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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 and a personnel evaluation form are also included. (AG)

June 1970

U S Training and
Employment Service
Technical Report
S-357 R

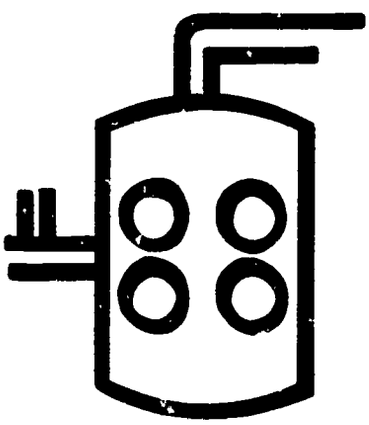
Development of USTES

APTITUDE TEST BATTERY FOR

STATIONARY ENGINEER

(any ind.)
950.782

U S DEPARTMENT OF LABOR
Manpower Administration



Technical Report on Development of USTES Aptitude Test Battery

For . . . .

Stationary Engineer (any ind.) 950.782

S-357R

(Developed in Cooperation with the
Colorado State Employment Service)

U.S. Department Of Labor
Manpower Administration

June 1970

FOREWORD

The United States Training and Employment Service General Aptitude Test Battery (GATB) was first published in 1947. Since that time the GATB has been included in a continuing program of research to validate the tests against success in many different occupations. Because of its extensive research base the GATB has come to be recognized as the best validated multiple aptitude test battery in existence for use in vocational guidance.

The GATB consists of 12 tests which measure 9 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, with a standard deviation of 20.

Occupational norms are established in terms of minimum qualifying scores for each of the significant aptitude measures which, in combination, predict job performance. For any given occupation, cutting scores are set only for those aptitudes which contribute to the prediction of performance of the job duties of the experimental sample. It is important to recognize that another job might have the same job title but the job content might not be similar. The GATB norms described in this report are appropriate for use only for jobs with content similar to that shown in the job description included in this report.

GATB Study #2587

Development of USTES Aptitude Test Battery

For

Stationary Engineer (any ind.) 950.782-054

S-357R

This report describes research undertaken for the purpose of developing General Aptitude Test Battery (GATB) norms for the occupation of Stationary Engineer (any ind.) 950.782-054. The following norms were established:

GATB Aptitudes	Minimum Acceptable GATB Scores
N - Numerical Ability	80
S - Spatial Aptitude	90
Q - Clerical Perception	75
K - Motor Coordination	80

Research Summary

Sample:

50 male Stationary Engineers employed in various firms in the Denver metropolitan area.

This study was conducted prior to the requirement of providing minority group information. Therefore, minority group status is unknown.

Criterion:

Supervisory ratings.

Design:

Concurrent (test and criterion data were collected at approximately the same time).

Concurrent Validity:

Phi coefficent = .37 ($P/2 < .005$)

Effectiveness of Norms:

Only 68% of the nontest-selected workers used for this study were good workers; if the workers had been test-selected with the above norms, 82% would have been good workers. Thirty-two percent of the nontest-selected workers used for this study were poor workers; if the workers had been test-selected with the above norms, only 18% would have been poor workers. The effectiveness of the norms is shown graphically in Table 1:

TABLE 1

Effectiveness of Norms

	Without Tests	With Tests
Good Workers	68%	82%
Poor Workers	32%	18%

SAMPLE DESCRIPTION

Size:

N = 50

Occupational Status:

Employed workers.

Work Setting:

Workers were employed by various firms in the Denver, Colorado metropolitan area.

Employer Selection Requirements:

Education: High school graduate.

Previous Experience: None required.

Tests: None used.

Other: Successful completion of a recognized apprenticeship program and licensed by the State of Colorado.

Principal Activities:

The job duties for each worker are comparable to those shown in the job description in the Appendix.

Minimum Experience:

All workers in the sample had at least 2 months of experience with their present employer.

TABLE 2

Means, Standard Deviations (SD), Ranges , and Pearson Product-Moment Correlations with the Criterion (r) for Age, Education and Experience

	Mean	SD	Range	r
Age (years)	42.1	9.4	23-58	.163
Education (years)	11.6	2.3	8-16	.256
Experience (mos) (present employer)	155.9	96.7	2-413	.177

EXPERIMENTAL TEST BATTERY

All 12 tests of the GATB, B-1002B (IBM) were administered during the period September-November, 1962.

