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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)

TECHNICAL REPORT

ON

STANDARDIZATION OF THE GENERAL APTITUDE TEST BATTERY

FOR

ASSEMBLER, ELECTRICAL ACCESSORIES II 7-00.904

B-328 or S-81

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

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U. S. DEPARTMENT OF LABOR
Bureau of Employment Security
Washington 25, D. C.
February 1956

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 Assembler, Electrical Accessories II 7-00.904.

II. Sample

The General Aptitude Test Battery, B-1002A, was administered on May 3 and 4, 1955 to a sample of sixty women employed as Assembler, Electrical Accessories II 7-00.904 by the Molded Insulation Company, Philadelphia, Pennsylvania. There are 120 women employed in this occupation at this company. The tested sample was selected on the basis of age, education, experience, and the ability of the company to release the workers for testing. Of the 60 women tested, three were excluded because they were over 45 years of age. Therefore, the final sample for this study includes 57 women.

The inexperienced workers are assigned to one of the simpler assembly operations and are moved into and taught the more difficult operations as they gain experience. The average girl can usually be assigned to one of four or five positions within her skill range, depending on production needs and absenteeism. The workers can learn the simpler operations in one day and become proficient in about two weeks. The company feels that a girl can learn most of the operations in about 18 months, depending on production needs and the rapidity with which she is moved from one operation to another. However, a girl could learn all of the operations in three months of concentrated training.

There are no age, education or experience requirements for this job. The selection of applicants is made by the Personnel Manager and Production Foreman on the basis of a personal interview.

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

Assembler, Electrical Accessories II 7-00.904

N = 57

	M	σ	Range	r
Age (years)	29.8	7.8	18-42	.151
Education (years)	10.2	1.5	7-12	-.004
Experience (months)	28.0	30.7	5-163	.442**

**Significant at the .01 level

GATB #2072
Spring 1955

STANDARDIZATION OF THE GENERAL APTITUDE TEST BATTERY FOR ASSEMBLER, ELECTRICAL ACCESSORIES II 7-00.904 B-328 or S-81

Summary

The General Aptitude Test Battery, B-1002A, was administered to a sample of 57 women employed as Assembler, Electrical Accessories II 7-00.904 at the Molded Insulation Company, Philadelphia, Pennsylvania. The criterion consisted of rank order supervisory ratings converted to linear scores. 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 Assembler, Electrical Accessories II 7-00.904 - B-328 or S-81

Table I shows, for B-1001 and B-1002, the minimum acceptable score for each aptitude included in the test norms for Assembler, Electrical Accessories II 7-00.904.

TABLE I

Minimum Acceptable Scores on B-1001 and B-1002 for B-328 or S-81

B-1001			B-1002		
Aptitude	Tests	Minimum Acceptable Aptitude Score	Aptitude	Tests	Minimum Acceptable Aptitude Score
T	CB-1-G CB-1-K	80	K	Part 8	85
F	CB-1-O CB-1-P	85	F	Part 11 Part 12	80
M	CB-1-M CB-1-N	90	M	Part 9 Part 10	85

Effectiveness of Norms

The data in Table IV indicate that 10 of the 19 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, 29 of the 38 workers who made qualifying test scores, or percent, were good workers.

There are no significant correlations between age or education and the criterion. The significant correlation between experience and the criterion may indicate a bias on the part of the supervisor in favor of those workers with the most experience, or it may reflect a true relationship between job proficiency and length of experience. Since the criterion consists of subjective ratings, it was not feasible to correct the criterion statistically to nullify the influence of experience. The data indicate that the sample is suitable for test development purposes with respect to age, education, and experience.

III. Job Description

Job Title: Assembler, Electrical Accessories II 7-00.904

Job Summary: Performs any of a series of assembly line tasks in the assembling and testing of Radiosondes (an electronic instrument used to determine air currents, wind speeds and other facts at various heights), using hand tools such as screwdrivers, pliers, tweezers and soldering irons and other equipment such as testing meters and kick presses.

Work Performed: Stakes lugs to chassis: Places lugs in position, by hand, in jig set in base of press; actuates kick pressing pedal to bring down head of press and stake lugs to chassis; removes chassis by hand and places in chute.

Attaches coil and resistor: Positions coil on chassis; places small nut on protruding bolt to fasten it to chassis; tightens nut with hand socket wrench; positions small resistor in chassis; pushes wire resistor ends through eyes of lugs; crimps wire ends with hand tweezers; paints nut on end of coil.

