DOCUMENT RESUME

ED 061 308 TM 001 476

TITLE	Electronics Mechanic (Electronics) 726.281 -- Technical Report on Development of USTES Aptitude Test Battery.
INSTITUTION	Manpower Administration (DOL), Washington, D.C. U.S. Training and Employment Service.
REPORT NO	TR-S-103R
PUB DATE	Jun 70
NOTE	16p.
EDRS PRICE	MF-$0.65 HC-$3.29
DESCRIPTORS	*Aptitude Tests; *Cutting Scores; Electronics Industry; *Electronic Technicians; Evaluation Criteria; Job Applicants; *Job Skills; Norms; Occupational Guidance; *Personnel Evaluation; Test Reliability; Test Validity
IDENTIFIERS	Electronics Mechanic; GATB; *General Aptitude Test Battery

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 whic 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)

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June 1970

U.S. Training and
Employment Service
Technical Report
S-103 R

Development of USTES

APTITUDE TEST BATTERY FOR ELECTRONICS MECHANIC

(electronics)
726.281

U.S. DEPARTMENT OF LABOR
Manpower Administration

Technical Report on Development of USTES Aptitude Test Battery

For . . . .

Electronics Mechanic (electronics) 726.281

S-103R

(Developed in Cooperation with the
California 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 #2129

Development of USTES Aptitude Test Battery

For

Electronics Mechanic (electronics) 726.281-016

S-103R

This report describes research undertaken for the purpose of developing General Aptitude Test Battery (GATB) norms for the occupation of Electronics Mechanic (electronics) 726.281-016. The following norms were established:

GATB Aptitudes	Minimum Acceptable GATB Scores
S - Spatial Aptitude	95
P - Form Perception	90
M - Manual Dexterity	95

Research Summary

Sample:

50 male workers employed as Electronics Mechanics in California.

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 Coefficient = .54 ($P/2 < .0005$)

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, 90% 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 10% 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%	90%
Poor Workers	34%	10%

SAMPLE DESCRIPTION

Size:

N = 50

Occupational Status:

Employed Workers.

Work Setting:

Workers were employed by the Hawthorne, California plant of **Northrup** Aircraft, Inc.

Employer Selection Requirements:

Education: High school graduation with additional training in electronics preferred.

Previous Experience: Prior experience and training in electronics preferred.

Tests: The company's basic electronics test.

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 fifteen months total job experience.

TABLE 2

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

	Mean	SD	Range	r
Age (years)	30.2	6.6	22-48	-.099
Education (years)	12.4	1.5	9-16	.077
Plant Experience (months)	15.2	11.1	1-43	.311*
Total Experience (months)	46.3	19.8	15-137	.245

*Significant at the .05 level.

EXPERIMENTAL TEST BATTERY

All 12 tests of the GATB, B-1002A were administered during June 1956.

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 or more between the two ratings. The immediate supervisor rated each worker.

Rating Scale:

A descriptive rating scale was developed based on items considered by the Supervisor of Training and by Department Supervisors to be important for successful performance as an Electronics Mechanic. There were nine ratable traits in the rating scale with possible scores on each item ranging from 1-5. **Seven of these items are shown in the Appendix.**

Reliability:

A reliability coefficient of .85 was obtained between the initial ratings and the re-ratings, indicating a significant relationship. The final criterion score consists of the averaged scores of the two ratings.

Criterion Score Distribution:

Possible Range:	9-45
Actual Range:	18-41
Mean:	31.3
Standard Deviation:	5.7

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 29.

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 N which does not have a high correlation with the criterion was considered for inclusion in the norms because the qualitative analysis indicated that the aptitude might be important for the job duties and the sample had relatively high mean score and low standard deviation on this aptitude. Aptitude M which does not have a significant correlation with the criterion was considered for inclusion in the trial 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 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 for learning and applying electronic theory, reasoning and making judgments involved in experimental and developmental work, and in understanding the operation of complicated test equipment.
N - Numerical Aptitude	Required in the calculation of dimensions and also in being able to apply the fundamentals of algebra, geometry, and trigonometry as needed in the performance of the duties of this job.
S - Spatial Aptitude	Required in relating blueprints and diagrams to the duties of the job such as fitting objects into proper place when doing assembly and installation work and recognizing the relationships of the components to the chassis for final installations.
P - Form Perception	Required in the inspection of wiring and component assemblies.
K - Motor Coordination	Required to use tool and equipment efficiently.
F - Finger Dexterity	Required to manipulate precision measuring instruments into correct position and adjust them correctly to assure accurate reading.
M - Manual Dexterity	Required in the use of small hand tool and other equipment needed for assembly and installation work.

TABLE 4

Means, Standard deviations (SD), Ranges and Pearson Product-Moment Correlations with the Criterion (r) for the Aptitudes of the GATB; N=50

Aptitudes	Mean	SD	Range	r
G-General Learning Ability	118.8	12.3	94-146	.403**
V-Verbal Aptitude	114.5	13.8	78-141	.272
N-Numerical Aptitude	114 3	10.0	93-134	.113
S-Spatial Aptitude	116.2	20.7	74-166	.353*
P-Form Perception	107.0	15.3	73-144	.298*
Q-Clerical Perception	107.6	13.2	66-134	.210
K-Motor Coordination	111.8	16.2	76-148	.006
F-Finger Dexterity	107.6	16.2	78-153	-.071
M-Manual Dexterity	106.1	19.4	67-149	.011

*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	X*
Irrelevant									
Relatively High Mean	X	X	X	X					
Relatively Low Standard Dev.			X			X			
Significant Correlation With Criterion	X			X	X				
Aptitudes to be Considered for Trial Norms	G		N	S	P				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 G,M,S,P and M 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 S-95, P-90, and M-95 provided optimum differentiation for the occupation of Electronics Mechanic (electronics) 726.281-016. The validity of these norms is shown in Table 6 and is indicated by a phi coefficient of .54 (statistically significant at the .0005 level).

