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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

TURRET-LATHE OPERATOR 4-78.021

B-263 or S-33

Prepared By
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GATB #721

STANDARDIZATION OF THE GENERAL APTITUDE TEST BATTERY FOR TURRET-LATHE OPERATOR 4-78.021

B-263 or S-33

Summary

The General Aptitude Test Battery, with the exception of Part E, was administered to 36 male Turret-Lathe Operators 4-78.021 employed at the Vinco Corporation, Detroit, Michigan. Rank order ratings by foremen were used as the criterion. The aptitudes included in the norms were selected on the basis of statistical analysis of the data together with an analysis of job requirements. The aptitudes selected were Intelligence (G), Spatial Aptitude (S), Form Perception (P), and Manual Dexterity (M).

GATB Norms for Turret-Lathe Operator 4-78.021 B-263 or S-33

Table I shows the minimum acceptable scores for each aptitude included in the test norms for Turret-Lathe Operator 4-78.021.

TABLE I

Minimum Acceptable Scores for B-263 or S-33

Aptitude	Tests	Minimum Acceptable Aptitude Score
G	CB-1-H CB-1-I CB-1-J	85
S	CB-1-F CB-1-H	85
P	CB-1-L CB-1-A	85
M	CB-1-M CB-1-N	85

Effectiveness of Norms

The data in Table V indicate that 9 of the 12 poor workers, or 75% of them, did not achieve the minimum scores established as cutting scores on the recommended test norms. This shows that 75% of the poor workers would not have been hired if the recommended norms had been used in the selection process. Moreover, 19 of the 22 workers who made qualifying test scores, or 86%, 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 Turret-Lathe Operator 4-78.021.

II. Sample

The tested sample consisted of 36 male Turret-Lathe Operators 4-78.021 from the Vinco Corporation, Detroit, Michigan. These workers, tested during the period June 10 through June 25, 1952, represent all available employees in this occupational classification in this plant. The training period for operators with no previous experience is from six months to a year. Personal interviews are used by the company as the basis for selecting employees. Although not a strict selection requirement of the company, completion of the tenth grade is considered desirable with high school graduation preferred. Also considered desirable, but not absolutely necessary, is some training in machine shop practice, preferably in the setup and operation of a turret lathe.

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

TABLE II

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

Turret-Lathe Operator 4-78.021

N = 36

	M	σ	Range	r	σ_r
Age (years)	33.8	7.5	24-53	-.17	.16
Education (years)	10.7	1.5	8-13	.13	.16
Plant Experience (months)	21.4	23.0	1-100	.08	.16
Total Experience (months)	78.2	33.4	30-144	.11	.16

The data in Table II indicate that neither age nor education acts as a selection factor and that employee ratings (the criterion used) were not influenced by the age, education, or experience of the workers.

III. Job Description

A. D.O.T. Title and Code: Turret-Lathe Operator 4-78.021

B. Job Summary: Sets up, adjusts, and operates a turret lathe with hexagonal and special cross sliding turrets which semi-automatically perform a cycle of cutting operations (boring, counter-sinking, drilling, rabbeting, facing, turning, routing, etc.), to a machine aluminum and magnesium castings and hardened steel forgings or steel bar stock (40 or higher Rockwell reading). May machine from one to a few hundred parts per setup.

C. Work Performed

Sets Up Turret Lathe: Examines blueprints and process sheets (the latter if available) to determine type and sequence of machining necessary. May remove cross sliding turret by loosening set screws with a wrench and lifting it off post. Cleans metal chips and other foreign matter from machine with an air hose, hooked wire and/or brush. Selects proper type turret on shelf near the machine or may exchange old turret at tool crib. Selects cutters (carbide type) and gauges necessary for the job by calling for them at the tool crib. (Job usually consists of four to six cutting operations.) May return the old cutters and gauges. May sharpen own tools or request tools already sharpened and dress them with a hone. Inserts new turret on post and tightens in place with set screws. Inserts proper cutting tools in their proper stations on turret and sets them in place by tightening the jaws on chucks or by tightening set screws. May remove face plate, chuck, or collet and exchange it at the tool crib for the type required. Sets new one in place on the machine. Sets cross-slide and hexagonal turret carriage stops to the limits desired for each cutting operation, using dial indicators, indexes and other gauges and measuring instruments as guides for imaginary angles and depth of cuts. Sometimes the first article is machined without stops, its dimensions obtained by closely controlling the action of each cutter by hand indexing and frequent measurement of the work with proper gauges and measuring instruments. Each feed stop may then be set where the worker stopped machining the first article. Also, sometimes it is necessary to hand feed certain cutting operations to prevent the cutting tools from burning or breaking. Selects appropriate spindle and feed speeds for each operation. Oils turret lathe by filling reservoirs and by oiling bearings with an oil can. Checks, and if necessary, fills coolant reservoir with soda ash and water. Sets turrets in position to begin the first cutting operation.

