carried in the open-topped rear compartment. It had railroad couplers fitted front and rear to push or pull rail cars. The Type 95, on the other hand, was a tracked vehicle with two pair of wheels that could be lowered from the vehicle floor by a screw mechanism operated by a PTO to ride on rail tracks, or raised to permit operation as a tracked vehicle. A sprinkling mechanism was provided to apply sand to the rails for traction in snow. The wheels could also be moved in and out to accommodate different track gauges. Like the Type 91 it was unarmed except for crew-carried weapons. It had 8mm thick armor.



Armored Rail Cars.

1 For example, the only tracked combat vehicles produced in December 1941 were the Type 95 light and Type 97 medium tanks. Of the 63 mediums turned out in that month, only 5 were built in-house at Sagami, with the remainder coming from MHI (40), Hitachi (10), Nippon Seiko (5) and Kisha Seiko (3). Of the 53 Type 95s produced, 15 were produced in-house at the Kokura Arsenal, with the remainder coming from MHI (30), and Niigata (8). Kobe Seiko also produced small numbers of Type 95s at this time, but did not present any for acceptance in that month.

2 The exact numbers are unknown as they appear to have been purchased directly by the Kwantung Army rather than through the IJA Ordnance Bureau.

3 The process, however, was considerably more practical. Because the Type 2 was not watertight the engine and electrical system had to be removed and re-installed for transit. The Type 3 was watertight and could be readied for operation in ten minutes from the surfacing of a submarine. No operational use of this feature, however, appears to have been attempted in either case.

4 A hollow charge shell for the 57mm that was said to penetrate 55mm of armor was developed, and deliveries started in September 1944. It does not appear to have been used in combat, and with a muzzle velocity of only 380 m/s the likelihood of getting a hit at any but short ranges would have been poor.

5 The 75mm Type 99 was resurrected briefly to arm the Type 2 gun tank, small numbers of which were built in 1944. The Type 99 was compatible with the Type 2 hollow-charge projectile, but it is uncertain if any were supplied.

# 20

# Chemical

The definition of "chemical weapons" varies greatly depending who is using the term, in what context, and, unfortunately, the political or rhetorical point being made. In most armies the development (although not usually the deployment) of obscuring smoke is a function of the chemical warfare service. Illumination and signal flares can also be part of the chemical remit. For our purposes we will consider "chemical weapons" here to include munitions that disperse toxic agents and hand-delivered obscuring smoke devices.

There is confusion even as regards the term toxic agents (referred to by the Japanese as "special smoke"), however. The dispute is over whether non-lethal irritants such as tear gas and pepper spray commonly used by police belong in the same category as potentially lethal substances such as nerve and blister agents. The Japanese did distinguish, using the term "light" gasses to denote irritants.

For hand-delivered obscuring smoke devices the Army and the Navy initially preferred a mix of 45% carbon tetrachloride, 25% metallic zinc and 25% zinc oxide, the balance being kieselguhr. This was replaced by the more efficient mixture of 50% hexachlorethane (HC) and 25% each of metallic zinc and zinc oxide in later devices. In contrast the more dangerous white phosphorous (WP) was used in artillery and mortar projectiles.

SNLF troops in the battle for Shanghai in 1937 with their Navy Type 97 Model 2 gas masks.

The toxic agents were assigned colors that matched the colored bands around their associated projectiles. Green was the color assigned to tear gas, the only composition used being Chloracetophenone (CAP), more recently known as phenacyl chloride (CN). The other "light gas" was red, the vomiting agent diphenylcyanoarsine (DC).[1]

Two lethal gases were produced in quantity. Factories turned out both mustard gas (H) and lewisite (L), both blister, or vesicant, agents that were combined in a 50/50 mix to yield their yellow gas. In addition, small batches of shells and grenades with brown (hydrocyanic acid, or HCN) and blue (Phosgene) were produced for testing and field trials but, except for the grenades, never issued in quantity, the latter proving unstable over time once encased in steel shell bodies.

Green and red gases were used in considerable numbers in China. Yellow gas appears to have been used as well, although on a more limited scale. The decision was made early on, however, not to use toxic gases, lethal or not, against the western allies. This reflected the realization that the Allies, and particularly the US, had massive chemical industries that Japan could not hope to match. As the war grew closer to the densely-populated homeland IGHQ terminated the production of poison gas munitions in late 1943 and early 1944 and even went so far as to recall chemical munitions from advance depots to avoid unauthorized use by a hot-headed local commander facing defeat. Thus, when the British re-occupied south-east Asia after the war they not only found no chemical weapons in the Netherlands East Indies, but none in Singapore or Malaysia either.

The hand-emplaced smoke candles, using carbon tetrachloride and HC smoke, and green and red gasses, were generally handed out to infantry units as needed, to be used by organic personnel who had received some specialized training. Red- and yellow-band gas shells were produced in large numbers for the 90mm trench mortar battalions, and these often took on the role of the primary gas-delivery units. Red- and yellow-band artillery rounds were also produced, but appear to have been less often used than the rounds delivered by the trained gas personnel of the mortar battalions. In addition there were briefly a few specialized gas units that could deliver bulk chemical agents.

Obscurant smoke was, of course, in general use in all theaters, although not usually on the scale employed by the Allies.

Toxic gases were used in China almost from the beginning of the war. For the most part these were green and red gases generated by candles usually to aid a company- or battalion-size attack. The scale and density varied greatly. An example of an exceptionally large deployment was that of the 20th Division at Chu-Wuo in July 1938, where the division stockpiled 18,000 special candles for an attack and used 6,000 to 7,000 of them along a 5 km front. More common was the use of about a hundred special candles by a battalion. In all cases, of course, terrain the meteorological information was critical to ensure that the smoke drifted into the enemy lines and not back onto friendly troops.

| Smoke Candle Data | | | | |
|---|---|---|---|---|
| Type | L (mm) | Dia (mm) | Wt (kg) | fill |
| Obscurant Smoke | | | | |
| Type 94 small A | 175 | 56 | 1 | CT |
| Type 94 large A | 483 | 152 | 20 | CT |
| Type 94 floating | 792 | 79 | 7 | HC |
| 1 kg smoke rev4 | 210 | 53 | 1 | CT |
| 1 kg smoke rev7 | 210 | 53 | 1 | HC |
| 10 kg | 241 | 152 | 10 | CT |
| 40 kg floating | 356 | 305 | 40 | FS |
| Type 99 SP | 208 | 53 | 1.2 | HC |
| Green Gas | | | | |
| Type 89 Green | 183 | 56 | 0.25 | CAP |
| Red Gas | | | | |
| Small Red | 183 | 56 | 0.27 | DC |
| Medium Red | 249 | 112 | 2 | DC |
| Large Red | 470 | 200 | 13 | DC |
| Type 98 SP Red | 206 | 52 | 0.5 | DC |

### Hand-Carried Munitions

The hand-delivered chemical munitions were called candles and could be thought of in two different ways. There were those that were obscurants vs those that emitted irritant gases; and there were those that were emplaced or thrown by hand vs those that had an ejection feature to project the payload a short distance forward.

The standard Army hand candle was the Type 94 Small, a thin tube containing about 800 g of the carbon tetrachloride smoke mixture, replacing the slightly smaller Type 88. One end of the tube had a removable cap sealed by waterproof tape. Removing the cap exposed a match-head inset into the tube and uncovered a small rough scratch block that the soldier would rub across the match to ignite it while holding it pointed away from his body. That would ignite the mixture inside the tube, spewing out sparks and smoke. He would then throw the candle holding it by its base. It emitted smoke for about two minutes, usually giving a screen 70-100 m long and 7 m wide. Several candles could be used to yield a more opaque cloud. A replacement, the Type B, featured an air-tight cap, but apparently was produced only in small numbers in 1944.

The Type 94 Small smoke candle was small enough to be carried by individual soldiers without encumbrance.

The Navy equivalent was the “1-kg smoke candle”, functionally almost identical to the Type 94 Small with a burn time of about a minute and a half. This went through several modifications, the most common being Revision 4 and Revision 7, the latter being introduced in 1941 and featuring an HC composition in place of the earlier carbon tetrachloride.

Where denser smoke was needed the Army relied on the Type 94 Large candle. This actually came in two variants, the more common “A” and the slightly smaller “B”. Both were cylindrical cans with a screw top that covered a match head and scratch pad and were filled with the carbon tetrachloride composition. The A model gave off a very thick smoke for 4-5 minutes that could cover 700-1,000 m of front with a cloud 20 m thick, while the B model, at 16 kg weight, burned longer at 8 minutes but only could only cover 350-500 m of front before dissipating. These, of course, were hand-emplaced rather than thrown. The Navy equivalent was their 10-kg smoke candle, a smaller version of the Type 94 Large.

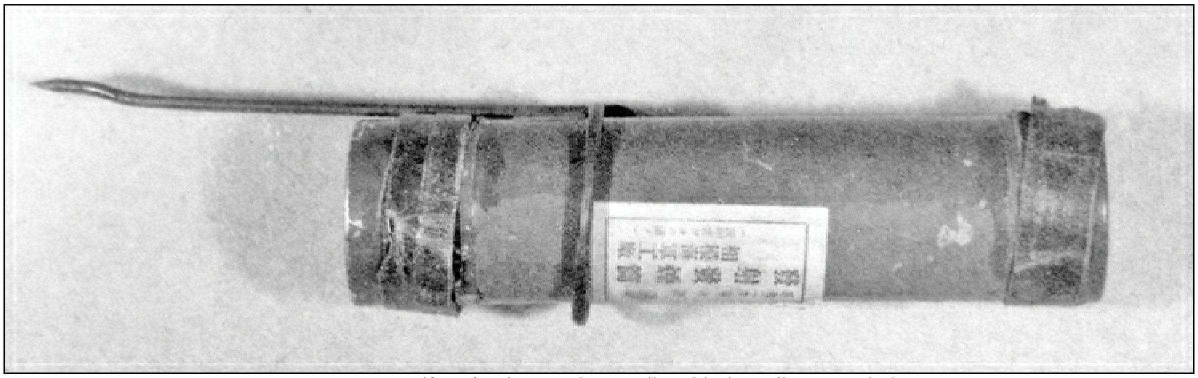
The Army also developed the Type 94 Floating Candle, a tall, thin tube filled with the HC mixture that featured an inflatable rubber “donut” around its upper portion that enabled it to float with its top above water. Once again this came in two models, the more common 7-kg Model B which could generate smoke for 8 minutes to cover 200-400 m, or the 9-kg Model A which worked for 6 minutes to cover 300-500 m. In both cases these were to be dropped overboard from ships or boats to cover landings or river crossings.

The Type 94 Large smoke candle, which would be called a smoke pot in most western armies.

So-called frangible grenades were developed for a more specific use. Used singly or in pairs these could be used to blind a point target, such as a pillbox embrasure, that did not require a full smoke screen cloud. The frangible grenades were simply flat-bottom glass spheres a mere 90mm high and 70mm in diameter. The first of these, designated (apparently retroactively) as the Type B was in production and deployed to the front in 1942 and was filled with 188 g of a mixture of titanium tetrachloride 60% and silicon tetrachloride 40%, both smoke agents. Tests after the war showed the smoke cloud to be effective for only about five seconds, far too short to be useful.

The Type B was followed by the Types C and A, which replaced the scarce filling with chlorosulphonic acid (FS), which also proved to be a more effective smoke-producer. The smoke cloud here lasted about a minute, but in the Type C the filling splattered too much on impact, reducing its effectiveness, so glass wool was successfully added to yield the Type A to slow down the burn a little and keep it more concentrated.[2]


A frangible smoke grenade A and its carrying box.

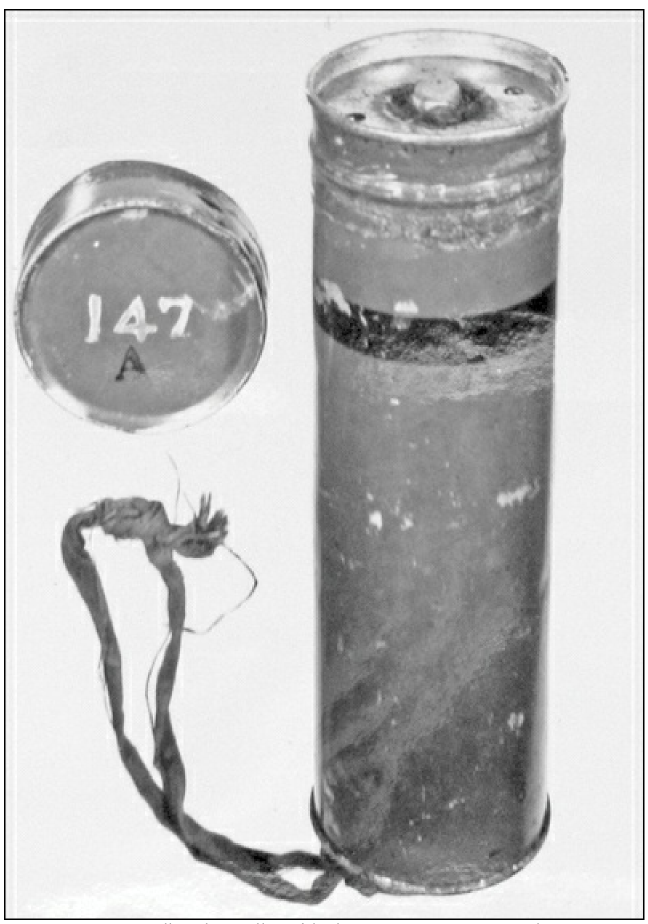


A Type 99 self-projecting smoke candle with the spike extended.

Smoke candles that had to be hand emplaced or thrown were subject to obvious tactical limitations. In response the Army developed the self-projecting candle. This placed the candle inside a tube, open at one end, with a small load of propellant at the bottom and this design proved so useful that by the outbreak of the Pacific War it had replaced the hand-held Type 94 Small in production.

A wire spike was provided on the outside that the soldier could slide to the rear and stick into the ground to provide the proper elevation for the launch tube. A match head on the outside of the launch tube near the bottom led to a 7-second pyrotechnic train that led, in turn, to the propellant. Initiating the propellant both pushed the candle itself out the front of the launch tube and ignited a powder delay fuze that ignited the smoke mixture 4-5 seconds later. A white line along the top provided a rough sight and simple string was packed into the rear cap to estimate elevation. The candle had a maximum range of 300 meters at 45° elevation The 240-g HC smoke cloud had an effective duration of a minute and a half.

The Type 89 Green Candle, although somewhat dated, remained the standard hand-thrown tear gas device for most of the war.[3] It was similar in function to the Type 94 Small smoke candle but featured a small black-powder delay element between the match head and the main payload, which was about 20% CN, 56% nitrocellulose and the balance camphor. Burning time of the CN payload was about 150 seconds. It was partially replaced in production by the similar Type A which had been re-introduced for reasons unclear.




A small red candle with the top cover removed.

Of equal importance were the red (vomiting gas) candles. The standard such at the start of the war was the Type 93, succeeded by Experimental Type 98, and then the Type 100 Small. The small red candle was a simple tin tube fitted with top and bottom plates. The bottom plate featured a wire ring to which was usually attached a loop of string for carrying. The top plate had three holes, two on the periphery serving as vents and one in the center fitted with a match head. The top plate was protected by a cover that was held in place by adhesive tape. The 160-g payload consisted of about 50% nitrocellulose, 35% diphenylcyanarsine and diphenylarsenic acid, and the balance camphor and other minor elements.

For use the top cover was removed and a scratch block used to ignite the match head. After a few seconds this ignited the nitrocellulose, the burning of which expelled the DC as gas through the two vents.

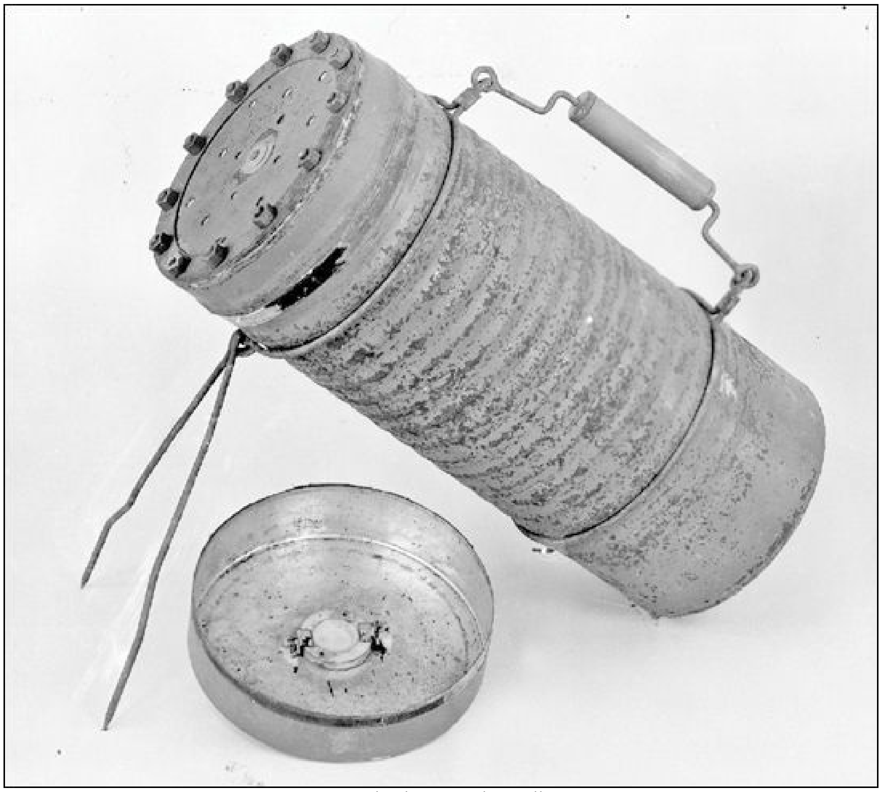
The medium red candles were somewhat larger and used a different generating system. The tube was divided into upper and lower chambers, with the lower chamber containing 390 g of fuel in the form of ammonium nitrate mixed with about 10% charcoal as a binder. The upper chamber held 400 g of pumice balls impregnated with an equal amount of DC. In this case the match head ignited the fuel, generating heat that diffused the DC as a gas.

