


**ENERGY SOLUTIONS**

**Crew Leader**

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**Crew Leader Job Task Analysis (JTA)**



**Weatherization Crew Leader Job Task Analysis**




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**JTA Definition and Organization**

- ▶ A JTA is a foundation for any valid credentialing program.
- ▶ Helps identify the core knowledge areas, critical work functions, and/or skills typically found across a representative sampling of current practitioners or workers.
- ▶ Realistic assessment that reflects the knowledge, skills, and abilities required to competently perform a job.
- ▶ JTA are organized by:  
 Domains, Tasks, Knowledge, Skills and Abilities (KSA)




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**Crew Leader Definition**

Crew Leader

- ▶ “A Crew Leader is responsible for supervising and assisting in the retrofitting activities specified in the scope of work.
- ▶ He or she is responsible for interacting with the client plus managing personnel and materials on the job site in a safe and effective manner.
- ▶ The Crew Leader is responsible for quality control, testing procedures, documentation, and conducting a walk through in preparation that all work is completed in a satisfactory manner.”




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**Jobs Task Analysis (Domains and Tasks)**

Crew Leader

- ▶ Develop Plan to Execute Scope of Work (Domain 1) p.2
  - Identify materials and staffing needs
  - Prepare homeowner/occupants for the scope of work
  - Determine readiness of the job site for the scope of work
  - Identify work site safety hazards and inform crew of safety requirements
- ▶ Prepare and Maintain Job Site (D2) p.4
  - Locate and verify access to specific work areas
  - Protect interior/exterior of house
  - Set up tools and materials
  - Report out of scope preexisting conditions




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**JTA Outline**

Crew Leader

- ▶ Implement Scope of Work (D3) p.5
- ▶ Manage Project (D4) p.12
  - Conduct diagnostic testing
  - Adjust scope of work as needed to reflect current conditions
  - Report out of scope preexisting conditions
  - Post necessary paperwork
  - Monitor safety practices
  - Maintain and document project progression, personnel control, and compliance
- ▶ Finalize Job (D5) p.14
  - Verify that all components of the scope of work have been completed in compliance with required codes and standards
  - Complete all post-work documentation as required



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ENERGY SOLUTIONS **Domain 1 (p.2)**

# Develop Plan to Execute Scope of Work

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ENERGY SOLUTIONS **Paperwork**

Develop Plan to Execute Scope of Work

## The Crew Leader Job Starts and Ends with the Paperwork

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ENERGY SOLUTIONS **Client Files**

Develop Plan to Execute Scope of Work

### What documents will you need onsite?

- ▲ Original audit form
- ▲ Work scope
- ▲ Materials list
- ▲ Change Order

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ENERGY SOLUTIONS **Audit Form**

Develop Plan to Execute Scope of Work

**The audit form should specify details such as:**

- ▲ Client contact information
- ▲ Size of home (sq. ft & volume)
- ▲ Location of home
- ▲ Baseload Measures
- ▲ Water heating
- ▲ Window Air Conditioners
- ▲ Pre/Post diagnostic results
- ▲ Existing safety concerns and measures

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ENERGY SOLUTIONS **Work Scope**

Develop Plan to Execute Scope of Work

A work scope should include all the measures to be completed during the work process.

- ▲ Prerequisites
- ▲ Health and Safety measures
- ▲ Energy Efficient upgrades
- ▲ IAQ improvements

The CL can now compare the work onsite to the original work scope to ensure quality and safe work practices.

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ENERGY SOLUTIONS **Materials List**

Develop Plan to Execute Scope of Work

There are multiple ways of compiling a materials list.


This is an example of using an audit template with a materials library. (NEAT/MHEA)

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**Other Documents**  
Develop Plan to Execute Scope of Work

**Process forms/ sign-off, certain waivers, etc.**

- ▶ Lead safe documentation?
- ▶ CO safety awareness?
- ▶ Liability waivers?
- ▶ Change orders
- ▶ Any other documents regarding the weatherization process?



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**Chain of Command**  
Develop Plan to Execute Scope of Work

**Who, What , When, and Where**

- ▶ Contractors-The CL (Crew Leader) should contact contractors with issues of their work, as well as supervise the work going on
- ▶ Energy Auditors- The CL should contact the EA with any issues or missed opportunities found at the site (Major changes may require a re-work of the audit software)
- ▶ Crew- The CL should have a good command of those working under them
- ▶ Office- (Coordinator, Program Manager) Communicate with the office issues that need to be corrected and how the timeline of the job will be affected

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**Develop a Strategy**  
Develop Plan to Execute Scope of Work

- ▶ Are there questions generated from the review?
- ▶ In what order does the works need to be completed?
- ▶ Are there issues you see in the audit or work scope?
- ▶ What corrective actions need to be made?
- ▶ Can goals be achieved?
- ▶ Who can help with the outcome (goals)?

