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ABSTRACT

The United States Training and Employment Service General Aptitude Test Battery (GATB), first published in 1947, has been included in a continuing program of research to validate the tests against success in many different occupations. The GATB consists of 12 tests which measure nine aptitudes: General Learning Ability; Verbal Aptitude; Numerical Aptitude; Spatial Aptitude; Form Perception; Clerical Perception; Motor Coordination; Finger Dexterity; and Manual Dexterity. The aptitude scores are standard scores with 100 as the average for the general working population, and a standard deviation of 20. Occupational norms are established in terms of minimum qualifying scores for each of the significant aptitude measures which, when combined, predict job performance. Cutting scores are set only for those aptitudes which aid in predicting the performance of the job duties of the experimental sample. The GATB norms described are appropriate only for jobs with content similar to that shown in the job description presented in this report. A description of the validation sample is included. (AG)

FINAL REPORT

# TECHNICAL REPORT

# ON

# STANDARDIZATION OF THE GENERAL APTITUDE TEST BATTERY

# FOR

# CEMENTER 8-57.51

B-347

S-94







U. S. Employment Service in
Cooperation with
Florida State Employment Service

U. S. DEPARTMENT OF LABOR
Bureau of Employment Security
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# STANDARDIZATION OF THE GENERAL APTITUDE TEST BATTERY FOR CEMENTER 8-57.51

B-347 S-94

## Summary

The General Aptitude Test Battery, B-1002A, was administered to 62 women applicants who were later employed as Cementers by Patton Rubber Company, Inc., Lake Worth, Florida. The tests were administered during the period from March 15, 1955 through May 26, 1955. Four Cementers were eliminated from the sample because they did not remain on the job long enough to be validly rated. Two more workers were eliminated from the sample because of physical limitations. The final experimental sample consisted of 56 Cementers. All Cementers were tested prior to beginning work and in no cases were test results known to supervisors or anyone dealing with hiring. Supervisory ratings were used as the criterion for this sample. On the basis of the statistical and qualitative analyses, Aptitudes P-Form Perception, F-Finger Dexterity and M-Manual Dexterity were selected for inclusion in the test norms.

## GATB Norms for Cementer 8-57.51 - B-347 S-94

Table I shows, for B-1001 and B-1002, the minimum acceptable score for each aptitude included in the test norms for Cementer 8-57.51.

TABLE I

Minimum Acceptable Scores on B-1001 and B-1002 for B-347 S-94

| B-1001 | | | B-1002 | | |
|---|---|---|---|---|---|
| Aptitude | Tests | Minimum Acceptable Aptitude Score | Aptitude | Tests | Minimum Acceptable Aptitude Score |
| P | CB-1-A<br>CB-1-L | 75 | P | Part 5<br>Part 7 | 75 |
| F | CB-1-O<br>CB-1-P | 85 | F | Part 11<br>Part 12 | 80 |
| M | CB-1-M<br>CB-1-N | 70 | M | Part 9<br>Part 10 | 70 |

## Effectiveness of Norms

The data in Table IV indicate that 10 of the 16 poor workers, or 62 percent of them, did not achieve the minimum scores established as cutting scores on the recommended test norms. This shows that 62 percent of the poor workers would not have been hired if the recommended test norms had been used in the selection process. Moreover, 36 of the 42 workers who made qualifying test scores, or 86 percent, were good workers.

TECHNICAL REPORT

## I. Problem

This study was conducted to determine the best combination of aptitudes and minimum scores to be used as norms on the GATB for the occupation of Cementer 8-57.51.

## II. Sample

During the period of March 15, 1955 through May 26, 1955, 62 women applicants who were later employed as Cementers by Patton Rubber Company, Inc., Lake Worth, Florida, were tested with the GATB, B-1002A. Four of these were eliminated from the sample because they did not remain on the job long enough to be validly rated by their supervisor. Two others were eliminated from the sample because of physical limitations, one was nearsighted, the other was not tall enough to work efficiently on the standard tables used in the plant. The final sample consisted of 56 Cementers.

The company requires that applicants be between the ages of 20 and 45 to be considered for employment as a Cementer. An exception to this requirement was made in the case of one woman 4[illegible] years old, who was hired because she appeared to be exceptionally capable. There were no minimum education requirements although high school graduates were preferred. Experience was not required since Cementer is a new job in the area.

The plant superintendent and other supervisors agreed that the amount of training required on the job was less than a week; therefore, employees who had worked one week, or more, were used in the sample.

Table II shows the means, standard deviations, ranges, and Pearson product-moment correlations (corrected for broad categories) with the criterion for age, education and experience.

