

QUICK NOTES ABOUT GERMAN WW2 U-BOAT OPTICS

Most german U-Boat types (Types VII, IX and XXI) were equipped with two periscopes, one for attack and the second for navigation purposes.

The periscopes were produced by several different manufacturers, Zeiss, Askania and Nedinsco, but overall followed similar designs, there being a set of earlier (Installed mostly on the Type II and Type VIIBs) and another of later types. The chief difference between them was that later types were binocular, sacrificing other features in favour of that one, and they were also easier and cheaper to produce. The earlier types were found mainly in pre-war and early war U-Boats, while the later types were the most common ones.

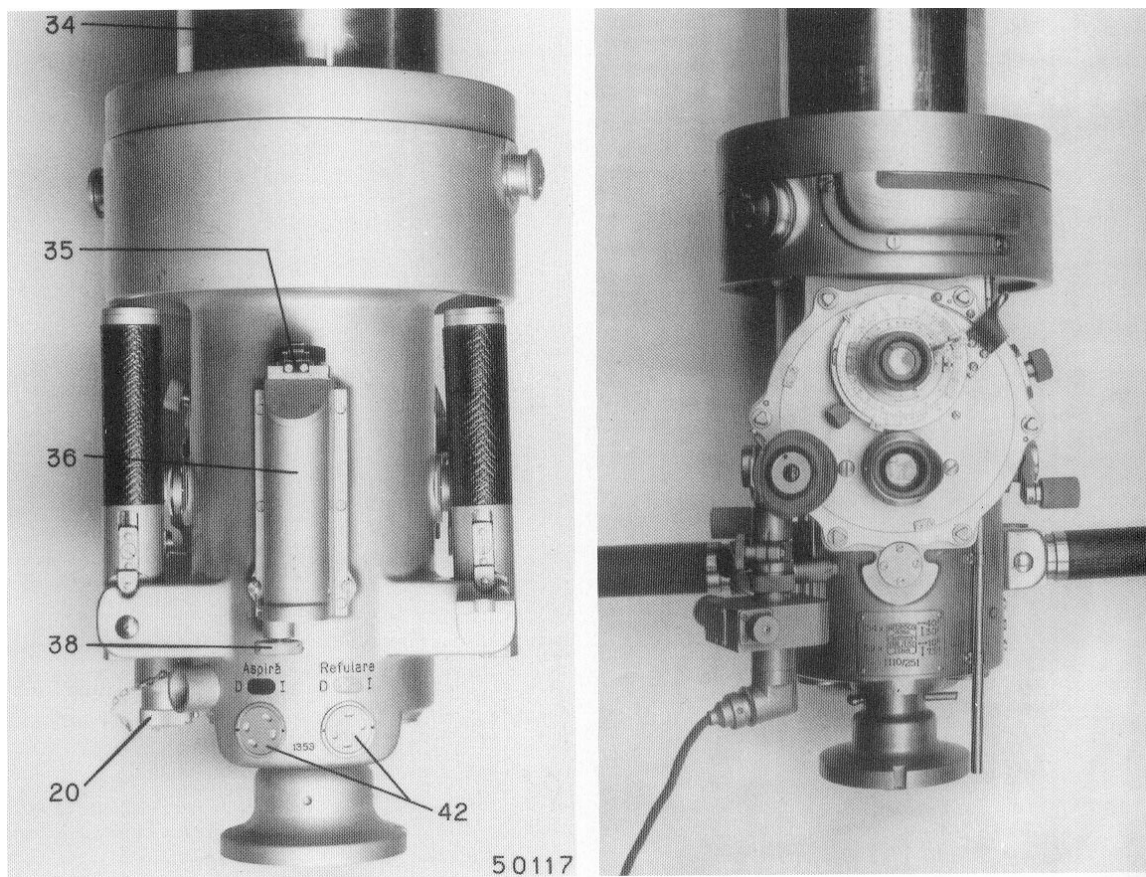


ATTACK PERISCOPES:

Attack periscopes had a reduced diameter head, and a thinner tube, making them less visible to the enemy.

Earlier types were close to what WW1 U-Boats equipped and had an integrated split prism stadimeter, linked to a wiz-wheel visible in the outside. This allowed to measure both height and width of the visible target, providing distance and angle on the bow if height and length were known or estimated.

