

Maintenance Worker Selection:
High Validity and Low Adverse Impact

Michigan Municipal League
Employment Testing Consortium Project

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Session Agenda

- 1) Introduction
- 2) Job Analysis Information
- 3) Performance Measurement Instrument
- 4) Development of Examination and Data Collection
- 5) Data Analysis and Results
- 6) Use of Completed Exam

Introduction

- **Michigan Municipal League**
 - 510 Michigan Cities and Village

- **Human Resources Services Department**
 - Entry and Promotional Written and Oral Exams
 - Assessment Centers
 - Labor Relations Services
 - ADA Consulting Services
 - Commercial Drivers License (CDL)
 - Drug and Alcohol Testing Consortium
 - Municipal Benefit Services

- **Employment Testing Consortium (ETC)**
 - 22 Member Municipalities
 - Principally Detroit Area
 - Assemble Resources to Conduct Validation Research Projects

- **HR Strategies**
 - Now part of Aon Consulting, Inc.

Job Analysis Information

- **238 total employees completed questionnaire**

- 179 workers
 - 59 supervisors

- **Employed in 21 Michigan cities**

- **Task Statements**

- Started with 156 statements
 - 73 statements were rated as "important"
 - Grouped "important" 73 tasks into 10 task dimensions:

Communicating with others	Custodial duties
Working with equipment and tools	Equipment maintenance
Parks/recreation/grounds maintenance	Physical activities
Reading diagrams and text	Responsible work habits
Street maintenance	Water/sewer maintenance

- **Knowledge, Skill and Ability (KSA) Statements**

- Started with 93 statements
 - 54 statements were rated as "important"
 - Grouped "important" KSA's into 10 KSA dimensions:

Communications	Memory and learning
Operating Vehicles	Paying attention
Physical abilities	Reading
Safety	Using hands and fingers
Using tools	Work orientation

- **Two Job Clusters**

- Custodian

- General maintenance worker included:

- Parks maintenance
 - Parks and building maintenance
 - Street maintenance
 - Public works maintenance
 - Water and sewer maintenance

Performance Measurement Instrument

- **Very important part of a criterion validity study**
- **Used Behaviorally – Anchored performance rating format**
- **Used "Critical Incidents" collected in Job analysis questionnaire**
- **Subject matter experts (SME's) rated 225 performance examples**
- **Used 9 point scale**
- **Training materials prepared for appropriate rating techniques**
- **Two job skills areas dropped for low reliability**
 - 47 employees rated/re-rated by same supervisor
 - 77 employees rated by two supervisors
- **Four performance factor composites**
 - (see table 1)
- **Plus:**
 - Overall 9 point rating
 - Overall average score

Table 1

Performance Factor Composites

Factor	Dimensions/Skills
<ul style="list-style-type: none">• Learning and Reasoning Skills	<ul style="list-style-type: none">• Making Estimates• Using Mechanical Skills• Solving Problems• Learning and Applying Knowledge• Making Choices or Solving Problems
<ul style="list-style-type: none">• Work Habits	<ul style="list-style-type: none">• Demonstrating Responsible Work Habits• Work Responsibility• Working Productively• Maintaining Quality Standards• Work and Communicating with Others
<ul style="list-style-type: none">• Cognitive Skills	<ul style="list-style-type: none">• Memory and Learning• Reading and Writing• Working with Numbers• Communication Skills
<ul style="list-style-type: none">• Physical Abilities	<ul style="list-style-type: none">• Physical Abilities

Development of Examination and Data Collection

- **Survey of 55 larger cities in USA**
33 responses (2 used random selection or "lottery")
- **Computerized literature searches**
- **Not many validation studies**
(No criterion validated test studies to our knowledge)
- **Initial research test battery**
 - Reading comprehension
 - Arithmetic
 - Forms and reports
 - Following oral directions
 - Responsibility scale (Gordon Personal Profile)
 - Emotional stability scale (Gordon Personal Profile)
 - Background information inventory
 - Grip strength
 - Arm strength
- **Data collection**
 - Slow process (2 1/2 years)
 - 3 to 4 hours per employee
 - Suspicion about data collection
 - 332 incumbent workers tested and rated by their supervisor
 - from 36 Michigan jurisdictions
 - 272 Whites
 - 41 African-Americans
 - 13 Other minorities
 - 9 Females

