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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-262R

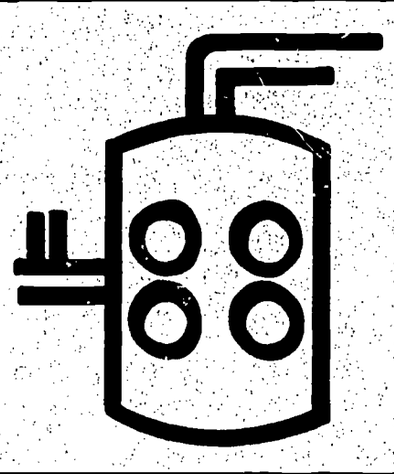
Development of USTES

APTITUDE TEST BATTERY FOR

BOILERMAKER

(boilermaking)I
805.281

U.S. DEPARTMENT OF LABOR
Manpower Administration



Technical Report on Development of USTES Aptitude Test Battery

For . . . .

Boilermaker (boilermaking) I 805.281-010

S-262R

(Developed in Cooperation with the Tennessee,
Kentucky, and Alabama State Employment Services)

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 #2438

Development of USTES Aptitude Test Battery
for
Boilermaker (boilermaking) I 805.281-010
S-262R

This report describes research undertaken for the purpose of developing General Aptitude Test Battery (GATB) norms for the occupation of Boilermaker (boilermaking) I 805.281-010. The following norms were established:

GATB Aptitudes	Minimum Acceptable GATB Scores
N-Numerical Aptitude	70
S-Spatial Aptitude	80
Q-Clerical Perception	70
M-Manual Dexterity	70

Research Summary

Sample:

81 male workers employed as Boilermakers at six Tennessee Valley Authority Steam Plants in Tennessee, Kentucky, and Alabama. 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).

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 = .33 ($P/2 < .005$)

Effectiveness of Norms:

Only 67% of the nontest-selected workers used for this study were good workers; if the workers had been test-selected with the above norms, 78% would have been good workers. Thirty-three 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 22% 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	67%	78%
Poor Workers	33%	22%

SAMPLE DESCRIPTION

Size:

N = 81

Occupational Status:

Employed Workers.

Work Setting:

Workers were employed by six Tennessee Valley Authority Steam Plants in Tennessee, Kentucky, and Alabama.

Employer Selection Requirements:

Education: None required.

Previous Experience: None required.

Tests: None used.

Other: Age of 18-25 years for inexperienced applicants and 18-29 for experienced applicants.

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 four years 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)	42.1	7.9	27-61	-.203
Education (years)	11.4	1.5	9-16	.240*
Experience (months)	140.8	66.3	52-408	-.218*

*Significant at the .05 level.

EXPERIMENTAL TEST BATTERY

All 12 tests of the GATB, B-1002B, were administered during the period March 10 to December 18, 1962.

CRITERION

The criterion data consisted of supervisory ratings of job proficiency made at approximately the same time as the tests were administered with a time interval of two weeks between the two ratings. The immediate supervisor rated each worker.

Rating Scale:

Form SP-21 "Descriptive Rating Scale" was used. The scale (see Appendix) consits 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 .88 was obtained between the initial ratings and the re-ratings, indicating a significant relationship. The final criterion score consists of the combined scores of the two ratings.

Criterion Score Distribution:

Possible Range:	18-90
Actual Range:	32-90
Mean:	59.8
Standard Deviation:	12.9

Criterion Dichotomy:

The criterion distribution was dichotomized into low and high groups by placing 33% 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 54.

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. Aptitudes N and S which do not have a significant correlation with the criterion were considered for inclusion in the norms because the qualitative analyses indicated that these aptitudes were important for the job duties and the sample had a relatively low standard deviation for aptitude N and a relatively high mean score for aptitude S. Aptitude M was considered for inclusion in the norms because it was considered of critical importance to the job duties. Tables 3, 4, and 5 show the results of the qualitative and statistical analysis.

TABLE 3
Qualitative Analysis
(Based on the job analysis, the aptitudes indicated appear to be important to the work performance)

Aptitude	Rationale
G-General Learning Ability	Required in acquiring knowledge of and skill in the craft.
N-Numerical Aptitude	Required in applying knowledge of geometry in locating and marking reference points of columns or plates on foundations and fitting structures; and in determining pressure limits.
S-Spatial Aptitude	Required in reading blueprints, sketches and drawings; and in judging space when installing boilers, pressure vessels and tanks.
P-Form Perception	Required in inspecting equipment to ascertain need for repairs; and in shop sketching and drafting.
M-Manual Dexterity	Required in aligning and fitting structures or plate sections in assembling boiler frames, in using plumb bobs, levels, wedges, dogs, and turn buckles; and in riveting, welding and calking.

