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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)

FINAL REPORT

# TECHNICAL REPORT

ON

# STANDARDIZATION OF THE GENERAL APTITUDE TEST BATTERY

FOR

CASER (clock & watch) 6-72.105
DIALER (clock & watch) 6-72.198
FINAL INSPECTOR, MOVEMENT ASSEMBLY (clock & watch) 6-72.326
HANDS ASSEMBLER (clock & watch) 6-72.197
INSPECTOR, CASING (clock & watch) 6-72.221
LINER AND GASKET INSERTER (clock & watch) 8-72.10
LINT REMOVER (clock & watch) 8-72.10
SWEEP-SPRING ATTACHER (clock & watch) 8-72.10
(FINISHING DEPARTMENT)





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

U. S. DEPARTMENT OF LABOR
Bureau of Employment Security
Washington 25, D. C.
February 1959

GATB #2214
February 1958

# STANDARDIZATION OF THE GENERAL APTITUDE TEST BATTERY FOR WATCH ASSEMBLY OCCUPATIONS IN THE FINISHING DEPARTMENT

## B-413


## Summary

The General Aptitude Test Battery, B-1002A, was administered to a sample of 60 women employed in the Finishing Department at U. S. Time Company, Abilene, Texas. The occupations covered in the Finishing Department are as follows:

Caser 6-72.105
Dialer 6-72.198
Final Inspector, Movement Assembly 6-72.326
Hands Assembler 6-72.197
Inspector, Casing 6-72.221
Liner and Gasket Inserter 8-72.10
Lint Remover 8-72.10
Sweep-Spring Attacher 8-72.10

The criterion consisted of broad category supervisory ratings. On the basis of mean scores, correlations with the criterion, job analysis data, and their combined selective efficiency, Aptitudes K-Motor Coordination, F-Finger Dexterity, and M-Manual Dexterity were selected for inclusion in the test norms.


## GATB Norms for Watch Assembly Occupations in the Finishing Department - B-413

Table I shows, for B-1001 and B-1002, the minimum acceptable score for each aptitude included in the test norms for Watch Assembly Occupations in the Finishing Department.

TABLE I

Minimum Acceptable Scores on B-1001 and B-1002 for B-413

| B-1001 | | | B-1002 | | |
|---|---|---|---|---|---|
| Aptitude | Tests | Minimum Acceptable Aptitude Score | Aptitude | Tests | Minimum Acceptable Aptitude Score |
| T | CB-1-G<br>CB-1-K | 90 | K | Part 8 | 95 |
| F | CB-1-O<br>CB-1-P | 90 | F | Part 11<br>Part 12 | 85 |
| M | CB-1-M<br>CB-1-N | 95 | M | Part 9<br>Part 10 | 90 |

Effectiveness of Norms

The data in Table IV indicate that 14 of the 20 poor workers, or 70 percent of them, did not achieve the minimum scores established as cutting scores on the recommended test norms. This shows that 70 percent of the poor workers would not have been hired if the recommended test norms had been used in the selection process. Moreover, 36 of the 42 workers who made qualifying test scores, or 86 percent, were good workers.

TECHNICAL REPORT

I. Problem

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 Watch Assembly Occupations in the Finishing Department.

II. Sample

The General Aptitude Test Battery, B-1002A, was administered during the period December 10, 1957 to February 10, 1958 to a sample of 60 women employed in the Finishing Department, U. S. Time Company, Abilene, Texas. These workers were shifted about in the entire Finishing Department. All of the workers had completed an on-the-job training program.

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

TABLE II

Means (M), Standard Deviations ($\sigma$), Ranges, and Pearson Product-Moment Correlations (Corrected for Broad Categories) with the Criterion ($_{o}r$) for Age, Education, and Experience

Watch Assembly Occupations in the Finishing Department
N = 60

| | M | $\sigma$ | Range | $_{o}r$ |
|---|---|---|---|---|
| Age (years) | 29.2 | 9.4 | 17-60 | -.101 |
| Education (years) | 10.7 | 1.5 | 6-14 | .055 |
| Experience (months) | 19.6 | 20.7 | 2-98 | .055 |

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

Job Descriptions

Job Titles: Caser 6-72.105
Dialer 6-72.198
Final Inspector, Movement Assembly 6-72.326
Hands Assembler 6-72.197
Inspector, Casing 6-72.221
Liner and Gasket Inserter 8-72.10
Lint Remover 8-72.10
Sweep-Spring Attacher 8-72.10

CASER

Job Summary: Assembles bezel to back of watch using a kick press machine which snaps bezel of watch to back of watch case; inspects watch for dust, lint, and position of dust seal. Fastens back of case on bezel using a press-type machine with press head and mast that holds and turns watch bezel. Removes service crown from watch movement; places movement in bezel; inserts permanent crown in watch movement using tweezers or a jeweler's screwdriver.

