

OBJECTIVE AND METHODOLOGY

- 1 The objective of the research project was "To obtain an objective, independent expert opinion on the colour vision standards appropriate for UK seafarers and a recommended method of testing".
- 2 The study consisted of a literature review and an assessment of current colour vision examination methods employed by the Marine Safety Agency. Visits were made to MSA offices which carry out colour vision examinations on appeal in Southampton, Glasgow and Aberdeen. No colour vision examinations had been carried out at the fourth location, in Newcastle, during the 12 months prior to the investigation and this office was not visited. A review was made of 129 records held in Aberdeen which gave details of results obtained with the Holmes - Wright lantern (Type B). A visit was made to the medical department at HM Dockyard at Portsmouth to discuss the colour vision requirements and examination procedures used by the Royal Fleet Auxilliary.
- 3 Letters seeking information about colour vision advice given to students were sent to 15 Colleges in the United Kingdom which provide training courses for seafarers.
- 4 Colour recognition needed by seafarers in the deck and other departments was assessed on voyages by passenger ferry between Southampton and Cowes at night and between Portsmouth and Cherbourg by night and during the day.

SUMMARY OF REPORT

- 5 Colour vision examination methods used by the Merchant Navy since 1900 are reviewed in this report. Particular emphasis has been given to lantern tests to determine the relevance of this test to the modern marine service. A recent review of colour vision standards for transport by the Committee Internationale d'Eclairage (CIE) (1996) continues to recommend that masters, mates, coxswains and navigational watchkeepers should have normal colour vision. The report by the International Maritime Organisation (IMO)(1990) suggests that pseudoisochromatic plate tests have replaced lanterns for meeting this standard. The Ishihara plates is the test of choice. However, lanterns are often given as a second test or on appeal. Holmes - Wright lanterns Type A and B, the Farnsworth lantern and the Beyne lantern are all used in IMO member countries at the present time. Other lanterns are in service in Canada and in Japan. Although new Holmes - Wright lanterns are not available to purchase, the MSA has maintained satisfactory maintenance and existing lanterns should give good service for the foreseeable future.
- 6 The current colour vision testing procedure employed by the MSA for the deck department is similar to that in other IMO member countries but changes in the way test results are interpreted are recommended.
- 7 The CIE (1996) recommends that ship's engineers and associated personnel should be "defective colour vision safe". The report is equivocal about appropriate testing methods. There is lack of uniformity in IMO member states. The current tests for Engineers and Radio/Electrician Officers used by the MSA are unreliable and unsatisfactory. The Farnsworth D15 test is recommended as a replacement because there is good evidence that colour deficient people who pass the D15, without error, are able to work safely with

industrial and electrical colour codes. The D15 is currently used to select British firefighters and deck officers in European inland waterways. The City University test is recommended as an alternative if the D15 test is not available. In the absence of either, the Ishihara plates may be used as a screening test.

- 8 Consideration has been given to the option of colour vision examinations being done by optometrists or marine colleges. Optometrists are experienced in colour vision examinations but the level of expertise varies. Marine colleges have no experience of colour vision testing and are unwilling to take on this function. In consequence it is recommended that approved doctors should remain responsible for colour vision examination with the Ishihara plates and, where necessary, with the Farnsworth D15 or City University test. Referral can be made by an approved doctor to an optometrist for an examination with the City University test if necessary. Clear instructions must be given on test administration and interpretation of the results.
- 9 Different types of congenital red - green colour deficiency are described in Appendix 1. Appendix 2 gives details of clinical colour vision tests and recommended examination methods. Marine colour codes are listed in Appendix 3 and possible colour confusions by colour deficient people are discussed in Appendix 4.

Summary of Colour Vision Requirements

Deck Department

- 10 It is recommended that new entrants and in-service members of the deck department should have normal colour vision and that the method of examination should be the same for all age groups. Normal colour vision is shown by the ability to pass the Ishihara plates or by no errors on the Holmes-Wright Type B lantern on appeal. A lantern test on appeal is clearly justified because the visual task reproduces signal recognition at sea and testing with Ishihara plates may fail some candidates whose colour vision is adequate to satisfy safety needs.

