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ABSTRACT

The United States Training and Employment Service Teneral 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-340R

Development of USTES

APTITUDE TEST
BATTERY FOR

STEAM-POWER-PLANT OPERATOR

(light, heat & power)
952.782

U.S. DEPARTMENT OF LABOR
Manpower Administration

Technical Report on Development of USTES Aptitude Test Battery

For . . . . . .

Steam-Power-Plant Operator

(light, heat & power) 952.782-040

S-340P

(Developed in Cooperation with the
California State Employment Service)

Manpower Administration
U.S. Department of Labor

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 #2547

DEVELOPMENT OF USTES APTITUDE TEST BATTERY

for

Steam-Power-Plant Operator (light, heat & power) 952.782-040

S-340R

This report describes research undertaken for the purpose of developing General Aptitude Test Battery (GATB) norms for the occupation of Steam-Power-Plant Operator (light, heat & power) 952.782-040. The following norms were established:

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

Sample:

120 males employed as Steam-Power-Plant Operators in California. This study was conducted prior to the requirement of providing minority group information. 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, standard deviations, aptitude-criterion correlations and selective efficiencies.

Concurrent Validity:

Phi coefficient = .40 ($P/2 < .0005$)

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, 81% would have been good workers. 34% of the nontest-selected workers used for this study were poor workers; if the workers had been test-selected with the above norms, only 19% 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	66%	81%
Poor Workers	34%	19%

SAMPLE DESCRIPTION

Size:

N = 120

Occupational Status:

Employed workers.

Work Setting:

Workers were employed by the Los Angeles City Department of Water and Power.

Employer Selection Requirements:

Education: High school diploma or its equivalent.

Previous Experience: None required.

Tests: None specified.

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 study had at least eight months total job experience.

TABLE 2

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

	Mean	SD	Range	r
Age (years)	40.4	10.3	21-61	-.174
Education (years)	12.0	1.3	8-16	.054
Experience (months)	71.9	48.6	8-212	-.112

EXPERIMENTAL TEST BATTERY

All the tests of the GATB, B-1002B, were administered to the sample group during the period of May through June 1964.

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:

An adaptation of USTES Form SP-21, "Descriptive Rating Scale" was used. The scale consisted of eight items. Each item has five alternative responses corresponding to different degrees of job proficiency.

Reliability:

A reliability coefficient of .93 was obtained between the initial ratings and the reratings, indicating a significant relationship. The final criterion consists of the combined scores of the two ratings.

Criterion Score Distribution:

Possible Range:	16-80
Actual Range:	17-80
Mean:	56.3
Standard Deviation:	10.8

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 51.

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. 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 performed)

Aptitude	Rationale
G - General Learning Ability	Required to understand principles and methods and to learn procedures involved in the direction and control of steam-electric generating units from a central control room.
V - Verbal Aptitude	Required to understand instructions set forth in station instruction bulletins, clearance orders, and OK to work orders, and understand oral status reports. Required to read and comprehend information contained in the various station logs, and enter concise and meaningful information in station logs. Must be able to communicate with load dispatcher. Must be able to instruct equipment operators and direct and control the work of subordinates.
P - Form Perception	Required to perceive pertinent detail when reading dials, gages, and recording meter graphs. Required to observe that indicating signal lights, meters, and gages are in agreement with the settings of remote control devices. Required to view combustion shadings and pattern characteristics of flames on closed circuit television. Required to inspect station equipment and related systems, detect abnormalities, and take corrective measures.
Q - Clerical Perception	Required to read indicating meters, gages, and recording devices, and to accurately record readings obtained on daily operating reports. Required to perceive pertinent details contained in clearance and OK to work orders.
M - Manual Dexterity	Required to operate and adjust remote control and manually actuated devices in accordance with planned or emergency switching sequences and to place equipment in or out of service.

