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Job/Task Analysis for an Operating Engineer/Building Technician

April 6, 2011 — November 9, 2011

Professional Testing, Inc.
Orlando, Florida

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Interim Subcontract Report
NREL/SR-5500-52673
September 2011

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JOB/TASK ANALYSIS
FOR AN

OPERATING ENGINEER/ BUILDING TECHNICIAN

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Conducted: May 11-13, 2011

Operating Engineer/Building Technician
Job Description

An Operating Engineer/Building Technician is a professional who manages commercial and laboratory buildings by maintaining, operating, and repairing HVAC, life safety, electrical, and plumbing systems, and performing general building maintenance to optimize equipment performance, maintain the building's operability, and ensure the comfort and safety of occupants.

A proposed content outline resulting from this Job/Task Analysis follows.

Operating Engineer/Building Technician	
A	Operating HVAC Systems
B	Maintaining HVAC Systems
C	Repairing HVAC Systems
D	Overseeing Life Safety Systems
E	Maintaining Electrical Systems
F	Maintaining Plumbing Systems
G	Performing General Building Maintenance

This Job/Task Analysis used input from a broad group of industry practitioners and was facilitated by Professional Testing, Inc. for the National Renewable Energy Laboratory and the U.S. Department of Energy.

Contents

1.0 Introduction

The National Renewable Energy Laboratory secured the services of Professional Testing to help develop a job/task analysis (JTA) for operating engineers/building technicians.

JTA is a procedure for analyzing the tasks performed by individuals in an occupation, as well as the knowledge, skills, and abilities required to perform those tasks. Specifically, a JTA can be defined as "any systematic procedure for collecting and analyzing job-related information to meet a particular purpose" (Raymond 2001). JTA can be used to describe, classify, and evaluate jobs; ensure compliance with legal and quasi-legal requirements; develop training, promote worker mobility, plan workforces, increase efficiency and safety, and appraise performance (Brannick et al. 2007).

JTA is traditionally used by secondary and postsecondary educators, test developers, and business, industry, government, and military trainers to help identify core knowledge areas, critical work functions, and skills that are common across a representative sampling of current practitioners.

This project used the "developing a curriculum" (DACUM) method to conduct a JTA. DACUM is an occupational analysis led by a trained facilitator, where practitioners in a specific occupation come together for a multiday workshop to provide input about the specific tasks, knowledge, and skills needed to perform their job.

This document provides draft results of the analysis and will form the basis for a subsequent "industry validation" phase, where a larger group of industry practitioners will evaluate the list of job-related tasks. This group will ensure that the identified tasks and weighting factors accurately represent the job of an operating engineer/building technician. This step will also provide an opportunity for industry to identify any missed tasks or any that were included erroneously.

This document should be used as a starting point for understanding the job of an operating engineer/building technician as currently practiced. It is not meant to function as a "best practices" guide.

2.0 Subject Matter Expert Selection Process

Professional Testing helped to establish the criteria for selecting the DACUM panel of subject matter experts (SMEs). To be eligible for the workshop panel, applicants were required to submit an electronic application and to demonstrate that they were active practitioners in their field. To create a representative panel of practitioners, Professional Testing selected SMEs from a larger applicant pool to ensure:

- Geographic diversity
- Representation of a wide range of experience levels (novice to expert)
- No single organization or organization size dominated the group
- All sectors were represented with no single sector dominating (public versus private)
- Diversity of industry-related credentials, represented by the panelists.

Six applicants meeting the above criteria were selected to create the operating engineer/building technician SME panel.

3.0 Job/Task Analysis Workshop

The operating engineer/building technician JTA workshop was held in Denver, Colorado, May 11–13, 2011.

The DACUM Philosophy:

- **Practitioners can describe and define their jobs more accurately than anyone else.**
- **One of the most effective ways to define a job is to describe the tasks practitioners perform.**
- **All jobs can be effectively and sufficiently described in terms of the tasks successful workers perform.**
- **All tasks, to be performed correctly, demand certain knowledge, skills, abilities, attributes, and tools.**

Day 1 consisted of an introduction to the DACUM process. The trained DACUM facilitator explained the JTA process and provided the SME panel with duty and task statement definitions. A duty reflects a large area of work for a specific profession; multiple tasks describe how to perform each duty. The presentation then shifted to a discussion about operating engineers/building technicians, more specifically the "who, how, what, and why" of the profession. The SME panelists compiled this information into a comprehensive list to capture key operating engineer/building technician job components.

The next step was to identify duty (or domain) areas. Once the SME panelists reached consensus on the duty areas, they delineated each duty by identifying the required tasks.

On Day 2, the facilitator projected a spreadsheet that contained the identified duty areas and corresponding task statements. The SMEs were asked to list the steps under each task and to identify the knowledge, skills, abilities, and tools needed to complete each task.

On Day 3, work concluded with the SMEs finalizing an overarching job description for operating engineers/building technicians.

4.0 Results

This document presents aspects of an operating engineer/building technician, as captured by the 6-member panel during the May 11–13, 2011 JTA workshop in Denver, Colorado. The tables that follow reflect job requirements and are meant to provide a clear understanding and detailed description of the work performed.

5.0 References

Brannick, M. T., Levine, E. L., & Morgeson, F. P. (2007). *Job and work analysis: Methods, research and applications for human resource management*. Thousand Oaks, CA: Sage.

Raymond, M.R. (2001). Job analysis and the specification of content for licensure and certification examinations. *Applied Measurement in Education 14*(4), 369-415.

6.0 Nomenclature

Table 1 provides a list of the acronyms and abbreviations used in this document. In addition to increasing the efficiency of communications, many technical and process acronyms are useful in memory retention and learning. Occupational acronyms are therefore of interest to trainers and curriculum designers.

Table 1: List of Acronyms and Abbreviations

Nomenclature	Definition
AHJ	Authority having jurisdiction
BAS	Building automation system
DACUM	Developing a curriculum
F	Fahrenheit
HVAC	Heating, ventilation, and air-conditioning
JTA	Job/task analysis
MSDS	Material safety data sheets
O_2	Oxygen
O&M	Operations & maintenance
PPE	Personal protective equipment
PRV	Pressure reducing valve
SME	Subject matter expert

7.0 Proposed Content Blueprint

The SMEs rated the list of job-related duties and tasks defined during the JTA workshop based on a two-factor scale: the importance of the duty area or task to overall job performance and the frequency with which duties and tasks are performed. The result is a weighted ranking of the duties and tasks known as a *content blueprint*.

The proposed content blueprint provides an initial basis from which an assessment (e.g., a certification or licensure examination) may be constructed and provides curriculum developers with a model to align training to the core needs of the occupation.

Table 2: Proposed Content Blueprint for Operating Engineers/Building Technicians

	Duties and Tasks	Weighting
A	**Operating HVAC Systems**	**9%**
1	Collect Operating Data	2%
2	Adjust BAS Parameters	2%
3	Analyze Equipment Performance	2%
4	Coordinate HVAC System Changes	2%
5	Check Operational Efficiencies	1%
B	**Maintaining HVAC Systems**	**32%**
1	Change Air Filters	2%
2	Clean Air Filters	2%
3	Clean Coil Water Strainer	1%
4	Clean Condenser or Fan Coils	1%
5	Clean Cooling Tower Basin	2%
6	Clean Cooling Tower Strainers	2%
7	Clean Pump Strainers	2%
8	Clean Side Stream Filter	2%
9	Clean Side Stream Separator	1%
10	Perform Air Damper Maintenance	1%
11	Perform Air Dryer Maintenance	1%
12	Perform Boiler Maintenance	2%
13	Perform Expansion Tank Maintenance	1%
14	Perform Fan Maintenance	2%
15	Perform Heat Exchanger Maintenance	1%
16	Perform Pump Maintenance	2%
17	Perform Steam Trap Maintenance	1%
18	Perform Valve Maintenance	1%
19	Perform Water Treatment Testing	2%
20	Perform Air Compressor Maintenance	1%
21	Clean Chiller Tubes	1%
22	Test Secondary Boiler Fuel System	1%

Table 2 (Continued): Proposed Content Blueprint for Operating Engineers/Building Technicians