Work Performed: Assembles bezel to back of watch using a kick press machine which snaps bezel of watch to back of watch case (this machine is called a caser). Removes movement in back of watch case from assembly line and checks and adjusts position of dust seal. Places assembly in nest of caser. Takes bezel from table and places and positions it on assembly in nest of caser. Kicks pedal to bring press head of caser down on bezel and press it against case until slots in side of bezel fit over locker bumps of case back. Removes assembly from nest of machine and inspects watch for dust, lint, and blemishes on case or crystal. Rejects watches that have dust inside or scratches on outside. May open cases using a decaser to make minor adjustments or to remove foreign matter. Places assembly on conveyor belt.

Fastens back of case on bezel using a press-type machine with a press head and nest that holds and turns watch bezel (this machine is called a torqueing machine). Removes watch from carrier and places carrier in basket. Places and positions watch face down in nest of torqueing machine. Presses foot pedal to lower press head on back of case. Pushes lever to turn nest of machine into starting position. Pulls lever to turn holding ring and fit holding ring under projection on inside of back ring of bezel. Removes foot from pedal to lift press head. Removes watch from nest of machine and places it in watch tray.

Takes watch movement from carrier. Pulls service crown end of set lever toward back of movement using point of tweezer prong or a jeweler's screwdriver. Lifts service crown out of movement. Places and positions movement in bezel. Oils permanent crown by touching stem next to crown with needle of hypodermic oiler. Inserts permanent crown through bezel into movement; presses down on crown to engage stem in movement. Reaches into movement under bezel by crown with tweezer prong or with jeweler's screwdriver, and pushes set lever down to lock stem in place. Places movement in carrier.

DIALER

Job Summary: Attaches dial assembly to watch movement using an air press type machine which consists of three small plungers in nest used to press legs of dial around edge of front of movement.

Work Performed: Takes watch movement from tray and dial with dial holder attached from dial pad. Positions dial on movement with "3" at crown by fitting dial legs in holes in front of movement. Positions movement in nest of machine. Pulls down air lever to lower press head onto dial to hold dial in place. Presses air button to eject three dial leg bending plungers into nest to push dial legs up against inside of front of movement. Releases air buttons. Removes assembly from nest of machine and places it in carrier. Places carrier on conveyor belt.

FINAL INSPECTOR, MOVEMENT ASSEMBLY
Job Summary: Inspects watch movements to detect damaged parts, foreign matter and stoppers, using a magnifying glass.

Work Performed: Removes watch movement from carrier and holds it at an angle with "9" edge up and dial out. Turns movement clockwise and counter-clockwise to allow looking through movement from different angles. Inspects for stoppers, damaged parts, lint, dust, and other foreign matter using a loupe. Places movement back in carrier and sets carrier on conveyor belt. Separates rejects and classifies them as hairsprings, stoppers, pins, pillar screws, and wheels and places them in separate trays. Cleans movements of dust or lint by picking out dust and lint using tweezers. Keeps record of reject by type of reject on tally sheet.

HANDS ASSEMBLER
Job Summary: Assembles minute hand on watch dial using a punch machine. Inserts sweep staff in movement and attaches sweep second hand to staff using a hand punch machine. Checks and adjusts watch hands on dial for clearance and off hour.

Work Performed: Removes watch movement from carrier and winds crown to turn hour hand to point to "12" by turning hour hand clockwise. Checks to see that hour hand clears dial. Raises hour hand with tweezers if it fails to clear dial. Positions movement in nest of hand punch machine. Picks up minute hand with tweezers and fits it on pinion over hour hand. Hits lever to lower punch of machine onto assembly and press minute hand down friction tight on staff. Removes movement from nest of machine and places it face down in carrier.

Removes movement from carrier. Picks up sweep staff with tweezers from tray. Runs pointed end of staff through cent hole in back of movement. Positions movement in nest of hand punch machine. Picks up sweep hand with tweezers and fits hole in sweep hand over end of sweep staff on dial of watch. Hits hand lever to lower punch onto assembly and drive sweep hand on sweep staff friction tight. Removes movement from nest of hand punch machine and replaces it in carrier dial up.

Removes watch movement from carrier and checks for off hour by turning crown to point hands to "12." Looks at hands of watch to check for specified clearance of hands. Adjusts hands that are off hour by setting hour hand at "12" and slipping minute hand on staff with tweezers until it is directly over hour hand. Adjusts and straightens hands of watch using tweezers until hands have required clearance and set on staff. Replaces watch movement in carrier.