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**Prepare a Production Schedule**  
Develop Plan to Execute Scope of Work

**Crews and Subcontractors**

- ▶ Prerequisites  
What needs completed prior to the crew starting?
- ▶ Sequencing measures
- ▶ Hours needed for completion of work scope measures  
(# of workers) x (hours on the job) = Total Hours

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**Domain 1– Task 1**

**Identify Materials and Staffing Needs**

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**(Example) Estimating Materials**  
Identify Materials and Staffing Needs

**Do you have enough material to complete the job?  
Do you have a materials list?**

- ▶ How many bags of loose fill fiberglass would you need to cover 1600 ft<sup>2</sup> of attic floor to R-49 if one bag covers 17 ft<sup>2</sup>?
  - ▶  $1600 \text{ ft}^2 / 17 \text{ ft}^2 = 95 \text{ bags}$
- ▶ How many squares of shingle would it take to cover a 450 ft<sup>2</sup> shed roof if one square of shingles covers 100 ft<sup>2</sup>?
  - ▶  $450 \text{ ft}^2 / 100 \text{ ft}^2 = 4.5 \text{ squares}$

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**Recognizing Individual Skill Sets**  
 Identify Materials and Staffing Needs

**What about the crew?**

**Face it, some folks are better at certain things than others.**

- ▲ Assign the crew to what they're best at
- ▲ Try to cross train as time allows
- ▲ Try to make room to move up inside the crew
- ▲ If possible, pick the contractors that will give you the best quality of work
- ▲ Recognize the need for additional training for technicians and contractors
- ▲ Take opportunities to train in the field (coach)

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**(Example) Predicting Amount of Work Hours**  
 Identify Materials and Staffing Needs

**How long will this job take?**

- ▲ Your boss says you have 2 days to weatherize an upcoming home with your three-person crew
- ▲ Can you do it?

The scope consist of the following:

1. Air seal the crawl and attic of the typical 1500 ft<sup>2</sup> home
2. Insulate the crawl with R-19 batt insulation
3. Insulate the attic with R-30 loose fill insulation. Includes rulers and markers
4. Install Vapor barrier ground cover in crawl

*Continued on next slide*

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**(Example) Predicting Amount of Work Hours**  
 Identify Materials and Staffing Needs

**How long will this job take?**

5. Air seal and sweep two doors
6. Replace one windowpane; Cutting the glass on site
7. Dense pack the walls (1280 ft<sup>2</sup>); Removing a siding board and replacing
8. Insulate the water heater and water lines

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**Maintaining Tools, Equipment, and Materials**  
 Identify Materials and Staffing Needs

**Can your crew do a good job with broken or missing tools?**

- ▲ Ladders
- ▲ Hand tools
- ▲ Powered Hand Tools
- ▲ Generator
- ▲ Combustion Analyzer
- ▲ Personal CO Monitor

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**Maintaining Tools, Equipment, and Materials**  
 Identify Materials and Staffing Needs

**Storage, inspection, maintenance and calibration of tools and equipment is essential to a smooth-running crew.**





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**Safety and PPE**

Identify Materials and Staffing Needs


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**Industry Standards**  
Identify Materials and Staffing Needs: Safety and PPE

**Possess a working knowledge of:**

- ▶ Department of Energy (DOE) Weatherization Assistance Program regulations and policies
- ▶ Environmental Protection Agency (EPA) guidelines for asbestos, lead, mold, and other health hazards
- ▶ Safety Data Sheets (SDS)
- ▶ OSHA regulations. Worker Safety




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**Crew Leader Requirements**  
Identify Materials and Staffing Needs: Safety and PPE

**Must demonstrate the ability to:**

- ▶ Select, fit, and use the appropriate Personal Protection Equipment (PPE) for a particular task
- ▶ Perform basic diagnostic tests of homes
- ▶ Safely use basic hand and power tools
- ▶ Use a basic first aid kit to treat common job-site injuries
- ▶ Work lead safe
- ▶ Identify serious mold conditions
- ▶ Assess work area safety hazards



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**Personal Protective Equipment**  
Identify Materials and Staffing Needs: Safety and PPE




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**Personal Protective Equipment**  
Identify Materials and Staffing Needs: Safety and PPE

**Wear the right PPE for the job!**

- ▶ If it is not comfortable, it is likely you will not wear it when needed.
- ▶ You must be properly fit tested by an accredited professional.



