 <p style="text-align: center;">State of Ohio Weatherization Program Standards</p>	Section	MECHANICAL SYSTEMS INSTALLATION
	Subject	Heating Units

TUNE-UPS AND REPAIRS 301-1.1

A tune-up involves a visual inspection, some testing procedures, cleaning and adjustments to improve the combustion and seasonal efficiency of the heating system.

tune-up
301-1.1a

Repairs involve the replacement or reconstruction of defective or unsafe parts for the purpose of ensuring the safe operation of the heating system.

repairs
301-1.1b

NON-OPERATIONAL UNITS 301-1.2

Repair or replace non-operational heating units.

repair/replace
301-1.2a

Replacements of heating units using weatherization funds must be cost justified using NEAT.

cost-effectiveness
301-1.2b

NEAT

Switching from the existing fuel source to a different fuel source for use by the heating unit is prohibited without the prior written approval of OEE. Requests for fuel switching must describe the technical reasons for the decision and include cost justification and written authorization from the party responsible for fuel payments.

fuel switching
301-1.2c

The output rating of all replacement heating units shall be sized according to Manual J or NEAT calculations. Documentation of sizing calculations shall be maintained in the client file.

sizing
301-1.2d

NEAT

All new units shall carry a minimum one (1) year warranty on workmanship. Each customer shall receive all manufacturer’s product warranty information, clear maintenance instructions, educational information as necessary and a local phone number of who to contact for warranty problems.

warranty
301-1.2e

All units shall be installed in conformance with manufacturer’s instructions, local codes, and/or NFPA manuals as required.

local codes
301-1.2f

*FUEL SUPPLY 301-1.3***repair/replace supply lines**

301-1.3a

Repair or replacement of fuel supply lines shall be restricted to the length between the fuel storage tank and the heating unit, or in the case of metered fuels, the length between the meter and the heating unit. Repair leaks in the fuel supply lines. Replacement of fuel supply lines must meet the applicable NFPA material code for the fuel type. Installation of sediment trap and replacement of displacement rotor member valves (water valves) is only required if the fuel supply line has to be broken, i.e., repair fuel leak or a new appliance.

fuel filters, oil

301-1.3b

Change, clean or add fuel filters in oil-fired units.

oil nozzle & electrodes

301-1.3c

Replace the oil nozzle in oil-fired heating units according to the size on the unit data plate or by performing a post-weatherization condition heat loss calculation to determine the new nozzle size. Re-adjust or replace and adjust the electrodes.

gas/oil pressure

301-1.3d

Use a manometer to check the manifold gas pressure and adjust according to manufacturer's instructions. If unable to locate manufacturer's recommended pressures, it is possible to use 11" water column for LP/propane and 3.25-3.75" water column inches for natural gas. Set oil pump pressure to PMI. With oil burners it is too important to give a range.

Btu input

301-1.3e

Verify the Btu input of a metered fuel unit by clocking the meter. If the unit is over- or under-fired, adjust the gas pressure. Replace orifices in propane and natural gas units with the proper sized orifice, if necessary.

*ELECTRICAL POWER SUPPLY 301-1.4***main power safety**

301-1.4a

Repair or replace an unsafe power supply to the unit.

dedicated circuit

301-1.4b



Install a properly sized and fused dedicated circuit for the heating unit if one is necessary based on wire condition, a history of circuit failure, or a new unit is to be installed.

hazardous wiring

301-1.4c

Replace any wiring in, or connected to, the heating unit that is charred, frayed, or has damaged insulation. Correct loose or improper wiring connections. Repair or replace defective wiring in, or leading to, the heating unit in accordance with NFPA 70, the National Electric Code.

HEATING UNIT CLEARANCES 301-1.5

Ensure that the unit is located so that clearances from combustible materials are in accordance with the applicable NFPA code for the fuel type (#54 for gas, #31 for fuel oil, #211 for solid fuel) or PMI. Move units that do not meet approved clearances or install approved heat shielding materials to reduce the clearances needed in accordance with approved NFPA methods.

**heating unit
clearances**
301-1.5a

VENT SYSTEM INTEGRITY 301-1.6

Repair or replace sections of the venting system that are corroded, rusted, clogged or blocked, contain cracks or holes, or are unsealed, loose or disconnected, in accordance with the applicable NFPA code for the fuel type (#54 for gas, #31 for fuel oil, #211 for solid fuel). Clean solid fuel chimneys that contain creosote.

damaged/corroded
301-1.6a

Ensure that all venting materials meet clearances from combustible materials in accordance with the applicable NFPA code. Correct any instances where vent clearances are not met.

clearances
301-1.6b

Securely fasten vent-to-chimney connections.

vent connections
301-1.6c

Repair or replace any vent connector pipe that dips or sags, or does not have a rise of at least 1/4" per foot of run.