**Army Smoke Candle Production**

| | 1931 | 1932 | 1933 | 1934 | 1935 | 1936 | 1937 | 1938 |
|---|---|---|---|---|---|---|---|---|
| Obscurant Smoke Candles | | | | | | | | |
| Type 94 Small | 37,500 | 15,000 | 128,000 | 30,000 | 0 | 30,000 | 269,700 | 30,900 |
| Type 94 Large | 600 | 600 | 300 | 500 | 9,500 | 1,000 | 1,400 | 1,000 |
| Type 94 Floating | 1,600 | 500 | 100 | 200 | 700 | 1,000 | 3,300 | 180,300 |
| Type 99 SP | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Green (Tear Gas) Candles | | | | | | | | |
| Type 89A | 6,100 | 14,000 | 78,000 | 45,000 | 22,500 | 0 | 0 | 0 |
| Type 89B | 1,500 | 2,000 | 6,400 | 12,400 | 11,000 | 0 | 0 | 0 |
| Type 89C | 700 | 0 | 0 | 1,000 | 600 | 0 | 0 | 0 |
| Type 94 | 0 | 0 | 0 | 0 | 0 | 0 | 179,300 | 263,500 |
| Red (Vomiting Gas) Candles | | | | | | | | |
| Type 93 | 0 | 0 | 100 | 2,300 | 1,600 | 1,000 | 103,900 | 308,900 |
| Large | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Type 98 Medium | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 200 |
| Type 98 SP | 0 | 0 | 0 | 0 | 9,500 | 0 | 0 | 50,000 |
| Type 100 Small | 0 | 600 | 300 | 0 | 0 | 0 | 0 | 110,500 |
| Brown (Nerve Gas) Grenades | | | | | | | | |
| Frangible HCN Grenade | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | 1939 | 1940 | 1941 | 1942 | 1943 | 1944 | 1945 | |
| Obscurant Smoke Candles | | | | | | | | |
| Type 94 Small | 2700 | 55000 | [a]0 | [a]0 | [a]0 | [a]0 | 0 | |
| Type 94 Large | 700 | 14000 | 65800 | 26160 | 26861 | 0 | 9000 | |
| Type 94 Floating | 10100 | 100 | 80000 | 80000 | 65970 | 60200 | 0 | |
| Type 99 SP | 11000 | 16600 | 98800 | 701200 | 154600 | 145500 | 0 | |
| Green (Tear Gas) Candles | | | | | | | | |
| Type 94A | 0 | 13500 | 289700 | 300000 | 220000 | 27340 | 0 | |
| Type 94 | 150000 | 1700 | 528500 | 5400 | 97832 | 0 | 0 | |
| Red (Vomiting Gas) Candles | | | | | | | | |
| Type 93 | 57500 | 0 | 0 | 0 | 0 | 0 | 0 | |
| Large | 300 | 5000 | 20300 | 30000 | 14000 | 3044 | 0 | |
| Type 98 Medium | 6100 | 96000 | 100000 | 10000 | 0 | 0 | 0 | |
| Type 98 SP | 84900 | 63900 | 0 | 0 | 0 | 0 | 0 | |
| Type 100 Small | 188000 | 174400 | 107000 | 47600 | 140 | 0 | 0 | |
| Brown (Nerve Gas) Grenades | | | | | | | | |
| Frangible HCN Grenade | 0 | 0 | 87000 | 55000 | 25000 | 41000 | 0 | |

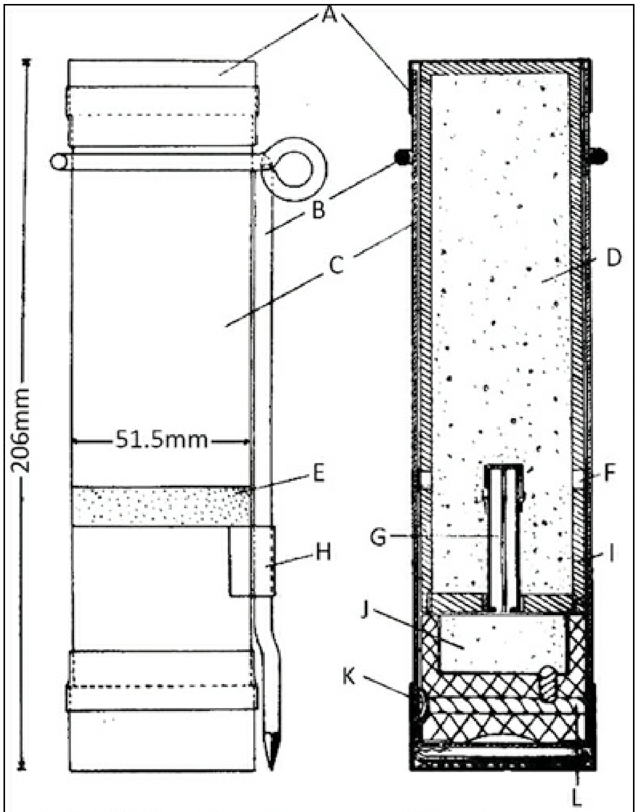
[a] The figures in this table are those supplied by the Tokyo 2nd Arsenal. The Ordnance Bureau showed production of about 300,000 Type 94 small per year during these years.

This system was inherently slower than that of the small candle, and the goal here was apparently to increase the length of time it was active. The small candle burned for only six seconds and was effective for only one to two minutes before the gas dispersed under normal conditions. The medium candle put out gas for 17 seconds that was effective for three and a half minutes. Under good conditions the cloud would drift downwind 70 to 100 m before dissipating. For even larger applications there was the large red candle weighing 13 kg.



A 13-kg large red candle.

The unpleasant nature of the DC cargo made self-projecting candle design an attractive option for the red systems. This was similar to the Type 99 regular smoke candle except for the payload, which was now a DC mixture similar to that of the small red candle. The need to incorporate propellant and the delay fuze meant that the chemical payload was cut in half compared to the hand-emplaced small model, down to 81 g. Thus, even though the ability to project the candle 150 m was handy, it was taken out of production in 1940. It was to be replaced by the Type 100 red SP candle, that carried 154 g of payload to 250 m, but this appears to have made it into only limited production in 1941.




A top lid; B spike; C launcher tube; D chemical fill; E painted red band; F smoke vent; G fuze; H spike clip; I candle tube; J propellant; K match head; L pyrotechnic train.

Type 98 red SP candle.

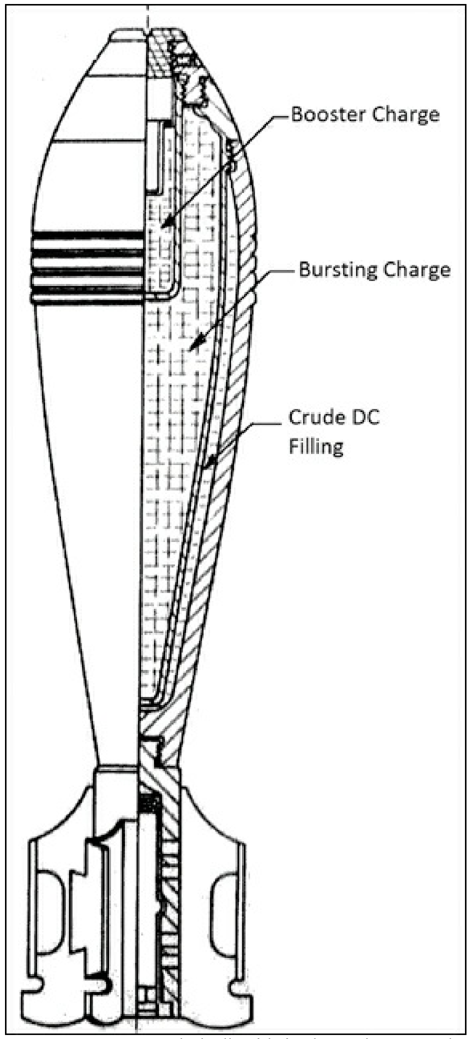
The last of the hand-delivered gas munitions was the frangible HCN grenade. This was almost identical to the frangible smoke grenade, but was instead filled with 385 cc of prussic, or hydrocyanic, acid (HCN), along with a small amount of powdered copper as a stabilizer. It thus differed from the other hand gas systems not only in the device itself, but that it carried a lethal payload, albeit a fairly small one probably suitable only for neutralizing point targets, such as pillboxes.

The prussic acid frangible grenade and its carrying can.

**Projectiles**

For the most part the various chemical shells were similar to their more conventional counterparts in exterior form and ballistics. The most significant difference, of course, was in the filling. The primary unique design feature was the incorporation of a screw-in burster charge tube that projected back from the fuze well into the body of the shell. This held an explosive burster charge that, when initiated by the fuze's booster charge, split the projectile open to allow the gas material to diffuse into the air.

The Army's primary gas delivery weapons were the trench mortars, which were produced in 90mm and (in much smaller quantities) 150mm calibers. As a result the most widely-used chemical rounds were the Type 95 rounds, in red (vomiting) and yellow (blister) varieties, fired from the 90mm Type 94 and Type 97 mortars.



The 90mm Type 95 red shell with its large burster charge.

These unusual rounds were actually combination HE/gas shells, with large burster charges that had the same profile as the interior of the shell, but slightly smaller, with the chemical fill occupying small annular void between the burster and the shell wall. As a result the Type 95 DC shell carried 660 g of TNT and only 220 g (165 cc) of the diphenylcyanarsine filling, compared to 1 kg of TNT for the Type 94 HE shell. The toxic effect was thus presumably somewhere between that of the small and medium red candles. Ballistics, including range, were the same as for the HE round. The Type 95 red shell was the most widely-used chemical round in the China theater. Doctrine defined usage of these rounds in terms of coverage of a 4 hectare (40,000 $m^2$) area held by troops with no or poor-quality gas protection, common in China. To completely destroy the enemy or eliminate his will to fight required 400 rounds, neutralization (half cannot fight) 200 rounds, and for suppression 80 rounds.

The Navy made much smaller numbers of tear and mustard gas mortar projectiles in their characteristic 12-fin 81mm configuration, but little is known of them.

Most of the artillery gas projectiles were more conventional, with a larger relative gas payload. The most common were the 75mm Type 92 shells, in red and yellow models, both used in operations in China. The yellow model had a burster charge of 79 g of picric acide and a main payload of 960 g (570 cc) of a 50/50 mixture of lewisite and mustard. The red round, however, was more like the red mortar round in that it had an oversize burster charge, although not to the latter's extreme. The shell itself weighed 6.85 kg, of which only 225 g was the DC filler.

The 105mm Type 93 red projectile was similar to the 75mm red. It featured a burster tube 60mm in diameter and and 410mm long, reaching all the way to the bottom of the shell cavity. Thus, the shell weighing 15.8 kg included 372 g of TNT burster as well as the 763 g of DC fill. The 105mm yellow shell, on the other hand, had a shorter burster tube and more chemical fill, about 1900 cc or 2.5 kg of the mustard/lewisite mix.

The medium artillery was not left out. Chemical projectiles were developed in “yellow” (blister), “red” (vomiting) and “blue & white” (choking gas & smoke) versions. These were approved for the 10cm Type (Taisho) 14 gun and 15cm Type (Taisho) 4 howitzer in March 1934, for the 10cm Type (Meiji) 38 gun in December 1934, and for the 10cm Type 92 gun in January 1937. An experimental “brown” (blood and nerve poison) was authorized for the 15cm Type (Taisho) 4 in November 1940. It is not known if gas rounds were authorized for the 15cm Type 96 howitzer.

A cutaway 105mm yellow chemical shell. Note the burster charge tube extending part way down into the body.

The 15cm projectiles followed the pattern the smaller brethren, with the yellow shell having a smaller burster and a 3400 cc chemical payload, while the red shells had a burster tube 75mm diameter that extended all the way to the bottom. It appears that few 105mm chemical rounds and possibly no 150mm rounds at all were fired in combat.

The Navy produced “gas cans” in four calibers that could be used to convert normal HE rounds into chemical rounds. Only small numbers were built with a view to supporting invasions, but as soon as Japan moved to the defense production ceased.

| Production of Chemical Projectiles 1938-45 | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | 1938 | 1939 | 1940 | 1941 | 1942 | 1943 | 1944 | 1945 |
| Army | | | | | | | | |
| 75mm Type 92 Red | 69,600 | 50,000 | 112,300 | 126,360 | 0 | 0 | 0 | 0 |
| 75mm Type 92 Yellow | 6,000 | 0 | 41,480 | 70,320 | 40,000 | 14,400 | 0 | 0 |
| 90mm Type 95 Red | 40,000 | 4,000 | 97,580 | 350,007 | 91,993 | 58,000 | 0 | 0 |
| 90mm Type 95 Yellow | 13,000 | 0 | 43,000 | 17,014 | 13,952 | 0 | 0 | 0 |
| 90mm Blue* | 0 | 1,000 | 0 | 0 | 0 | 0 | 0 | 0 |
| 90mm Brown* | 0 | 100 | 0 | 0 | 0 | 0 | 0 | 0 |
| 105mm Type 93 Red | 1,200 | 8,300 | 16,800 | 32,986 | 24,014 | 0 | 0 | 0 |
| 105mm Type 92 Yellow | 0 | 1,000 | 12,800 | 81,472 | 4,528 | 5,000 | 0 | 0 |
| 150mm Type 93 Red | 0 | 0 | 4,500 | 20,622 | 13,678 | 0 | 0 | 0 |
| 150mm Type 92 Yellow | 0 | 0 | 6,000 | 37,465 | 8,535 | 15,000 | 0 | 0 |
| 150mm Blue* | 0 | 0 | 1,000 | 0 | 0 | 0 | 0 | 0 |
| 150mm Brown* | 0 | 0 | 0 | 100 | 0 | 0 | 0 | 0 |
| Navy | | | | | | | | |
| 81mm Mortar | 0 | 0 | 0 | 0 | 0 | 0 | >1,200 | 0 |
| 120mm Gas Can | ? | ? | ? | 7,000 | 3,000 | 0 | 0 | 0 |
| 127mm Gas Can | ? | ? | ? | 5,000 | 4,000 | 0 | 0 | 0 |
| 140mm Gas Can | ? | ? | ? | 4,000 | 3,000 | 0 | 0 | 0 |
| 150mm Gas Can | ? | ? | ? | 3,000 | 4,000 | 0 | 0 | 0 |
| * For trials | | | | | | | | |

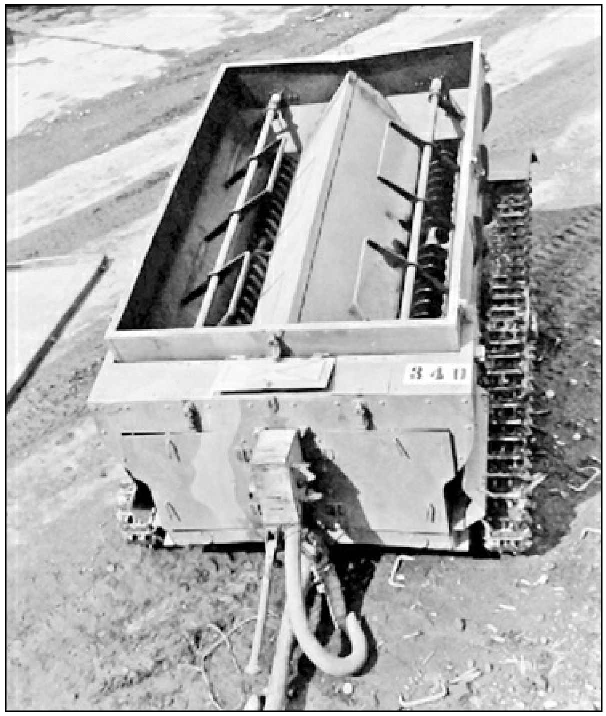
**Bulk Agent Applications**

Persistent blister agents, mustard and lewisite, were useful for area-denial roles. They could be spread over the ground as droplets of liquid rendering an area impassible except to troops wearing cumbersome protective clothing. The preferred method was by aircraft, either aerial spraying or the large number of 30- and 50-kg bombs built by the Army and the Navy.

The means for delivering bulk agent on the ground was the Type 94 chemical unit, a tracked trailer drawn behind a slightly modified tankette. It carried 265 liters of blister agent that was spread behind it in a path 2-4 meters wide by a spray device operated by the rotation of the road wheels.

A companion piece was the Type 97 decontamination unit, which was fitted to carry chloride of lime decontamination powder. This material was dispersed by two rotating dispensers at the rear of the trailer.

Both types of trailers were deployed to Manchuria for most of the war, and then brought back to Japan as the threat to the homeland increased.


A Type 97 decontamination trailer with top removed.

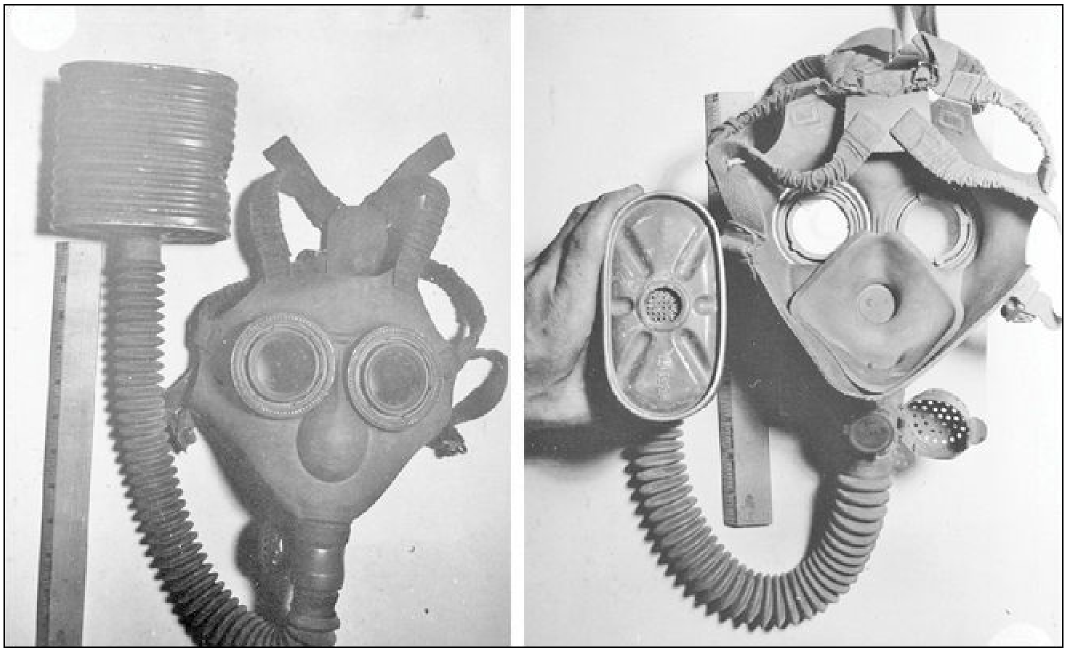
## Individual Protection

The first line of defense against enemy chemical agents was, of course, the gas mask issued to each soldier. The early Type 89 was quickly replaced by the Type 91, then the Type 95, the latter being the standard mask in service by the outbreak of the war. The major shortcoming of the Type 91 was that its canister had multiple small perforations on the bottom plate for air inlets, meaning that it could not be proofed against moisture seeping in. The Type 95 remedied this by providing a single larger orifice with a rubber stopper starting in 1935. The Type 95 was, in turn, replaced on the production line in 1940 by the Type 99, featuring a flexible rubber inner mask covering the nose, which reduced lens fogging due to exhaling.

