



State of Ohio
Weatherization Program
Standards

Section **MECHANICAL SYSTEMS
INSPECTION**

Subject **Heating Units**

NON-OPERATIONAL UNITS 201-1.1

No weatherization work may be done until a non-operational primary heating unit is repaired or replaced.

repair/replace
201-1.1a



If the heating unit must be replaced, a NEAT audit must be performed if weatherization funds are used to replace the heating unit.

cost-effectiveness
201-1.1b



All unvented, fuel-fired primary heating units, unvented fuel-fired water heaters, or unvented, gas, clothes dryers present in a dwelling which cannot be vented, must be removed or replaced with properly-vented units before proceeding with any weatherization work. Notify the client/owner/authorized agent and arrange to have the unit replaced/removed.

**unvented primary
heating units**
201-1.1c

In dwellings where an unvented, secondary heating unit is present, inform the client/owner/authorized agent verbally and in writing of the potential health hazards of operating an unvented appliance in the post-weatherized dwelling and provide information on safe alternatives. Document the presence of the unvented, secondary heating unit in the HWAP client file. Install a carbon monoxide detector.

**unvented secondary
heating units**
201-1.1d

FUEL SUPPLY 201-1.2

Fuel must be available (except for solid fuel units) to begin the inspection process.

fuel availability
201-1.2a

When no fuel is available for solid fuel units, check for:

solid fuel
201-1.2b

- i. Heat exchanger leakage and corrosion.
- ii. Unsafe and/or improper wiring, if applicable.
- iii. Unsafe and/or improper venting and clearances.

fuel leakage, gas
201-1.2c

Use a combustible gas leak detector to check for liquefied petroleum (LP) or natural gas leaks from all accessible gas supply lines and gas-fired appliances. Verify every suspected leak with a commercial leak detector solution. Determine the source and severity of the problem and corrective actions.

major gas leaks
201-1.2d



If the gas leak is major (see 1504 Abbreviations and Definitions), immediately inform the owner/occupant and leave the dwelling. Contact the fuel vendor, and have the problem corrected. Document all actions taken in the customer file.



No weatherization work may be done until major gas leaks are corrected.

minor gas leaks
201-1.2e

If the gas leak is minor (see 1504, Appendices and References), inform the owner/occupant and have the problem corrected.

fuel leakage, oil
201-1.2f

Visually check for fuel leakage in kerosene and fuel oil heating units. Visually check the fuel oil storage tank for leaks.



No weatherization work may be done until oil or kerosene leaks are corrected.

Btu input
201-1.2g

When appropriate, test to determine if the heating unit is over- or under-fired by clocking the meter on natural gas units and calculating the actual Btu input. On propane units, the heating technician/heating contractor may take a gas pressure test, measure the orifice, and calculate the actual Btu input. Determine corrective actions.

ELECTRICAL POWER SUPPLY 201-1.3

main power safety
201-1.3a

Inspect the main electrical power supply to the heating unit to determine whether it is safe.

dedicated circuit
201-1.3b

Inspect the wiring to the heating unit. Determine whether the electrical circuit to the heating unit is in accordance with the applicable NFPA code for the fuel type (#54 for gas, #31 for fuel oil, #211 for solid fuel).

If no dedicated circuit exists, it is not necessary to install one unless the wiring is in poor condition, or there is a history of circuit failure, or a new heating unit is to be installed.

Visually inspect all wiring at, or in, the heating unit to detect charred, frayed, or missing wire insulation, and improper or loose connections.

hazardous wiring
201-1.3c



If the wiring is hazardous, inform the customer of the problem and have it corrected before doing any weatherization work.



