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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

FIREMAN II 2-65.10

B-380 or S-120

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

U. S. DEPARTMENT OF LABOR
Bureau of Employment Security
Washington 25, D. C.
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GATB #2159
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STANDARDIZATION OF THE GENERAL APTITUDE TEST BATTERY FOR FIREMAN II 2-63.10

B-380 or S-120

Summary

The General Aptitude Test Battery, B-1002A, was administered to 60 workers employed as Fireman II 2-63.10 at eleven of the twelve fire companies operated by the Fort Wayne, Indiana, fire department. The criterion consisted of supervisory ratings on a descriptive rating scale. On the basis of mean scores, correlations with the criterion, job analysis data and and their combined selective efficiency, Aptitudes G-Intelligence, S-Spatial Aptitude, P-Form Perception and M-Manual Dexterity were selected for inclusion in the test norms.

GATB Norms for Fireman II 2-63.10 - B-380 or S-120

Table I shows, for B-1001 and B-1002, the minimum acceptable score for each apatitude included in the test norms for Fireman II 2-63.10.

TABLE I

Minimum Acceptable Scores on B-1001 and B-1002 for B-380 or S-120

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	95	G	Part 3 Part 4 Part 6	90
S	CB-1-H CB-1-F	95	S	Part 3	90
P	CB-1-A CB-1-L	95	P	Part 5 Part 7	95
M	CB-1-M CB-1-N	95	M	Part 9 Part 10	90

Effectiveness of Norms

The data in Table V indicate that 18 of the 25 poor workers, or 72 percent of them, did not achieve the minimum scores established as cutting scores on the recommended test norms. This shows that 72 percent of the poor workers would not have been hired if the recommended test norms had been used in the selection process. Moreover, 31 of the 38 workers who made qualifying test scores, or 82 percent, were good workers.

TECHNICAL REPORT

I. Problem

This study was undertaken 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 Fireman II 2-63.10.

II. Sample

The potential sample consisted of 194 men employed as Fireman II 2-63.10 by the Fort Wayne, Indiana Fire Department at 12 fire houses strategically located within the corporate city limits. On March 12, 13, and 14, 1957, the General Aptitude Test Battery was administered to 61 of these workers employed at 11 of the fire houses. One worker was eliminated from the tested sample because of age, leaving a final experimental sample of 60 workers for the statistical analysis.

Applicants for the job of Fireman must be between 23 and 35 years of age and must be in excellent physical condition. High school graduation, or its equivalent, is not a strict requirement, but is preferred. Beginning in February 1952 tests were used as an aid in selecting Firemen. The tests used were the Bennett Test of Mechanical Comprehension and the Fort Wayne Fire Department General Test, a test of general intelligence. Sixty percent of the applicants were eliminated on the basis of scores on these tests.

An intensive, all inclusive 30-day training course is given to each recruit in the Department's training school. After successful completion of the training, the recruit is assigned to a fire company.

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

Fireman II 2-63.10
N = 60

	M	σ	Range	r
Age (years)	33.5	5.6	25-48	-.208
Education (years)	11.8	.8	10-14	-.078
Experience (months)	74.6	51.6	8-201	-.072

None of the correlations in the above table is significant; the data for age, education and experience appear to be reasonable for workers on this type of job; and the age and education ranges are within limits recommended for GATB testing. Therefore, 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: Fireman II 2-63.10

Job Summary: Fights fires and performs emergency rescue work. Rides on fire truck to scene of fire. Connects and mans hose to play water or chemicals on the fire, or uses portable fire extinguisher in places not easily accessible with a hose. Demolishes doors, windows, partitions, or buildings as necessary, to reach and combat the fire. Rescues persons overcome by fire or smoke and administers first aid to them. May drive fire truck, operate pumping equipment and aerial ladders. May investigate cause of fires, perform salvage work and inspect buildings for possible fire hazards. Performs other emergency rescue work as required.

