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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

# WIRE DRAWER (wire)







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

December 1962

# STANDARDIZATION OF THE GENERAL APTITUDE TEST BATTERY

# FOR

# WIRE DRAWER 4-88.511

# B-487

## Summary

The General Aptitude Test Battery, B-1002A, was administered to a final sample of 50 women employed as Wire Drawer 4-88.511 by the Sylvania Electric Products Company, Towanda, Pennsylvania. The criterion consisted of supervisory ratings. On the basis of mean scores, standard deviations, correlations with the criterion, job analysis data, and their combined selective efficiency, Aptitudes (P) Form Perception, (Q) Clerical Perception, and (M) Manual Dexterity, were selected for inclusion in the final test norms.

GATB Norms for Wire Drawer, 4-88.511 B-487

| B-1001 | | | B-1002 | | |
|---|---|---|---|---|---|
| Aptitude | Tests | Minimum Acceptable Aptitude Score | Aptitude | Tests | Minimum Acceptable Aptitude Score |
| P | CB-1-A<br>CB-1-L | 85 | P | Part 5<br>Part 7 | 85 |
| Q | CB-1-B | 95 | Q | Part 1 | 95 |
| M | CB-1-M<br>CB-1-N | 80 | M | Part 9<br>Part 10 | 80 |

## Effectiveness of Norms

The data in Table IV indicate that 13 of the 16 poor workers, or 81 percent of them, did not achieve the minimum scores established as cutting scores on the recommended test norms. This shows that 81 percent of the poor workers would not have been hired if the recommended test norms had been used in the selection process. Moreover, 27 of the 30 workers who made qualifying test scores, or 90 percent, were good workers.

TECHNICAL REPORT

## 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 Wire Drawer 4-88.511.

## II. Sample

The GATB, B-1002A, was administered during October 1960, and January and February 1961 to a sample of 50 female workers employed as Wire Drawer 4-88.511.at the Sylvania Electric Products Company, Towanda, Pennsylvania. The entire work force performing the job of Wire Drawer at this company is 60. Of these, 50 volunteered to participate in the study. The plant has three work shifts of Wire Drawers and conditions during each shift, such as hours of work, work performed, and rate of pay, are similar.

Applicants apply at the plant and are interviewed by the personnel manager. No tests are used by the company in selecting workers for employment. A general physical examination is given each new worker. No age, educational or weight limits are imposed except that the worker should be over five feet tall. Hires are not required to have previous experience in this occupation. Inexperienced workers of average intelligence and normal reflexes are considered to have the ability to learn the job in two weeks; experienced workers should adapt to the job in one day. All of the workers in the sample are considered experienced workers.

TABLE I

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

| N = 50 | M | $\sigma$ | Range | r |
|---|---|---|---|---|
| Age (years) | 36.7 | 8.7 | 21-50 | -.144 |
| Education (years) | 11.1 | 1.5 | 5-13 | .218 |
| Experience (months) | 41.1 | 40.4 | 2-180 | .088 |

There are no significant correlations between the criterion and the variables of age, education or experience. Therefore, the sample for this study is suitable for USES test development purposes.

III. Job Description

Job Title: WIRE DRAWER (wire) 4-88.511

Job Summary: --Draws hot tungsten wire through successively smaller carbide or diamond dies to reduce diameter, increase length, and produce a smooth finish. Lights wire drawing furnace, slips coil or spool of wire over upright spindle of wire drawing machine and draws wire through die, using pliers. Measures wire with micrometer to see if diameter as drawn through die falls within tolerance limits. Changes dies in accordance with size requirements. Keeps records of all wire run through machine and cleans work area and furnace.

Work Performed.--Lights wire drawing furnace and threads wire through die: Slips coil or spool of wire over upright spindle of wire drawing machine to prepare for threading. Turns valve to supply gas and lights with taper which is lighted from fire of one of other wire drawing units on the same bench. Deftly grasps end of wire from spool and loops wire around pulley and through notches of graphite pot. Dips end of wire in pointing pot to cause hot sodium nitrate to remove enough metal to make a point on the end of the wire, and then dips wire end in water to cool and remove nitrate, and then in graphite. Using pliers, grasps die, which has been kept hot by heating over a gas flame if it is of carbide, and deftly enters pointed end of wire in die. Grasps end of wire which projects through hole in die with needle nose pliers and pulls about two feet of wire through die. Feels how wire comes through die to judge condition of tapered inner working surface. Releases die from heavy pliers and lowers die into die holder by a deft movement of right hand in which needle nose pliers grip wire end. Winds end of wire through notches in edges of take-up bobbin or around thumbscrew to provide secure attachment for drawing.

Measures wire with micrometer to see if diameter as drawn through die falls within tolerance limits. Presses button to start capstan head which rotates bobbin and feeds wire through die. Watches graphite as it collects where it is rubbed off wire to see whether it appears granular or wet as an indication of wire temperature as wire passes through furnace before entering die. Tests die temperature by touching die with edge of piece of white paper to see if it turns brown, as indication of proper heat on die. Observes sheen of wire on bobbin after drawing to determine condition of die and adequacy of heat supplied by wire drawing furnace. Measures wire with micrometer at intervals to make sure size remains within tolerance. Fills pointing pot, graphite, and water pots as supplies become low. Unscrews hand nut from capstan spindle and unloads filled spools. Delivers filled spools for weighing after drawing. Throws any ends broken off into scrap box for further attempts at threading.

