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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

BOARDER II 6-14.171

AND

BOARDING-MACHINE OPERATOR 6-14.173

B-274
or
S-41

Studies Conducted by
North Carolina State Employment Service

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March 1953

STANDARDIZATION OF THE GENERAL APTITUDE TEST BATTERY FOR BOARDER II 6-14.171 AND BOARDING-MACHINE OPERATOR 6-14.173

B-274 or S-41

Summary

The General Aptitude Test Battery (B-1001) was administered to samples of 27, 24, and 52 workers employed as Boarder II 6-14.171 and/or Boarding Machine Operator 6-14.173 in five North Carolina hosiery company plants. The sample of 27 (26 women and 1 man) consisted of 14 workers from the Carol-May Finishing Company, Incorporated, of Concord, 8 workers from the Charlotte Finishing Company of Charlotte, and 5 workers from the Chadbourn Hosiery Mills, Incorporated, of Charlotte. Most of these workers had spent some time as Boarder II and Boarding Machine Operator. The workers in the sample of 24 were women employed as Boarder II at the Oakhurst Plant of the Hudson Hosiery Company of Charlotte. The workers in the sample of 52 were women employed as Boarding Machine Operator at the Brevard Street Plant of this company. The criterion for each of the samples consisted of production records. On the basis of a qualitative analysis of the two jobs and statistical analysis of the data in terms of correlations with the criteria and mean scores for the separate and combined samples, the aptitudes selected for inclusion in the norms are Aiming (A), Finger Dexterity (F), and Manual Dexterity (M).

GATB Norms for Boarder II 6-14.171 and Boarding Machine Operator 6-14.173, B-274 or S-41

Table I shows for B-1001 and B-1002 the minimum acceptable scores for each aptitude included in the test norms for Boarder II 6-14.171 and Boarding Machine Operator 6-14.173.

TABLE I

Minimum Acceptable Scores on B-1001 and B-1002 for B-274 or S-41

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

Effectiveness of Norms

The data in Table V indicate that 15 of the 30 poor workers, or 50% of them, did not achieve the minimum scores established as cutting scores on the recommended test norms. This shows that half of the poor workers would not have been hired if the recommended test norms had been used in the selection process. Moreover, 57 of the 72 workers who made qualifying test scores, or 79%, 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 occupations of Boarder II 6-14.171 and Boarding-Machine Operator 6-14.173.

II. Samples

Sample A: This sample originally consisted of 15 workers from the Hugh Grey Hosiery Company, Concord, North Carolina; 14 workers from the Carol-May Finishing Company, Incorporated, Concord, North Carolina; 8 workers from the Charlotte Finishing Company, Charlotte, North Carolina; and 5 workers from the Chadbourn Hosiery Mills, Incorporated, Charlotte, North Carolina. All of these workers were experienced, and most had spent some time as Boarder II 6-14.171 and Boarding Machine Operator 6-14.173. The equipment used and the working conditions in the four plants were approximately the same. Plant officials felt that production records in all except the Hugh Grey Company plant could be considered comparable. Since the Hugh Grey Company, which provided 15 workers, limited production per person to 80 dozen per day while emphasizing quality, production records for these workers could not be considered comparable to those from the other 3 plants in which there was no restriction on production. Therefore, the 15 Hugh Grey workers were not included in the experimental sample, and only the remaining 27 workers for whom production records could be considered comparable were retained in the experimental sample. All but one of the workers were women.

Sample B: In March, 1953, the entire GATB (B-1001), except Part E, was administered to 24 women employed as Boarder II 6-14.171 at the Oakhurst Plant of the Hudson Hosiery Company, Charlotte, North Carolina. All of the tested sample had met "production" set at 14 dozen hose completed per hour, and had passed the three-month training period. All were included in the experimental sample.

Sample C: In March, 1953, the entire GATB, except Part E, was administered to 54 women employed as Boarding Machine Operator 6-14.173 at the Brevard Street Plant of the Hudson Hosiery Company, Charlotte, North Carolina. Two of the tested sample were not included in the experimental sample because they had not reached the normal training period of three months. Thus, the experimental sample consisted of 52 workers.

Table II-A shows for samples A, B, and C, the means, standard deviations, ranges, product-moment correlations with the criterion, and standard errors of correlation for age, education, and experience.