Data Analysis and Results

- **Refinement of the test battery**
Item analysis
- **Comparison of groups on performance measures**
(see Table 2)
- **Comparison of groups on test scores**
(see Table 3)
- **Validity coefficients for test scores**
(see Table 4)
- **Test battery validity data**
(see Table 5)
- **Test battery group comparisons**
(Fairness analysis)
(see Table 6)
- **Incumbents with "Above Average" ratings**
(see Table 7)
- **Test battery adverse impact ratios**
(see Table 8)

Table 2
Comparison Between Employee Ethnic Groups
on Composite Performance Measures

Performance Measures	Mean (Standard Deviation) by Ethnic Group				Significance of Difference ^b	
	Overall (n = 332)	Whites (n = 272) ^a	African- Americans (n = 41)	All Minorities (n = 54)	Whites vs. African- Americans	Whites vs. all Minorities
Learning and Reasoning Skills	5.69 (1.29)	5.82 (1.24)	5.05 (1.28)	5.06 (1.41)	0.61**	0.59*
Work Habits	5.91 (1.41)	6.00 (1.37)	5.18 (1.41)	5.42 (1.52)	0.58**	0.41*
Cognitive Skills	6.12 (1.31)	6.17 (1.30)	5.75 (1.17)	5.84 (1.39)	0.33**	ns
Physical Abilities	6.33 (1.83)	6.27 (1.81)	6.34 (2.03)	6.54 (1.93)	ns	ns
Overall 9-Point Rating	5.98 (1.48)	6.08 (1.44)	5.39 (1.64)	5.46 (1.57)	0.69**	0.42**
Overall Average	5.92 (1.15)	6.01 (1.13)	5.35 (1.11)	5.49 (1.17)	0.57**	0.45*

^a Values in parentheses represent maximum sample sizes within each employee group. Individual sample sizes vary slightly across composite performance measures.

^b Comparison of group mean differences are based on analysis of variance. Where statistically significant differences exist and adversely affect the non-protected group, entries indicate the size of the difference in total group standard deviation units.

Key: ** = p less than .01; * = p less than .05; ns = not statistically significant.

Table 3
**Comparison Between Employee
Ethnic Groups on Test Scores**

Test	Mean (Standard Deviation) by Ethnic Group			Significance of Difference ^b	
	Whites (n = 272) ^a	African- Americans (n = 41)	All Minorities (n = 54)	Whites vs. African- Americans	Whites vs. all Minorities
Grip Strength	117.15 (20.58)	110.09 (25.99)	112.24 (23.92)	ns	ns
Gordon Personality Profile					
Responsibility	28.08 (4.60)	25.95 (5.67)	25.69 (5.61)	0.44**	0.49*
Emotional Stability	26.27 (4.80)	25.56 (5.39)	25.63 (5.58)	ns	ns
MML Tests					
Reading Comprehension	26.83 (4.12)	22.32 (6.84)	22.22 (7.14)	0.94**	0.92*
Arithmetic	27.71 (3.32)	24.17 (5.69)	23.94 (6.23)	0.91**	0.90**
Forms and Reports	26.07 (4.25)	20.51 (6.74)	20.37 (7.36)	1.11**	1.07**
Following Oral Directions	26.75 (2.69)	22.83 (5.23)	22.87 (5.47)	1.15**	1.08**
Background Information Inventory	20.38 (6.39)	18.54 (6.98)	18.80 (7.18)	ns	ns

^a Values in parentheses represent maximum sample sizes within each employee group. Individual sample sizes vary slightly across tests.

^b Comparison of group mean differences are based on analysis of variance. Where statistically significant differences exist and adversely affect the non-protected group. Entries indicate the size of the difference in total group standard deviation units.