Keeps records and changes dies in accordance with size requirements. Compares measured wire size as shown by ticket. Secures proper dies from die room and returns work, damaged, or incorrect size dies. Keeps log of all wire run, including bobbin weight before and after running and size data, by lot and bundle number. Subtracts from total weight of each bobbin run off. Carries wire to raters for weighing of standard length section to determine size of very fine wire, and delivers dies to raters

for weighing of standard length section to determine size of very fine wire, and delivers dies to raters for periodic weighing to check amount of wear.

Cleans work area and furnace. Picks up broken pieces of wire and brushes graphite accumulation from around die. Wire brushes burner of furnace to keep fire even and adequate.

IV. Experimental Battery

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

V. Criterion

The criterion consisted of broad category supervisory ratings prepared by the production manager on February 27, 1961. The workers in the sample were placed in one of the following three broad categories: "Top Operator", "Good Operator", and "Fair Operator." A "Top Operator" was defined as one who learns and adjusts quickly, and whose quality and quantity of work are above average. A "Good Operator" was defined as one who learns and adjusts in normal time, and whose quality and quantity of work are adequate. A "Fair Operator" was defined as one who took longer than usual to learn the job, and whose quality and quantity of work are less than adequate. The broad category ratings were converted to numerical scores; workers rated as "Top Operators" were assigned the quantitative value of 62, workers rated as "Good Operators" were assigned the quantitative value of 50, and workers rated as "Fair Operators" were assigned the quantitative value of 39. The final criterion distribution had a mean value of 50.0 and a standard deviation of 9.1.

VI. 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:

Clerical Perception (Q): Required to read standard micrometer accurately at periodic intervals, to maintain necessary tolerance; to accurately compare wire size as shown by micrometer with size requirement on job ticket; and to perform elementary arithmetic (addition and subtraction) and keep legible records.

Motor Coordination (K): Required to enter end of wire in die and grasp it on other side with needle nose pliers, even though wire at its smallest point approaches the limit of human visual capacity.

Finger Dexterity (F) and Manual Dexterity (M): Required to handle coils of wire, filled and empty bobbins, pliers, machine controls, and micrometers; to lower die into die holder by manipulating die after it is threaded on wire.

The job analysis data indicated that the following aptitude was irrelevant for successfully performing the job duties of the job: V - Verbal Aptitude.

B. Quantitative Analysis:

TABLE II

Means (M), Standard Deviations ($\sigma$), and Pearson Product-Moment Correlations with the Criterion (r) for the Aptitudes of the GATB; N = 50

| Aptitudes | M | $\sigma$ | $c^r$ |
|---|---|---|---|
| G-Intelligence | 96.1 | 14.5 | .292* |
| V-Verbal Aptitude | 98.2 | 16.2 | .344* |
| N-Numerical Aptitude | 96.0 | 14.8 | .297* |
| S-Spatial Aptitude | 95.2 | 14.8 | .147 |
| P-Form Perception | 99.6 | 14.1 | .278 |
| Q-Clerical Perception | 104.2 | 12.9 | .504** |
| K-Motor Coordination | 99.4 | 16.5 | .313* |
| F-Finger Dexterity | 102.6 | 20.2 | .151 |
| M-Manual Dexterity | 91.0 | 19.6 | .315* |

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

C. Selection of Test Norms:

TABLE III

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 | | | | | | | |
| Relatively High Mean | | | | | X | X | X | X | |
| Relatively Low Sigma | X | | X | | X | X | | | |
| Significant Correlation with Criterion | X | X | X | | | X | X | | X |
| Aptitudes to be Considered for Trial Norms | G | | N | | P | Q | K | F | M |

Trial norms consisting of various combinations of Aptitudes G, N, P, Q, K, F and M with appropriate cutting scores were evaluated against the criterion by the tetrachoric correlation technique. A comparison of the results showed that B-1002 norms consisting of P-85, Q-95 and M-80 had the best selective efficiency.

VII. Validity of Norms (Concurrent)

The validity of the norms was determined by the tetrachoric correlation between the test norms and the criterion and applying the Chi Square test. The criterion was dichotomized by placing 32 percent of the sample in the low criterion group because this percent was considered to be the unsatisfactory or marginal workers.

Table IV shows the relationship between test norms consisting of Aptitudes P, Q and M with critical scores of 85, 95 and 80, respectively, and the dichotomized criterion for Wire Drawer 4-88.511. Workers in the high criterion group have been designated as "good workers" and those in the low criterion group as "poor workers."

TABLE IV

Validity of Test Norms for Wire Drawer 4-88.511
(P-85, Q-95, M-80)

| N = 50 | Non-Qualifying Test Scores | Qualifying Test Scores | Total |
|---|---|---|---|
| Good Workers | 7 | 27 | 34 |
| Poor Workers | 13 | 3 | 16 |
| Total | 20 | 30 | 50 |

$r_{tet} = .82$ $\quad \chi^2 = 14.250$

$r_{tet} = .23$ $\quad P/2 < .0005$

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 P, Q and M with minimum scores of 85, 95 and 80 , respectively, have been established as B-1002 norms for Wire Drawer 4-88.511. The equivalent B-1001 norms consist of P-85, Q-95 and M-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 OAP's (revised 10/61). The data for this sample will be considered for future groupings of occupations in the development of new occupational aptitude patterns.