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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

RADIO RECEIVER ASSEMBLER (electronics) 6-98.010

B-419 or S-155

U. S. Employment Service in
Cooperation with
New York State Employment Service

U. S. DEPARTMENT OF LABOR
Bureau of Employment Security
Washington 25, D. C.
March, 1959

GATB #2212
January 1958

STANDARDIZATION OF THE GENERAL APTITUDE TEST BATTERY FOR RADIO RECEIVER ASSEMBLER 6-98.010

B-419 or S-155

Summary

The General Aptitude Test Battery, B-1002A, was administered to the sample of 59 women employed as Radio Receiver Assembler 6-98.010 by the General Electric Receiver Plant, Utica, New York. The criterion consisted of combined broad category supervisory ratings. On the basis of mean scores, standard deviations, correlations with the criterion, job analysis data, and their combined selective efficiency, Aptitudes K-Motor Coordination, F-Finger Dexterity, and M-Manual Dexterity were selected for inclusion in the test norms.

GATB Norms for Radio Receiver Assembler 6-98.010 - B-419 or S-155

Table I shows, for B-1001 and B-1002, the minimum acceptable score for each aptitude included in the test norms for Radio Receiver Assembler 6-98.010.

TABLE I

Minimum Acceptable Scores on B-1001 and B-1002 for B-419 or S-155

B-1001			B-1002		
Aptitude	Tests	Minimum Acceptable Aptitude Score	Aptitude	Tests	Minimum Acceptable Aptitude Score
T	CB-1-G CB-1-K	90	K	Part 8	95
F	CB-1-O CB-1-P	80	F	Part 11 Part 12	75
M	CB-1-M CB-1-N	80	M	Part 9 Part 10	80

Effectiveness of Norms

The data in Table IV indicate that 9 of the 17 poor workers, or 53 percent of them, did not achieve the minimum scores established as cutting scores on the recommended test norms. This shows that 53 percent of the poor workers would not have been hired if the recommended test norms had been used in the selection process. Moreover, 33 of the 41 workers who made qualifying test scores, or 80 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 Radio Receiver Assembler 6-98.010.

II. Sample

The General Aptitude Test Battery, B-1002A, was administered to a sample of 102 women employed as Radio Receiver Assembler 6-98.010 by the General Electric Receiver Plant, Utica, New York. The potential sample included approximately 500 employees in this category, organized into four production lines, each line under the supervision of a different foreman. The sample of 102 workers was selected by a random method which consisted of selecting line positions at equal intervals. There was an informal impression of plant management that the lines in the upstairs portion consisted of better workers, although there was no wage differential and a t-test of significance did not disclose any significant difference between the ratings of the upstairs and downstairs workers. Selection by the position method throughout the length of each line was calculated to remove this difficulty. Of the 102 workers tested, 43 were eliminated from the sample because of the uncertainty about the reliability of the foremen's ratings. Therefore, the final sample consisted of 59 women.

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 (σ), Ranges, and Pearson Product-Moment Correlations (Corrected for Broad Categories) with the Criterion (c^r) for Age, Education, and Experience

Radio Receiver Assembler 6-98.010
N = 59

	M	σ	Range	c^r
Age (years)	33.5	8.7	21-49	-.195
Education (years)	9.8	1.8	6-12	.012
Experience (months)	40.0	40.8	2-139	.292*

*Significant at the .05 level

The correlations between the variables of age, education, and experience and the criterion are based on N's of 58, 56, and 46, respectively. There are no significant correlations between the criterion and age or education. However, the correlation of .292 between experience and the criterion is significant at the .05 level. This may indicate that those workers who had been on the job longer were better workers, and/or that the supervisors who made the ratings were biased in favor of the workers with greater experience.

III. Job Description

Job Title: Radio Receiver Assembler 6-98.010

Job Summary: Performs highly repetitive, short-cycle operations in the conveyorized assembly of portable, table model, and clock radios. Uses hand and power-driven tools, such as screw drivers, pliers, wire cutters, and soldering irons. May perform related bench and sub-assembly duties such as packing, riveting, spray painting, wire forming, and cutting.

Work Performed: Assembles radio chassis by working with from 30 to 50 other assemblers at a conveyor line. Performs repetitive short-cycle operations which are assigned to a work station and which are as follows:

Mounts parts on printed circuit-boards, as instructed orally and/or by diagram, selecting proper parts--usually 1, 2 or 3--from parts hopper or tray; mounts each part on moving circuit-board by pressing or simple fitting into appropriate holes on board.

Trims soldered terminal, removing soldered chassis from conveyor and with pliers snipping off excessive length of terminal and other parts. Replaces chassis on conveyor.

Crimps and solders wires by attaching the end of precut wires to terminals with long-nosed pliers and solders crimped connections with electric soldering iron.

Drives screw with power screw driver, pulling down counter-balanced screw driver, inserting head of screw, positioning screw in chassis where indicated, and tightening by squeezing lever.

Assembles FM component, selecting and placing FM part, soldering and bending wires into designated position, and attaching them firmly. (This is the conventional type of assembly, and not the printed-circuit assembly.)

Performs a variety of sub-assembly operations, such as riveting, lacquer spraying, etc.

Assembles instruments into cabinet by working with from 15 to 25 other assemblers on the conveyor line. Performs such repetitive, short-cycle operations as:

Examining cabinets, installing crystals in clocks, installing speaker, positioning speaker, and fastening it in place using power-driven screw driver.

Packs radio by working with 2 or 3 assemblers at end of conveyor line. Opens and shapes flattened carton, inserts radio and literature, staples top and bottom with hand stapler, and keeps a simple tally of type and style of radio packed.

