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ILLUMINATION FOR BATTLESHIP AIRCRAFT NIGHT OPERATIONS, FURTHER TESTS.

By
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NAVY DEPARTMENT
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BUREAU OF ENGINEERING

Illumination for Battleship Aircraft

Night Operations, Further Tests.

NAVAL RESEARCH LABORATORY
ANACOSTIA STATION
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ABSTRACT

Night landing tests with an SOC-2 seaplane on the Anacostia River at the Naval Air Station led to a system of illumination and a method of landing which appeared to be satisfactory for conditions at sea. The system of illumination consisted of an ordinary 36-inch 12-kilowatt searchlight which directed a long streak of light on the water. Two grayish yellow color filters, transmitting about 1/20 of the light, 6 inches square, were mounted on either side of the plane's windshield. The plane approached toward the streak of light at an angle of about 10 or 20 degrees and landed on the water close alongside of the beam, never being in the beam until after contact with the water. The color filters may not always be necessary, but may be helpful for a beginner.

Tests with a polarized system, consisting of a polarized searchlight and polarized filters on the windshield, indicated that the polarized system was no better than, and perhaps slightly inferior to, the above unpolarized system.

CHAPTER 1

INTRODUCTION

1. Authorization. The work was authorized by references (a), (b), and (c).

Reference: (a) CO USS NEVADA ltr. BB36/A21-1/P11(116) of 13 January 1936 to BuEng., and five endorsements thereto.
(b) BuEng.ltr. C-BB/S66-(1-13-Ds) of 6 May 1936.
(c) BuAero.ltr. Aer-E-34-AMS, A4/VV, N39/NA6 of 6 May 1936 to NAS, Anacostia.
(d) NRL Report No. H-1339 of 14 January 1937.

Reference (a) requested the development of suitable illumination of a ship's slick for battleship aircraft night landing. References (b) and (c) authorized the investigation with appropriate cooperation of the Bureau of Aeronautics, Bureau of Engineering, and the Naval Research Laboratory.

2. Scope of the present report. Preliminary tests of several methods of illumination, reported in reference (d), were carried out in December 1936, all the tests being on land. The present report records further experiments in March and April 1937, with the polarized system of illumination and with illumination by an ordinary unpolarized searchlight. In these tests all landings were made on inland water. The experiments and conclusions are fully described in the Pilot's Report given in Chapter 3, and are briefly summarized in Chapter 2.

CHAPTER 2

TESTS OF UNPOLARIZED AND POLARIZED SYSTEMS

3. A 36-inch, 12-kilowatt searchlight was mounted on a truck on the pier at the Naval Air Station, Anacostia, and directed a long streak of light along the water. The searchlight was about 12 feet above the surface of the water. All tests were carried out by Lieutenant J.G. Crommelin in an SOC-2 seaplane.

4. Unpolarized, ordinary searchlight system. The ordinary searchlight was used and two colored glass filters 6 inches square were mounted on either side of the windshield of the cockpit of the plane. As the result of many landings, the pilot worked out a landing method which he believed to be satisfactory. The method is illustrated in Plate 1, which is drawn to scale. The plane approaches on a course towards the beam, near the beam, but never in the beam, and lands on the water alongside of the illuminated streak. Full details of the maneuver from the pilot's viewpoint are given in Chapter 3, paragraph 24.

5. The color filters used on the plane were a grayish yellow, transmitting about 1/20 of the light. The spectral transmission curve of the filter and a sample of the color are shown in Plate 2. It seems certain that the exact color of the filter is of little importance as long as the filter reduces the visible light intensity to about 1/10 or 1/20. A green, orange, or gray filter would be equally good, probably a red or blue color would be less desirable. It also seems probable that color filters on the windshield are desirable and may be necessary for a beginner, as is pointed out in Chapter 3, paragraph 25.