**Army Individual Gas Protection Equipment Production**

| | Gas Mask | Horse Gas Mask | Decontamination Suit | Partial Decontamination Suit | Decontamination Leggings | Gas Cape |
|---|---|---|---|---|---|---|
| 1935 | 150,000 | 10,000 | 0 | 0 | 10,000 | 0 |
| 1936 | 150,000 | 10,000 | 0 | 0 | 10,000 | 0 |
| 1937 | 500,000 | 35,000 | 100,000 | 150,000 | 50,000 | 3,000,000 |
| 1938 | 500,000 | 35,000 | 100,000 | 100,000 | 45,000 | 2,000,000 |
| 1939 | 500,000 | 35,000 | 50,000 | 50,000 | 30,000 | 1,500,000 |
| 1940 | 678,000 | 50,000 | 40,000 | 50,000 | 20,000 | 1,000,000 |
| 1941 | 680,000 | 50,000 | 40,000 | 50,000 | 30,000 | 1,400,000 |
| 1942 | 764,000 | 50,000 | 30,000 | 60,000 | 20,000 | 1,400,000 |
| 1943 | 890,000 | 40,000 | 20,000 | 90,000 | 40,000 | 700,000 |
| 1944 | 1,635,000 | 10,000 | 5,000 | 5,000 | 0 | 700,000 |
| 1945 | 334,000 | 0 | 0 | 0 | 0 | 20,000 |

All of the masks were lighter than their US counterparts and, indeed, got lighter with each model. At 30cm the hose between the canister and the facepiece was a little short on the Type 95, but on the Type 99 reverted to the to 43cm of the Type 91. The canisters contained hopcalite and extruded charcoal as their absorbent, as well as an accordion-type mechanical filter.


Front and rear shots of the Type 99 gas mask.

| Army Gas Mask Data | | | |
|---|---|---|---|
| | Type 91 | Type 95 | Type 99 |
| Total wt incl carrier (g) | ? | 1400 | 1200 |
| Canister wt (g) | 786 | 767 | 513 |
| Facepiece wt (g) | 431 | 404 | 385 |
| breathing resistance (mm water) | 75 | 59 | 48 |
| smoke penetration (%) | 8.4 | 1.9 | 1.9 |
| phosgene resistance (min) | 13 | 21 | 2.5 |
| smoke penetration (%) | 0.8 | 1.1 | 0.7 |
| Hydrogen Cyanide resistance (min) | 2.4 | 2.4 | 1.7 |

The masks were well-made and breathing resistance was good in all three models, in fact, it was easier to breathe in the Japanese masks than in US versions. On the other hand, they were not as effective. The US standard was that no more than 1% of smoke could penetrate the canister, but all three Japanese models exceeded that, although the two more modern ones not by that much.[4] The smoke resistance test was designed to measure the canister's ability to filter out gases, such as tear and vomiting. The tests designed to see how long the canister could hold up against fatal droplet agents, such as phosgene, also showed them to be somewhat less effective than US models. As it turns out they appear to have been sufficient for the uses assigned, which were primarily to prevent loss of effectiveness from the inevitable "drift-back" of the red and yellow gases used in China.

Another area of concern was the delivery of fatal droplet agents by aerial means. For protection the Army issued disposable paper capes that could be donned when a threat was imminent and discarded after being contaminated, having kept the droplets off the soldiers' skin. The capes were made of three-layer brown opaque paper, included a hood, and were large enough to provide complete coverage of the wearer's body. There were two models, with and without sewn "wings" for the arms.

Decontamination kits, holding cotton swabs and bleaching powder were also part of the protection scheme. These were used to neutralize mustard and lewisite. A Type 96 bleaching powder bag was issued one per five soldiers and refill cartons were issued at company level. Personnel assigned to decontamination duties were further issued heavy rubber protective suits that they could wear while carrying out their tasks in contaminated areas with contaminated gear.

Protective gear, to include gas masks and protective coverings, were also available for horses. That made sense, since the Army might have to move through contaminated areas with their heavy equipment and supplies.

A protective cape offered limited protection against aerial spraying.

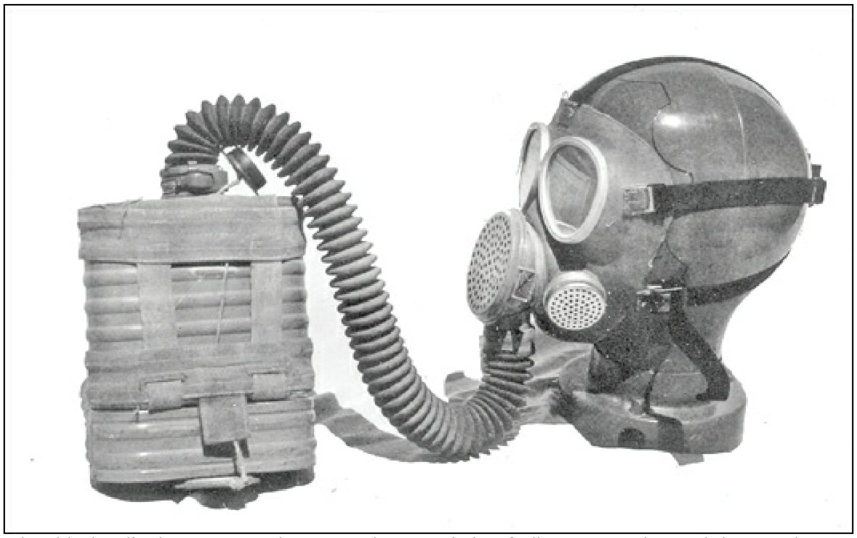
The Navy's efforts were largely driven by their concern for shipboard operations. For instance, there was a special gas mask for use on submarines in the event of battery acid leak. Even for general-purpose use the masks included a secondary canister that added protection against carbon monoxide, an important consideration when fighting fires aboard ship.

The Navy gas masks were built, except for small parts, and assembled by Showa Gomu KK, who then shipped them to the Sagami Naval Arsenal, where the canisters were filled with the activated coconut charcoal and issued. The firm built 243,000 during 1931-1940.

An Army decontamination suit and gas mask.

| Navy Individual Gas Protection Equipment Production 1941-45 | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Gas Mask Type 93 Mk 2 | Gas Mask Type 93 Mk 3 | Gas Mask Type 93 Mk 4 | Gas Mask Type 97 | Gas Mask Type 3 | Type 98 Protective Suit | Light Protective Suit | Gas Cape |
| 1941 | 57,000 | 0 | 0 | 2,000 | 0 | 500 | 500 | 0 |
| 1942 | 70,000 | 0 | 0 | 5,000 | 0 | 1,000 | 1,000 | 0 |
| 1943 | 20,000 | 40,000 | 0 | 10,000 | 1,000 | 1,000 | 1,000 | 0 |
| 1944 | 0 | 400,000 | 100,000 | 1,000 | 3,000 | 470 | 80,000 | 170,000 |
| 1945 | 0 | 150,000 | 10,000 | 0 | 2,000 | 0 | 20,000 | 30,000 |

The standard Navy gas mask at the start of the war was the Type 97 Mark 2. It was a bit heavy, with a total weight of 3.4 kg, although this was reduced to 1.8 kg as worn, but not including the secondary canister. Breathing resistance was low and the main canister was said to filter out 99.85% of smoke and to last 70-80 minutes in a 0.5% chlorine gas environment. The secondary canister provided 30-40 minutes protection against carbon monoxide.



A Navy Type 97 gas mask with the diaphragm over the nose, characteristic of all Navy masks, and the supplemental diaphragm to its side.

The Mark 2 was replaced mid-war by the Marks 3 and 4, the former for use on land and the latter for shipboard use. The two models shared a common facepiece and main canister. The main canister was reduced in weight, from 980 g to 660 g, but retained the same breathing resistance and smoke filtration. Protection against chlorine fell to 40-50 minutes, however. The main difference between the two was that the Mark 3 disposed of the secondary canister as unnecessary, while the Mark 4 included an even larger one to increase CO protection to 90-120 minutes.

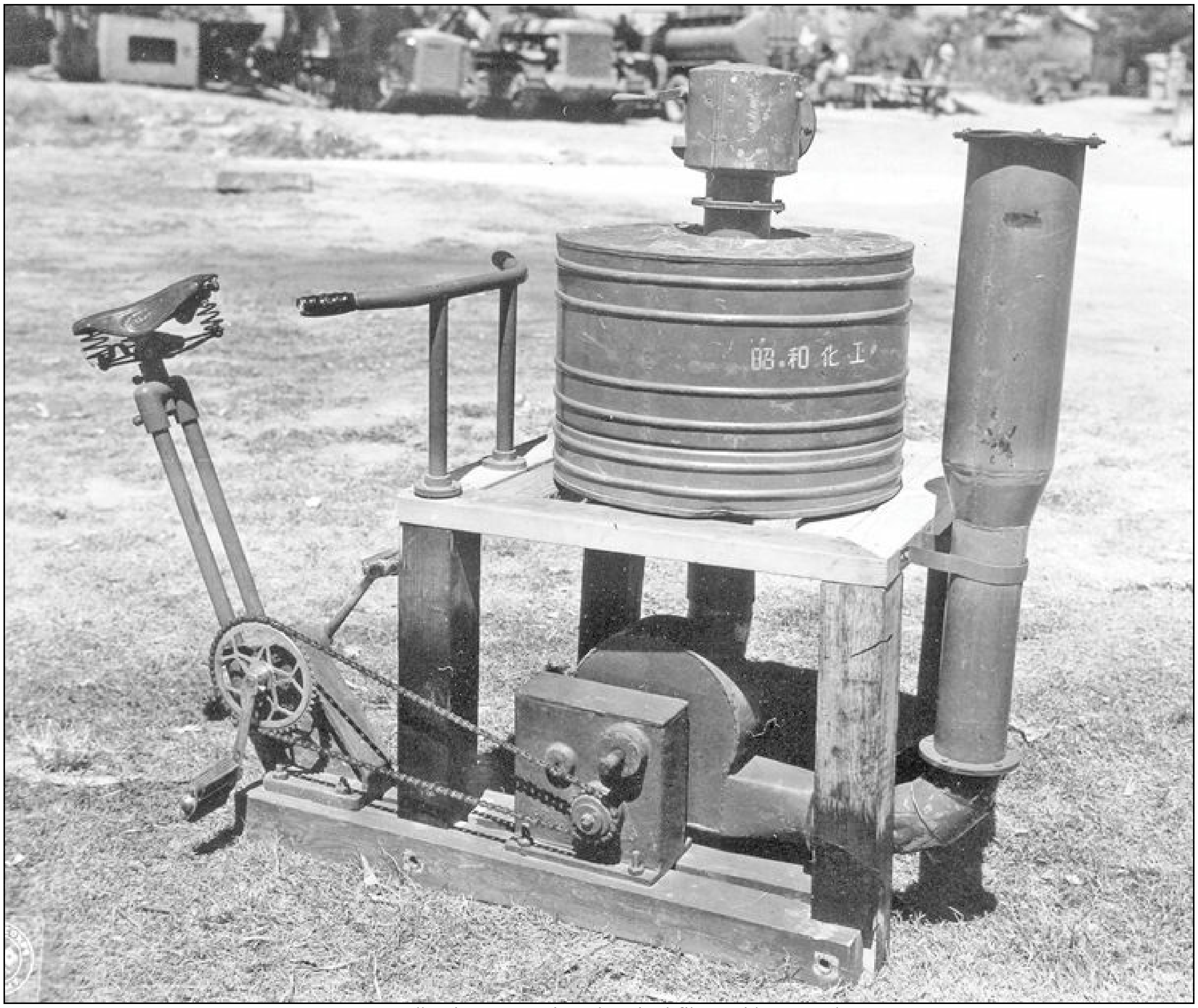
A special variant was developed for commanders that improved voice transmission by use of a dual diaphragm. Swapping out for this different facepiece turned a Type 93 into a Type 97. A Type 5 gas mask was developed near the end of the war that replaced some of the scarce materials used in the Type 93 Mark 3 with those more available in anticipation of the ground battle at the end of the war, but it does not appear to have made it into full-scale production.

The Navy, of course, also fielded protective outfits for use in contaminated areas, and gas capes, in this case made of impregnated cloth, for temporary protection from aerial sprays.

**Unit Equipment**

The Army did develop collective filtration devices to provide clean air to enclosed areas. The Type 97 chemical filter was formed as a cylinder 46cm in diameter and 27cm high, filled with soda lime and extruded charcoal at the bottom and an accordion mechanical filter at the top. The air could be moved through the filter by an electric motor or manual device. In either event, it would have been sufficient only for a small enclosure. The device would have generated overpressure in the enclosure, but probably only slightly and a shortage of relatively airtight structures in the front line areas meant that few Type 97s were actually deployed to combat.

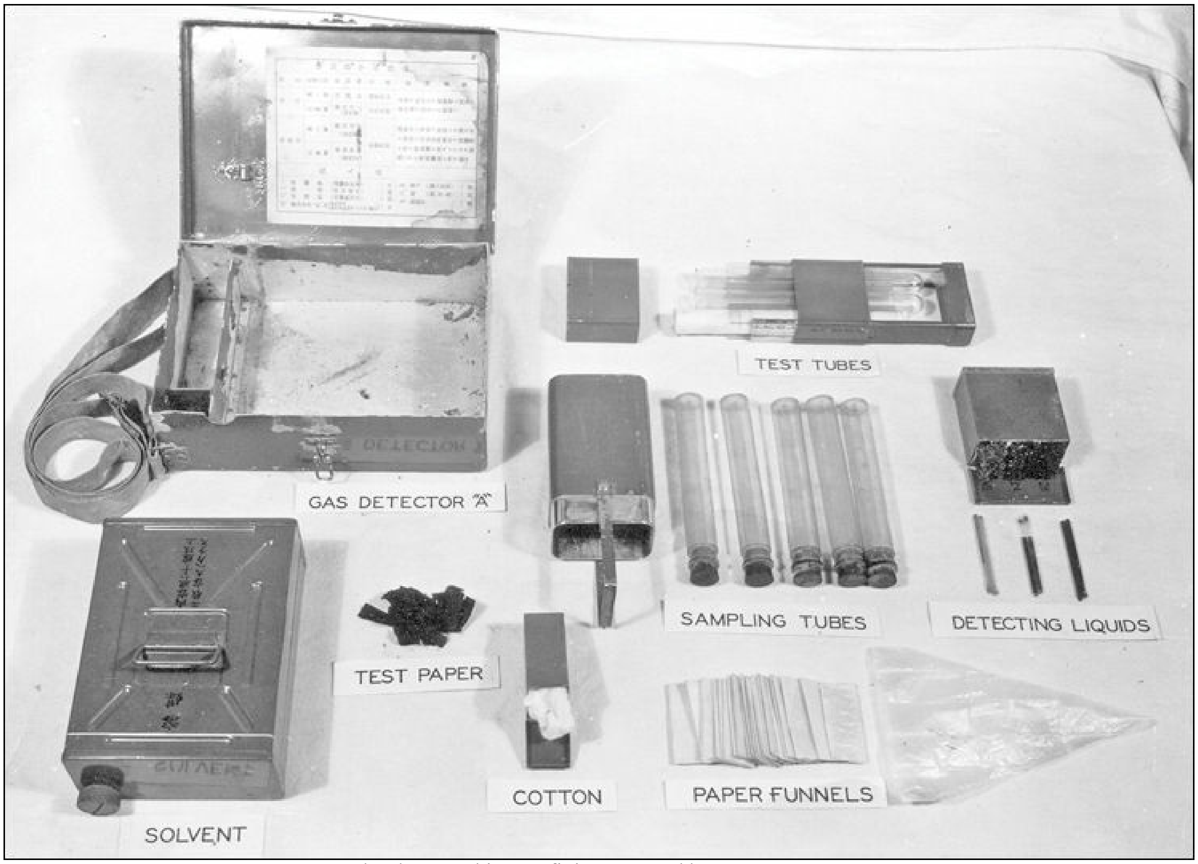
A larger system, the Type 100 filtration system, could deliver 6 $m^3$ per minute of filtered air, but was large and intended for use with fixed buildings, seeing most of its use for command and control facilities in the homeland.



A Type 97 collective protection chemical filter with manual power.

The only detection devices available to the troops identified liquid or solid agents, not gases. This was the role of the Type 95 Detector, produced in A and B kits. The Type 95A had test tubes, a can of solvent, 50 tubes of each of three solutions, and assorted iodine-impregnated paper strips, etc. This kit could test for mustard and lewisite in water and on solids. The much less common Type 95B featured a tube through which air or water could be drawn to detect the presence of those same agents.

A variant of the Type 95 detectors was the Type 96 patrol detector kit. This was intended for marking routes through potentially contaminated areas. It included a can of high-grade bleaching powder (that smoked and burned when in contact with blister agents), a granular reagent that reacted to blister gases by turning color, and a package of blue paper testing strips that changed to yellow-brown if blister agents were present in the atmosphere. The kit also included a small wind flag, rolls of white cotton tape to mark a passageway or contaminated area during daytime and slow-burning match cord to perform the same function at night by burning slowly, taking about 30 minutes to go about 20 cm.



The detector kit 95A fit into a metal box 21x15x6 cm.

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1 The Allies often referred to this type as "sternutatory", or sneezing, gas.

2 Production figures for the frangible smoke grenades are uncertain. The candle production table shown here, drawn up the Tokyo 2nd Arsenal right after the war, specifically refers to frangible HCN grenades only. It is possible that those numbers actually include frangible smoke grenades as well.

3 There was also a Type 89 tear gas grenade, a plastic cylinder 12cm high and 5cm in diameter with a pyrotechnic delay in a central well. This was never deployed to the combat zones and may have been a domestic police munition.

4 The performance values given in the table were derived from a large number of used masks captured in the field by the Allies. Performance when new were probably a bit better.

21

# Mine Warfare

## Mines

Essentially defensive in nature, land mines received little attention from the Army. A rather small anti-tank mine was designed in the early 1930s and standardized as the Type 93 but was initially produced only in small quantities.

The Type 93 placed 910 g of picric acid explosive inside a two-part circular metal container 170mm in diameter 45mm thick. A central passage was provided, into which was screwed a detonator charge from the bottom with a fuze above it. The fuze incorporated a spring-loaded striker that was held in place by a shear wire. Pressure on the fuze pushed the striker bolt down, cutting the shear wire, and allowing the striker to leap forward, hitting and initiating the detonator charge. Initially intended as an anti-tank mine, it was fitted with fuze wires that would not shear until about 120 kg was placed on the mine, but during the war a 5-kg shear wire was introduced, turning it into an anti-personnel mine.