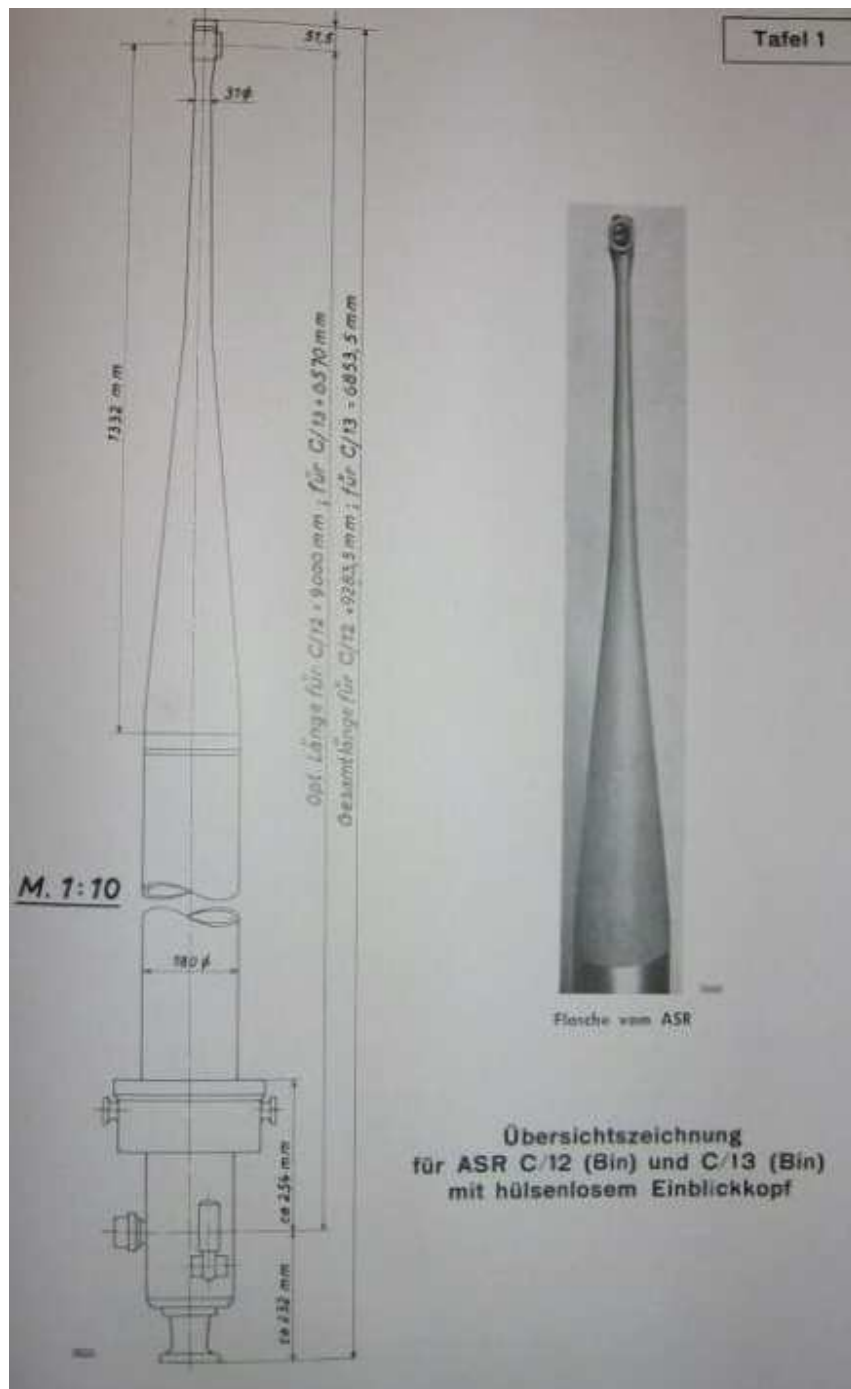
On the left eye, the commander could see the so called "Dreieckslupe", a small camera that presented three gradable scales in different colours for target, torpedo and sighting line, to construct the torpedo firing solution.