Work Performed: Fights fires and performs emergency rescue work. Answers fire alarms or requests for emergency rescue operations relayed to station by telephone, Gamewell ticker tape and bell or buzzer code system. Transmits alarm information to other members of department. Rides to scene of operation on "pumper," "ladder," "aerial ladder" or "rescue" truck. Connects hoses (using proper couplings and nozzles), lays and mans hoses to play stream of water on fire. Climbs conventional ladders or aerial ladder (100 feet high) to reach high places or to direct water at fire. Makes forceable entry to open doors, windows or to cut through structural materials to gain access to fire area, to free trapped persons or to provide ventilation in structure (for escape of gas and smoke), using various tools such as axes, steel cutters, lever bars and cutting torches. Uses both water and chemicals to combat and extinguish fire, selecting proper type necessary to combat particular fire (electric, explosives, oil, gasoline and various types of inflammable materials). Performs rescue operations by removing persons from various structures or other entrapments. Administers first aid in cases of heart attack, drowning, burns and other emergency situations, employing such mechanical devices as Pulmotors and oxygen equipment or using various first aid materials and techniques. When directed by superiors, drives truck to scene of operation and operates pumping equipment by connecting hoses and regulating valves and levers and observing gauges to insure proper operation; operates aerial ladders (mechanical and hydraulic) manually or by moving levers and observing dial indicator to assure proper angles or stress being put on equipment to insure maximum safety of operation. At direction of superiors performs such duties as investigation of causes of fire, general clean up and overhaul of premises after a fire, and covering of exposed areas to prevent further damage by wind, rain or possible rekindling of fire. Participates in cleaning and maintenance of all apparatus and equipment and policing of living, eating and sleeping quarters, building and grounds of station. Performs any other duties requested by superiors such as making personal calls on business establishments and private homes to inspect them for possible fire hazards and files written reports on conditions found.

IV. Experimental Battery

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

V. Criterion

The Chief of Fire Department Training, who is responsible for training, assigning, transferring, upgrading and terminating firefighting personnel, rated all of the participants on March 18, 1957. He made a second rating on April 2, 1957. Ratings from other supervisors were not obtained because practically all personnel actions are based on performance appraisals by the Chief of Training.

The ratings were based on a descriptive rating scale consisting of nine items covering the various aspects of duties performed by a firefighter. Weights of 1 through 5 were assigned to the alternatives indicating the degree of job performance attained. The minimum possible total score was 9 and the maximum possible total score was 45. The product-moment correlation between the first and second sets of ratings was .99, indicating practically perfect agreement.

The second set of ratings was used as the final criterion. The mean criterion score was 30.4, the standard deviation of scores was 5.9, and the range of scores was 21-42 for the 60 workers in the sample.

VI. Statistical and Qualitative 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

Fireman II 2-63.10
N = 60

Aptitude	M	σ	r
G-Intelligence	106.2	12.2	.489**
V-Verbal Aptitude	99.5	12.2	.292*
N-Numerical Aptitude	106.5	14.3	.473**
S-Spatial Aptitude	109.1	15.1	.378**
P-Form Perception	102.9	12.4	.528**
Q-Clerical Perception	101.3	11.6	.480**
K-Motor Coordination	102.6	13.3	.340**
F-Finger Dexterity	103.5	15.8	.385**
M-Manual Dexterity	108.6	15.4	.326*

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

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 have importance in this occupation:

Intelligence (G) - required to learn various methods of combating fires, effecting rescues and performing first aid; required to read and understand verbal instructions and to prepare written reports; required to operate complicated equipment such as pumping apparatus, aerial ladders, generators, Pulmotors and oxygen units.

Spatial Aptitude (S) - required to visualize spatial relationships in positioning equipment, in avoiding overhead wires and other objects when raising aerial ladders to desired heights, and in driving or moving apparatus in congested areas.

Finger Dexterity (F) - required to manipulate small objects rapidly and accurately in performing first aid and in using and caring for firefighting equipment.

Manual Dexterity (M) - required to move hands easily and skillfully in assembling, operating and disassembling equipment, and in climbing ladders, crawling and lifting disabled persons or other objects.

