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Signed Richard E. Reedy
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SUPPLEMENT TO
TECHNICAL BULLETIN # 53-7
RESEARCH REPORT
BUREAU OF NAVAL PERSONNEL
PERSONNEL ANALYSIS DIVISION

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SUPPLEMENT TO THE
FINAL REPORT
of
RESEARCH PROJECT N7onr-39423, NR 152 129
THE DEVELOPMENT AND EVALUATION OF A METHODOLOGY FOR
ESTABLISHING VISUAL REQUIREMENTS FOR NAVAL PERSONNEL

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In accordance with instructions of the Bureau of Naval Personnel, the following conclusion based on the research conducted on Navy Contract N7onr-39423, which is reported in "Technical Bulletin 53-7" (3), is included in this supplement. Conclusion No. 5.

Also outside the realm of this program of research but of considerable interest are the implications of the results for selection and placement of personnel. Results of the dial reading tasks used in Phase III and Phase IV of the research, indicated that with every increment in near-visual acuity there is some increment in performance. This means that with increments in near-visual acuity above the so-called normal, or 20/20, (Armed Forces Vision Tester Score of 9), level of acuity, the efficiency of performance was increased. This leads to the conclusion that the efficiency of performance on highly critical tasks might be improved by rigid visual requirements for those jobs. However, further research is recommended concerning this possibility before a definite conclusion is made.

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Further, at the suggestion of the Bureau of Naval Personnel the following discussion concerning specific findings with respect to which types of dials are best or poorest in terms of time and accuracy of performance are also included in this supplement. This recommendation resulted from conclusion No. 4 reported in "Technical Bulletin No. 53-7"(1). The conclusion was reported as follows:

"Although not within the realm of this study, the results of the program of research conducted appear to have implications for equipment design. The results of Phase III clearly indicate that certain types of dials are read faster and more accurately at all levels of visual acuity than other types of dials. These results warrant the conclusion that operators with poorer visual acuity could perform at a given level of proficiency on certain dials as well as, or better than, operators with better acuity could perform on other types of dials. Further, the efficiency of operators at all levels of acuity would be increased by the use of certain types of dials".

In discussing specific findings concerning the different types of dials it must be emphasized that the task in the job-sample test utilized required the subject to give a precise quantitative reading of the numerical value on the dial being read. Further, the factors affecting dial reading performance must be considered. In the type of task presented to the subjects in the job-sample test, two factors appeared to have an important effect upon performance: (1) the visual discrimination required; and (2) the amount of interpretation required in giving an exact reading. It is quite likely that the effect of these factors on performance would be quite different in a different dial reading task, i.e. check reading and/or qualitative indications from the dials.

The ten visual tasks in the job-sample test consisted of nine dials and one counter. The counter utilized is shown in Figure 1, the counter labeled Fuze Seconds being the one used. Four of the dials utilized in the job-sample test are shown in Figure 2. These four dials are considered as covering the range of complexity of the dials used.

In terms of accuracy and speed of response to the visual task (dial), the counter was far superior at all levels of vision. (See Figures 4 and 5). In interpreting these results the fact that a precise quantitative reading was required is emphasized. The results would not necessarily be the same if the task has been one of check reading the instruments, or if the task had been one of obtaining a qualitative indication from the dials. Further, analysis of the dials in the job-sample test showed that the more complex the dial in terms of the amount of interpretation required, the greater the decrease in both speed and accuracy of performance.

In summarizing the specific findings, it might be stated that the findings pertaining to dial design substantiates the findings of research reported elsewhere (1,2)¹. It is further felt that a research program, designed specifically to study dial design, would be necessary to provide a basis for suggestions for changes in dial design in order to improve upon accuracy and speed of performance on dial reading tasks under operating conditions.

1. These references also contain excellent bibliographies of research findings pertaining directly to dial design.

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2. Kappauf, W. E. Design of instrument dials for maximum legibility. Part V. Origin location, scale break, number location, and contrast direction. AF Technical Report, No. 6366, United States Air Force, Wright Air Development Center, Wright-Patterson Air Force Base, Dayton, Ohio, May 1951.
3. Tiffin, J., Miller, G.K., and Chew, W.B. The development and evaluation of a methodology for establishing visual requirements for naval personnel. Technical Bulletin #53-7, Personnel Analysis Division, Bureau of Naval Personnel, 27 October 1953.