CRITERION

The criterion data consisted of supervisory ratings of job proficiency made at approximately the same time as test data were collected. Two sets of independent ratings were made by the supervisors with a two to three week interval between ratings.

Rating Scale:

Form SP-21, "Descriptive Rating Scale" was used. This scale (see Appendix) consists of nine items covering different aspects of job performance. Each item has five alternatives corresponding to different degrees of job proficiency.

Reliability:

The correlation between the two independent ratings was .87. The final criterion consisted of the average of the two sets of ratings.

Criterion Score Distribution:

Possible Range:	9-45
Actual Range:	23.0-43.5
Mean:	33.4
Standard Deviation:	5.5

Criterion Dichotomy:

The criterion distribution was dichotomized into low and high groups by placing 32% of the sample in the low criterion group to correspond with the percentage of workers considered unsatisfactory or marginal. This was approximately one-third of the total sample. Workers in the high criterion group were designated as "good workers" and those in the low group as "poor workers." The criterion critical cutting score is 30.

APTITUDES CONSIDERED FOR INCLUSION IN THE NORMS

Aptitudes were selected for tryout in the norms on the basis of a qualitative analysis of job duties involved and a statistical analysis of test and criterion data. Aptitude S which does not have a high correlation with the criterion was considered for inclusion in the norms because the qualitative analysis indicated that it was important for the job duties and the sample had a relatively high mean score on this aptitude. Tables 3,4, and 5 show the results of the qualitative and statistical analyses.

TABLE 3

Qualitative Analysis
(Based on the job analysis, the aptitudes indicated appear to be important to the work performance)

Aptitudes	Rationale
G - General Learning Ability	Necessary to read and comprehend log book to familiarize self with functioning of all aspects of job; to acquire knowledge in order to diagnose trouble in any part of system and to repair and/or adapt present facilities or install new systems and equipment according to changing needs; to participate in the training of individuals in the apprentice program.
V - Verbal Ability	Necessary to confer with operators; to keep adequate logs and to understand diagnostic manuals.
N - Numerical Aptitude	Necessary for dial reading and understanding the mathematics of automatic controls.
S - Spatial Perception	Necessary to isolate and diagnose malfunctions of equipment and to repair or install new systems.
Q - Clerical Perception	Necessary to make readings from charts or various measuring devices and to record all pertinent information in log.
M - Manual Dexterity	Necessary to operate and maintain necessary equipment and to use various tools.

TABLE 4

Means, Standard Deviations (SD), Ranges, and Pearson Product-Moment Correlations with the Criterion (r) for the Aptitudes of the GATB.

Aptitude	Mean	SD	Range	r
G-General Learning Ability	105.3	17.5	66-153	.247
V-Verbal Aptitude	100.9	16.2	75-148	.164
N-Numerical Ability	101.5	16.4	61-143	.383**
S-Spatial Aptitude	109.0	16.7	58-140	.025
P-Form Perception	92.7	14.4	61-120	-.028
Q-Clerical Perception	97.2	14.3	68-147	.271
K-Motor Coordination	94.8	18.6	58-140	.284*
F-Finger Dexterity	99.2	18.7	52-137	.076
M-Manual Dexterity	100.5	25.0	32-153	.188

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

TABLE 5

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			X
Irrelevant									
Relatively High Mean	X		X	X					
Relatively Low Standard Dev.					X	X			
Significant Correlation With Criterion	X		X			X	X		
Aptitudes to be Considered for Trial Norms	G		N	S		Q	K		

DERIVATION AND VALIDITY OF NORMS

Final norms were derived on the basis of a comparison of the degree to which trial norms consisting of Aptitudes G, N, S, Q, and K at trial cutting scores were able to differentiate between the 68% of the sample considered to be good workers and the 32% of the sample considered to be poor workers. Trial cutting scores at five-point intervals approximately one standard deviation below the mean are tried because this will eliminate about one-third of the sample with three-aptitude norms. For two-aptitude norms, minimum cutting scores of slightly more than one standard deviation below the mean will eliminate about one-third of the sample; for four-aptitude norms, cutting scores of slightly less than one standard deviation below the mean will eliminate about one-third of the sample. The phi coefficient was used as a basis for comparing trial norms. Norms of N-80, S-90, Q-75, and K-80 provided optimum differentiation for the occupation of Stationary Engineer (any ind.) 950.782-054. The validity of these norms is shown in Table 6 and is indicated by a phi coefficient of .37 (statistically significant at the .005 level).