Operates Turret Lathe: Loosens collet or chuck jaws or removes nuts on a face plate with a wrench. Inserts bar stock or part between jaws and tightens with a wrench or replaces nuts or studs of face plate and tightens with a wrench. May balance face plate and part by tightening or loosening nuts that control position of weights. If bar stock is used, pulls out bar stock from collet jaws and sets the protruding end by turning a hand wheel which controls the stop and pushes the end back until a proper length is obtained. Tightens the jaws of collet with a wrench to hold stock in place. Pushes electric switch to start in operation. May turn on valve to start flow of coolant. Moves cutting tools to position near beginning of cut. Engages clutch starting

spindle rotation. Engages clutch starting feeding mechanism or hand indexes and feeding. Observes cutting operation. Withdraws hexagonal or cross-slide turret from working position by turning a hand wheel or moving a lever. Checks cut. Rotates (indexes) hexagonal or cross-slide turret to new position to present appropriate tool for each step in the cycle of operations. At the completion of cycle of operations, stops the flow of coolant and may make a complete check of the operations with proper gauges and measuring instruments as well as by sight and feel to insure that an acceptable job has been done. May adjust tool or indexing to conform to specifications and resume the operation or operations required. Stops machine spindle rotation and moves the turrets out of the way. Loosens nuts or jaws and removes the part except when bar stock is used, brings the cut-off tool into position and engages feeding mechanism until the part drops. May file off burrs of finished piece with a file. Picks up finished stock and places in a box. Repeats operations if more than one part is required.

D. Physical Demands: Constant standing or walking; frequent lifting of metal parts to fasten to chucks (usually under 10 lbs.) and occasionally chucks, face plates and turrets (under 50 lbs.); frequent use of either one or both hands to grasp hand tools, parts and measuring devices; frequent use of finger tips to determine smoothness of cut; frequent use of eyes to read blueprints, process sheets and measuring instruments and to observe machine operation and make adjustments; keen hearing to detect machine malfunctioning; and maintenance of a high working speed to keep up with production.

E. Working Conditions: Working around others on the inside; adequate lighting and ventilation; fairly noisy with machines occasionally emitting a high-pitched screeching sound; frequently sprayed with drops of soda ash and water or oil; may get grease, oil and dirt on hands and clothes when setting up, adjusting, or operating machine tool; and footwear may soak up oil from floor.

F. Hazards: Possibility of injury to feet by dropping tools, jigs, or fixtures; may injure fingers and hands if caution is not used in setting up, adjusting, and operating machine tool; some possibility of electric shock if care is not taken to keep breaker or switch boxes closed at all times; and may be subject to skin rashes from contact with coolant.

G. Responsibility: Some responsibility for machines with estimated values from $4,000 to $10,000; full responsibility for machined parts valued from $5 to $500. Responsibility for safety of others when working with magnesium.

H. Promotion Policy: May be promoted from Chucking Lathe (Automatic Turret-Lathe) Operator and given additional training. Seniority and potential ability are the major selection factors for trainees obtained through promotional sources. Skilled workers are recruited from outside sources. Skilled turret-lathe operators may be promoted to a position of foreman or to a job as a Hand Screw Machine Operator in a tool room, providing labor agreements with the workers in the tool room do not conflict with such procedures.

I. Knowledge and Skills Required: Must know how to read and interpret mechanical blueprints and process sheets; know how to set up and adjust a turret lathe; know how to sharpen and dress cutting tools; know proper spindle and feed speeds for various types of metal-cutting operations; know what cutting operations require a coolant and which must be cut dry; be familiar with the use and application of various chucks, jigs, or fixtures, and the various types of gauges and measuring instruments used on turret lathe operations.

Should be able to work accurately to close tolerances (as close as 1/8 of a thousandth of an inch); be able to determine quickly from a blueprint and process sheet the cuts to be performed, sequence of operation, and types of cutting tools to be used; be able to make the setup on a turret lathe quickly and accurately; be able to read the various types of measuring instruments and convert the reading to the decimal reading on the blueprint.

J. Aptitude Factors

Manual Dexterity:	To set up, adjust, and operate machine.
Intelligence:	To understand and follow complex instructions and to make decisions.
Spatial Aptitude:	To read and understand blueprints and relate this understanding to the setup and adjustment of the machine tool.
Form Perception:	To note whether cutting operations are progressing properly and to inspect the finished part.
Finger Dexterity:	To use precision measuring instruments.

IV. Experimental Battery

All of the tests of the GATB with the exception of Part E, were administered to the sample group.

V. Criterion

Of the 36 workers involved in the study, 18 worked on the afternoon shift and the other 18 were on the day shift. The workers in each group were ranked by their foreman on quality and quantity of work. The ranks for each group were then converted to linear scores and the two groups combined by considering all of the obtained linear scores as one continuous distribution.