vent slope
301-1.6d

Repair or replace any vent system parts necessary so that it does not exceed the allowable number of elbows in the vent system. Refer to the applicable NFPA code for the fuel type (#54 for gas, #31 for fuel oil, #211 for solid fuel) for venting requirements..

vent elbows
301-1.6e

If the chimney is the primary vent stack for the dwelling, and it is not in sound condition, it must be repaired or replaced with an approved chimney liner or approved, double-walled, metal vent material as specified by codes listed in the applicable NFPA code for the fuel type (#54 for gas, #31 for fuel oil, #211 for solid fuel).

chimney condition
301-1.6f

Clean solid fuel chimneys that contain creosote, soot, scale or other debris.

solid fuel chimneys
301-1.6g

DRAFT 301-1.7

draft test
301-1.7a

Perform a draft test on all vented combustion-type appliances in accordance with the Table 301-1.7 (see Figure 301-1.7 for probe placement) and correct any draft and venting problems in accordance with the applicable NFPA code for the fuel type (#54 for gas, #31 for fuel oil, #211 for solid fuel).

draft, "worst case"
301-1.7b

Perform the "worst case scenario" draft test (see 1506-4).

draft, furnace
301-1.7c

Start the heating unit. Insert the draft probe into the appropriate location listed in Figure 301-1.7. Measure and record the draft at two minutes. Determine whether the draft reading is within the acceptable ranges identified in Table 301-1.7. If draft is not within acceptable limits, determine the reason and correct.