TABLE II-A

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

Boarding-Machine Operator 6-14.173
Boarder II 6-14.171
Sample A (N=27) Sample B (N=24) Sample C (N=52)

		M	σ	Range	r	σ_r
Age (years)	Sample A	28.5	4.5	20-35	.00	.19
	Sample B*	29.8	7.0	19-46	.58	.14
	Sample C	31.4	6.7	21-44	-.04	.14
Education (years)	Sample A	9.6	1.7	6-13	.12	.19
	Sample B	10.1	2.0	6-12	-.03	.20
	Sample C	10.4	1.7	6-12	.02	.14
Experience (years)	Sample A	4.6	2.3	1-11	.13	.19
	Sample B	3.9	2.7	1-11	.59	.13
	Sample C	6.8	4.2	1-17	.21	.13

*N = 23

Table II-B shows the means, standard deviations, and ranges for age, education, and experience for the combined sample.

TABLE II-B

Means (M), Standard Deviations (σ), and Ranges for Age, Education and Experience

Boarding-Machine Operator 6-14.173
Boarder II 6-14.171

Combined Sample (N = 103)

	M	σ	Range
Age (years)*	30.3	6.4	19-46
Education (years)	10.1	1.8	6-13
Experience (years)	5.5	3.7	1-17

*N = 102

Table II-A shows that there is a significant correlation between experience and the criterion for Sample B. It is suggested that this relationship was caused by either or both of the following factors: (1) the presence of a learning period covering part or all of the experience range of the sample; (2) a tendency for the better workers to remain on the job longer than the poorer workers. Since all of the workers in Sample B had at least one year

of experience, it seems reasonable to assume that the workers in this sample had completed most if not all of the learning period and that most of the experience-criterion relationship was caused by operation of the second factor. Therefore, no attempt was made to adjust the criterion for experience. There is also a significant correlation between age and the criterion for Sample B. This correlation is probably largely due to the following: because of the wide experience range covering 10 years, there tends to be a substantial correlation between age and experience; since experience is positively related to the criterion, age tends to show a similar relationship. None of the remaining correlation coefficients shown in Table II-A is significant. A comparison between mean scores shown in Table II-A shows that the three samples differ little with respect to both average age and average education.

III. Job Description

A. Boarder II 6-14.171

Job Summary: Operates a pre-boarding machine to shape and mold (set yarn) nylon hosiery prior to dyeing.

Work Performed

Pulls undyed stocking over metal form (board), alines heel, toe, and leg sections to the shape of the form, and smoothes out over surface of form. Presses button to actuate mechanism which carries dressed forms into a heating chamber where stockings are permanently shaped and set under steam pressure. (The amount of steam pressure to be applied and the length of drying time are automatically controlled and depend upon the denier and gauge of the nylon.)

Strips stockings from forms after they have passed through the shaping and setting chamber. Places stockings in a cloth bag attached to the work table for dyeing. Observes stockings for defects and flaws and sets defective ones aside for repairing.

B. Boarding-Machine Operator 6-14.173

Job Summary: Operates a boarding machine to shape and dry freshly dyed nylon full-fashioned hosiery.

Work Performed

Manipulates hand lever or hip press control to raise and lower forms into position for dressing with stockings, into position for drying, and into position for removing dried hosiery from the forms.

From a side position, pulls damp stocking over the heated form, alines foot, heel, and leg sections to shape of the form; smoothes fabric to prevent appearance of wrinkles when stocking is dry and so that the stocking seam will be straight. Stretches the leg of the stocking on the form so that the top of the stocking reaches the proper gage line on the form. Uses a mirror attached to the boarding machine to observe correct stocking length on the opposite side of the form from which the worker is standing.

Strips hosiery from forms when dried by loosening toe from form, and folds stockings and places them on a table. May adjust valves on boarding machine

to admit proper heat to metal forms (boards).

A comparison between the job descriptions for Boarder II and Boarding Machine Operator indicates that there is little difference between the two jobs in work performed. The primary difference between the two jobs seems to lie in the stage of completion at which the hosiery is handled and the emphasis on quality of production. Although the Boarding-Machine Operator handles the product at a later stage than does the Boarder II, and presumably quality is of greater importance at this later stage, the aptitudes required appear to be the same for the two jobs. The aptitudes which appear important from a job analysis point of view are as follows:

Manual Dexterity (M) was most evident from observing the workers on the job. This aptitude appears important because the worker is required to be able to use hands and arms with ease and speed in grasping, reaching, and pulling stockings into place and alining stockings on the form. Manual Dexterity is also required in removing stockings from the form.