TABLE II

Means (M), Standard Deviations ($\sigma$), Ranges, and Pearson Product-Moment Correlations (Corrected for Broad Categories) with the Criterion ($c_r$) for Age, Education and Experience

Cementer 8-57.51

N = 56

| | M | $\sigma$ | Range | $c_r$ |
|---|---|---|---|---|
| Age (years) | 32.7 | 7.6 | 20 - 48 | -.226 |
| Education (years) | 10.5 | 1.8 | 6 - 14 | .069 |
| Experience (months) | 2.1 | 1.5 | 1 - 5 | .452* |

* Significant at the .01 level

The correlations between age and the criterion and education and the criterion are not significant. The correlation between experience and the criterion is significant at the .01 level, indicating that those Cementers with more experience tend to be better workers and/or that the supervisor who made the ratings tended to be biased in favor of workers with more experience. In this connection, it should be noted that only 11 of the original sample of 56 were working as Cementers at the time the ratings were made (the remaining 45 workers had left the job for various reasons, but the superintendent was familiar enough with the performance of these workers to rate them). Of these, 10 were rated as "satisfactory workers" and only one was rated as a "poor worker."

The data in Table II indicate that the sample is suitable for test development purposes with respect to age, education, and experience.

## III. Job Description

Job Title: Cementer 8-57.51

Job Summary: Cements and joins rubber-coated fabrics used in the construction of life rafts. Cleans the edges of two pieces of fabric to be joined, using cleaning fluid and cheesecloth. Applies a light coat of cement to the edges of both pieces of fabric. Applies another coat of cement after first coat dries. (A total of two light coats and two heavy coats are usually applied.) Allows the cement to dry to proper consistency as judged by eyesight or by testing cement with finger. Joins pieces of fabric by overlapping them to a pre-marked line. Applies pressure to overlapped parts, using a hand roller. Removes air bubbles and finger-shaped air pockets on the curved edges, using hand stitcher to insure proper adhesion. Continues this operation, joining pieces together in the proper manner until the raft is completed.

## IV. Experimental Battery

All of the tests of the GATB, B-1002A, were administered to the sample group.

## V. Criterion

The criterion consisted of the plant superintendent's ratings. Possibilities of obtaining a more objective criterion were thoroughly explored, but this was not feasible. The plant superintendent was instructed not to be influenced by a worker's longevity of service, personality, and other characteristics obviously not measurable with the GATB. He was asked to rate all workers in the sample on the basis of how quickly they were able to learn the work from the standpoint of both quality and quantity.

The experimental design was set up so that supervisory ratings would be used and expressed in terms of "good workers," "average workers," and "poor workers." The plant superintendent felt that without some objective method of measuring job performance, which was impractical to establish, he would only be able to rate work performance in the three broad categories as stated above. At the actual time ratings were made, the superintendent still felt that he could not rate one Cementer over another Cementer within the broad categories.

Two separate ratings were made by the superintendent in August 1955. The second ratings were made two weeks after the first ratings. The second ratings showed no deviation from the first ratings.

Ratings from other supervisors were not obtained since there were no other supervisors in the plant who knew enough about the work performance of all the Cementers in the sample to make valid ratings. Since the study ran over several months, some Cementers had left the job for various reasons and only the plant superintendent, who kept notes on the quantity and quality of work performed, was familiar enough with these workers to rate them validly.

The number of workers classified into each category and the quantitative score corresponding to each category, computed for purposes of the statistical analysis, are shown below:

| Category | N | Quantitative Score |
|---|---|---|
| Good | 20 | 60 |
| Average | 20 | 49 |
| Poor | 16 | 38 |

## VI. Statistical and Qualitative Analysis

Table III shows the means, standard deviations and Pearson product-moment correlations (corrected for broad categories) with the criterion for the aptitudes of the GATB. The means and standard deviations of the aptitudes are comparable to general working population norms with a mean of 100 and a standard deviation of 20.

TABLE III

Means (M), Standard Deviations ($\sigma$), and Pearson Produce-Moment Correlations (Corrected for Broad Categories) with the Criterion ($c_r$) for the Aptitudes of the GATB

Cementer 8-57.51

N = 56

| Aptitude | M | $\sigma$ | $c_r$ |
|---|---|---|---|
| G-Intelligence | 91.5 | 15.8 | .380** |
| V-Verbal Aptitude | 93.8 | 16.0 | .361** |
| N-Numerical Aptitude | 87.3 | 18.6 | .288* |
| S-Spatial Aptitude | 93.9 | 16.2 | .469** |
| P-Form Perception | 96.8 | 20.2 | .460** |
| Q-Clerical Perception | 94.9 | 15.5 | .342** |
| K-Motor Coordination | 99.1 | 19.0 | .328* |
| F-Finger Dexterity | 102.3 | 19.4 | .310* |
| M-Manual Dexterity | 95.2 | 19.8 | .140 |

* Significant at the .05 level
** Significant at the .01 level

The statistical results were interpreted in the light of the job analysis data. The job analysis indicated that the following aptitudes measured by the GATB appear to be important for this occupation:

Form Perception (P) - required to line up rubber fabrics accurately, to see air bubbles or other minor flaws where rubber fabrics have been joined, and to remedy these flaws quickly to insure proper adhesion.