Table 301-1.7 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

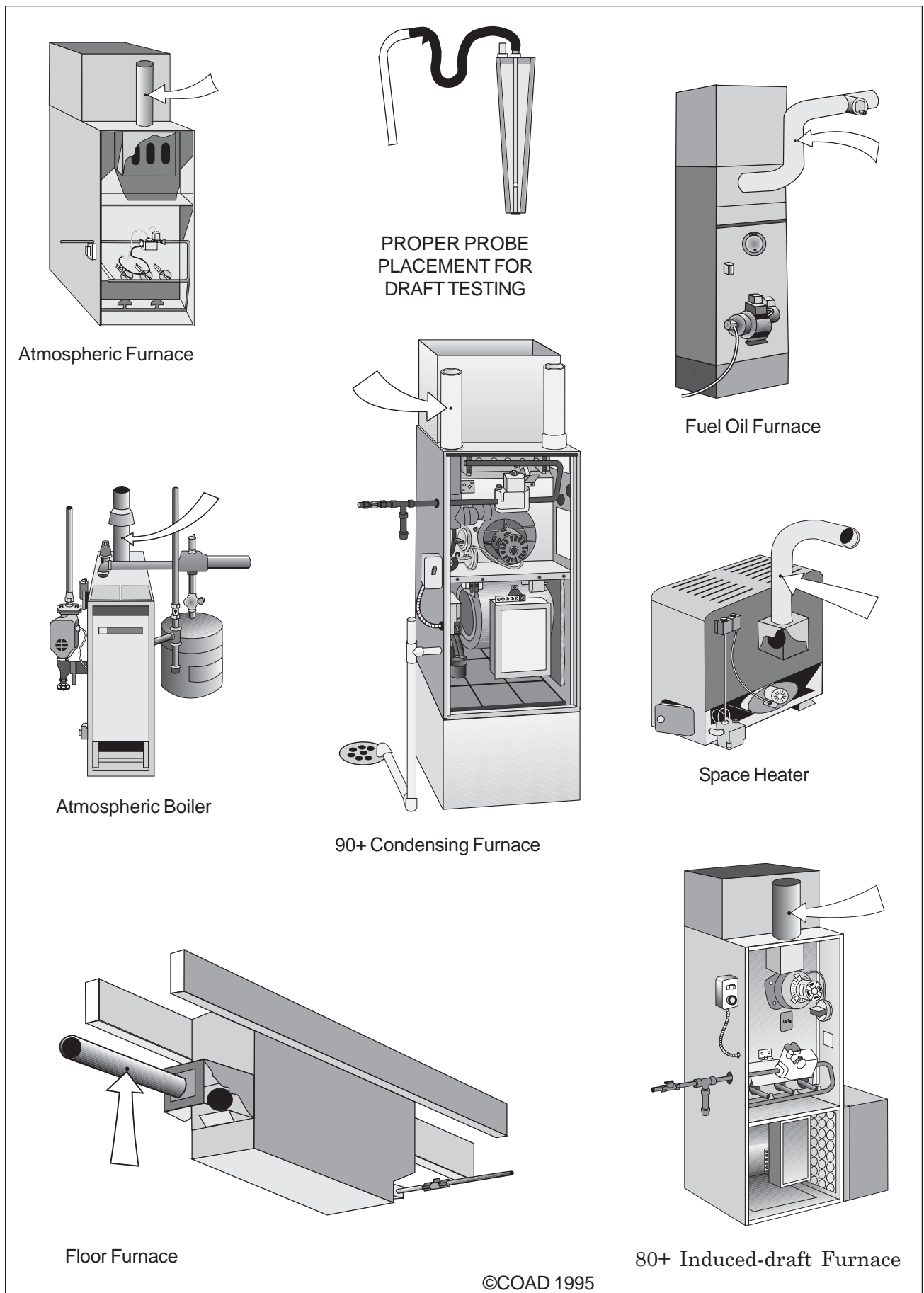


Figure 301-1.7

COMBUSTION SAFETY AND EFFICIENCY 301-1.8

clean burners
301-1.8a

Clean gas burners of dirt and rust. Repair or replace them if necessary.

clean combustion chamber
301-1.8b

Clean the combustion chamber on oil-fired units, replace or repair any defects in the combustion chamber, and seal the area around the air (blast) tube, inspection port and other areas to reduce uncontrolled, excess air.

power gas burners
301-1.8c

Seal openings around power gas burners.

carbon monoxide (CO)
301-1.8d

With the heating unit operating, insert the sampling probe into the appropriate location listed in Table 301-1.8d and illustrated in Figure 301-1.8. Measure and record the amount of CO in the flue gasses. More than 100 ppm in the flue is not permitted. If the cleaning and tuning work does not reduce the CO level below 100 ppm in the unit, repeat the procedures outlined above and retest. If the CO levels are still not below 100 ppm, consult with an OEE representative.

Table 301-1.8d 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	Vent pipe before barometric damper
Gas-fired Boilers	Vent pipe before draft diverter
Sealed Combustion Units	Exhaust vent pipe

combustion analysis
301-1.8e

Insert the sampling probe of a calibrated digital combustion analyzer into the location listed in Table 301-1.8d and illustrated in Figure 301-1.8. Adjust the heating unit so that the unit is within the acceptable combustion gas levels in Table 301-1.8e.

Table 301-1.8e 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	300-480° F	N/A	100	
	Condensing	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

Perform a worst case draft test. If unit passes test, no additional measures are needed. If unit does not pass, address the problem using one of the methods described in the applicable NFPA code for the fuel type (#54 for gas, #31 for fuel oil, #211 for solid fuel), or use a system that is designed to ensure combustion air.

combustion air
301-1.8f

HEAT EXCHANGER 301-1.9

Clean the heat exchanger. Remove soot and debris. Reseal with appropriate materials.

clean heat exchanger
301-1.9a

If cracks or holes exist in the heat exchanger, replace the heat exchanger if a new one can be located, or have the unit replaced. No weatherization work can be performed until the repair or replacement is complete.