	Duties and Tasks	Weighting
C	**Repairing HVAC Systems**	**14%**
1	Calibrate Equipment Controls	2%
2	Change Cooling Tower Fill Media	1%
3	Fabricate Sheet Metal	1%
4	Recover Refrigerant	1%
5	Repair Air Dampers	1%
6	Repair Refrigerant Leaks	2%
7	Replace BAS Input and Output Components	1%
8	Replace Mechanical Pump Seals	1%
9	Replace Pumps	1%
10	Troubleshoot Mixing Box	1%
11	Troubleshoot Fan Coil Units	1%
12	Troubleshoot Variable Air Volume Box	1%
D	**Overseeing Life Safety Systems**	**14%**
1	Operate Fire Alarm Panel	2%
2	Test Fire Alarm Systems	2%
3	Test Emergency Generator	2%
4	Test Fire Pumps	2%
5	Test Sprinkler Systems	2%
6	Test Smoke and Heat Sensors	1%
7	Inspect Fire Extinguishers	2%
8	Inspect Sprinkler Drip Legs	1%
E	**Maintaining Electrical Systems**	**13%**
1	Troubleshoot Lighting Systems	1%
2	Adjust Lighting Programming	1%
3	Replace Lamps	2%
4	Replace Ballasts	1%
5	Maintain Lamps and Ballast Inventory	1%
6	Change Electrical Fuses	1%
7	Change Control Boards	1%
8	Change Electrical Fixtures	1%
9	Change Electrical Relays	1%
10	Replace Electrical Motors	1%
F	**Maintaining Plumbing Systems**	**12%**
1	Maintain Plumbing Fixtures	1%
2	Maintain Sewage Injectors	1%
3	Maintain Water Heaters	1%
4	Identify Irrigation Leak Location	1%
5	Maintain Drains	2%
6	Maintain Backflow Preventers	2%
7	Maintain Pressure Reducing Valves (PRV)	2%
8	Replace Water Filters	1%
9	Winterize Irrigation System	1%

Table 2 (Continued): Proposed Content Blueprint for Operating Engineers/Building Technicians

	Duties and Tasks	Weighting
G	**Performing General Building Maintenance**	**6%**
1	Maintain Door Hardware	1%
2	Maintain Roof Systems	1%
3	Maintain Ceiling Tiles	1%
4	Maintain Flooring	1%
5	Maintain Window Systems	1%
6	Perform Minor Wall Repairs	1%
Total		**100%**

8.0 Knowledge

The SMEs identified and categorized specific types of knowledge needed to be a proficient operating engineer/building technician (Table 3). General knowledge areas (calculations, basic measurements, and communications), although not exclusive to this occupation, were also identified using a group consensus process (Table 4). The panelists concluded that a practitioner must master the knowledge in both tables to be competent as an operating engineer/building technician.

Table 3: Specialized Knowledge Required of Operating Engineers/Building Technicians

Specialized Knowledge	
Actuator types	Fire monitoring company contact information
Adhesive types	Fire pump types
Air dryer systems	Fire sprinkler system types
Backflow preventer types/operations	Flooring types
Ballast types	Fluid systems
Board types	Flush valve types
Boiler types	Fuel types/systems
Ceiling systems	Fuse types
Ceiling tile types	Gas systems
Chemistry (basic)	Generator types
Chiller water systems/types	Health and safety procedures
Cold water systems/types	Heat transfers
Component types	Heating systems
Compressor types	Heat exchanger types
Computer systems/programs	Hot water systems/types
Condenser equipment	Hot work procedures
Condenser water systems	How to read gauges
Control systems	HVAC systems
Cooling tower types/equipment	Hydronic systems
Damper systems	Irrigation systems/types
Deionized water	Lamp types
Digital controls/systems	Landscaping
Domestic water systems	Lighting controls/systems
Door closure types	Lighting fixture types
Door hinge types	Lockout/tagout procedures
Door lock types	Mechanical seal types
Electrical fixture types	Mechanical systems
Electrical systems	Mixing box types
Electronics	Monitoring company contact information
Equipment operations/performance	Motor types
Equipment sequence of operations	MSDS
Expansion tank types	Operating procedures/parameters
Fan coil unit types	Plumbing fixture types
Fan types	Plumbing systems
Faucet types	Pneumatic controls/systems
Filter performance	Pressurized systems/vessels
Filter types/sizes	PRV types
Fire alarm system/panel types	Pump types/operation
Fire extinguisher types	Refrigerant types

Table 3 (Continued): Specialized Knowledge Required of Operating Engineers/Building Technicians

Specialized Knowledge	
Refrigeration systems	Test equipment
Relay types	Tuning a control loop
Roofing systems/materials	Valves
Safety procedures	Variable air volume types
Separator systems	Ventilation systems
Sewage system types	Wall repair techniques
Sheet metal fabrication	Water chemicals
Side stream filter types	Water testing equipment
Sprinkler system types	Window operator types
Steam systems	Window seal types
Steam trap types	Window shading types
System controls	Window types
Systems served	

Table 4: General Knowledge Required of Operating Engineers/Building Technicians

General Knowledge	
Calculations	
Change numbers from fractions into decimals and back	Perform simple math operations of addition
Change numbers from percent into decimals and back	Perform simple math operations of division
Collect information to solve a problem	Perform simple math operations of multiplication
Compare numbers	Perform simple math operations of subtraction
Figure averages	Solve formula calculations with one unknown
Make rough estimates	Solve percent problems
Measure angles	Solve problems with graphs
Perform math operations using signed (positive and negative) numbers	Solve ratio problems
Perform math operations using single and multiple digit numbers	Transfer number sequences from a source into a column
Perform mathematical operations with decimals	Use a calculator
Perform mathematical operations with fractions	
Basic Measurements	
Calculate the perimeter and areas of common figures	Measure linear distances (length, width, etc.)
Convert measurements from one unit to another (English to metric, etc.)	Measure temperature to within 1 degree F
Estimate and approximate measurements	Measure volume (cubic inches, liters, etc.)
Measure accurately to 0.01 inches	Measure weights using devices calibrated in ounces
Measure area (square inches, square centimeters, etc.)	Measure weights using devices calibrated in pounds
Measure length to 1/32 of an inch	Read and use the scale of a drawing

Table 4 (Continued): General Knowledge Required of Operating Engineers/Building Technicians

General Knowledge	
Calculations	
Read measurements taken with common measuring tools	Record measurements, using appropriate unit notations (feet, yards, etc.)
Read, interpret, and use size/scale relationships	Use tools to measure quantities and solve problems involving measurements
Communications	
Ask questions	Participate in brainstorming
Communicate using the vocabulary/terminology of a related trade	Read and follow a map, chart, plan, etc.
Communicate with co-workers and/or business people verbally (face-to-face)	Read and follow directions found in equipment manuals and code books
Communicate with co-workers and/or business people verbally (telephone, radio)	Read and interpret directions found on labels, packages, or instruction sheets
Communicate with co-workers and/or business people in writing (letters, memos)	Read codes (building codes, electrical codes, standards, etc.)
Evaluate options/alternatives	Read drawings and specifications sheets
Evaluate solutions	Read flowcharts
Explain procedures	Read statistical data
Find information in catalogs	Read information from tables and graphs (bar, circle, etc.)
Find information in references (machinery handbook, tap/drill charts, etc.)	Research information
Follow verbal job instructions	Summarize information
Listen	Write words and numbers legibly

9.0 Skills, Abilities, and Attributes

A proficient worker possesses key skills, abilities, and attributes that influence job success. Skills are developed through experience and training and may apply to a wide range of tasks; proper skills enable workers to perform their tasks with precision and quality.

Abilities and attributes are more fundamental than knowledge and skills; they represent underlying, enduring traits, both cognitive and physical, that support the successful performance of a wide range of job tasks.

The panelists identified task-specific skills and abilities, as well as broad attributes (e.g., analytic, creative, patient), to define the recommended traits an operating engineer/building technician should possess (Table 5).

Human Resource professionals and job analysts often analyze skills, abilities, and attributes to compare jobs in terms of worker characteristics.