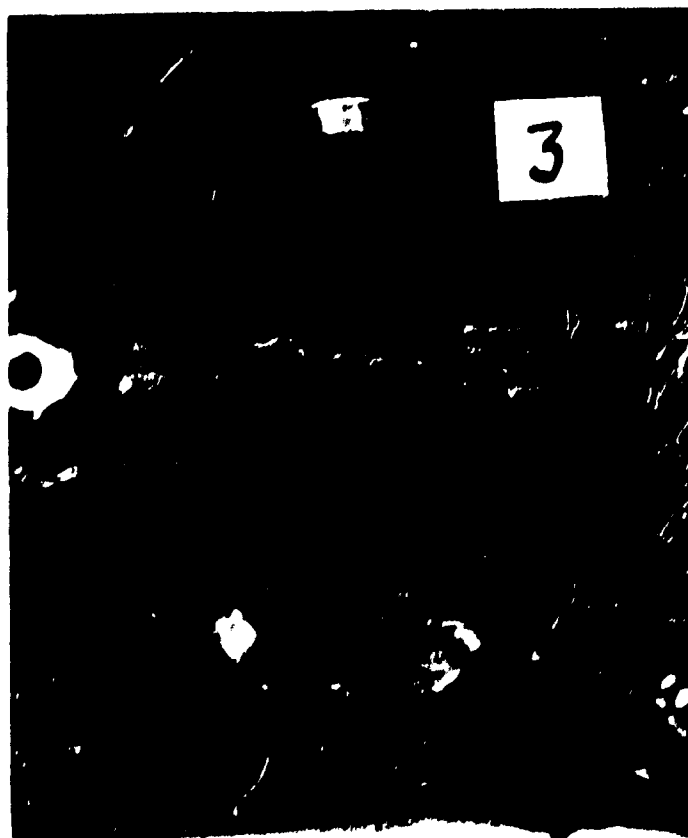


Fig. 1. Counters utilized in the job sample test. Performance on the counter labeled "Fuze Seconds" is shown in Figures 4 and 5 as Dial 2.



Fig. 2. Four dials utilized in the job-sample test. Performance on the large dial in the lower half of the figure is shown in Figures 4 and 5 as Dial 7. (See Fig. 3).

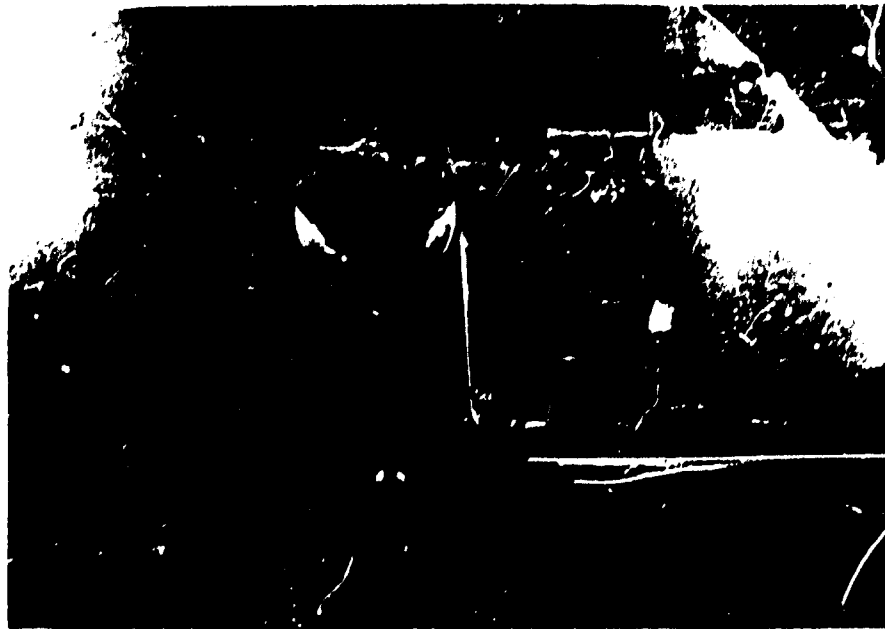


Fig. 3. Close-up view of dial of the same type as Dial 7. Performance in terms of speed and accuracy of performance, was poorer at all levels of vision on this type dial. (See Figures 4 and 5).

