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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

WOODWORKING MACHINE OPERATOR, GENERAL (woodworking) 6-33.910

B-408 or S-144

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

U. S. DEPARTMENT OF LABOR
Bureau of Employment Security
Washington 25, D. C.
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STANDARDIZATION OF THE GENERAL APTITUDE TEST BATTERY FOR WOODWORKING MACHINE OPERATOR, GENERAL 6-33.910

B-408 or S-144

Summary

The General Aptitude Test Battery, B-1002A, was administered to a total sample of 59 men employed as Woodworking Machine Operators. The sample consisted of 25 workers at the Crawford Furniture Company, New Bethlehem, Pennsylvania and 34 workers at the Lewisburg Chair and Furniture Company, Lewisburg, Pennsylvania. The criterion consisted of supervisory ratings made on a Descriptive Rating Scale. On the basis of mean scores, correlations with the criterion, job analysis data, and their combined selective efficiency, Aptitudes G-Intelligence, N-Numerical Aptitude, F-Finger Dexterity, and M-Manual Dexterity were selected for inclusion in the test norms.

GATB Norms for Woodworking Machine Operator, General 6-33.910 - B-408 or S-144

Table I below, shows, for B-1001 and B-1002, the minimum acceptable scores for each aptitude included in the test norms for Woodworking Machine Operator 6-33.910.

TABLE I

Minimum Acceptable Scores on B-1001 and B-1002 for B-408 or S-144

B-1001			B-1002		
Aptitude	Tests	Minimum Acceptable Aptitude Score	Aptitude	Tests	Minimum Acceptable Aptitude Score
G	CB-1-H CB-1-I CB-1-J	80	G	Part 3 Part 4 Part 6	75
N	CB-1-D CB-1-I	80	N	Part 2 Part 6	75
F	CB-1-O CB-1-P	80	F	Part 11 Part 12	75
M	CB-1-M CB-1-N	75	M	Part 9 Part 10	75

Effectiveness of Norms

The data in Table IV indicate that 14 of the 18 poor workers, or 78 percent of them, did not achieve the minimum scores established as cutting scores on the recommended test norms. This shows that 78 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 37 workers who made qualifying test scores, or 89 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 Woodworking Machine Operator, General 6-33.910.

II. Sample

The General Aptitude Test Battery, B-1002A, was administered during the period September 4, 1957 to September 24, 1957 to a total sample of 59 men employed as Woodworking Machine Operators. Thirty-four men were employed at the Lewisburg Chair and Furniture Company, Lewisburg, Pennsylvania and 25 at the Crawford Furniture Company, New Bethlehem, Pennsylvania. Woodworking machine operations at the two plants were similar and the various job duties were very much alike in detail. After completing the maximum training period of 12 months, the worker is usually able to perform successfully on most machine operations. All workers included in the sample are experienced workers. (Nine workers whose experience ranged from three to ten months have had previous experience in woodworking operations prior to their present employment.)

There is no experience requirement for this occupation. An eighth grade education is preferred. Training time varies from four to twelve months for inexperienced workers and from one to six months for those with previous experience. In plant training is given by an experienced worker or by the foreman. Workers acquire specific job skills through this training, such as, setup and operation of woodworking machinery, reading blueprints, and detecting production errors. A worker may be promoted to foreman.

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

Woodworking Machine Operator, General 6-33.910
N = 59

	M	σ	Range	r
Age (years)	37.3	8.7	20-54	-.116
Education (years)	9.9	1.9	6-14	.112
Experience (months)	51.7	52.7	3-288	.157

There are no significant correlations between age, education, or experience and the criterion. 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: Woodworking Machine Operator, General 6-33.910

Job Summary: Receives work orders from foreman. Cuts to size and shape dried cabinet lumber by setting up and operating woodworking machines, such as, planers, shapers, stickers, tenoners, mortisers, routers, rip saws, cut-off saws, band saws, edge sanders, belt sanders, and drum sanders. The machines have a table or guide to hold the wood piece in position with relation to the cutting element, or are provided with feed rolls which accomplish the same thing.

Work Performed: Receives work orders: Receives blueprints, sketches, and verbal instructions from foreman. May observe and measure sample pieces with rule or refer to detail drawings for information on dimensions and part relationships.

Sets up woodworking machines: Selects machine to be used for each operation by observing whether it is scheduled for use on some other operation, whether it will efficiently work the size piece or pieces to be run, and whether another machine will do the job more efficiently. Selects cutting tools which may be knives ground to shape, straight knives, saw discs or bands, belts, sheets or discs of abrasive paper, depending on the tool-holding and piece-feeding facilities of the machine and on the quality of the surface to be produced by the operation. Adjusts fence, guides or feed rolls with wrench or handwheels so that work pieces will be held in correct relation to the cutting element of the machine. Adjusts speed of feed on some machines by changing belts from one pulley ratio to another or changes gears so that the rate of moving the workpiece past the cutting element is at a maximum for the quality of the surface to be produced. May grind shaper and sticker knives free hand on grinding wheel using a sketch, sample, or template as a guide, taking care to grind knives so that all of a set have the same contour and that proper rake and clearance for cutting wood are provided, and that the knives are balanced. May grind planer knives by attaching a special sharpening device to the machine and cranking the motor-driven grinding wheel of the attachment along the edge of the planer knives.

