Chapter 5

SPECIFICATION OF SELECTED ENERGY-EFFICIENCY OPTIONS

5.1 Overview

This chapter provides the A/E with the text of specifications for use in revitalization and new construction projects as a supplement to specifications cited in the project's Request for Proposal or Statement of Work and applicable military standards manuals identified in Sect. 2.2, "Design, Analysis, and Selection of Options for New Housing,"and Sect. 2.3, "Design, Analysis, and Selection of Options for Revitalized Housing."

5.2 Infiltration Repair Specifications and Construction Tips

Use the following materials and procedures to correct identified infiltration deficiencies in the building envelope.

MATERIALS

Apply sealants after thoroughly removing moisture, dust, dirt, oil, grease, or other substances which may diminish the bond of the sealant material.

Mastic and Fiberglass Tape (Fiberglass Mesh)

Mastic sealants are available in water-based form for sealing penetrations and repairing holes in walls and ceilings. Water-based mastics are preferable to petroleum-based mastics because of shorter curing times, easier cleanup, and more "forgiving" application characteristics. When used with fiberglass tape, mastic can seal and provide strength to repairs of practically any configuration. Mastic should generally be applied over the entire joint between mated surfaces and must not be diluted.

Mastic sealants shall conform to the following safety requirements of Underwriters Laboratory (UL) Standard 181, Class 1:

- a flame spread rating of less than 25 and
- a smoke development rating of less than 50 in the dry, final state.

In addition, the mastic sealants shall conform to these characteristics:

- a solids content greater than 50% to reduce shrinkage on drying;
- the capability to adhere to many surfaces—sheet metal, drywall, fiberboard, concrete, wood, and plastic; and
- a temperature range that includes the highest and lowest temperatures likely to be encountered.

Urethane Foam

This material shall have the same safety requirements as mastic sealant and shall be UL rated.

Caulking

Long-lasting (20 years or more) silicone caulking materials are required for sealing leaks in building envelopes. A treated variety must be used if the caulking will be painted. This material shall have the same safety requirements as mastic sealant and shall be UL rated.

Blocking Materials

For large voids that cannot be sealed with fiberglass tape and mastic, rigid fiberglass or fiberboard of 0.5 in. or more in thickness shall be cut to shape and sealed in the void space with mastic, urethane foam, or caulk. The following alternative materials may be used when approved by the military inspector on the project: corrugated cardboard, plywood, and plastic bags filled with fiberglass insulation. Large voids typically occur at electrical and plumbing penetrations and in attic bypasses such as unblocked walls.

Flashing

Metal flashing cut to shape must be used to close gaps around flues and chimneys to avoid placing combustible material next to those hot surfaces.

PROCEDURES

Seal penetrations, gaps between materials, and holes in walls using the materials described previously and using the following procedures:

Penetrations

Use urethane foam for sealing around electrical and plumbing penetrations because it expands to fill the void totally as it cures. Mastic and fiberglass tape may be used for this application if urethane foam is unavailable. Use metal flashing and fireplace mortar to seal around flues and chimneys, as combustible material must not be placed adjacent to those hot surfaces.

Holes and Gaps in Walls and Ceilings

Mastic and fiberglass tape shall be used in most cases to seal these types of leaks. For larger holes (2-in. diameter), use fiberboard to fill the hole or gap, and use mastic or caulk to seal around the filler.

Attic Bypasses and Voids Around Plumbing Chases

These usually larger voids require a fiberboard filler to be cut to fit the shape of the void. Seal these with mastic, caulk, or urethane foam.

Sill Plate to Band Joist Seal

Apply urethane foam to fill all gaps and voids between the sill plate and band joist.

5.3 Infiltration Performance Testing of Housing Units

BLOWER-DOOR TESTING

Randomly selected new and/or revitalized housing units shall be tested to determine the compliance of the unit with the allowable air-leakage rate specified for the building envelope. Units shall be selected by the program manager. Testing shall be performed by a firm qualified to perform inspections using blower doors in accordance with procedures specified in Appendix C for building envelope testing. The testing firm shall be independent of the installing contractors or equipment suppliers for this project. The specifications provided in Appendix B can be used to hire a qualified firm.

