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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 is also included. (AG)

TECHNICAL REPORT

ON

STANDARDIZATION OF THE GENERAL APTITUDE TEST BATTERY

FOR

WELDER, INERT GAS 4-85.025

B-480 or S-207

U. S. Employment Service in
Cooperation with
California State Employment Service

November 1962

GATB #2343
October 1960

STANDARDIZATION OF THE GENERAL APTITUDE TEST BATTERY

FOR

WELDER, INERT GAS 4-85.025

B-480 or S-207

Summary

The General Aptitude Test Battery, B-1002A, was administered during October 1960 to a final sample of 50 males employed as Welder, Inert Gas 4-85.025 by the Food Machinery and Chemical Corporation, Ordnance Division, San Jose, California. The criterion consisted of supervisory ratings on a descriptive rating scale. On the basis of mean scores, standard deviations, correlations with criterion, job analysis data and their combined selective efficiency, Aptitudes G - Intelligence, S - Spatial Aptitude, and P - Form Perception were selected for inclusion in the final test norms.

GATB Norms for Welder, Inert Gas 4-85.025 - B-480 or S-207

Table I shows, for B-1001 and B-1002, the minimum acceptable score for each aptitude included in the test norms for Welder, Inert Gas 4-85.025.

TABLE I

Minimum Acceptable Scores on B-1001 and B-1002 for

Welder, Inert Gas 4-85.025

B-1001			B-1002		
Aptitude	Tests	Minimum Acceptable Aptitude Score	Aptitude	Tests	Minimum Acceptable Aptitude Score
G	CB-1-H CB-1-I CB-1-J	75	G	Part 3 Part 4 Part 6	70
S	CB-1-F CB-1-H	85	S	Part 3	80
P	CB-1-A CB-1-L	80	P	Part 5 Part 7	80

Effectiveness of Norms

The data in Table V indicate that 15 of the 20 poor workers, or 75 percent of them, did not achieve the minimum scores established as cutting scores on the recommended test norms. This shows that 75 percent of the poor workers would not have been hired if the recommended test norms had been used in the selection process. Moreover, 21 of the 26 workers who made qualifying test scores, or 81 percent, were good workers.

I. Purpose

This study was conducted to determine the best combination of aptitudes and minimum scores to be used as norms on the General Aptitude Test Battery for the occupation of Welder, Inert Gas 4-85.025.

II. Sample

The General Aptitude Test Battery, B-1002A, was administered during October 1960 to a total sample of 59 men employed as Welder, Inert Gas 4-85.025 by the Food Machinery and Chemical Corporation, San Jose, California. The potential sample consisted of 75 male employees evenly distributed among five different work stations as MIG welders. The sample of 59 was selected by the employer at random so that enough workers would be remaining at each work station to continue production. Of the 59 workers tested, nine were eliminated; one who was unable to take apparatus tests due to deformity of the fingers of the favored hand, one who had a third grade education, and seven with experience of less than two years which was not representative of workers generally hired by the employer.

Tests have not been used in selection of workers for this job by this firm. Generally, arc welders with at least two years experience are hired and converted to MIG welding. Applicants are required to prepare a standard employment form, have an oral interview with the employment officer and are given a work performance test by a foreman. Selection is based on evaluation of arc experience and work performance test. There are no formal education or age requirements.

The length of formal training time determined by management to be adequate for the transition from arc to MIG welding is two weeks in their training school. All workers in the sample are considered experienced MIG welders. The length of experience used for members of the sample was their combined arc and MIG welding experience.

Table II shows the means, standard deviations, ranges, and Pearson product-moment correlations with the criterion for age, education, and experience.

TABLE II

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

Welder, Inert Gas 4-85.025

N = 50

	M	σ	Range	r
Age (years)	38.6	8.8	23-57	-.187
Education (years)	9.8	1.7	7-14	.072
Experience (months)	106.5	69.3	24-252	.207

There are no significant correlations between age, education or experience and the criterion. The data in Table II indicate the sample is suitable for test development purposes with respect to age, education and experience.

III. Job Description

Job Title: Welder, Inert Gas 4-85.025

Job Summary: Welds aluminum alloy parts together using Metallic Inert Gas equipment. Regulates power control equipment; installs torch nozzle, electrode and copper contact tip of desired size depending on thickness of metal to be welded. Sets and adjusts flow of argon to shield electrode, arc and weld from atmosphere, thereby eliminating use of flux and preventing formation of slag. Cleans metal where weld is to be made. Fastens workpiece in place and starts an arc by touching electrode to workpiece. Guides welding torch containing electrode along line of weld. Visually checks weld for uniformity of weld bead after breaking arc.