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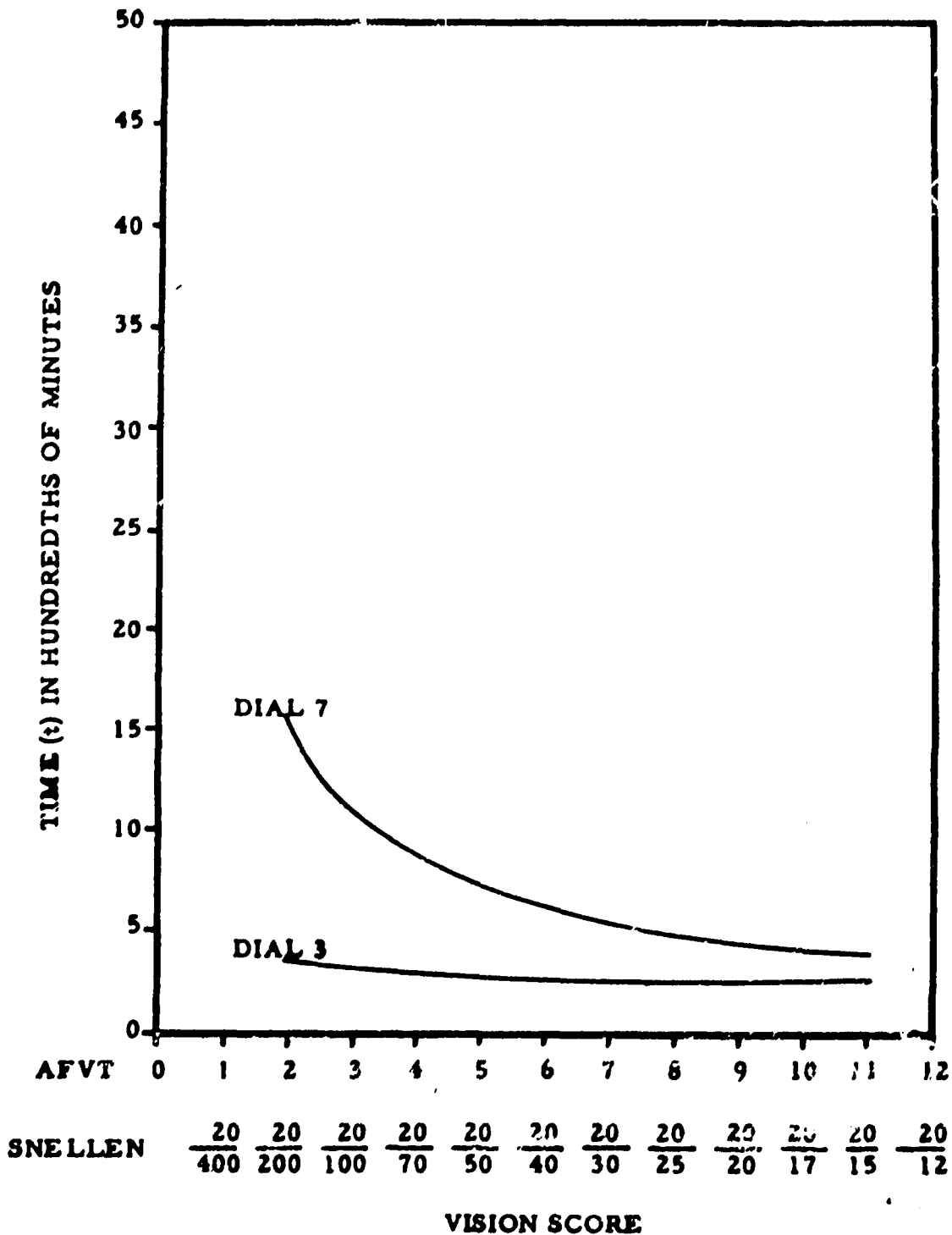


FIG. 4 . COMPARISON OF RELATIONSHIP BETWEEN BEST EYE NEAR VISUAL ACUITY SCORE ON ARMED FORCES VISION TESTER AND PERFORMANCE TIME ON DIALS 3 (EASIEST) AND 7 (MOST DIFFICULT).