Table 5: Skills, Abilities, and Attributes Required of Operating Engineers/Building Technicians

Skills, Abilities, and Attributes	
Ability to operate fire alarm/panel	Inventory skills
Ability to operate recovery equipment	Listening skills
Ability to read gauges	Literate
Ability to work on boiler systems	Locksmithing skills
Ability to work on steam systems	Manages stress/pressure
Accurate/Precise	Mathematical skills
Adaptable/Flexible	Multi-tasker
Alignment skills	Non-aggressive
Brazing skills	Open-minded to change
Calibration skills	Painting skills
Carpeting skills	Patience
Common sense	Persistent
Computer skills	Personal hygiene
Confident	Physical stamina
Conscientious	Plumbing skills
Control skills	Pneumatic skills
Cooperative	Positive attitude
Courteous	Possesses high self-esteem
Critical thinker	Possesses integrity
Customer-oriented	Pride in job
Dependable	Problem-solving skills
Detail-oriented	Professional
Eager to learn new things	Programming skills
Electrical skills	Punctual
Enthusiastic	Quality focused
Ethical	Respectful
Focused	Responsible/accountable
Free of substance abuse	Rigging skills
Goal-oriented	Safety conscious
Helpful	Self-control
Honest	Self-discipline
Industrious	Self-motivated

Table 5 (Continued): Skills, Abilities, and Attributes Required of Operating Engineers/Building Technicians

Skills, Abilities, and Attributes	
Sheet metal skills	Time management skills
Soldering skills	Tolerant
Stock room skills	Trustworthy
Takes initiative	Unbiased
Team player	Wall repair skills
Tiling skills	Written communication skills
Mechanical skills	
Ability to lift heavy objects	Analytical
Ability to read and understand O&M manuals	Good hand-eye coordination
Ability to understand mechanical systems	Manual dexterity
Ability to use hand tools	Mathematical skills
Ability to use power tools	Problem-solving skills
Ability to work with hands	Understanding tolerances

10.0 Physical Conditions

In any job, the environment in which tasks are completed and the specific physical requirements necessary to complete each task must be understood. Awareness of physical conditions is useful for a variety of purposes, including ergonomic design, safety analysis, and the identification of job elements that are deemed essential functions for compliance with The Americans with Disabilities Act.

Table 6 contains the list of panelist-recommended physical conditions an operating engineer/building technician should possess.

Table 6: Physical Conditions Recommended for Operating Engineers/Building Technicians

Physical Conditions	
Bend forward frequently	Stoop, kneel, or crouch
Carry objects heavier than 50 pounds	Talk
Climb ladders, stairs, poles, etc. using legs and/or arms	Walk
Detect abnormal noises	Work around or near high voltage power sources or equipment
Feel size, shape, and temperature or texture of objects with the hands	Work around or near magnetic equipment or materials
Handle hot or cold objects	Work at heights of 1 to 25 feet above ground or floor level
Hear speech	Work in a squatting position for more than five (5) minutes per hour
Hold or move objects using the fingers	Work in changing temperatures (in and out of buildings repeatedly)
Hold or move objects using the hands but not the fingers	Work in confined spaces
Judge depth (the position and distance of objects) with the eyes	Work in damp places (high humidity, some standing water)
Lift 100 pounds maximum	Work in dry places (lacking any natural moisture or humidity)
Lift objects from ground to overhead level	Work in dust, oils, fumes, or smells
Lift objects from ground to waist level	Work in high temperatures (85 to 130 degrees F)
Lift objects from waist to overhead level	Work in low temperatures (0 to 45 degrees F)
Pull objects with arms or hands	Work in noisy places (85 decibels or higher with ear protection)
Push objects with arms or hands	Work in one place (no change of work location)
Reach with arms and hands in any direction	Work inside
See and discriminate colors	Work on slippery surfaces
See clearly at 20 feet or more (with/without optical assistance)	Work outside
See clearly at 20 inches or less (with/without optical assistance)	Work while standing on portable ladders
Stand all of the time	Work while standing on scaffolding
Stand at all	Work while wearing protective equipment (respirators, hoods, etc.)
Stand part of the time	Work with hands and arms over head level

11.0 Tools, Equipment, and Resources

Each occupation requires a unique set of support materials. It is important to identify the tools, equipment, and other tangible objects, as well as the resources (e.g., information technologies, codes and standards) required for a worker to effectively accomplish tasks. Table 7 lists the panelist-identified inventory of tools, equipment, and resources necessary to perform the identified tasks.

Table 7: Tools, Equipment, and Resources Used by Operating Engineers/Building Technicians

Tools, Equipment, and Resources	
General Tools, Equipment, and Resources	
Adhesives	Inspection sheets
Air compressor	Insulation tools
Alignment tools/devices	Inventory sheets
Anti-seize	Irrigation tools
Backflow preventer parts	Job hazard codes and requirements
Ballast	Labeling machine
Baseline data	Ladder
Bearings	Lamps
Belts	Leak detector
Brazing and soldering equipment	Locking devices
Brooms/brushes	Log sheets
Calibration equipment	Lubrication equipment/lubricant
Ceiling grid materials	Manometer
Ceiling tiles	Mechanical seal
Chemical cleaners	MSDS
Circuit card	New electrical fixtures
Cleaning equipment/supplies	New pump
Codes and requirements of AHJ	Oil
Combustion analyzer	O&M manuals
Computer	Packing materials
Computer test equipment	Paint / painting tools
Control board	Plumbing codes
Coupler	Plumbing fixtures
Damper repair materials	Pneumatic equipment
Drain snake	Pressure gauges
Drywall	Pressure washer
Electrical codes	Printer
Electrical meters	Program
End gaskets	Temperature measuring device
Enzymes	PRV parts
Fill media	Rain gear
Filters	Recovery equipment
Fin brush	Refrigerant
Fin comb	Refrigerant gauges
Flashlight	Refrigerant handler certification
Flooring materials/supplies	Refrigeration test equipment
Gaskets	Replacement components
Grounding strap	Rigging equipment
Hose	Roofing tools/supplies

Table 7 (Continued): Tools, Equipment, and Resources Used by Operating Engineers/Building Technicians

Tools, Equipment, and Resources	
General Tools, Equipment, and Resources	
Sand paper	Thermometer
Sealant materials	Test equipment
Sealing devices	Tube cleaning machine/brushes
Sheaves	Vacuum pump
Sheet metal/tools	Water filters
Shovel	Water testing equipment/chemicals
Spackle	Water testing manual
Sprayer	Window decals
Squeegee	Window operators
Telephone	Window shades
Temperature probe	Wire brushes
Electrical Equipment	
Amp probe	Electrically insulated tools
Electrical gloves	Fuse pullers
Electrical jumpers	Wire
Electrical multimeter	Wire cutters
Electrical tape	Wire nuts
Hand Tools	
Adjustable wrench	Nut drivers
Allen wrenches	Pipe wrenches
Ball-peen hammer	Pliers
Channel locks	Pocket knife
Chisel	Pocket level
Cleaning brushes	Rubber mallet
Combination wrenches	Screw drivers
Deburring tool	Socket
Extension magnet	Strap wrench
File	Tape measure
Flashlight	Torque wrench
Hacksaw	Tube bender
Hammer	Tubing cutters
Inspection mirror	Water key
Measuring device	
Plumbing Tools	
Aviator snips	Pipe cutters
Basin wrench	Plastic cutter
Chipping hammer	Plumb bob
Closet auger	Ratchet cutters
Flaring tool	Rope
Hand dies	Sandcloth
Inside cutter	Saw
Laser levels	Spud wrench
Markers	Square
No-hub wrench	Stop wrenches

Table 7 (Continued): Tools, Equipment, and Resources Used by Operating Engineers/Building Technicians

Tools, Equipment, and Resources	
Plumbing Tools	
Strap wrench	Tube bender
Striker	Tubing cutters
Swage	Water key
Torch	Wire brush
PPE	
Eye protection/safety glasses	Respirator
Face shield	Rubber boots
Fall protection	Vests
Gloves	Welding jacket
Hardhat	Work shoes
Hearing protection	
Testing and Balancing Equipment	
Differential pressure gauges	Manometer
Flow hoods	Pitot tubes
Flow measuring device	Pressure gauge
Flow tree	Thermometers
Magnehelic gauges	

12.0 DACUM Chart

The DACUM chart (Table 8) is a tabular representation of the JTA. Capital letters identify major job duty areas. Numbers identify tasks, and lowercase letters identify the steps required to accomplish each task. Moving horizontally across the chart, adjacent columns detail (1) specialized knowledge, (2) skills and abilities, and (3) tools, equipment, and resources required to perform each task. The information contained in these columns is related to each task and does not necessarily correspond to a specific step.

The importance of the DACUM chart is to show the relationship between job tasks and the specialized knowledge, skills and abilities, and tools, equipment, and resources required to perform each task. This concept, called *job-relatedness*, is essential to compliance with key legal and professional validity standards pertaining to the use of JTA information in employee selection. Such information is also critical to the development of high-stakes assessments for occupational licensing and certification examinations.