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**OSHA Standards**  
Identify Materials and Staffing Needs: Safety and PPE

**Occupational Safety & Health Act (OSHA) standards**

- ▶ Ladder safety
- ▶ Fall protection
- ▶ Personal protection equipment (PPE)
- ▶ Respiratory protection
- ▶ Motor vehicles
- ▶ Power-operated hand tools
- ▶ Fire prevention
- ▶ Permit-required confined spaces
- ▶ Other worker-related OSHA standards



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**Truck Checklist**  
Identify Materials and Staffing Needs: Safety and PPE

**Vehicle Daily Inspection Checklist**

Vehicle # \_\_\_\_\_ Date \_\_\_\_\_

Item	OK	Service
Oil	_____	_____
Water	_____	_____
Power Steering Fluid	_____	_____
Brake Fluid	_____	_____
Transmission Fluid	_____	_____
Tires:		
Left Front	_____	_____
Right Front	_____	_____
Left Rear	_____	_____
Right Rear	_____	_____
Lights	_____	_____
Inspection	_____	_____
MSDS Binder	_____	_____
Certificate Binder	_____	_____
First Aid Kit	_____	_____
Fire Extinguisher	_____	_____

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**Safety Data Sheets**  
Identify Materials and Staffing Needs: Safety and PPE

**OSHA QUICKCARD™**

**Hazard Communication Safety Data Sheets**

The Hazard Communication Standard (HCS) requires chemical manufacturers, distributors, or importers to provide Safety Data Sheets (SDSs) (formerly known as Material Safety Data Sheets or MSDSs) to communicate the hazards of hazardous chemical products. As of June 1, 2015, the HCS will require new SDSs to be in a uniform format, and include the section numbers, the headings, and associated information under the headings below:

**Section 1. Identification** includes product identifier, manufacturer or distributor name, address, phone number, emergency phone number, recommended use, restrictions on use.

**Section 2. Hazard(s) identification** includes all hazards regarding the chemical, required label elements.

**Section 3. Composition/information on ingredients** includes information on chemical ingredients, trade secret claims.

**Section 4. First aid measures** includes important symptoms/effects, acute, delayed, required treatment.

**Section 5. Fire fighting measures** lists suitable extinguishing techniques, equipment, chemical hazards from fire.

**Section 6. Accidental release measures** lists emergency procedures, protective equipment, proper methods of containment and cleanup.

**Section 7. Handling and storage** lists precautions for safe handling and storage, including incompatibilities.

**Section 8. Exposure controls/personal protection** lists OSHA's Permissible Exposure Limits (PELs), ACGIH Threshold Limit Values (TLVs), and any other exposure limit used or recommended by the chemical manufacturer, importer, or employer preparing the SDS where available as well as appropriate engineering controls, personal protective equipment (PPE).

**Section 9. Physical and chemical properties** lists the chemical's characteristics.

**Section 10. Stability and reactivity** lists chemical stability and possibility of hazardous reactions.

**Section 11. Toxicological information** includes routes of exposure, related symptoms, acute and chronic effects, numerical measures of toxicity.

**Section 12. Ecological information\***

**Section 13. Disposal considerations\***

**Section 14. Transport information\***

**Section 15. Regulatory information\***

**Section 16. Other information**, includes the date of preparation or last revision.

\*Note: Since other Agencies regulate this information, OSHA will not be enforcing Sections 12 through 15 (29 CFR 1910.1200(g)(2)). Employees must ensure that SDSs are readily accessible to employees. See Appendix C of 1910.1200 for a detailed description of SDS contents.


For more information:  
 Occupational Safety and Health Administration  
 2020-sdcg (09/15/2014) (1874)  
 U.S. Department of Labor  
 OSHA 3403-1QR 2013

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**OSHA Standards**  
Identify Materials and Staffing Needs: Safety and PPE

**Respiratory Protection Program**  
based on OSHA 29 CFR 1910.134



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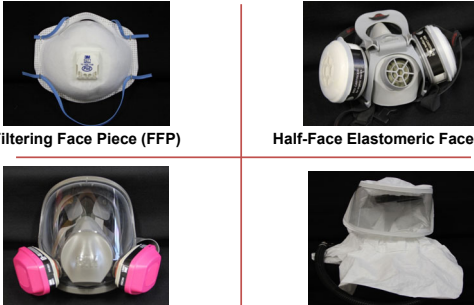
**Selecting A Respirator**  
Identify Materials and Staffing Needs: Safety and PPE

- ▲ Qualities of the respirators, filters, cartridges?
- ▲ What's the task?
- ▲ Where's the task?
- ▲ What are the likely contaminants?
- ▲ Qualities and quantity of contaminants?
- ▲ How long and how often the exposure?
- ▲ NIOSH approved

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**Respirator Types**  
Identify Materials and Staffing Needs: Safety and PPE



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**Hazards & Respirators**  
Identify Materials and Staffing Needs: Safety and PPE

Hazard	Respirator
Nuisance or irritant particles (blown insulation)	N,R,P 95 ffp or filters w/ elastomeric face piece
Hazardous particles (Lead containing dust)	P(purple), R(orange), N(teal) 100 ffp or filters w/ elastomeric face piece
Isocyanates (2-part foam) with open access and some ventilation	N, R, P 100 with OV canister (purple & black) or Supplied Air Respirator (inline hood)
Isocyanates (2-part foam) without open access w/ no ventilation	Could be IDLH; we don't go there

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**Other Limitations of Respirators**  
Identify Materials and Staffing Needs: Safety and PPE

