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DEFINITION AND MEASUREMENT OF VDS TOWLINE KITE ANGLES.(U)
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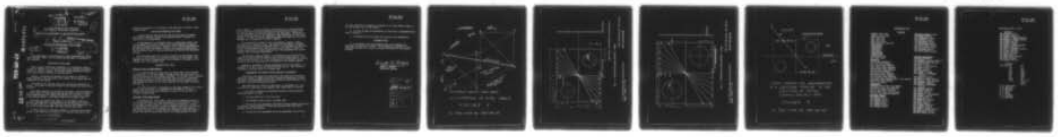

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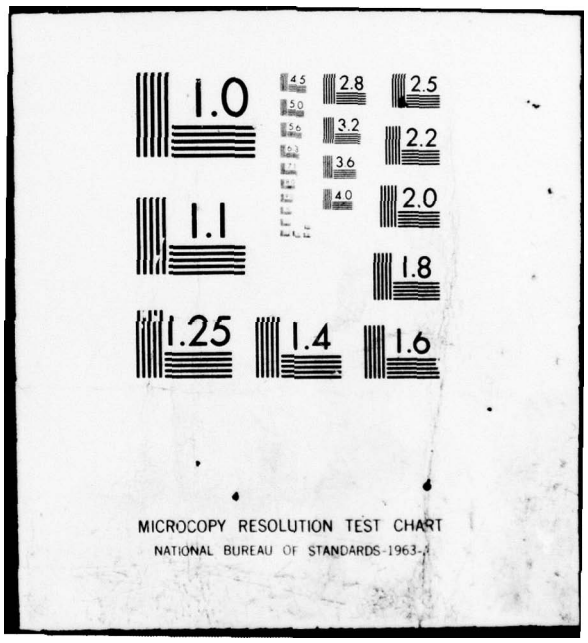
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U. S. Navy Underwater Sound Laboratory
Fort Trumbull, New London, Connecticut

DEFINITION AND MEASUREMENT OF VDS TOWLINE KITE ANGLES

by
Donald A. Nichols

USL Technical Memorandum No. 933-164-65
24 April 1965
10p.

INTRODUCTION

This memorandum is concerned with an angle associated with towed-sonar towlines. Kite angle is defined and the means for measuring it are described.

DEFINITION OF KITE ANGLE

While towing a towed-sonar transducer, it is desirable, ideally, to have the towline lie in a vertical plane that includes the direction of motion. Usually, however, the towline and the direction of motion form a plane that is inclined to the ideal plane.

Figure 1 illustrates the geometry of kite angle as viewed by a person standing on the port side of the fantail of the towing ship and looking aft at the towline.

Plane AEHD is the vertical plane that includes the direction of motion. Plane AEGC is the plane formed by the towline and the direction of motion.

Plane DHGC represents the surface of the water. Line AG represents a visible portion of the towline that emerges from the water at point G and proceeds upward and forward through the air to point A, a point on the outboard sheave. (The sheave itself is not shown in Fig. 1.)

Kite angle is defined (see figure 1) as the angle, formed on a vertical plane ABCD that is perpendicular to the direction of motion, by a vertical line AD, in that vertical plane and the intersection, line AC, of the inclined plane AEGC with that vertical plane ABCD.

In other words, it is the angle formed on a vertical plane perpendicular to the direction of motion by (1) a vertical line and (2) the

horizontal projection of the towline in the direction of motion to that vertical plane.

A DEVICE FOR MEASURING KITE ANGLE

A proper name for the device that USL has been using to measure kite angle is probably "towline kite angle protractor"; however, we usually call it an angleometer.

An angleometer is a rectangular sheet of transparent plastic with lines engraved on one side. These lines, suitably marked in degrees, are used to measure kite angle. Figures 2 and 3, USL drawings SKC-44454 and SKC-44455, show the details of small- and large-size angleometers. The two circular holes in each provide means for holding the angleometer securely.

The line marked zero (0) at top and bottom, the zero-degrees line, is the line that is made to be vertical during use on board ship. The unmarked line that is perpendicular to and crosses at the middle of the vertical line is the horizon line.

MEASURING KITE ANGLE

Effects of Ship on Measurements

It is obvious that the towed body and towline must follow wherever the ship goes. If the ship takes a zig-zag course, the kite angle will oscillate between port and starboard extremes. If the ship is on a straight course and the wind is blowing across the ship from port to starboard, the resultant direction of the ship motion will be to the right of the ship heading and there will be a port component of kite angle induced by the wind.

If we are interested in measuring the kite angle caused by the towline and/or towed body only, it is necessary for the ship (1) to take a heading into or with the true direction of motion of the wind and (2) to make a straight wake.