Engineers / Radio Officers / Electrician Officers

- 11 New recruits and in-service members of the engine-room or radio departments should not have significant colour deficiency. The test of choice is the Farnsworth D15 test or, if this test is not available, the City University test. If neither is available, the Ishihara plates may be used as a screening test, with the Farnsworth D15 or City University only for candidates who fail the Ishihara plates.

Other Departments

- 12 There is no colour vision requirement for other departments such as catering or purser and no colour vision requirement for deckhands. However, it is recommended that all deckhands should be made aware that colour deficiency is a bar to career advancement when they join the marine service.

Recommended Amendments to Colour Vision Examination Procedures

13 Modifications to the present colour vision examination methods are recommended as shown in Table 1.

Table 1 : Summary of Recommendations for colour vision standards and tests

CATEGORY OF SEAFARER	RECOMMENDED TEST	RECOMMENDED STANDARD
1) Deck department (including new entrants and serving seafarers)	Initial : Ishihara plates Confirmatory test : Holmes-Wright B lantern	Normal red-green colour vision. 3 errors or fewer on the 16 Transformation and Vanishing plates of the 38 plate test OR 2 errors or fewer on the 12 Transformation and Vanishing plates of the 24 plate test. Correct recognition of signal lights. Correct recognition of all single and paired red, green and white lights after dark adaptation at simulated distances of two or one mile(s).
2) Engineers / Radio Officers / Electrician Officers	Initial : Farnsworth D15 or City University test or Ishihara plates Confirmatory : Farnsworth D15 or City University Test	No error in colour ordering and no significant colour confusion. No error on either the D15 or the City University test. For the Ishihara plates, normal red - green colour vision, 3 errors or fewer on the 16 Transformation and Vanishing plates of the 38 plate test OR 2 errors or fewer on the 12 Transformation and Vanishing plates of the 24 plate test. No error in colour ordering and no significant error colour confusion. No error on either test.
3) Others - Catering department, Purser etc	No colour vision requirement	

14 **Ishihara plates:** The Introductory plate followed by all the Transformation and Vanishing plates of the Ishihara test should be used for colour vision screening. There are 16 Transformation and Vanishing plates in the 38 plate Ishihara test and 12 Transformation and Vanishing plates in the 24 plate test. A pass is three mistakes, or fewer, on the 38 plate test and 2 mistakes, or fewer, on the 24 plate test. Failure is six errors on the 38 plate test and 5 errors on the 24 plate test. The candidate is re-examined if more than three and fewer than 6 errors are made (more than two and fewer than 5 on the 24 plate test). More than three errors on re-examination is a fail (more than two on the 24 plate test).

- 15 **The Holmes-Wright Lantern Type B:** The Holmes-Wright lantern (Type B) should be given on appeal to candidates for the deck department who fail the Ishihara test. The minimum period of dark adaptation, in a room from which all light is excluded, is 10 minutes. Fifteen minutes dark adaptation is preferred. The present examination procedure should be continued. After explanation of the visual task and the colour names allowed, one sequence of 9 colours is shown at large aperture and 5 sequences of paired colours at small aperture. It is recommended that permitting errors on three specific colour pairs is discontinued and that any error naming a single colour or any colour in a colour pair is failure of the test. For deck officers the test should continue to be carried out at an effective viewing distance of 2 miles (viewing at 6m) or at 1 mile (viewing at 3m) for boatmasters as in the present regulations.
- 16 **The Modified Colour Test and Trade Test:** These tests are used for engine room and radio department personnel. Neither the Modified Colour test card nor the Holmgren wool test are satisfactory. Unspecified trade tests, consisting of naming or matching electrical components, are also unsatisfactory. It is recommended that these tests are replaced by the Farnsworth D15 test. A single error is failure of the test. If the D15 test is not available the City University test can be used as an alternative. A single error is failure of either test. If neither is available, the Ishihara plates may be used as an initial screening test.
- 17 **Test Location:** An internal room with black walls is not required for colour vision testing. However, facilities for excluding all light are needed if a lantern test is to be given. Natural north sky illumination or an equivalent artificial illuminant is needed for tests composed with pigment colours. Reliance on natural day light restricts colour vision testing in winter months. The Crompton craft light is not a satisfactory illuminant. The use of daylight fluorescent illumination or a dedicated north sky illuminant, such as the MacBeth SolSource, is recommended. Daylight fluorescent sources, such as Colorite lamps, are used in most ophthalmic and medical consulting rooms and are satisfactory for colour vision testing.