The DACUM chart depicts the job element relationships associated with each task, and can therefore easily be used to assess the relevance of current programs (curriculum), develop instructional objectives and training content, sequence instructional materials, and develop examination, competency, and performance evaluation instruments.

Table 8: DACUM Chart for Operating Engineers/Building Technicians

	Duties, Tasks, and Steps	Specialized Knowledge	Skills and Abilities	Tools, Equipment, and Resources
A	**Operating HVAC Systems**			
1	Collect Operating Data			
a	Read pressure gauges	• How to read gauges • Operating procedures/parameters	• Literate • Written communication skills	• Computer • Log sheets • O&M manuals • Printer
b	Operate BAS computers			
c	Read temperature gauges			
d	Read control panels			
e	Check oil levels			
f	Log equipment read-outs			
g	Report inconsistencies			
h	Record meter readings			
2	Adjust BAS Parameters			
a	Open graphic pages	• Computer systems/programs • Control systems • Equipment operations/performance • Tuning a control loop	• Computer skills	• Computer • O&M manuals
b	Select parameters to be changed			
c	Enter new parameter values			
d	Create new variables			
e	Delete old variables			
f	Verify parameter changes			
3	Analyze Equipment Performance			
a	Collect trends of operational parameters	• Equipment sequence of operations • Equipment operations/performance • Test equipment	• Computer skills • Mathematical skills	• Baseline data • O&M manuals • Test equipment
b	Collect data from performance tests			
c	Compare trends and data			
d	Report findings			
4	Coordinate HVAC System Changes			
a	Open computer graphics	• Control systems • Equipment sequence of operations • Fluid systems • HVAC systems • Lockout/tagout procedures • Safety procedures	• Computer skills	• Computer • Hand tools • Locking devices • O&M manuals
b	Start alternate equipment			
c	Verify alternate equipment is online			
d	Apply changes to system configuration			
e	Disable initial equipment			
f	Verify valve positions			
g	Verify equipment shutdown			

Table 8 (Continued): DACUM Chart for Operating Engineers/Building Technicians

	Duties, Tasks, and Steps	Specialized Knowledge	Skills and Abilities	Tools, Equipment, and Resources
A	**Operating HVAC Systems**			
5	Check Operational Efficiencies			
a	Check chiller performance	• Chiller water systems/types • Electrical systems • Equipment operations/performance • Hot water systems/types • HVAC systems • Pneumatic controls/systems • Ventilation systems	• Ability to read gauges • Mathematical skills	• Computer test equipment • Electrical equipment • Hand tools • O&M manuals • Pneumatic test equipment • Testing and balancing equipment
b	Check boiler performance			
c	Check ventilation performance			
d	Check pressure data			
e	Check temperature data			
f	Check amperage data			
g	Check voltage data			
h	Check air flow data			
i	Check water flow data			
B	**Maintaining HVAC Systems**			
1	Change Air Filters			
a	Disable ventilation equipment	• Filter performance • Filter types/sizes • HVAC systems	• Mechanical skills list (Table 5)	• Hand tools • Ladder • Locking devices • PPE
b	Remove old air filters			
c	Install new air filters			
d	Enable ventilation equipment			
2	Clean Air Filters			
a	Disable ventilation equipment	• Filter performance • Filter types/sizes • HVAC systems • Lockout/tagout procedures • Safety procedures	• Mechanical skills list (Table 5)	• Air compressor • Hand tools • Ladder • Locking devices • PPE • Pressure washer
b	Remove dirty air filters			
c	Rinse air filter			
d	Steam air filter			
e	Blow out air filter			
f	Send air filters out for debris removal			
g	Install clean air filter			
h	Enable ventilation equipment			

Table 8 (Continued): DACUM Chart for Operating Engineers/Building Technicians

	Duties, Tasks, and Steps	Specialized Knowledge	Skills and Abilities	Tools, Equipment, and Resources
B	**Maintaining HVAC Systems**			
3	Clean Coil Water Strainer			
a	Isolate water strainer	• Lockout/tagout procedures • Pressurized systems/vessels • Safety procedures	• Mechanical skills list (Table 5)	• Hand tools • Ladder • Locking devices • O&M manuals • PPE
b	Drain water strainer			
c	Remove strainer housing			
d	Rinse water strainer			
e	Reinstall water strainer			
f	Refill water strainer			
g	Place water strainer in service			
4	Clean Condenser or Fan Coils			
a	Disable equipment	• Condenser equipment • Lockout/tagout procedures • Safety procedures	• Mechanical skills list (Table 5)	• Air compressor • Chemical cleaners • Cleaning supplies • Fin brush • Hand tools • Hose • Locking devices • MSDS • O&M manuals • PPE • Sprayer
b	Disassemble equipment			
c	Apply chemical cleaner to coils			
d	Rinse coils			
e	Blow out coils			
f	Cleanout condenser drip pan			
g	Reassemble condenser equipment			
h	Enable equipment			
5	Clean Cooling Tower Basin			
a	Disable cooling tower cell	• Cooling tower types/equipment • Lockout/tagout procedures • Safety procedures	• Mechanical skills list (Table 5)	• Brooms/brushes • Hand tools • Hose • Ladder • O&M manuals • PPE • Sprayer
b	Isolate tower basin			
c	Drain tower basin			
d	Spray fill media			
e	Remove debris			
f	Fill tower basin			
g	Enable cooling tower cell			

Table 8 (Continued): DACUM Chart for Operating Engineers/Building Technicians

	Duties, Tasks, and Steps	Specialized Knowledge	Skills and Abilities	Tools, Equipment, and Resources
B	**Maintaining HVAC Systems**			
6	Clean Cooling Tower Strainers			
a	Disable tower cell	• Cooling tower types/equipment • Lockout/tagout procedures • Safety procedures	• Mechanical skills list (Table 5)	• Hand tools • Hose • Locking devices • O&M manuals • PPE
b	Remove tower strainer			
c	Rinse tower strainer			
d	Reinstall tower strainer			
e	Enable tower cell			
7	Clean Pump Strainers			
a	Disable pump	• Lockout/tagout procedures • Pressurized systems/vessels • Pump types/operation • Safety procedures	• Mechanical skills list (Table 5)	• Anti-seize • Brooms/brushes • Hand tools • Hose • Locking devices • O&M manuals • PPE • Sealing devices
b	Isolate strainer			
c	Drain strainer			
d	Open strainer housing			
e	Remove strainer			
f	Rinse strainer			
g	Brush strainer			
h	Reinstall strainer			
i	Close strainer housing			
j	Fill strainer housing			
k	Prime pump			
l	Open isolation valves			
m	Enable pump			

Table 8 (Continued): DACUM Chart for Operating Engineers/Building Technicians

	Duties, Tasks, and Steps	Specialized Knowledge	Skills and Abilities	Tools, Equipment, and Resources
B	**Maintaining HVAC Systems**			
8	Clean Side Stream Filter			
a	Disable filter	• Lockout/tagout procedures • Safety procedures • Side stream filter types	• Mechanical skills list (Table 5)	• Hand tools • Hose • Locking devices • O&M manuals • PPE
b	Back flush filter media (i.e., for sand filter)			
c	Isolate filter			
d	Drain filter housing			
e	Open filter housing			
f	Remove filter			
g	Rinse filter			
h	Replace filters			
i	Install filter			
j	Close filter housing			
k	Fill filter housing			
l	Open isolation valves			
m	Enable filter system			
9	Clean Side Stream Separator			
a	Line-up system for back flushing	• Separator systems	• Mechanical skills list (Table 5)	• Hand tools • O&M manuals • PPE
b	Back flush separator			
c	Line-up system for normal operation			
10	Perform Air Damper Maintenance			
a	Disable damper equipment	• Damper systems • Electrical systems • Lockout/tagout procedures • Pneumatic controls/systems • Safety procedures	• Mechanical skills list (Table 5)	• Cleaning equipment/supplies • Hand tools • Ladder • Locking devices • Lubrication equipment/lubricant • O&M manuals • Pneumatic equipment • PPE
b	Configure system for maintenance			
c	Check damper operation			
d	Clean damper			
e	Lubricate damper linkages			
f	Adjust damper position			
g	Check actuators			
h	Return system to normal operation			