Assembles harness: Picks up test plug consisting of fiber 3/4" square with four metal contact pins and four vari-colored 6" long wires attached; picks up four additional wires of same colors and attaches to corresponding wires by twisting ends together with fingers; folds wires together and places piece of sticking plaster around them to hold them together.

Attaches test plug: Positions test plug in chassis by hand; pushes ends of four vari-colored wires through proper lugs in chassis; crimps ends over lugs with small needle nose pliers.

Solders previously crimped wire ends to lugs in chassis: Lifts work to electric soldering iron fixed to work table; touches parts to be soldered to soldering iron and applies wire solder.

Assembles part of switch frame: Positions switch frame on work table; places two small screws in position and tightens with hand screwdriver; places wire lift arm and two pins in position.

Adds commutator and diaphragm to frame: Places plastic commutator in position on frame over previously placed pins; bends and tightens pins with small pliers; places frame in jig and positions two screws in frame; places diaphragm in position on frame by hand; places bearing cover in jig attached to work table; positions part of assembled frame and diaphragm on jig set on table over bearing cover; gives previously positioned screws a few turns with hand screwdriver; places assembly at right and turns wheel on work counter to tally one piece.

Attaches wheel and arm: Removes frame from jig and places small wheel in position on frame by hand; places pin to hold wheel and tightens with tweezers; positions arm by hand and tightens screw to hold it, using small screwdriver; places small spring in position and attaches it and another previously positioned spring to proper parts of frame, using tweezers; replaces frame in jig and places assembly at right.

Adjusts travel arm and diaphragm: Uses hand screwdriver to adjust screws on travel arm; tests travel arm for motion by moving it with finger; adjusts it to move easily without too much play; sets diaphragm screws and springs for motion by use of screwdrivers and needle nose pliers; places piece of sticking plaster with number on the diaphragm.

Centers link pin: Centers link pin of travel arm, adjusting it with screwdriver and socket wrench so that it moves freely without excessive play.

Sets pivot: Adjusts pivot screws for fine adjustment; places nesting gage over pivot; tightens screws in proper position with socket wrench.

Sets frame in chassis: Places chassis on work table; positions assembled frame in chassis; places small screw in frame and gives it a few turns with hand screwdriver to hold it to chassis.

Installs frame: Pushes wires in proper position, out of way of other parts of switch assembly; pushes frame into proper position in chassis; tightens screw holding frame to chassis, using hand screwdrivers; cuts insulation from wire end and pushes end of wire through proper lug in chassis; pushes pin through hole in end of frame and part of chassis and crimps it to hold frame to chassis, using small pliers.

Crimps wires: Pushes wires of commutator through proper lugs in base and crimps them, using tweezers.

Checks commutator arm (weight checker): Paints ends of contacts, using small brush; cleans face of commutator with precipitated chalk and small cloth; adjusts commutator arm for balance, using a testing meter and allen wrench to adjust arm properly; places assembly on table for final inspection and test.

Makes final visual inspection and tests circuits: Picks up completed assembly; examines it visually to determine that all parts and wires are properly positioned; tests action of arm and diaphragm by moving them with fingers; plugs assembled switch into circuit meter and moves arm across commutator to determine that all circuits are operating; places number on assembly and places in tray; places in one tray if approved; places in another tray with note of defect, if defective.

IV. Experimental Battery

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

V. Criterion

The criterion consists of supervisory ratings in rank order. Both the Production Engineer and the Production Foreman were equally familiar with all of the workers in the sample. Therefore, each of these supervisors prepared two sets of independent ratings on all of the workers in the sample. Each distribution of rank order ratings was converted to linear scores. Intercorrelations were computed between (1) the first and second ratings made by the Production Engineer; (2) the first and second ratings made by the Production Foreman; (3) the first ratings of the Production Engineer and the first ratings of the Production Foreman; and (4) the second ratings made by each of these supervisors. The obtained results are as follows:

		Production Engineer 2nd Rating	Production Foreman 1st Rating
Production Engineer:	1st Rating	.935	.578
Production Foreman:	2nd Rating	.666	.739

From the data in the above table it is apparent that the ratings of the Production Engineer are highly consistent and that the first and second ratings of the Production Foreman do not show the same degree of agreement. The intercorrelations between the ratings of the Production Engineer and the Production Foreman show only a moderate degree of agreement. On the basis of these results it was decided that the ratings of the Production Engineer be used for validation purposes. The linear scores based on the first and second ratings of the Production Engineer were averaged in order to obtain the most reliable criterion.

