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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 also included. (AG)

TECHNICAL REPORT

ON

STANDARDIZATION OF THE GENERAL APTITUDE TEST BATTERY

FOR

ELECTRONICS-UNIT ASSEMBLER (electronics) 6-98.014

BOAT LOADER B-439 - 726.884

(Supersedes B-248)

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

U. S. DEPARTMENT OF LABOR
Bureau of Employment Security
Washington 25, D. C.

August 1960

GATB #2276
October 1959

ELECTRONICS-UNIT ASSEMBLER 6-98.014

B-439

(Supersedes B-248)

Summary

The General Aptitude Test Battery, B-1002A, was administered to a sample of 63 female applicants who were later employed as Electronics-Unit Assemblers 6-98.014 at Westinghouse Electric Company, Youngwood, Pennsylvania. The criterion consisted of supervisory ratings based on a Descriptive Rating Scale. On the basis of mean scores, standard deviations, correlations with the criterion, job analysis data, and their combined selective efficiency, Aptitudes P-Form Perception, Q-Clerical Perception, and K-Motor Coordination were selected for inclusion in the test norms.

GATB Norms for Electronics-Unit Assembler 6-98.014 - B-439

Table I shows, for B-1001 and B-1002, the minimum acceptable score for each aptitude included in the test norms for Electronics-Unit Assembler 6-98.014.

TABLE I

Minimum Acceptable Scores on B-1001 and B-1002 for B-439

B-1001			B-1002		
Aptitude	Tests	Minimum Acceptable Aptitude Score	Aptitude	Tests	Minimum Acceptable Aptitude Score
P	CB-1-A CB-1-L	100	P	Part 5 Part 7	100
Q	CB-1-B	100	Q	Part 1	100
T	CB-1-G CB-1-K	105	K	Part 8	105

Effectiveness of Norms

The data in Table I indicate that 17 of the 22 poor workers, or 77 percent of them, did not achieve the minimum scores established as cutting scores on the recommended test norms. This shows that 77 percent of the poor workers would not have been hired if the recommended test norms had been used in the selection process. Moreover, 30 of the 35 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 General Aptitude Test Battery for the occupation of Electronics-Unit Assembler 6-98.014.

II. Sample

The GATB, B-1002A, was administered during the period September 1958 through January 1959 to 65 female applicants who were later employed as Electronics-Unit Assemblers 6-98.014 at Westinghouse Electric Company, Youngwood, Pennsylvania. Applicants were recruited through the local office of the Pennsylvania State Employment Service. The test scores were not considered in the referral process. The company required that applicants have at least an eighth grade education. No previous experience was required. All new workers were given on-the-job training by the assembly line supervisor. Training time for new workers was 30 days. All workers in the experimental sample had completed their training period and had at least 10 months of experience as an assembler.

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

TABLE II

Means (M), Standard Deviations (σ), Ranges, and Pearson Product-Moment Correlations with the Criterion (r) for Age, Education, and Experience

Electronics-Unit Assembler 6-98.014

N = 63

	M	σ	Range	r
Age (years)	23.1	7.6	18 - 46	-.174
Education (years)	11.6	1.1	8 - 14	.122
Experience (months)	10.4	.524	10 - 12	.178

There are no significant correlations with the criterion for age, education, or experience. The data in Table II indicate that this sample is suitable for test development purposes with respect to age, education, and experience.

III. Job Description

Job Summary: Assembles sub-miniature components, such as silicon discs, molybdenum discs, germanium discs, spherical pellets of indium, spherical pellets of germanium, flat metal pieces, wires, base rings and cells to produce such electronic devices as transistors and diodes. Uses vacuum pickups or tweezers to pick up minute parts and position them properly, in correct sequence, in fusion boats.

Work Performed: Prepares work station previous to actual assembly of units. Dons white nylon gloves. Inserts hands and arms through openings of a plastic housing in which the air is dehumidified to prevent contamination of the product. Removes covers from small shallow dishes of thin glass which are used as sterile containers for sub-miniature transitor components. Removes block of solid graphite from the cabinet in which the block was placed to remove specific amounts of moisture, and places block on table surface in position to receive components as they are assembled.