Key: ** = p less than .01; * = p less than .05; ns = not statistically significant.

Table 4
Summary of Validity Coefficients for the Trial Tests
Overall Sample

Tests	Performance Composites					Overall 9-Point Rating	Overall Average
	Learning and Reasoning Skills	Work Habits	Cognitive Skills	Physical Abilities			
Grip Strength	.12	.10 ^{ns}	.05 ^{ns}	.17		.17	.12
Gordon Personal Profile							
Responsibility	.26	.32	.25	.13		.30	.32
Emotional Stability	.19	.20	.17	.11		.21	.22
MML Tests							
Reading Comprehension	.28	.17	.33	.07 ^{ns}		.25	.28
Arithmetic	.31	.17	.32	.10 ^{ns}		.25	.30
Forms and Reports	.30	.17	.34	.12		.25	.30
Following Oral Directions	.29	.15	.24	.11		.22	.26
Background Information Inventory	.29	.25	.22	.14		.26	.29

Note: Correlations are based on sample sizes ranging from 319 to 332 participants.
All correlations are statistically significant at p less than .05 level unless noted otherwise; ns = not statistically significant.

Table 5

**Test Battery Validity
Maintenance Worker Test Battery**

Test Battery: Background Information Inventory (BII)
Emotional Stability
Forms and Reports
Reading Comprehension

Model: Score = (2 x BII) +
Emotional Stability +
Forms and Reports +
Reading Comprehension

**Validity of the
Battery for:**

	Validity Coefficient			
	Total Sample (n=332)	White (n=272)	African- American (n=41)	All Minorities (n=54)
Learning and Reasoning Skills	.37**	.27**	.41*	.45**
Work Habits	.29**	.28**	.28 ^{ns}	.18 ^{ns}
Cognitive Skills	.35**	.34**	.16 ^{ns}	.36**
Physical Abilities	.16**	.19**	.15 ^{ns}	.12 ^{ns}
Overall 9-Point Rating	.34**	.29**	.42**	.35**
Performance Rating Average	.38**	.33**	.35*	.38**

Table 6

Test Battery Group Comparisons

<i>Subgroup Performance^a:</i>	Mean		S.D.
Race Group			
White (n=272)	119.94		18.60
African-American (n=41)	106.46		24.85
<i>Difference</i>		(0.65)**	
All Minorities (n=54)	105.81		26.10
<i>Difference</i>		(0.68)**	

^a Comparisons of group mean differences are based upon analysis of variance. Where statistically significant differences exist and adversely affect the non-protected group, entries indicate the size of the difference in total group standard deviation units. Comparisons based upon employee sex group were not conducted due to insufficient female sample size.

Key: ** = p less than .01; * = p less than .05; ^{ns} = not statistically significant. Parenthetical entries indicate the size of the difference in total sample standard deviation units.

