

Best Practices for Weatherization

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Best Practices for Weatherization

What We Will Talk About

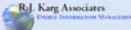
- Determining best practices for your weatherization program.
  - What are best practices?
  - Sources of best practices.
  - Process of effective development of best practices.
- Suggested best practices for northern climates.

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Best Practices for Weatherization


Based on Best Practices Projects

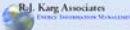
- *North Dakota Weatherization Field Standards, 2002.*
- *Maine Weatherization Field Standards, 2004.*
- *New Hampshire Weatherization Field Standards, 2004.*
- ***Specification of Energy-Efficient Installation and Maintenance Practices for Residential HVAC Systems, Consortium for Energy Efficiency, 2000, [www.cee1.org/resid/re-ac/hvac.php3](http://www.cee1.org/resid/re-ac/hvac.php3).***
- *Manual of Accepted Practices for Maine Model Energy Code, Maine Public Utilities Commission, 2005.*
- *Midwest Weatherization Best Practices Field Guide, 2005.*

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What's that Best Practice?!



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**What are Best Practices?**

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Best Practice Clean up in ND



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### What are Best Practices? 1

- The most effective methods for installing energy saving measures.
  - Dense pack wall insulation for walls, for example.

### What are Best Practices? 2

- The best materials to use for weatherization work.
  - Borate-only cellulose rather than cellulose with ammonium sulfate, for example.

### What are Best Practices? 3

- The best equipment to use for weatherization work.
  - Insulation blowing machine that has capacity to supply a static pressure of at least 80 inches of water at the machine takeoff, for example.

### What are Best Practices? 4

- The best maintenance schedule for weatherization equipment.
  - Combustion analyzers and carbon monoxide instruments should be calibrated according to the manufacturers recommendations (every six months), for example.

### Is There a Maintenance Problem?



### What are Best Practices? 5

- The most effective methods for performing diagnostic procedures.
  - Use advanced Building Tightness Limit (BTL<sub>a</sub>) procedure to determine ventilation needs of the house for acceptable indoor air quality, for example.

## What are Best Practices? 6

- The most effective methods protecting the health and safety of clients and weatherization workers.
  - For example:
    - Perform worst-case draft test after all work is completed in appropriate dwellings.
    - Perform worst-case draft test at the end of every work day in appropriate dwellings.

## NOT a Best Practice



## Sources of Best Practices

## Sources for Best Practices - 1

- Your state weatherization practices.
  - Don't forget to appraise the methods of your own program first.
  - Ask for ideas from energy coordinators, estimators/auditors, crew foremen, crew workers, contractors, and others. Include all in process so that they become interested in the process.

## Sources for Best Practices - 2

- Existing state, regional, or national weatherization standards.
  - Most state standards and some other relevant documents are in the "public domain".

## Sources for Best Practices - 3

- Consult with national experts in appropriate fields.
  - Interview experts. Have your questions ready and organized before you call.

## Sources for Best Practices - 4

- Field research.
  - Research that you conduct before deciding on a best practice method.
  - Pilot studies regarding tentative best practices.

## Sources for Best Practices - 5

- Codes.
  - NFPA codes: 31 (oil), 54 (gas), 211 (venting), 70 (electric).
  - International Energy Conservation Code.
  - Local and state codes.

## Sources for Best Practices - 6

- Manufacturer's information and standards.
  - For example, specifications for insulation blowing machines.
  - Blower door and duct blower instruction manuals.

# Process of Effective Development of Best Practices

## Recommendations for Best Practices Process - 1

- Determine for YOUR program.
- Process of selection should include as many people from YOUR program as possible.
  - Be creative with ways to get "buy in" at all levels, including top management (yes, Executive Directors, too).
  - Set up ongoing advisory group that is vertically integrated.
- The PROCESS is probably as important as the outcome (best practices).