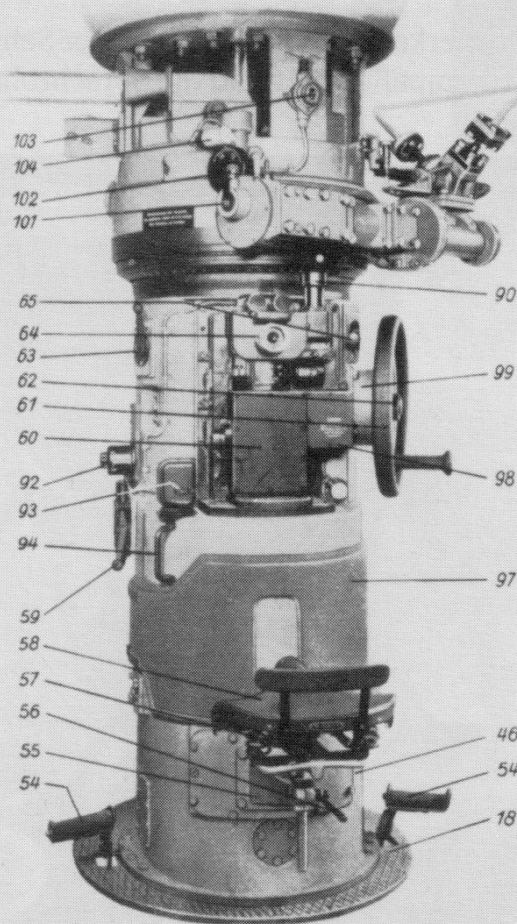
This type of periscope is still to be seen in the Vessikko:



Later types were the C/9, C/12 and C/13, all having minimal differences between them, and all having an installable binocular eyepiece. The loss of interior space required to install the additional prisms forced to drop the split-prism stadimeter, thus distance was calculated simply with the graticule. It was felt that the better depth perception, light admission and clearer view for the observer more than compensated this.



Finally, the Standsehrohr -or standing periscope- was not a full periscope in itself, but a housing with additional prisms, the ocular, the chair and the controls. In that system, any of the upper parts of the other attack periscopes could be installed, the C/12 being the most common. This gave not just the advantages of the fixed height, but also allowed quickly changing damaged periscope tubes, which were independent from the rest of the installation.



2900

Mittelteil des Stand-Sehrohres (Einblickseite)

- | | |
|---|--|
| 18 Geteiltes Abdeckblech für Bootsschacht | 90 Rückdreheinrichtung für rechtweisende Peilrichtung |
| 46 Schachtrohr | 92 Einstellknopf am Verdunklungswiderstand für Teilkreisbeleuchtung |
| 54 Fußhebel für Drehung | 93 Serienschalter für Heizung und Teilkreisbeleuchtung |
| 55 Träger für Sattel | 94 Handgriff zum Abstützen des Beobachters |
| 56 Klemmhebel für Höhenverstellung des Sattels | 97 Knieschutz |
| 57 Klemmhebel für radiale Verstellung des Sattels | 98 Deckel für Tochtermotor |
| 58 Sattel für Beobachter | 99 Lager für Zielwinkelhandrad |
| 59 Steuerhebel für Hubantrieb | 101 Ölstandfenster für Schnecke |
| 60 Okularkopf | 102 Öler für Schnecke |
| 61 Zielwinkelhandrad | 103 Serienschalter für Heizung und Beleuchtung der Höhenstandteilung |
| 62 Schalthebel für Drehung „grob“ und „fein“ | 104 Einschraublampe für Höhenstandteilung |
| 63 Einstellhebel für Kippwinkel | |
| 64 Okular | |
| 65 Schalthebel für Vergrößerungswechsel | |

Das Mittelteil des im Turm der Typ VII C-Boote eingebauten Standsehrohres.

This periscope also had a set of moveable scales integrated above the ocular, allowing to set the desired Vorhalt (Lead) angle from a picked bearing.

Technical data:

