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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 included. (AG)

# TECHNICAL REPORT

ON

# STANDARDIZATION OF THE GENERAL APTITUDE TEST BATTERY

FOR

OIL-BURNER-INSTALLATION-AND-SERVICEMAN
(any ind.)

S-273



U. S. Employment Service
in Cooperation with
New York State Employment Service

July 1963

GATB # 2457

# STANDARDIZATION OF THE GENERAL APTITUDE TEST BATTERY

# FOR

# OIL BURNER SERVICE AND INSTALLATION MAN (any ind.) 5-83.026

## B-550


## Summary

The General Aptitude Test Battery, B-1002A, was administered to a final sample of 77 men, each employed as Oil Burner Service and Installation Man 5-83.026, at 25 oil companies in New York State. 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, Aptitude G-Intelligence, S-Spatial Aptitude and F-Finger Dexterity were selected for inclusion in the final test norms.


GATB Norms for Oil Burner Service and Installation Man 5-83.026, B-550

| B-1001 | | | B-1002 | | |
|---|---|---|---|---|---|
| Aptitude | Tests | Minimum Acceptable Aptitude Score | Aptitude | Tests | Minimum Acceptable Aptitude Score |
| G | CB-1- H<br>CB-1- I<br>CB-1- J | 100 | G | Part 3<br>Part 4<br>Part 6 | 95 |
| S | CB-1- F<br>CB-1- H | 90 | S | Part 3<br>Part | 85 |
| F | CB-1- O<br>CB-1- P | 90 | F | Part 11<br>Part 12 | 85 |

## Effectiveness of Norms

The data in Table IV indicate that only 68 percent of the non-test-selected workers used for this study were good workers; if the workers had been test-selected with the above norms, 78 percent would have been good workers. 32 percent 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 22 percent would have been poor 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 Oil Burner Service and Installation Man 5-83.026.

II. Sample

In the summer of 1961, the New York State Employment Service received a request from the Oil Heat Institute of Long Island for assistance in overcoming problems in the selection of trainees for the job of Oil Burner Service and Installation Man 5-83.026. The Oil Heat Institute of Long Island (OHILI) is an association of oil dealers in Nassau and Suffolk Counties.

Meetings with executives of OHILI and a number of oil dealers revealed that most companies were experiencing difficulty in evaluating the job potential of newly hired serviceman trainees. Trainees were selected almost at random and frequently had to spend weeks and even months on the job before it was determined whether or not they could profit from on-the-job and formal training. Clearly, this was a waste from the point of view of both employer and employee. A series of formal evening courses for trainees had been established and equipped by OHILI in cooperation with several local Boards of Education on Long Island in an earlier relatively unsuccessful attempt to resolve recruitment and selection problems.

As an aftermath of meetings between representatives of OHILI and the NYSES, the Institute's Executive Secretary secured the participation of a number of companies in a test development study. Specific arrangements were made for samples to be tested by the New York State Employment Service in Hempstead, Patchogue and Bay Shore. Because of the onset of the heating season and the consequent heavy demand upon potential sample members, testing was temporarily discontinued at the request of OHILI and resumed in the fall of 1962. A final sample consisting of 77 servicemen was collected in the series of testing sessions; six individuals tested were not included in the final because of invalid test results. The 77 individuals in the final sample were employed at 25 oil companies in Long Island, New York.

TABLE I

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

| N = 77 | M | $\sigma$ | Range | r |
|---|---|---|---|---|
| Age (years) | 38.2 | 8.2 | 20-62 | .041 |
| Education (years) | 10.9 | 1.5 | 8-16 | -.051 |
| Experience (months) | 125.5 | 77.5 | 4-384 | .052 |

III. Job Description

Job Title: Oil Burner Service and Installation Man 5-83.026

Job Summary: Installs and services oil heating equipment in home or commercial establishments: Receives installation assignment and assembles materials and equipment needed for installation. Installs oil burner equipment and connects new equipment. Installs oil tank; runs oil supply line from tank to burner. Connects smoke pipe from furnace to chimney. Mounts oil burner controls. Tests operation of oil burner and checks and regulates fire efficiency. Services oil burners; cleans furnace and boilers.

Worked Performed: Examines work order specifying equipment to be installed, and customer's address, or receives oral direction from supervisor concerning installation requirements. Discusses any unusual features, and on complex installations studies and interprets floor-plan sketch supplied.

Checks service truck to see that it contains required inventory of tools and supplies. Loads heating equipment and drives to customer's home. Unloads equipment and moves it near installation site, using hand truck or dolly.