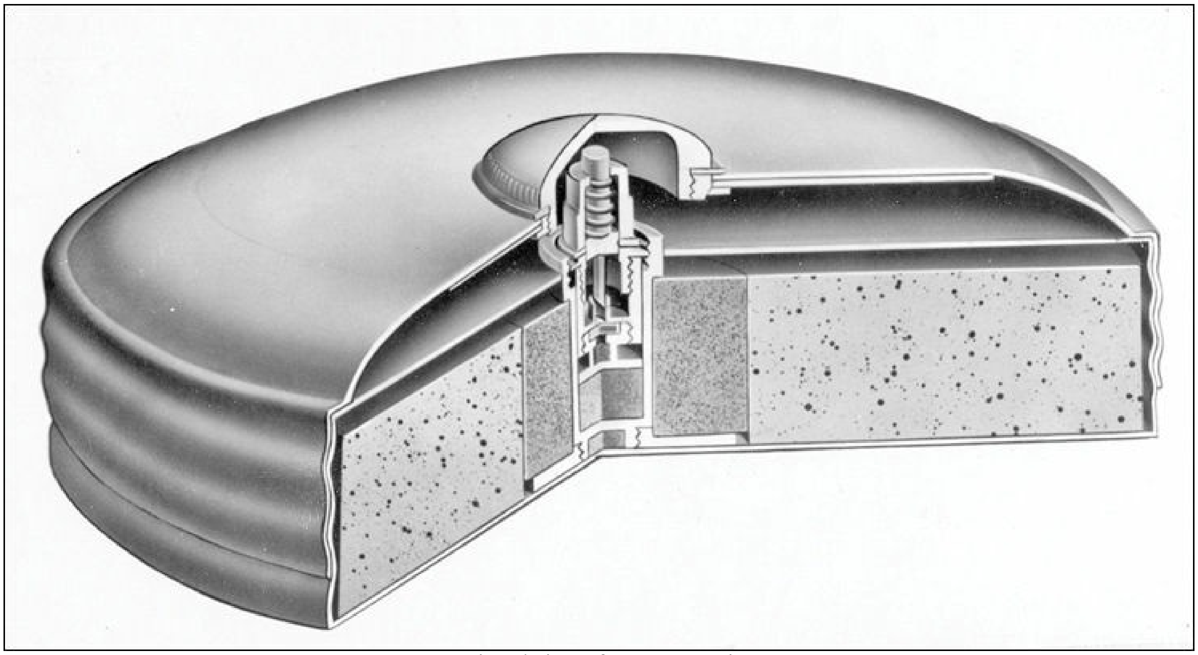
Production of the Type 93 seems to have tracked with concerns about Soviet aggression in the far east, after allowing for bureaucratic and production lags. Indeed, it reportedly stopped completely during FY40 (April 1940 to March 1941).

As an anti-tank mine it could break the track of a tank, but rarely caused much additional damage, having only about 1/3 of the explosive of the standard US M1 antitank mine. Indeed, even jeeps and trucks were usually repairable, suffering only crushed wheels and broken axles. Several expedient remedies were used to increase the lethality of the Type 93. One was to simply stack two mines, one atop the other, in the hole in the ground. Another was to dig a much larger hole and use the mine as the detonator for a much larger device, such as an artillery shell or even an aerial bomb. An artillery shell would certainly disable a tank and tests with a 63-kg aerial bomb completely destroyed an M4 Sherman tank and would have killed or disabled the crew.

**Land Mine Production**

| | | FY34 | FY35 | FY36 | FY37 | FY38 | FY39 |
|---|---|---|---|---|---|---|---|
| Army | Type 93 | 500 | 3,500 | 12,500 | 29,500 | 156,830 | 110,820 |
| | | **FY40** | **FY41** | **FY42** | **FY43** | **FY44** | **FY45** |
| Army | Type 93 | 0 | 88,000 | 115,000 | 93,730 | 0 | |
| Army | Type 3 ceramic | 0 | 0 | 0 | 0 | 340,000 | 25,000 |
| Army | Bar | 0 | 0 | 0 | 0 | unk | 20,000 |
| Navy | Model 1 | 0 | 0 | 0 | 8,000 | 0 | 0 |
| Navy | Model 2 | 0 | 0 | 0 | 0 | 62,000 | 0 |
| Navy | Type 3 ceramic | 0 | 0 | 0 | 0 | unk | unk |

A Type 3 ceramic mine, buried, showing just the fuze, and uncovered.


Sectioned view of a Type 93 mine.


A Type 3 ceramic mine.

In February 1943 the Army decided that the limited supply of metals could be better spent than on land mines, and launched an effort to develop an alternative. Pottery was chosen for the mine body in view of its hardness, weather resistance and availability of production facilities and the result was designated the Type 3 ceramic mine. A wall thickness of 10mm was chosen as the minimum that would retain its shape in the ovens. In May 1944 a contract was placed with Shigaraki Buki Pottery Co for 980,000 mine bodies for delivery over the next year. The firm's 17 small factories produced them by hand, including the use of plaster-of-paris molds on potter's wheels and, not surprisingly, fell behind. By the end of the war 791,329 had been produced, of which 408,000 were shipped to the Osaka Army Arsenal for filling, 123,740 to the Sagami Navy Arsenal, and the balance remained at the factory. Of those shipped to the Army about 375,000 were actually filled and assembled, while Navy production is unknown.

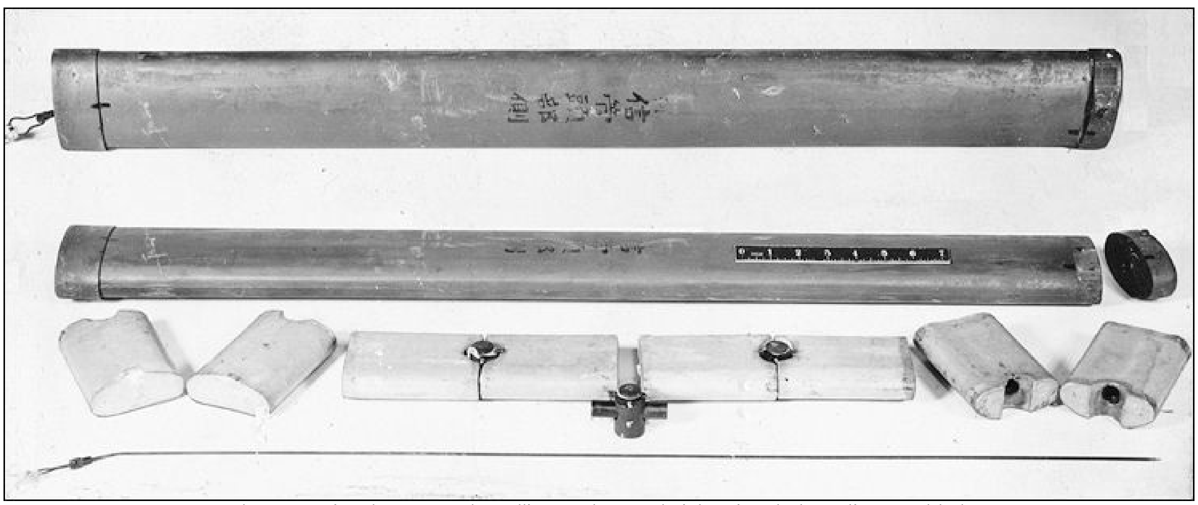
The Type 3 was built in two sizes, one with a diameter of 215mm and thickness of 90mm with 2 kg of Type 88 explosive, and the the other 270mm x 90mm with 3 kg of explosive. The Japanese rated them as having effective anti-personnel radii of 8 meters and 10 meters, respectively. The Type 3 also incorporated a new, dual-mode fuze. Downward pressure of about 10 kg overcame the resistance of the primary spring and pushed the plunger down onto the striker which then, in turn, struck the percussion cap. There was also a spring-loaded hammer element inside the plunger that was held in the disarmed (upper) position by a fork, the base of which extended outside the fuze body. Pulling the fork out released the hammer element, which struck the striker, initiating the mine. The fork could be pulled out by a trip wire with a pull of about 2 kg.

That the ceramic mine body was almost undetectable to the magnetic mine detectors of the time was purely a serendipitous side effect of the need to conserve metals. Indeed, US mine detectors could detect the metal in the mine fuze, rendering clearance slower but still possible. A continuing problem was that the anti-personnel effectiveness radii given above was accurate only if the mine was above the ground. When buried almost all its effect was concentrated straight up. This had been recognized early and a development program launched for a “jumping” or projected mine in July 1943. The payload and wall thickness were chosen to be identical to that of the lighter Type 3 ceramic mine but the configuration was changed to that of a can 16cm in diameter by 17cm high. An 8 g propellant charge would throw the mine into the air and 0.3-second delay element would detonate it at a height of 1 meter.

Shigaraki Buki built 900 cases and these were shipped to the 3rd Army Laboratory for static testing, which showed moderate effectiveness at 10 meters, a target 1.5 meters high by 5 m wide being hit by 6 fragments 10mm or larger and 20 smaller fragments. Based on these findings the jumping mine was accepted for service use in October 1944, and a wildly optimistic goal of 150,000 units per month proposed, but was never actually placed in production for fear of dramatically reducing the flow of Type 3 ceramic mines.

In any event, the jumping mine was overtaken by the slightly later development of the Type 4 Amphibious Mine. This was simply two Type 3 ceramic mines placed one atop the other inside a thin sheet metal can. The can had sufficient extra volume above the mines that water could be admitted to regulate its depth in water, notably turning it into a shallow-water bottom mine. In the Type 4 the fuze was mounted to the top of the can and was fitted with an array of spokes radiating outward at about a 45° angle, to approximately the edge of the can. Arms were attached to the spokes and the fuze such that pushing down on an arm also pushed down on the fuze, detonating the mine. The Type 4 was accepted on 3 August 1945 as the new standard mine for the Army, for both land and water use, but of course that action was soon academic.

A unique type of mine was the bar mine, called by the Allies the “yardstick mine”. This was a thin tube of sheet metal, oval in cross-section, 91cm long and 8.5x4.5cm across. In it were placed eight blocks, each 300 g of picric acid, with each of four pairs sharing a fuze placed in between. The plunger in each fuze was held in place by a shear wire that would be cut with the application of about 120 kg of pressure. Allied intelligence noted the possibility of replacing this shear wire with a thinner one, creating an anti-personnel mine, but it is not known if this was actually done. In any event, the limited explosive power of the mine meant that it often did not break tank tracks, but it could disable a wheeled vehicle.



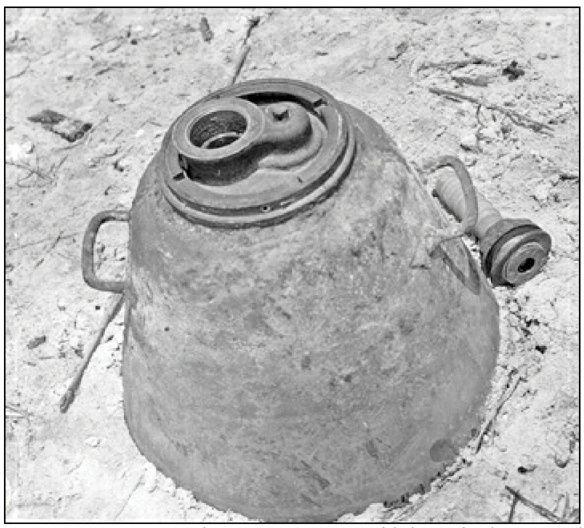
The Bar Mine, known to the Allies as the Yardstick Mine; below, disassembled.

The Navy was apparently slightly less concerned about metal shortages and its beach-defense mines to protect their new ocean bases were more conventional. The initial model, the Type 1, was a large device in the shape of a truncated cone of pressed steel 360mm in diameter at the base and 178mm across at the top, being 270mm high. Projecting from the top was a single pole, or horn, made of lead containing a long glass vial filled with sulfuric acid. Bending the horn, as, for instance, when hit by a landing craft or run over by a tank, caused the vial to break. The acid fell into an electric cell, generating a current that detonated the mine. With 10 kg of explosive the mine was clearly capable of disabling a landing craft or destroying a tank. The horn and electric cell could be replaced by a simple electric connection to a wire run from a remote observation post for command detonation.

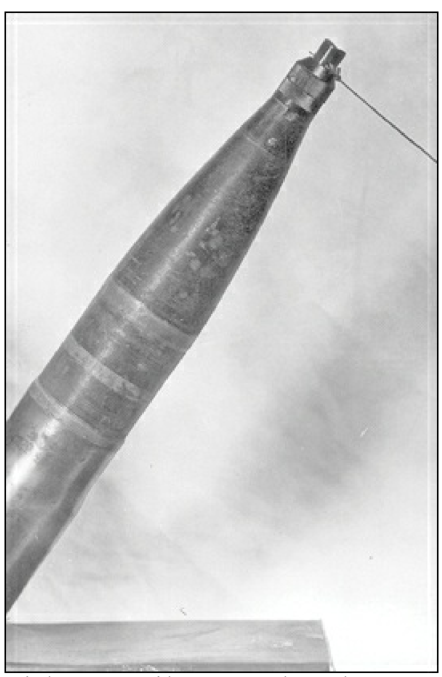
Production was turned over to the Maizuru and Yokosuka Naval Yards and five private firms, but relatively few were actually built, all between July and November 1943. Instead, it was replaced by the much larger Type 2.

The Type 2 had a hemispherical body made of rolled steel 520mm across at the base and 270mm high, weighing 48 kg, of which 21 kg represented explosive fill. Operation was the same as the Type 1 but the larger mine had two horns, either of which could initiate detonation. The same organizations produced the Type 2, but in larger numbers, beginning in August 1944 and running to January 1945 In both cases the mines were usually buried with just the horns protruding above ground.

A Navy Type 1 beach mine with its single horn removed and laying to the side.



Much more common was the Navy Type 2, with its twin detonator horns.



Artillery projectiles were often converted into mines, usually buried nose-up with pressure plates above. Here, one has been converted by replacing the normal fuze with a pull-type fuze from a pottery mine.

Regardless of the design these mines were produced only in small quantities, at least relative to the production in other major combatants. In compensation large numbers of improvised mines were fabricated at the front lines. Anything that could hold explosives and a fuze was pressed into service, including wood boxes, artillery cartridge cases, and even hollowed-out coconuts. In some cases standardized instructions were sent out to the field, including for a wood box 18x18x12cm to be filled with 2 kg of Type 88 explosive and the fuze from a Type 3 ceramic mine. Also pressed into duty as land mines were artillery shells and aerial bombs buried nose up, such that a tank or other vehicle passing above would detonate the explosive.

In the event, the Japanese rarely made effective use of land mines. The numbers and densities involved were small compared to usage in Europe. Deployment, although sometimes clever, tended to be predictable and easily countered, perhaps due to the lack of training in the subject.

**Mine Detectors**

Development of mine detectors was carried out by the 3rd Army Laboratory, responsible for engineer equipment, and began around 1930. The first tests were carried out in late 1932 and continued through mid-1938, at which time the first detector was standardized as the Type 98.

The Type 98 used a search coil 43cm in diameter and 8cm high but only 6mm thick attached to a wooden handle 73cm long. This was an audible-alert system, using two radio-frequency oscillators tuned to slightly different frequencies, the difference yielding an audible frequency. The presence of metal near the loop caused an oscillation frequency change, which changed the pitch of the output signal. This was fed to a headset with a single earphone.

The unit was used in China but was not successful and only about a hundred were built. At 20 kg it was heavy and clumsy, and battlefield noise could overwhelm the single earphone provided. Tests conducted immediately after the war by US engineers showed that it could detect an 8 kg slug of iron at a distance of 30cm in the air, but not if it was buried the same distance underground.

A GI demonstrates the prone coil of the Type 100, although kneeling rather than in the proper position for moving under fire. Note the power pack and control box on his back.

An effort was immediately launched to remedy those shortcomings with the assistance of the 7th Army Laboratory (physics) and the Nippon Electric Co. In October 1939 three new models were subjected to tests, the Models A and B being improvements on the Type 98, and Type C being a completely new detector. Following testing using the Soviet T-4 mine as a target, the Model A was discarded in early 1940 and by April efforts were being concentrated on a hybrid of the other two.

Further development led to the Type 100, an induction-balance device using a galvanometer dial in lieu of audible signals. Two coils were provided, one for searching in the prone position and one at the end of a wooden pole for use in the standing position.

The Type 100 evolved into the Type 2, which was identical except that it used only a single search coil on an extensible handle and employed standard batteries. A 30cm handle was used when operating prone, and two 50cm handles could be attached at an angle for upright operation. With an operating weight of 14 kg it was somewhat handier than the Type 98 and certainly more useful. Japanese manuals rated it as effective against large and small mines buried at depths of 40cm and 25cm, respectively. Post war tests showed that it could detect the 8 kg iron slug on the surface at 46cm, and when buried 25cm underground. The standard called for a skilled operator to clear a 2-meter frontage at 5 meters per minute when prone and 10 meters per minute upright. Production was handed over to Nippon Electric, who built 300 Type 100s during 1940-42, and 900 Type 2s during 1942-43, at which time production of mine detectors ceased.

An attempt was made to turn the Type 2 into a vehicular system by mounting two of them on a cart that could be pushed by light truck, but by the later part of the war the need for mine detectors had become so slight that it was not pursued after a couple of unsuccessful prototypes were built. Similarly, no development aimed toward detecting non-metallic mines was undertaken beyond a little basic research.

A Type 2 mine detector being operated standing up.

# Tactical River-Crossing

With limited transport capacity the Japanese emphasized ease of portability in their bridging equipment to a greater degree than any other combatant. Boats folded and pontoons were sectional and broke down into small pieces for assembly at the crossing site. Even after the concessions to portability, however, bridging equipment was issued as organic equipment only in small quantities.

At the light end of the spectrum were the pneumatic boats, designated Type 91 in small, medium and large sizes. All were of heavy rubber or rubberized cotton and propelled by paddles, neither motor mounts nor oar locks being provided. In all cases there were actually two buoyancy chambers in the rim, so that even if one were holed, the boat could still float. A foot-operated bellows was provided for each chamber. Wooden floor boards were provided that were installed before inflating the boat. Inflating the medium boat took two men (one on each bellows) three minutes, and five minutes for the large boat.

| Type 91 Pneumatic Boats | | | | |
|---|---|---|---|---|
| | Weight | Length | Width | Depth |
| small | 15.8 | 2.0 | 1.0 | 0.3 |
| medium | 46.8 | 3.5 | 1.4 | 0.4 |
| large | 74.5 | 4.5 | 1.6 | 0.4 |

The small boat was folded and carried in a canvas bag for transport, with floor boards packed separately. It could seat four soldiers with their equipment. The medium boat had seating for eight, and an equal number could hang onto the ropes attached to the rim. It also could be rolled into a container and carried by two men on a bamboo pole. The large boat could hold 12 inside and about the same number could hang on to the ropes outside.

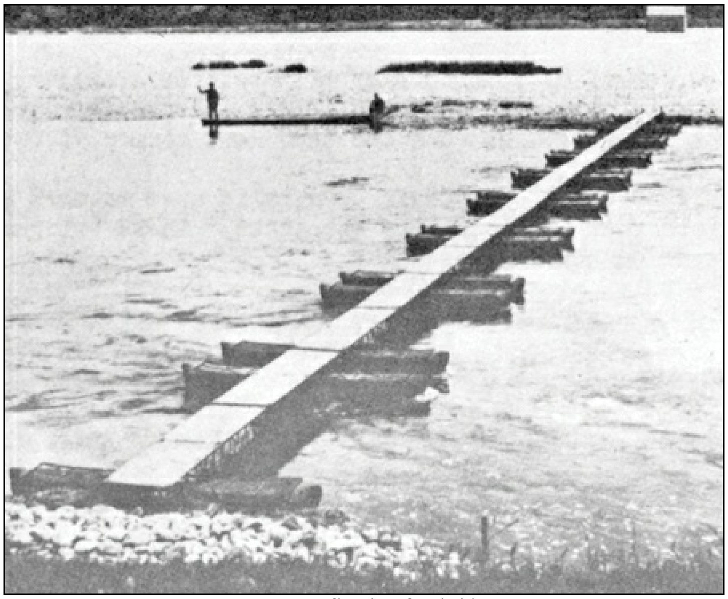
The scale of issue of these items was limited, a divisional engineer regiment usually had less than a half-dozen of the small models in the material platoon, and none were carried elsewhere in the division. Nevertheless, several thousand of the Type 91s were built, the small being the most common and the large the least, and they were issued on an "as needed" basis to units facing rivers.