HEATING UNIT CLEARANCES 201-1.4

Visually inspect the heating unit to determine whether clearances from combustibles are in accordance with the applicable NFPA code for the fuel type (#54 for gas, #31 for fuel oil, #211 for solid fuel).

heating unit clearances
201-1.4a

VENT SYSTEM VISUAL INSPECTION 201-1.5

Determine whether the vent system is in accordance with the applicable NFPA code for the fuel type (#54 for gas, #31 for fuel oil, #211 for solid fuel). Visually inspect the vent system to determine that it extends from the heating unit to the outside of the dwelling. Look for excessive corrosion or rust, cracks, holes and loose, unsealed, or disconnected sections. Repair of an existing problem is mandatory.

clearance and termination
201-1.5a

Inspect the vent/chimney connections to determine whether they are securely fastened.

vent connections
201-1.5b

Determine whether the vent connector is installed with no dips or sags, and rises at least 1/4" per foot of run.

vent slope
201-1.5c

Determine whether the number of elbows exceeds that allowed in the codes cited in Table 201-1.5.

vent elbows
201-1.5d



Determine whether any chimney in use is in sound condition. Determine whether existing liners, bricks or blocks and mortar are in good condition.

chimney condition
201-1.5e

chimney liner
201-1.5f

Determine whether chimney repair or a new liner is needed. All fan-assisted appliances shall vent into a properly-sized lined chimney.

DRAFT TESTING 201-1.6

draft, "worst case"
201-1.6a

Set up the "worst case scenario" for draft testing (see 1506-4). All draft tests must be taken under "worst case scenario" conditions.

Table 201-1.6 Draft Test Locations and Acceptable Readings

Heating Unit Type	Draft Gauge Probe Placement	Worst Case Acceptable Draft Readings at Listed Outdoor Temperatures (F)				
		<20	21-40	41-69	61-80	>80
Gas Atmospheric Appliances (Furnace, Space Heater, Boiler Floor Furnace)	Flue (after diverter)	-5 Pa -.02 wc'	-4 Pa -.016 wc"	-3 Pa -.012 wc'	-2 Pa -.008 wc"	-1 Pa -.004 wc"
Gas Fan-Assisted	Flue (1 1/2 times the diameter of the flue from the flue collar or elbow)	-5 Pa -.02 wc'	-4 Pa -.016 wc"	-3 Pa -.012 wc'	-2 Pa -.008 wc"	-1 Pa -.004 wc"
Oil Burners	Flue (before Barometric Damper)	-15 Pa -.06 wc'	-13 Pa -.053 wc"	-11 Pa -.045 wc'	-9 Pa -.038 wc"	-7 Pa -.03 wc"
Gas 90+ Furnace	Exhaust Pipe	PMI	PMI	PMI	PMI	PMI

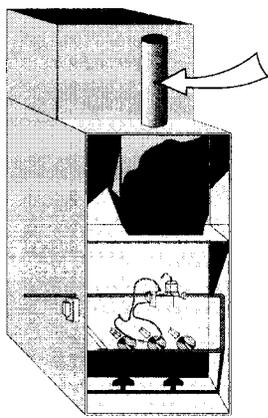
draft
201-1.6b

Start the heating unit. Insert the draft probe into the appropriate location listed in Table 201-1.6 and illustrated in Figure 201-1.6. At two minutes, measure the draft and determine whether the draft reading is within the acceptable ranges identified in Table 201-1.6.

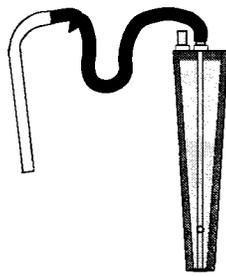
COMBUSTION SAFETY AND EFFICIENCY TESTING 201-1.7

carbon monoxide (CO)
201-1.7a

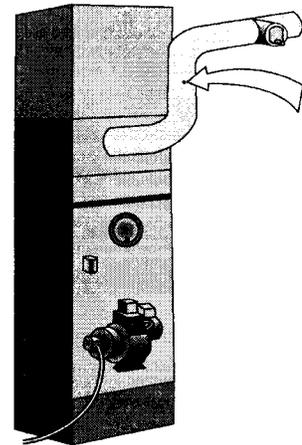
With the heating unit operating in winter operating condition, insert the sampling probe into the appropriate location listed in Table 201-1.7a and illustrated in Figure 201-1.7. Measure and record the amount of CO in the flue gasses. The low reading must be 100 ppm or less.