Obtaining Kite-Angle Values

In measuring the kite angle, a man with an angleometer stands on the fantail and looks in a direction opposite to the direction of motion to the apparent point where the towline crosses the horizon. It may be necessary for him to move to port or starboard from his first-selected viewing position in order to position his eyes in the proper place to meet those conditions. He then holds the angleometer with both hands (1) between his eyes and the towline and (2) in a plane parallel to plane

ABCD of Figure 1. He then positions the horizon line of the angleometer in line with the horizon and positions the vertical line so that it and the towline appear to cross the horizon at the same point. See Figure 4. He then reads the angle on the angleometer that corresponds to the towline position. By means of several readings, average kite angle and kite angle extremes can be determined to within 5 degrees.

Kite angles may be either to port or starboard. Figure 1 shows a kite angle of 30 degrees to port. When using the angleometer to measure port kite angles, as shown in Figures 1 and 4, it is necessary and desirable to hold the angleometer with your two hands as you revolve it about the horizon line so that the angle graduations on the angleometer are aligned properly with the towline inclination.

The kite angle shown in Figure 1 is designated a port kite angle because the towline enters the water to port of the outboard sheave. (Point G lies to port of point A.) If the towline kites to starboard, the point of its entry into the water would lie to starboard of the outboard sheave.

Because of the method of making measurements of the kite angle, it is necessary to be able to see the horizon and the towline. This restricts the method to daylight hours on non-foggy days.

MEASUREMENTS FOR TOWLINE AND/OR TOWED-BODY ADJUSTMENTS

Since large kite angles are undesirable, kite angle may be measured during the process of making towline and towed-body adjustments to reduce the angle. The adjustments that we have in mind are those required to be made for stern-towed towlines and bodies.

When measuring kite angles for application to adjustments of a towline and/or a towed body, it is important that these steps be followed:

1. The time for making the measurements should be during daylight hours when there is no fog.

2. The ship heads into or with the wind.

3. The helmsman steers to make a straight wake.

4. The man with the angleometer positions his eyes properly athwartship in relation to the direction of motion and the point where the towline appears to cross the horizon.

5. The man with the angleometer holds the angleometer up and before

his eyes, positions it properly in relation to (1) plane ABCD of Figure 1, (2) the horizon, and (3) the towline.

6. He looks through the angleometer and sees what is diagrammatically shown in Figure 4.

7. He estimates the kite angle with the aid of the angleometer.

RECOMMENDATIONS

It is recommended that the procedures that were discussed for measuring kite angles be followed. The procedure is considered to be reasonably reliable and to have an accuracy sufficient for the purposes intended.