PERFORMANCE REQUIREMENTS

Building envelope air leakage shall be greater than or equal to (*enter minimum value determined from Sect. 4.2.6*) but no more than (*enter maximum value determined from Sect. 4.2.6*) natural air changes per hour.

NUMBER OF TESTS REQUIRED

Infiltration testing shall initially be performed on 10% of the housing units (e.g., 10 of 100 housing units). If 90% of the tested units pass the stated performance requirements (e.g., nine of the ten tested units), no additional testing will be required. If less than 90% of the initial sample pass (e.g., fewer than nine units), then the failed units shall receive corrective action and be retested, and an additional 10% of the housing units (e.g., ten additional units) shall be tested. If 90% of the tested units pass (e.g., 18 of the 20 tested units), no additional testing will be required. This testing procedure shall continue in groups of 10% throughout the new and/or revitalized housing units until at least 90% of the tested units comply with the stated performance requirements.

Infiltration testing may be performed after completion of all housing units being constructed or revitalized under the project. However, testing the building envelope on an ongoing basis is recommended to avoid replicating the same deficiencies in units yet to be constructed or revitalized. In this case, for example, a 100-housing-unit project could be divided into five groups of 20 units. Testing would be performed on 2 of the first 20 housing units completed. If both units pass, no additional testing would be required for the first group of 20 housing units. After the second group of 20 housing units are completed, 2 of these 20 units would be tested to determine if the second group of housing units passes. Testing by group would continue until all housing units were completed.

CORRECTION OF AIR-LEAKAGE DEFICIENCIES

The contractor shall supply all labor and material required to make the leakage of all tested units conform to the stated performance requirements. Units initially failing to meet the stated performance requirements shall be retested to verify their conformance after corrective actions have been accomplished.

5.4 Windows and Doors

Windows and glass exterior doors (doors whose surface is 50% or more glazed) shall meet the following standards and must be certified by an independent test laboratory. Windows that slide (double-hung, single-hung, and horizontal sliding) and glass exterior doors shall meet the standards for "hung" windows that follow. Standards for casement windows shall refer to all hinged or fixed windows. Jalousie windows, greenhouse windows, and other unspecified types of windows may not be used unless they are tested and conform to the standards for hung windows.

Windows shall meet the following design pressure standards as designated by the National Fenestration Rating Council:

- hung: DP25 (corresponds roughly to former Grade 40), and
- casement: DP40 (corresponds roughly to former Grade 60).

The following specific tests and minimum standards are required to achieve these design pressure standards.

- Operating force: The force necessary to unlatch and open the window shall not exceed 30 lb for hung and 35 lb for casement.
- Air infiltration: Using ASTM E 283, "Standard Test Method for Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors," the rate shall not exceed 0.25 cfm/ft^2 for hung and 0.15 cfm/ft^2 for casement at a test pressure of 1.57 psf.
- Water penetration: Using ASTM E 547, "Standard Test Method for Water Penetration of Exterior Windows, Curtain Walls, and Doors by Cyclic Static Air Pressure Differential," there shall be no water penetration at 3.75 psf in three 5-minute cycles with a 1-minute rest between cycles for hung, and at 6.00 psf for casement.
- Structural testing—Using ASTM E 330, "Standard Test Method for Structural Performance of Exterior Windows, Curtain Walls, and Doors by Uniform Static Air Pressure Difference," there shall be no glass breakage, damage to hardware, or permanent deformation that would cause any malfunction or impair the operation of the unit. Residual deflection of any member shall not exceed 0.4% of its span. Windows shall be subjected to pressures of 37.5 psf for hung and 60 psf for casement.
- The maximum U-value for the whole window shall not exceed the following:
  - hung: 0.50 U-value (not less than R-2), and
  - casement: 0.40 U-value (not less than R-2.5).

The U-value shall be calculated using ASTM E 1423, "Standard Practice for Determining the Steady State Thermal Transmittance of Fenestration Systems," and\or the National Fenestration Ratings Council's NFRC 100-91, "Procedure for Determining Fenestration Product Thermal Properties."

Double-glazed units shall have a nominal air space of at least 3/8 in. but not more than 1 in. The low-E coating, if present, must have an emissivity value less than 0.40.