Magnifications: 1,5x / 6x

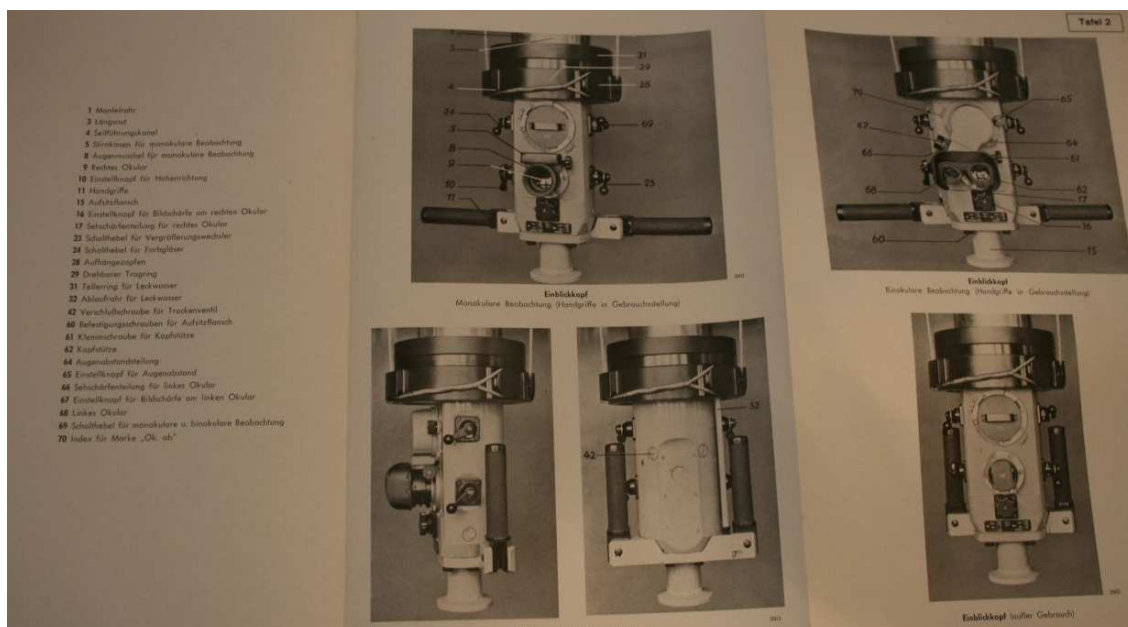
Angular field of view: 38° (Low power) / 9° (High power)

Exit pupil: 3,5 mm

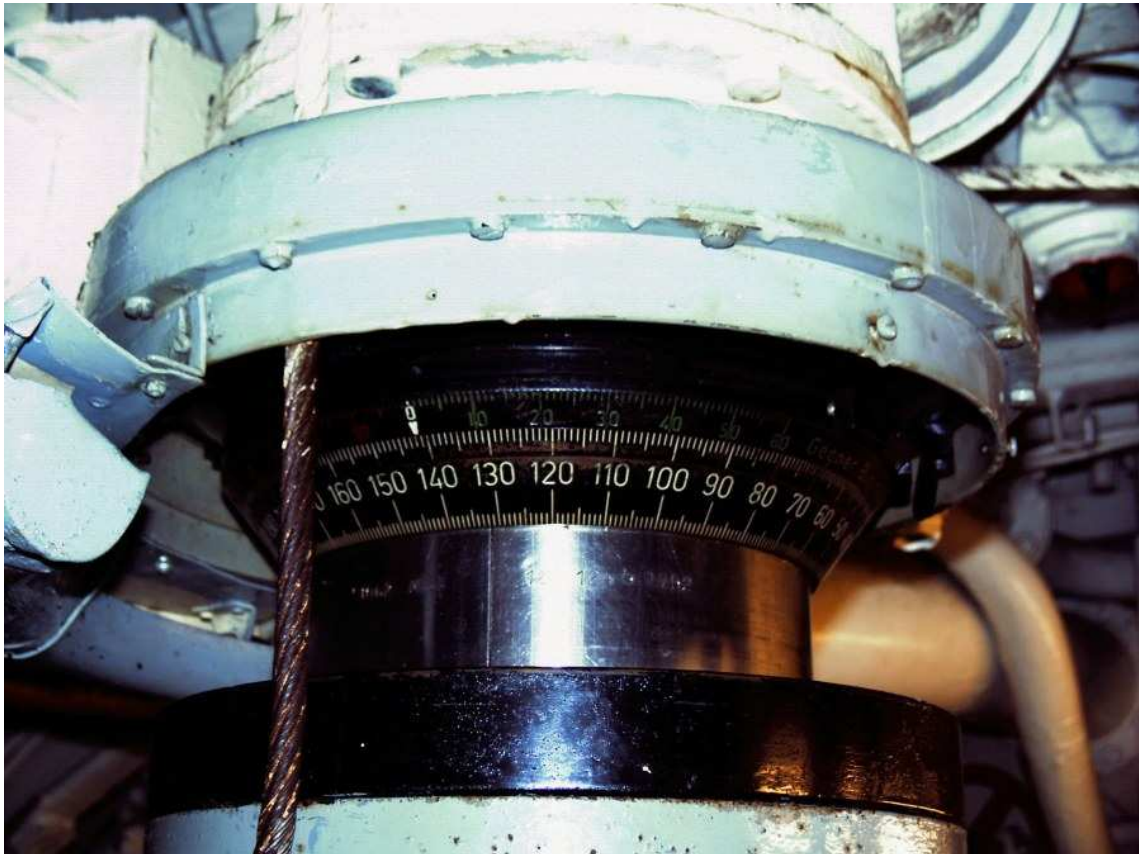
Tilt: +20° -15°

OBSERVATION PERISCOPES:

Those periscopes allowed better light transmission and were as such intended for observation and night attack purposes. Again the models were variations of the C/9 to C/12 series, with similar characteristics except the mentioned improved light allowance. These periscopes rarely incorporated the features for specific attack purposes (Zielkurswinkel wheel, split prism stadimeter) but were mostly binocular.