INSPECTOR, CASING
Job Summary: Inspects watches for rejects. Places rejects in separate reject trays. Keeps record of rejects and records number of watches that pass inspection.

Work Performed: Places tray of watches in front of work position. Picks up watch from tray. Turns watch in hand; looks at watch and inspects to detect foreign matter on dial or inside crystal, for blemishes on crown, bezel, case, or crystal, and for closed case. Pulls out and turns crown to check for pull

out, off hour, clearance, bad set, tight set, and adjust. Pushes crown in to engage stem and turns crown to check watch for wind. Turns and shakes case to check for loose movement. Replaces watch in watch tray. Repeats process until all watches in tray have been checked. Inspects tray of watches to detect watches that have stopped and for jumping sweephands. Places rejects in separate reject trays classified according to reject cause. Keeps record of rejects by classification of reject on record sheet. Records number of watches that pass inspection on record sheet. Removes tray from in front of work position.

LINER AND GASKET INSERTER
Job Summary: Places liner in bezel around movement and gasket in back of watch case and positions back on case. Inserts liner and gasket in bezel and places and positions case back and closing ring on bezel.

Work Performed: Removes movement in bezel from carrier and metal liner from stack. Fits metal liner in bezel around movement. Holds movement and picks up back of case from carrier. Takes rubber gasket from stack and places it in back of case. Presses gasket into place with thumb. Places and positions case back on bezel. Places assembly in carrier.

Removes watch movement in bezel from carrier. Picks up plastic liner from stack and fits it in bezel around movement. Takes gasket from stack and fits it over liner in bezel by pushing edge of gasket under projection on inside edge of bezel. Takes case back and closing ring from carrier; places and positions closing ring on case back. Places assembly in carrier.

LINT REMOVER
Job Summary: Removes lint and dust from watch movement using a vacuum. Removes movement from carrier and holds movement by crown.

Work Performed: Places movement in vacuum on edge with face away from operator. Holds watch in vacuum two or three seconds. Lifts movement out of vacuum, turns it clockwise to position dial toward operator. Replaces and holds movement in vacuum for two or three seconds. Removes movement from vacuum and places it in carrier on table at side of work position.

SWEEP-SPRING ATTACHER
Job Summary: Attaches sweep spring to movement using a jeweler's screwdriver.

Work Performed: Removes movement from carrier and places in nest of holding block. Picks up sweep spring with tweezers and places solid end of spring over sweep staff and hold in other end of spring over sweep spring hole in movement with leg of spring down. Picks up screw from tray with jeweler's screwdriver by forcing blade of screwdriver in slot of screw friction tight. Places screw in hole in screw spring and screws it into back of movement. Removes assembly from nest of block and places it in carrier. Places carrier on conveyor belt.

## 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. The finishing department foreman and the plant superintendent rated each worker on her ability to perform assigned duties on all the jobs in the Finishing Department. The workers were placed in one of three categories: "good," "average," or "poor." This placed 22 workers in the "good" group, 18 workers in the "average" group, and 20 workers in the "poor" group. For computational purposes the qualitative ratings were converted to quantitative scores of 60, 50, and 39 for the good, average, and poor groups, respectively.

## VI. Statistical and Qualitative Analyses

### A. Statistical Analysis:

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

TABLE III

Means (M), Standard Deviations ($\sigma$), and Pearson Product-Moment Correlations (Corrected for Broad Categories) with the Criterion ($_{c}r$) for the Aptitudes of the GATB

Watch Assembly Occupations in the Finishing Department
N = 60

| Aptitudes | M | $\sigma$ | $_{c}r$ |
|---|---|---|---|
| G-Intelligence | 97.5 | 17.0 | .370** |
| V-Verbal Aptitude | 96.9 | 15.5 | .196 |
| N-Numerical Aptitude | 91.9 | 16.2 | .400** |
| S-Spatial Aptitude | 104.8 | 22.0 | .376** |
| P-Form Perception | 105.6# | 19.6 | .430** |
| Q-Clerical Perception | 103.2 | 15.8 | .460** |
| K-Motor Coordination | 105.1 | 14.3 | .549** |
| F-Finger Dexterity | 109.3# | 17.4 | .561** |
| M-Manual Dexterity | 106.8# | 17.7 | .496** |

** Significant at the .01 level
# Relatively High Mean Score

The highest mean scores in descending order of magnitude were obtained for Aptitudes F, M, and P, respectively. All the aptitudes, except Aptitude S, have standard deviations of less than 20. Aptitude V has the lowest standard deviation.