6. Polarized searchlight system. The searchlight was equipped with a polarizing screen mounted about 6 inches in front of the front glass of the searchlight. Two polarizing plates 6 inches square were mounted on either side of the windshield of the cockpit of the plane. The same system of approach and landing was used as was employed with the unpolarized system. The polarized system was found to offer no advantages over the unpolarized system. In fact the polarized system was slightly inferior, probably because of the lowered intensity of the searchlight beam occasioned by the polarizing filter.

7. Two types of polarizing filters on the searchlight were compared, one made of polarizing plates of the Polaroid Corporation and the other of plates of the Polarized Products Company. The first were more expensive and somewhat better optically than the second. The pilot observed no noticeable difference between the two.

CHAPTER 3

REPORT OF PILOT ON NIGHT LANDING TESTS OF SEAPLANES

8. On 30 March 1937, extensive night landing tests were conducted with a SOC-2 seaplane using the illumination from a standard searchlight equipped with a polarized lens. Two polarized filters were installed on the windshield of the seaplane in the same location as those used on previous tests on the SOC-1 landplane.

9. The knowledge gained from the previous landplane tests was utilized to good advantage in the seaplane operations and greatly simplified and expedited the experiments both from the pilot's point of view and from the viewpoint of the illumination personnel.

10. The Anacostia River, due to its small size and surrounding obstructions, was far from an ideal seaplane operating area for night landings and take offs. The searchlights were set up on a large truck and driven out on the small boat dock just in front of the administration building. This, the only location for the lights, together with the restrictions imposed by the narrow channel necessitated approaches being made either up or down the river regardless of the existing wind direction.

11. The light beam was trained down the river and depressed so that it struck the water some four to five hundred yards from the dock. The surface of the water was almost smooth and a three to four knot cross wind was blowing across the beam from right to left looking toward the light.

12. The pilot began his approach toward the light from a distance of about one and one half miles and from an altitude of 1000 feet. The reflection from the light mirrored in the smooth water alongside the dock was somewhat dazzling when observed by the naked eye and this dazzling reflection persisted when observed at any horizontal angle for approximately 10 degrees to either side of the beam. This glare could be entirely eliminated by the windshield filters.

13. The first landing was not executed with the degree of confidence and precision necessary for successful routine operations.

14. The pilot experienced some difficulty in judging his altitude for breaking the glide and also in determining his distance from the light at the point of landing. His impression while in flight just prior to contact with the water was that he was very near the searchlight whereas in reality the plane after landing stopped at least 500 yards short of the dock.

15. A rapid analysis of the difficulty experienced on the first landing led the pilot to the conclusion that his approach was made too close

to the center of the beam and too nearly parallel to the beam, as he was somewhat blinded when reaching the levelling-off point of his glide. This analysis proved correct, for subsequent landings made on a course converging toward the beam at an angle of from 5 to 10 degrees were very comfortable. It should be reiterated that the plane should remain clear of the beam and in the dark area until contact with the water is made.

16. In an attempt to improve the lighting, the beam was elevated so that it did not impinge directly upon but remained practically parallel to the surface of the water. This definitely decreased the positiveness of the lighting and greatly increased the difficulty of the one landing which was then made. Therefore the light was again depressed until its beam struck the water at a plainly visible angle.

17. A total of at least twelve landings was made on this occasion and it was definitely decided that the polarized searchlight and the polarized windshield filter provided a safe means of illuminating the surface of the water for night landings of seaplanes.

18. However, in view of the increased ease of landing with each effort and the increased ease of avoiding blinding glares which accrued from experience, the pilot requested that a plain unpolarized searchlight with a plain colored glass windshield filter be tried out.

19. On 13 April 1937, a series of tests were conducted with the same SOC-2 seaplane and a polarized searchlight with polarized windshield filters in comparison with a plain unpolarized searchlight in conjunction with a plain unpolarized colored glass windshield filter.

20. The same lighting and piloting technique as previously employed on 30 March were carried out.

21. A total of five landings was made with the polarized searchlight and polarized windshield filters. The results confirmed the opinions arrived at on 30 March. One landing wherein the pilot remained in the direct beam during his entire approach was attempted. As was anticipated, the direct beam of the light greatly increased the glare and difficulty of judging the speed, attitude, and altitude of the plane.