IV. Experimental Battery

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

V. Criterion

The criterion for this study consisted of combined broad category ratings based on the rank order ratings made by three foremen. Broad category groupings were used to combine the criterion data into one distribution in order to reduce the influence of any error that might result from merging rank-order ratings which were made by different foremen and may be lacking in comparability. Initially, the first and second rank-order ratings made by each of the three foremen were categorized separately into broad categories of above average (A), average (B), and below average (C), with approximately one-third of the workers assigned to each category. To obtain the final criterion, the first and second broad category ratings for each worker (N=59) were combined. For example: if a worker was categorized as above average the first time and as average the second time, he was given a final rating of AB; a person who was categorized average twice was given a final rating of BB. Combining first and second ratings in this manner resulted in a final broad category criterion consisting of five groups, AA, AB, BB, BC, and CC, which included 17, 6, 13, 6, and 17 workers, respectively. For computational purposes the qualitative ratings were converted to quantitative scores of 62, 54, 50, 46, and 38 for the AA, AB, BB, BC, and CC groups, respectively.

VI. Statistical and Qualitative Analyses

A. Statistical 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 (σ), and Pearson Product-Moment Correlations (Corrected for Broad Categories) with the Criterion (c^r) for the Aptitudes of the GATB

Radio Receiver Assembler 6-98.010
N = 59

Aptitudes	M	σ	c^r
G-Intelligence	86.4	13.2	-.059
V-Verbal Aptitude	90.4	14.0	-.163
N-Numerical Aptitude	87.0	13.7	.188
S-Spatial Aptitude	87.1	16.9	-.031
P-Form Perception	94.2	18.0	.153
Q-Clerical Perception	98.4	12.7	.116
K-Motor Coordination	105.5#	16.8	.195
F-Finger Dexterity	107.7#	17.9	.315*
M-Manual Dexterity	115.8#	17.2	.132

*Significant at the .05 level
#Relatively high mean score

The highest mean scores in descending order of magnitude were obtained for Aptitudes M, F, and K. All the aptitudes have standard deviations of less than 20. Aptitude Q has the lowest standard deviation.

For a sample of 59 cases, correlations of .334 and .257 are significant at the .01 level and the .05 level of confidence, respectively. Aptitude F correlates significantly with the criterion at the .05 level.

B. Qualitative Analysis:

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 examine cabinets for defects.

Motor Coordination (K) - required to assemble FM components, trim soldered terminals, and crimp and solder wires.

Finger Dexterity (F) - required to install crystals in clocks. Also required to place and fit FM parts into appropriate holes on circuit-boards.

Manual Dexterity (M) - required to perform the operations of riveting and lacquer spraying, and to use power drill.

C. Selection of Test Norms:

Based on the quantitative and qualitative evidence cited above, Aptitudes K, F, and M warranted further consideration for inclusion in the test norms. The evidence for each of these aptitudes is indicated below.

Aptitude	Relatively High Mean Score	Significant Correlation with the Criterion	Importance Indicated by Qualitative Analysis
K	X		X
F	X	X	X
M	X		X

Although Aptitude P appeared to be important on the basis of the job analysis data, it was not considered further for inclusion in the norms because there was not sufficient quantitative evidence of significance.

Various combinations of Aptitudes K, F, and M, with appropriate cutting scores were selected as trial norms. The relationship between each set of trial norms and the criterion (dichotomized as indicated in Section VII) was determined.

A comparison of the results showed that B-1002 norms consisting of K-95, F-75, and M-80 had the best selective efficiency.

In test development studies an attempt is made to develop a set of norms such that the cutting score for each aptitude included in the norms will be set at a five-point score level close to one standard deviation below the aptitude mean of the experimental sample. Adjustments of cutting scores from one standard deviation below the mean are made to effect better selective efficiency of the norms. In this study the aptitude cutting scores are each within 19 points of one standard deviation below the aptitude mean of the sample.

VII. Concurrent 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 receiving combined ratings of AA, AB, BB, or BC being placed in the high criterion group, and with those receiving combined rating of CC being placed in the low criterion group. This resulted in 17 of the 59 workers, or 29 percent of the sample, being placed in the low criterion group.

Table IV shows the relationship between test norms consisting of Aptitudes K, F, and M with critical scores of 95, 75, and 80, respectively, and the dichotomized criterion for Radio Receiver Assembler 6-98.010. 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 K, F, and M with Critical Scores of 95, 75, and 80, Respectively, and the Criterion for Radio Receiver Assembler 6-98.010

N = 59

	Non-Qualifying Test Scores	Qualifying Test Scores	Total
Good Workers	9	33	42
Poor Workers	9	8	17
Total	18	41	59

$r_{tet} = .51$ $\quad X^2 = 4.279$

$\sigma r_{tet} = .23$ $\quad P/2 < .025$

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 mean scores, correlations with the criterion, job analysis data, and their combined selective efficiency, Aptitudes K, F, and M with minimum scores of 95, 75, and 80, respectively, are recommended as B-1002 norms for the occupation of Radio Receiver Assembler 6-98.010. The equivalent B-1001 norms consist of T-90, F-80, and M-80.

IX. Determination of Occupational Aptitude Pattern

When 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. The only one of the existing 23 occupational aptitude patterns which meets these criteria for this study is OAP-17 which consists of K-85, F-80, and M-80 for B-1002 and T-80, F-85, and M-85 for B-1001. The selective efficiency of OAP-17 for this sample was determined by means of the tetrachoric correlation technique. No significant relationship was obtained between OAP-17 and the dichotomized criterion for this experimental sample. Therefore, none of the existing 23 occupational aptitude patterns is recommended for the occupation of Radio Receiver Assembler 6-98.010. However, the data for this sample will be considered for future groupings of occupations in the development of new occupational aptitude patterns.