

# Japanese Type 91 AP Projectiles

## Nose Shape Measurements

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### 46 cm Capped Type 91 AP Projectile

Length of Projectile with Windscreen: 4.251 cal.  
DITTO without Windscreen but with Cap Head: 3.077 cal.  
DITTO to Top of 0.674 cal. Wide Cap Head Threaded Edge: 2.829 cal.  
DITTO to 0.709 cal. Wide Flat Nose without Cap Head: 2.768 cal.  
DITTO without AP Cap: 2.63 cal.

DITTO to Top of Forward Bourrelet: 1.852 cal.  
DITTO to Center of 0.984 cal. S.O. Pointed Nose Arc: 1.77 cal.  
DITTO to Center of 3.178 cal. S.O. Lower AP Cap Shoulder Arc: 1.795 cal.  
DITTO to Center of 0.464 cal. S.O. Cap Head Face Arc: 2.616 cal.  
DITTO to 0.978 cal. Wide Lower Edge of AP Cap: 2.063 cal.  
DITTO to 23° Conical Nose/Lower AP Cap Shoulder Arc Boundary: 2.446 cal.

Width at Conical Nose/Lower AP Cap Shoulder Arc Boundary: 0.891 cal.

Nose Height with Cap Head: 1.225 cal.  
Nose Height without Cap Head: 0.916 cal.  
Nose Height without AP Cap: 0.778 cal.

### 41 cm Capped Type 91 AP Projectile

Length of Projectile with Windscreen: 4.24 cal.  
DITTO without Windscreen but with Cap Head: 3.0 cal.  
DITTO to Top of 0.659 cal. Wide Cap Head Threaded Edge: 2.843 cal.  
DITTO to 0.707 cal. Wide Flat Nose without Cap Head: 2.78 cal.  
DITTO without AP Cap: 2.683 cal.

DITTO to Top of Forward Bourrelet: 1.893 cal.  
DITTO to Center of 1.098 cal. S.O. Pointed Nose Arc: 1.854 cal.  
DITTO to Center of 3.329 cal. S.O. Lower AP Cap Shoulder Arc: 1.822 cal.  
DITTO to Center of 0.768 cal. S.O. Cap Head Face Arc: 2.246 cal.  
DITTO to 0.937 cal. Wide Lower Edge of AP Cap: 2.098 cal.  
DITTO to 23° Conical Nose/Lower AP Cap Shoulder Arc Boundary: 2.436 cal.

Width at Conical Nose/Lower AP Cap Shoulder Arc Boundary: 0.869 cal.

Nose Height with Cap Head: 1.107 cal.  
Nose Height without Cap Head: 0.887 cal.  
Nose Height without AP Cap: 0.79 cal.

## Japanese Type 91 Projectiles – Nose Shape Measurements

### 36 cm (actually 14" = 35.56 cm) Capped Type 91 AP Projectile (& Cap Head for 15.5 cm design)

Length of Projectile with Windscreen: 4.317 cal.  
DITTO without Windscreen but with Cap Head: 3.04 cal.  
DITTO to Top of 0.671 cal. Wide Cap Head Threaded Edge: 2.885 cal.  
DITTO to 0.697 cal. Wide Flat Nose without Cap Head: 2.821 cal.  
DITTO without AP Cap: 2.694 cal.

DITTO to Top of Forward Bourrelet: 1.949 cal.  
DITTO to Center of 0.99 cal. S.O. Pointed Nose Arc: 1.876 cal.  
DITTO to Center of 3.037 cal. S.O. Lower AP Cap Shoulder Arc: 1.864 cal.  
DITTO to Center of 0.8 cal. S.O. Cap Head Face Arc: 2.258 cal. (= 2.453 w/15.5 cm shell)  
DITTO to 0.973 cal. Wide Lower Edge of AP Cap: 2.154 cal.  
DITTO to 23° Conical Nose/Lower AP Cap Shoulder Arc Boundary: 2.473 cal.

Width at Conical Nose/Lower AP Cap Shoulder Arc Boundary: 0.88 cal.

Nose Height with Cap Head: 1.091 cal. (= 15.5 cm shell)  
Nose Height without Cap Head: 0.872 cal.  
Nose Height without AP Cap: 0.745 cal.

### 20 cm (actually 8" = 20.32 cm) Uncapped Type 91 AP Projectile (& most for 15.5 cm design)

Length of Projectile with Windscreen: 4.469 cal.  
DITTO without Windscreen but with Cap Head: 3.361 cal. (= 3.235 w/15.5 cm shell)  
DITTO to Top of 0.63 cal. Wide Cap Head Threaded Edge: 3.08 cal.  
DITTO to 0.689 cal. Wide Flat Nose without Cap Head: 3.007 cal.