VI. Statistical and Qualitative 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

Assembler, Electrical Accessories II 7-00.904
N = 57

Aptitudes	M	σ	r
G-Intelligence	81.7	12.5	.163
V-Verbal Aptitude	85.6	11.2	.193
N-Numerical Aptitude	82.5	15.5	.026
S-Spatial Aptitude	85.1	15.3	.176
P-Form Perception	94.5	14.6	.083
Q-Clerical Perception	95.8	15.5	.267*
K-Motor Coordination	99.3	15.7	.105
F-Finger Dexterity	93.5	16.9	.252
M-Manual Dexterity	99.2	19.0	.281*

*Significant at the .05 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 appeared to be important for this occupation:

> Motor Coordination (K) - required to place parts in position and to use tools deftly and quickly.
>
> Finger Dexterity and Manual Dexterity (F and M) - required in all phases of the work in handling, positioning, adjusting and tightening parts such as screws, indicator arms, lugs and springs; also required in the use of tools such as pliers, tweezers, gages, and wire solder.

The highest mean scores in decreasing order of magnitude were obtained for Aptitudes K, M, and Q, respectively. All of the aptitudes have standard deviations of less than 20, with Aptitudes G and V exhibiting the smallest standard deviations. When N=57, correlations of .340 and .262 are significant at the .01 level and the .05 level, respectively. Aptitudes Q and M correlate significantly with the criterion at the .05 level of confidence.

Aptitudes K, F, and M were considered for inclusion in the test norms on the basis of the qualitative and quantitative factors cited above. Aptitudes K, F, and M appeared to be important in terms of job analysis data; Aptitudes K and M exhibited the highest mean scores and, in addition, Aptitude M showed significant correlation with the criterion.

Tetrachoric correlations with the criterion were computed for several sets of trial norms consisting of various combinations of Aptitudes K, F, and M with appropriate cutting scores. The results obtained indicated that all three of these aptitudes should be included in the test norms. The cutting score for Aptitude K was set at one standard deviation below the mean score and rounded to the nearest five-point score level. For Aptitudes F and M the cutting scores were set at one standard deviation below their respective mean scores and rounded to the higher adjacent five-point score levels to effect better selective efficiency. This resulted in cutting scores of 85, 80, and 85 for Aptitudes K, F, and M, respectively.

Although Aptitude Q has a relatively high mean score and shows significant correlation with the criterion, it does not appear to be important on the basis of job analysis data. Therefore, Aptitude Q was not included in the test norms.

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 by placing one-third of the sample in the low group. Those workers who received an average linear score of 39 or more were placed in the high criterion group and designated as "good workers." Those workers who received an average linear score of 38 or less were placed in the low criterion group and designated as "poor workers."

Table IV shows the relationship between test norms consisting of Aptitudes K, F, and M with critical scores of 85, 80, and 85, respectively and the criterion for Assembler, Electrical Accessories II 7-00.904.

TABLE IV

Relationship between Test Norms Consisting of Aptitudes K, F, and M with Critical Scores of 85, 80, and 85, Respectively and Criterion for Assembler, Electrical Accessories II 7-00.904

N = 57

	Non-Qualifying Test Scores	Qualifying Test Scores	Total
Good Workers	9	29	38
Poor Workers	10	9	19
Total	19	38	57

$r_{tet} = .47$ $\quad X^2 = 3.562$

$\sigma_{r_{tet}} = .22$ $\quad P/2 < .05$

The data in the above table indicate a 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 K, F, and M with minimum scores of 85, 80, and 85, respectively, are recommended as B-1002 norms for the occupation of Assembler, Electrical Accessories II 7-00.904. The equivalent B-1001 norms consist of T-80, F-85, and M-90.

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 17 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. The selective efficiency of OAP-17 for this sample was determined by means of the tetrachoric correlation technique. A tetrachoric correlation of .50 with a standard error of .23 was obtained, which indicates a significant relationship between OAP-17 and the criterion for the experimental sample. The proportion of the sample screened out by OAP-17 was .28, which is within the required range of .10 to .60. Therefore, it is recommended that OAP-17 be used in counseling for the occupation of Assembler, Electrical Accessories II 7-00.904.

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