It quickly became apparent that a slightly larger model was needed, leading to the issue of the Type 92 light pontoon float, identical in configuration but 5.5 m long and 1.9 m wide. Two of these were laid side-by-side and wooden decking placed on top to create a raft with a 2,000 kg capacity.

Air-filled rubber boats, although portable and useful for patrols, were inefficient given their need to move back and forth across the water. For moving infantry a floating footbridge was adopted, although relatively late, as the Type 97. Small kapok-filled floats were joined in pairs by saddles. A wooden treadway rested on these saddles to form a floating footbridge suitable for a single column of infantrymen. A set of Type 97 footbridge was 50 m long and could be carried in a single truck. During the war a total of 100 km of this footbridge were built, of which 30 km were sent to the Kwantung Army, 50 km to the China theater, and 20 km remained in the home islands. They were issued as needed, not as TO&E items, and some probably found their way down to Burma and the south Pacific as well.

Supporting divisions that required river-crossing capabilities were the Type E independent engineer companies, battalions and regiments of the GHQ pool, with battalions and regiments having four companies, a transport company and a materiel platoon, carrying a total of 160 collapsible boats with outboard motors and ten sets of raft equipment.


A Type 91 medium pneumatic boat.


A Type 97 floating footbridge.


It looks like these soldiers in China ran out of Type 97 material about halfway from the far bank and, like soldiers everywhere, improvised.

These collapsible assault boats, the Type 93 collapsible boat, and its successor, the slightly larger Type 95, were clever designs that optimized portability on land at the slight expense of sturdyness. From the introduction in 1933 they quickly became the standard river-crossing material of the Army.

| **Folding Assault Boats** | | | | |
|---|---|---|---|---|
| | Weight | Bow section | Stern section | Propulsion |
| Type 93 | 205 kg | 3.4x1.4x0.6 m | 3.4x1.4x0.6 m | manual |
| Type 95 | 200 kg | 4.0x1.45x0.68 m | 3.4x1.45x0.68 m | Type 95 motor |

Both models were collapsible, and were shipped in two segments that were assembled at the crossing site. Each segment, made of plywood with rubber join pieces, could be folded flat for transport. Each of these carried 16 men including a crew of three. The Type 93 was propelled by manual sculling, while the later model was provided with the Type 95 outboard motor, a 4-stroke, 2-cylinder unit weighing 60 kg and providing 14 hp.

The Type 95 folding boat was the standard river crossing device. GIs unfold one in the top photo, the bottom shows one folded and one ready for use.

All of the wooden folding boats were made the same way, starting with sheets of cypress or pine 3-7mm thick that were dried and formed into 2- or 4-layer plywood using milk casein glue. The hinges were made of 2- or 3-ply rubberized cotton fabric glued and riveted to the wood.

Where heavier loads had to be transported raft kits were provided. A kit provided the wood balk and chess,[1] two-step ramps and connections to fix three Type 95 boats together side-by-side and place balk across them and lay chess on that. The Type 95 raft had a total weight of 1,175 kg and was powered by the motors of the two outer boats or those of all three. Such a raft had a payload of 2 tons, sufficient to carry any of the Army's light field pieces. With some creative local modifications to the decking, it proved possible to lash four boats together, raising the payload to 3 tons, although this would have been difficult to handle.

The Type 95s not only formed the basis for the Type E engineer units, where they were most commonly used for rafts, but were also distributed as needed to divisions and regiments from the general pool. Independent river crossing material transport companies were formed that could deliver Type 95s to divisional engineer regiments if required, essentially turning them into

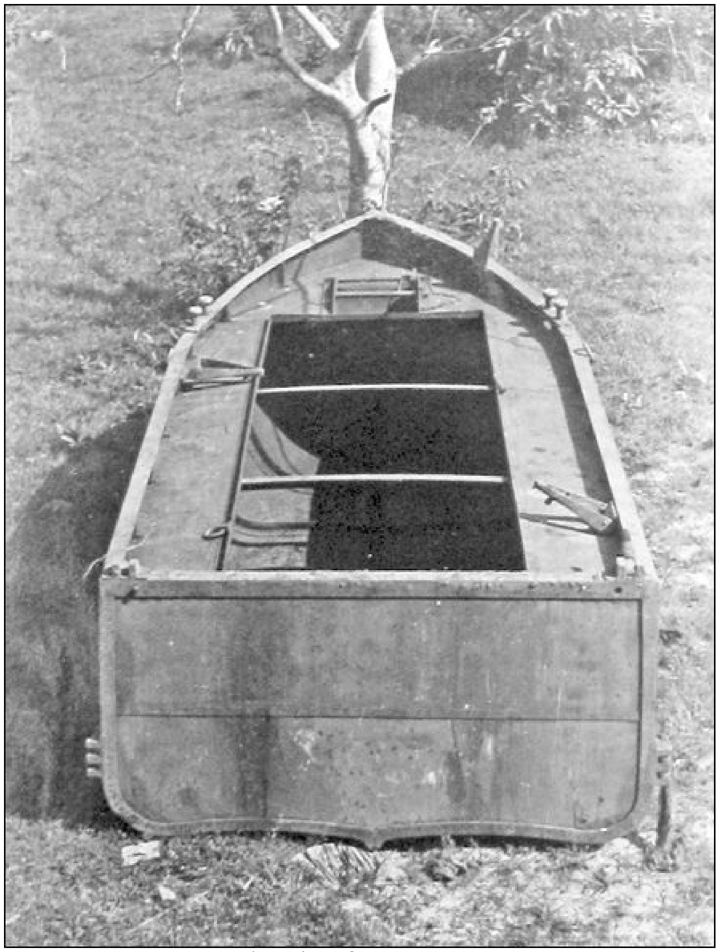
Type C regiments temporarily, and the boats could also be handed out as individual items. A total of 10,000 of these boats (along with 200 Type 93s) were built, almost all by Chiba Woodworks; with 2,000 being sent to Manchuria, 3,000 to China, 2,000 to south Asia, 1,000 to the Pacific theater, and remainder retained at home.

About 20 of a slightly larger version, the Type 99 command boat, were also built to act as tugs to pull and maneuver the Type 99s across wide stretches and to exercise command during crossings. These were in three folding parts totaling 8.6 meters in length and featured a Type 99 motor in the center section driving through a tunnel in the rear section.

A Type B floating bridge in service in China. Note the cables from the bows of the pontoons to the shore to hold them against the current.

For heavier loads the venerable Type A (from 1932) and Type B (from 1908) bridge/raft systems were used. The older Type B as a bridge was up to 150 m long and used 27 metal pontoons and 9 trestles and could be broken down to be carried on no fewer than 400 horse-drawn carts. In order to fit into carts the rigid steel pontoons were each made up of as many as five sections of two types: bow/stern and mid. Each section had a length of 2.71 m and a width of 1.31 meters, but the bow and stern sections were 0.77 meters high, the mid sections 0.89 m. The end sections weighed 140 kg each, while the mid sections weighed 150 kg. The sections were spanned by wood chess and balk to create a 5-ton bridge or raft.

The Type B pontoons could, of course, be used for rafts as well as bridges. Here, a pair of Type B pontoons ferrying horses pre-war.


An end section of a Type B pontoon.

The Type B was the primary medium bridge and raft system in the Army prior to the war. About a hundred were built by Yokogawa Kyoryo; with 30 being sent to Manchuria, 40 to China, 10 to the southern theater, and 20 retained at home.

Many concessions had been made to the need to deploy the Type B on one-horse carts and in 1926 the same firm began development of a replacement for carriage on trucks. The result was the Type A, accepted in 1932. This time the pontoons were assembled from only two identical sections, each rounded on one end and flat on the other. Each steel section was 5.01 x 1.65 x 0.88 m and weighed 350 kg and these were bridged by wood balk and chess to create 150 m of bridging using 21 pontoons and 6 trestles with a 10-ton capacity. Such a bridge set could be carried by a hundred trucks.

By the time full-scale production was set to begin, however, heavier loads were being envisioned. In the end only three sets were built, all being sent to the Kwantung Army.

At the other end of the floating bridge spectrum was the “pack type”, which could create 135 m of 3-ton bridging using 36 pontoons and 9 trestles that could be carried on 300 pack horses. This utilized pontoons of two 1.3-meter end sections and three 1.2-meter mid sections of rigid steel. Some 50 units of this WW I design were built by Yokogawa Kyoruyo, with ten being deployed to Manchuria, 35 to China and 5 in the home islands.

By the mid-1930s the most pressing need for the bridging engineers was to increase payload. Trucks were being added to the force structure, the 6-ton Type 96 howitzer and its tractor artillery were coming into service and a new tank, the 15-ton Type 97 medium, was about to be introduced. The Type A bridge/raft system would clearly be inadequate and work began on a new standard medium river-crossing system.

The new Type 99 represented the epitome of portable rafting systems. The Type 99 pontoon had folding wood bow and stern sections, and three rigid wood center sections. Unusually, the center sections ran lengthwise, one on each side and one running down the middle between the bow and stern sections. The assembled pontoon weighed 1,045 kg and was 11.1 m long, 2 m wide and 0.6 m deep.

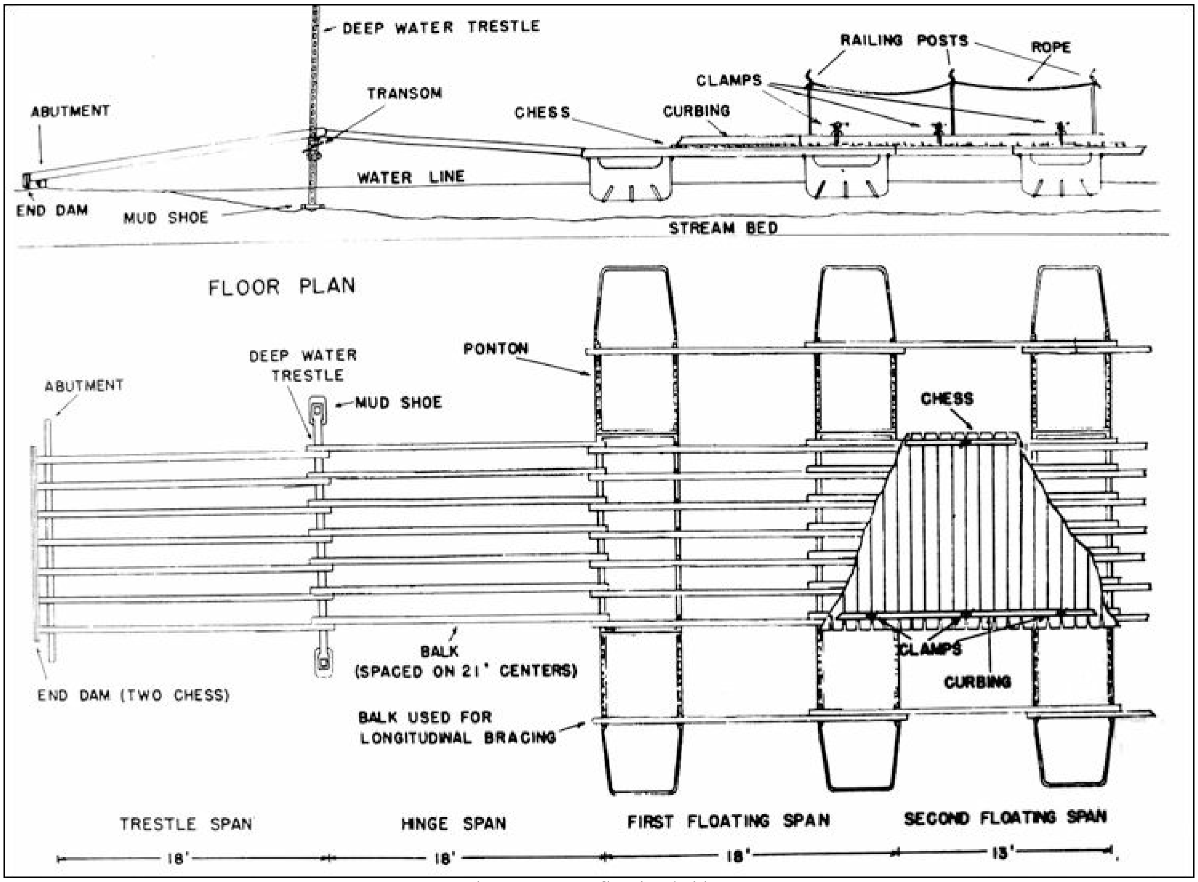
Three pontoons were assembled into a raft. Wooden spacers kept the pontoons 1.3 meters apart and the wood balk used to position them in place. A novel element was that cables were then run from one end of each balk under the pontoons and to the other end. Turnbuckles were used to tighten the cables until the balk were actually slightly bowed up without cargo on top. The result was a strong and rigid raft. Type 96 4-cylinder, 4-stroke inboard/outboard motors were fitted to the stern of each pontoon, yielding a speed of 10.5 km/hr. An entire raft could be transported in seven trucks. The only shortcoming of the Type

99, and that relatively minor, was that the single-step ramp for loading and unloading required the raft be grounded against the bank of the river, which could slow operations.

About 500 Type 99 rafts were built and they performed well in service, particularly in the Malaya/Singapore operation of 1941/42. Nevertheless, rafting was inherently inefficient and an almost simultaneous development effort was undertaken for a heavier floating bridge than the Types A and B.

The result was the Type 100 floating bridge, which used two trestles, one just off each bank, and rigid steel pontoons as needed. Each of the pontoons was carried in three sections that were assembled to total 816 kg and 10.7 m long by 1.6 m wide. Anchors upstream held the rafts in place. The Type 100 bridge had a capacity of 7.5 tons and could operate in currents up to 8 km/hr. If needed, a five-pontoon raft could also be assembled from this equipment, with a capacity of 17.5 tons, although throughput would, of course, be much slower than on a bridge.

A Type 99 raft being assembled, showing the bow section and the three side-by-side mid sections of the pontoon, along with part of the decking.




The Type 100 floating bridge.

A trial set was delivered to the Engineering School in October and 1939 yielding good results. The Type 100 was to have been the Army's standard floating bridge, but in fact only ten sets, each of 150 meters, were built, nine of which went to the Kwantung Army and the other staying in the homeland.

As soon as the Type 100 was standardized, however, its shortcomings became apparent. It used scarce metal, the great weight of the pontoons and decking significantly reduced the capacity of the bridge; the anchors were not entirely reliable in holding the pontoons in place; and assembling and erecting the bridge was time-consuming. Development was begun in 1941 of a new floating bridge with a 20-ton capacity, capable of spanning a wide stream with a 8 km/hr current, quick assembly and using standard transport. Development of the "20-ton Bridge" was completed in 1943.

The new bridge was a complete break with prior practice. It represented the first Japanese use of a cable anchor system. A thick cable was run across the river, firmly anchored at both ends, slightly upstream from the desired crossing location. Wires could then be run from the bows of the pontoons to the cable to hold them in place. The cable also often formed the basis for a supplemental footbridge to take infantry off the main span. The cable system also facilitated erection of the bridge. The pontoons were assembled from five rigid wood segments to total 1,100 kg and 10 m long by 1.6 wide, with assembly on turntables and electric winches provided to move them into place. The new bridge dispensed with the trestles used in the Type 100 and instead a landing ramp was connected directly to the first pontoon on each side, meaning those pontoons had to be different from the others, being reinforced for grounding. The roadway was 2.5 m wide and made entirely of wood. Each bridge unit was 150 m long and carried in 150 trucks.

The Army regarded the new 20-ton bridge as highly successful, but as tactical requirements had changed only five were built, with two going to the Kwantung Army, two being sunk enroute to the southern theater, and one retained at home. A single example of a lighter, 10-ton, variant was built but not further produced.

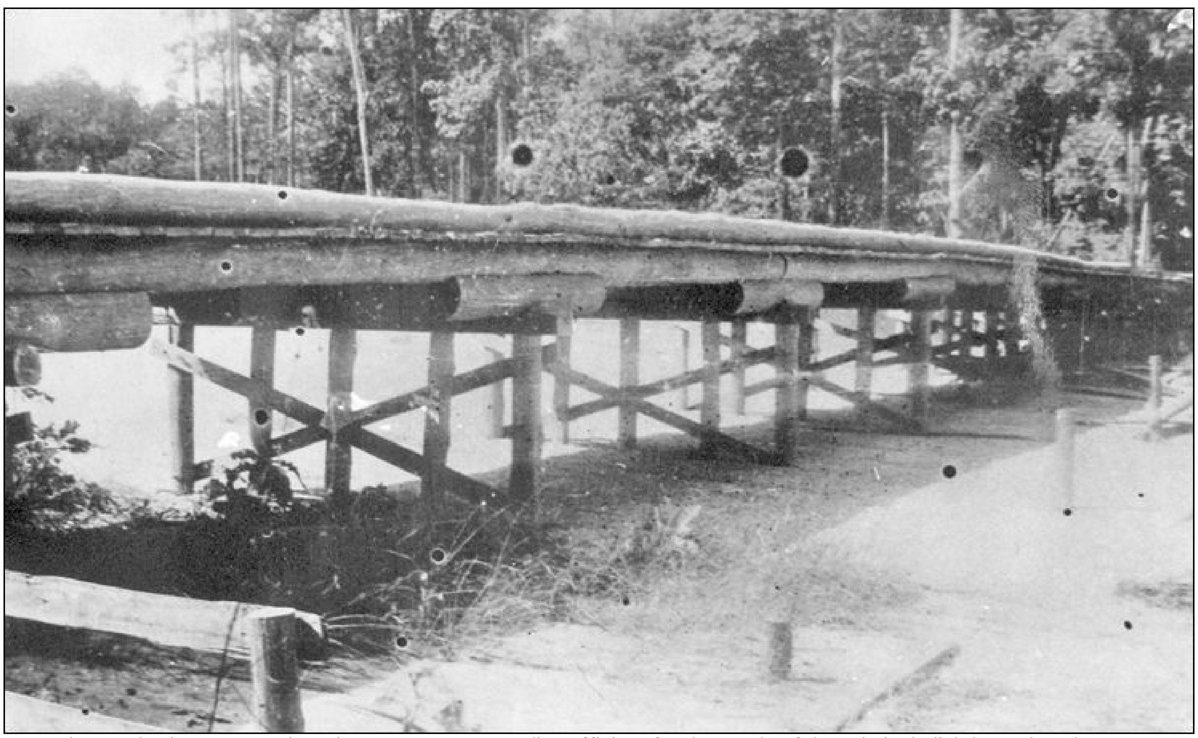
Two dry footbridges, miniature trestle units, were produced. One was made of two hinged sections while the other, the more common Type 98, usually consisted of two end sections and a center section that were attached to each other on assembly by bolts. The end sections of the Type 98 were 3.5 m long, while the mid section was 2.8 m, and an entire 3-section bridge weighed only 70 kg. Assembled with three sections the Type 98 could carry 315 kg on the center section without appreciable sagging, and assembled with four, or perhaps even five, sections could carry a steady column of men at normal interval.