DITTO to Top of Forward Bourrelet: 2.318 cal.  
DITTO to Center of 1.275 cal. S.O. Lower Nose Shoulder Arc: 2.19 cal.  
DITTO to Center of 0.903 cal. S.O. Cap Head Face Arc: 2.584 cal. (see 36 cm w/15.5 cm shell)  
DITTO to 23° Conical Nose/Lower Nose Shoulder Arc Boundary: 2.5 cal.

Width at Conical Nose/Lower Nose Shoulder Arc Boundary: 0.929 cal.

Nose Height with Cap Head: 1.043 cal. (see 36 cm w/15.5 cm shell)  
Nose Height without Cap Head: 0.689 cal.

### Other Type 91 AP Projectiles

- 1) **15.5 cm Uncapped Design:** Use 20 cm size measurements in calibers for all measurements other than Cap Head shape BUT use 36 cm size Cap Head shape to change any 20 cm size measurements that are changed by Cap Head shape. Exact data is not known to me at present.
- 2) **31 cm & 51 cm Planned Capped Designs:** Use 46 cm measurements for all quantities. This is a good assumption for these slightly improved projectiles.

## Japanese Type 91 Projectiles – Nose Shape Measurements

### Notes

- 1) There is some evidence that a modified 36 cm and 46 cm Type 91 AP projectile, called the Type 1, with a slightly longer and more pointed windscreen and a single wide British-style driving band – similar to pictures of known experimental 48 cm AP projectiles that were tested during World War II – was introduced at some time during World War II, but there are no photographs of these projectiles, to my knowledge. The 46 cm size, if actually produced, may have never actually been issued to YAMATO or MUSASHI, though some 36 cm Type 1 AP shells seem to have been used during World War II. These changes did not affect any shell performance criteria.
- 2) The Cap Head has no function whatsoever at over 45° obliquity against homogeneous armor, being knocked aside immediately on impact. Against face-hardened armor, the Cap Head shatters, but it seems to provide some protection to the 15.5 cm and 20.3 cm uncapped projectiles, allowing holing of these plates more easily, but not preventing these projectiles themselves from shattering when they try to penetrate through the holes just made. The Cap Head and windscreen are knocked off by impact with practically anything, including the surface of the ocean, which is what it was designed to do, so as to allow the tapered flat nose to cut through the water with minimum deflection or speed loss and enable the projectile to hit the target deep underwater at a longer miss distance, which it actually only did ONCE, to my knowledge, against the US Navy light cruiser USS BOISE.
- 3) The 15.5 cm Type 91 Cap Head design was a virtual copy of the 36 cm Cap Head in outer contour, but this shell had a much larger explosive cavity and the AP cap and nose were fused together (made in one piece from the start). It used the same rather blunt button-shaped Cap Head. When thicker armor was expected in foreign ships – though obviously not the use of face-hardened armor in cruiser-size ships – a thicker, more-pointed Cap Head was added to the 20.3 cm design to improve penetration into homogeneous ductile armor at low obliquity. Otherwise, weight considerations imply that the 15.5 cm design was more-or-less identical to the 20.3 cm design. The 20.3 cm size was found to have excellent homogeneous armor penetration ability in post-World War II US Navy tests of this projectile and the last German “L/4.4” APC projectiles in comparison to US Navy AP projectiles.
- 4) The thicker, more-rounded Cap Head used with the capped 46 cm Type 91 projectile (similar to the 20.3 cm Cap Head, but blunter) was part of an effort to improve the projectile’s oblique impact (30-35 degrees) penetration ability against face-hardened armor, but the improvements were rather small, if any, so I do not separate the 46 cm design from the earlier capped 36 cm and 41 cm designs in this regard. None were up to most foreign designs of the same period in AP capability, since the underwater (diving) hit concept and minimum drag for maximum possible range body shape seems to have absorbed all innovation, including retaining the circa-1921 British 15” Mark V AP projectile’s 20-degree-obliquity-versus-0.67-caliber-VC-plate test specs adopted along with the last British APC shells of that type bought at that time. Most foreign World War II-era AP projectile tests required - or, at least, could pass - a 30-degree or, in the US Navy case, up to 35/40-degree obliquity test against up to caliber-thickness face-hardened plate with an intact explosive cavity and fully-functional base fuze after penetrating the plate.
- 5) “S.O.” means “Secant Ogive” nose shape. This is a single circular arc forming the outer contour, but here the arc center is lower and closer to the centerline than if the radius line to the joint of the arc and the cylindrical body or other adjacent projectile part’s edge were at right angles to the centerline (= a “Tangent Ogive” shape), so that the nose arc meets the upper body cylinder or that other part’s edge with a distinct crease or shoulder at the joint (Tangent Ogive shapes “feather” at the joint perfectly, with no shoulders or creases there). Distances given here are from projectile bottom up to the given center level along the projectile centerline.
- 6) These measurements are from actual blueprints made after World War II by cutting Japanese projectiles apart at either the U.S. Naval Proving Ground or a U.S. projectile manufacturer’s steel plant and making measurements.