22. The plane then returned to the beach and the polarized windshield filters were replaced by the plain unpolarized colored glass windshield filters. The plain unpolarized searchlight was turned on and the pilot took off. No new or unexpected difficulty was encountered on the first landing. The increased brilliance of the searchlight was discernible with the naked eye; however, the colored glass windshield filters were ample protection from the glare. Six landings were made using this equipment. Four landings were effected with the beam on the pilot's left side and two with the beam on his right side. The landing light on the plane was not used at all.

23. It is the pilot's definite opinion that for night landings on the water the plain searchlight and plain windshield filters afford slightly better illumination than the polarized lens and filters.

24. The following method of approach was found to be simple, safe, and easy in the SOC-2 seaplane: The approach was initiated from a point at an altitude of approximately 1000 feet (this altitude was necessary to clear the obstructions along the river banks; at sea it is thought that 500 feet would be the correct initial altitude) and about a mile to a mile and a half distant from the searchlight. The wing flaps were lowered only half down as most of the landings had to be made cross wind. The line of approach converged toward the light beam at about a 5 to 10 degree angle and was directed at the streak on the water where the beam of light impinged upon the surface. The plane remained in the dark area the entire time during the approach and landing and quite frequently did not transect the beam even on the run after landing. It was found that the surface of the water was not so well outlined on the far side of the light as on the near or searchlight side; therefore pilots are cautioned to avoid landing too soon. The pilot's instinctive reaction will be to favor the far side of the light streak as the searchlight appears much nearer than it actually is.

25. Experience will dictate the use of the windshield filters. After completing a number of landings the pilot found that at practically no phase of the approach were the filters necessary. However, they may be very necessary for the beginner.

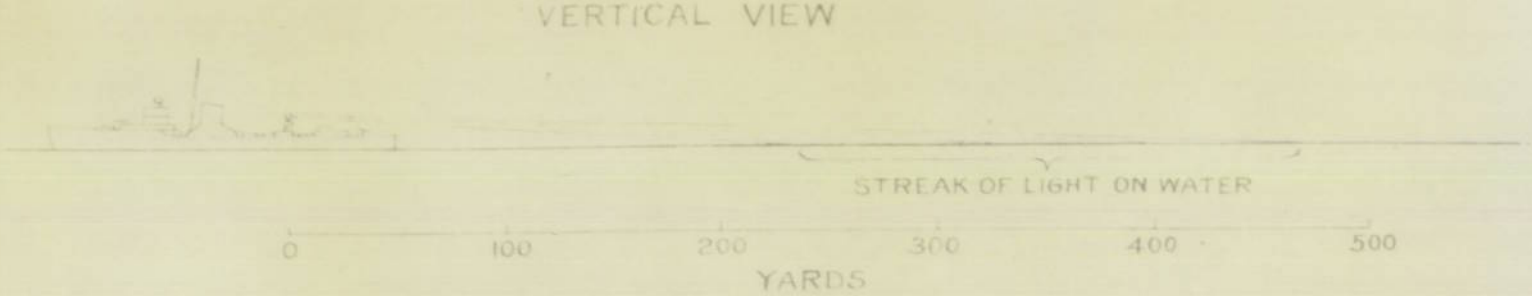
26. The pilot wishes to stress again that he considers the plain searchlight ample illumination and the plain colored glass windshield filters ample glare protection for night landings of seaplanes. The use of the plane's wing landing light is optional.