In the upper part, there was also an adjustable ring for lead angle aiming (See it above the bearing scale):



Technical data:

Length: 7,55 metres

Magnifications: 1,5x / 6x

Angular field of view: 38° (Low power) / 9° (High power)

Exit pupil: 7mm

Tilt: +90° -10°

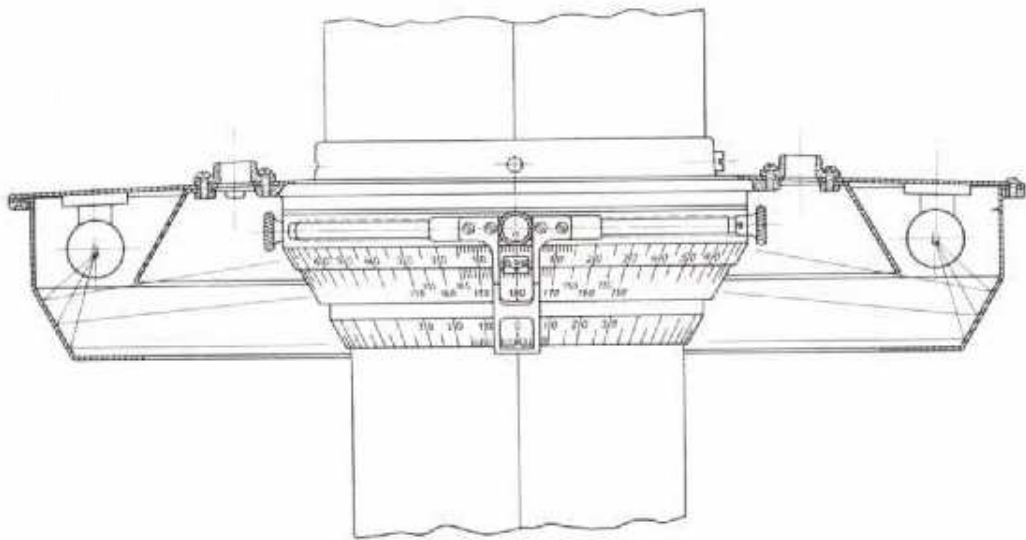
Light at side of field cut down to about 30 per cent. of the light in the centre.

ADDITIONAL FEATURES:

All scopes had two interchangeable coloured filter glasses, one orange and one grey. The first one allowed better visibility against sunset/sunrise, the second was intended to neutralize the bright reflections of sun on the wave caps.

The ocular was adjustable to sight defects in the observer (Dioptries)

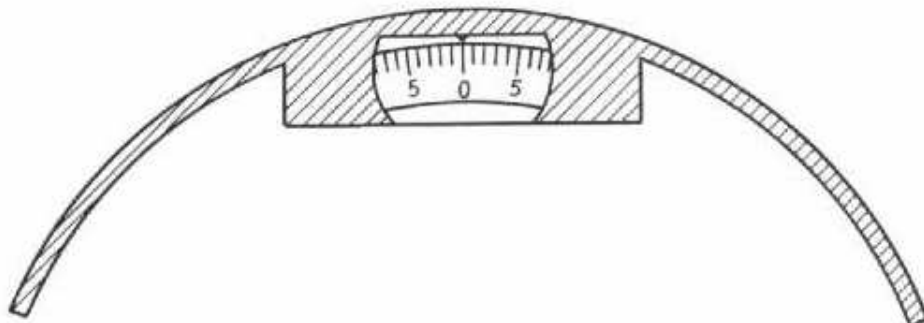
The bearing scale was visible through the ocular in the upper part of the field of view in observation scopes. In the attack scope it wasn't always, it depended from the model installed.



ca. $\frac{1}{4}$ nat. Größe

1451

Teilkreis mit Lampenkranzbeleuchtung



1452

ca. $1:2\frac{1}{2}$ der scheinbaren Größe
Teilkreis-Innenablesung

UZO:

The UZO was just a night sight for torpedo targeting, with only the bearing line transmission function. It didn't feature any rangefinding device or help, only a vertical line was visible in the ocular. The IWO who operated it estimated distance to target based on the percentage of the lense covered by the objective and its size. Printed tables helped with that, but distance was not hugely important since night surface shooting was done mostly with small or no parallax (i.e. with the U-Boot aiming at the target, because it reduced the visible silhouette) and in those shots distance hardly matters.