Picks up small round, flat metal piece with tweezers and positions it properly into depression or hole in top surface of block of solid graphite. Fills all of the holes in the boat with metal pieces before beginning next assembly operation.

Moves block of solid graphite under a pedestal-mounted type of reading-glass to more closely observe next assembly operation. Picks up flat paper-thin piece of germanium metal with tweezers and visually checks it under the reading-glass for such defects as cracks, dirt, and improper shape. Places approved disc into depression on face of metal piece, using reading-glass and vacuum pickup to assure proper alignment. Places cover on graphite block and attaches holding-clips to keep cover in place.

Places small shallow dish of extremely small spherical indium pellets under reading-glass. Picks up a pellet with tweezers and visually examines it under reading-glass to assure that it is round and free of burrs and pits. Places approved pellet into funnel-shaped opening on top surface of block of solid graphite and checks through reading-glass to assure that pellet passes through throat of opening. Places a pellet in each of the openings in the cover of the block of graphite. Places loaded block of graphite on conveyor belt to a hydrogen-fired oven, or furnace.

Lifts block of graphite off conveyor belt coming from the hydrogen-fired furnace and places it under reading-glass. Places small shallow dish containing pre-cut lengths of extremely fine wire under the reading-glass. Picks up a wire with tweezers and visually examines it under the reading-glass for such defects as bends or improper length. (Proper length is determined by comparing wire to scale on the reading-glass.) Places approved wire into funnel-shaped openings of the cover of the block of graphite with tweezers, assuring the lower end of wire makes contact with unit within the block of graphite. Places a wire in each of the openings in the cover of the block of graphite. Places the block of graphite on conveyor belt to a furnace in which assembled transistor components are soldered together by means of ohmic soldering.

Lifts block of graphite off conveyor belt coming from furnace used for soldering, and places it on table in front of assembler. Removes holding clips and lifts cover from the block of graphite. Turns graphite block upside-down to unload assembled units onto round paper disc. Picks up each unit with tweezers and examines it under reading-glass for such defects as dissolved pellets and unsoldered wires. Places approved units in small plastic box. Records fusion date and number of units in box on box cover. Records in logbook such information as graphite block number, crystal number, date and daily production total.

IV. Experimental Battery

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

V. Criterion

The final criterion consisted of ratings based on the Descriptive Rating Scale developed by the Bureau of Employment Security, Form SP-21. The shop foreman made rank order ratings on October 2, 1959 and descriptive rating scale ratings on October 9, 1959. The rank order ratings were converted to linear scores. A Pearson product-moment correlation of .85 was obtained between the two sets of ratings. The descriptive rating scale ratings were used as the final criterion for validation purposes because the descriptive rating scale is a finer measure of the various aspects of job performance than the rank order ratings criterion. The possible range of the criterion scores was from 9 to 45. The actual range was 11 to 43 with a mean score of 27.7 and a standard deviation of 6.6.

VI. Qualitative and Quantitative Analyses

A. Qualitative Analysis:

The job analysis indicated that the following aptitudes measured by the GATB appear to be important for this occupation.

Form Perception (P) - required to visually check germanium discs for cracks, dirt and improper shape; inspection of pellets and wires; and to examine units for defects such as dissolved pellets and unsoldered leads.

Motor Coordination (K), and Finger Dexterity (F) - required to pick up germanium discs with tweezers; pick up pellets with tweezers and to place pellets into opening on top surface of boat cover.

On the basis of the job analysis data, Aptitudes V and N were considered obviously unimportant for performing the duties of this job and were considered "irrelevant" aptitudes.

