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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 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 evaluation sample is included. (AG)

TECHNICAL REPORT

ON

VALIDATION OF THE GENERAL APTITUDE TEST BATTERY

FOR

METALLURGICAL TECHNOLOGY - TECHNICAL INSTITUTE TRAINING 0-67.

B-604 or S-324

U. S. Employment Service
in Cooperation with
New York State Employment Service

November 1964

GATB # 2505

STANDARDIZATION OF THE GENERAL APTITUDE TEST BATTERY

FOR

METALLURGICAL TECHNOLOGY - TECHNICAL INSTITUTE TRAINING 0-67.

B-604 or S-324

Summary

The General Aptitude Test Battery, B-1002B, was administered to a final sample of 59 male students enrolled in the two-year Metallurgical Technology curriculum at the Erie County Technical Institute, Buffalo, New York. This training was established under Title VIII of the National Defense Education Act of 1958. The criterion consisted of grade-point averages. On the basis of mean scores, standard deviations, correlations with the criterion, job analysis data, and their combined selective efficiency, Aptitudes G-Intelligence, N-Numerical Aptitude and S-Spatial Aptitude were selected for inclusion in the final norms.

GATB Norms for Metallurgical Technology - Technical Institute Training 0-67., ~~B-604,~~ S-324

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	120	G	Part 3 Part 4 Part 6	115
N	CB-1- D CB-1- I	115	N	Part 2 Part 6	110
S	CB-1- F CB-1- H	105	S	Part 3	100

Effectiveness of Norms

The data in Table IV indicate that only 64 percent of the non-test-selected students used for this study were good students; if the students had been test-selected with the above norms, 77 percent would have been good students. 36 percent of the non-test-selected students used for this study were poor students; if the students had been test-selected with the above norms, only 23 percent would have been poor students.

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 in screening applicants for referral to a training curriculum in Metallurgical Technology. (These norms may be particularly useful in screening applicants for training established under Title VIII of the National Defense Education Act of 1958.)

II. Purpose

The General Aptitude Test Battery, B-1002B, was administered in March 1962 and July 1963 to 69 senior male students enrolled in a two-year Metallurgical Technology curriculum at the Erie County Technical Institute, Buffalo, New York. This training was established under Title VIII of the National Defense Education Act of 1958. Ten students were eliminated from the sample due to the collection of incomplete test and/or criterion data. Therefore, the final sample consisted of 59 male students who successfully completed the two-year course of study.

The two-year curriculum in Metallurgical Technology at the Erie County Technical Institute is accredited by the Engineers Council for Professional Development. Graduates are awarded the Degree of Associate in Applied Science. The requirements for enrollment are: high school graduation; recommendation by high school principle; completion of high school courses in mathematics and physics and a good background in elementary chemistry; evidence that the student is physically qualified for the curriculum; acceptance through formal application; qualifying on admission interview and tests.

TABLE I

Mean (M), Standard Deviation (σ), Range, and Pearson Product-Moment Correlation with the Criterion (r) for Age

N = 59	M	σ	Range	r
Age (years)	20.7	1.5	19-27	.292*

*Significant at the .05 level

III. Course Description

Title of Course Curriculum: Metallurgical Technology

Summary: The Metallurgical Technology curriculum at the Erie County Technical Institute requires two years of instruction. Students spend three quarters of each year in classes and laboratories at the Institute and are employed in industry for the remaining portion of the year. The curriculum provides for basic training in the fundamentals involved in the production of new metals and alloys, and in more efficient methods of production and use of metals. Students are prepared for technical, production and supervisory positions in the metallurgical field.

Technical Curriculum: The following courses comprise the core of technical subjects in Metallurgical Technology.

Physical Metallurgy: Principal processes in the production of iron, steel, copper, nickel and aluminum; theory of alloys and metal structures; properties of stainless steel, tool steel and cast irons; casting, welding, forging, stamping and powder metallurgy.

Chemistry: The study of matter; atomic and kinetic theory; atomic weights; acids and bases; analytical chemistry; gas and fuel analysis; ferrous and nonferrous metal and alloy analytic methods.

Foundry: Elementary foundry practice; foundry furnaces and equipment.

Mechanical Drawing: Instruction in the fundamentals of mechanical drawing; blueprint reading and sketching.

Industrial Instruments: Basic physical concepts; theory and use of pyrometers, thermocouple; expansion, resistance and radiation; pressure measurement; liquid and gas flow instruments; automatic control theory and practice.

Spectroscopy: The nature of light; wave length, emission spectrum; photography of the spectrum; the study and use of the spectograph; quantitative analysis and methods for metals.

Strength of Materials: The study of physical properties of common materials; riveted and welded joints; pressure vessels, beam design and torsion; effects of repeated loads and eccentric loading.

Physics: The nature of heat; calorimetry, industrial furnaces and fuels; optics; the fundamental principles of statics, torque, friction, centroids, curvilinear and rectilinear motion.

Refractories and Furnaces: The physical and chemical properities of all refractory materials.

Machine Tools: The use of high-speed and tungsten carbides as cutting tools; milling machines and grinders; special and multitooled machines.

Production Methods: Production planning and control; preparation of operation sheets, process flow charts and plant layout.