The manufacturer of the window must present a copy of a letter from an independent testing laboratory certifying the performance of the window supplied by the manufacturer. This letter must state that a window comparable to the one being used has been tested and meets or exceeds the standards outlined.

Manufacturers of wood or wood-clad windows must present a written statement declaring that the wood is preservative-treated in accordance with the latest version of

NWWDA Industry Standard I.S.4, “Water Repellent Preservative Treatment for Millwork.”

It is the installer’s responsibility to obtain the installation specifications from the manufacturer of the window being installed and to install, insulate, and finish (paint) the window according to those specifications.

5.5 HVAC Equipment

FURNACES AND BOILERS

The AFUE rating of all new furnaces and boilers—as determined in Sect. 4.2.11, "Heating and Cooling Equipment Replacement Selection," or 4.2.12, "Heating and Cooling Equipment Selection"—shall be specified for newly purchased units. All new gas-fired units shall have intermittent ignition devices (IIDs). A new condensing furnace that will be installed inside the housing unit shall be a sealed-combustion unit that uses 100% outside air for combustion. A new flue or chimney liner shall be specified with the installation of a new furnace or boiler if it is required to meet building codes, to maintain a proper draft, or to ensure material compatibility with the new flue gas conditions. A new flue or chimney liner shall be specified for the hot water system if a new condensing system is installed.

The commissioning procedure outlined in this section shall be specified for all new furnaces and boilers to ensure correct installation and operation of the unit.

AIR CONDITIONERS

The SEER rating as determined in Sect. 4.2.11, "Heating and Cooling Equipment Replacement Selection," or Sect. 4.2.12, "Heating and Cooling Equipment Selection," shall be specified for newly purchased units. Specify condensing (outside) units to be equipped with a housing that protects the fins (units shall not have exposed plate-type fins). Specify the location of the outdoor unit so that there are no restrictions around it (such as shrubs and decks) that block airflow or promote recirculation. Specify a clear area around the outdoor unit of at least 2 ft. Specify the outdoor unit location to be greater than 6 ft from the exhaust of the clothes dryer.

The commissioning procedure outlined in this section shall be specified for all new air conditioners to ensure correct operation of the unit.

HEAT PUMPS

Specifications for new heat pumps are the same as for air conditioners with one addition. Specify that heat pumps with resistance heaters shall have an outdoor thermostat to prevent the resistance heaters from turning on at ambient temperatures above 45°F or other preselected temperature.

The commissioning procedure outlined in this section shall be specified for all new heat pumps to ensure correct operation of the unit.

INTERMITTENT IGNITION DEVICES

Field-installed IIDs shall be certified by the American Gas Association (see the association's *Directory of Certified Appliances and Accessories,* "Automatic Intermittent Pilot Ignition Systems for Field Installation").

COMMISSIONING AND TUNE-UP OF FURNACES AND BOILERS

The contractor shall commission all newly installed fossil-fuel-fired heating systems and tune up all existing systems by completing the following tasks.

1. Perform a visual inspection of gas- and oil-fired systems to ensure safe operation. Check for the presence of an electrical cutoff switch, proper grounding, insecure wiring, or combustible materials near the flue. Verify the adequacy of combustion air. Inspect the furnace heat exchanger for cracks and any evidence of flame roll-out. Inspect the flue and chimney for structural decay, leaks, accumulation of deposits, and the presence of a flue liner. For fuel-oil systems, verify the presence of a filter and a shutoff valve in the fuel supply line and the

presence and functional condition of a barometric damper in the flue connection. Inspect the fuel supply line and storage tank for leaks. Correct all deficiencies found.

2. For furnaces, set circulation fan "off" limit switches at 90–95°F and high-limit switches at 200–250°F, or set the switches in accordance with manufacturer specifications if they differ. Circulation fan "on" limit switch settings for furnaces are system dependent. Choose the lowest possible temperature setting that avoids "rocking on" or cycling of the fan after the burner has shut off, generally from 120°F to 160°F. For boilers, set system operating temperatures and high-limit switch settings to standard recommended values of the manufacturer.