Finger Dexterity (F) - required to make accurate and rapid movements with fingers to join pieces of rubber fabric together properly.

Manual Dexterity (M) - required to move the hands and arms easily and skillfully in handling the life rafts especially after three or four joints have been cemented together.

The data in Table III show that (1) the highest mean scores in decreasing order of magnitude were obtained for Aptitudes F, K and P, respectively; (2) Aptitudes G, V, S, P and Q have correlations significant at the .01 level with the criterion; and (3) Aptitudes N, K and F have correlations significant at the .05 level with the criterion.

On the basis of the above statistical and qualitative evidence, Aptitudes G, S, P, K, F and M were considered further for inclusion in the norms. Aptitudes P and F appear important from the qualitative analysis of the job, have relatively high mean scores and significant correlations with the criterion. Aptitudes G and S have significant correlations with the criterion. Aptitude K has a relatively high mean score and a significant correlation with the criterion. Aptitude M does not have a high mean or a significant correlation with the criterion, but this aptitude appears essential for successful job performance from a qualitative standpoint. It was on this basis that Aptitude M was also selected for tryout in the norms.

Tetrachoric correlations with the dichotomized criterion were computed for several sets of trial norms consisting of various combinations of Aptitudes G, S, P, K, F and M and appropriate cutting scores. The best selective efficiency was obtained with a combination of Aptitudes P, F and M. Therefore these three aptitudes were selected for inclusion in the test norms.

The cutting score for Aptitude P was set at one standard deviation below the aptitude mean and rounded to the nearest five-point score level. The cutting scores for Aptitudes F and M were each set at the lower five-point score level adjacent to one standard deviation below the aptitude mean. Setting cutting scores at these levels yielded the best selective efficiency for the norms and resulted in cutting scores of 75, 80 and 70 for Aptitudes P, F and M, respectively.

Although Aptitudes V, N and Q each have significant correlations with the criterion, these aptitudes do not have high means nor do they appear important enough from the qualitative analysis to warrant further consideration for inclusion in the test norms. Therefore, these aptitudes were not selected for tryout in the norms.

## VII. Predictive Validity of Norms

For the purpose of computing the tetrachoric correlation coefficient between the test norms and the criterion and applying the Chi Square test, the criterion was dichotomized with those workers who were rated as "good" and "average" in job performance placed in the high criterion group. Those workers who were rated as "poor" were placed in the low criterion group.

Table IV shows the relationship between test norms consisting of Aptitudes P, F and M with critical scores of 75, 80 and 70, respectively, and the criterion for Cementer. Workers in the high criterion group have been designated as "good workers" and those in the low criterion group as "poor workers."

TABLE IV

Relationship between Test Norms Consisting of Aptitudes P, F and M with Critical Scores of 75, 80 and 70, Respectively, and the Criterion for Cementer 8-57.51

N = 56

| | Non-Qualifying Test Scores | Qualifying Test Scores | Total |
|---|---|---|---|
| Good Workers | 4 | 36 | 40 |
| Poor Workers | 10 | 6 | 16 |
| Total | 14 | 42 | 56 |

$r_{tet} = .80$ $\quad X^2 = 14.117$

$\sigma_{r_{tet}} = .24$ $\quad P/2 < .0005$

The data in the above table indicate a high and significant relationship between the test norms and the criterion for this sample.

## VIII. Conclusions

On the basis of mean scores, correlations with the criterion, job analysis data and their combined selective efficiency, Aptitudes P, F and M with minimum scores of 75, 80 and 70, respectively, are recommended as B-1002 norms for the occupation of Cementer 8-57.51. The equivalent B-1001 norms consist of P-75, F-85 and M-70.

## IX. Determination of Occupational Aptitude Pattern

If the specific test norms for an occupation include three aptitudes, only those occupational aptitude patterns which include the same three aptitudes with cutting scores that are within 10 points of the cutting scores established for the specific norms are considered for that occupation. OAP-16 is the only one of the existing 22 Occupational Aptitude Patterns that meets these criteria for this study. The B-1002 norms for OAP-16 are P-75, F-80 and M-80. The selective efficiency of OAP-16 for this sample was determined by means of the tetrachoric correlation technique. A significant relationship was obtained between the OAP and the dichotomized criterion. A tetrachoric correlation of .70 with a standard error of .23 was obtained. The proportion of the sample screened out by OAP-16 was .34, which is within the required range of .10 to .60. Therefore, it is recommended that OAP-16 be used in counseling for the occupation of Cementer 8-57.51.