The Army never developed heavier rapid-emplacement dry bridging, similar to the Allied Bailey bridge. For smaller culverts and streams behind the lines the regular engineer regiments used local timber and hand tools to fashion wood bridges. Trusses and decking in steel and wood for roadways and rail lines were available, but required deliberate construction efforts.

As for the manpower, use of material heavier than the Type 95 folding boats, was the responsibility of a few Type C (bridging) independent engineer regiments and companies. The bridging material itself was assigned to bridging material companies, who would deliver the material to the crossing site for construction by divisional or Type C units. Relatively few of these companies were formed. During July-October 1937 the Army raised ten horsed-drawn companies, presumably using Type B equipment, these being activated as divisional units, with two companies each to the 2nd and 9th Divisions, and one company each for the 5th-8th, 12th and 14th Divisions. A further ten bridging material companies were formed in July 1941, 21st, 22nd, 24th-29th, 31st and 32nd, all for the Kwantung Army. These were motorised units, each with 150 trucks, presumably equipped with Type 100 bridging. The large numbers of bridging sets not issued presumably reflected recognition of the need to leave bridging in place and re-supply bridging units with new material for the next crossing.

A complete Type 98 footbridge, with two end sections and a mid section, being demonstrated by US technicians.


Most dry (non-floating) bridges in the forward areas were built the old-fashioned way, largely without power tools and using local materials.


The results, however, as here in Burma, were usually sufficient for the needs of the relatively lightly-equipped Army.

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1 In bridging the balk are the support and the chess the mats, the balk analogous to floor joists and chess the flooring itself.

# Communications

The Army's communications equipment tended to be satisfactory at the higher levels of command, where modified commercial units could be used, but the closer they got to the front lines problems arose. This was particularly true with regards to radios, which suffered from mediocre frequency stability that made netting difficult and poor moisture proofing that reduced their life expectancy in the jungles that the Army unexpectedly found itself fighting in.

## Radios

During the 1920s the Army developed several families of radios bearing common "type" designations (mostly 86 and 87), distinguished from each other by varying "mark" models. Of these, only the Type 87 Mark 1 (a heavy, fixed GHQ unit) and the Type 87 Mark 2 (a ground/air unit) saw service in the Pacific theater.

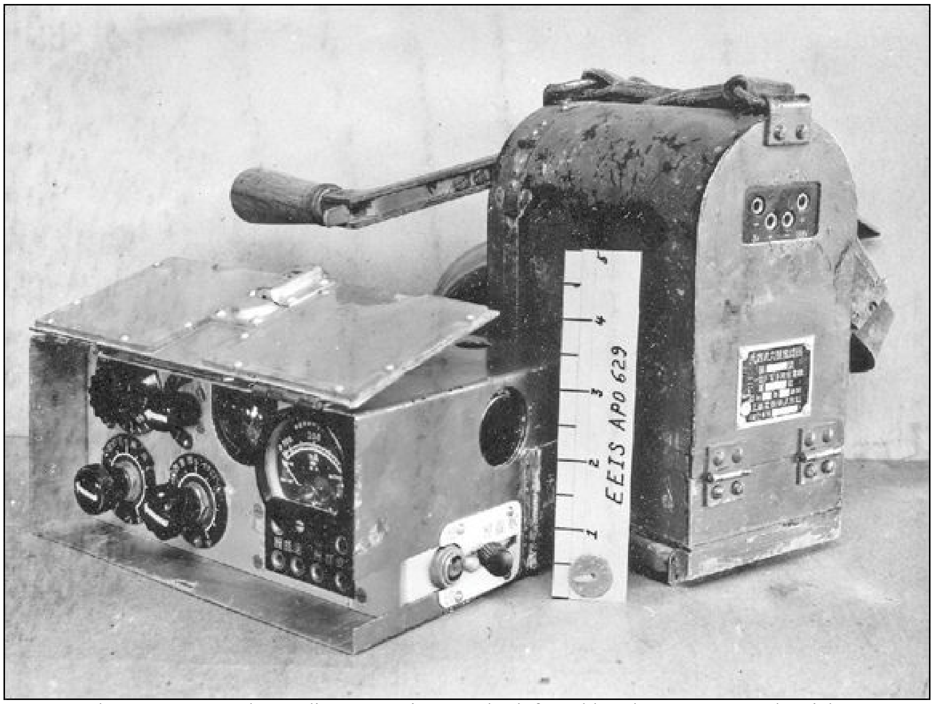
A Type 86 Mark 5 of the 2nd Medium Artillery Regiment in 1936. Some of these probably remained in service for the start of the war with China.

A whole new generation of radios were introduced by the Army in 1934, all designated the Type 94. They spanned the gamut from "walkie-talkies" to large fixed sets for operational-level communications. These were:

Type 94 Mark 1: wagon-mounted set with diesel generator and range of 500 km
Type 94 Mark 2A: carried on Type 39C cart, range of 200 km
Type 94 Mark 2B: carried on 6 pack horses, range 150 km
Type 94 Mark 2C: air/ground signal unit on M94 truck
Type 94 Mark 2D: set on M93 heavy car and could be used while moving – range 60 km
Type 94 Mark 3A: standard divisional set
Type 94 Mark 3B: for cavalry
Type 94 Mark 3C: air/ground set for division HQ
Type 94 Mark 3D: for anti-aircraft HQs, range 50 km

Type 94 Mark 4A: pack set for artillery, range 7 km
Type 94 Mark 4B: for armored vehicles, range 1 km
Type 94 Mark 4C: for tanks, range 1 km
Type 94 Mark 4D: pack unit for cavalry, range 20 km
Type 94 Mark 5: pack or man-ported unit for infantry regiments
Type 94 Mark 6: man-packed unit for infantry battalion and company nets

The smallest of the radios was the Type 94 Mark 6, made up of three main elements: a transceiver, battery pack and a hand generator. The transceiver had a single tube and three coils to cover overlapping frequency bands of 24-31, 28-36 and 34-45 mc, with coil selection made by a switch in the cover. It worked in both AM and CW (morse) modes, with power provided by a battery for the receiver and the separate hand generator for transmitting. It was the only member of the Type 94 generation to use a simple whip antenna rather than an inverted L type.



The Type 94 Mark 6 radio, transceiver on the left and hand generator on the right.

The radio was carried in three leather bags with shoulder straps: one each for the transceiver, hand generator, and battery pack with accessories. With a transceiver weight of 2.8 kg, with another 1.8 kg for the battery pack it could be monitored in the receive mode while walking. Switching to transmit was simple, but did involve keeping the hand generator turning.

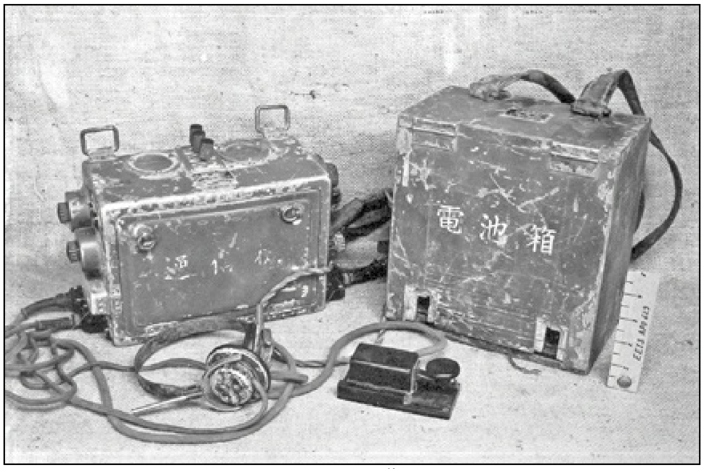
**Army Signal Materiel Production 1930s**

| | 1931 | 1932 | 1933 | 1934 | 1935 | 1936 | 1937 | 1938 | 1939 | 1940 |
|---|---|---|---|---|---|---|---|---|---|---|
| Large Radios | 0 | 5 | 12 | 17 | 23 | 33 | 41 | 69 | 88 | 105 |
| Medium Radios | 12 | 38 | 70 | 85 | 90 | 90 | 100 | 100 | 110 | 120 |
| Small Radios | 80 | 130 | 400 | 600 | 650 | 650 | 700 | 720 | 730 | 750 |
| Telephones | 1,500 | 1,500 | 1,500 | 1,500 | 1,700 | 1,700 | 2,000 | 2,000 | 2,500 | 3,000 |
| Insulated Wire (rolls) | 1,200 | 1,200 | 1,500 | 1,500 | 1,900 | 1,700 | 1,700 | 2,000 | 2,000 | 2,000 |
| Large Heliograph | 0 | 0 | 0 | 0 | 0 | 0 | 50 | 0 | 0 | 0 |
| Small Heliograph | 0 | 0 | 0 | 0 | 0 | 0 | 17 | 0 | 0 | 0 |

The most portable of the Army's sets the Mark 6 was not without its shortcomings. Its range was a little short for its intended use as the link between rifle companies and their battalion HQs, especially in jungles and mountains. The old superregenerative circuitry led to loss of frequency stability, making netting of radios difficult. Finally, little effort was devoted to making the cases moisture and mold resistant, shortening their service lives in the Pacific and south Asia.

A contemporary of the Mark 6 was the "small radio unit" designed as a private venture by the Takanashi Co. It was a small three-tube CW and voice transceiver operating AM in the 2.5 to 4.5 mc band (twenty 100 kc channels) with an output of 0.5 to

1.5 w. It was carried in two small cabinets, a 4-kg unit on the chest holding the transceiver unit, and a 5-kg unit on the back for the batteries. Unlike the Mark 6 it had no generator. Its inverted-L antenna, 3 m high and 10 m long, prevented its use on the move. The large antenna was made necessary by the low sensitivity of the receiver, which also suffered from poor selectivity, requiring some skill on the part of the operator. Range was 8-15 km in the CW mode, and 3-8 km using voice, subject to terrain. Although a purely private venture, the Army purchased some of these radios as Small Radio Unit Ko, the manufacturer's designation being the the No.6 portable radio, then and later the No.66B.[1]



A No.66B radio set.

A specialized short-range radio was the Type 96 Mark 7, an ultra short wave receiver operating as a line-of-sight unit. The antenna was flat in the horizontal plane, but parabolic vertically. It could be mounted on a tripod or strapped to a soldier's chest for mobile use. The set operated between 250 and 300 mcs and had a useful range of 12 km in good weather and about half that under poorer conditions, such as rain. Voice modulation was often poor, but tone modulation could be counted on. It was intended for use among transports in a convoy, but was also used for ship to shore communications by landing parties, and only a few hundred appear to have been built starting in 1939 and running through 1943 or 1944.

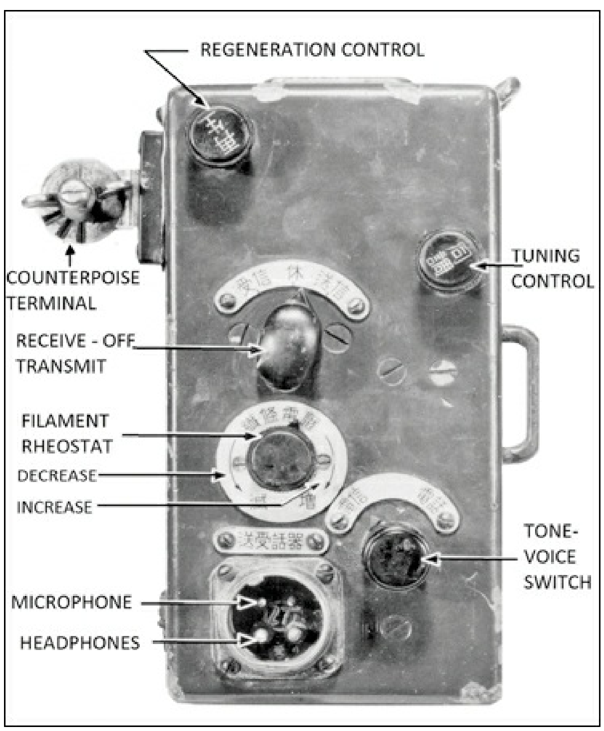
The Navy's analog to the Type 94 Mark 6 was the Type 97, used by landing forces and the various ground defense units. This was much like the Army radio, having a transceiver, battery, and hand generator. It also operated off a single tube – a dual triode, with one triode acting as an oscillator when transmitting and a self-quenching superregenerative detector in reception; while the other served as a modulator in transmission and a audio amplifier in reception. Unlike the Type 94/6 it could transmit from battery power, although presumably only for short periods. It utilized a 123cm vertical antenna and a 60cm horizontal counterpoise. In common with other Japanese tactical radios, it used a superregenerative circuit for reception, which could sometimes radiate almost as much power in the receive mode as transmitting, causing interference with other nearby sets on close frequencies and making enemy direction finding simpler.

The major difference between the Army and Navy radios was that the latter operated in only a single band, 23.5 to 31.6 mc. It also had rubber gaskets that provided some waterproofing and had a more rugged chassis, although it was still not tropicalized against fungus. Dimensions and weights were very similar, the Navy model weighing 2.90 kg for the receiver, 3.58 kg for the generator and 4.67 kg for the batteries. The Army radio had a slightly greater range, 2 km vs 1.5 km for the Navy set.

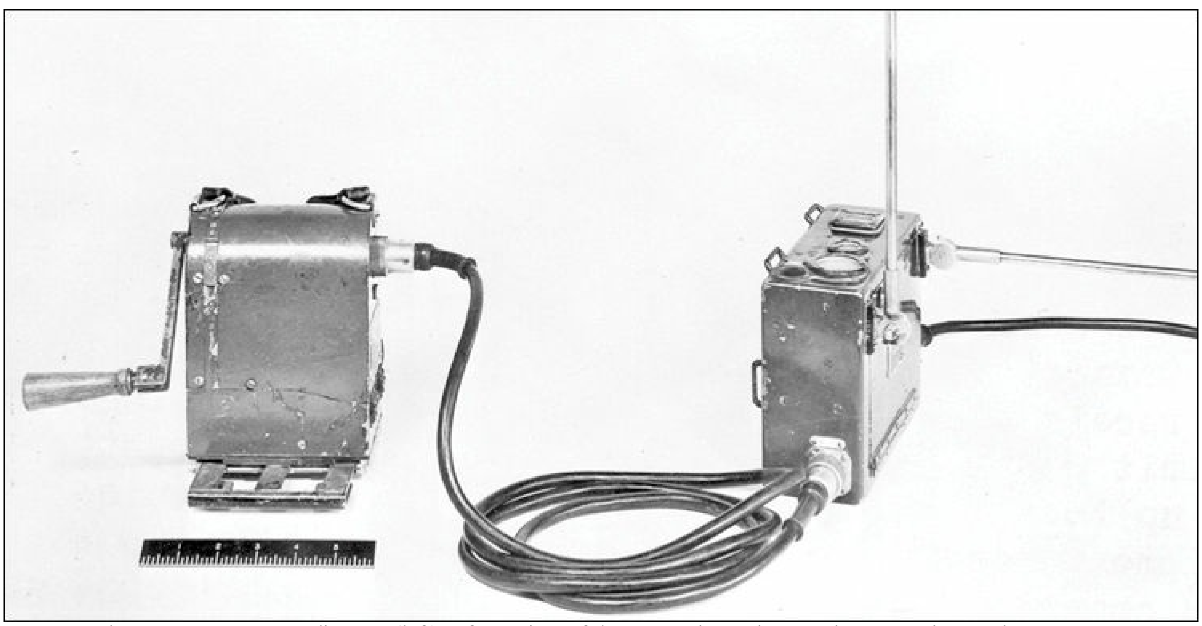
A US Marine demonstrates the chest-carried Type 96 Mark 7 line-of-sight radio.

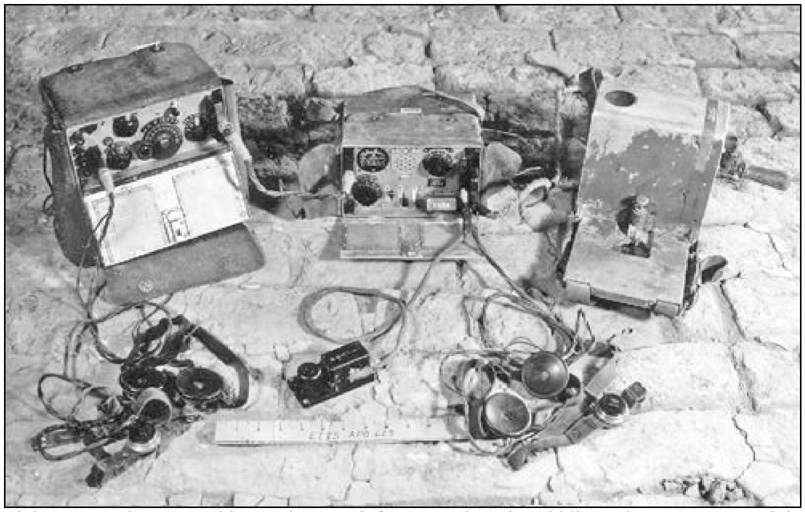
The hand-powered generator was compact and featured a single folding handle and retractable base plates for stability.

The next step up the organizational ladder for the Army was the Type 94 Mark 5. This featured a transmitter in one bag, receiver with batteries in a second, and hand generator in a third. The transmitter used one double triode tube, operating in parallel and driven by a crystal in the CW (morse) mode and in series driven by a cole microphone for the phone function. Frequency stability was quite good in the CW mode, although probably less so in the voice mode. The receiver used three tubes and regenerative detection, but an RF amplifier prevented radiation when the detector oscillated. With a frequency band of .85 to 5.1 mc the Mark 5 could not talk with the Mark 6 radios deployed further forward.




A pair of Type 97s being used by SNLF sailors on the China coast near Shantou, July 1939. Note the counterpoise projecting horizontally from the lower radio.


The Navy’s Type 97 radio. Top (left) – front view of the transceiver; above – the transceiver and generator.



Type 95 Mark 5 radio. Right – complete set with receiver on left, transmitter in middle and generator on right; below – receiver unit.

The Type 92F hand generator featured a flywheel to help stabilize speed at the prescribed 70 rpm at the handle, which converted to 5,200 rpm at the armature after gearing. A voltmeter helped the operator keep the speed (and thus output) at the proper levels.