3. Adjust each burner under the guidance of combustion analysis to maximize its steady-state efficiency. Measure the percentage oxygen reading and net stack temperature to calculate the steady-state efficiency. Adjust this efficiency for smoke number for oil-fired systems. For existing oil-fired systems, targets are to achieve at least a steady-state efficiency of 80% with a flue gas containing 7% oxygen and a smoke number 1.

4. Measure the carbon monoxide level in each burner after the burner has run continuously for 5 minutes. Adjust the burner if carbon monoxide readings greater than 250 ppm occur. Adjustments include cleaning burners and eliminating heat exchanger obstructions. Also, make carbon monoxide measurements 5 ft from the space-heating system and in the living area of the housing unit. Readings greater than 5 ppm indicate leakage from the furnace or flue. Identify and correct the source of the carbon monoxide leakage in these areas.

5. Use at least one of several methods to ensure that heat exchangers are not cracked in furnaces. Measure the percentage oxygen reading in the flue immediately before and after the fan turns on. A change in the reading indicates a cracked heat exchanger. Additionally, observe the burner flame to see if it changes when the fan turns on. Again, a change indicates a cracked heat exchanger.

6. Limit the temperature rise across the heat exchanger of a furnace to 80°F and the exit temperature of supply air to 160°F by maintaining adequate airflow. Try to keep the temperature rise across the heat exchanger within the upper half of the range specified by the manufacturer for new equipment. Current airflow can be measured at return grills using a hand anemometer, measuring the area of the return opening and accounting for the area of the grill if it remained in place while the velocity measurements were taken.

7. Perform draft measurements to ensure that adequate draft is present and that spillage is minimized. Measure the draft with the system off first. After turning the system on, record the draft at 1-minute intervals for 3 to 5 minutes, as well as the time needed to stop spillage. Spillage can best be observed using chemical smoke. Drafts of 0.02 to 0.06 in. water shall be obtained. Spillage shall stop within 30 seconds.

8. For the condensing system, verify the correct installation of the exhaust and air intake pipes. The exhaust pipe must be pitched at least 1/4 in. per foot so that condensate can drain back to the furnace. Supports must be adequate so that the exhaust pipe does not sag between supports. The exhaust pipe must be sized following manufacturer instructions. The air intake pipe (if present) must be located away from dryer vents and power-vented water heaters so that it does not draw in contaminated air. Exhaust and

air intake pipes must be run out the same side of the housing unit and be located above anticipated snow levels.

9. Verify the correct operation of the thermostat by checking the anticipator setting (if present) and the cut-on and cutoff temperatures relative to the set point.

10. Other tasks to be performed include checking and adjusting the manifold pressure of gas-fired systems, adjusting belt tensions, checking the condition and operation of the circulation fan of furnaces, checking the condition and operation of circulating pumps of boilers, checking the operation of zone valves of boiler systems, and using a gas detector to identify the presence of gas leaks.

11. Document the commissioning/tune-up results by providing the military inspector for the project with the following information:

- initial and final steady-state efficiencies,
- net stack temperature,
- oxygen concentration,
- smoke number (oil only),
- circulation fan "on" and "off" limit temperatures,
- high-limit temperature,
- carbon monoxide levels,
- temperature rise across heat exchanger,
- draft readings, and
- deficiencies found and corrective actions taken.

COMMISSIONING AND TUNE-UP OF AIR CONDITIONERS AND HEAT PUMPS

The following tasks shall be accomplished in commissioning new or tuning up existing equipment.

1. Measure the airflow rate across the indoor coil. The rate must be 350 to 450 cfm per ton of cooling capacity for efficient operation. This rate must be established before the system can be correctly charged.

2. For new systems that are not precharged, charge the system by weighing in the proper amount of refrigerant according to nameplate or manufacturer instructions after accounting for the length of refrigerant lines.

3. For all systems, check and adjust the refrigerant charge based on superheat and subcooling measurements made with the system operating in the cooling mode. These measurements give the most reliable results when the ambient temperature is greater than 80°F. For heat pumps that must be tuned up in the winter, check and adjust the refrigerant charge based on the hot gas temperature method. Use this method only when conditions prevent the use of the superheat and subcooling method. The charge shall not be adjusted based on performance curves or noninstrumented approaches.

