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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)

ED 063414

TECHNICAL REPORT

ON

STANDARDIZATION OF THE GENERAL APTITUDE TEST BATTERY

FOR

MODULE ASSEMBLER (electronics) 6-98.027

B-506 S-229

(Supersedes B-443)

TM 001 241

U. S. Employment Service
in Cooperation with
New York and Ohio State Employment Services

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(Revised)

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2386

STANDARDIZATION OF THE GENERAL APTITUDE TEST BATTERY

FOR

MODULE ASSEMBLER (electronics) 6-98.027

B-506

(Supersedes B-443)

Summary

The General Aptitude Test Battery was administered to two samples of Module Assemblers 6-98.027 for the purpose of validating and cross-validating occupational norms. The date of criterion data collection, criterion type, and the number included in each final sample are shown below:

Sample	Year	Criterion	N
Validation (Ohio)	1961	Supervisory Ratings	52
Cross-Validation (New York)	1959	Supervisory Ratings	50

GATB Norms for Module Assembler 6-98.027, B-506.

B-1001			B-1002		
Aptitude	Tests	Minimum Acceptable Aptitude Score	Aptitude	Tests	Minimum Acceptable Aptitude Score
Q	CB-1-B	85	Q	Part 1	85
F	CB-1-O CB-1-P	95	F	Part11 Part12	90
M	CB-1-M CB-1-N	115	M	Part 9 Part10	110

Effectiveness of Norms

Validation Sample (Ohio)

The data in Table IV-A indicate that only 73 percent of the non-test-selected workers used for this study were good workers; if the workers had been test-selected with the above norms, 85 percent would have been good workers. 27 percent of the non-test-selected workers used for this study were poor workers; if the workers had been test-selected with the above norms, only 15 percent would have been poor workers.

Cross-Validation Sample (New York)

The data in Table IV-B indicate that only 70 percent of the non-test-selected workers used for this study were good workers; if the workers had been test-selected with the above norms, 87 percent would have been good workers. 30 percent of the non-test-selected workers used for this study were poor workers; if the workers had been test-selected with the above norms, only 13 percent would have been poor workers.

TECHNICAL REPORT

I. Purpose

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 Module Assembler 6-98.027.

II. Sample

Validation Sample (Ohio)

The General Aptitude Test Battery, B-1002A, was administered during the period May- September 1961 to a sample of 52 workers employed as Module Assemblers 6-98.027 by the Radio Corporation of America at the RCA plant in Cambridge, Ohio. Tests were not used in the selection of these workers for employment. All of the workers in the sample were considered to have sufficient experience for the collection of valid criterion data.

TABLE I-A

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

Validation Sample (Ohio)

N = 52	M	σ	Range	r
Age (years)	35.3	8.2	22-50	-.003
Education (years)	11.0	1.7	8-12	-.033
Experience (months)	48.3	22.0	8-92	.187

Cross-Validation Sample (New York)

The GATB, B-1002A was administered to 60 female employees of the General Electric Company, Auburn, N. Y. who were engaged in a miniature electronics components assembly operation. Of this number, a company official indicated that 10 employees, although assigned to the work area, were not directly engaged in making miniature assemblies. These employees, therefore, were excluded from this study. Test scores were available in the Auburn local office for 25 employees who had been tested during February-November 1958. The remaining 25 employees were tested during April-July 1959 after being laid off because of discontinuance of the operation at Auburn. The company had no selection standards for assembly jobs except that such employees be women.

Since the specialty devices operation was considered a pilot project at Auburn, employees selected for miniature assembly operations were obtained from other parts of the plant on an "availability" basis. The operation supervisors accepted the employees sent to them and tried them out on the job. The training time for satisfactory performance as miniature assemblers was judged by the foreman to be, on an average, from 3 to 4 weeks. On the basis of inspection of completed work, the foreman was able to determine whether an employee was satisfactory.