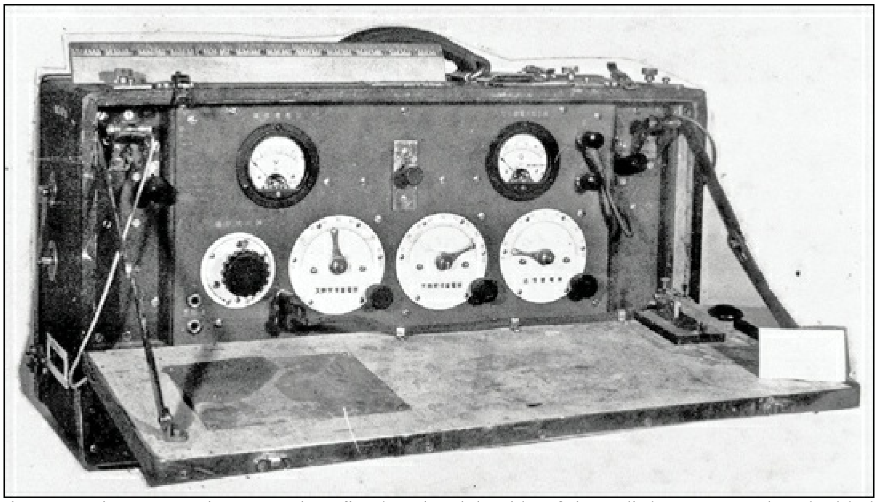
The set was used primarily to establish a regimental net, that is, between a regiment HQ and its subordinate battalion HQs. It could be carried by two or three men or, for administrative moves, a pack horse could carry two sets. It took its two-man crew about five minutes to get the set up and fully running, much of that time being the set up of the antenna, an inverted L-shape 2 meters high and 15 meters long. A simple 1-meter pole antenna with top loading was available for quick operation at the expense of some range, which was about 10 km with the large unit.

The Mark 5 was one of the most common and probably the most important tactical radio in Army service. Production was supervised by the Tokyo 1st Arsenal and initially undertaken by Tōkyō Musen Denki KK up to January 1943, when it switched to other products. Tōyō Tsūshinki KK, joined production in 1939 followed by Takanishi Seisakusho K, which started building them in early 1941 and ramped up to about 115 sets per month.[2]

The sets were not waterproofed, nor were they tropicalized against fungus, which reduced their service lives in jungle conditions.

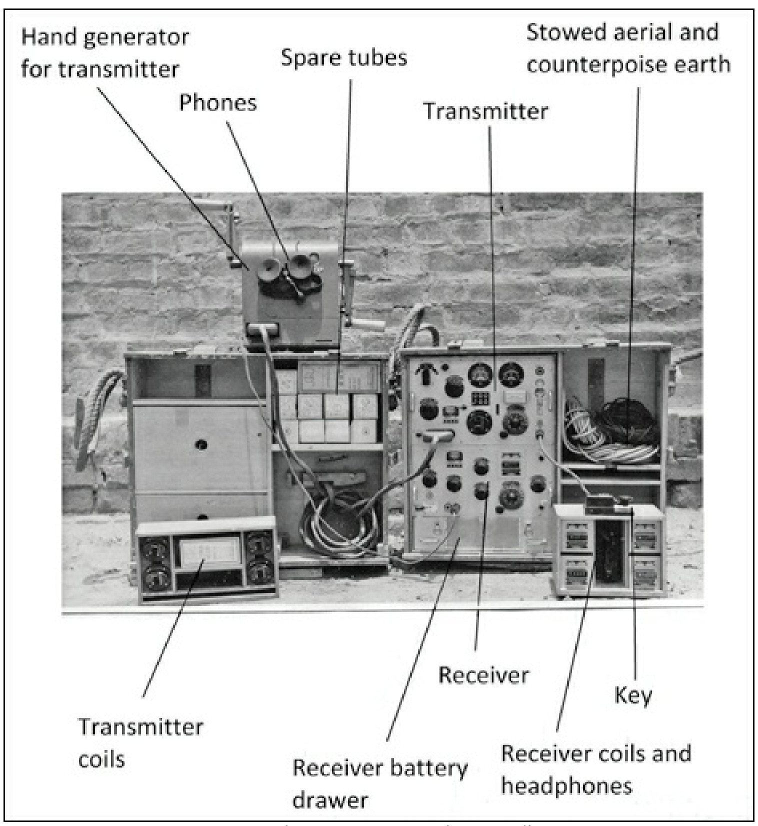
Development of a replacement for the Mark 5, known as the Light Radio Set A, began in May 1938. One goal was to improve the moisture resistance of the unit, a problem here as well as in the smaller Mk 6. Another was to change over to the superheterodyne system for improved receiver frequency stability, and a third was to incorporate a push-to-talk feature to speed the switch over from transmission to reception. All this was to be accomplished without increase volume or weight. The Mark 5 was already a cramped design, difficult to repair, and these requirements repeatedly yielded experimental models that were too complicated and packed too tightly. As a result development was halted until July 1944 when other research on frequency stabilization offered possible improvements, but the war the war ended before a trials model could be completed.

The Navy equivalent for echelons of ground units above those using the Type 97 were mostly commercial offerings from Tokyo Musen Denki (Tokyo Radio Co), also known as TM and Teimu. Immediately above the Type 97 organizationally was the TM Compact, also known as the TM Handy and other similar names in English, a design dating back to 1932. This transceiver sent out in the CW (morse) mode, but could receive voice signals as well; nevertheless, with its receiver band of 4.1 to 11.5 mc it could not hear the Navy's Type 97 portable frontline units. The transceiver was 53x33x23cm, weighed 16 kg and had a rated range of 10 km with its 1.5 watts of output, while the battery pack was 40x23x20cm and weighed another 10.9 kg.



The Navy's TM Handy transceiver. Note the morse key fixed to the right side of the pull-down cover that doubled as a writing surface.

The division radio net, that is between a division HQ and its subordinate regiments, was handled primarily by the Type 94 Mark 3 radio. The Mk 3A was carried in three chests, either on two pack horses or a single Type 39 cart. One chest housed the transmitter and receiver (and its battery). The second held the two-person hand generator and accessories, and the third spare batteries and repair parts. Also included was the antenna bag, which held two sectioned metal poles 7 m high and 20 m of single-strand wire.




A complete Type 94 Mark 3A radio.

The transmitter had a base coil and four removable coils to yield five frequency bands covering 0.4 to 5.7 mc, and operated in the CW (morse) mode only. It included a range of plugs, sockets, switches and a capacitor to optimize the antenna for any chosen frequency. The receiver was a six-stage superheterodyne type with a small band-spread capacitor to allow fine tuning.

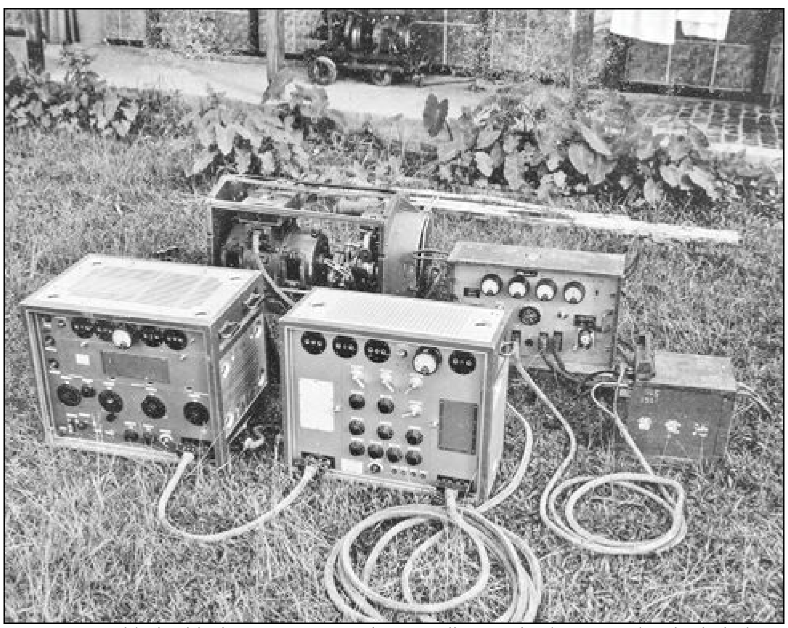
It could receive voice as well as CW signals. It could thus network with the Mark 5 radios further forward, assuming the latter had trained morse signallers to read the messages.

The Mark 3C filled a similar role; it was only half as powerful but it could transmit speech, and its transmitter and receiver were in separate cabinets, allowing the whole unit to be hand carried by six men if need be. In both 3A and 3C models, it took the radio's crew of 6 men 10-20 minutes to set the unit up and get it running.

| Army Signal Materiel Production 1941-45 | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 1941 | | 1942 | | 1943 | | 1944 | | 1945 | |
| | Apr-Jun | Jul-Dec | Jan-Jun | Jul-Dec | Jan-Jun | Jul-Dec | Jan-Jun | Jul-Dec | Jan-Jun | Jul-Aug |
| Large Radios | 10 | 48 | 37 | 35 | 125 | 222 | 218 | 216 | 274 | 45 |
| Medium Radios | 13 | 61 | 60 | 35 | 271 | 339 | 378 | 469 | 312 | 118 |
| Small Radios | 105 | 315 | 205 | 300 | 1,190 | 1,570 | 1,570 | 1,830 | 2,500 | 810 |
| Tactical Telephones | 620 | 1,220 | 1,340 | 1,900 | 3,540 | 9,150 | 12,000 | 17,500 | 16,710 | 1,200 |
| Insulated Wire (reels) | 300 | 660 | 620 | 380 | 2,600 | 11,200 | 16,600 | 22,600 | 19,650 | 2,050 |
| Photophones | 50 | | 38 | | 170 | | 296 | | 0 | |

To enable the division headquarters to monitor multiple nets simultaneous they were also issued several "division auxiliary radio receivers" that basically duplicated the receiver of the Mark 3A set. It was carried in an aluminum alloy case with back pack straps, with the receiver on the top and a compartment for dry batteries on the bottom.

Development of an improved radio of this class was launched in May 1938 as the "medium-type radio set". The main goals were reduction in size and weight, and incorporation of voice capability with a push-to-talk function. These efforts were stymied by higher priority projects and by a continued failure to reduce the volume of the unit without compromising reliability and repairability. Finally, in February 1943 the 5th Technical Laboratory was able to send a prototype to the Signal School for evaluation. A few changes were suggested, but improvements to frequency stability in other projects caused a redirection here as well. In July 1944 construction of a revised prototype was begun, but the war ended before it could be quite completed.



HQs above division were provided with the Type 94 Mark 2A radio, a voice/CW set that included a gasoline generator.

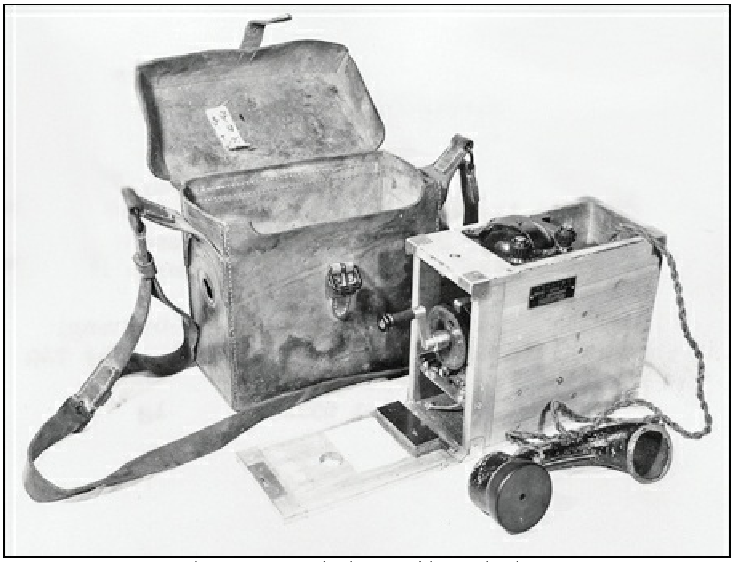
## Wire Communications

The wire system for front line troops was built around the Type 92 field telephone and Type 92 light field wire. The phone, of which no fewer than 51,500 were built 1941-45, weighed 6.5 kg and was fitted in a wooden box with canvas carrying bag. The box held two 1.5-volt dry cell batteries for transmission power, a normal hand set with microphone and speaker, an extra earphone so a second person could listen, and a 55-volt AC hand-cranked generator to ring distant phones.

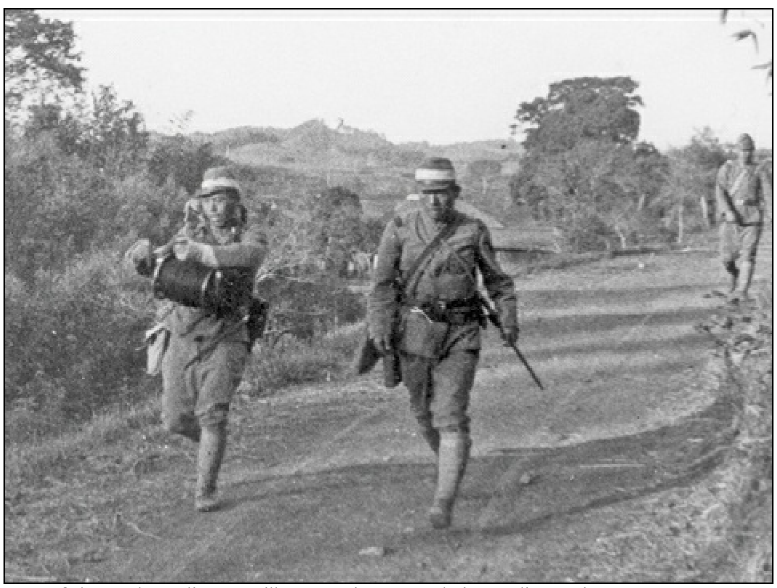
The standard front line wire was the Type 92 light field wire, which featured a 2.5mm 7-strand single conductor in rubber insulation covered with yellow braid. With only a single conductor it had to be used, of course, in the ground-return mode. The Type 92 light field wire was strong and the insulation was effective, although it tended to abrade. An even lighter wire, the

Type 93, was available for short-term use, this having a single 1.5mm conductor with no insulation other than the colored braid. The Type 92 wire came in 500-m reels weighing 5.6 kg, while the thinner Type 93 came on 250-m reels weighing only 1.1 kg. There was also a Type 92 bare wire with no insulation at all, but this appears to have been little used.

The Type 92 telephone was rated as having a range of 40 km when used with the Type 92 light field wire, a figure that increased to 300 km when used with dual conductor (reciprocal circuit) wire. The former combination was widely used, the most common wire signal allotment for an infantry regiment being 24 Type 92 phones, 70 km of Type 92 light field wire, and two small (8-10 line) switchboards.



The Type 92 telephone with carrier bag.

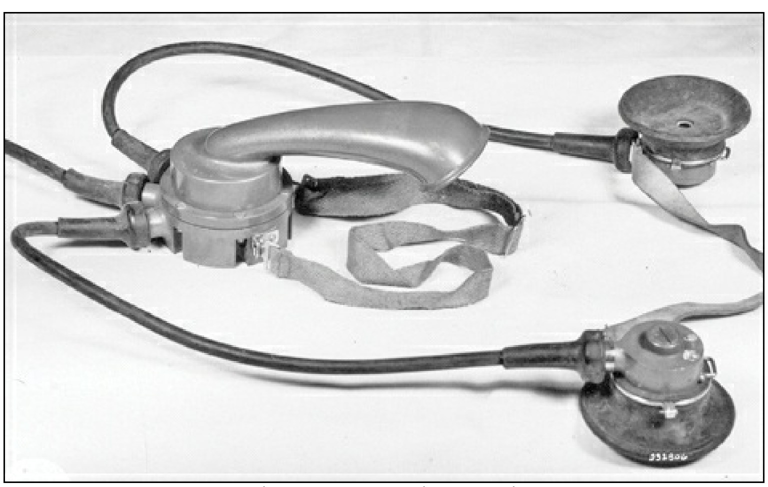


A lineman of the 2nd Medium Artillery Regiment reels in medium wire on pre-war maneuvers.

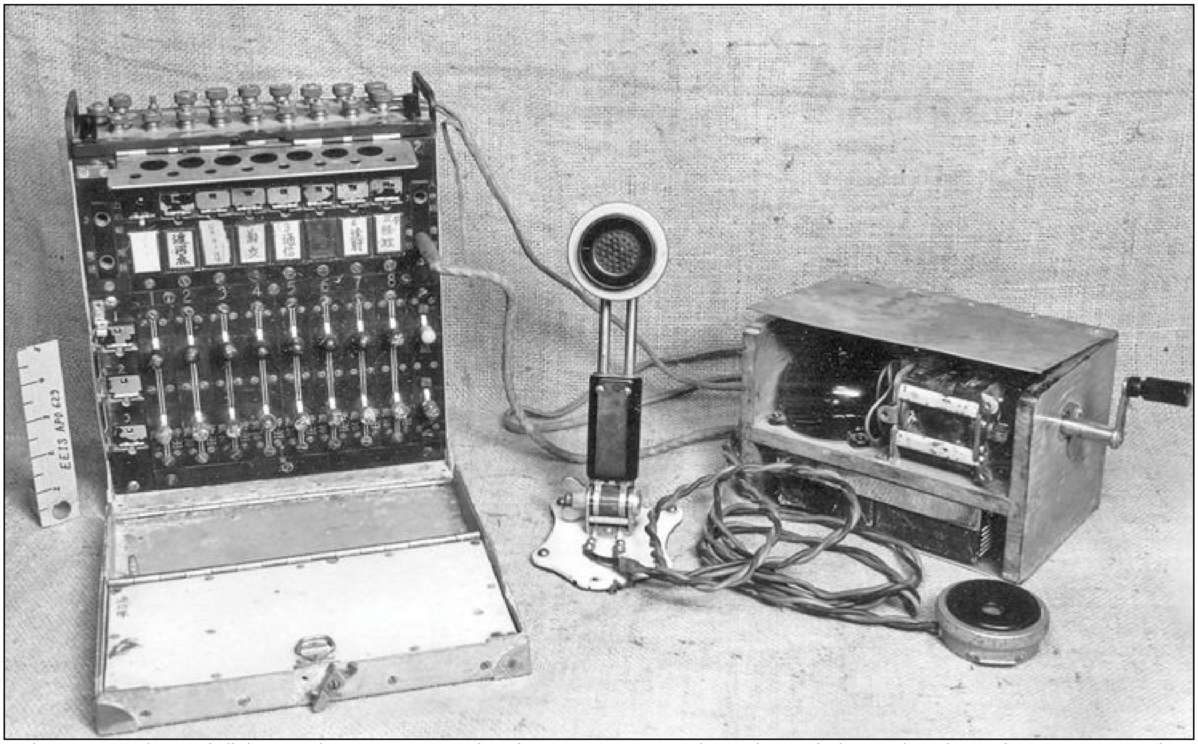
Wire teams, as this one on maneuvers, were provided not only with reels and chest harnesses for easy unwinding and recovery, but also special forked-tip poles to hang the wires overhead. One soldier here also packs semaphore flags.

For patrol and outpost use the Type 93 sound-powered telephone as provided, although production was only about a tenth that of the Type 92. The range for this unit dropped to 5 km with the Type 92 field wire and 10 km with the dual conductor wire.