4. Ensure that the air temperature difference across the indoor coil is 15 to 20°F when the system is operating in the cooling mode.

5. Perform a visual inspection to ensure safe operation of the system. Inspect the fused disconnect, wiring, contactors, relays, pressure controls, and other electrical safety circuits. Tighten electrical connections as needed and correct any deficiencies found.

6. Verify the correct operation of the thermostat by checking the anticipator setting (if present) and the cut-on and cutoff temperatures relative to the set point. For heat pumps, check the operation of resistance heaters to ensure that they are wired correctly to their control circuits (they cycle correctly, are staged correctly, and are not on all the time). Also, test the defrost operation of heat pumps.

7. Other tasks to be performed include checking the voltage and amperage to all motors, cleaning the indoor fan if dirt has built up (especially if the airflow across the indoor coil is less than 350 cfm per ton of cooling capacity), checking bearings, lubricating all moving parts as required, checking and adjusting belt tension, inspecting and cleaning the condensate drain if necessary, and cleaning the outdoor and indoor coils if necessary. As an option, perform a meggar test of hermetically sealed compressors to check the condition of electrical insulation.

8. Document the commissioning/tune-up results by providing the military inspector for the project with the following information:

- airflow rate across the indoor coil and the capacity of the unit;
- initial and final measurements used to charge or check the charge of the system;
- temperature difference across the indoor coil; and
- deficiencies found and corrective actions taken.

5.6 Air Distribution System Repair and Construction Specifications

Use the following materials and procedures to install new ductwork and to correct identified infiltration deficiencies in existing ductwork.

DUCT MATERIALS

New duct systems or replacement ducts shall be fabricated from sheet metal, rigid fiberglass, or fiberboard using the following guidelines. Systems constructed entirely of flexduct are not permitted. However, flexducts may be used as branch connections to supply registers in only those cases where space limitations and short distance runs make installation of metal or fiberboard ducts prohibitively costly or difficult.

Mechanical fasteners shall be used to secure all joints between sections of duct, especially between sections of air ducts and plenums, ducts and terminal fittings, connections at the air handler equipment, connections of branch ducts to main trunk ducts, and duct sections constructed of different materials. Materials intended to seal against air leaks— such as mastics, caulks, and fiberglass tape—shall not be used to fasten sections of duct together.

Metal Ducts

Install metal ducts according to *Duct Construction Standard—Metal and Flexible* (SMACNA 1985, first edition). Seal joints and connections in metal ductwork in accordance with Table 5.1. Fasten transverse joints that are friction-fitted with at least three metal screws equally spaced around the joint. Insulate metal ducts in unconditioned spaces (e.g., attics, crawl spaces, garages) to an insulation value of at least R-6. Wrap the outside of ducts with foil-faced fiberglass batts that are attached with metal-faced duct tape.

Rigid Fiberglass (Fiberboard) Ducts

Fabricate fiberboard ducts from ductboard with metal facing on the outside surface. Fiberboard ducts shall be either round (preformed off site) or rectangular (formed on site from precut, standard-size sections). Install fiberboard ducts according to *Fibrous Glass Duct Construction Standards* (SMACNA 1992, sixth edition). Fiberboard duct sections shall be fastened together using clinching staples. Fiberboard shall provide an insulation value of at least R-6. Lap and seal on-site joints with a combination of fiberglass mesh and mastic (see Table 5.1).

Flexible Ducts (Flexducts)

Prefabricated, round ducts with 2- to 12-in. diameters shall each have an inner, flexible, nonporous core of plastic supported by a metal coil for strength. An outer liner shall enclose fiberglass insulation between the core and the outer liner to provide an insulation level of at least R-6. Acceptable flexduct shall be air-duct rated by National Fire Protection Association 90B, “Warm Air Heating and Air Conditioning Systems,” 1989, and shall meet the testing requirements of Standard UL-181 for factory-made air ducts and air connectors.

