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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 Desterity. 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

INDUSTRIAL CHEMISTRY TECHNOLOGY - TECHNICAL INSTITUTE TRAINING 0-67.

B-605 or S-325

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

November 1964

GATB # 2529

STANDARDIZATION OF THE GENERAL APTITUDE TEST BATTERY

FOR

INDUSTRIAL CHEMISTRY TECHNOLOGY - TECHNICAL INSTITUTE TRAINING 0-67.

B-605 or S-325

Summary

The General Aptitude Test Battery, B-1002B, was administered to a final sample of 55 senior students enrolled in the two-year Industrial Chemistry Technology curriculum at the Erie County Technical Institute, Buffalo, New York. This training course 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, V-Verbal Aptitude and P-Form Perception were selected for inclusion in the final test norms.

GATB Norms for Industrial Chemistry Technology - Technical Institute Training 0-67., B-~~605~~ S-325

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
V	CB-1- J	105	V	Part 4	105
P	CB-1- A CB-1- L	110	P	Part 5 Part 7	105

Effectiveness of Norms

The data in Table IV indicate that only 65 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, 81 percent would have been good students. 35 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 19 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 Industrial Chemistry 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. Sample

The General Aptitude Test Battery, B-1002B, was administered in March 1962 and June 1963 to 73 senior students enrolled in a two-year Industrial Chemistry 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. Eighteen students were eliminated from the sample due to the collection of incomplete test and/or criterion data. Therefore, the final sample consisted of 55 students, 46 male and nine female, who completed the two-year course of study.

The two-year curriculum in Industrial Chemistry 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 principal; good high school background in mathematics and science; 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 = 55	M	σ	Range	r
Age (years)	20.5	2.3	19-30	-.011

III. Course Description

Title of Course Curriculum: Industrial Chemistry Technology

Summary: The Industrial Chemistry 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 theoretical and practical training in preparation for positions such as analyst, technical salesman, research assistant, technicians in process development, and supervisors in the chemical operator field.

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

General Chemistry: Fundamental concepts of symbols, formulas, equations; atomic structure; chemical bonding; gaseous, liquid and solid states; weights; oxidation-reduction. Principles of qualitative analysis; laws of chemical equilibrium. Periodic classification of elements; electrochemistry; acids, bases and salts; nuclear chemistry.

Quantitative Analysis: The laws of mass action; quantitative separations; basic laboratory procedures and gravimetric analysis. Theory of acidimetry and alkalimetry, precipitation and complexion formation; volumetric apparatus; advanced analytical procedures.

Instrument Methods of Analysis: Theory of gas analysis; pH determination; colorimetry; photometry; spectrophotometry; calorimetry; chromatoraphy and electrophoresis. Laboratory procedures utilizing modern instruments in performing experiments.

Unit Operations: Principles of stoichiometry; fluid flow; sizing; material handling; sampling procedures. Fluid measurement; heat transfer; filtration. Theory and application of mass transfer; absorption, extraction; distillation; evaporation, and drying.

Organic Chemistry: Theory of bonding, electronegativity and polarity; reaction mechanisms; alcohols and phenols; ethers. Carboxylic acids; esters and amides; amines; geometric isomers; plastics and resins.

Physical Chemistry: The structure of matter; gas laws; principles of thermodynamics; laws of solution; properties of liquids; properties of solvents. Properties of solutions; solubility; absorption; humidity; physical chemistry laboratory procedures.

Physics: The study of matter; specific gravity; pressure gages and manometers; energy, power and machines. Gas laws; heat exchanges; transfer of heat; heating devices. Static electricity; DC electricity; AC electricity; induction furnaces.

Industrial Stoichiometry: The study of material balances; thermophysics; thermochemistry; fuels and combustion; material and energy balances.

Calculus: The study of derivatives; limits; trigonometric functions; exponential functions; logarithmic functions; methods of integration; first and second moments.

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

Subject	Classroom Hours	Laboratory Hours
General Chemistry	130	100
Quantitative Analysis	70	190
Instrument Methods of Analysis	20	70
Unit Operations	110	140
Organic Chemistry	70	100
Physical Chemistry	70	50
Physics	140	70
Industrial Stoichiometry	40	---
Calculus	70	---
Senior Conference, Field Trips	40	40
Health Education, Sociology, Economics, Coordinating Conference	110	---
Human Relations Communication Skills	140	---
Mathematics	120	---

The course of study consists of approximately 1100 hours of classroom instruction and 750 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 Industrical Chemistry Technology course curriculum. However, the following are titles of positions held by graduates of the Industrial Chemistry Technology curriculum at the Erie County Technical Institute, Buffalo, New York:

Analyst
Assistant Chemist
Chemist
Control Chemist
Control Technician
Development Technician
Junior Chemist
Laboratory Group Leader
Laboratory Technician
Pilot Plant Foreman
Pilot Plant Operator
Process Foreman
Research Assistant
Research Technician
Sales Development Technician
Sales Service Technician
Shift Chemist
Spectrographic Technician
Technical Assistant

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 Chemistry 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 2.00-3.56, a mean of 2.40 and a standard deviation of .36.

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 curriculum:

Intelligence (G) - required in learning and understanding fundamentals of course materials, including theory, principles and extensive laboratory procedures.

Verbal Aptitude (V) - required in understanding written technical information, and in presenting information orally and in writing.

Numerical Aptitude (N) - required in applying mathematical concepts to problems, calibrating and reading instruments, making computations, recording laboratory findings and preparing reports.

Form Perception (P) - required in laboratory experiments and in making volumetric observations.

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 = 55

Aptitudes	M	σ	r
G-Intelligence	126.2	12.3	.461**
V-Verbal Aptitude	115.7	10.5	.262*
N-Numerical Aptitude	123.5	14.7	.203
S-Spatial Aptitude	122.2	15.7	.413**
P-Form Perception	121.8	12.9	.278*
Q-Clerical Perception	117.3	15.7	.039
K-Motor Coordination	116.2	16.2	-.035
F-Finger Dexterity	103.8	16.4	.007
M-Manual Dexterity	116.3	16.5	-.026

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

Trial norms consisting of various combinations of Aptitudes G, V, N, S and P 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, V-105 and P-105 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, V and P with critical scores of 115, 105 and 105, 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 Industrial Chemistry Technology
(G-115, V-105, P-105)

N = 55	Non-Qualifying Test Scores	Qualifying Test Scores	Total
Good Students	6	30	36
Poor Students	12	7	19
Total	18	37	55

Phi Coefficient = .47
x^2 = 12.199
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 the results of this study, Aptitudes G, V and P with minimum scores of 115, 105 and 105, respectively, have been established as B-1002 norms for selecting students for the two-year Industrial Chemical Technology curriculum described on pages 3-4 of this report. The equivalent B-1002 norms consist of G-120, V-105 and P-110.

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 Industrial Chemistry Technology (see page 4 of this report), no OAP analysis was made on the data for this study.