Finger Dexterity (F) appears to be important in positioning full fashioned hosiery seams correctly on the form and in smoothing the fabric quickly and gently to assure that no wrinkles will appear when the stocking is dry. This aptitude also appears to be required in adjusting stocking heels and tops of stockings to conform with correct gauge lines on the form. Ability to use fingers quickly in placing stockings on heated forms and in removing them from forms without burning fingers is a necessary requirement for successful performance of the job.

Motor Speed (T) appears necessary in order to pick up stockings quickly, to use swift motion up and down in placing and smoothing hose over form, and to remove hose from form in time with the automatic clocking of the heating chamber where stockings are set and shaped under steam pressure on an alternate set of boards. Speed is also required in order to have maximum use of heating unit with a minimum laspse of time between filling.

Aiming or Eye-Hand Coordination (A) appears necessary in order to make accurate movements in picking up stockings, reaching above head to place hose on form, adjusting stocking to proper gauge line on form, and in removing hose from form quickly. There is a quick adjustment necessary from the take-off to the place-on motion as each form is stripped, then covered with another stocking before proceeding to the next form.

IV. Experimental Battery

All of the tests of the GATB (B-1001), with the exception of Part E, were administered to the three samples.

V. Criterion

Sample A: Objective work production records in terms of the average number of dozens of stockings completed per day were secured for the period of 16 weeks immediately preceding the testing project from the three plants furnishing 14, 8, and 5 workers. Officials of the three plants felt that production records in one plant would be comparable to those from the other plants, and also that production records of Boarder II's and Boarding Machine Operators were comparable. It was observed that the three participating plants were very similar with regard to working conditions and type of machinery used. Because of the above considerations, it was judged feasible to integrate the 27 workers for statistical processing of the data.

Sample B: Objective production records, in terms of average number of dozen hose boarded per hour, were used as the criterion. Average production ranged from 14 to 16 dozen hose boarded per hour. No records were kept on the number of hose that had to be reboarded.

Sample C: Objective production records, in terms of average number of dozen hose boarded per hour obtained for the nine-week period from December 29, 1952 through February 27, 1953, were used as the criterion. Quality of production is emphasized by the plant and records were kept on the number of reboards necessary for each worker. However, since the number of rebcards rarely went above 3 or 4 per 600 dozen, total output was not affected to an appreciable degree.

VI. Statistical and Qualitative Analysis

Table III-A shows the means, standard deviations, product-moment correlations with the criterion, and standard errors of correlation for the aptitudes of the GATB for samples A, B, and C. Table III-B shows the aptitude means and standard deviations for the combined sample.

The aptitude means and standard deviations are comparable to general population norms with a mean of 100 and a standard deviation of 20.

TABLE III-A

Means (M), Standard Deviations (σ), Product-Moment Correlations with the Criterion of Production Records (r), and Standard Errors of Correlation (σ_r) for the Aptitudes of the GATB

Boarder II 6-14.171
Boarding-Machine Operator 6-14.173

Sample A (N=27) Sample B (N=24) Sample C (N=52)

Aptitude	Sample	M	σ	r	σ_r
G-Intelligence	A	86.2	12.9	-.23	.18
	B	83.2	12.9	-.18	.20
	C	92.1	14.5	-.16	.14
V-Verbal Aptitude	A	83.5	10.6	-.29	.18
	B	81.6	10.1	-.27	.19
	C	90.1	11.8	-.14	.14
N-Numerical Aptitude	A	83.7	13.9	.02	.19
	B	81.8	16.3	-.02	.20
	C	91.8	17.9	-.04	.14
S-Spatial Aptitude	A	91.0	17.4	-.29	.18
	B	92.2	14.9	-.17	.20
	C	95.5	18.0	-.14	.14
P-Form Perception	A	91.0	15.1	.04	.19
	B	87.9	17.5	-.25	.19
	C	95.9	19.4	-.07	.14
Q-Clerical Perception	A	83.6	15.1	.13	.19
	B	77.1	16.2	-.12	.20
	C	93.3	15.3	.07	.14
A-Aiming	A	85.6	17.1	.35	.17
	B	85.5	19.5	.14	.20
	C	96.0	16.0	.16	.14
T-Motor Speed	A	86.6	16.7	.40*	.16
	B	79.5	19.2	.13	.20
	C	90.9	17.4	.08	.14
F-Finger Dexterity	A	98.3	16.0	.42*	.16
	B	88.0	16.0	.28	.19
	C	96.2	17.7	.10	.14
M-Manual Dexterity	A	110.4	17.6	.42*	.16
	B	98.9	12.6	.45*	.17
	C	110.0	16.9	.32*	.12

*Significant at the .05 level.