Technical data:

Angular field	7°25'
Magnification	7.1 x.
Exit pupil	7 mm.

U-BOOT BINOCULARS:

Binoculars handed to U-Boot crews were Zeiss items of big quality, protected externally with a rubber coat (Which usually has broken in modern collection items). They were 7x50 water resistant binoculars with a field of view of $7,25^\circ$ and an exit pupil of 7mm (Ideal for night use), but the commanders were given special high quality 8x60 items.

Example of crew binocular:



Example of Commander binocular:



GRATICLES:

There were different types of graticles in the scopes, some with less and some with more divisions. All of them used the radians system to allow easier mental calculations of distance (Though printed tables were available) and angle.

The most widely known is the one displayed in the film Das Boot, usually employed in earlier periscopes. The marks do not correspond to degrees, but instead the "10" is approx 6 °, because tangent of that value is 0,10 and it allowed an easy formula for calculating distance.

This formula is:

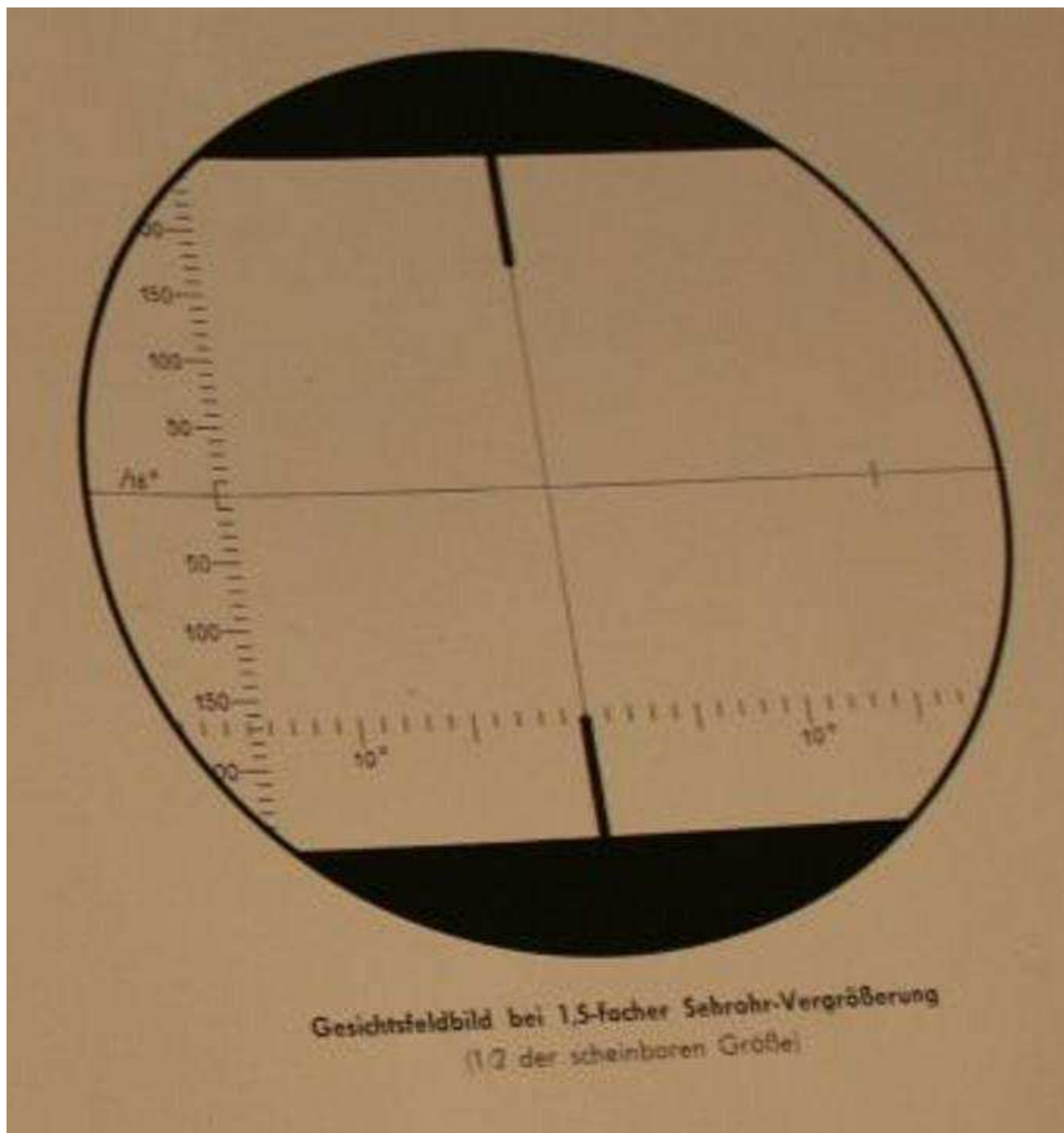
Target height x 1000 / Scale marks = Distance in meters