TABLE I-B

Means (M), Standard Deviations (σ), Ranges, and Point Biserial Correlations with the Criterion ($r_{p\ bis}$) Education, and Experience
Cross-Validation Sample (New York)

N = 50	N	M	σ	Range	r
Age (years)	50	36.8	7.5	24-50	-.309*
Education (years)	50	10.2	1.7	6-12	.096
Experience (days)	49	122.1	96.4	10-472	.045

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

III. Job Description

Job Title: Module Assembler (electronics) 6-98.027

Job Summary: Performs duties to assemble electronic equipment and sub-assemblies such as module boards, matrix boards and heat sink plates, using special tools and working from blueprints, diagrams, and instruction sheets. Prepares electronic equipment components by cleaning all incoming mechanical and electrical parts. Cuts and bends leads of electronic components. Inserts bent and cut components into matrix boards. Attaches a protective covering board to matrix board. Solders component leads to printed circuit of matrix board. Prepares kits containing all of the various components to be attached to a given module board. Inserts components in module boards and clinches component leads. Cuts and assembles wires to be used to connect module assemblies.

Work Performed: Prepares Components: Cleans all incoming mechanical and electrical parts using vacuum cleaner and cloths. Places parts in protective containers and routes to storage area. Cuts and bends leads of electronic components by inserting the component in a Mark V Cutting & Bending Machine which automatically cuts and bends the leads or places the component over a metal dye and bends and cuts leads to specified length, using a hand wire cutter. Places components in trays of like components preparatory to matrix assembly operation. Inserts bent and cut components into matrix boards used to hold components during burn-in tests. Places labels containing consecutively numbered serial numbers on each component, using tweezers and brush dipped in glue. Attaches a protective covering board to matrix board with a screwdriver. Solders components leads to printed circuit of matrix board using a hand soldering iron. Routes matrix assembly to burn-in test. After burn-in test, places identifying color codes on components using toothpicks dipped in various colored paints. Removes components from matrix boards using hand wire cutters.

Assembles Module Boards: Places components in trays of like components. Prepares kits containing all the various components to be attached to a given module board. Writes number and types of components to be included in kit on pressurized tape and affixes tape to styrene foam board. Places foam board in kit boxes and inserts components as indicated on tape. Places specified type of module boards in a holder and selects kit containing specified components. Inserts components in module board and clinches component leads using a dowel-like handtool or by placing module board in mechanical clinching machine. Cleans module board assembly by immersing in solvent, rinsing in water, and drying with air hose. Places module board in a grooved pallet and places pallet on a moving belt which carries it into soldering machine. Removes module assembly from soldering machine and places it in a rack of dishwashing machines which removes flux from boards. Removes boards from washing machine and dries them with air hose. Varnishes components on module board using small paint brush. Places boards in oven to dry varnish. Attaches handles to module boards using adhesive cement and cures cement by placing module board in oven. Applies masking tape to specified terminals and components of module assemblies preparatory to epoxy moisture proofing spraying operation.

Connects Module Assemblies: Cuts and assembles wires to be used to connect module assemblies according to specified length and color. Strips insulation from ends of wire using thermal stripping tool. Attaches wires to terminals using special wire wrap gun or by hand soldering as per specifications. Attaches cannon connectors to ends of wire using special crimping handtool. Keeps production counts and marks process tags indicating operations accomplished. Makes adjustments on handtools such as replacing soldering tips and air hose bits.

IV. Experimental Battery

All the tests of the GATB, B-1002A, were administered to the validation and cross-validation samples.

V. Criterion

Validation Sample (Ohio)

In September 1961, each worker was rated by his immediate supervisor on a rating scale consisting of the following three items: work quantity, work quality and job knowledge. Each item had five major categories for rating purposes, and each major category was subdivided into three sections for rating purposes. Therefore, each item was rated on a 15 point rating scale. The possible range of final criterion scores on all three items combined was 3-45. The actual range of final criterion scores was 6-33, with a mean of 25.4 and a standard deviation of 5.6.

Cross-Validation Sample (New York)

The criterion data were collected on May 15, 1959 and consisted of supervisory ratings of "success" or "failure" on the job. The foreman in direct charge of the employees involved in this study was the sole judge of each employee's performance. Satisfactory performance was indicated by retention on the job. Those judged unsatisfactory were reassigned to other jobs in the same area or returned to their former positions in other parts of the plant. Thirty-five workers were rated as satisfactory and 15 were rated as unsatisfactory.