Table 7

**Percentage of Incumbents with
"Above Average" Performance Ratings**

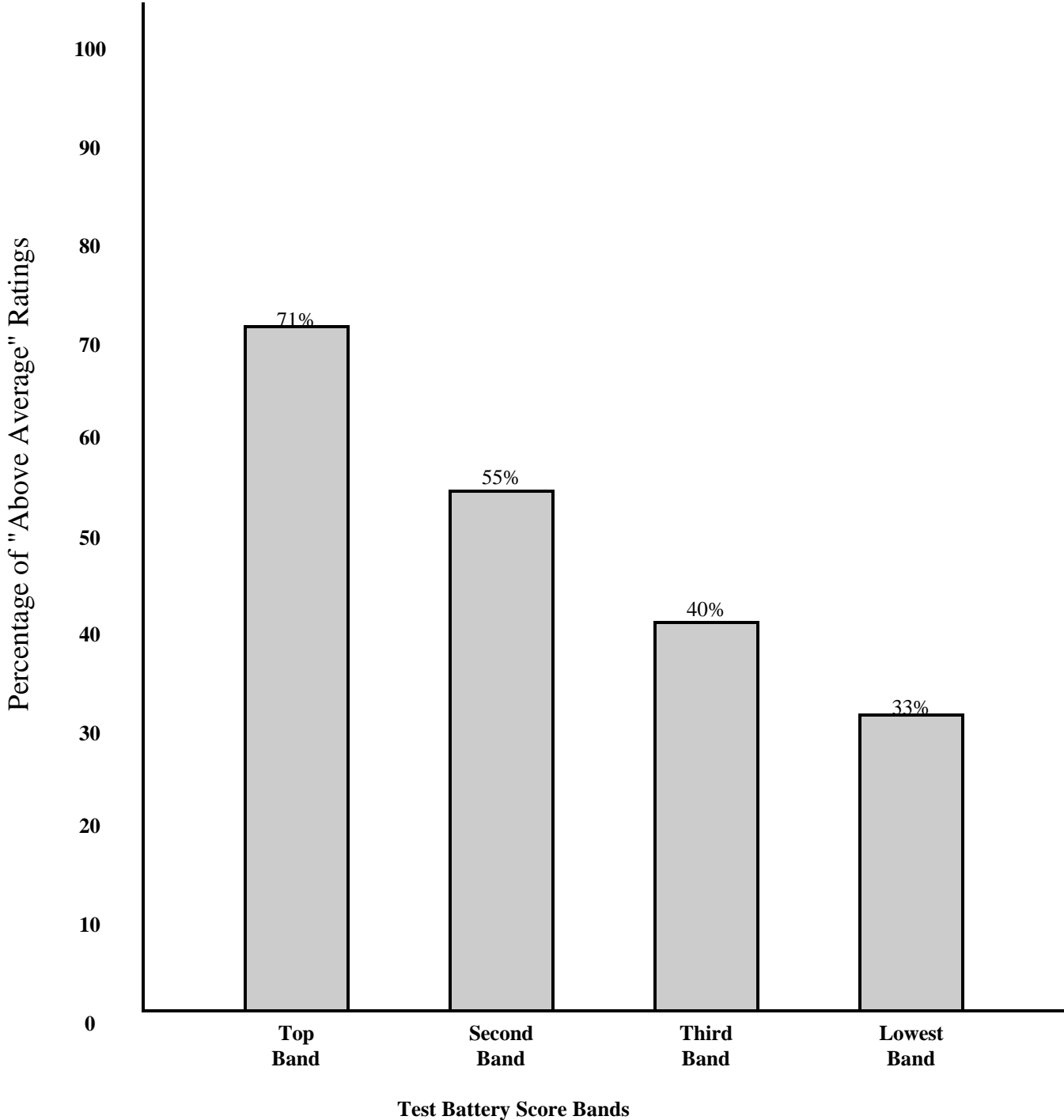


Table 8

**Maintenance Worker Test Battery
Passing Rates and Adverse Impact Ratios
at Alternative Cut-Off Scores**

Westland/Garden City Applicants

Cut-Off Score	Percentage of Passing (n=597)	Expected Ethnic Group Passing Rates		Adverse Impact Ratios^a
		African- American (n=95)	White (n=481)	
142	26.0%	20.0%	27.4%	.73
132	53.9	44.2	53.4	.83
121	76.5	64.2	78.8	.81
104	91.0	84.2	92.3	.91

^a The Adverse Impact Ratio is calculated by dividing the passing rate of the minority group by the passing rate of the majority group.

Use of Completed Exam

- **Job categories covered by this exam**
 - Building maintenance workers
 - Parks maintenance workers
 - Street maintenance workers
 - Public works maintenance workers
 - Water and sewer maintenance workers
- **Possible job titles include:**
 - Laborer
 - Truck driver
 - Driver/laborer
 - Equipment operator
 - _____ Maintenance worker
 - Building and grounds specialist
 - _____ Etc.
- **Link-up study**
 - Similarity of tasks and KSA's between study group and another position in another jurisdiction
- **Technical report available**
 - 150 page report, \$30
- **Contact for more information**
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