Shuts off electric line, and disconnects old furnace or boiler, using wrenches, hammer, screwdriver, and pliers. When necessary, drains radiation lines and disconnects unions. Unsolders connections with torch. Moves old equipment out of the way, and discards worn-out or unusable duct or pipe sections. Sets new equipment in spot decided upon. Assembles firebox, hot water coil, boiler sections, oil burner, jacket, trim, and accessories, using ordinary hand tools.

Measures duct or pipe requirements, using folding rule or tape. Returns to shop and constructs galvanized or aluminum ducts, if needed, using foot operated shears, bending brake, roll-forming and seaming machines. Cuts required lengths of galvanized steel pipe with vise and pipe cutter, and threads pipe ends with stock and die or threading machine, applying cutting oil for lubrication during process. Returns to job and connects ducts between furnace and old duct work, with "S" cleats and drive sleeves. Connects piping on boilers by soldering or by means of threaded nipples and unions.

Moves tank into designated location and turns it on end. Attaches tank legs by screwing them into leg brackets with pipe wrench. Screws oil shut-off valve into threaded tank connection, and connects filter to valve with short nipple. Stands tank upright on legs in permanent location. Takes measurements for fill-pipe and vent-pipe; cuts and threads pipes. Cuts holes for pipes through foundation with bull-point drill and 3 pound sledge or an electric hammer. Runs pipes through drilled holes and, with oil gage, screws into threaded openings in oil tank. Adds water to ready-mixed cement and, with small trowel, closes openings around pipes and foundation. Screws in pipe plugs to close any unused tappings in oil tank.

Work Performed: continued—Takes measurements and cuts suitable length of 3/8" or 1/2" copper tubing with tube cutter. Smooths and rounds inside of tubing ends with tubing reamer; slips threaded nuts over copper tubing and flares ends tubing with flaring tool for compression joint. Connects tubing at tank, and runs to burner, tightening nuts at each end of tubing with small wrench. Cuts channel in concrete with chisel and sledge or with chipping tool, lays in pipe, and cements over it.

Measures, cuts and fits together pipe sections and elbows. Cements smoke pipe into chimney, or fits into existing chimney pipe; attaches pipe to heating unit with sheet metal screws. With tin snips, cuts and inserts draft regulator into smoke pipe.

Screws aquastats (which control hot water temperature) into boiler tappings with pipe wrench. Inserts stack control into smoke pipe and secures with set-screw. Disconnects low voltage wires from old thermostat and replaces with new one. In new installation, installs thermostat by drilling hole through floor and snaking wires up through partition. Connects wires to terminals on thermostat and to circulator relay, or stack control, following wiring diagram on complex control systems. Reconnects power line at burner using solderless emergency switch in accordance with underwriters' code requirements, using pliers, side cutting pliers, and wire strippers.

Opens oil supply and turns on switch to start burner. Observes flame, adjusting air shutter on burner to obtain optimum air-fuel mixture to produce cleanest (smoke-free) flame possible. Allows burner to run until entire unit heats up to normal operating temperature. During warm-up, checks operation of automatic controls by changing settings of aquastats, and by shutting off oil supply to check timing period of stack control, noting number of seconds elapsing before burner shuts off. Replaces any control device not functioning properly.

Inserts tube of draft gage through slight-hole of heating unit door and notes strength of flue draft as shown on gage; adjusts draft regulator in smoke pipe by moving damper weight in or out while observing gage until reading comes within standard range. Makes smoke tests by drilling 1/4" hole with electric drill in smoke pipe between furnace and draft regulator; places filter paper disc in smoke-test gun and inserts tube of gun into smoke-pipe; draws sample of flue gas by actuating plunger of gun; withdraws tube from smoke pipe and compares smoke ring on filter with smoke-density chart; changes setting of air shutter on burner until smoke density is within allowed range for good fire efficiency; or if unable to get proper smoke density by regulating air-shutter, substitutes oil-spray nozzles having different spray angles until proper smoke-density reading is obtained. Makes $CO^2$ test of flue gas; inserts tube of $CO^2$ test instrument into smoke-pipe, squeezes bulb of tester to withdraw sample of flue gas; shakes tester to mix gas with $CO^2$ liquid (sodium or postassium hydroxide) and notes reading on scale of tube of test instrument. Takes stack temperature by inserting stub of dial thermometer into smoke pipe. Computes actual stack temperature by subtracting room temperature from stack reading, consults stack-loss slide rule and notes percentage of fire efficiency. If efficiency is low, readjusts air-shutter, or tries other spray nozzles until improvement is obtained.

