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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-201 R

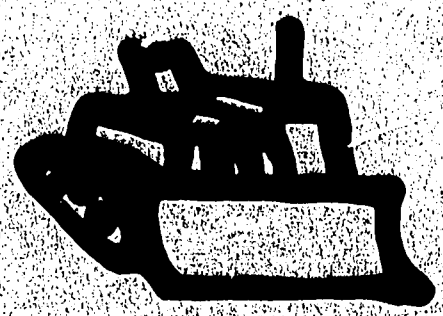
Development of USTES

APTITUDE TEST BATTERY FOR

CONSTRUCTION-EQUIPMENT MECHANIC

(const.)
620.281

U.S. DEPARTMENT OF LABOR
Manpower Administration



Technical Report on Development of USTES Aptitude Test Battery

For . . . .

Construction - Equipment Mechanic (const.) 620.281

S-201R

(Developed in Cooperation with the
Tennessee 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 #2338

Development of USTES Aptitude Test Battery

For

Construction - Equipment Mechanic (const.) 620.281-046

S-201R

This report describes research undertaken for the purpose of developing General Aptitude Test Battery (GATB) norms for the occupation of Construction-Equipment Mechanic (const.) 620.281-046. The following norms were established:

GATB Aptitudes	Minimum Acceptable GATB Scores
N - Numerical Aptitude	75
S - Spatial Aptitude	85
F - Finger Dexterity	75

Sample:

50 male workers employed as Construction - Equipment Mechanics in Tennessee. This study was conducted prior to the requirement of providing minority group status. Therefore, minority group composition is unknown.

Criterion:

Supervisory ratings.

Design:

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

Minimum aptitude requirements were determined on the basis of a job analysis and statistical analyses of aptitude mean scores, aptitude-criterion correlations and selective efficiencies.

Concurrent Validity:

Phi Coefficient = .31 ($P/2 < .025$)

Effectiveness of Norms:

Only 66% of the nontest-selected workers used for this study were good workers; if the workers had been test-selected with the above norms, 77% would have been good workers. Thirty-four 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 23% would have been poor workers. The effectiveness of the norms is shown graphically in Table 1:

TABLE I

Effectiveness of Norms

	Without Tests	With Tests
Good Workers	66%	77%
Poor Workers	34%	23%

SAMPLE DESCRIPTION

Size:

N = 50

Occupational Status:

Employed Workers.

Work Setting:

Workers were employed by the Power Equipment Company in Knoxville, Nashville, Chattanooga and Kingsport, Tennessee.

Employer Selection Requirements:

Age : Eighteen years of age or older preferred.

Education: High school education preferred,

Previous Experience: None required.

Tests: None used.

Other: Personal interview.

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 final sample had at least five months job experience.

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)	33.0	7.9	20-52	.344*
Education (years)	10.2	2.0	6-14	-.145
Experience (months)	78.4	46.7	5-184	.386**

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

Although Table I shows that the final criterion correlates significantly with the experience, the fact that separate ratings made by the Service Manager and Shop Foreman (criterion I and criterion II) each correlate significantly with experience is somewhat indicative of a true relationship between job performance and experience. Since age and experience on the job are typically related, one would expect these two variables to be similarly related to job performance.

EXPERIMENTAL TEST BATTERY

All 12 tests of the GATB, B-1002B, were administered during August 1970.

CRITERION

The criterion data consisted of supervisory ratings of job proficiency made at approximately the same time as the tests were administered. Criterion I consisted of ratings of workers in each of the four branches by their respective service manager. Criterion II consisted of ratings of workers in each branch by their respective shop foreman.

Rating Scale:

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

Reliability:

A reliability coefficient of .794 was obtained between the service managers' ratings and the shop foremens' rating. Therefore, these criteria were combined to obtain a final criterion.

Criterion Score Distribution:

Possible Range:	18-90
Actual Range:	42-87
Mean:	63.5
Standard Deviation:	10.7

Criterion Dichotomy:

The criterion distribution was dichotomized into low and high groups by placing 34% of the sample in the low group to correspond with the percentage of workers considered unsatisfactory or marginal. Workers in the high criterion group were designated as "good workers" and those in the low group as "poor workers." The criterion critical score is 57.

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 analyses of test and criterion data. Aptitudes S and F which do not have high correlations with the criterion, were considered for inclusion in the norms because the qualitative analysis indicated that the aptitudes might be important for the job duties and the sample had relatively high mean scores on these aptitudes. Aptitude N was considered for inclusion in the trial norms because Aptitude G which qualified for consideration, was eliminated from consideration in this reanalysis in order to minimize the verbal requirements of the battery. (In the composition of Aptitude G, arithmetic reasoning has the highest factor loading.) 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	Required in understanding instructions, in understanding underlying priciples of equipment and sub-assemblies thereof, and in making judgments.
S - Spatial Aptitude	Required in comprending the relationship of parts in assemblies when working with these assemblies and diagrams thereof.
P - Form Perception	Required in making visual comparisons and discriminations and in seeing slight differences in many and various parts; to visually inspect parts for wear, improper adjustment or broken sections. Required in the selection of proper tools or equipment to remove or replace unit or parts.
F - Finger Dexterity	Required to move tools and equipment skillfully.
M - Manual Dexterity	Required in moving the hand easily and skillfully when handling tools and parts and when operating equipment.