TABLE 4

Means, Standard Deviations (SD), Ranges and Pearson Product-Moment Correlations with the Criterion (r) for the Aptitudes of the GATB; N=~~59~~ 91

	Mean	SD	Range	r
G - General Learning Ability	95.9	14.3	68-134	.257*
V - Verbal Aptitude	93.4	11.7	77-132	.240*
N - Numerical Aptitude	92.0	14.5	66-131	.212
S - Spatial Aptitude	98.8	17.9	64-150	.185
P - Form Perception	87.6	16.8	37-136	.140
Q - Clerical Perception	86.6	12.8	58-120	.267*
K - Motor Coordination	88.2	18.3	53-138	.184
F - Finger Dexterity	86.2	20.6	44-144	.207
M - Manual Dexterity	86.5	21.3	26-138	.166

* Significant at the .05 level

TABLE 5

Summary of Qualitative and Quantitative Data

Type of Evidence	Aptitudes G	V	N	S	P	Q	K	M
Job Analysis Data								
Important	X		X	X	X			X
Irrelevant								
Relatively High Mean	X	X		X				
Relatively Low Standard Deviation	X	X	X			X		
Significant Correlation with Criterion	X	X				X		
Aptitudes to be Considered for Trial Norms	G	V	N	S		Q		M*

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 at trial cutting scores were able to differentiate between the 67% of the sample considered to be good workers and the 33% 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 socres 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-70, S-80, Q-70, and M-70 provided optimum differentiation for the occupation of Boilermaker(boilermaking) I 805.281-010. The validity of these norms is shown in Table 6 and is indicated by a Phi Coefficient of .33 (statistically significant at the .005 level).

TABLE 6

Concurrent Validity of Test Norms

	Nonqualifying Test Scores	Qualifying Test Scores	Total
Good Workers	12	42	54
Poor Workers	15	12	27
Total	27	54	81

Phi Coefficient = .33 Chi Square (X^2_y) = 8.7

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-37 which is shown in the 1970 edition of Section II of the Manual for the General Aptitude Test Battery. A Phi Coefficient of .21 is obtained with the OAP-37 norms of N-80, S-95, M-85.

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 one 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? (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.

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FACT SHEET

Job Title

Boilermaker (boilermaking) I 805.281-010

Job Summary

Erects, installs, repairs or maintains boilers, pressure vessels, tanks, and accessories such as superheaters, economizers, coal and ash handling equipment, heaters, coal bunkers, burners and evaporators using blueprints, sketches, drawings and other instructions under the supervision of a foreman.

Work Performed

Locates and marks reference points of columns or plates on foundation by applying knowledge of geometry and using master straight edge, squares, transit and measuring tape. Sets up rigging or signals crane operator to lift parts to specified position. Aligns and fits structures or plate sections to assemble boiler frame, tanks, vessels or other structures, using plumb bobs, levels, wedges, dogs, turn buckles, and other boilermaker tools. Hammers, cuts, files or grinds irregular sections or structures to fit together. Rivets, bolts, or welds structures and sections together. Positions drums and headers into supports which are bolted or welded to frame. Aligns and connects tubes to drums and headers, using tube expander. Bells, beads with power hammer, or welds tube ends to insure leakproof joints. Bolts or welds casing sections, uptakes, stacks, baffles and such fabricated parts as chutes, air heaters, fan stands, feeding tube, catwalks, ladders, coal hoppers and safety hatch to frame. Installs manholes, handholds, valves, gauges, and feedwater connection in drums to complete assembly of watertube boilers. Assists foreman in testing boilers, tanks, vats, and pressure vessels by pumping in water or gas to specified pressure. Inspects equipment to ascertain need for repairs. Repairs boilers, tanks, accessory equipment by unbolting or cutting defective sections or tubes, straightening plates with torch and/or jacks, installing new or rebuilt parts, fitting and welding new sections and replacing worn lugs or bolts. May rivet and calk sections of vessels using pneumatic riveting and calking hammers. May fabricate such parts as stacks, uptakes, ducts, penstocks, chutes and other plate work. Directs the work of boilermaker helpers, laborers, apprentices and acts as lead man over another boilermaker as assigned.

Effectiveness of Norms

Only 67% of the non-test-selected workers used for this study were good workers; if the workers had been test-selected with the S-262 norms, 78% would have been good workers. 33% of the non-test-selected workers used for this study were poor workers; if the workers had been test-selected with the S-262 norms, only 22% would have been poor workers.

Applicability of S-262R Norms

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

GPO 896-543

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