- ▲ Must be in good shape
  - Mechanically and sanitarly
- ▲ Must be worn
  - Correctly and fit tested
- ▲ Matching filters/canisters to hazards
- ▲ Not to be worn in O<sub>2</sub> deficient worksites
- ▲ Employees must be medically cleared
  - Except for filtering face pieces in areas where respirators are not mandated

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**Filter/Cartridge Replacement**  
 Identify Materials and Staffing Needs: Safety and PPE

**Change Out Schedule**

**Filtering face pieces and filters:**

- ▶ P-95s
  - Keep until obviously dirty or difficult to breathe through
- ▶ P-100s
  - Throw away with each Pb containment area cleanup


**Cartridges:**

- ▶ P-100 w/ OV cartridges
  - Packets are opened at the start of 2-part foam application work
  - Cartridges are thrown away after 8 hours foam work or at the end of the work day, whichever comes first

www.wxtvonline.org

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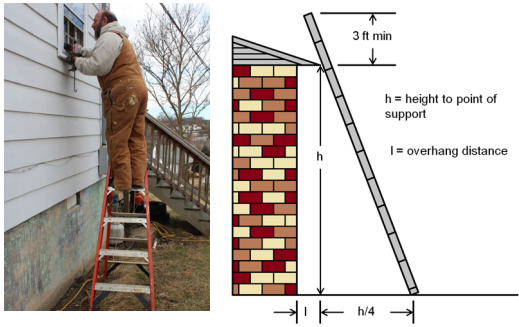
**OSHA Standards**  
 Identify Materials and Staffing Needs: Safety and PPE



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**Ladder Safety**  
 Identify Materials and Staffing Needs: Safety and PPE



h = height to point of support  
 l = overhang distance

3 ft min

h/4

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**Domain 1– Task 2**

**Prepare homeowner/occupants for the scope of work**

Crew Leader

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**Communicating With Clients**  
 Prepare homeowner/occupants for the scope of work

**Basics of Communication**

Respect

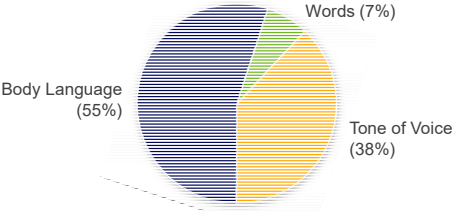
Boundaries

Understanding

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**Communication 101**  
 Prepare homeowner/occupants for the scope of work

**Communication of Feelings and Attitudes**



Body Language (55%)

Words (7%)

Tone of Voice (38%)

*Actions speak louder than words.*

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**Boundaries**  
Prepare homeowner/occupants for the scope of work

**Personal Space**

- Acceptable distance differs widely by culture
- Violating personal space is threatening

**Other Boundaries**

- Closed doors

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**Understanding**  
Prepare homeowner/occupants for the scope of work

**Understanding Each Other**

Includes understanding and being understood

- Intention** – What are you trying to communicate?
  - Getting Answers
  - Client Education
- Know your Audience** – Use terms they will understand.
- Barriers** – Are there barriers to effective communication?
  - Language
  - Culture
  - Poor Hearing or Sight

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**Communication**  
Prepare homeowner/occupants for the scope of work

- Speaking with the clients effectively is very important
- As the Crew Leader speaking effectively with the technicians is just as important
- Remember this during those coachable moments you will find yourself in

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**Understanding**  
Prepare homeowner/occupants for the scope of work

**Compliment Sandwich**

- 1) Start with the "bread"**  
*You're doing a great job with \_\_\_\_\_ & \_\_\_\_\_.*
- 2) Add some "meat"**  
*You need to improve on \_\_\_\_\_ & \_\_\_\_\_.*
- 3) Top it off with more "bread"**  
*Keep up the good work!*

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**Poor Interaction**  
Prepare homeowner/occupants for the scope of work

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**Good Interaction**  
Prepare homeowner/occupants for the scope of work

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**Communication Summary**  
Prepare homeowner/occupants for the scope of work

**Remember...**

- ▲ Actions speak louder than words.
- ▲ **Respect** – We are in their homes.
- ▲ **Boundaries** – Recognize and respect personal space.
- ▲ **Understand** – Work to understand, and be understood.

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**Manage Client Expectations**  
Prepare homeowner/occupants for the scope of work

**What the client can expect from the crew:**

- ▲ Work to take place during the hours agreed to in advance
- ▲ Their questions to be answered honestly
- ▲ Respect for the home and all property to be maintained
- ▲ Work messes to be cleaned promptly or by the end of the work day
- ▲ All work performed agrees with what the energy auditor or crew leader explained to the client
- ▲ Work performed will not jeopardize the health and safety of anyone on site

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**Manage Client Expectations**  
Prepare homeowner/occupants for the scope of work

**What is expected from the client:**

- ▲ Permission to enter all rooms and areas of the home
- ▲ Access to all rooms and areas of the home
- ▲ Maintain testing conditions temporarily when needed
- ▲ Disclosure of any client specific issues
  - ▲ Comfort concerns
  - ▲ Allergies
  - ▲ Valuable items to protect
- ▲ Ask questions they have about the nature of the work
- ▲ Sign off on all necessary documents