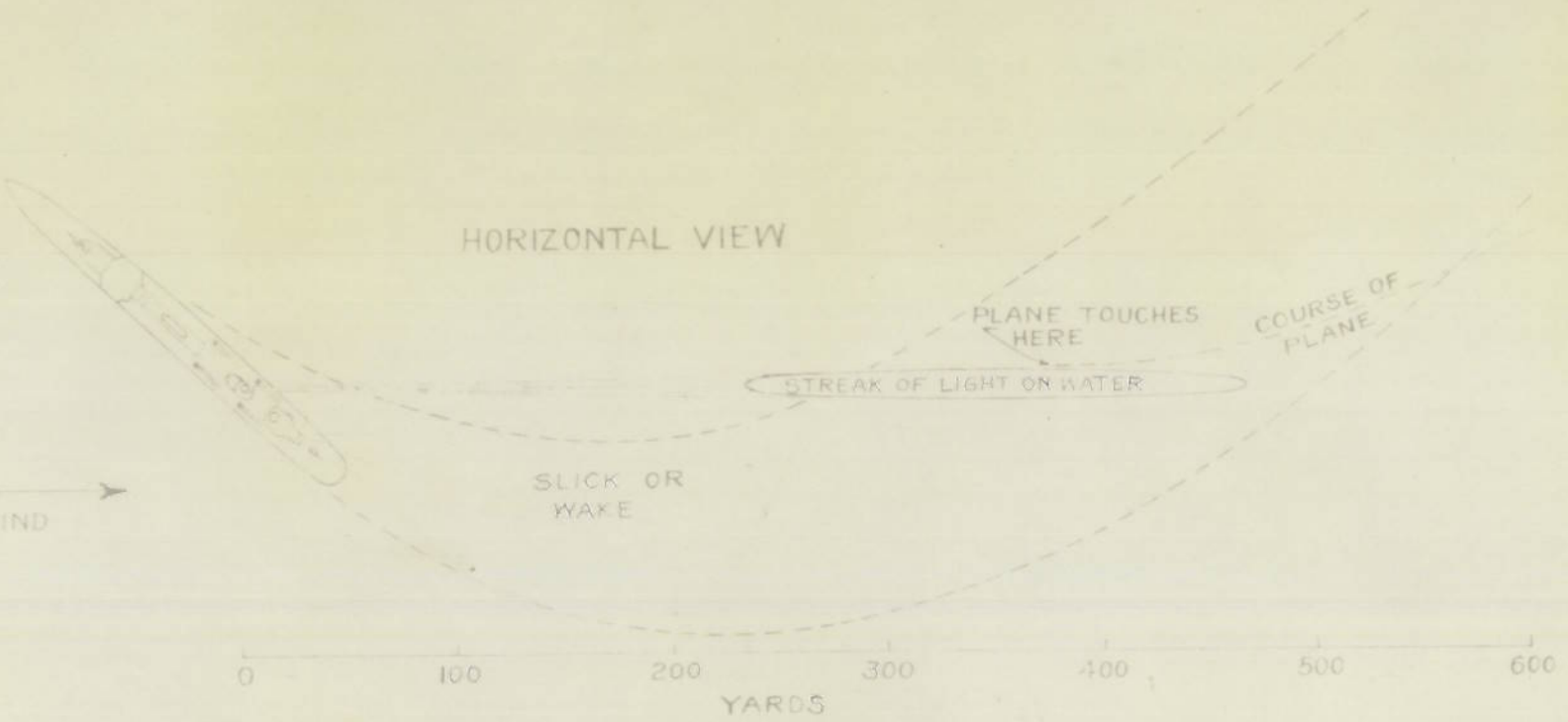
27. Further, it is thought that this method of illumination may well be employed for night landings of all seaplanes. In sheltered anchorages and harbors the approach could be made away from the source of light and down the beam. It is believed that the narrow beam method of illumination combined with the near-parallel shadow area approach is superior to the flood light illumination for night landings of seaplanes.

28. It is again recommended that the approach required for landing in the slick and toward the parent vessel's searchlight be practiced on land in landplanes or in sheltered waters prior to attempting this night maneuver in the open sea; and that all pilots be required to check out in this phase of training before operating from vessels at sea at night.

29. The SOC-2 seaplane possesses such excellent landing qualities for this type of work that it is thought the confidential nature of its construction should be carefully guarded.

J.G. Crommelin,
Lieutenant, USN.