For a sample of 60 cases, correlations of .331 and .255 are significant at the .01 level and the .05 level of confidence, respectively. All the aptitudes except Aptitude V correlate significantly with the criterion at the .01 level.

B. Qualitative Analysis:

The statistical results were interpreted in the light of the job analysis data. The job analysis indicated that the following aptitudes measured by the GATB appear to be important for these occupations.

Form Perception (P) - required to position hands of watch accurately, to place small parts in correct position in the assembly, and to inspect watch movements closely for defects.

Motor Coordination (K), Finger Dexterity (F), and Manual Dexterity (M) - required to handle watch movements and small parts fast and dexterously, to work with tweezers to make adjustments quickly, and to use hands and arms to take assemblies from supply trays.

C. Selection of Test Norms:

Based on the quantitative and qualitative evidence cited above, Aptitudes P, K, F, and M warranted further consideration for inclusion in the test norms. The evidence for each of these aptitudes is indicated below.

| Aptitude | High Mean Score | Significant Correlation with the Criterion | Importance Indicated by Qualitative Analysis |
|---|---|---|---|
| P | X | X | X |
| K | | X | X |
| F | X | X | X |
| M | X | X | X |

Although Aptitudes G, N, S, and Q showed significant correlations with the criterion at the .01 level, these aptitudes were not considered further for inclusion in the norms because there was no other quantitative and qualitative evidence of significance.

Various combinations of Aptitudes P, K, F, and M, with appropriate cutting scores were selected as trial norms. The relationship between each set of trial norms and the criterion (dichotomized as indicated in section VII) was determined.

A comparison of the results showed that B-1002 norms consisting of K-95, F-85, and M-90 had the best selective efficiency.

In test development studies an attempt is made to develop a set of norms such that the cutting score for each aptitude included in the norms will be set at a five-point score level close to one standard deviation below the aptitude mean of the experimental sample. Adjustments of cutting scores from one standard deviation below the mean are made to effect better selective efficiency of the norms. In this study the aptitude cutting scores are each within 10 points of one standard deviation below the aptitude mean of the sample.

## VII. Concurrent Validity of Norms

For the purpose of computing the tetrachoric correlation coefficient between the test norms and the criterion and applying the Chi Square test, the criterion was dichotomized with those workers rated as Good and Average placed in the high criterion group, and with those rated as Poor placed in the low criterion group. This resulted in 20 of the 60 workers, or 33 percent of the sample, being placed in the low criterion group.

Table IV shows the relationship between test norms consisting of Aptitudes K, F, and M with critical scores of 95, 85, and 90, respectively, and the dichotomized criterion for the Watch Assembly Occupations in the Finishing Department. Workers in the high criterion group have been designated as "good workers" and those in the low criterion group as "poor workers."

TABLE IV

Relationship between Test Norms Consisting of Aptitudes K, F, and M with Critical Scores of 95, 85, and 90, Respectively, and the Criterion for Watch Assembly Occupations in the Finishing Department

N = 60

| | Non-Qualifying Test Scores | Qualifying Test Scores | Total |
|---|---|---|---|
| Good Workers | 4 | 36 | 40 |
| Poor Workers | 14 | 6 | 20 |
| Total | 18 | 42 | 60 |

$r_{tet} = .85$ $\quad X^2 = 20.089$

$\sigma_{r_{tet}} = .22$ $\quad P/2 < .0005$

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 mean scores, correlations with the criterion, job analysis data, and their combined selective efficiency, Aptitudes K, F, and M with minimum scores of 95, 85, and 90, respectively, are recommended as B-1002 norms for the Watch Assembly Occupations in the Finishing Department. The equivalent B-1001 norms consist of T-90, F-90, and M-95.

## IX. Determination of Occupational Aptitude Pattern

When the specific test norms for an occupation include three aptitudes, only those occupational aptitude patterns which include the same three aptitudes with cutting scores that are within 10 points of the cutting scores established for the specific norms are considered for that occupation. The only one of the existing 23 occupational aptitude patterns which meets these criteria for this study is OAP-17 which consists of K-85, F-80, and M-80 for B-1002 and T-80, F-85, and M-85 for B-1001. The selective efficiency of OAP-17 for this sample was determined by means of the tetrachoric correlation technique. A tetrachoric correlation of .69 with a standard error of .27 was obtained, which indicates a significant relationship between OAP-17 and the criterion for this experimental sample. The proportion of the sample screened out by OAP-17 was .13, which is within the required range of .10 to .60. Therefore, it is recommended that OAP-17 be used in counseling for the Watch Assembly Occupations in the Finishing Department.