VI. Statistical and Qualitative Analysis

Table III shows the means, standard deviations, product-moment correlations with the criterion and standard errors of correlation for the aptitudes of the GATB. Table IV shows the means and standard deviations, standardized means and standardized standard deviations, product-moment correlations with the criterion, and standard errors of correlation for the tests of the GATB.

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

TABLE III

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

Turret-Lathe Operator 4-78.025

N = 36

Aptitudes	M	σ	r	σ_r
G - Intelligence	102.8	16.8	.19	.16
V - Verbal Aptitude	95.1	14.4	.00	.17
N - Numerical Aptitude	101.5	17.9	.08	.17
S - Spatial Aptitude	106.8	19.3	.30	.15
P - Form Perception	98.4	18.8	.37	.14
Q - Clerical Perception	85.0	13.9	-.09	.16
A - Aiming	82.5	17.8	.36	.14
T - Motor Speed	85.4	19.9	.28	.15
F - Finger Dexterity	97.0	16.1	.12	.16
M - Manual Dexterity	107.3	20.1	.09	.16

TABLE IV

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

Turret-Lathe Operator 4-78.021

N = 36

Tests	M	σ	M'	σ'	r	σ_r
A - Tool Matching	20.8	5.5	99	19	.42	.14
B - Name Comparison	56.0	13.9	85	14	-.09	.16
C - H Markings	37.3	6.7	82	18	.42	.14
D - Computation	26.4	6.5	100	17	.04	.17
F - Two-Dimensional Space	22.5	6.6	100	16	.40	.14
G - Speed	121.6	23.5	86	23	.27	.15
H - Three-Dimensional Space	20.1	6.8	108	20	.27	.15
I - Arithmetic Reason	9.6	3.2	105	19	.14	.16
J - Vocabulary	18.6	6.7	95	14	.00	.17
K - Mark Making	64.6	8.2	87	17	.24	.16
L - Form Matching	25.3	7.5	98	19	.15	.16
M - Place	93.3	8.3	112	19	.12	.16
N - Turn	99.1	9.7	95	22	.03	.17
O - Assemble	27.5	3.7	99	16	.08	.17
P - Disassemble	27.7	3.0	94	17	.16	.16

The aptitudes with the highest means are M, S, G, N, and P, respectively. The aptitudes with significant (.05 level) correlations with the criterion are P and A (see Table III). The aptitudes measured by the GATB which appear to be related to job performance on the basis of the job analysis (see section III) are G, S, P, F, and M.

Aptitudes G, S, P, and M were selected for inclusion in the norms on the basis of their relatively high means and their importance as indicated by the job analysis. (Aptitude P also has a significant correlation with the criterion.) Aptitude N has a relatively high mean, but was not included since it does not have a significant correlation with the criterion, nor was it identified as important from the job analysis. Although Aptitude A has a significant correlation with the criterion, it was not included because it does not have a high mean, was not identified as important from the job analysis, and does not add to the selective efficiency of the norms. Aptitude F, identified as important from the job analysis, was not included because it does not have a high mean or a significant correlation with the criterion.

The cutting scores for Aptitudes G, S, and M were each set at one standard deviation below the aptitude mean and rounded to the nearest five-point interval. The cutting score for Aptitude P was set at approximately five points above one standard deviation below the Aptitude P mean since this upward adjustment results in an increase in the predictive efficiency.

Table V shows the relationship between test norms consisting of Aptitudes G, S, P, and M each with a cutting score of 85, and the criterion with a critical linear score of 43. The critical criterion score of 43 was chosen because this is the point below which 1/3 of the sample falls. Workers in the high criterion group (upper two-thirds) have been designated as "good workers" and those in the low criterion group (lower third) as "poor workers."

TABLE V

Relationship Between Test Norms Consisting of Aptitudes G, S, P, and M with Critical Scores of 85, 85, 85, and 85 Respectively and Criterion with a Critical Linear Score of 43 for Turret-Lathe Operator 4-78.021

	Non-Qualifying Test Scores	Qualifying Test Scores	Total
Good Workers	5	19	24
Poor Workers	9	3	12
Total	14	22	36

$r_{tet} = .75$ $\quad X^2 = 7.73$

$\sigma_{r_{tet}} = .28$ $\quad p/2 < .005$

The small p/2 value of less than .005 corresponding to the obtained Chi Square value of 7.73 indicates that the positive relationship between the norms and the criterion shown in Table V is a significant one. The tetrachoric correlation coefficient of .75 indicates that for this sample the relationship is relatively high.

VII. Conclusions

Aptitudes G, S, P, and M, each with a cutting score of 85, are recommended for use as norms for Turret-Lathe Operator 4-78.021.

It is recommended that check studies on this occupation be conducted to verify the applicability of the test norms that have resulted from this study.