Work Performed: Prepares workpiece for welding: Places aluminum alloy workpiece(s) to be welded on work table or against structure of larger workpiece to which weld is to be made using clamps, jigs, and/or fixtures. When using template marks workpiece with scriber, checks markings with tape measure and positions smaller workpieces using clamps. Occasionally uses hammer in positioning workpiece. Cleans weld area using electric wire buffer or liquid solvent. Sets equipment for welding: Switches on DC generator. Sets levers to the correct voltage and amperage needed for workpiece which may vary in thickness from one-eighth of an inch to one and one-half inches. Attaches ground to workpiece or to any metal part holding workpiece to complete circuit. Sets and adjusts gas valve for pressure and flow needed, depending upon thickness of metal, to maintain proper gas coverage. Checks to see that water is circulating in gun to keep it cool, to prevent burn-out, by observing flow of water at return conduit outlet located one inch above re-entry opening in water tank. When required blows oxidation residue from wire guide tube using air hose to prevent new wire from becoming contaminated.

Unscrews nozzle from gun and replaces with nozzle giving correct gas coverage when change in gas coverage is needed for different metal thickness. Unscrews copper contact tip from gun and replaces with tip size suitable for wire when wire size which varies from three one-hundredths of an inch to three thirty-seconds of an inch is changed for different metal thickness. Replaces with new spool when wire spool depleted, defective or wire size is changed. Unscrews wire guide coupling from wire drive control assembly, pulls any remaining wire from guide tube. Threads wire from spool through assembly and feeds wire by hand into wire guide tube. Reconnects wire guide tube to wire drive control assembly. Changes gear ratio on wire drive control assembly for new wire feed speed when wire size is changed. Squeezes trigger or pushes button of gun (welding torch) to automatically feed wire through remaining length of guide tube and gun. When using a MIGette welding gun wire spool is replaced in gun itself in same manner as on overhead wire drive control assembly. Uses side cutters to cut excess wire to within one-half inch of nozzle of gun. Puts on protective goggles and gloves to safeguard eyes and hands and covers face and neck with safety helmet containing proper shade of eye filter lens for protection against blinding light, burns from spatter of sparks and ultraviolet rays.

Welds aluminum alloy parts with Metallic Inert Gas welding equipment: Squeezes trigger or pushes button of gun which starts argon and aluminum alloy wire (electrode) flowing through gun. Scratches wire against workpiece to establish arc quickly withdrawing gun so that nozzle is one-half incy from workpiece. Holds gun at a ten to fifteen degree lead angle to workpiece for best gas coverage to shield weld from atmosphere, thereby eliminating need for flux and preventing formation of slag. Holds gun with nozzle at starting point until fusion occurs. When puddle forms moves gun along line of weld using one hand to hold and guide gun at a constant distance from weld and, if necessary, other hand to support wrist or gun. Listens to sound of arc to ascertain that nozzle is correct distance from workpiece. Sound of arc will vary with length of arc needed for different thickness of workpieces. A crackling sound indicates correct distance using a short arc, and a constant sizzling sound indicates correct distance using a long arc. Moves gun at steady rate of speed along line of weld coordinating with speed of wire flow for uniform weld. Irregular bead or porous weld will result if gun moves too fast; if moves too slow produces overlap of metal at edges.

Uses steel backing strip when welding on thin (one-eighth inch) workpiece to prevent weld from falling through. Makes tack-welds at each end and at intervals along line of workpiece to prevent movement of workpiece from marked position when unable to clamp workpiece firmly along line where weld is to be made. Places workpieces in a fixture which is then placed in a trunnion to rotate fixture in order to weld large workpiece on reverse side. Allows weld to cool and cleans weld before making subsequent pass when build-up of a surface requires more than one pass of gun. Welds metal along horizontal line or on flat surface from a standing, kneeling, squatting, sitting or lying position. Releases trigger or button when pass is completed, in order to break arc and stop wire and gas flowing through gun. Pushes safety helmet away from face to inspect weld. Adjusts potentiometer to increase or decrease amperage and wire feed when weld indicates wire is feeding too slow or too fast. Visually checks flow meter and adjusts valve to correct gas flow when weld indicates poor gas coverage. Removes clamps and/or jigs from workpiece which is then removed from worktable or fixture when welds on workpiece completed. Occasionally uses hammer and crowbar to remove workpiece from fixture and/or trunnion.

Experimental Battery

All the tests of the GATB, B-1002A, were administered to the sample group.