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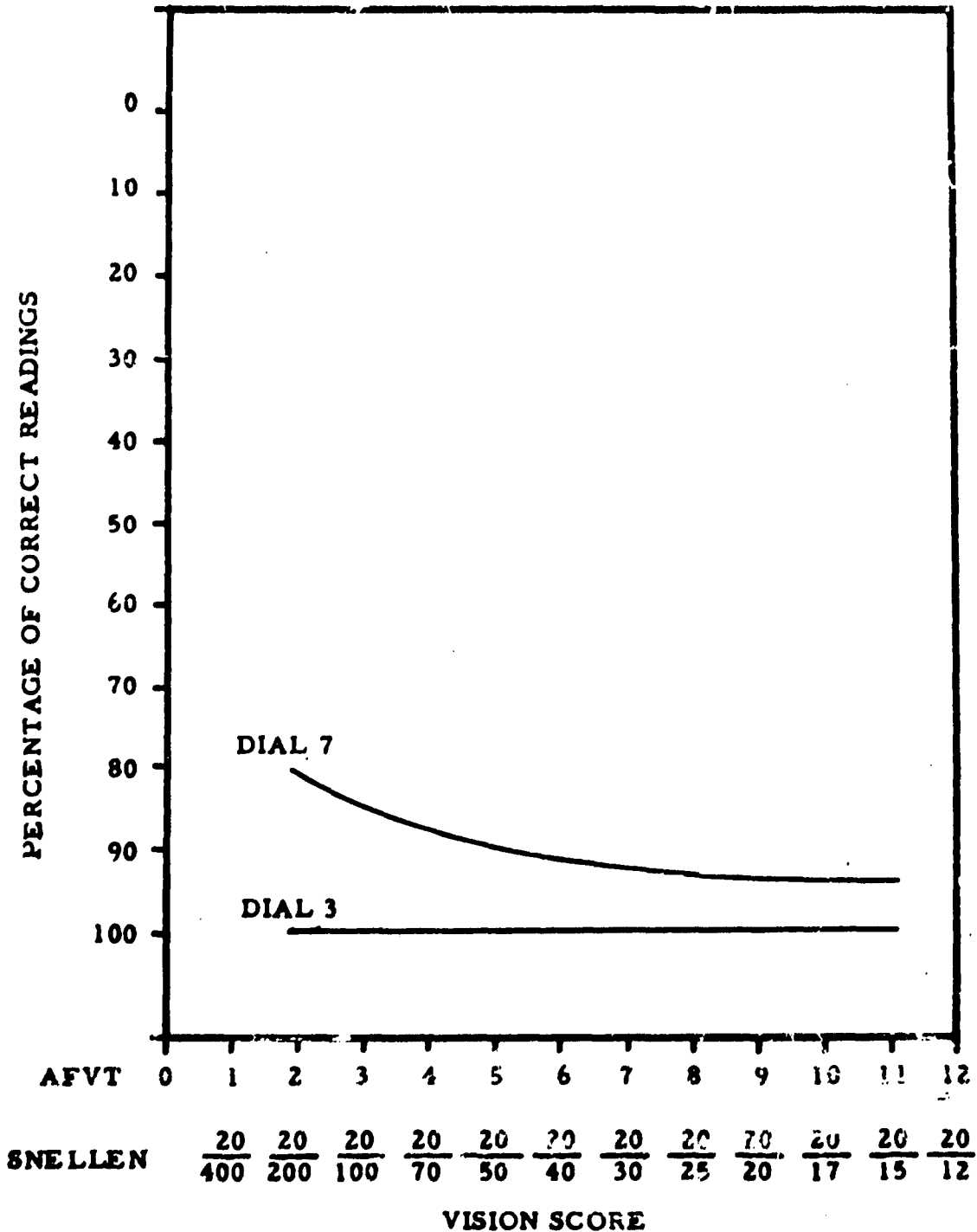


FIG. 5 . COMPARISON OF RELATIONSHIP BETWEEN BEST EYE NEAR VISUAL ACUITY SCORE ON ARMED FORCES VISION TESTER AND PERCENTAGE OF CORRECT READINGS ON DIALS 3 (EASIEST) AND 7 (MOST DIFFICULT).