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**Initial Walk Through**  
Determine readiness of the job site for the scope of work

**What to look for during the initial walk through:**

- ▲ Emergency shut offs
- ▲ Safety concerns
  - ▲ Appropriate PPE available?
- ▲ Pre-requisite work completed?
- ▲ Pre-existing conditions
- ▲ Accessibility to all rooms and areas of the home
- ▲ Work scoped properly
- ▲ Missed opportunities
- ▲ Mechanical issues



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**Emergency Shut Offs**  
Determine readiness of the job site for the scope of work

**First things to locate:**

- ▲ Breaker/Electrical Shut Off
- ▲ Fuel Shut Off
- ▲ Water Shut Off
- ▲ Thermostats

*Remember:  
Accidents can happen!*



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**Safety & Site Conditions**  
Determine readiness of the job site for the scope of work



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### Safety & Site Conditions

Determine readiness of the job site for the scope of work



NeighborWorks

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**ENERGY SOLUTIONS**

### Safety & Site Conditions

Determine readiness of the job site for the scope of work



NeighborWorks

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### Safety & Site Conditions

Determine readiness of the job site for the scope of work

Crew must use **Lead-Safe** weatherization practices



NeighborWorks


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### What's Wrong ?

Determine readiness of the job site for the scope of work



NeighborWorks

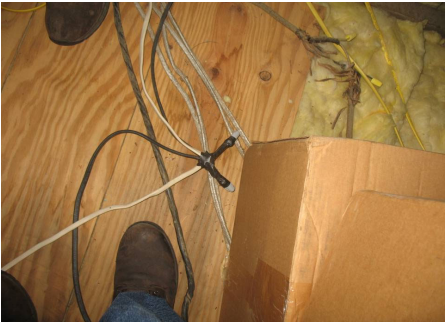
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### What's Wrong ?

Determine readiness of the job site for the scope of work



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### Knob & Tube

Develop Plan to Execute Work Order On Site



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**What's Wrong?**

Determine readiness of the job site for the scope of work

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**Vermiculite**

Determine readiness of the job site for the scope of work

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**Problems**

Identify work site safety hazards and inform crew of safety requirements

**If problems are found, you will need to address them prior to starting work**

Photo Courtesy of The US Department of Energy

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**Follow Up**

Adjust scope of work as needed to reflect current conditions

**Discuss missed opportunities with the auditor**

When issues occur, communication with the auditor is paramount. They must understand what went wrong and how they can correct that issue in the future.

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**Change Orders**

Adjust scope of work as needed to reflect current conditions

**After the initial walk through, did you find missed opportunities that may need to be addressed?**

- ▶ Missed opportunities should be documented in a change order
- ▶ Change orders should be submitted to the Energy Auditor
- ▶ The Energy Auditor is responsible for entering the measure in the audit program to determine if its cost effective

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**Communication with the Crew**

Identify work site safety hazards and inform crew of safety requirements

**After the initial walk through, discuss with the crew:**

- ▶ Expectations the client has of them
- ▶ Client health and safety concerns
- ▶ Location of shut offs
- ▶ Completion of prerequisite work
- ▶ Any job site safety hazards and plans to address job site safety hazards
- ▶ Any need for lead safe weatherization practices
- ▶ Appropriate use of PPE
- ▶ Pre-existing conditions found during the inspection
- ▶ Accessibility concerns
- ▶ Work has been scoped appropriately
- ▶ Develop change orders necessary

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**Client Walk Through and Sign-Offs**  
 Identify work site safety hazards and inform crew of safety requirements

**Let the client know what's going on!**

- ▶ Conduct informative walk through with the client to explain what the crew will be doing
- ▶ Conduct informative walk through with the client to verify specific homeowner issues (medical issues, valuables, pre-existing conditions, valuables, etc.)
- ▶ If things may have changed, make sure that all necessary sign-offs are recorded before work begins (this would also be a good time to confirm that all other sign-offs and information has been given to the client)

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**Domain 2 (p.4)**

**Prepare and Maintain Job Site**

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**Job Site Set-Up**  
 Prepare the House to Execute the Work Order

- ▶ Run power cords safely
- ▶ Prep cutting station
- ▶ Set up ladders
- ▶ Remove generator or run exhaust hose

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**Protective Barriers**  
 Protect interior/exterior of house

**Why do we need protective barriers?**

- ▶ Protect – Belongings
- ▶ Protect – Landscaping
- ▶ Protect – Occupants and Workers

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**Protective Barriers**  
 Protect interior/exterior of house

**Helps to protect client's belongings and reduce clean-up time**

- ▶ If you can't move an item, be sure to cover it
- ▶ Utilize 4-6 mil poly for wall systems
- ▶ Be sure to tape seams continuously

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**Domain 3 and 4 (p.5, p12)**

**Implement Scope of Work and Manage the Project**



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**Summary**  
Prepare the House to Execute the Work Order

**Pre-work Check List**

- ✓ Protect interior/exterior of the home
- ✓ Set up containment
- ✓ Worst-Case CAZ
- ✓ Combustion Analysis
- ✓ Revise work scope/order if needed






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**Revise Work Order**  
Prepare the House to Execute the Work Order

**What if your numbers are significantly different?**

- ▲ Change orders need to be submitted
- ▲ The auditor may need to use the new numbers in the energy audit software
- ▲ Changes in the work scope need to be explained to the client
- ▲ Is there a change to the hours of work needed?
- ▲ Are the materials and tools needed on site?