TABLE III-B

Means (M) and Standard Deviations (σ) for the Aptitudes of the GATB

Boarder II 6-14.171
Boarding Machine Operator 6-14.173

Combined Sample
(N=103)

Aptitude	M	σ
G-Intelligence	88.5	14.2
V-Verbal Aptitude	86.4	11.8
N-Numerical Aptitude	87.4	17.2
S-Spatial Aptitude	93.6	17.3
P-Form Perception	92.8	18.2
Q-Clerical Perception	85.8	16.5
A-Aiming	90.8	17.9
T-Motor Speed	87.1	18.2
F-Finger Dexterity	94.9	17.4
M-Manual Dexterity	107.5	16.9

Table IV-A shows the means, standard deviations, standardized means, standardized standard deviations, product-moment correlations with the criterion, and standard errors of correlation for the tests of the GATB for Samples A, B, and C. Table IV-B shows the means, standard deviations, standardized means and standardized standard deviations for the tests of the GATB for the combined sample.

The standardized means and standardized standard deviations of the tests are comparable to general population norms with a mean of 100 and a standard deviation of 20.

TABLE IV-A

Means (M), Standard Deviations (σ), Standardized Means (M'), Standardized Standard Deviations (σ'), Product-Moment Correlations with the Criterion of Production Records (r), and Standard Errors of Correlation (σ_r) for the Tests of the GATB

Boarder II 6-14.171
Boarding-Machine Operator 6-14.173

Sample A (N=27) Sample B (N=24) Sample C (N=52)

Tests	Sample	M	σ	M'	σ'	r	σ_r
A-Tool Matching	A	18.74	4.56	92	16	.09	.19
	B	18.12	5.32	89	19	-.21	.19
	C	19.50	5.19	94	18	-.09	.14
B-Name Comparison	A	54.56	15.12	83	15	.13	.19
	B	48.12	16.19	77	16	-.12	.20
	C	61.98	15.26	91	15	.07	.14
C-H Markings	A	38.74	7.02	86	19	.29	.18
	B	39.96	7.09	89	19	.12	.20
	C	43.54	6.08	99	16	.13	.14
D-Computation	A	19.89	5.31	82	19	.05	.19
	B	19.88	6.56	82	17	.00	.20
	C	23.14	6.84	91	18	-.02	.14
F-Two-Dimensional Space	A	17.70	7.14	88	17	-.28	.18
	B	19.17	7.12	91	17	-.14	.20
	C	21.56	8.02	97	19	-.10	.14
G-Speed	A	121.67	20.49	86	20	.34	.17
	B	113.71	18.88	79	18	.10	.20
	C	125.50	20.24	90	20	.01	.14
H-Three Dimensional Space	A	14.70	5.87	92	17	-.29	.18
	B	14.96	5.14	83	15	-.15	.20
	C	15.94	6.25	95	18	-.14	.14
I-Arithmetic Reason	A	6.89	2.56	89	15	-.05	.19
	B	6.08	2.63	85	15	-.07	.20
	C	7.71	2.73	95	16	-.11	.14
J-Vocabulary	A	13.30	4.89	84	11	-.30	.18
	B	12.38	4.70	82	10	-.27	.19
	C	16.31	5.48	90	12	-.14	.14
K-Mark Making	A	65.74	6.92	89	14	.35	.17
	B	63.17	9.13	84	19	.13	.20
	C	67.77	8.04	93	16	.15	.14
L-Form Matching	A	23.15	5.36	92	14	-.07	.19
	B	21.54	6.06	88	15	-.26	.19
	C	26.17	8.30	100	21	-.01	.14
M-Place	A	91.39	7.28	107	17	.31	.17
	B	87.79	4.45	100	10	.46	.16
	C	91.50	7.36	108	17	.33	.12
N-Turn	A	107.04	8.08	114	19	.48	.15
	B	100.42	8.81	98	20	.29	.19
	C	105.79	7.83	111	18	.17	.13
O-Assemble	A	27.48	3.50	99	15	.26	.18
	B	24.33	4.05	86	18	.23	.19
	C	25.81	4.17	92	18	.00	.14
P-Disassemble	A	28.33	3.42	97	19	.53	.14
	B	28.38	2.69	97	15	.25	.19
	C	29.98	3.28	106	18	.25	.13