TABLE 6

Concurrent Validity of Test Norms
S-95, P-90, and M-95

	Nonqualifying Test Scores	Qualifying Test Scores	Total
Good Workers	7	26	33
Poor Workers	14	3	17
Total	21	29	50

Phi coefficient = .54 Chi square (X^2_y) = 14.8

Significance level = $P/2 < .0005$

DETERMINATION OF OCCUPATIONAL APTITUDE PATTERN

The data for this study met the requirements for incorporating the occupation studied into OAP-35 which is shown in the 1970 edition of Section II of the Manual for the General Aptitude Test Battery. A Phi coefficient of .22 is obtained with the OAP-35 norms of N-85, S-95, and F-80.

HOW MUCH WORK DOES HE GET DONE? (Worker's ability to make efficient use of his time and to work at high speed.)

( ) Very low work output. Performs only at an unsatisfactory pace.

( ) Low work output. Performs at a slow pace.

( ) Fair work output. Performs at an acceptable but not a fast pace.

( ) High work output. Performs at a fast pace.

( ) Very high work output. Performs at an unusually fast pace.

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.)

( ) Has very limited knowledge. Does not know enough to do his job adequately.

( ) Has little knowledge. Knows enough to "get by."

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

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

( ) Has almost complete knowledge. Knows enough to do outstanding work.

HOW LARGE A VARIETY OF HIS ASSIGNED JOB DUTIES CAN HE PERFORM EFFICIENTLY? (Worker's ability to handle several different operations in his work.)

( ) A very limited variety. Cannot perform different operations adequately.

( ) A small variety. Performs few different operations efficiently.

( ) A moderate variety. Performs some different operations with reasonable efficiency.

( ) A large variety. Performs several different operations efficiently.

( ) An unusually large variety. Performs very many different operations efficiently.

HOW ACCURATE IS HE IN HIS WORK (Worker's ability to avoid making mistakes.)

( ) Very inaccurate. Makes very many mistakes. Work needs constant checking.

( ) Inaccurate. Makes frequent mistakes. Work needs more checking than is desirable.

( ) Fairly accurate. Makes mistakes occasionally. Work needs only normal checking.

( ) Accurate. Makes few mistakes. Work seldom needs checking.

( ) Highly accurate. Rarely makes a mistake. Work almost never needs checking.

HOW WELL AND ACCURATELY DOES HE COMMUNICATE WITH OTHERS? (Worker's ability to understand and give instructions or to ask and answer appropriate questions in discussion of his work with co-workers or supervisor.)

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

( ) Has a little trouble along this line, Sometimes is confused, or confuses others.

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

( ) Better than average. Seldom gets mixed up.

HOW QUICKLY DID HE LEARN THE JOB DUTIES AND NEW TASKS OR OPERATIONS? (Worker's ability to learn rapidly the work he has to do.)

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

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

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

( ) Caught on quickly to most of the job duties he had to learn.

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

CONSIDERING ALL THE FACTORS ALREADY RATED, AND ONLY THESE FACTORS, HOW SATISFACTORY IS HIS WORK? (Worker's "all-around" ability to do his job.)

( ) Definitely unsatisfactory. Would be better off without him. Performance usually not acceptable.

( ) Not completely satisfactory. Of limited value to the organization. Performance somewhat inferior.

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

( ) Very good. A valuable worker. Performance usually better than average.

( ) Outstanding. An unusually competent worker. Performance almost always top notch.

Rated by_____ Title_____ Date_____

June 1970 S-103R

FACT SHEET

Job Title

Electronics Mechanic (electronics) 726.281-016

Job Summary

Builds, tests, repairs and adjusts electronic equipment used in guidance control systems and for testing purposes. Sets up, assembles, aligns and checks prototype precision electro-mechanical and electronic equipment used in aircraft and guidance systems. Works from blueprints, sketches, diagrams and/or verbal instructions and uses machine and hand tools.

Work Performed

Plans sequence of operations: Using complex electrical drawings, diagrams and verbal instructions, plans to construct, repair, modify or calibrate electronic equipment used in guidance and control systems or for testing purposes, including prototype models of electronic units.

Builds complete experimental models of electronic devices: Working from blue-prints, sketches, schematic diagrams, block diagrams and/or verbal instructions from Department Supervisor, operates such machine tools as drill press to drill holes through metal parts. Selects such electronic components as plugs, junction boxes, tubes, switches, capacitors and transformers and assembles complete electronic devices with aid of such small hand tools as pliers, cutters, probe, clamps and various screw-drivers. Connects wires to electronic parts with soldering iron. Plans and builds jog boards and wiring templates to use in the assembly of models for experimental and developmental assemblies and subassemblies by cutting and drilling wooden boards, driving nails and placing pegs to be used to guide wires which will be made into cables for electronic assemblies.

Assembles and adjusts precision electronic instruments: Sets up and assembles prototype precision electro-mechanical and electronic instruments using hand tools. Aligns, calibrates and adjusts electronic gear to specifications by performing such typical operations as rewiring electrical components, reworking mechanical parts, and modifying test gear.

Tests electronic devices: Tests the performance of completed electronic units and instrument assemblies, using such test equipment as circuit analyzer, vacuum tube voltmeter, Simpson meter, oscilloscope and ohmmeter. Performs functional testing of completed sextant, using required test equipment. Diagnoses malfunctioning of electronic equipment by making checks and measurements to isolate output measure-ments.

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-103R norms, 90% 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-103R norms, only 10% would have been poor workers.

Applicability of S-103R Norms

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

GP O 899-425

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