DOCUMENT RESUME

ED 069 765 TM 002 220

TITLE	Production Mechanic, Tin Cans (tinware) 619.380--Technical Report on Development of USTES Aptitude Test Battery.
INSTITUTION	Manpower Administration (DOL), Washington, D.C. U.S. Training and Employment Service.
REPORT NO	USTES-TR-S-370
PUB DATE	Nov 69
NOTE	15p.
EDRS PRICE	MF-$0.65 HC-$3.29
DESCRIPTORS	*Aptitude Tests; *Cutting Scores; Evaluation Criteria; Job Applicants; *Job Skills; Metals; Norms; Occupational Guidance; *Personnel Evaluation; *Production Technicians; Test Reliability; Test Validity
IDENTIFIERS	GATB; *General Aptitude Test Battery; Production Mechanics

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)

November 1969 United States Training and Employment Service Technical Report S-370

Development of USTES Aptitude Test Battery

for

Production Mechanic, Tin Cans
(tinware) 619.380

U.S. DEPARTMENT OF LABOR
MANPOWER ADMINISTRATION

Technical Report on Development of USTES Aptitude Test Battery

For . . . . .

Production Mechanic, Tin Cans (tinware) 619.380

S-370

(Developed in Cooperation with the New York, Pennsylvania, and Texas State Employment Services)

U. S. Department of Labor
Manpower Administration

November 1969

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 #2598

DEVELOPMENT OF USTES APTITUDE TEST BATTERY

For

Production Mechanic, Tin Cans (tinware)

619.380-030

S-370

This report describes research undertaken for the purpose of developing General Aptitude Test Battery (GATB) norms for the occupation of Production Mechanic, Tin Cans (tinware) 619.380-030. The following norms were established:

GATB Aptitudes	Minimum Acceptable GATB Scores
G - General Learning Ability	90
S - Spatial Aptitude	90
F - Finger Dexterity	90

RESEARCH SUMMARY

Sample:

66 male workers (48 fully trained workers and 18 trainees) employed as Production Mechanics, at American Can Company plants in New York and Pennsylvania. 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 $= .36$ ($P/2 < .005$)

Effectiveness of Norms: Only 76% of the non-test-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. 24% of the non-test-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 norms is shown graphically in Table 1:

TABLE 1

Effectiveness of Norms

	Without Tests	With Tests
Good Workers	76%	90%
Poor Workers	24%	10%

SAMPLE DESCRIPTION

Size: N=66

Occupational Status: Employed workers

Work Setting: Workers were employed in American Can Company plants in Fairport, New York and Lemoyne, Pennsylvania.

Employer Selection Requirements:

Education: No consistent requirement

Previous Experience: No requirement

Tests: Basic computational skills 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 Production Mechanic trainees are selected from present employees of the company. All fully trained workers had completed a training period of 3000 - 6000 hours depending on the type of equipment maintained.

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)	36.7	5.2	27-49	-.091
Education (years)	11.2	1.4	6-13	.127
Experience (months)	83.2	62.7	6-238	.267*

*Significant at .05 level

EXPERIMENTAL TEST BATTERY

All 12 tests of the GATB, B-1002B were administered during the period September through November 1965.

CRITERION

The criterion data consisted of supervisory ratings of job proficiency. Ratings and reratings for each worker were made at approximately the same time as the tests were administered with a time interval of from two to three weeks between the two ratings.

Rating Scale: USES Form SP-21, "Descriptive Rating Scale." 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 coefficient of reliability between the two ratings obtained from the Master Mechanics of the New York plant (N=37) was .84. Several supervisors rated and rerated individuals at the Pennsylvania plant. The coefficient of reliability between the two ratings made by the two foremen at the Pennsylvania plant doing most of the rating was .89 and .98. The final criterion score consisted of the combined scores of the two sets of ratings for each subsample.

Criterion Score Distribution:

Possible Range:	18-90
Actual Range:	41-90
Mean:	60.7
Standard Deviation:	10.6

Criterion Dichotomy: The criterion distribution was dichotomized into high and low groups by placing 24% of the sample in the low group to correspond with the percentage of workers considered unsatisfactory or marginal by the Master Mechanics and all Foremen concerned. Workers in the high criterion group were designated as "good workers" and those in the low group as "poor workers."

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 G, S, Q, F, and M were considered for inclusion in the test norms on the basis of the qualitative and statistical analyses. Aptitudes G, S, Q, and M which do not have high correlations with the criterion were considered for inclusion in the norms because the qualitative analysis indicated that Aptitudes G, S, and M were important for the job duties. In addition, the sample had relatively low mean scores for Aptitudes G, S, Q, and M and relatively low standard deviations for Aptitudes G and Q. 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	Necessary to read and understand instruction; to gain knowledge of properties of metals and coatings used in production of cans and to exercise independent judgement and confer with others to resolve problems.
S - Spatial Aptitude	Necessary to read and interpret blueprints and understand drawings; to position and align to make proper settings.
F - Finger Dexterity	Necessary to handle a variety of small tools and small parts involved in adjusting and repairing can making machinery.
M - Manual Dexterity	Necessary to move hands and wrists skillfully in all placing and turning motions involved in setting up, adjusting and repairing machinery.