Donald A. Nichols

DONALD A. NICHOLS
Mechanical Engineer

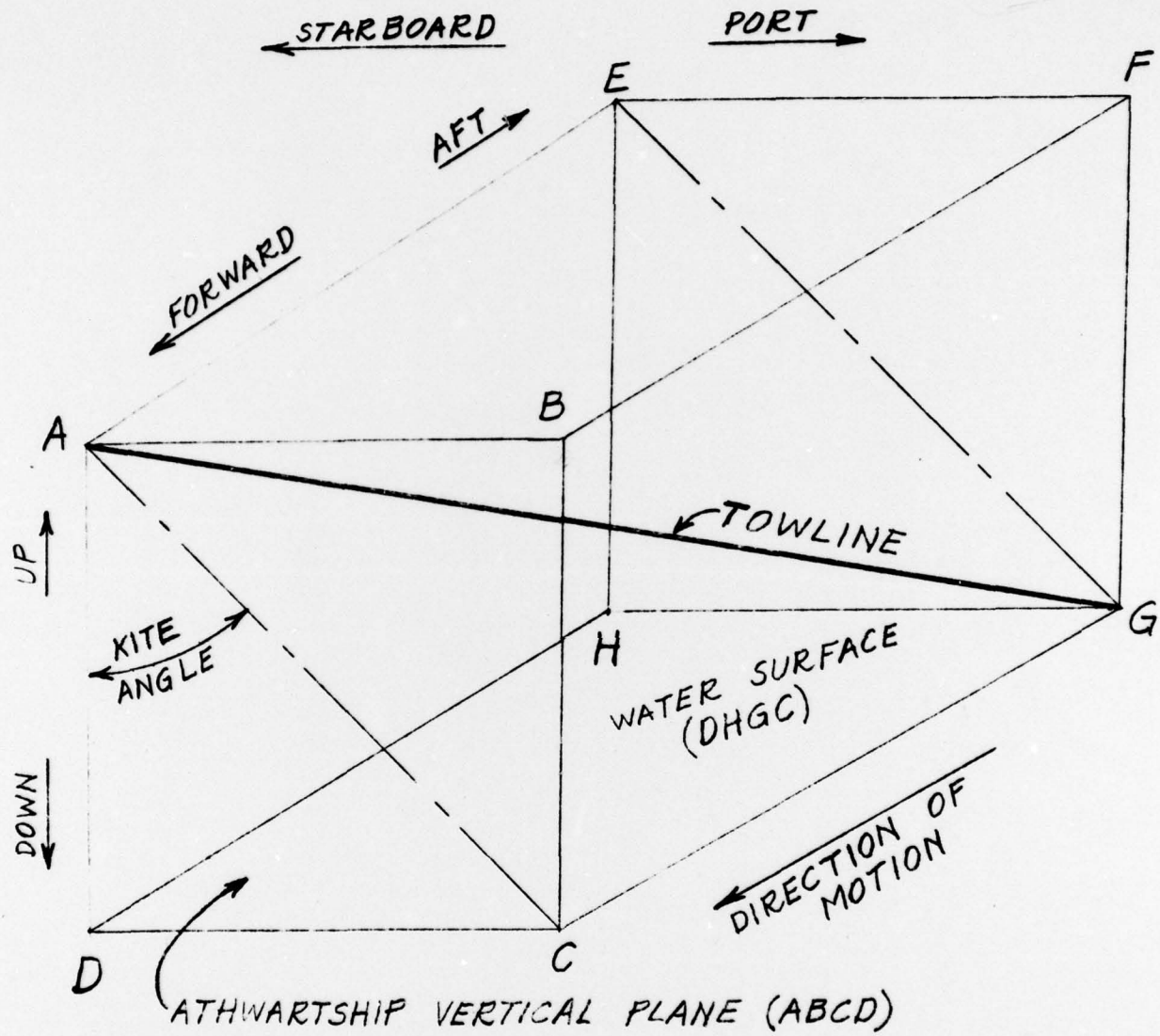

ILLUSTRATION OF KITE ANGLE