TABLE IV-B

Means (M), Standard Deviations (σ), Standardized Means (M'), and Standardized Standard Deviations (σ') for the Tests of the GATB

Boarder II 6-14.171
Boarding-Machine Operator 6-14.173

Combined Sample (N=103)

Tests	M	σ	M'	σ'
A-Tool Matching	18.98	5.10	92	18
B-Name Comparison	56.81	16.46	86	16
C-H Markings	41.45	6.92	93	19
D-Computation	21.52	6.61	87	17
F-Two-Dimensional Space	19.99	7.77	93	19
G-Speed	121.75	20.54	87	20
H-Three-Dimensional Space	15.39	5.93	94	17
I-Arithmetic Reason	7.12	2.75	91	16
J-Vocabulary	14.60	5.44	86	12
K-Mark Making	66.16	8.25	90	17
L-Form Matching	24.30	7.40	95	19
M-Place	90.55	6.94	106	16
N-Turn	104.86	8.51	109	20
O-Assemble	25.90	4.13	92	18
P-Disassemble	29.18	3.30	102	18

Tables III-A and III-B show that for each separate sample as well as for the combined sample, the aptitudes with the highest means are F and M.

A comparison of aptitude means for the three samples plotted on the same graph showed that the profiles were very nearly parallel and that although the mean scores for Boarding Machine Operator (Sample C) are, in general, higher than for Boarder II (Sample B), the differences are not large enough to necessitate the establishment of separate sets of norms for the two occupations.

Table III-A shows that the aptitudes with significant (.05 level) correlations with the criterion are T (Sample A only), F (Sample A only), and M (Samples A, B, and C).

The aptitudes which appear to be important from the job analysis are A, T, F, and M (see Section III).

On the basis of qualitative analysis of the jobs and statistical analysis of the data from the three samples, Aptitudes A, F, and M were chosen for inclusion in the norms. Aptitude M was selected because of its high mean, significant correlation for each of the three samples, and importance as

indicated from the job analysis. Aptitude F was selected because of its high mean, significant correlation for Sample A, and importance from the job analysis. Aptitude A was selected because of its importance from the job analysis and because it added to the predictive efficiency of the norms which included Aptitudes F and M. Although Aptitude T has a significant correlation for Sample A, and seems important from the job analysis, this aptitude was not selected because it did not add to the predictive efficiency of the norms.

The recommended norms consist of Aptitudes A, F, and M, with cutting scores of 75, 75, and 90, respectively. The cutting score for each aptitude was set at one standard deviation below the aptitude mean of the combined sample and rounded to an adjacent five-point score level.

Since the production records for the three samples were obtained from different plants, and since quality is emphasized more for Boarding Machine Operator than for Boarder II, it seemed more reasonable to assume comparability of the three samples rather than equivalence of the production records. Therefore, for purposes of showing the predictive efficiency of the recommended norms for the combined sample, the criterion for each of the three studies was dichotomized so that as close as possible to 1/3 of each sample was placed in the low criterion group of the combined sample.

Table V shows the relationship between norms consisting of A-75, F-75, and M-90 and the criterion for the total sample (Samples A, B, and C combined). Workers in the high criterion group have been designated as "good workers" and those in the low criterion group as "poor workers."

TABLE V

Relationship between Test Norms Consisting of Aptitudes A, F, and M with Critical Scores of 75, 75, and 90, Respectively and the Criterion for the Total Sample (Samples A, B, and C Combined)

Boarder II 6-14.171
Boarding Machine Operator 6-14.173

	Non-Qualifying Test Scores	Qualifying Test Scores	Total
Good Workers	16	57	73
Poor Workers	15	15	30
Total	31	72	103

$r_{tet} = .46$ $\quad X^2 = 6.691$

$\sigma_{r_{tet}} = .17$ $\quad p/2 < .005$

The p/2 value corresponding to the Chi Square value obtained for Table V indicates that the relationship between the norms and the criterion is significant for the total sample consisting of Samples A, B, and C combined. The tetrachoric correlation coefficient of .46 obtained for the total sample indicates that the size of the relationship between the norms and the criterion for the total sample is satisfactory.

VII. Conclusions

On the basis of the above analysis, norms consisting of A-75, F-75, and M-90 are recommended for use as national norms for the occupations of Boarder II 6-14.171 and Boarding Machine Operator 6-14.173. When the Separate-Answer-Sheet Form of the GATB, B-1002, is used, the recommended norms are K-75, F-75, and M-90.