TABLE 6

Concurrent Validity of Test Norms
N-80, S-90, Q-75, and K-80

	Nonqualifying Test Scores	Qualifying Test Scores	Total
Good Workers	7	27	34
Poor Workers	10	6	16
Total	17	33	50

Phi coefficient = .37 Chi square (X^2_y) = 6.75

Significance level = $P/2 < .005$

DETERMINATION OF OCCUPATIONAL APTITUDE PATTERN

The data for this study met the requirements for incorporating the occupation studied into OAP-38 which is shown in the 1970 edition of Section II of the Manual for the General Aptitude Test Battery. A Phi coefficient of .15 is obtained with the OAP-38 norms of N-80, S-85, and K-80.

SP-21

A-P-P-E-N-D-I-X

DESCRIPTIVE RATING SCALE
(For Aptitude Test Development Studies)

Score____

RATING SCALE FOR _____
D. O. T. Title and Code

Directions: Please read Form SP-20, "Suggestions to Raters", and then fill in the items listed below. In making your ratings, only <u>one</u> box should be checked for each question.

Name of Worker (print) _____
(Last) (First)

Sex: Male_____ Female_____

Company Job Title: _____

How often do you see this worker in a work situation?

☐ See him at work all the time.

☐ See him at work several times a day.

☐ See him at work several times a week.

☐ Seldom see him in work situation.

How long have you worked with him?

☐ Under one month.

☐ One to two months.

☐ Three to five months.

☐ Six months or more.

A. How much work can he get done? (Worker's ability to make efficient use of his time and to work at high speed.)

☐ 1. Capable of very low work output. Can perform only at an unsatisfactory pace.

☐ 2. Capable of low work output. Can perform at a slow pace.

☐ 3. Capable of fair work output. Can perform at an acceptable but not a fast pace.

☐ 4. Capable of high work output. Can perform at a fast pace.

☐ 5. Capable of very high work output. Can perform at an unusually fast pace.

B. How good is the quality of his work? (Worker's ability to do high-grade work which meets quality standards.)

☐ 1. Performance is inferior and almost never meets minimum quality standards.

☐ 2. The grade of his work could stand improvement. Performance is usually acceptable but somewhat inferior in quality.

☐ 3. Performance is acceptable but usually not superior in quality.

☐ 4. Performance is usually superior in quality.

☐ 5. Performance is almost always of the highest quality.

C. How accurate is he in his work? (Worker's ability to avoid making mistakes.)

☐ 1. Makes very many mistakes. Work needs constant checking.

☐ 2. Makes frequent mistakes. Work needs more checking than is desirable.

☐ 3. Makes mistakes occasionally. Work needs only normal checking.

☐ 4. Makes few mistakes. Work seldom needs checking.

☐ 5. Rarely makes a mistake. Work almost never needs checking.

D. How much does he know about his job? [illegible] understanding of the principles, equipment, materials and methods that have to do directly or indirectly with his work.)

☐ 1. Has very limited knowledge. Does not know enough to do his job adequately.

☐ 2. Has little knowledge. Knows enough to "get by."

☐ 3. Has moderate amount of knowledge. Knows enough to do fair work.

☐ 4. Has broad knowledge. Knows enough to do good work.

☐ 5. Has complete knowledge. Knows his job thoroughly.

E. How much aptitude or facility does he have for this kind of work? (Worker's adeptness or knack for performing his job easily and well.)

☐ 1. Has great difficulty doing his job. Not at all suited to this kind of work.

☐ 2. Usually has some difficulty doing his job. Not too well suited to this kind of work.

☐ 3. Does his job without too much difficulty. Fairly well suited to this kind of work.

☐ 4. Usually does his job without difficulty. Well suited to this kind of work.

☐ 5. Does his job with great ease. Exceptionally well suited for this kind of work.