FIGURE 1

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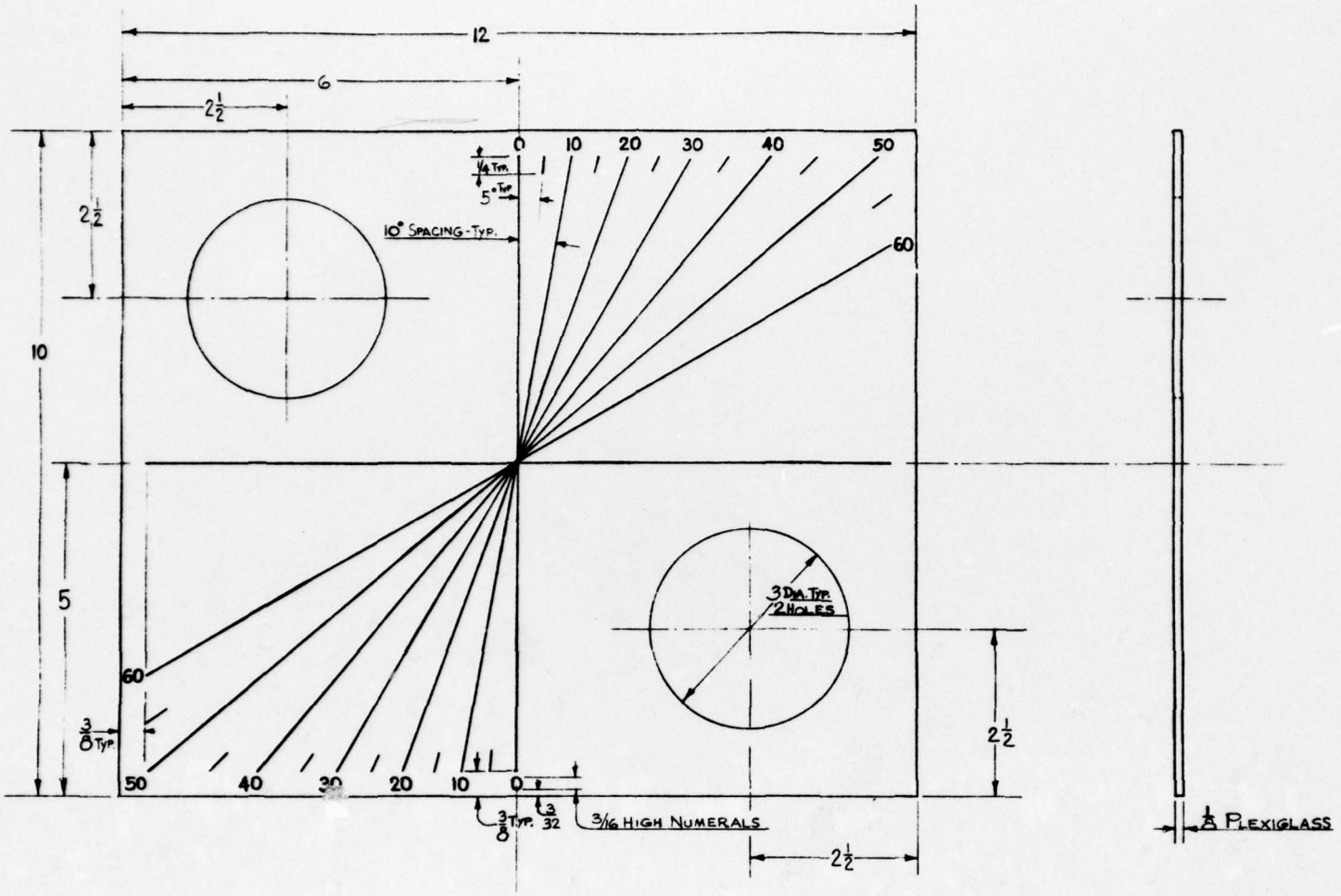