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### Installing Foundation Insulation in ND



This is great for ND, but not in New England 25

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### Recommendations for Best Practices Process - 2

- Use a high degree of diplomacy during process.
- Try not to force practices on those who will have to use them. Better to work for consensus during and after the process.
- Show respect for needs and routine at all levels.
- Try to structure as an ongoing process, rather than as a one-time event.
  - This sets up structure of continuity.
  - Brings credibility to efforts.

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### Recommendations for Best Practices Process - 3

- Include a method for final approval and recognition of the best practices.
  - All attend a statewide meeting to discuss, adopt, and begin using.
- Build in and document a method of revising best practices at least once every two years.

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### Recommendations for Best Practices Process - 4

- Recognize the issue that crews and/or contractors perform weatherization work.
- Unless your source is public domain, make sure you get permission to use method, protocol, recommendation, etc.
- Follow up with appropriate training. Try to use field training over classroom training.

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### Recommendations for Best Practices Process - 5

- Format the best practices document so that it can be easily altered in the future.
- Always keep the program/agency mission statement in mind. This helps cut through self-interest.
- After your mission statement, make the best practices document the centerpiece of your program.

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### NOT a Best Practice



Bubble wrap doesn't cut it! 30

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## Model Weatherization Best Practices for Northern Climates

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## Blower Door

- Perform at least a pre- and post-weatherization blower door test and record CFM<sub>50</sub> values.
- While blower door is depressurizing, inspect interior of dwelling, including basement.

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## Wisconsin Blower Door Test



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## Air Sealing

- Use blower door guided air sealing methods.
- Develop a protocol for air sealing:
  - Target CFM<sub>50</sub> values (for example, Ohio).
  - Cost-effective air sealing (for example, Wisconsin).
- Thermal boundary and pressure boundary (air barrier) should be aligned.
- Do not seal penetrations in basement ceiling unless
  - Such sealing will minimize health and safety problems;
  - Such penetrations are leaking to the outdoors.

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## Attic Bypass in Rhode Island



From basement to attic

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## Attic Insulation

- Use borate-only cellulose.
- Complete attic bypass work before installing attic insulation.
  - If attic is floored, remove enough flooring to thoroughly inspect for and treat all air bypasses.
  - Do not install insulation above attic floor without written permission of client.
- If attic is already insulated, make sure that added insulation passes the energy audit SIR test.
- Ventilate attic properly.

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## 2" Setback from Chimney



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## Wall Insulation

- Dense pack closed walls with borate-only cellulose after all appropriate preparation work.
- Cellulose density shall average at least 3.5 lb/ft<sup>3</sup> and not be less than 3.25 lb/ft<sup>3</sup>.
- Cellulose shall be installed with an appropriate tube long enough to reach ALL parts of each wall cavity.
- Siding shall be removed before each fill hole is drilled in the sheathing. Holes shall be plugged before the siding is replaced.
- Etc.

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## Basement Insulation

- Basements usually should be considered part of the thermal envelope.
- Rim joist/sill area should be air sealed and insulated to at least an R-10.
- Basement walls should be insulated to 2 feet below grade if state energy audit yields an appropriate SIR.

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## Crawl Spaces

- It is preferred to include crawl spaces as part of the thermal envelope.
- Install a ground cover on crawl space floor, regardless of the thermal boundary location.
- When appropriate insulate crawl space walls to at least R-10.
- Do not vent crawl space (climate dependant).

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## Floor Insulation

- Insulate floors to a minimum of R-19.
- Install insulation so that it is in contact with the underside of the subfloor above.
- Fasten insulation securely in place, but do not use house wrap or chicken wire.

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## Floor Insulation in Massachusetts



## Window and Door Measures

- Window and door measures should be determined by cost-effectiveness procedures.
- Use lead-safe practices.

## Indoor Air Quality

- Ensure that dwelling complies with ASHRAE 62.1 (BTLA) or 62.2 upon completion of the weatherization job.
- Identify IAQ problems and, if possible, eliminate sources.
- Measure flow at exhaust fans. Replace fans if required.