Install flexduct according to *Duct Construction Standard—Metal and Flexible* (SMACNA 1985, first edition). Seal joints between flexducts and metal collars and register boots at the inner core with approved mastic or joint sealant as directed in Table 5.1. Install flexducts so that their length is minimized. Flexduct bends shall not exceed 90 degrees and must have a radius greater than one diameter. Flexducts shall be mechanically fastened to all metal ducts and metal fittings using drawbands that are preferably metal. Flexducts must be fastened to fiberboard ducts using twist-in

Table 5.1. Sealing requirements for duct systems		
Duct joint or connection	System replacement and/or extension	System repair
Transverse joints in round metal ducts, consecutive lengths	Screw metal joint, mastic and fiberglass tape[a] seal	Screw metal joint, mastic and fiberglass tape[a] seal
Snap-lock joints in round or rectangular metal ducts	None	None
Metal collar to metal or fiberboard duct or junction box	Mastic	Mastic
Metal elbow swivel joints	None	None
Joints in fiberboard ducts	Mastic plus fiberglass tape	Mastic plus fiberglass tape
Return main connection to return grill	Secure with screws and caulk gaps	Add blocking material as necessary, caulk gaps
Return duct joints	Rectangular metal—no joint seal Sheetrock—not allowed	Rectangular metal—no joint seal Sheetrock—mastic joints
Air handler return platform	Sheetrock to framing, caulk or mastic joints	Sheetrock or ductboard to framing, caulk or mastic joints
Building return cavities	Rectangular metal duct	Mastic or caulk joints
Flexduct to metal collars at connections or duct boots	Seal inner liner to collar with mastic, minimum 1-in. overlap; use band around outer liner.[b]	Seal inner liner to collar with mastic, minimum 1-in. overlap; use band around outer liner.[b]
Plenums to air handler	Mastic or caulk	Mastic or caulk
Air handler penetrations	Metal-faced tape	Metal-faced tape
Panned floor joist returns	Not allowed	Remove metal pan and caulk all joints; replace metal pan and caulk joints.
Floor truss cavity or stud bay cavity returns	Remove when possible; replace with rectangular metal ductwork.	Remove when possible; replace with rectangular metal ductwork.
Floor cavity returns	Mastic or caulk joints and penetrations	Mastic or caulk joints and penetrations

[a]Use for gaps more than 1/8–1/4 in. wide.
[b]Metal or nylon bands are required in attics with temperatures above 120°F.

(screw attachment) bend-tabs or screw-tabs and flanges.

JOINT SEALANTS

Apply the following sealants as specified in Table 5.1 after thoroughly removing moisture, dust, dirt, oil, grease, or other substances that may diminish the bond of the sealant material.

Mastics and Fiberglass Tape (Fiberglass Mesh)

Use water-based mastics with fiberglass tape to seal and provide strength to all joints. Water-based mastics are preferable to petroleum-based mastics because of shorter curing times, easier cleanup, and more "forgiving" application characteristics. When used with fiberglass tape, mastic can seal and provide strength to repairs of practically any configuration. Mastic should generally be applied over the entire joint between mated surfaces and must not be diluted. Use fiberglass mesh when gaps are larger than 1/8 in.

Mastic sealants shall conform to the following safety requirements of UL Standard 181, Class 1:

- a flame spread rating of less than 25, and
- a smoke development rating of less than 50 in the dry, final state.

In addition, the sealants shall conform to these characteristics:

- a solids content greater than 50% to reduce shrinkage on drying;
- the capability to adhere to many surfaces—sheet metal, drywall, fiberboard, concrete, wood, and plastic; and
- a temperature range that includes the highest and lowest temperatures likely to be encountered.

Caulking

Long-lasting (20 years or more) silicone caulking materials are required for sealing leaks in duct systems. This material shall have the same safety requirements as mastic sealant and shall be UL rated.

Gasketing

Joints can be sealed using gasketing material placed between the surfaces to be mated and fastened with sufficient force to compress the gasketing material. All voids and cracks at the joint must be filled by the gasketing material.

Duct Tape

Metal-faced pressure sensitive or heat-activated tapes that meet UL Standard 181 shall be used only for sealing penetrations and joints on equipment where access for maintenance is required. Fabric duct tape or tape with rubber-based adhesives is prohibited as a sealing material except as a temporary material to support a joint during fabrication. Remove all fabric tape before the completion of the installation. Pressure-sensitive tape must be applied using a squeegee (rather than by hand), and to surfaces that are at the proper temperature as prescribed by industry standards.