The data in Table III show that (1) the highest mean scores in decreasing order of magnitude, were obtained for Aptitudes S, M, N and G; and (2) significant correlations with the criterion were obtained for Aptitudes G, N, S, P, Q, K and F (.01 level) and Aptitudes V and M (.05 level).

Table IV summarizes the qualitative and quantitative evidence of significance for the aptitudes of the GATB.

TABLE IV

Summary of Qualitative and Quantitative Evidence of Significance for the Aptitudes of the GATB

Aptitude	Relatively High Mean	Significant (.01 level) Correlation with Criterion	Importance Indicated by Qualitative Analysis
G	X	X	X
V			
N	X	X	
S	X	X	X
P		X	
Q		X	
K		X	
F		X	X
M	X		X

Based on the qualitative and quantitative evidence indicated in the above table, Aptitudes G, S, P, F and M were considered further for inclusion in the test norms. There is both qualitative and quantitative evidence for Aptitudes G, S, F and M. Aptitude P was also selected for further consideration because this aptitude has a higher correlation with the criterion than any other aptitude and it does not seem unreasonable from the standpoint of job duties. Aptitude N, on the other hand, has a significant correlation with the criterion and a high mean score, but appears so unimportant in the job duties that it was not selected for further consideration.

Several sets of norms, consisting of various combinations of Aptitudes G, S, P, F and M with appropriate cutting scores, were selected for tryout. The relationship between each of these sets of trial norms and the dichotomized criterion was determined by means of the tetrachoric correlation technique. For the purpose of computing tetrachoric correlations, the criterion was dichotomized using a critical score of 30. This point was chosen because the Chief of Training indicated that this was the point of demarcation between acceptable and marginal workers. A comparison of the relationships between sets of trial norms and the dichotomized criterion showed that norms consisting of G-90, P-95 and M-90 had the best selective efficiency of any set of norms tried. Addition of Aptitude S with a cutting score of 90 to these norms did not change the selective efficiency of the norms for this sample. However, since Aptitude S seems important from the qualitative analysis, has the highest mean score and a significant correlation with the criterion, addition of S-90 to the norms appeared to be warranted.

VII. Concurrent Validity of Norms

Table V shows the relationship between test norms consisting of Aptitudes G, S, P and M with critical scores of 90, 90, 95 and 90, respectively, and the dichotomized criterion for Fireman II 2-63.10. 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 G, S, P and M with Critical Scores of 90, 90, 95 and 90, Respectively, and the Criterion for Fireman II 2-63.10

N = 60

	Non-Qualifying Test Scores	Qualifying Test Scores	Total
Good Workers	4	31	35
Poor Workers	18	7	25
Total	22	38	60

$r_{tet} = .84$ $\quad X^2 = 20.506$

$\sigma_{r_{tet}} = .21$ $\quad P/2 < .0005$

The data in the above table indicate a significant relationship between the test norms and the criterion for this sample.

VIII. Conclusions

On the basis of mean scores, correlations with the criterion, job analysis data and their combined selective efficiency, Aptitudes G, S, P and M with minimum scores of 90, 90, 95 and 90, respectively, are recommended as B-1002 norms for the occupation of Fireman II 2-63.10. The equivalent B-1001 norms consist of G-95, S-95, P-95 and M-95.

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 these four aptitudes with cutting scores that are within 10 points of the cutting scores established for the specific norms are considered for that occupation. The only one of the existing 23 occupational aptitude patterns which meets these criteria for this study is OAP-8, which consists of G-95, S-95, and M-85. The selective efficiency of OAP-8 for this sample was determined by means of the tetrachoric correlation technique. A tetrachoric correlation of .61 with a standard error of .21 was obtained, which indicates a significant relationship between OAP-8 and the criterion for the experimental sample. The proportion of the sample screened out by OAP-8 was .37, which is within the required range of .10 to .60. Therefore, it is recommended that OAP-8 be used in counseling for the occupation of Fireman II 2-63.10.