For example, a 25 metres mast destroyer on the "10" mark would be at

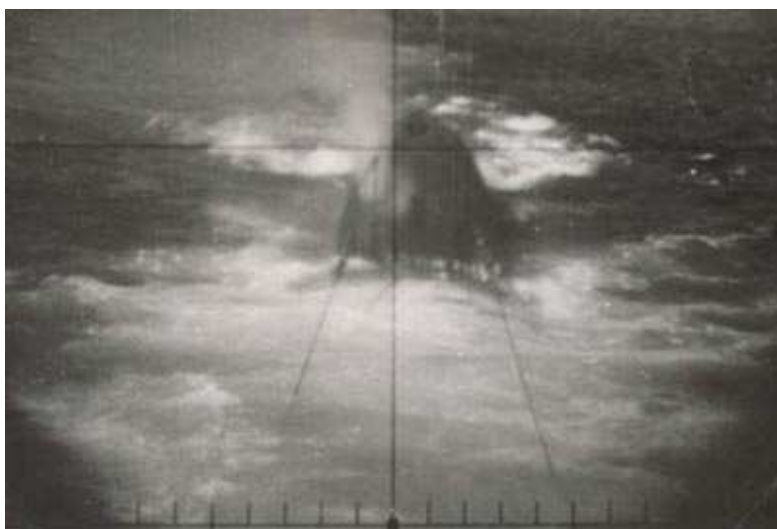
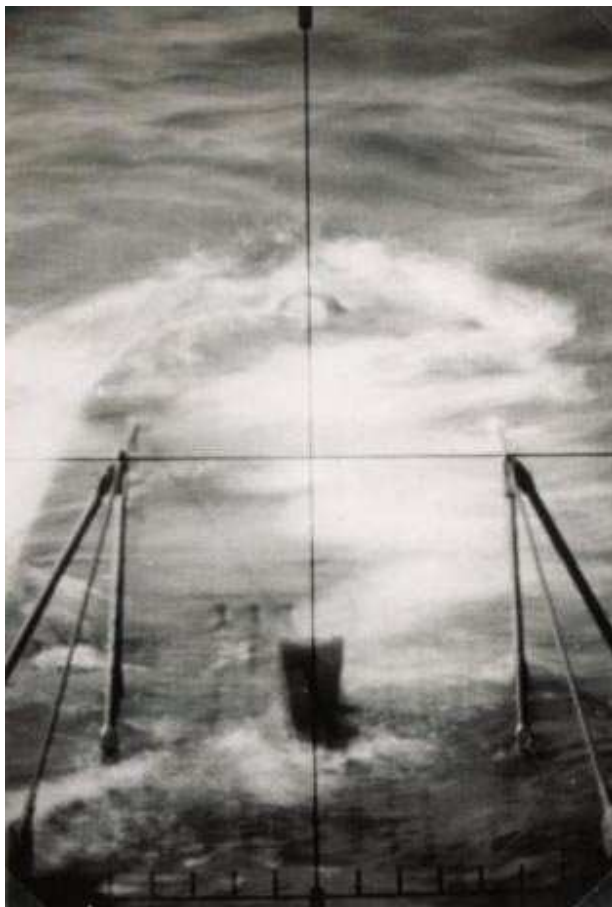
$25 \times 1000 / 10 = 250$ metres at 1,5x zoom and 4 times that at 6x zoom (1000 metres)