## Worst-Case Draft Testing

- Perform a worst-case draft test at the end of each work day in appropriate dwellings.
- Perform a worst-case draft test after all weatherization work is completed.
- If dwelling fails the worst-case draft test, repair problem.

## Zone Pressure Diagnostics

- Use ZPD when appropriate:
  - Attached garages.
  - Moisture problems in attics.
  - To check air sealing efforts (attic bypasses, basement walls, etc.).

## Gas Water Heaters

- Check for adequate draft and lack of spillage under worst-case conditions.
- Carbon monoxide concentrations in the vent connector must be 50 ppm or less.
- Check for gas leaks at water heater and for the length of gas supply lines leading to water heater.

## Furnaces and Boilers

- Perform a combustion efficiency test.
- Measure carbon monoxide in vent connector.
- Test for draft and spillage under worst-case conditions.
- Check for gas leaks at unit and in gas supply lines.
- Check for temperature rise in furnaces.
- Clock gas meter for gas systems.
- Oil systems must be cleaned and tuned annually.

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## Oil Boiler w/o Service for 2.5 Years



Clogged heat exchanger at top



Underside of heat exchanger from firebox

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## Heating System Replacements

- Base replacements on energy audit SIR.
- When deciding whether to repair or replace, consider the remaining service life of existing.
- ALWAYS calculate the design heat load requirements for a replacement system.
- Whenever possible, replacement should be direct-vent, sealed combustion.

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## Air Conditioning (Cooling)

- Window units should be removed during the heating season (preferred) or sealed with an airtight cover.
  - Replacement units should be ENERGYSTAR rated.
- For central units a professional service person should be hired to check coil air flow, inspect for refrigerant leaks and proper charge, and adjust controls.

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## Heat Pumps

- All heat pumps with electric auxiliary must be served by a control system that minimizes the operation of the electric resistance heaters.
- Inform clients about routine operation and maintenance.
- A professional service person should be hired to check coil air flow, inspect for refrigerant leaks and proper charge, and adjust controls.

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## Gas Range Testing

- Inspect the range top and oven burners for proper operation and maintenance.
- Measure the range top burners for carbon monoxide levels (as-measured).
- Measure the oven bake burner for carbon monoxide levels (air-free).
- Deliver appropriate client education regarding use and maintenance.

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## Duct Leakage, Site-Built Homes

- Bring ductwork within thermal envelope, if possible.
- If cannot bring within thermal envelope, seal joints with mastic and insulate to a minimum of R-8.
- Seal large leaks within the thermal envelope and leaks that might have a hazardous impact on health and safety.

## Taping Registers & Grilles for Duct Leakage Testing



## Duct Leakage, Mobile Homes

- Convert belly return system to living-space return.
- Perform duct leakage test to the outdoors with duct blower and blower door, OR, use pressure pan.
- Sum of pressure pan reading should be three or less.

## Sealing Duct Boots with Mastic



## Mobile Home Measures

- Test and repair ductwork for leakage.
- Insulate ceilings, walls, and bellies when cost effective according to state energy audit.
- Replacement water heaters should be HUD approved.

## Mobile Home Wall-Stuffing Method



## Duct-Inducted Room Pressures

- Provide pressure relief when pressures are more than 3 Pascals between a room and the main body of the dwelling when the air handler is operating.
- Test and adjust before the final worst-case draft test.

## Health and Safety

- Inspect and/or install smoke alarms.
- Inspect and/or install CO alarms where needed.
- Vent dryers.
- No unvented (vent-free) combustion.
- Use lead-safe weatherization practices.
- Inspect for health and safety problems.
- Perform worst-case draft test.



## Baseload Measures

- Fluorescent lamps used for replacement should be ENERGYSTAR rated.
- Install low-flow showerheads.
- Replace refrigerators when appropriate.
  - Replacement refrigerators should be ENERGYSTAR rated.

## Organic Refrigerator Meter