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:

Spatial Aptitude (S) - required to read and interpret blueprints, and to relate symbols found on diagrams and prints to physical components.

Form Perception (P) - required to make comparisons and discriminations between similar components so that proper parts are used to assemble specific finished products.

Motor Coordination (K) - required to coordinate eye and hand movements in the assembly procedure.

Finger Dexterity (F) and Manual Dexterity (M) - required to manipulate small components and to do fine soldering work, and to do all phases of assembly operations which require the use of various hand tools.

On the basis of the job analysis data, V-Verbal Aptitude was rated "irrelevant" for successfully performing the duties of this job.

B. Quantitative Analysis: Validation Sample (Ohio)

TABLE II

Means (M), Standard Deviations (σ), and Pearson Product-Moment Correlations with the Criterion (r) for the Aptitudes of the GATB; N = 52

Aptitudes	M	σ	r
G-Intelligence	97.4	14.3	.130
V-Verbal Aptitude	101.4	15.6	-.029
N-Numerical Aptitude	96.4	12.4	.228
S-Spatial Aptitude	93.6	16.5	.165
P-Form Perception	100.8	15.1	.000
Q-Clerical Perception	107.3	13.9	.123
K-Motor Coordination	103.9	16.1	.123
F-Finger Dexterity	113.1	13.9	.139
M-Manual Dexterity	118.6	17.9	.417**

**Significant at the .01 level

C. Selection of Test Norms: Validation Sample (Ohio)

TABLE III

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	X	X
Irrelevant		X							
Relatively High Mean						X		X	X
Relatively Low Sigma	X		X			X		X	
Significant Correlation with Criterion									X
Aptitudes to be Considered for Trial Norms						Q		F	M

Trial norms consisting of various combinations of Aptitudes Q, F and M with appropriate cutting scores were evaluated against the criterion by means of the Phi Coefficient technique. A comparison of the results showed that B-1002 norms consisting of Q-85, F-90 and M-110 had the had the best selective efficiency.

VII. Validity of Norms

The validity of the norms was determined by computing a Phi Coefficient between the test norms and the criterion and applying the Chi Square test. The criterion was dichotomized by placing 27 percent of the sample in the low criterion group because this percent was considered to be the unsatisfactory or marginal workers.

Table IV-A shows the relationship between test norms consisting of Aptitudes Q, F and M with critical scores of 85, 90 and 110, respectively, and the dichotomized criterion for Module Assembler 6-98.027. Workers in the high criterion group have been designated as "good workers" and those in the low criterion group as "poor workers."

TABLE IV-A

Validity of Test Norms for Module Assembler 6-98.027

(Q-85, F-90, M-110)

Validation Sample (Ohio)

N = 52	Non-Qualifying Test Scores	Qualifying Test Scores	Total
Good Workers	9	29	38
Poor Workers	9	5	14
Total	18	34	52

Phi Coefficient = .38

χ^2 = 7.467

P/2 < .005

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

VIII. Cross-Validation of Norms

Table IV-B shows the relationship between B-1002 test norms consisting of Aptitudes Q, F and M with critical scores of 85, 90 and 110, respectively, and the dichotomized criterion for the cross-validation sample. Workers in the high criterion group have been designated as "good workers" and those in the low criterion group as "poor workers."

TABLE IV-B

Cross-Validation of Test Norms (Q-85, F-90, M-110)

Cross-Validation Sample (New York)

N = 50	Non-Qualifying Test Scores	Qualifying Test Scores	Total
Good Workers	15	20	35
Poor Workers	12	3	15
Total	27	23	50

Phi Coefficient = .34

χ^2 = 5.850

P/2 < .01

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

IX. Conclusions

On the basis of the results of this study, Aptitudes Q, F and M with minimum scores of 85, 90 and 110, respectively, have been established as B-1002 norms for Module Assembler 6-98.027. The equivalent B-1001 norms consist of Q-85, F-95 and M-115.

X. Determination of Occupational Aptitude Pattern

The data for this study did not meet the requirements for incorporating the occupation studied into any of the 35 OAP's included in Section II of the Guide to the Use of the General Aptitude Test Battery, January 1962. The data for this sample will be considered for future groupings of occupations in the development of new occupational aptitude patterns.