INSTALLATION PROCEDURES FOR NEW DUCTWORK

Size duct systems according to the Air-Conditioning Contractors of America (ACCA) Manual J, and design duct systems according to the ACCA's Manual D. Submit design forms to the contracting officer. Follow the previously outlined material specifications for ducts and joint sealants, the requirements in Table 5.1, and the procedures outlined below.

Return Ducts

Return ducts shall be constructed with the following additional requirements:

1. Locate return ducts in the conditioned space whenever practical to minimize exchange with unconditioned air.

2. Use of building cavities, building framing, floor truss cavities, and panned floor joists for return ducts is prohibited.

3. Enclose raised floor platforms and other return plenums for furnaces and air handlers with drywall and seal all penetrations and joints with mastic or caulk.

4. Provide a separate return duct for each level of a multilevel unit.

5. Attach and seal return ducts to the wall at return grills to isolate building cavity air from the return duct.

Supply Ducts

Supply ducts shall be constructed with the following additional requirements:

1. Locate supply ducts within the conditioned space whenever practical.

2. Extend duct boots at supply registers through the wall, ceiling, or floor material with registers tightly fitted to duct boots to prevent loss of conditioned air to the building cavity.

Air Handler

Use the following procedures to eliminate air leaks at the air handler:

1. Seal penetrations, seams, and gaps in the air handler cabinet with metal-faced duct tape or "tape applied mastics" (foil tapes with 15 mil or thicker butyl adhesive).

2. Seal joints between the air handler cabinet and the main supply and return ducts or plenums with mastic or caulk.

Supports

Support ductwork at intervals of no more than 5 ft. Fiberboard ducts and flexducts in attics may require additional support when elevated above floor joists. Supports shall be metal hangers or other materials that will not penetrate the duct surface.

REPAIR PROCEDURES

Follow the material specifications for ducts and joint sealants outlined previously. When insulation on sheet-metal ductwork is either damaged or nonexistent, attach foil-faced fiberglass batts rated at R-6 or more with metal-faced duct tape. Follow the sealing requirements for "system repair" specified in Table 5.1 to repair existing ductwork. Pull back or remove insulation to expose joints. Remove all fabric duct tape encountered.

Supply Ducts

Use the following procedures to repair existing supply ducts:

1. Seal gaps between supply boots and supply registers with fiberglass tape, mastic, and blocking material to prevent loss of conditioned air.

2. Fasten joints in round metal ducts that leak from lack of sealant (i.e., that are fastened with fabric tape only) with sheet metal screws and seal with mastic and fiberglass tape.

Return Ducts

Use the following procedures to repair existing return ducts:

1. Seal gaps between return ducts, return grills, and the wall at return grills to isolate building cavity air from the return duct.

2. Seal the joints in return ducts made of drywall with mastic where they are accessible.

3. Interior walls under a raised floor furnace or air handler platform shall have drywall or ductboard securely attached to the framing.

Seal all penetrations and joints with mastic or caulk.

4. Replace panned floor joist returns with new ductwork or seal all interior and exterior joints with caulk or mastic. Block off any connections to building cavities.

Air Handler

Use the following procedures to repair air leaks at the air handler:

1. Seal penetrations in the air handler cabinet with metal-faced duct tape or “tape applied mastics” (foil tapes with 15 mil or thicker butyl adhesive).

2. Seal joints between the air handler cabinet and the main supply and return ducts or plenums with mastic or caulk.

5.7 Air Distribution System Performance Testing

DIAGNOSTIC TESTING

Randomly selected new and/or revitalized housing units shall be tested to determine the compliance of the unit with the allowable air-leakage rate specified for the air distribution system. Units shall be selected by the program manager. Testing shall be performed by a firm qualified to perform inspections using blower doors in accordance with procedures specified in Appendix E for air distribution system testing. The testing firm shall be independent of the installing contractors or equipment suppliers for this project. The specifications provided in Appendix B can be used to hire a qualified firm.

PERFORMANCE REQUIREMENTS

Air distribution system air leakage shall be less than or equal to 150 cfm when the system is pressurized at 50 Pa.