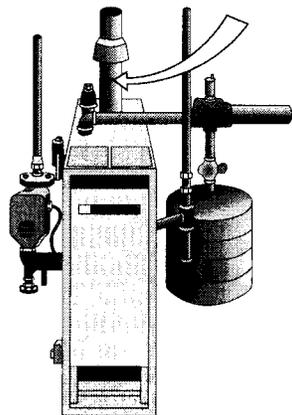
Atmospheric Furnace



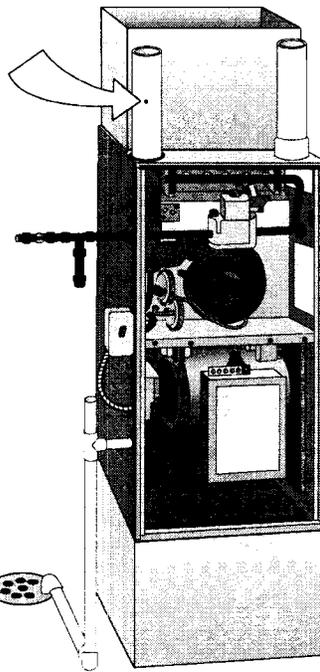
PROPER PROBE
PLACEMENT FOR
DRAFT TESTING



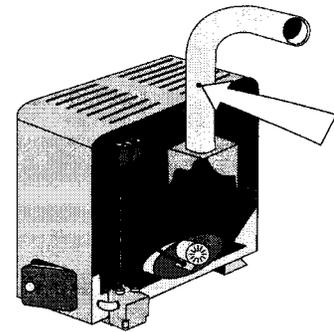
Fuel Oil Furnace



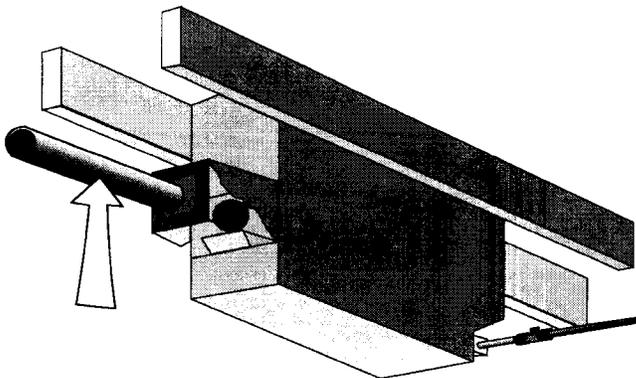
Atmospheric Boiler



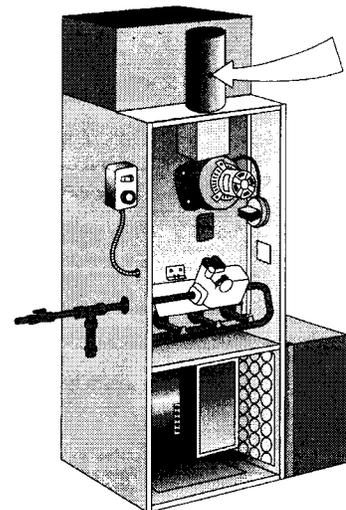
90+ Condensing Furnace



Space Heater



Floor Furnace



80+ Induced-draft Furnace

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Figure 201-1.6

Table 201-1.7a CO and Combustion Analyzer Probe Placement Locations

Heating Unit Types	Probe Location
Gas-fired Central Furnaces and Direct Heating Equipment	Each heat exchanger port
Oil-fired Central Furnaces and Direct Heating Equipment	Twice the diameter of the vent pipe down stream from any elbow and ½ the diameter of the vent pipe before the single acting barometric draft control
Gas-fired Boilers	Vent pipe before draft diverter
Sealed Combustion Units/Fan-assisted appliances	Exhaust vent pipe