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	106.8	12.4	80-138	.187
V - Verbal Aptitude	97.7	10.1	72-119	.124
N - Numerical Aptitude	104.4	11.4	76-131	.168
S - Spatial Aptitude	112.2	15.5	71-140	.199
P - Form Perception	105.8	14.7	74-139	.105
Q - Clerical Perception	106.3	11.2	78-136	-.102
K - Motor Coordination	97.0	17.3	51-146	.062
F - Finger Dexterity	96.7	18.3	61-158	.300*
M - Manual Dexterity	107.4	20.6	62.167	.217

* Significant at the .05 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
Irrelevant									
Relatively High Mean	X			X		X			X
Relatively Low Standard Dev.	X	X	X			X			
Significant Correlation with Criterion								X	
Aptitudes to be Considered for Trial Norms	G			S		Q		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 aptitudes G, S, Q, F and M at trial cutting scores were able to differentiate between the 76% of the sample considered good workers and the 24% 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 1/3 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 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 G-90, S-90 and F-90 provided the optimum degree of differentiation for the occupation of Production Mechanic, Tin Cans (tinware) 619.380-030. The validity of these norms is shown in Table 6.

TABLE 6

Concurrent Validity of Test Norms
G-90, S-90, and F-90

	Nonqualifying Test Scores	Qualifying Test Scores	Total
Good Workers	15	35	50
Poor Workers	12	4	16
Total	27	39	66

Phi Coefficient (ϕ) = .36
Chi Square (χ^2) = 8.4
Significance Level = $P/2 < .005$

DETERMINATION OF OCCUPATIONAL APTITUDE PATTERN

The data for this study did not meet the requirements for incorporating the occupation studied into any of the 36 OAP's included in Section II of the Guide to the Use of the General Aptitude Test Battery. The data for this sample will be considered for future groupings of occupations in the development of new occupational aptitude patterns.

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 <u>only</u> 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: Production Mechanic, Tin Cans (tinware) 619.380-030

Job Summary: Sets up, disassembles, repairs, replaces parts, assembles and makes necessary adjustments to Double Die Presses; sets up, adjusts and repairs Canco Bodymaker Machines and disassembles, repairs, replaces parts, assembles and makes required adjustments to Double Seamer Machines in order to improve quality of product, increase efficiency, lower cost , reduce spoilage, increase production with fewer adjustments and break downs in the production of metal cans.

Work Performed:

Double Seamer Machine

Assembles column, base and gear train and installs base gears, shafts and column turret assembly. Checks column, all base gears, shafts, bushings and other parts for wear, scoring and defective teeth. Installs column turret assembly and checks ring gear. Attaches lifter turntable assembly; checks turntable gear bushings, cage threads and cage adjusting sleeve threads, cage adjusting worm and worm wheelgear and installs cage adjusting sleeve in turntable. Attaches lifter turntable assembly. Mounts cage assembly and inspects parts. Installs vertical shaft and inspects shaft and parts. Assembles drive case and arranges and assembles bevel gear. Installs drive case cover assembly and mounts tie rod and drive case. Installs clutch linkage assembly and assembles drive clutch. Attaches motor base oil tank and mounts marker assembly. Installs feed-disc assembly; lifter cam assembly and positive discharge assembly. Assembles and positions seaming head drive. Makes settings and adjustments to Double Seamer for cam height and diameter changes to meet production scheduling.

Double Die Presses

Checks dies, sets dies and punch back plate and bolster plate. Adjusts knock-outs and knock-out cams. Sets the spline; arranges die feed table, attaches strippers and installs and adjusts gripper fingers. Mounts end ejector, sets feed magazines, fits and regulates inserting bars and sets stroke of finger bars. Assembles and adjusts strip feed fingers and adjusts vacuum release valve system. Adapts roll type scrap ejector; arranges chutes from dies to curlers and regulates tension in feed table. Sets and adjusts double wheel end curls for proper operation in curling ends of metal cans.

Canco Bodymaker Machines

Examines bodymaker station and scrutinizes notcher stations to determine the settings and adjustments required. Cleans and inspects notching station for burr before placing units in machine. Inspects rear notcher and front notcher gauges and checks any revised settings of gauges to tolerance. Examines feed station; procures accurate sample blank for use in setting up feed station. Examines side feed stop plate and fingers. Checks condition of roll station and forming roll feed plate for proper operation and examines simcoe style adjustments for correct functioning. Looks over carrier cylinder to insure proper operation. Checks operating condition of horn support. Examines physical and operating condition of edger roll bars and clamp steels. Checks stroke of carrier bars to insure good working order; examines friction cage. Scrutinizes closing fingers for proper adjustment, working condition and wear. Scans bumper hammer, examines preflux station and sets up and adjusts sideseamer for required operation.

Effectiveness of Norms: Only 76% of the nontest-selected workers used for this study were good workers; if the workers had been test-selected with the S-370 norms, 90% would have been good workers. 24% of the nontest-selected workers used for this study were poor workers; if the workers had been test-selected with the S-370 norms, only 10% would have been poor workers.

Applicability of S-370 Norms:
The aptitude test battery is applicable to jobs which include a majority of the job duties described above.

GPO 887-427