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**Monitor Safety**  
Implement Scope of Work and Manage the Project

**CL is responsible for the safety of all those on the work site!**

- ▲ OSHA 30 required for BPI certification









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**Monitor Safety**  
Implement Scope of Work and Manage the Project

**CL is responsible for the safety of all those on the work site!**

- ▲ Confined Space

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**Communicate with Crew**  
Implement Scope of Work and Manage the Project

**They don't know what you're thinking?**

- ▲ Recognize teachable moments
- ▲ Expectations
- ▲ Scheduling/Timeframes









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**Document Progress/Monitor Resources**  
Implement Scope of Work and Manage the Project

- ▲ Material usage
- ▲ Hours worked
- ▲ Measures complete
- ▲ Pictures

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## Maintain Quality Control

Implement Scope of Work and Manage the Project

**The crew leader is the first line of quality control**

- ▲ Inspect/Verify
- ▲ Monitor contractors
- ▲ Mentor Crew



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## Verify Containment Clean Up

Implement Scope of Work and Manage the Project

**Verify containment areas are clean as well as the site**

- ▲ Clean as you go
- ▲ Monitor contractors, they are responsible for clean up of they're areas
- ▲ Enforce lead safe practices and clean up



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## Communicate with Homeowner

Implement Scope of Work and Manage the Project

**Keep the client in the loop.**

- ▲ Let the client know of any changes
- ▲ Show them completed measures
- ▲ Do they have questions
- ▲ Walk with them through the job at the end of the day and make sure they are satisfied with the way things are left



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## Conduct End of Day Walk Through

Maintain and document project progression, personnel control, and compliance

**End of each day**

- ▲ Evaluate cleanliness of containment zones
- ▲ Document work scope items that have been completed
- ▲ Verify all tools and materials have been removed from the home



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# Conduct Diagnostic Testing

Manage Project

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# Introduction to CAZ Combustion safety

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**Personal CO Monitor**



- A personal CO monitor should be worn at all times while working in a home with combustion appliances
- Always turn the monitor on outside, to adjust to any ambient CO that may be in the air
- Some CO monitors can be set to alarm at a desired threshold

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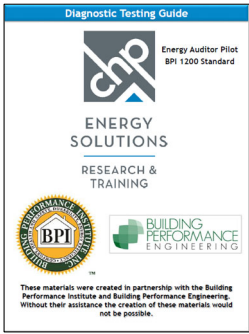
**Ambient CO in the home**



If **over 70 ppm** of Carbon Monoxide is detected inside, evacuate the house, and ventilate it until CO levels have dropped before re-entering to identify the problem.

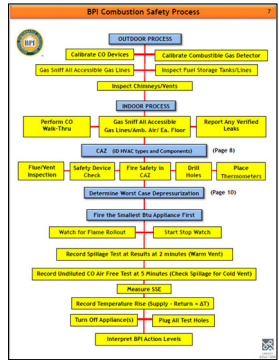
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**Diagnostic Guide**




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**Worst Case CAZ Depressurization Worksheet**



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**Worst Case CAZ Depressurization Worksheet**



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**Worst Case CAZ Depressurization Worksheet**



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## Worst Case CAZ Depressurization Worksheet

ENERGY SOLUTIONS

CAZ (ID HVAC types and Components) (Page 8)

Flue/Vent Inspection   Safety Device Check   Fire safety in CAZ   Drill Holes   Place Thermometers

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## Worst Case CAZ Depressurization Worksheet

ENERGY SOLUTIONS

**Combustion Safety Data Sheet**

Date: \_\_\_\_\_ Auditor: \_\_\_\_\_  
Client: \_\_\_\_\_ Installer/Contractor: \_\_\_\_\_

**CAZ Details:**

CAZ Location: \_\_\_\_\_ Seen with live tv gas in room: YES NO N/A  
 1. venting control installed: YES NO N/A  
 2. gas shut off valve: YES NO N/A  
 Verified with Balloon: \_\_\_\_\_ Ambient CO: \_\_\_\_\_  
 Electrical hazard: \_\_\_\_\_  
 Signs of Flame Rollout: \_\_\_\_\_  
 1. Measured Volume of CAZ (FD): \_\_\_\_\_  
 2. BTU/hr input: \_\_\_\_\_  
 Signs of Spillage: \_\_\_\_\_  
 3. If #2 is not the last 1 then combustion air may need to be added to CAZ  
 Any Safety Precautions: \_\_\_\_\_