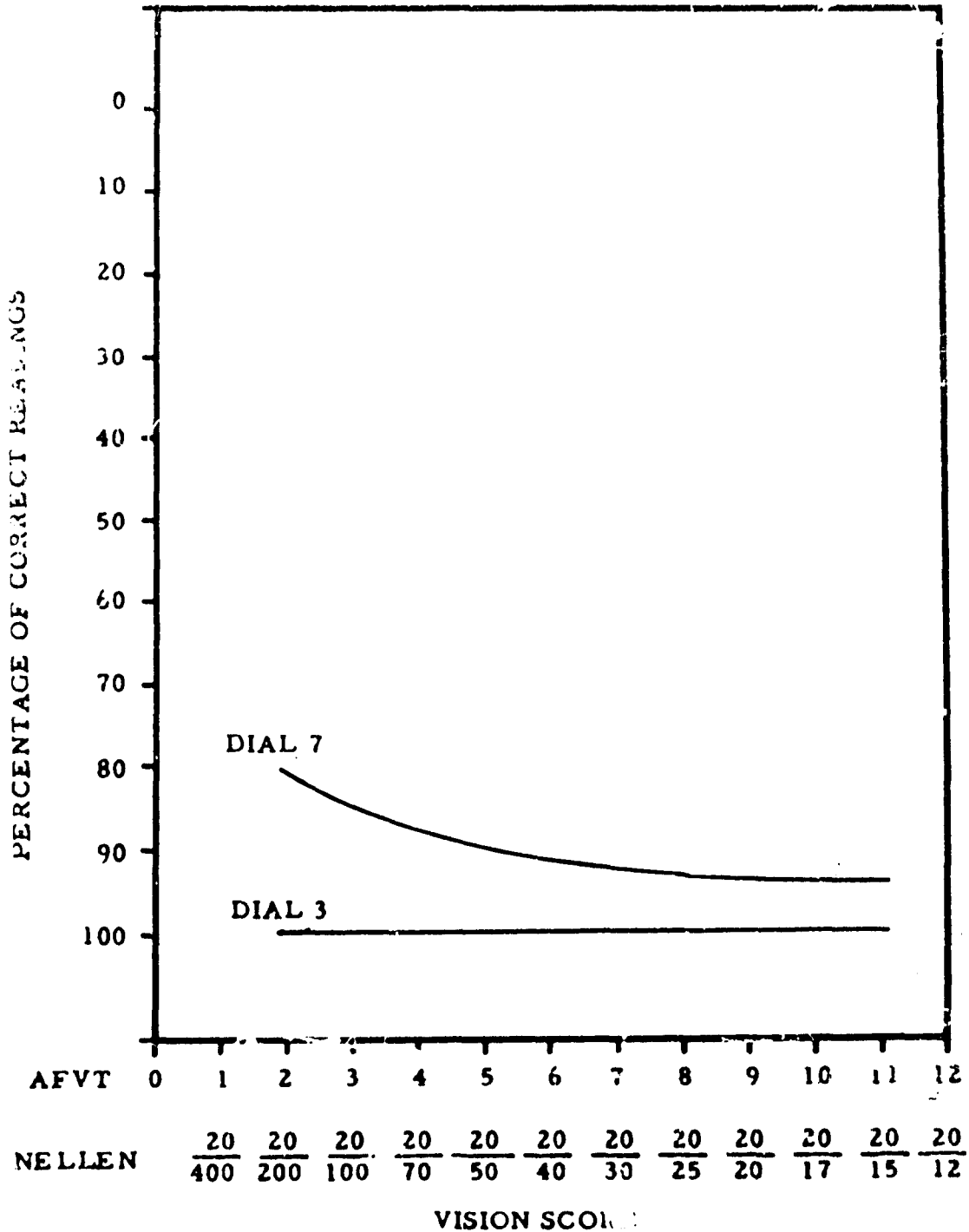


FIG. 5 . COMPARISON OF RELATIONSHIP BETWEEN BEST EYE NEAR VISUAL ACUITY SCORE ON ARMED FORCES VISION TESTER AND PERCENTAGE OF CORRECT READINGS ON DIAIS 3 (EASIEST) AND 7 (MOST DIFFICULT).