TABLE 4

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

N = 120

G - General Learning Ability	111.4	13.2	83-151	.354**
V - Verbal Aptitude	107.2	13.9	73-144	.276**
N - Numerical Aptitude	105.7	13.8	80-143	.242**
S - Spatial Aptitude	112.7	16.3	73-168	.228*
P - Form Perception	99.7	18.0	58-139	.263**
Q - Clerical Perception	103.7	14.6	75-143	.214*
K - Motor Coordination	99.0	14.9	56-132	.239**
F - Finger Dexterity	85.0	20.4	29-135	.291**
M - Manual Dexterity	100.6	22.7	44-150	.244**

*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
Irrelevant									
Relatively High Mean	X	X		X					
Relatively Low Sigma	X	X	X			X			
Significant Correlation With Criterion	X	X	X	X	X	X	X	X	X
Aptitudes to be Considered for Trial Norms	G	V	N	S	P	Q	K	F	M

DERIVATION AND VALIDITY OF NORMS

Final norms were derived on the basis of a comparison of the degree to which trial norms consisting of various combinations of G, V, N, S, P, Q, K, F, and M at trial cutting scores were able to differentiate between the 66% of the sample considered good workers and 34% of the sample considered 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 trial 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 trial 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. The optimum differentiation for the occupation of Steam-Power-Plant Operator (light, heat & power) 952.782-040 was provided by the norms of N-85, S-85, K-85 and F-75. The validity of these norms is shown in Table 6 and is indicated by a phi coefficient of .40 (statistically significant at the .0005 level).

TABLE 6

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

	Nonqualifying Test Scores	Qualifying Test Scores	Total
Good Workers	18	61	79
Poor Workers	27	14	41
Total	45	75	120

Phi coefficient (ϕ) = .40 Chi square (X^2_y) = 19.6

Significance level = $P/2 < .0005$

DETERMINATION OF OCCUPATIONAL APTITUDE NORMS

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 .16 is obtained with the OAP-38 norms of N-80, S-85, and K-80.

SP-21
Rev. 2/61

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 accomplish? (Operator's ability to organize job duties and make efficient use of his time.)

( ) 1. Capable of poor work output. Can perform only at a very slow rate.

( ) 2. Capable of fair work output. Can perform only at a slow rate.

( ) 3. Capable of good work output. Can perform at a fast rate.

( ) 4. Capable of high work output. Can perform at a very fast rate.

( ) 5. Capable of extremely high work output. Can perform at an unusually fast rate.

B. How accurate is he in his work? (Operator's ability to read meters and other indicating devices on control board and record readings which vary from normal. His ability to maintain accurate station logs.)

( ) 1. Makes many errors. Work needs constant checking.

( ) 2. Makes frequent errors. Work needs more checking than is desirable.

( ) 3. Makes errors occasionally. Work needs only normal checking.

( ) 4. Makes few errors. Work seldom needs checking.

( ) 5. Rarely makes an error. Work almost never needs checking.

C. How much does he know about his job? (Operator's understanding of the principles, equipment and methods of operation that are involved directly or indirectly with his work.)

( ) 1. Has very limited knowledge. Does not know enough to do adequate work.

( ) 2. Has limited knowledge. Knows enough to "get by".

( ) 3. Has moderate knowledge. Knows enough to do fair work.

( ) 4. Has broad knowledge. Knows enough to do good work.

( ) 5. Has complete knowledge. Knows his work thoroughly.

D. How quickly did he learn the job duties and new tasks or operations? (Operator's ability to learn rapidly the work he has to do.)

( ) 1. Learned very slowly. Needed careful and repeated instructions.

( ) 2. Somewhat slower than most operators in learning the job and in grasping new phases of the work.

( ) 3. Learned most things about his job in the usual amount of time.

( ) 4. Learned job duties more quickly than most operators.

( ) 5. Learned rapidly. Needed only the minimum amount of instructions for even the difficult job duties.

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

( ) 1. Has great difficulty doing his job. Not suited to this kind of work.

( ) 2. Has some difficulty doing his job. Is minimally 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 resourceful is he when something different or out of the ordinary occurs? (Operator's ability to apply what he already knows to a new situation.)

( ) 1. Very unresourceful. Almost never is able to decide on a course of action without assistance.

( ) 2. Unresourceful. Often has difficulty handling new situations. Needs assistance on all but simple situations.

( ) 3. Fairly resourceful. Sometimes knows what to do, sometimes doesn't. Can deal with situations that are not too complex.

( ) 4. Resourceful. Usually able to handle new situations.