F. How large a variety of job duties can he perform efficiently? (Worker's ability to handle several different operations in his work.)

☐ 1. Cannot perform different operations adequately.

☐ 2. Can perform a limited number of different operations efficiently.

☐ 3. Can perform several different operations with reasonable efficiency.

☐ 4. Can perform many different operations efficiently.

☐ 5. Can perform an unusually large variety of different operations efficiently.

G. How resourceful is he when something different comes up or something out of the ordinary occurs? (Worker's ability to apply what he already knows to a new situation.)

☐ 1. Almost never is able to figure out what to do. Needs help on even minor problems.

☐ 2. Often has difficulty handling new situations. Needs help on all but simple problems.

☐ 3. Sometimes knows what to do, sometimes doesn't. Can deal with problems that are not too complex.

☐ 4. Usually able to handle new situations. Needs help on only complex problems.

☐ 5. Practically always figures out what to do himself. Rarely needs help, even on complex problems.

H. How many practical suggestions does he make for doing things in better ways? (Worker's ability to improve work methods.)

☐ 1. Sticks strictly with the routine. Contributes nothing in the way of practical suggestions.

☐ 2. Slow to see new ways to improve methods. Contributes few practical suggestions.

☐ 3. Neither quick nor slow to see new ways to improve methods. Contributes some practical suggestions.

☐ 4. Quick to see new ways to improve methods. Contributes more than his share of practical suggestions.

☐ 5. Extremely alert to see new ways to improve methods. Contributes an unusually large number of practical suggestions.

I. Considering all the factors already rated, and only these factors, how acceptable is his work? (Worker's "all-around" ability to do his job.)

☐ 1. Would be better off without him. Performance usually not acceptable.

☐ 2. Of limited value to the organization. Performance somewhat inferior.

☐ 3. A fairly proficient worker. Performance generally acceptable.

☐ 4. A valuable worker. Performance usually superior.

☐ 5. An unusually competent worker. Performance almost always top notch.

FACT SHEET

Job Title:

Stationary Engineer (any ind.) 950.782-054

Job Summary:

Operates and maintains such equipment as low or high pressure boilers, engines, pumps, air compressors, generators, motors, turbines, and ventilating and refrigeration equipment in factories, office buildings, hospitals, and other types of industry. Keeps records of temperatures, equipment servicing and repair, hours of operation, fuel consumption, analysis of flue gases, and other pertinent information.

Work Performed:

Confers with operators being relieved, or relieving, to be informed, or to inform, about the equipment, special requirements to be fulfilled, and problems encountered.

Reads log book to familiarize self with functioning of all aspects of the job as encountered on the previous shifts. Checks charts, visual gauges, recording devices, and makes physical inspection of equipment as required to insure proper functioning of machinery and output of required services. Maintains closer watch on controls and regulators of the various systems during periods of rapid increase or decrease in required output.

Regulates and controls output of heat, refrigerant, electrical power, steam pressure and other allied auxilliary facilities for the proper operation of any particular type of firm. Takes periodic readings from charts and/or various measuring devices in a central control room or at specific locations throughout the establishment and records in log. Also records any pertinent information such as breakdowns, repairs, change over to auxilliary systems, etc. Makes necessary adjustments by opening or closing valves, or activating electronic devices to correct any unbalance or produce the required change.

Uses knowledge of thermodynamics, internal combustion engines, pumps, heat exchangers, fluid flows, fundamental theory and mathematics of automatic controls, wheatstone bridge, etc., in order to isolate and diagnose trouble in any part of any system throughout the establishment.

Uses acquired knowledge of such trades as plumbing, electricity, machine and motor mechanics, etc., and the use of the tools associated with these trades to repair and/or adapt present facilities or install new systems and equipment according to changing needs of the establishment.

May be required to participate in the training of individuals indentured in an apprenticeship program.

Effectiveness of Norms:

Only 68% of the nontest-selected workers used for this study were good workers; if the workers had been test-selected with the S-357R norms, 82% would have been good workers. Thirty-two percent of the nontest-selected workers used for this study were poor workers; if the workers had been test-selected with the S-357R norms, only 18% would have been poor workers.

Applicability of S-357R Norms:

The aptitude test battery is applicable to jobs which include a majority of duties described above.

GPO 899.423