Table 8 (Continued): DACUM Chart for Operating Engineers/Building Technicians

	Duties, Tasks, and Steps	Specialized Knowledge	Skills and Abilities	Tools, Equipment, and Resources
B	**Maintaining HVAC Systems**			
11	Perform Air Dryer Maintenance			
a	Isolate air dryer	• Air dryer systems • Heating systems • Lockout/tagout procedures • Pressurized systems/vessels • Refrigeration systems • Safety procedures	• Mechanical skills list (Table 5)	• Belts • Filters • Hand tools • Locking devices • Lubrication equipment/lubricant • O&M manuals • Oil • PPE • Refrigerant • Refrigeration test equipment • Sealing devices
b	Change air filter			
c	Check moisture indicator			
d	Clean condensing coil			
e	Check compressor oil			
f	Check refrigerant pressures			
g	Clean drip pan			
h	Check drive belts			
i	Check drain lines			
j	Lubricate fan bearings			
k	Enable air dryer			

Table 8 (Continued): DACUM Chart for Operating Engineers/Building Technicians

	Duties, Tasks, and Steps	Specialized Knowledge	Skills and Abilities	Tools, Equipment, and Resources
B	**Maintaining HVAC Systems**			
12	Perform Boiler Maintenance			
a	Disable boiler	• Boiler types • Fuel types/systems • Heating systems • Hydronic systems • Lockout/tagout procedures • Pressurized systems/vessels • Safety procedures	• Electrical skills • Mechanical skills list (Table 5)	• Codes and requirements of AHJ • Combustion analyzer • Electrical meters • Hand tools • Leak detector • Locking devices • Lubrication equipment/lubricant • Manometer • MSDS • O&M manuals • PPE • Sealing devices
b	Isolate feed water			
c	Isolate steam			
d	Isolate fuel system			
e	Drain boiler drum			
f	Check safeties			
g	Check electrical connection			
h	Check operating controls			
i	Clean burners			
j	Check refractory			
k	Remove hand holes			
l	Remove manway cover			
m	Inspect burner tubes			
n	Open fire doors			
o	Remove old fire door gaskets			
p	Clean fire door sealing surfaces			
q	Clean fire eye			
r	Rinse out water side			
s	Open low water cutouts			
t	Inspect low water cutouts			
u	Inspect water side			
v	Change water level sight glass			
w	Verify pressures			
x	Check operation of fuel supply valves			
y	Check operation of feed water regulator			
z	Check draft operation			
aa	Check O_2 sensor			
ab	Replace sealing gaskets			
ac	Refill boiler drum			
ad	Replace hand holes			

Table 8 (Continued): DACUM Chart for Operating Engineers/Building Technicians

	Duties, Tasks, and Steps	Specialized Knowledge	Skills and Abilities	Tools, Equipment, and Resources
B	**Maintaining HVAC Systems**			
12	Perform Boiler Maintenance			
ae	Replace manway holes			
af	Close fire doors			
ag	Open feed water isolation valves			
ah	Open fuel system isolation valves			
ai	Pressure test water side			
aj	Warm-up boiler			
ak	Perform combustion analysis			
al	Return the boiler to normal operation			
13	Perform Expansion Tank Maintenance			
a	Inspect physical condition of tank	• Expansion tank types	• Mechanical skills list (Table 5)	• Hand tools • O&M manuals • Pressure gauges
b	Check air pressure			
c	Check pressure relief valve			
14	Perform Fan Maintenance			
a	Disable fan	• Fan types • Lockout/tagout procedures • Safety procedures	• Mechanical skills list (Table 5) • Electrical skills	• Bearings • Belts • Electrical meters • Hand tools • Locking devices • Lubrication equipment/lubricant • O&M manuals • PPE • Sheaves
b	Lubricate fan bearings			
c	Clean fan blades			
d	Clean fan motor			
e	Remove belt guard			
f	Check fan belts			
g	Check alignment			
h	Reinstall belt guard			
i	Enable fan			
j	Take electrical readings			

Table 8 (Continued): DACUM Chart for Operating Engineers/Building Technicians

	Duties, Tasks, and Steps	Specialized Knowledge	Skills and Abilities	Tools, Equipment, and Resources
B	**Maintaining HVAC Systems**			
15	Perform Heat Exchanger Maintenance			
a	Check differential temperatures	• Heat exchanger types • Heat transfers • Lockout/tagout procedures • MSDS • Pressurized systems/vessels • Safety procedures • Systems served	• Mechanical skills list (Table 5)	• Brooms/brushes • Cleaning equipment/supplies • Hand tools • Hose • Locking devices • MSDS • O&M manuals • PPE
b	Isolate heat exchanger			
c	Check for leaks			
d	Replace zinc anodes			
e	Clean heat exchange surfaces			
f	Remove plates			
g	Clean plates			
h	Check O-rings or gaskets			
i	Fill vessel			
j	Return heat exchanger to service			
16	Perform Pump Maintenance			
a	Check pump pressure	• Lockout/tagout procedures • Plumbing systems • Pump types/operations • Safety procedures	• Mechanical skills list (Table 5)	• Alignment tools/devices • Brooms/brushes • Hand tools • Hose • Insulation tools • Locking devices • Lubrication equipment/lubricant • O&M manuals • PPE • Sealing materials
b	Check bearing temperatures			
c	Disable pump			
d	Isolate pump from system			
e	Check pump and motor alignment			
f	Lubricate bearings			
g	Inspect coupling and packing			
h	Drain pump housing			
i	Clean pump strainer			
j	Return pump to service			
k	Check pump seals			
l	Take electrical readings			

Table 8 (Continued): DACUM Chart for Operating Engineers/Building Technicians

	Duties, Tasks, and Steps	Specialized Knowledge	Skills and Abilities	Tools, Equipment, and Resources
B	**Maintaining HVAC Systems**			
17	Perform Steam Trap Maintenance			
a	Measure temperature differential	• Lockout/tagout procedures • Pressurized systems/vessels • Safety procedures • Steam systems • Steam trap types	• Mechanical skills list (Table 5)	• Gaskets • Hand tools • Locking devices • O&M manuals • PPE • Temperature measuring device • Wire brushes
b	Isolate steam trap			
c	Relieve pressure			
d	Remove front part of trap			
e	Clean internal components			
f	Replace gaskets			
g	Reinstall trap			
h	Return steam trap to normal operation			
18	Perform Valve Maintenance			
a	Inspect conditions of valve	• Plumbing systems • Valves	• Mechanical skills list (Table 5)	• Hand tools • Lubrication equipment/lubricant • O&M manuals • Packing materials • Wire brushes
b	Clean valve threads			
c	Inspect actuator			
d	Check valve packing			
e	Verify valve opening and closing			
f	Lubricate valve stem			
19	Perform Water Treatment Testing			
a	Obtain water samples	• Chemistry (basic) • Chilled water systems/types • Condenser water systems • Deionized water • Domestic water systems • Hot water systems/types • Steam systems • Water chemicals • Water testing equipment	• Mechanical skills list (Table 5)	• MSDS • O&M manuals • PPE • Water testing equipment/chemicals • Water testing manual
b	Analyze water sample			
c	Record findings			

Table 8 (Continued): DACUM Chart for Operating Engineers/Building Technicians

	Duties, Tasks, and Steps	Specialized Knowledge	Skills and Abilities	Tools, Equipment, and Resources
B	**Maintaining HVAC Systems**			
20	Perform Air Compressor Maintenance			
a	Disable compressor	• Compressor types • Mechanical systems • Pressurized systems/vessels	• Mechanical skills list (Table 5)	• Belts • Electrical meters • Filters • Hand tools • Locking devices • O&M manuals • Oil • PPE
b	Isolate compressor			
c	Blow down compressor			
d	Lubricate bearings			
e	Check oil levels			
f	Remove belt guard			
g	Check belts			
h	Change filters			
i	Check operating controls			
j	Reinstall belt guard			
k	Return compressor to normal operation			
l	Check electrical motor			
21	Clean Chiller Tubes			
a	Disable chiller	• Chilled water systems/types	• Mechanical skills list (Table 5) • Rigging skills	• End gaskets • Hand tools • Hose • Pneumatic equipment • PPE • Rain gear • Tube cleaning machine/brushes • Wire brushes
b	Isolate chiller			
c	Drain chiller			
d	Remove end bell housing			
e	Brush tubes			
f	Clean tube sheet			
g	Check end bell gasket			
h	Reinstall end bell			
i	Fill chiller			
j	Return chiller to normal operation			