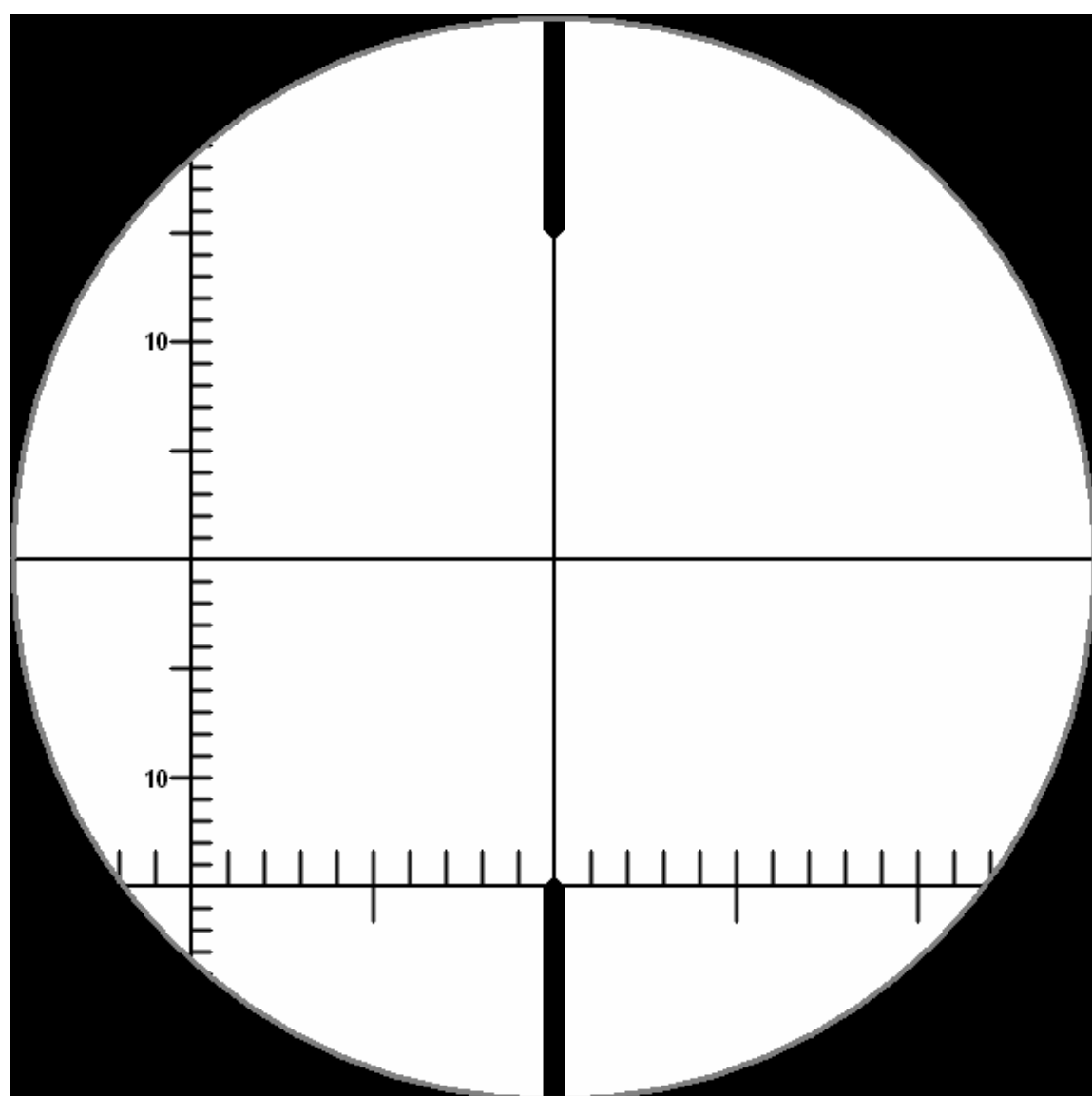
Since target information was not always available or reliable, the commanders estimated mast or funnel heights visually for distance calculating.

Reticle from the NLS 9 binocular (Observation periscope):



Reticle from the attack periscope of U-402





Reticle from an UZO:



Reticle inside the watch crew and commander's binoculars:



Sources:

- Several original periscope manuals
- British and American technical reports on the captured U-570
- U-Boat.net
- Iron Coffins by H. Werner
- Black May by M. Gannon
- J.Brennecke "Die Wende im UBootKrieg"
- H.Busch "The submarine war"
- U-Boot Commander's Handbook
- ONI Publications 9,14,42 y 43
- Private collections of militaria and WW2 optics