**Before Testing:**

\_\_\_\_\_ Have calibrated gas sniffer outside, checked all accessible ones and ambient on each floor  
 \_\_\_\_\_ Have calibrated CO meter outside, checked and verified that the house is safe  
 \_\_\_\_\_ Have the ambient CO monitor running at all times during testing  
 \_\_\_\_\_ Have located the system (type, location, size, etc.) and verified it's clean or removed  
 \_\_\_\_\_ Have identified the system (type), components, and safety controls  
 \_\_\_\_\_ Have identified test locations for Spillage, CO and CO2 efficiency measurements  
 \_\_\_\_\_ Have checked calibrated combustion analyzer outside and seen it needs to use

**Equipment Identification:**

	<b>Where to Test</b>	<b>CAZ</b>	<b>Gas - L.R.R.</b>
	Spillage	Draft Hood	N/A
	Before	Distance	Vent
	Air	Temperature	Temperature

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## Testing Gas Ovens and Ranges

ENERGY SOLUTIONS

- Gas stoves have different testing protocols than other combustion appliances
- Stoves are only evaluated for CO output and gas leaks

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## Gas Oven Testing

ENERGY SOLUTIONS

**Pretest Safety Checklist**

- I have already calibrated CO meter and checked the whole house
- I have the CO meter running at all times during testing
- I have already calibrated gas sniffer and sniffed all accessible gas lines.
- I have either:
  - turned on the kitchen exhaust fan
  - turned on the kitchen recirculation fan and opened a window

**Testing Protocol**

- Inspect the oven cavity for obstructions and remove any items and fill it or on oven. If it is considerably dirty, recommend the oven be cleaned to avoid unacceptable emissions.
- Remove any obstructions from the bottom burner (baker compartment).
- Inspect range top burners for cleanliness. If the burners are excessively dirty, recommend they be cleaned to avoid unacceptable emissions.
- Having gas well clearing or heat features are HOT activated, set oven to highest setting, usually 350 degrees.
- After 5 minutes of operation, check ambient CO in the vent.  
Measured CO from oven vent: \_\_\_\_\_  
CO should be less than 225ppm as measured.

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## Gas Sniffing Stoves

ENERGY SOLUTIONS

- Pull out the bottom drawer to sniff gas lines. Do NOT pull stove from wall!
- Do not fire stove if gas leaks are present

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## Gas Oven Testing

ENERGY SOLUTIONS


**Pretest Safety Checklist**

- I have already calibrated CO meter and checked the whole house
- I have the CO meter running at all times during testing
- I have already calibrated gas sniffer and sniffed all accessible gas lines.
- I have either:
  - turned on the kitchen exhaust fan
  - turned on the kitchen recirculation fan and opened a window

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**Gas Oven Test Preparation**



**Testing Protocol**


1. Inspect the oven cavity for cleanliness and remove any items and foil in or on oven. If it is excessively dirty, recommend the oven be cleaned to avoid unacceptable emissions.
2. Remove any obstructions from the bottom drawer/boiler compartment.
3. Inspect range top burners for cleanliness. If the burners are excessively dirty, recommend they be cleaned to avoid unacceptable emissions.
4. Making sure self cleaning or broil features are NOT activated, set oven to highest setting, usually 500 degrees.
5. After 5 minutes of operation, check undiluted CO in the vent.

Measured CO from oven vent: \_\_\_\_\_


CO should be less than 225ppm as measured.

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**Gas Oven Testing**



The oven vent is typically around the center of the back of the range top



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**Gas Oven Testing**

**CO Thresholds for Fossil-Fuel Fired Appliances**

Appliance	CO Threshold
Central Furnace (all categories)	400 ppm air free
Boiler	400 ppm air free
Floor Furnace	400 ppm air free
Gravity Furnace	400 ppm air free
Wall Furnace (BIV)	200 ppm air free
Wall Furnace (Direct Vent)	400 ppm air free
Vented Room Heater	200 ppm air free
Unvented Room Heater	200 ppm air free
Water Heater	200 ppm air free
Oven/Broiler	225 ppm as measured
Clothes Dryer	400 ppm air free
Refrigerator	25 ppm as measured
Gas Log (gas fireplace)	25 ppm as measured in vent
Gas Log (installed in a wood burning fireplace)	400 ppm air free in firebox

**CO Action Levels for Appliance Measurements**

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**Summary**

Combustion Safety

- Health and safety issues related to combustion equipment are some of the most important aspects of auditing a home.
- Understanding the basic principles of combustion, distribution, and venting will enable the auditor to recognize safety problems.
- Visual and diagnostic combustion appliance safety and efficiency inspections, and worst case CAZ testing reveal potentially dangerous situations and guide retrofit strategies.
- Practice appropriate test procedures for vented and non-vented appliances.
- Understanding the relationship between combustion safety problems and poorly designed or non-code-compliant vent systems is important to finding solutions.