The Type 93 8-line switchboard was light and compact, having two components, a switchboard in an aluminum case 13x23x28cm weighing 9.1 kg, and an operator's telephone and generator in a box of 14x19x13cm weighing 4.1 kg. It was designed to be used with ground-return circuits, thus there were 8 line terminals across the top, along with a ground terminal and two for the operator's phone. Two switchboards could be connected so one operator could handle 16 lines. The connections were accomplished by manipulating 18 switching keys and no cords were used. It also included a hand-cranked generator to ring the user phones. Signal power was by two batteries and this gave a rated range of 40 km with Type 92 light field wire.



The Type 92 sound-powered.

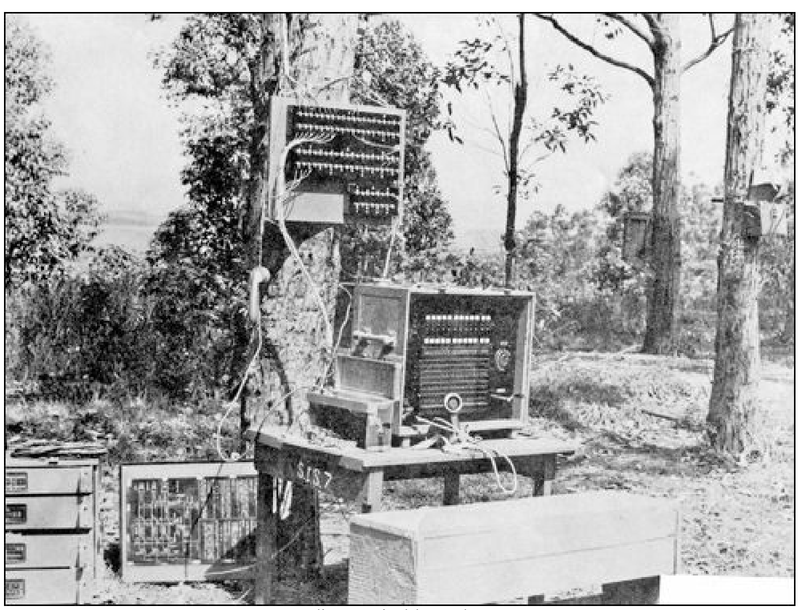


The Type 93 switchboard was not only much lighter and more compact than its US counterpart, but using switches rather than wires to connect phones made it much more suitable for compact spaces, such as foxholes. In fact, technical intelligence of the Burma-India Theater actually recommended American units replace their switchboards with Type 93s if they captured any.

The network between the division HQ and its immediately subordinate commands used 32 Type 92 phones and 100 km of Type 92 light field wire in conjunction with one small and two 20-line switchboards. The 20-line Type 1 switchboard was ruggedly built and used many of the features of the Type 93 8-line, most notably the use of switches instead of lines to connect phones. As with their smaller brethren, a pair of these could be connected together into one larger switchboard. A notable feature of the Type 1 was the ease with which a number of lines could be connected to form a “conference call”.

Most divisions also include a net monitoring system comprising a relay set and a telegraph unit. This enabled the communications chief or designated NCO to listen to incoming and outgoing radio messages and engage in voice conversations, while a telegraph operator had a head set that monitored both telegraph and radio conversations.

Line signals in the independent mixed brigade were on the same scale. An independent infantry battalion generally held four Type 92 telephones and 12 reels of Type 92 light field wire. The brigade signal unit would usually hold 24 Type 92 telephones, 80 km of wire and four small switchboards.



A 20-line switchboard set up.

## Other Signal Means

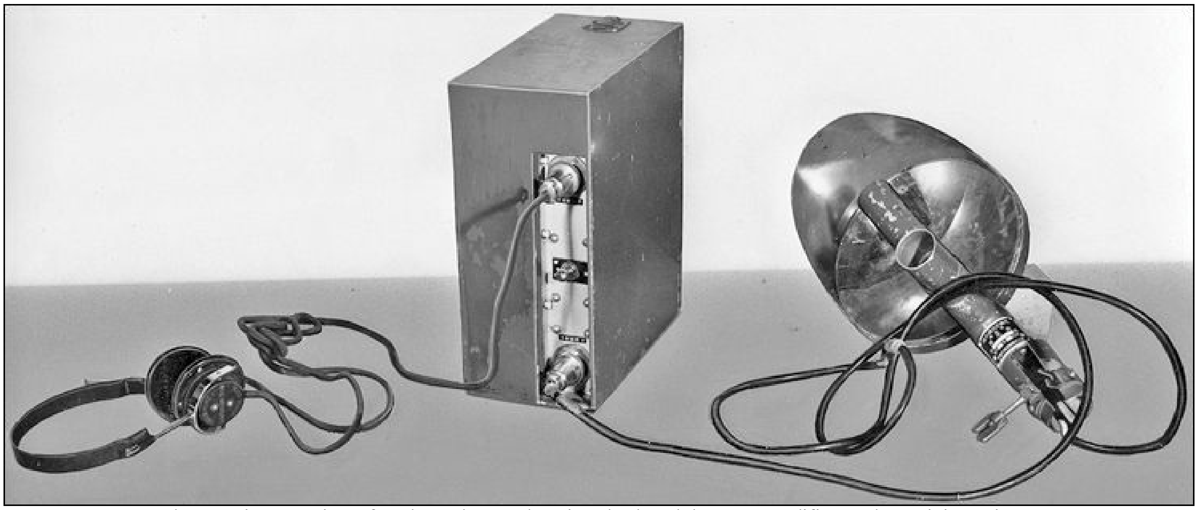
Heliographs, or signal blinking lights, were sometimes used but were apparently not part of the normal organizational equipment for tactical units. This may have been due to their limited utility in the jungles and mountains of the south Pacific and Burma, where line-of-sight was often very limited. The Type 92 heliograph came in three sizes, 10cm, 20cm and 30cm, and consisted of a light with shutter mounted on a tripod, a telescope and a hand generator. The light base was provided with elevation and azimuth scales to permit precise laying in conjunction with a tubular peep sight. The telescope, mounted above the lamp, was used to observe return signals and aid in aiming. Red, yellow and blue filters were available for the lamp, apparently to aid in distinguishing one from another. It was capable of sending about four words per minute over a maximum range on a clear day of about 8 km.

Their utility was limited and production ran at a very low rate – indeed only one year in the 1930s, 1937, saw any heliograph production, and that for only 19 of the smaller and 50 of the larger units.

A regimental commander checking on training on the Type 92 heliograph.

A related device was the photophone, which used a modulated light beam in the IR band to carry telegraphic or voice signals between two stations. Development started in 1929 and completed in 1941 with the adoption of the Model 2 Photophone. An order for 2,000 was placed with Nippon Kogaku, but trials in Manchuria were disappointing and production terminated early. Each unit consisting of a transmitting apparatus and lamp, a receiving amplifier and a hand generator. A complete unit was packed into two boxes, each of which could be carried by a man. In some cases a patrol was sent out with just a receiver unit and a mirror with which to identify their position to a distant transmitter. Theoretical range was about 4 km, but practical range was probably less than half that.

Semaphore flags were also widely issued, but once again their usage was limited by the need for line-of-sight between the signallers, and also by lack of security, being visible over a wider area than the narrowly-focused heliograph. Divisions in China held carrier pigeons for use by subordinate units when regular commications failed, although this appears to be the only theater that saw their use.


The receiver portion of a photophone, showing the headphones, amplifier and receiving mirror.

1 It is not clear how many were procured. A No.66B captured in Burma in 1944 carried an identification plate with the date of manufacture of October 1939 and a serial number of 3323, although it is not known how the firm serialized its products.

2 The Mark 5s and Mark 6s presumably comprised the "small radios" in the production tables.

# Notes on Sources

This postscript is intended as a guide for further research by English-language historians and enthusiasts. There is quite a bit of reliable information available in that language and this work has only scratched the surface, being intended as an overview. Nevertheless, the vast majority of that information is available only as archival sources, since the subject has been unfairly ignored for the last 60 years.

The destruction of almost all the Japanese records after the surrender left little in the way of primary source material on the development and production of Japanese ordnance. American experts did accompany the occupying forces into Japan in September 1945, but their efforts were limited by the belief that, unlike Germany, there was little to learn there from local products. Thus, while there was some input from Japanese experts, it was limited and sporadic.

One organization that conducted extensive research was the US Strategic Bombing Survey. They prepared reports on the status of bypassed islands in the Pacific and Japanese war industries, along with a wide variety of other specialized reports. Of particular note is their Study No.45 'Japanese Army Ordnance'. The report itself, dealing with the production of Army weapons, is rather basic and general. However, the large files of materials used to generate the report, held in Record Group 243 at the National Archives at College Park, include astounding recreations of production estimates for each item month-by-month through the war. The original records having been destroyed, the USSBS staff pulled in the production and procurement officials for the IJA Ordnance Bureau and each of its subordinate arsenals, separately, and had them use notes and memory to recreate the tables. The different tables did not always agree, but they are by far the best data available, having been generated by Japanese subject matter experts within a couple of months of the surrender, while memories were still fresh and notebooks at hand. These tables, only some of which were translated to English, are the source for almost all the production tables included here.

In addition, US Army Forces Pacific launched a significant effort to document Japanese ground armament and equipment after the war, using examples seized in the homeland and, to a lesser degree, surviving documents and interviews with Japanese experts. One effort was orchestrated by the Chief Ordnance Officer to create a series of surveys of Japanese ground armaments. The resultant studies were broad and comprehensive, covering weapons unknown to the Allies until the surrender, but were necessarily rather shallow and cursory. As catalogs, however, they are excellent. These are available at the National Archives in RG319 "P files" boxes 2650-2653. A second series was directed by the Coast Artillery branch, who supervised the writing of two excellent surveys, one on anti-aircraft and one on coast defense in Japan. These studies included organization of forces, and production and technical descriptions of equipment, although their coverage is limited to the Japanese homeland. These are available at the National Archives in RG319 "P Files" box 3350. The Office of the Chief Engineer of AFPAC also sponsored an array of smaller surveys of particular elements of Japanese Army engineer equipment. In addition, the Chief Signal Officer and the Chief Chemical Officer also provided post-war surveys.

GHQ, US Army Forces Pacific, AAA Research Board, A survey of Japanese Antiaircraft Artillery, 1 February 1946. An excellent and comprehensive post-war survey of homeland anti-aircraft defense, including tactics, organization and equipment, to include radar and fire control.

GHQ, US Army Forces Pacific, Seacoast Artillery Research Board; Survey of Japanese Seacoast Artillery, 1 February 1946. An excellent and comprehensive post-war survey of homeland coastal defense, including organization, tactics and equipment.

GHQ, US Army Forces Pacific, Office of the Chief Ordnance Officer; Ordnance Technical Intelligence Report No.4: Japanese Army Rockets, nd [prob Feb 1946]. A good summary of IJA, but only Army, efforts.

——; Ordnance Technical Intelligence Report No.10: Japanese Research & Development of Seacoast, Railway, Field, Tank, Antitank & Antiaircraft Artillery, Mortars, and Recoilless Rifles, 5 February 1946. An excellent survey of Japanese artillery during the war, with detailed data tables and photographs. Given the very broad subject matter each section is necessarily brief, but it benefits from postwar interviews with the designers and the use such documentation as remained, including many technical reports.

——; Ordnance Technical Intelligence Report No.11: Japanese Hollow Charge Research, 14 February 1946. A brief, but good, summary of the development of hollow charge weapons.

——; Ordnance Technical Intelligence Report No.19: Research, Development and Production of Small Arms and Aircraft Armament of the Japanese Army, 13 March 1946. A brief, but invaluable, survey of Japanese small arms development with

data tables and photographs.
——; Ordnance Technical Intelligence Report No.21: Japanese Automotive Research, Development and Production of Combat and General Purpose Vehicles, 23 March 1946. A survey of Japanese vehicles, stronger on combat vehicles than logistics vehicles, with data tables and photographs.
——; Ordnance Technical Intelligence Report No.27: Japanese Ordnance Activity in China and Manchuria, September 1946. Provides spotty coverage of the subject due to limited information.
GHQ, US Army Forces Pacific, Office of the Chief Signal Officer; Japanese Wartime Military Electronics and Communications (5 vols), 1 April 1946. A very interesting survey, but concentrating on personnel issues, such as training and manning, with little on equipment. [held in NARA RG 319, Publications Files, boxes 2121-22]
GHQ, US Army Forces Pacific, Office of the Chief Chemical Officer; Intelligence Report on Japanese Chemical Warfare (5 vols), 15 May 1946. Interesting discussions of intentions and capabilities, but the equipment sections, although large, are little more than photo albums with no effort made to provide information. [held in NARA RG 319, Publications Files, boxes 2097-98]
GHQ, US Army Forces Pacific, Office of the Chief of Engineers; Engineer Technical and Technological Survey; Japanese Military Bridge Equipment, 25 March 1946.
——; Japanese Stream Crossing Equipment, 22 March 1946.
——; Japanese Land Mine Detectors, 8 January 1946
——; Japanese Land Mines, Demolition Explosives and Demolition Accessories, 6 February 1946.
——; Japanese Military Electrical Equipment, 11 February 1946
——; Japanese Military Construction Equipment, 15 March 1946
——; Japanese Permanent Fortifications, 24 January 1946
——; Japanese Military Searchlights & Accessories, 26 January 1946
——; Japanese Barrage Balloon Equipment, 5 January 1946
——; Notes on Japanese Difficult Terrain Crossing Equipment, 5 April 1946
——; Notes on Japanese Obstacle Breaching Experiments, nd

The US Army Pacific also commissioned an unknown number, probably about a hundred, short reports on technical subjects of interest immediately after the surrender. These often included transcripts of interviews with Japanese officials and industrial managers, and examination of a wide range of items, include bridging equipment, barrage balloons, chemical weapons, etc. These, unfortunately, are scattered about in the records, but many are in RG496 Entry 56 in boxes 339, 341-44 and 347-350.

Department of the Army, TM 9-1985-5, Japanese Explosive Ordnance, March 1953, widely available in reprint. Although bearing a post-war date it appears to actually be a compendium of wartime information. Nevertheless, the two volumes are a valuable resource.

The US Navy also sent teams in as the Naval Technical Mission to Japan (NAVTECHJAP in naval parlance). Clearly, they felt they had little to learn from Japanese technology, as the reports were often short and provided little depth. Unfortunately, the underlying files from which these reports were prepared were either discarded or have not been cataloged.

US Naval Technical Mission to Japan (NavTechJap); Report E-03, Japanese Land-Based Radar. A post-war catalog of land-based radar with little developmental or historical information.

——; Report E-03, Japanese Land-Based Radar
——; Report E-05, Japanese Radio and Radar Direction Finders. A post-war catalog of direction-finding equipment.
——; Report O-09, Japanese Naval Rockets
——; Report O-19, Japanese Projectiles, General Types
——; Report O-18, Japanese Ordnance Fuzes. A short, general technology survey.
——; Report O-30, Japanese Anti-Aircraft Fire Control
——; Report O-35, Japanese Demolition Methods. Actually a catch-all report for various topics, including hollow-charge projectiles and incendiary compositions.
——; Report O-47(N) 1 & 2; Japanese Naval Guns & Mounts. Covers all weapon mounts from machine guns up to 16”. Some of these were used for coastal and AA defense.
——; Report O-54(N), Japanese Naval Guns, a comprehensive database of naval guns, including those used for coast defense.
——; Report O-56, Japanese Field and Amphibious Equipment, Kyushu Defense Systems. A collection of reports on various

pieces of Japanese ground forces equipment found on Kyushu at the surrender. It seems to have been done by USMC officers rather than naval officers, for it is much better than the other NavTechJap reports on ground equipment.
——; Report O-89, Japanese Naval Rockets. A brief and not very satisfying post-war survey of the subject, but with a useful data table.

There were, of course, a large number of examinations during the war of captured Japanese equipment. In the South West Pacific Area these were undertaken by the Army's 5250th Technical Intelligence Composite Company, who produced 104 formal reports from the field during the war and about 40 more in Japan in the immediate post-war period.

In the Central Pacific JICPAC was responsible for intelligence, and they produced many reports on a variety of subjects, including weapons encountered. In the Burma-India theater analysis of captured Japanese weapons and equipment was undertaken by the Enemy Equipment Intelligence Section (EEIS). The Navy examined Japanese munitions via the Mobile Explosive Investigation Units (MEIU). The Indian Army issued ammunition bulletins detailing Japanese ammunition recovered in Burma. All of these from the various theaters along with similar reports are, unfortunately, scattered about the Archives, in probably close to a thousand boxes, but the largest runs can be found at:

Chief of Ordnance (RG 156), OKD Files (Entry 921)
boxes K-439 to K-442, boxes 446 to 448.
War Department Staff (RG 165), Publication Files (Entry 79)
boxes 420, 805-809, 815-820, 1303, 2272, 2289, 2292-93, 2335, 2347
Army Staff (RG 319), Publication Files
boxes 2301, 2303, 2365
GHQ Far East Command (RG 554), G-2 Library File (Entry 143)
box 240
US Marine Corps (RG127), Records of Amphibious Corps (E1013)
box 7

French armament sales to Japan are cataloged in a series of tables in the file 7N3336 of the Army archives of the Service Historique de la Défense at Vincennes. The relative absence of British arms to Japan is documented in the corporate papers of Vickers Armstrong, held in the special collections of the Cambridge University Library.

Among secondary sources the best are those researched by and for collectors. Among those, to which readers are referred for detailed information on the subjects covered, are:

Honeycutt, Fred & Anthony, F. Patt; *Military Rifles of Japan*, 5th ed; (Julin Books, 2006, Palm Beach Gardens, FL)
Babich, Gregory & Keep, Thomas; *Imperial Japanese Grenade Rifles and Launchers* (Dutch Harlow Pub, 2004, Lemont PA)
Easterly, William; *A Comprehensive Study of Japanese Submachine Guns 1920-1945* (Easterly, 2011, San Juan TX)

There have been several post-war Japanese books, mostly narrowly-focused, but only one has been translated:

Nakagawa, Yasuzo; *Japanese Radar and Related Weapons of World War II* (Aegean Park Press, 1977, Laguna Hills CA)

Of the post-war Japanese surveys, the most comprehensive are best-regarded is

Takeuchi, Akira; *Nihon no taihō* [Encyclopedia of Japanese Army Artillery] (Shuppan Kyōdōsha, 1986, Tokyo)
Kimura, S. (ed.), *Nihon no Sensha to Sōkō Sharyō* [Japanese Tanks and Armoured Vehicles] (Argonauts, 2000, Tokyo)

In addition, there are quite a few small books and articles on Japanese wartime weapons, although these tend to have a narrow focus and disproportionately concentrate on tanks. Notable authorities on a broad range of subjects are Akira Takizawa and Yasufumi Kunimoto.

# Acknowledgements

The author is indebted to many fine people who went out of their way to help over the course of several decades. The staffs at various archives in the US and abroad, particularly the US National Archives at the former Suitland location, were ready to point me in the right direction. Where I later discovered gaps in my overseas research local friends jumped in to revisit distant archives for me. A computer crash years ago wiped out many of their names and efforts, but notable is Louis Capdeboscq in Paris. To the others I can offer only my apologies. Most importantly Akira Takizawa and Yasufumi Kunimoto provided invaluable guidance, with the former reading over large portions of the manuscript and correcting errors. Such errors as remain, of course, are entirely the author's.