Table 8 (Continued): DACUM Chart for Operating Engineers/Building Technicians

	Duties, Tasks, and Steps	Specialized Knowledge	Skills and Abilities	Tools, Equipment, and Resources
B	**Maintaining HVAC Systems**			
22	Test Secondary Boiler Fuel System			
a	Start secondary system	• Boiler types • Fuel types/systems • Heating systems • Lockout/tagout procedures • Safety procedures • Steam systems	• Ability to work on boiler systems • Ability to work on steam systems • Mechanical skills list (Table 5)	• Hand tools • Locking devices • O&M manuals • PPE
b	Isolate boiler			
c	Shut down boiler			
d	Remove primary fuel burner			
e	Install secondary fuel burner			
f	Align fuel train to secondary source			
g	Restart boiler			
h	Verify boiler operation			
C	**Repairing HVAC Systems**			
1	Calibrate Equipment Controls			
a	Calibrate BAS components	• Component types • Computer systems/programs • Electrical systems • HVAC systems	• Calibration skills • Electrical skills • Mathematical skills	• Calibration equipment • Electrical meters • Hand tools • O&M manuals
b	Isolate faulty component			
c	Adjust faulty component			
d	Verify calibration is correct			
e	Place component into normal operation			
2	Change Cooling Tower Fill Media			
a	Disable cooling tower cell	• Cooling tower types/equipment • Lockout/tagout procedures • Safety procedures	• Mechanical skills list (Table 5)	• Fill media • Hand tools • Ladder • Locking devices • O&M manuals • PPE
b	Isolate cooling tower cell			
c	Drain cooling tower cell			
d	Remove old fill media			
e	Install new fill media			
f	Fill cooling tower cell			
g	Restore tower to normal operation			
3	Fabricate Sheet Metal			
a	Take measurements for design	• Safety procedures • Sheet metal fabrication	• Mathematical skills • Mechanical skills list (Table 5)	• O&M manuals • PPE • Sheet metal/tools
b	Fabricate to specifications			
c	Remove defective sheet metal			
d	Install new material			
e	Check for leaks			

Table 8 (Continued): DACUM Chart for Operating Engineers/Building Technicians

	Duties, Tasks, and Steps	Specialized Knowledge	Skills and Abilities	Tools, Equipment, and Resources
C	**Repairing HVAC Systems**			
4	Recover Refrigerant			
a	Pump down refrigeration system	• Refrigerant types • Refrigeration systems	• Ability to operate recovery equipment • Mechanical skills list (Table 5)	• Hand tools • O&M manuals • PPE • Recovery equipment • Refrigerant handler certification • Refrigerant gauges
b	Disable refrigeration equipment			
c	Install gauges			
d	Hook up recovery equipment			
e	Transfer refrigerant to holding tank			
5	Repair Air Dampers			
a	Disable air damper	• Electrical systems • Lockout/tagout procedures • Pneumatic controls/systems • Safety procedures • Ventilation systems	• Electrical skills • Mechanical skills list (Table 5) • Pneumatic skills	• Hand tools • Locking devices • Damper repair materials • O&M manuals • PPE
b	Fix defective air damper component			
c	Verify operation of air damper			
d	Return air damper to normal operation			
6	Repair Refrigerant Leaks			
a	Recover refrigerant	• Refrigerant types • Refrigeration systems	• Brazing skills • Mechanical skills list (Table 5) • Soldering skills	• Brazing and soldering equipment • Hand tools • O&M manuals • PPE • Recovery equipment • Refrigerant gauges • Vacuum pump
b	Prepare leak area for repair			
c	Fix leak			
d	Check pressurized system for leaks			
e	Evacuate system			
f	Recharge system with refrigerant			
g	Check operation of system			
h	Return system to normal operation			

Table 8 (Continued): DACUM Chart for Operating Engineers/Building Technicians

	Duties, Tasks, and Steps	Specialized Knowledge	Skills and Abilities	Tools, Equipment, and Resources
C	**Repairing HVAC Systems**			
7	Replace BAS Input and Output Components			
a	Isolate component from system	• Control systems • Electrical systems	• Electrical skills • Mechanical skills list (Table 5)	• Hand tools • O&M manuals • PPE • Replacement components
b	Remove defective component			
c	Install new component			
d	Test operation of new component			
e	Restore system to normal operation			
8	Replace Mechanical Pump Seals			
a	Disable pump	• Lockout/tagout procedures • Mechanical seal types • Pump types/operations • Safety procedures	• Alignment skills • Mechanical skills list (Table 5)	• Alignment tools/devices • Gaskets • Hand tools • Locking devices • Mechanical seal • O&M manuals • PPE
b	Isolate pump			
c	Drain pump			
d	Disconnect motor coupling			
e	Remove pump			
f	Remove defective mechanical seal			
g	Install new mechanical seal			
h	Reinstall pump			
i	Reconnect motor coupling			
j	Align motor coupling			
k	Refill pump			
l	Restore pump to normal operation			

Table 8 (Continued): DACUM Chart for Operating Engineers/Building Technicians

	Duties, Tasks, and Steps	Specialized Knowledge	Skills and Abilities	Tools, Equipment, and Resources
C	**Repairing HVAC Systems**			
9	Replace Pumps			
a	Disable pump	• Lockout/tagout procedures • Pump types/operations • Safety procedures	• Alignment skills • Mechanical skills list (Table 5)	• Alignment tools/devices • Coupler • Gaskets • Hand tools • Locking devices • Mechanical seal • New pump • O&M manuals • Packing materials • PPE
b	Isolate pump			
c	Drain pump			
d	Disconnect motor coupling			
e	Remove defective pump			
f	Install new pump			
g	Connect motor coupling			
h	Align motor coupling			
i	Fill pump			
j	Check pump operation			
k	Return system to normal operation			
10	Troubleshoot Mixing Box			
a	Check the air flow trend log	• Actuator types • Digital controls/systems • Mixing box types • Pneumatic controls/systems • Ventilation systems	• Calibration skills • Electrical skills • Mechanical skills list (Table 5) • Pneumatic skills	• Calibration equipment • Hand tools • Ladder • Manometer • O&M manuals • PPE
b	Verify damper operation			
c	Verify air flow			
d	Check operation of thermostat			
e	Check calibration on thermostat			
f	Check the operation of the actuator			
g	Summarize findings to indicate problem			

Table 8 (Continued): DACUM Chart for Operating Engineers/Building Technicians

	Duties, Tasks, and Steps	Specialized Knowledge	Skills and Abilities	Tools, Equipment, and Resources
C	**Repairing HVAC Systems**			
11	Troubleshoot Fan Coil Units			
a	Check air flow	• Cold water systems/types • Control systems • Electrical systems • Fan coil unit types • Hot water systems/types • Lockout/tagout procedures • Mechanical systems • Pneumatic controls/systems • Safety procedures • Ventilation systems	• Control skills • Electrical skills • Mechanical skills list (Table 5) • Pneumatic skills	• Electrical meters • Fin comb • Hand tools • Locking devices • Manometer • O&M manuals • PPE • Thermometer
b	Check valve positions			
c	Check fan operations			
d	Check air filter			
e	Check coil cleanliness			
f	Check supply air temperature			
g	Check motor			
h	Check if power is present			
i	Check belt condition			
j	Summarize findings to indicate problem			
12	Troubleshoot Variable Air Volume Box			
a	Check the air flow trend log	• Cold water systems/types • Control systems • Electrical systems • Hot water systems/types • Lockout/tagout procedures • Pneumatic controls/systems • Safety procedures • Variable air volume types • Ventilation systems	• Control skills • Electrical skills • Mechanical skills list (Table 5) • Pneumatic skills	• Calibration equipment • Electrical meters • Fin comb • Hand tools • Ladder • Locking devices • O&M manuals • PPE • Temperature probe
b	Check the temperature trend log			
c	Check the thermostat operation			
d	Verify air flow			
e	Check actuator operation			
f	Check damper operation			
g	Check control operation			
h	Check valve position			
i	Check start-up parameters			
j	Check coil cleanliness			
k	Check programming			
l	Summarize findings to indicate problem			

Table 8 (Continued): DACUM Chart for Operating Engineers/Building Technicians

	Duties, Tasks, and Steps	Specialized Knowledge	Skills and Abilities	Tools, Equipment, and Resources
D	**Overseeing Life Safety Systems**			
1	Operate Fire Alarm Panel			
a	Inform monitoring company to place system in test	• Fire alarm system/panel types • Fire monitoring company contact information		• O&M manuals • Telephone
b	Log on to fire alarm panel			
c	Select device			
d	Disable device			
e	Acknowledge device is isolated			
f	Enable device			
g	Call monitoring company to place system back online			
2	Test Fire Alarm Systems			
a	Inform monitoring company to place system in test	• Fire alarm system/panel types • Monitoring company contact information		• Telephone
b	Inform building occupants of test			
c	Activate fire alarm system device			
d	Check audible and visual devices			
e	Reset systems			
f	Inform building occupants of test completion			
g	Inform monitoring company to place system back online			
3	Test Emergency Generator			
a	Notify building occupants of generator test	• Electrical systems • Generator types • Operating procedures/parameters		• Log sheets • O&M manuals • PPE
b	Check generator fluids			
c	Start generator			
d	Check generator operation			
e	Place generator back in normal operation			