TABLE 4

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

	Mean	SD	Range	r
G - General Learning Ability	92.9	13.2	61-137	.110
V - Verbal Aptitude	91.7	13.9	63-125	.112
N - Numerical Aptitude	87.6	13.4	45-120	.084
S - Spatial Aptitude	97.3	16.3	65-133	.089
P - Form Perception	89.8	17.4	56-126	.146
Q - Clerical Perception	90.7	13.2	61-126	.075
K - Motor Coordination	84.5	19.6	24-128	-.082
F - Finger Dexterity	93.8	21.0	38-143	.045
M - Manual Dexterity	90.9	23.5	5-135	.039

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

DERIVATION AND VALIDITY OF NORMS

Final norms were derived on the basis of the degree to which trial norms consisting of various combinations of aptitudes G, N, S and F at trial cutting scores were able to differentiate between the 66% of the sample considered to be good workers and the 34% 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 four-aptitude trial norms, cutting scores of slightly less than one standard deviation

below the mean will eliminate about one-third of the sample; for two-aptitude trial norms, minimum cutting scores of slightly more 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-75, S-85 and F-75 provided optimum differentiation for the occupation of Construction-Equipment Mechanic (const.) 620.281-046. The validity of these norms is shown in Table 6 and is indicated by a Phi Coefficient of .31 (statistically significant at the .025 level).

TABLE 6

Concurrent Validity of Test Norms
N-75, S-85 and F-75

	Nonqualifying Test Scores	Qualifying Test Scores	Total
Good Workers	6	27	33
Poor Workers	9	8	17
Total	15	35	50

Phi Coefficient = .31 Chi Square (X^2y) = 4.9

Significance Level = $P/2 < .025$

DETERMINATION OF OCCUPATIONAL APTITUDE PATTERN

The data for this study, did not meet the requirements for incorporating the occupation studied into an OAP. However, the occupation was placed in OAP-35 which is shown in the 1970 edition of Section II of the Manual for the General Aptitude Test Battery as a result of the qualitative analysis.

SP-21
Rev. 2/61

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 <u>ability</u> 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? (Worker's 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.

June 1970 S-201R

FACT SHEET

Job Title

Construction-Equipment Mechanic (const.) 620.281-046

Job Summary

Assembles, adjusts and maintains construction equipment, such as crawler or wheel-type tractors, power shovels and cranes, internal-combustion engines, air compressors, pumps and concrete mixers. Determines operating condition of equipment. Disassembles to reach defective parts, repairs or replaces parts and reassembles. Submits to supervisor written report indicating such things as equipment worked on, time on job, condition or malfunction, corrective action, and parts used.

Work Performed

Receives job order from service manager for each work assignment. Performs various inspection, maintenance and repair activities on equipment brought into the maintenance and repair shop, or, when conditions permit or demand, will perform this work at construction locations in which case service manager's supervision is at minimum. Reviews repair order and plans work: locates equipment, starts engine if possible, and operates equipment to check out is effective operation and determine malfunction and performance. May supervise and/or assist in the loading and unloading of equipment on a transporting conveyance. Moves equipment to shop area for repair procedures. Removes any or all units necessary to reach defective parts. Visually inspects parts for wear, improper adjustment, or broken sections. Uses hand tools and/or hoisting equipment to remove and replace various units.

Disassembles, repairs or replaces defective parts, and reassembles component assemblies of construction equipment such as cooling systems, engines, electrical systems, clutches, transmissions, differentials, final drives, and handbooks to diagnose malfunction, and/or determine disassembly or assembly procedures. Either removes or has removed by Motor Shop entire engine assembly when repair or overhaul is necessary.

Orders through parts clerk all replacement parts for equipment being repaired, utilizing knowledge of nomenclature of construction equipment parts. Uses equipment manufacturer's guides and handbooks to properly identify parts by size, part number model, etc. Accepts responsibility for ordering correct parts through the parts clerk and of recording charge to customer or job. Prepares a complete writen report on all work performend on a job. Gives detailed explanation of conditions, failures, and corrective action. Makes delivery and, after delivery, makes service calls on new equipment. Demonstrates and gives instructions in the proper operation and maintenance of all equipment sold by the company.

Assigns duties and oversees work of one or more construction equipment mechanic trainees or helpers. Makes complete machine inspection for repair job estimation or trade allowance purposes.

Effectiveness of Norms

Only 66% of the nontest-selected workers used for this study were good workers; if the workers had been test-selected with the S-201R norms, 77% would have been good workers. Thirty-four percent of the nontest-selected workers used for this study were poor workers; if the workers had been test-selected with the S-201R norms, only 23% would have been poor workers.

Applicability of S-201R Norms

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

GPO 898.809