Table 201-1.7b Acceptable Combustion Test Analysis Measurements

Heating Unit Type	(O ₂) Oxygen	Stack Temp.	Smoke Test	(CO) Carbon Monoxide Max. ppm
GAS (Natural Gas, Propane) Atmospheric	4-9%	300-600° F	N/A	100
Fan-assisted	4-9%	300-480° F	N/A	100
Condensing	PMI	PMI	N/A	100
Space Heaters	5-15%	300-650° F	N/A	100
Standard Power Burner	4-9%	275-550° F	N/A	100
OIL				
Standard Oil Burner	4-9%	325-600° F	1 or less	100
Flame Retention	4-7%	325-600° F	1 or less	100
Condensing	PMI	PMI	1 or less	100

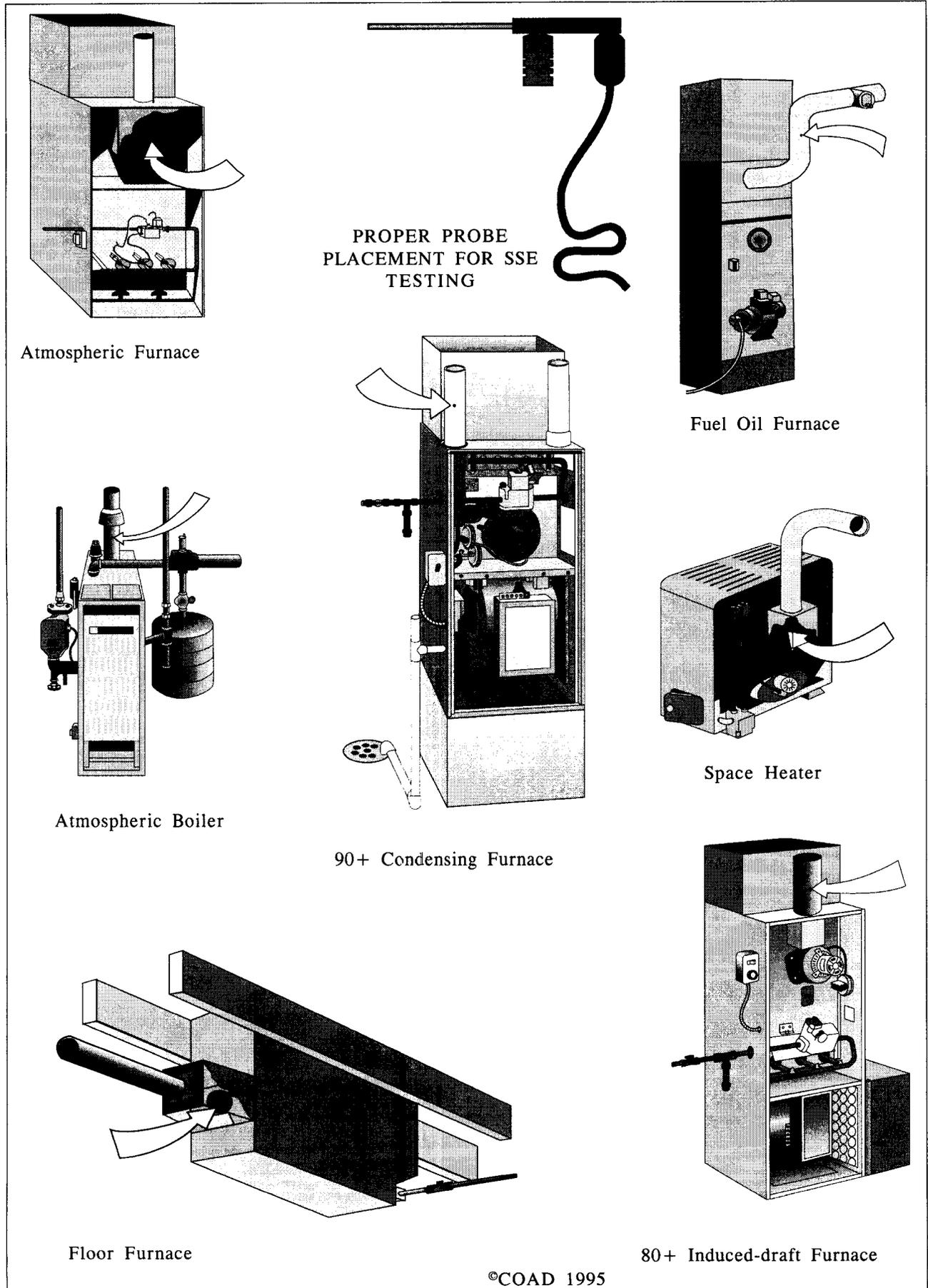


Figure 201-1.7

With the heating unit operating in winter operating condition, insert the sampling probe of a calibrated digital combustion analyzer into the appropriate location listed in Table 201-1.7a and illustrated in figure 201-1.7.

combustion analysis
201-1.7b

After the stack temperature stabilizes, measure and record the O₂ and the stack temperature readings. Determine whether the readings are within the acceptable limits listed in Table 201-1.7b or PMI.

Determine whether the combustion air requirements are in accordance with the applicable NFPA code for the fuel type (#54 for gas, #31 for fuel oil, #211 for solid fuel). (See 1506-11 Combustion Air/Specifically Engineered Systems). If the requirements are met, and carbon deposits and corrosion exist around the draft diverter, recheck for proper venting and backdrafting potential.

combustion air
201-1.7c

HEAT EXCHANGER INTEGRITY 201-1.8

Visually inspect the heat exchanger for evidence of deterioration and cracks or holes. Inspect for water leakage in boilers. Inspect for air leakage between boiler sections.

visual inspection
201-1.8a

With the heating unit operating, use a CO tester sensitive to at least 10 parts per million to test for CO in the distribution system and in the ambient air. If the source of CO is not the heating unit, then look for other possible sources of CO.