Operates woodworking machines: Observes that safety guards are in position and that all persons are clear of moving parts and areas toward which long pieces will be ejected as in planers and stickers. Engages clutch or presses motor starter button to start machine. Machines one piece, removes it, and inspects it visually for surface quality. If the machine is one which removes much from the surface, measures with rule to determine if size is within tolerance limits. Continues to insert pieces into machine or instructs helper to feed machine, and listens to and watches machine for signs of maladjustment. Listens to sound of cut being made for evidence of dull edges, and holds surfaced pieces to light occasionally to observe sheen which results from wood fibers not being clearly cut. May observe ammeters of multiple drum sanders to determine extent to which each drum is cutting. May guide workpieces by hand, as in scroll sawing to produce irregular shapes.

Instructs helper: Directs the actions of a helper, in many instances, to insure proper handling and loading of material and safety of helper and others. Explains steps in making setups and operating so that helper can, if he has the ability and interest, learn to operate the machine.

Lubricates and cleans machine: Brushes chips away from areas where they accumulate and oils bearings by filling oil cups, oiling with oil can, or greasing with grease gun. Sweeps chips or sawdust away from walk areas to reduce hazard.

IV. Experimental Battery

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

V. Criterion

The criterion consisted of supervisory ratings made on a Descriptive Rating Scale which reflected the workers' ability to perform successfully on all plant woodworking machine operations over a period of time. The foreman at the Crawford Furniture Company rated his workers on September 13, 1957; the foreman at the Lewisburg Chair and Furniture Company rated his workers on September 26, 1957. The distribution of scores ranged from 20 to 44, with a mean of 35.1 and a standard deviation of 5.1.

VI. Statistical and Qualitative Analyses

A. Statistical 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

Woodworking Machine Operator, General 6-33.910
N = 59

Aptitudes	M	σ	r
G-Intelligence	93.3#	16.6	.274*
V-Verbal Aptitude	88.3	13.7	.215
N-Numerical Aptitude	95.2#	17.4	.197
S-Spatial Aptitude	92.7	22.4	.333**
P-Form Perception	90.0	18.1	.195
Q-Clerical Perception	92.9	12.5	.193
K-Motor Coordination	88.8	18.8	.138
F-Finger Dexterity	91.7	11.3	.389**
M-Manual Dexterity	97.4#	23.0	-.036

** Significant at the .01 level
* Significant at the .05 level
# High mean score

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.

Intelligence (G) - required to understand and follow oral and written instructions, to interpret blueprints and sketches in order to determine the setup and type of machine to be used, and to plan sequence of steps on certain machines which perform a number of operations consecutively.

Numerical Aptitude (N) - required to take measurements and to make simple calculations.

Spatial Aptitude (S) and Form Perception (P) - required to observe sample pieces or refer to detail drawings for information on dimensions and part relationships. Also required to visualize finished items or product from sketches and blueprints.

Finger Dexterity (F) and Manual Dexterity (M) - required to turn knobs and set levers when adjusting machines and manipulating workpieces where guided by hand. Also required to work with hands to place and turn workpieces before and during the machine operations.

C. Selection of Test Norms:

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

Aptitude	High Mean Score	Significant Correlation with the Criterion	Importance Indicated by Qualitative Analysis
G	X	X	X
N	X		X
S		X	X
F		X	X
M	X		X

Although Aptitude P appeared to be important on the basis of job analysis data, it was not considered further for inclusion in the norms because there was no quantitative evidence of significance.

Various combinations of Aptitudes G, N, S, 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 norms consisting of G-75, N-75, F-75, and M-75 for B-1002 and equivalent norms of G-80, N-80, F-80, and M-75 for B-1001 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 affect better selective efficiency of the norms. In this study the aptitude cutting scores are each within 5 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 by placing approximately one-third of the sample in the low criterion group. This was accomplished by using a descriptive rating scale score of 30 as the criterion critical score and resulted in 18 of the 59 workers, or 31 percent of the sample, being placed in the low criterion group.

Table IV shows the relationship between test norms consisting of Aptitudes G, N, F, and M each with a critical score of 75 and the dichotomized criterion for Woodworking Machine Operator, General 6-33.910. 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 G, N, F, and M each with a Critical Score of 75 and the Criterion for Woodworking Machine Operator, General 6-33.910

N = 59

	Non-Qualifying Test Scores	Qualifying Test Scores	Total
Good Workers	8	33	41
Poor Workers	14	4	18
Total	22	37	59

$\sigma_{r_{tet}} = .79$ $\quad X^2 = 15.753$

$\sigma_{r_{tet}} = .22$ $\quad P/2 < .0005$

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 mean scores, correlations with the criterion, job analysis data, and their combined selective efficiency, Aptitudes G, N, F, and M each with a minimum score of 75 are recommended as B-1002 norms for the occupation of Woodworking Machine Operator, General 6-33.910. The equivalent B-1001 norms consist of G-80, N-80, F-80, and M-75.

IX. Determination of Occupational Aptitude Pattern

When the specific test norms for an occupation include four aptitudes, only those occupational aptitude patterns which include three of those four aptitudes with cutting scores that are within 10 points of the cutting scores established for the specific norms are considered for that occupation. Two of the existing 23 occupational aptitude patterns meet these criteria for this study. These occupational aptitude patterns and their B-1002 norms are OAP-10, G-75, F-75, and M-80.and OAP-19, G-80, N-75, and M-85. The selective efficiency of each of these OAP's for this sample was determined by means of the tetrachoric correlation technique. A significant relationship was obtained between OAP-10 and OAP-19, and the dichotomized criterion. Each OAP screened out a proportion of the sample that was within the required range of .10 to .60. However, the highest tetrachoric correlation, .62 with a standard error of .22 was obtained for OAP-10. The proportion of the sample screened out by OAP-10 was .37. Therefore, it is recommended that OAP-10 be used in counseling for the occupation of Woodworking Machine Operator, General 6-33.910.