ENGRAVING LINES:- 1/32 WIDE x 1/32 DEEP - FILL WITH BLACK MARKALL.

Fig. 2 - Towline Kite Angle Indicator - Small

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U. S. Navy Underwater Sound Laboratory
NP24 - 25952 - 5 - 65

Official Photograph

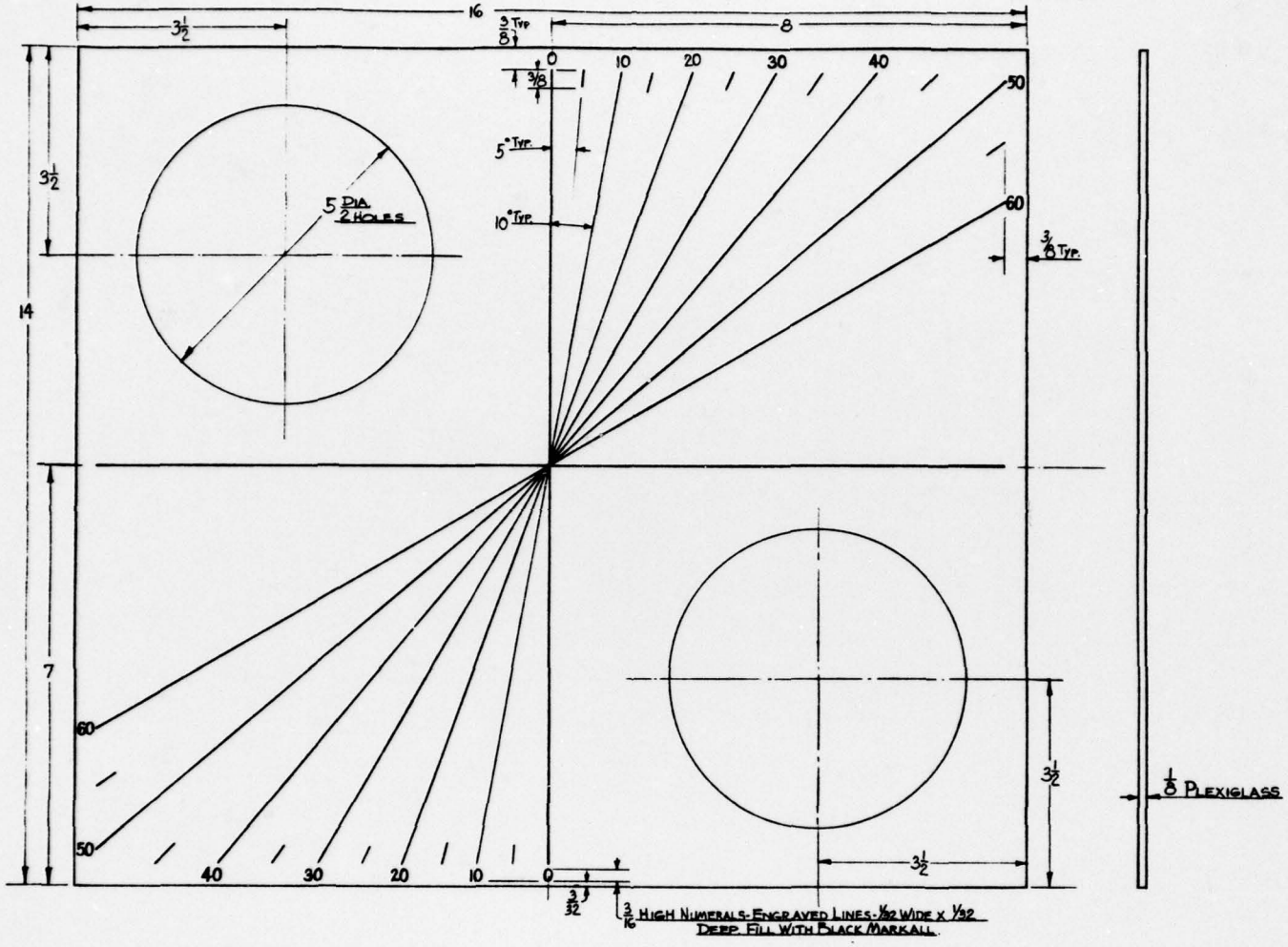

Fig. 3 - Towline Kite Angle Indicator - Large

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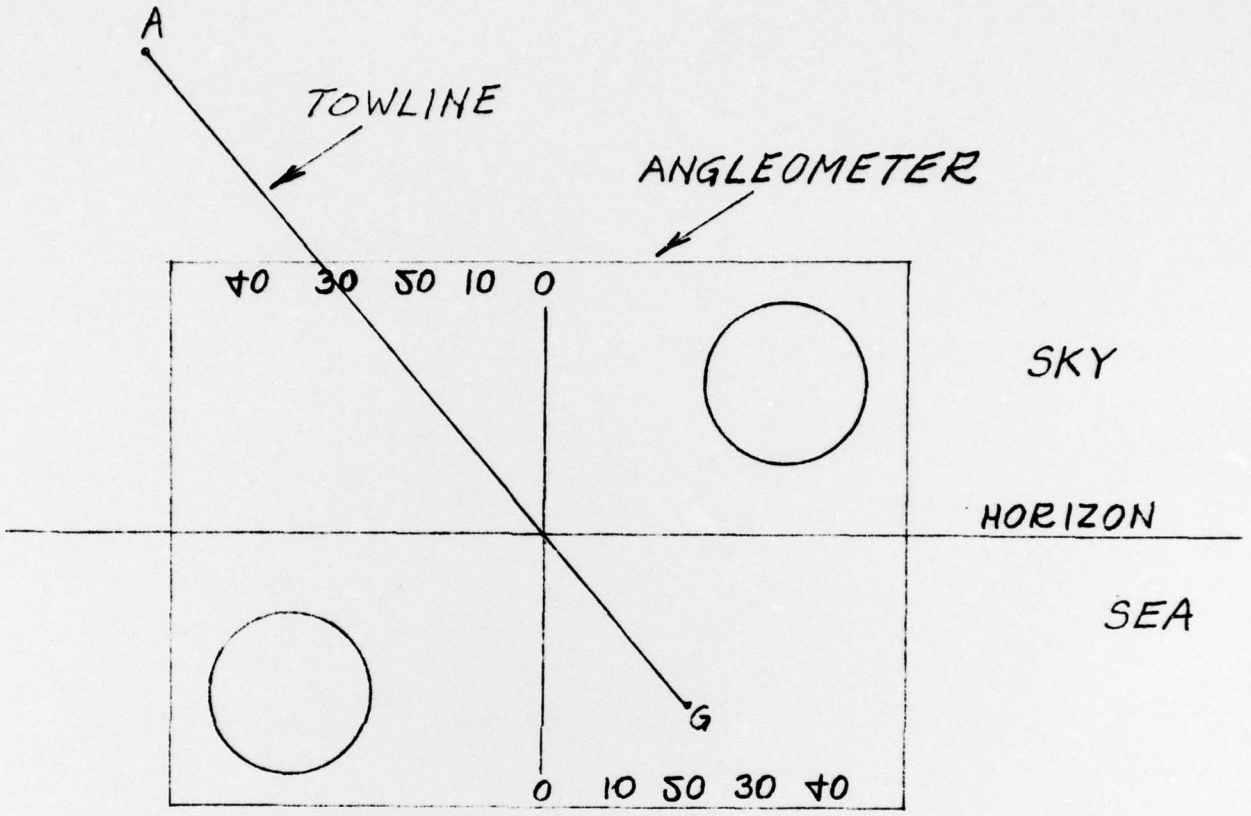

LOOKING THROUGH THE ANGLEOMETER IN A DIRECTION OPPOSITE TO THE DIRECTION OF MOTION (LOOKING DIRECTLY AFT)

FIGURE 4

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