NIGHT LANDING SITUATION

PLATE I

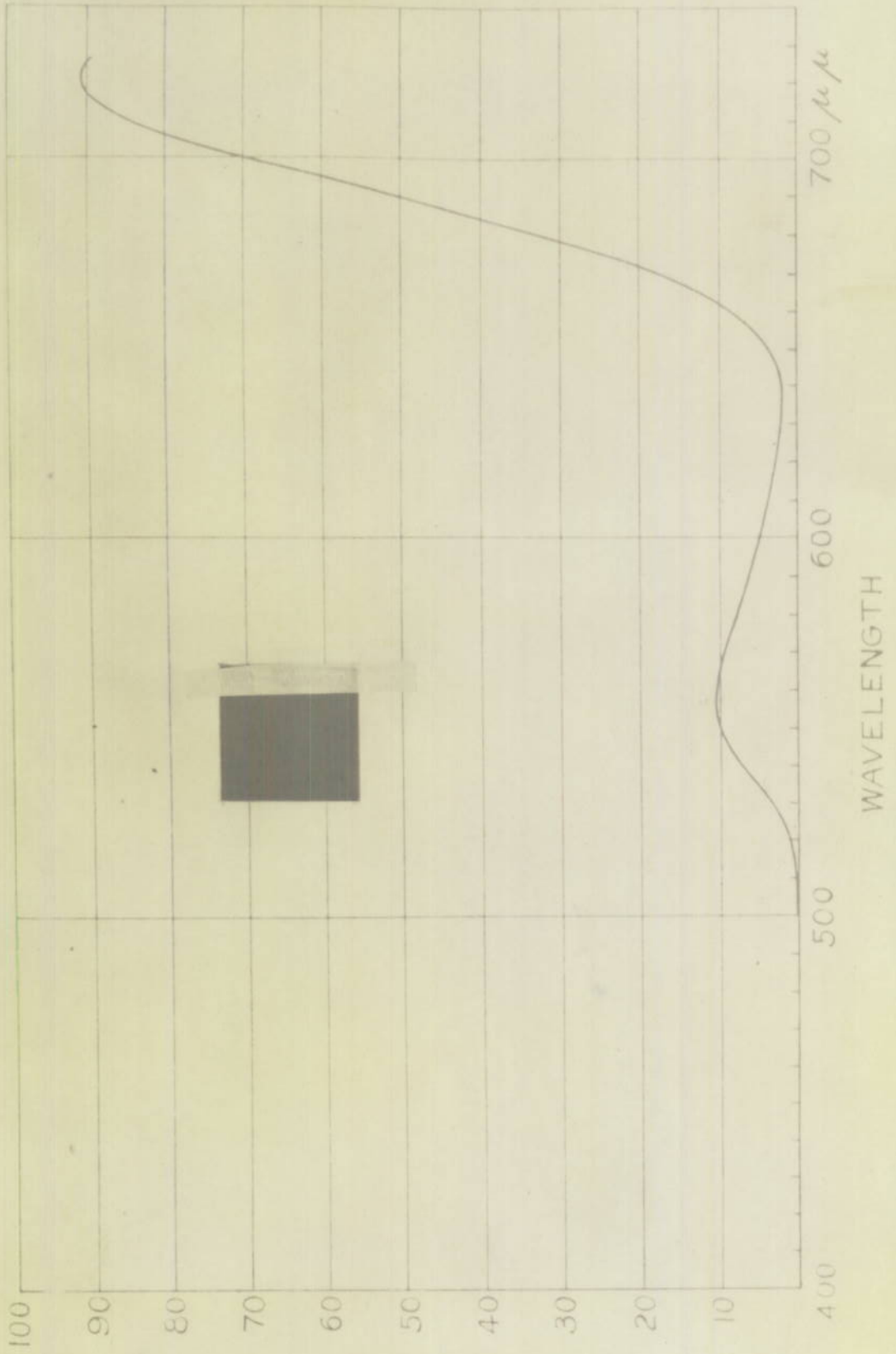


PLATE 2