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**Finalize Job and Complete Post Work Documentation**

Crew Leader


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**Verify Work Scope Completed**

Finalize Job

**End of project**

- Verify all components of the work scope are completed
- Verify change order items are complete

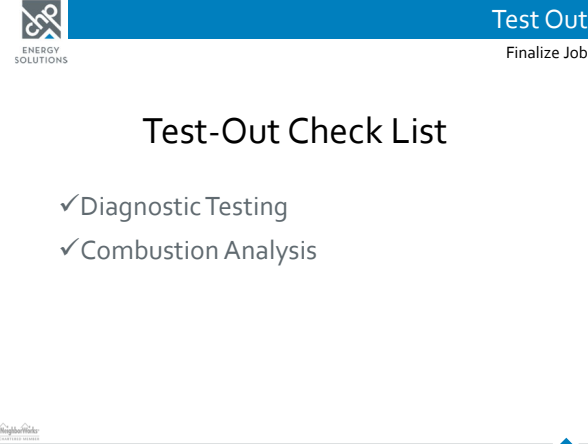


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**Test Out**  
Finalize Job

## Test-Out Check List

- ✓ Diagnostic Testing
- ✓ Combustion Analysis



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**Clean-Up**  
Finalize Job




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**Clean-Up**  
Finalize Job

### Crew must use Lead-safe weatherization practices




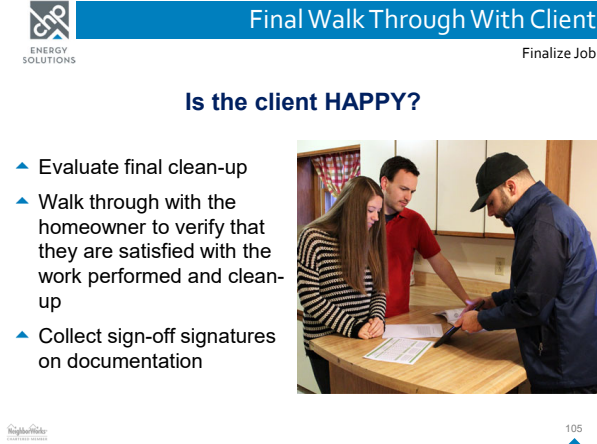


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**Final Walk Through With Client**  
Finalize Job

### Is the client HAPPY?

- ▲ Evaluate final clean-up
- ▲ Walk through with the homeowner to verify that they are satisfied with the work performed and clean-up
- ▲ Collect sign-off signatures on documentation

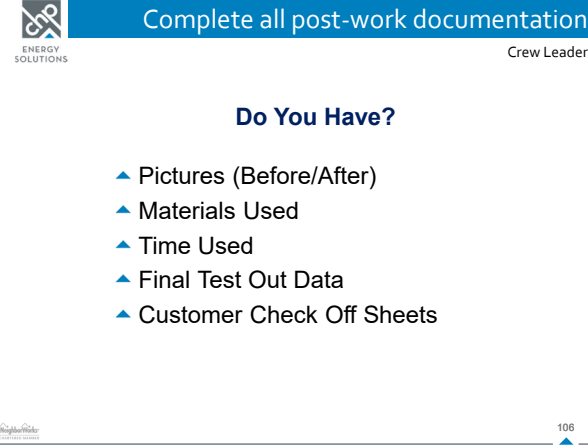



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**Complete all post-work documentation**  
Crew Leader

### Do You Have?

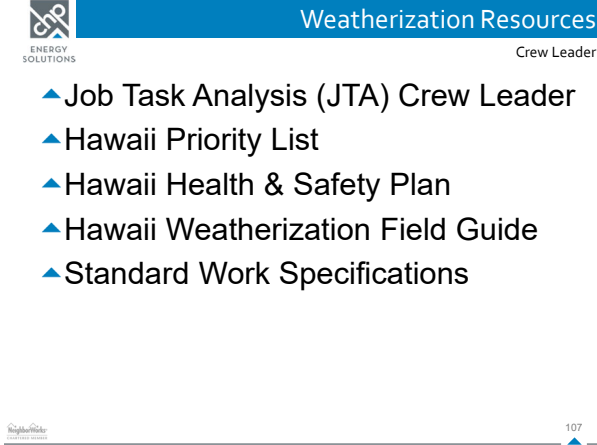
- ▲ Pictures (Before/After)
- ▲ Materials Used
- ▲ Time Used
- ▲ Final Test Out Data
- ▲ Customer Check Off Sheets



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**Weatherization Resources**  
Crew Leader

- ▲ Job Task Analysis (JTA) Crew Leader
- ▲ Hawaii Priority List
- ▲ Hawaii Health & Safety Plan
- ▲ Hawaii Weatherization Field Guide
- ▲ Standard Work Specifications



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