Criterion

The criterion for this study consisted of supervisory ratings based on the Descriptive Rating Scale developed by the Bureau of Employment Security, Form SP-21. The three first line supervisors prepared ratings and reratings for each worker with a time interval of eighteen days between the first and second ratings. The rating scale consisted of nine items covering different aspects of job performance with five alternatives for each item. Weights of one through five indicating the degree of job performance attained were assigned to each alternative. The Descriptive Rating Scale was used as the criterion as there were three raters, and this scale would best reflect the proficiency of the individual woeker. A correlation coefficient of .952 was obtained between

the two sets of ratings indicating a satisfactory degree of reliability. The final criterion consisted of the combined rating scale scores. The possible range of scores was eighteen through ninety. The actual range was twenty-four through ninety with a mean score of 61.340 and a standard deviation of 15.939.

VII. Qualitative and Quantitative Analyses

A. Qualitative Analysis:

The job analysis indicated that the following aptitudes measured by the GATB appear to be important for this occupation.

Form Perception (P) - required to follow line to be welded; to align workpieces on marked positions; to inspect weld bead for regularity; to snip wire to one-half inch of nozzle of gun.

Motor Coordination (K) - required to thread wire through wire drive assembly and feed wire into guide tube; to hold gun at proper distance and angle to workpiece; to coordinate eye-hand movements with speed of wire feed while following line of weld.

Finger Dexterity (F) and Manual Dexterity (M) - required in positioning and manipulating workpieces to be welded and in using tools; to set levers and dials; to make passes with torch; to change parts of welding apparatus.

On the basis of the job analysis data, the following aptitudes are considered obviously unimportant for performing the duties of this job and are considered "irrelevant" aptitudes: V-Verbal, and N-Numerical.

B. Quantitative Analysis:

Table III shows the means, standard deviations, and Pearson product-moment correlations with the criterion for the aptitudes of the GATB. The means and standard deviations of the aptitudes are comparable to general population norms with a mean of 100 and a standard deviation of 20.

TABLE III

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

Welder, Inert Gas 4-85.025

N = 50

Aptitudes	M	σ	r
G-Intelligence	89.2	15.8	.374**
V-Verbal Aptitude	89.4	14.9	.091
N-Numerical Aptitude	83.7	16.4	.400**
S-Spatial Aptitude	93.0	17.9	.459**
P-Form Perception	84.8	15.4	.307*
Q-Clerical Perception	87.9	10.6	.188
K-Motor Coordination	88.6	14.2	.259
F-Finger Dexterity	92.0	16.4	.112
M-Manual Dexterity	85.2	18.2	.037

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

C. Selection of [illegible] Norms

TABLE IV

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		X	X						
Relatively High Mean	X	X		X				X	
Relatively Low Sigma		X				X	X		
Significant Correlation with Criterion	X		X	X	X				
Aptitudes to be considered for trial norms	G			S	P		K	F	

Trial norms consisting of various combinations of Aptitudes G, S, P, K, and F with appropriate cutting scores were evaluated against the criterion by means of the tetrachoric correlation technique. A comparison of the results showed that B-1002 norms consisting of G-70, S-80, and P-80 had the best selective efficiency.

VII. Concurrent Validity of Norms

The validity of the norms was determined by computing a tetrachoric correlation coefficient between the test norms and the criterion and applying the Chi Square test. The criterion was dichotomized by placing 40 percent of the sample in the low criterion group because this percent was considered to be the unsatisfactory or marginal workers.

Table V shows the relationship between test norms consisting of Aptitudes G, S, and P with critical scores of 70, 80, and 80, respectively, and the dichotomized criterion for Welder, Inert Gas 4-85.025. Workers in the high criterion group have been designated as "good workers" and those in the low criterion group as "poor workers."

TABLE V

Validity of Test Norms for Welder, Inert Gas 4-85.025
(G-70, S-80, and P-80)

N = 50

	Non-Qualifying Test Scores	Qualifying Test Scores	Total
Good Workers	9	21	30
Poor Workers	15	5	20
Total	24	26	50

$r_{tet} = .65$ $\quad X^2 = 8.016$
$\sigma_{r_{tet}} = .22$ $\quad P/2 < .005$

The data in the above table indicate a significant relationship between the test norms and the criterion for the sample.

VIII. Conclusions

On the basis of the results of this study, Aptitudes G, S, and P with minimum scores of 70, 80, and 80, respectively, have been established as B-1002 norms for the occupation of Welder, Inert Gas 4-85.025. The equivalent B-1001 norms consist of G-75, S-85, and P-80.

IX. Determination of Occupational Aptitude Pattern

The specific norms established for this study did not meet the requirements for allocation to any of the existing 35 occupational aptitude patterns (Revised 10/61). The data for this sample will be considered for future groupings of occupations in the development of new occupational aptitude patterns.