The subjects in the Metallurgical Technology curriculum and the approximate number of classroom and laboratory hours in each subject are as follows:

Subject	Classroom Hours	Laboratory Hours
Physical Metallurgy	220	140
Chemistry	100	110
Foundry	10	100
Spectroscopy	50	50
Industrial Instruments	70	50
Strength of Materials	70	70
Physics	100	---
Refractories and Furnaces	20	40
Machine Tools	---	40
Mechanical Drawing	---	70
Production Methods	40	20
Communication Skills	140	---
Mathematics	180	---
Sociology Health Education Coordinating Conference Economics Industrial & Labor Relations	130	---
Laboratory Processes Casting Design Electricity Non-Destructive Inspection Metallurgical Topics	100	80

The course of study consists of approximately 1230 hours of classroom instruction and 770 hours of laboratory work.

NOTE: Since technical institute training curriculums usually prepare students for broad categories of technical work rather than for specific jobs, a specific Dictionary of Occupational Titles classification cannot be assigned to the Metallurgical Technology course curriculum. However, the following are titles of positions held by graduates of the Metallurgical Technology curriculum at the Erie County Technical Institute, Buffalo, New York:

Assistant Metallurgist	Observer--Rolling Mill
Foundry Laboratory Technician	Observer--Open Hearth
Heat Treat Technician	Research Laboratory Technician
Materials Testing Technician	Spectroscope Technician
Melting Superintendent	Technical Sales
Metallurgical Laboratory Technician	X-Ray Technician

IV. Experimental Battery

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

V. Criterion

The criterion data collected consisted of "total" and "refined" grade-point averages. The total grade-point average consisted of the ratio between the total number of honor points earned and the total number of credit hours taken in the two-year course of instruction. Honor points assigned to each letter grade are: A = 4, B = 3, C = 2, D = 1, and F = 0. The refined grade-point average was the student's grade-point average for only the core of technical subjects in Industrial Technology (see section III of this report). Pearson product-moment correlations were computed between each of the GATB aptitudes and (1) total grade-point averages, and (2) refined grade-point averages. Of these criteria, higher correlations were obtained with the total grade-point averages. Therefore, total grade-point averages were used as the final criterion, having a range of 2.00-3.70, a mean of 2.44 and a standard deviation of .39.

VI. Qualitative and Quantitative Analyses

A. Qualitative Analysis

On the basis of job analysis data, the following aptitudes measured by the GATB were rated "important" for success in this two-year training curriculum:

Intelligence (G) - required to learn and understand theory and principles of technical course content, functioning of equipment, and analyzing information, and to make decisions concerning changes in methods and procedures.

Verbal Aptitude (V) - required to understand written materials and present verbal ideas.

Numerical Aptitude (N) - required to prepare technical reports and make mathematical calculations.

Spatial Aptitude (S) - required in relating diagrams to equipment, and comprehension of crystal structure.

Clerical Perception (Q) - required to perceive measures on instruments, calibrate meters and gages, and to record readings.

B. Quantitative Analysis:

TABLE II

Means (M), Standard Deviations (σ), and Pearson Product-Moment Correlations with the Criterion (r) for the Aptitudes of the GATB; N = 59

Aptitudes	M	σ	r
G-Intelligence	120.5	10.6	.357**
V-Verbal Aptitude	107.6	8.8	.157
N-Numerical Aptitude	121.3	11.0	.221
S-Spatial Aptitude	122.2	17.5	.279*
P-Form Perception	126.8	18.2	.257*
Q-Clerical Perception	116.9	14.5	.143
K-Motor Coordination	113.3	15.8	.205
F-Finger Dexterity	115.6	19.1	.164
M-Manual Dexterity	122.4	18.1	.064

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

C. Selection of Test Norms:

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									
Relatively High Mean			X	X	X				X
Relatively Low Sigma	X	X	X			X			
Significant Correlation with Criterion	X			X	X				
Aptitudes to be Considered for Trial Norms	G	V	N	S	P	Q			

Trial norms consisting of various combinations of Aptitudes G, V, N, S, P and Q 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 G-115, N-110 and S-100 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 34 percent of the sample in the low criterion group because this percent was considered to be the unsatisfactory or marginal students.

Table IV shows the relationship between test norms consisting of Aptitudes G, N and S with critical scores of 115, 110 and 100, respectively, and the dichotomized criterion for the experimental sample of students. Individuals in the high criterion group have been designated as "good students" and those in the low criterion group as "poor students."

TABLE IV

Validity of Test Norms for
Metallurgical Technology
(G-115, N-110, S-100)

N = 59	Non-Qualifying Test Scores	Qualifying Test Scores	Total
Good Students	9	30	39
Poor Students	11	9	20
Total	20	39	59

Phi Coefficient = .32
X^2 = 6.006
P/2 = .01

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 the results of this study, Aptitudes G, N and S with minimum scores of 115, 110 and 100, respectively, have been established as B-1002 norms for selecting students for the two year Metallurgical Technology curriculum described on pages 3-4 of this report. The equivalent B-1001 norms consist of G-120, N-115 and S-105.

IX. Determination of Occupational Aptitude Pattern

Since a specific (6 digit) Dictionary of Occupational Titles classification cannot be assigned to the two-year curriculum in Metallurgical Technology (see page 4 of this report), no OAP analysis was made on the data for this study.