Table 8 (Continued): DACUM Chart for Operating Engineers/Building Technicians

	Duties, Tasks, and Steps	Specialized Knowledge	Skills and Abilities	Tools, Equipment, and Resources
D	**Overseeing Life Safety Systems**			
4	Test Fire Pumps			
a	Call monitoring company to place system in test	• Fire alarm system/panel types • Fire pump types • Fire monitoring company contact information		• Flashlight • Log sheets • Telephone
b	Disable water flow device			
c	Start fire pump			
d	Verify fire pump operation			
e	Stop fire pump			
f	Enable water flow device			
g	Call monitoring company to place system back online			
5	Test Sprinkler Systems			
a	Call monitoring company to place system in test	• Fire alarm system/panel types • Fire monitoring company contact information • Fire sprinkler system types	• Ability to operate fire alarm/panel	• Hand tools • Telephone
b	Bypass fire alarm outputs			
c	Open test ports			
d	Verify flow alarm signals			
e	Close test ports			
f	Reset fire alarm panel			
g	Restore fire alarm outputs			
h	Call monitoring company to place system back online			
6	Test Smoke and Heat Sensors			
a	Call monitoring company and place system in test	• Fire alarm system/panel types • Fire monitoring company contact information	• Ability to operate fire alarm/panel	• Telephone • Testing equipment
b	Bypass fire alarm panel outputs			
c	Manually activate smoke and heat sensors			
d	Verify alarm signal at fire alarm control panel			
e	Reset fire alarm panel			
f	Restore fire alarm outputs			
g	Call monitoring company and place system back online			

Table 8 (Continued): DACUM Chart for Operating Engineers/Building Technicians

	Duties, Tasks, and Steps	Specialized Knowledge	Skills and Abilities	Tools, Equipment, and Resources
D	**Overseeing Life Safety Systems**			
7	Inspect Fire Extinguishers			
a	Locate fire extinguishers	• Fire extinguisher types		• Flashlight • Log sheets
b	Verify proper charge on indicator			
c	Verify hose is in good condition			
d	Verify horn is in good condition			
e	Verify pin is in place			
f	Verify tamper seal is in place			
g	Update inspection tag			
h	Log fire extinguisher inspection			
8	Inspect Sprinkler Drip Legs			
a	Isolate drip leg	• Sprinkler system types	• Mechanical skills list (Table 5)	• Hand tools • PPE
b	Remove cap or plug			
c	Drain drip leg			
d	Reinstall cap or plug			
e	Place back in normal operation			
E	**Maintaining Electrical Systems**			
1	Troubleshoot Lighting Systems			
a	Check lamps	• Ballast types • Electrical systems • Lamp types • Lighting controls/systems	• Electrical skills	• Electrical meters • Hand tools • Locking devices • Ladder • PPE
b	Check ballasts			
c	Verify power is running to ballasts			
d	Check lighting program			
e	Summarize findings to indicate problems			
2	Adjust Lighting Programming			
a	Log into programming controls	• Digital controls/systems • Lighting controls/systems • System controls	• Computer skills	• Computer • O&M manuals
b	Change lighting program			
c	Save program changes			
d	Verify program changes			
e	Log out of programming controls			

Table 8 (Continued): DACUM Chart for Operating Engineers/Building Technicians

	Duties, Tasks, and Steps	Specialized Knowledge	Skills and Abilities	Tools, Equipment, and Resources
E	**Maintaining Electrical Systems**			
3	Replace Lamps			
a	Disable circuit	• Electrical systems • Lamp types • Lighting fixture types • Safety procedures	• Electrical skills	• Hand tools • Ladder • Lamps • Locking devices • PPE
b	Remove old lamps			
c	Install new lamps			
d	Enable circuit			
e	Verify new lamp lights			
f	Recycle lamps			
4	Replace Ballasts			
a	Disable circuit	• Ballast types • Electrical systems • Lighting controls/systems • Lighting fixture types • Lockout/tagout procedures • Safety procedures	• Electrical skills • Mechanical skills list (Table 5)	• Ballast • Electrical meters • Hand tools • Ladder • Locking devices • O&M manuals • PPE
b	Verify circuit is de-energized			
c	Remove old ballast			
d	Install new ballast			
e	Enable circuit			
f	Verify lamp lights			
g	Recycle ballast			
5	Maintain Lamps and Ballast Inventory			
a	Inventory lamps and ballasts	• Ballast types • Lamp types	• Inventory skills • Mathematical skills • Stock room skills	• Hand tools • Inventory sheets • Ladder • PPE
b	Set minimum and maximum levels			
c	Track lamp and ballast usage			
d	Order lamps and ballasts			
e	Stock lamps and ballasts			
6	Change Electrical Fuses			
a	De-energize circuit	• Electrical systems • Fuse types • Lockout/tagout procedures • Safety procedures	• Electrical skills • Mathematical skills • Mechanical skills list (Table 5)	• Electrical codes • Electrical meters • Hand tools • Locking devices • PPE
b	Verify circuit is de-energized			
c	Remove defective fuse			
d	Verify new fuse is good			
e	Install new fuse			
f	Reenergize circuit			
g	Verify equipment operation			

Table 8 (Continued): DACUM Chart for Operating Engineers/Building Technicians

	Duties, Tasks, and Steps	Specialized Knowledge	Skills and Abilities	Tools, Equipment, and Resources
E	**Maintaining Electrical Systems**			
7	Change Control Boards			
a	De-energize circuit	• Board types • Control systems • Electrical systems • Electronics • Lockout/tagout procedures • Safety procedures	• Electrical skills • Computer skills • Programming skills	• Circuit card • Control board • Electrical meters • Grounding strap • Hand tools • Ladder • Locking devices • O&M manuals • PPE
b	Verify circuit is de-energized			
c	Remove defective control board			
d	Install grounding device			
e	Install new control board			
f	Install programming			
g	Reenergize circuit			
h	Verify equipment operation			
i	Recycle control board			
8	Change Electrical Fixtures			
a	De-energize circuit	• Electrical fixture types • Electrical systems • Lockout/tagout procedures • Safety procedures	• Electrical skills • Mechanical skills list (Table 5)	• Electrical meters • Hand tools • Ladder • Locking devices • New electrical fixtures • O&M manuals • PPE
b	Verify circuit is de-energized			
c	Remove defective fixtures			
d	Install new fixture			
e	Reenergize circuit			
f	Verify circuit operation			
9	Change Electrical Relays			
a	De-energize electrical circuit	• Electrical systems • Lockout/tagout procedures • Relay types • Safety procedures	• Electrical skills	• Electrical meter • Hand tools • Ladder • Locking devices • O&M manuals • PPE
b	Verify circuit is de-energized			
c	Remove defective relay			
d	Install new relay			
e	Reenergize electrical circuit			
f	Verify equipment operation			
g	Recycle electrical relay			

Table 8 (Continued): DACUM Chart for Operating Engineers/Building Technicians

	Duties, Tasks, and Steps	Specialized Knowledge	Skills and Abilities	Tools, Equipment, and Resources
E	**Maintaining Electrical Systems**			
10	Replace Electrical Motors			
a	De-energize electrical circuit	• Electrical systems • Lockout/tagout procedures • Mechanical systems • Motor types • Safety procedures	• Electrical skills • Mechanical skills list (Table 5) • Rigging skills	• Alignment devices • Electrical meters • Hand tools • Locking devices • O&M manuals • PPE • Rigging equipment
b	Verify circuit is de-energized			
c	Disconnect motor from electrical system			
d	Disconnect motor from equipment			
e	Remove motor			
f	Check electrical configuration			
g	Install new motor			
h	Reconnect motor to equipment			
i	Reconnect motor to electrical system			
j	Reenergize circuit			
k	Verify correct motor rotation			
l	Verify equipment operation			
m	Recycle old motor			
F	**Maintaining Plumbing Systems**			
1	Maintain Plumbing Fixtures			
a	Locate plumbing fixtures	• Faucet types • Flush valve types • Health and Safety • Hot work procedures • Plumbing fixture types • Plumbing systems • Safety procedures	• Brazing skills • Electrical skills • Mechanical skills list (Table 5) • Plumbing skills • Soldering skills	• Cleaning equipment/supplies • Hand tools • Ladder • O&M manuals • Plumbing codes • Plumbing fixtures • PPE
b	Check plumbing fixtures for leaks			
c	Check plumbing fixtures for proper operation			
d	Record deficiencies			
e	Repair plumbing fixtures			
f	Repair plumbing piping			
g	Replace plumbing fixtures			