Work Performed: continued—Receives oral service assignment in shop or by two-way radio dispatch in truck, indicating customer's difficulty, and drives truck to address given. Diagnoses fault and makes various checks such as of emergency switch, oil supply, ignition, electric current at fuse box and stack control using voltmeter. Checks thermostat to see that temperature setting is higher than room temperature. Calibrates thermostat if it fails to operate at demand-setting by removing cover and turning adjusting screw until electrical contacts close or mercury switch tips over; checks to see that circulator is running when thermostat calls for heat; checks aquastat to see that temperature setting is high enough and resets if necessary. Repairs or replaces faulty controls, oil or water pipes, expansion tank, air ducts, motors, wiring, switches, etc. Records service on customer's service card, and explains work performed to customer. Itemizes materials and replacement parts for billing by office, or collects service charges from customer.

Removes soot and scale from smoke-pipe and fire-box with wire brushes and vacuum cleaners; removes nozzle assembly and installs new nozzle if necessary; inspects, adjusts and replaces ignition electrodes if required. Checks and regulates fire efficiency. Periodically checks tools and spare parts required as standard inventory in 3/4 ton service truck assigned to him, and replaces stock from storeroom as needed.

IV. Experimental Battery

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

V. Criterion

The criterion data collected consisted of two sets of independent ratings made by the service manager of each oil company on USES Form SP-21, "Descriptive Rating Scale." A period of at least two weeks elapsed 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 proficiency attained, were assigned to the alternatives. A reliability coefficient of .84 was obtained for the criterion. Therefore, the two sets of ratings were combined, resulting in a distribution of final criterion scores of 19.5-45.0, with a mean of 35.0 and a standard deviation of 5.7.

VI. Qualitative and Quantitative Analyses

A. Qualitative Analysis:
On the basis of the job analysis data, the following aptitudes were rated "important" for success in this occupation.

Intelligence (G) - required in studying and interpreting installation plans and in acquiring knowledge of automatic controls, settings, regulators, etc.

Spatial Aptitude (S) - required in interpreting floor-plan sketches, judging space when installing oil burner equipment and in reading diagrams for correct installation.

Form Perception (P) - required in inspecting equipment to ascertain need for repairs.

Motor Coordination (K) - required in connecting and installing assemblies such as pipes, tools, supply lines, etc.

Finger Dexterity (F) - required in cutting and connecting small tubing with flaring tool and in using various small tools in installations.

Manual Dexterity (M) - required in installing, cleaning and servicing various units of oil burner.

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 = 77

| Aptitudes | M | $\sigma$ | r |
|---|---|---|---|
| G-Intelligence | 104.1 | 13.7 | .093 |
| V-Verbal Aptitude | 103.3 | 14.6 | .122 |
| N-Numerical Aptitude | 99.4 | 14.3 | .153 |
| S-Spatial Aptitude | 103.4 | 15.8 | .003 |
| P-Form Perception | 98.9 | 16.6 | .182 |
| Q-Clerical Perception | 99.0 | 14.4 | .130 |
| K-Motor Coordination | 99.9 | 16.3 | .228* |
| F-Finger Dexterity | 97.6 | 18.3 | .274* |
| M-Manual Dexterity | 108.3 | 18.8 | .137 |

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 | X | X |
| Irrelevant | | | | | | | | | |
| Relatively High Mean | X | X | | X | | | | | X |
| Relatively Low Sigma | X | X | X | | | X | | | |
| Significant Correlation with Criterion | | | | | | | X | X | |
| Aptitudes to be Considered for Trial Norms | G | V | | S | | | K | F | M |

Trial norms consisting of various combinations of Aptitudes G,V,S,K,F and M with appropriate cutting scores were evaluated against the criterion by means of the Phi Coefficient technique. A comparison of the results showed that B-1002 norms consisting of G-95, S-85 and F-85 had the best selective efficiency.

## VII. Validity of Norms

The validity of the norms was determined by computing a Phi Coefficient 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 G, S and F with critical scores of 95, 85 and 85 respectively, and the dichotomized criterion for Oil Burner Service and Installation Man 5-83.026. 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 Oil Burner Service and Installation Man 5-83.026 (G-95, S-85, F-85)

| N = 77 | Non-Qualifying Test Scores | Qualifying Test Scores | Total |
|---|---|---|---|
| Good Workers | 17 | 35 | 52 |
| Poor Workers | 15 | 10 | 25 |
| Total | 32 | 45 | 77 |

Phi Coefficient = .259

$\chi^2$ = 5.159

P/2 < .025

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 F with minimum scores of 95, 85 and 85 , respectively, have been established as B-1002 norms forOil Burner Service and Installation Man 5.83.026 The equivalent B-1001 norms consist of G-100, S-90 and F-90.

## IX. Determination of Occupational Aptitude Pattern

The data for this study did not meet the requirements for incorporating the occupation studied into any of the 35 OAP's included in Section II of the Guide to the Use of the General Aptitude Test Battery, January 1962. The data for this sample will be considered for future groupings of occupations in the development of new occupational aptitude patterns.