carbon monoxide (CO)
201-1.8b



During the combustion efficiency tests on forced-air systems, measure and record any change in the O₂ reading when the furnace blower motor comes on. If there is a change in the reading, reinspect the heat exchanger. Other industry accepted tests may be performed to confirm the problem.

**oxygen fluctuation,
forced air systems**
201-1.8c

If a crack in the heat exchanger is verified, then the heat exchanger or the heating unit must be replaced.

verified crack
201-1.8d

No weatherization work may be performed on a building until any cracked heat exchanger is repaired or replaced.

**cracked heat
exchanger**
201-1.8e

TEMPERATURE RISE 201-1.9

With the heating unit and blower operating, measure the temperature in a duct within 12 inches of the supply and return plenums. Determine whether the temperature rise is PMI, or within the acceptable range of 40° F - 70° F for mid to high efficiency furnaces, or if a data plate is not present on an atmospheric unit, within the acceptable range of 60° F and 90° F.

measurement
201-1.9

*CONTROLS 201-1.10*

Determine whether the fan is activated properly by the fan control.

fan control, forced-air units
201-1.10a

Check the high limit setting on forced-air heating units. Determine whether it is working correctly.

high limit control, forced-air units
201-1.10b

Determine whether the blower motor, belt, and fan are clean and operating properly. Determine if the blower motor needs lubrication.

blower operation/condition
201-1.10c



Determine whether there is an aquastat on the boiler and whether it is working correctly.

aquastat, boiler
201-1.10d

Determine whether the water pump is operating properly.

water pump, boiler
201-1.10e

Inspect the operating condition of the thermostat. Determine whether the thermostat will properly activate the heating unit.

thermostat
201-1.10f