Table 8 (Continued): DACUM Chart for Operating Engineers/Building Technicians

	Duties, Tasks, and Steps	Specialized Knowledge	Skills and Abilities	Tools, Equipment, and Resources
F	**Maintaining Plumbing Systems**			
2	Maintain Sewage Injectors			
a	Check sewage injector operation	• Health and safety • Motor types • Pump types • Sewage system types	• Electrical skills • Mechanical skills list (Table 5) • Plumbing skills • Rigging skills	• Hand tools • Locking devices • Lubrication equipment/lubricant • O&M manuals • PPE • Rigging equipment
b	Lubricate motor			
c	Lubricate pump			
d	Verify control operations			
e	Clean sump pump			
f	Repair sewage injector			
g	Replace sewage injector			
3	Maintain Water Heaters			
a	Inspect water heater for leaks	• Electrical systems • Gas systems • Hydronic systems • Mechanical systems • Plumbing systems • Safety procedures	• Electrical skills • Mechanical skills list (Table 5) • Plumbing skills	• Electrical meters • Hand tools • O&M manuals • PPE
b	Check relief valves			
c	Check water temperature settings			
d	Blow down water heater			
e	Inspect water heater burner			
f	Test electrical heating elements			
g	Check circulator pump operation			
h	Check circulator pump oil levels			
4	Identify Irrigation Leak Location			
a	Pressurize irrigation system	• Irrigation systems/types • Landscaping • Plumbing systems	• Mechanical skills list (Table 5) • Plumbing skills	• Hand tools • Irrigation tools • Locking devices • O&M manuals • PPE • Shovel
b	Isolate each zone			
c	Monitor water meters			
d	Walk irrigation lines			
e	Pinpoint leak location			
f	Make repairs			
g	Return system to normal operation			

Table 8 (Continued): DACUM Chart for Operating Engineers/Building Technicians

	Duties, Tasks, and Steps	Specialized Knowledge	Skills and Abilities	Tools, Equipment, and Resources
F	**Maintaining Plumbing Systems**			
5	Maintain Drains			
a	Unclog drains	• Health and safety • Plumbing systems • Safety procedures	• Mechanical skills list (Table 5) • Plumbing skills	• Drain snake • Enzymes • Hand tools • Ladder • MSDS • Plumbing codes • Plumbing tools • Plunger • PPE
b	Repair sanitary drains			
c	Check trap primers			
d	Verify water flow			
e	Inspect drain piping			
f	Replace drain piping			
g	Check piping for leaks			
h	Add enzymes to drains			
i	Prime traps			
6	Maintain Backflow Preventers			
a	Notify occupants of shutdown	• Backflow preventer types/operations • Plumbing systems	• Mechanical skills list (Table 5) • Plumbing skills	• Backflow preventer parts • Hand tools • Inspection sheets • Locking devices • O&M manuals • Plumbing codes • PPE
b	Isolate backflow preventer			
c	Install test gauges			
d	Check operation of backflow preventer			
e	Check relief valves			
f	Replace defective backflow preventer parts			
g	Record testing results			
h	Place backflow preventer back in service			
7	Maintain Pressure Reducing Valves (PRV)			
a	Verify pressure setting of PRV	• Lockout/tagout procedures • Mechanical systems • Plumbing systems • PRV types • Safety procedures	• Mechanical skills list (Table 5) • Plumbing skills	• Hand tools • Ladder • Locking devices • O&M manuals • Plumbing tools • PPE • PRV parts • Sealing materials
b	Adjust PRV pressure setting			
c	Isolate PRV			
d	Repair PRV			
e	Replace PRV			
f	Place PRV back in service			
g	Re-verify pressure setting of PRV			

Table 8 (Continued): DACUM Chart for Operating Engineers/Building Technicians

	Duties, Tasks, and Steps	Specialized Knowledge	Skills and Abilities	Tools, Equipment, and Resources
F	**Maintaining Plumbing Systems**			
8	Replace Water Filters			
a	Isolate filter cartridge	• Filter types/sizes • Plumbing systems	• Mechanical skills list (Table 5) • Plumbing skills	• Hand tools • O&M manuals • Plumbing tools • Water filters
b	Drain filter cartridge			
c	Remove old filter			
d	Install new filter			
e	Refill filter cartridge			
f	Return water filter to normal operation			
9	Winterize Irrigation System			
a	Isolate water supply	• Irrigation systems/types • Lockout/tagout procedures • Safety procedures	• Mechanical skills list (Table 5) • Plumbing skills	• Air compressor • Hand tools • Hose • Irrigation tools • Locking devices
b	Drain irrigation piping			
c	Blowout irrigation lines with compressed air			
d	Turn off irrigation controls			
G	**Performing General Building Maintenance**			
1	Maintain Door Hardware			
a	Inspect door locks	• Door closure types • Door lock types • Door hinge types	• Locksmithing skills • Mechanical skills list (Table 5)	• Hand tools • Ladder
b	Inspect door hinges			
c	Inspect door closures			
d	Re-key door locks			
e	Adjust door closures			
f	Replace door closures			
g	Repair door hinges			
2	Maintain Roof Systems			
a	Clean roof drains	• Roofing systems/materials • Safety procedures	• Electrical skills • Mechanical skills list (Table 5) • Plumbing skills • Sheet metal skills	• Cleaning equipment/supplies • Electrical meters • Hand tools • PPE • Roofing tools/supplies • Sheet metal/tools
b	Check roof for leaks			
c	Inspect roof flashing			
d	Inspect lightning arrestor system			
e	Repair roof leaks			
f	Repair flashing			
g	Clean roof			
h	Inspect window washing mounts			

Table 8 (Continued): DACUM Chart for Operating Engineers/Building Technicians

	Duties, Tasks, and Steps	Specialized Knowledge	Skills and Abilities	Tools, Equipment, and Resources
G	**Performing General Building Maintenance**			
3	Maintain Ceiling Tiles			
a	Inspect ceiling tiles	• Ceiling systems • Ceiling tile types • Safety procedures	• Mechanical skills list (Table 5)	• Ceiling grid materials • Ceiling tiles • Hand tools • Ladder • PPE
b	Replace ceiling tiles			
c	Repair ceiling grid			
d	Replace ceiling grid			
e	Clean ceiling tiles			
f	Order ceiling materials			
4	Maintain Flooring			
a	Inspect flooring	• Adhesive types • Flooring types	• Carpeting skills • Tiling skills	• Adhesives • Cleaning equipment/supplies • Flooring materials/supplies • Hand tools
b	Repair flooring			
c	Replace flooring			
d	Clean flooring			
e	Repair baseboard or cove base			
f	Clean baseboard or cove base			
g	Replace baseboard or cove base			
5	Maintain Window Systems			
a	Inspect window seals	• Window operator types • Window seal types • Window shading types • Window types	• Mechanical skills list (Table 5)	• Hand tools • Labeling machine • Ladder • PPE • Sealant materials • Window decals • Window operators • Window shades
b	Inspect window shading			
c	Inspect window glazing			
d	Check windows for leaks			
e	Label safety glass			
f	Repair window seals			
g	Repair window shading			
h	Replace window shading			
i	Inspect window operators			
j	Repair window operators			
k	Replace window operators			

Table 8 (Continued): DACUM Chart for Operating Engineers/Building Technicians

	Duties, Tasks, and Steps	Specialized Knowledge	Skills and Abilities	Tools, Equipment, and Resources
G	**Performing General Building Maintenance**			
6	Perform Minor Wall Repairs			
a	Prep area for repairs	• Wall repair techniques	• Painting skills • Wall repair skills	• Drywall • Hand tools • Paint/painting tools • PPE • Sand paper • Spackle
b	Spackle walls			
c	Patch holes with drywall			
d	Sand spackle or drywall repair			
e	Touch up paint on walls			

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