B. Quantitative Analysis:

Table III shows the means, standard deviations, and Pearson product-moment correlations 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 (σ), and Pearson Product-Moment Correlations with the Criterion (r) for the Aptitudes of the GATB

Electronics-Unit Assembler 6-98.014

N = 63

Aptitudes	M	σ	r
G-Intelligence	100.2	10.6	.339**
V-Verbal Aptitude	100.0	12.3	.235
N-Numerical Aptitude	102.9	13.9	.351**
S-Spatial Aptitude	98.6	13.6	.154
P-Form Perception	109.8	12.4	.287*
Q-Clerical Perception	117.5	13.9	.266*
K-Motor Coordination	113.9	14.3	.261*
F-Finger Dexterity	104.3	15.7	.273*
M-Manual Dexterity	102.7	17.2	.181

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

Aptitudes P, Q, and K have the highest mean scores and aptitudes G, V, S, and P have relatively low standard deviations.

For a sample of 63 cases, correlations of .323 and .248 are significant at the .01 level and the .05 level of confidence, respectively. Aptitudes G and N correlate significantly with the criterion at the .01 level. Aptitudes P, Q, K, and F correlate significantly with the criterion at the .05 level.

C. Selection of Test Norms

TABLE IV

Summary of Qualitative and Quantitative Data

Type of Evidence	Aptitudes								
	G	V	N	S	P	Q	K	F	M
Job Analysis Data									
Important					X		X	X	
Irrelevant		X	X						
Relatively High Mean					X	X	X		
Relatively Low Sigma	X	X		X	X				
Significant Correlation with Criterion	X		X		X	X	X	X	
Aptitudes to be considered for trial norms	G				P	Q	K	F	

Trial norms consisting of various combinations of Aptitudes G, P, Q, K, and F with appropriate cutting scores were evaluated against the criterion by means of the tetrachoric correlation technique. A comparison of the results showed that B-1002 norms consisting of P-100, Q-100 and K-105 had the best selective efficiency.

VII. Validity of Norms

The validity of the norms was determined by computing a tetrachoric correlation coefficient between the test norms and the criterion and applying the Chi Square test. The criterion was dichotomized by placing as close as possible to one-third of the sample in the low criterion group. A criterion critical score of 26 was used and resulted in 22 of the 63 workers, or 35 percent of the sample, being placed in the low criterion group.

Table V shows the relationship between test norms consisting of Aptitudes P, Q, and K with critical scores of 100, 100, and 105 respectively, and the dichotomized criterion for Electronics-Unit Assembler 6-98.014. Workers in the high criterion group have been designated as "good workers" and those in the low criterion group as "poor workers."

TABLE V

Validity of Test Norms (P-100, Q-100, K-105)

Electronics-Unit Assembler 6-98.014

N = 63

	Non-Qualifying Test Scores	Qualifying Test Scores	Total
Good Workers	11	30	41
Poor Workers	17	5	22
Total	28	35	63

$r_{tet} = .71$ $\quad X^2 = 12.782$

$^{o}r_{tet} = .21$ $\quad P/2 < .0005$

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

VIII. Conclusions

On the basis of the results of this study, Aptitudes P, Q, and K with minimum scores of 100, 100, and 105 respectively, have been established as B-1002 norms for the occupation of Electronics-Unit Assembler 6-98.014. The equivalent B-1001 norms consist of P-100, Q-100, and T-105.

The data for the Pennsylvania study (N = 63) were analyzed in conjunction with the data for the Florida study (N = 34) which resulted in the B-248 aptitude test norms for the occupation of Electronics-Unit Assembler 6-98.014. An attempt was made to establish one set of norms which would have good selective efficiency for the Pennsylvania and Florida samples separately and in combination. This attempt was unsuccessful. The Pennsylvania sample was used as the basis for the development of national norms for the occupation of Electronics-Unit Assembler 6-98.014 because it was the larger and more representative sample.

IX. Determination of Occupational Aptitude Pattern

The specific norms established for this study did not meet the requirements for allocation to any of the existing 23 occupational aptitude patterns. The data for this sample will be considered for future groupings of occupations in the development of new occupational aptitude patterns.