( ) 5. Very resourceful. Practically always resolves what to do when confronted with new situations. Rarely needs assistance.

G. How well and accurate does he communicate with others? (Operator's ability to understand and give instructions; to give adequate instructions or reports on abnormal or hazardous conditions; and to give and receive messages via telephone and/or radio.)

( ) 1. Has a good deal more difficulty than most in maintaining clear communication with others.

( ) 2. Has trouble with communication. Sometimes is confused or confuses others.

( ) 3. Satisfactory. Usually gives and takes information fairly accurately.

( ) 4. Better than average. Seldom has any difficulty with communication.

( ) 5. Excels in understanding and making himself understood.

H. Considering all the factors already rated, and only these factors, how satisfactory is his work? (Operator's "all-around" ability to perform his job.)

( ) 1. Unsatisfactory. Performance usually not acceptable. Probably would not be kept in the event of a reduction in force.

( ) 2. Not completely satisfactory. Of limited value to the organization. Performance occasionally not acceptable.

( ) 3. Satisfactory. A fairly proficient worker. Performance generally acceptable.

( ) 4. Good. A valuable operator. Performance usually excellent.

( ) 5. Outstanding. An unusually competent operator. Performance usually superior.

June 1970 S-340 R

FACT SHEET

Job Title

Steam-Power-Plant Operator (light, heat & power) 952.782-040

Job Summary

Controls steam-electrical generating unit from central station, and maintains station logs and operating reports.

Work Performed

Confers with operator of previous shift and observes settings on control board to determine operational status of boiler unit, turbo-generator unit, electrical unit, and related equipment. Compares settings on control board with illuminated signal lights to determine if units are functioning according to settings. Reads log entries from previous shift to detect unusual switching operations or equipment being placed in or out of service.

Reads meters and gages on control boards to determine if combustion control, rate of water flow, and steam pressure are being maintained at specified temperatures and pressures, and if generator is operating and electric current if flowing at specified voltage and amperage. Adjusts remote control devices to regulate fuel-air ratios, temperatures, and pressures. Views flame of boiler fuel burners on closed circuit television, and turns combustion control knobs to restore flame pattern to specification. Reads boiler drum water level gage and adjusts controls to maintain specified level. Observes synch roscope and synchronizing voltmeters on generator recorder board to ascertain if generator voltage output is in cyclic phase with power distribution network. Turns controls to trip generator out of service when meters indicate out-of-phase condition. Turns controls to regulate generator and regain synchronism with network, and closes switch at point where synchronism indicates balanced phase relationship between generator and network.

Reads indicating meter, gages, and recording devices at times specified by station instruction bulletin, and records readings on daily operating reports. Records in log such data as switching and flame control actions, cable connection sites, work clearance and O.K. to work order activities, and switch or turbine shutdown time.

Studies clearance and O.K. to work orders to determine type and location of repair, maintenance, or construction to be done. Evaluates switching steps necessary to execute order to insure that order, when executed, will not disturb non-related circuits, circuit components, or equipment. Plans switching sequence to provide specified disconnections, and rotates knobs in accordance with switching plan. Observes meters and signal lights before and after each switching step to ascertain that de-energizing is proceeding

according to plan. Opens and locks in position manual switches. Records time switches were opened, type of switches, and location of switches on station remote control switching form. Releases clearance or O.K. to work orders to person responsible for work.

Confers with station operators and reviews station logs to determine operational status of mechanical and electrical systems and related equipment and to detect unusual switching actions preparatory to inspecting stations. Inspects electro-mechanical and related generating and auxiliary equipment and observes metering instruments and pressure, temperature, level, and tension gages to detect such malfunctions as abnormal heat or noise or leaks in steam, fuel, air, and water lines and valves. Manipulates hand controls or notifies central control to shut down and isolate defective equipment. Operates controls needed to adjust and correct malfunction. Notifies central control of types of corrections or alterations made.

Effectiveness of Norms

Only 66% of the non-test-selected workers used for this study were good workers; if the workers had been test-selected with the S-340 R norms, 81% would have been good workers. 34% of the non-test-selected workers used for this study were poor workers; if these workers had been test-selected with the S-340 R norms, only 19% would have been poor workers.

Applicability of S-340 R Norms

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

GPO 898.733