**heat exchanger,
cracks or holes**
301-1.9b

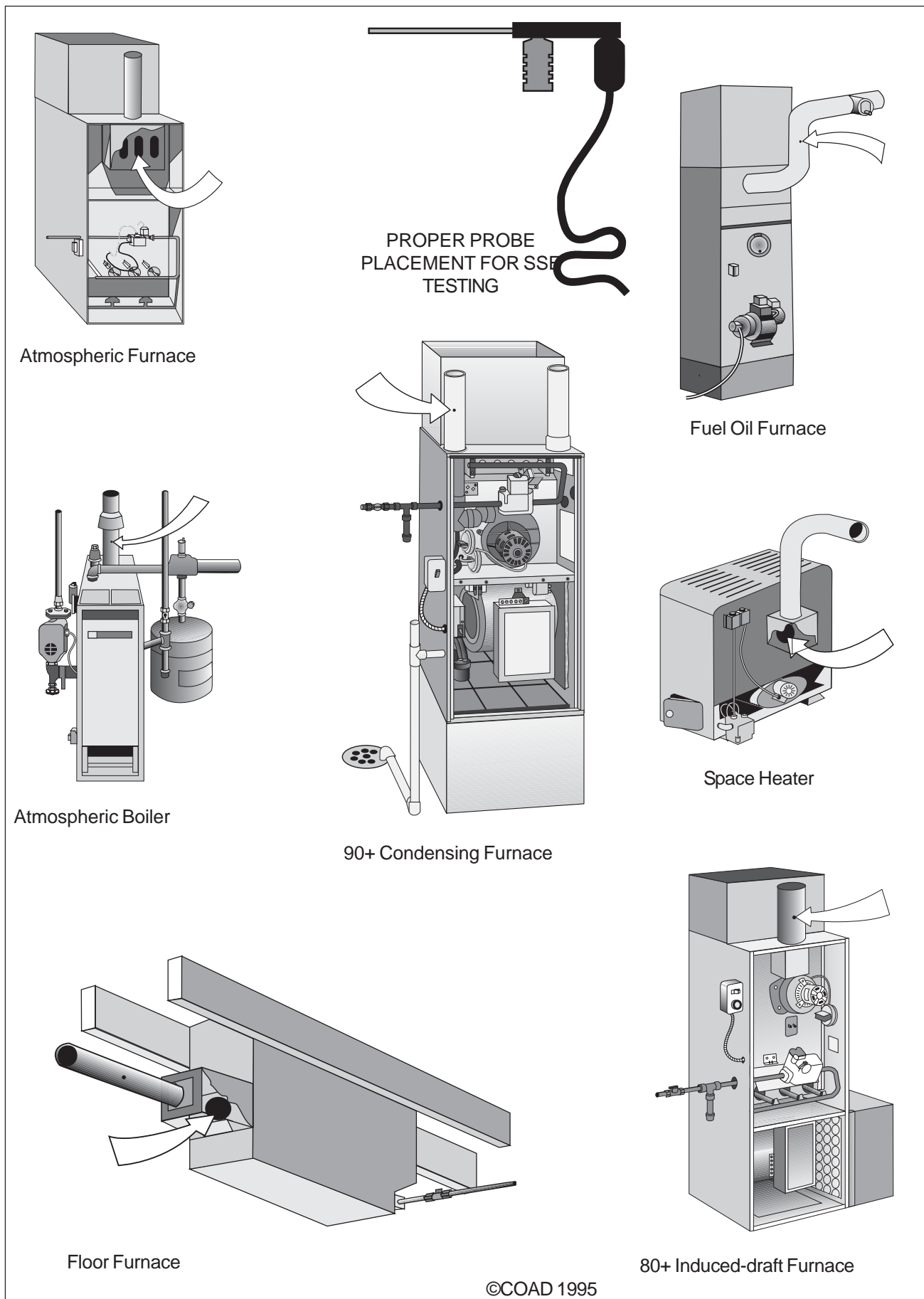


Figure 301-1.8

TEMPERATURE RISE 301-1.10

Perform a temperature rise test, and take corrective action if the temperature rise is not within the acceptable range listed in the manufacturer's specifications. Refer to Tables 301-1.10a.i and 301-1.10a.ii for remedies.

corrective action
301-1.10a

Table 301-1.10a.i Typical Solutions for High Temperature Rise

PROBLEM:	CHECK FOR:	REMEDY:
High Temperature Rise [>90°/PMI]	<ul style="list-style-type: none"> • Fan speed too slow • Obstruction in duct work • Inadequate return/distribution ductwork • Blower belt/filter/AC coil defective or dirty • Unit overfired • Dirty or defective blower 	<ul style="list-style-type: none"> • Set fan speed higher or replace motor • Remove obstruction • Install proper ductwork • Clean or replace belt/filter/AC coil • Adjust fuel pressure, change orifices • Clean or replace blower

Table 301-1.10a.ii Typical Solutions for Low Temperature Rise

PROBLEM:	CHECK FOR:	REMEDY:
Low Temperature Rise [<60°/PMI]	<ul style="list-style-type: none"> • Fan speed too fast • Excessive air flow from blower • Unit underfired • Low stack temperature (PMI) • Cycling on high limit 	<ul style="list-style-type: none"> • Set fan speed slower or replace motor • Adjust air flow or replace blower • Adjust fuel pressure or change orifices • Resize the vent pipe • Clean or replace blower, install more or larger duct work

CONTROLS 301-1.11

Replace defective fan/limit controls and test the new control after putting the unit into operation.

fan/limit control
301-1.11a

Move improperly located thermostats to an area free from drafts or heat from the heating system, lights, or appliances. Replace defective thermostats.

thermostat location
301-1.11b



thermostat replacement
301-1.11c

Adjust the heat anticipator in the thermostat to match the amp draw of the system controls.

heat anticipator
301-1.11d

*AUTOMATIC FUEL SAFETY SHUT-OFF 301-1.12***test gas valve**
301-1.12a

Test gas valves to ensure that, in the event of a pilot outage, the flow of gas to the burners is interrupted. For gas valves with 100% safety shutoff, ensure that the flow of gas to the pilot is also interrupted in the event of a pilot outage. Ensure that the tip of the thermocouple is enveloped by the pilot flame. Replace defective gas valves and thermocouples.

safety check
301-1.12b

Perform a safety check of the primary control and cad cell in oil fired units. Replace defective primary controls or cad cells.

*BOILER CONTROLS 301-1.13***boiler controls**
301-1.13a

Verify that boiler safety controls such as the low water cutoff, automatic water feed, relief valve and circulating pumps are functioning properly. Replace or repair any defective components.

*ELECTRIC FURNACES 301-1.14***sequencing**
301-1.14a

Check for proper sequencing and operation of elements. Replace defective elements and other defective components.

line voltage
301-1.14b

Check for adequate line voltage and correct as necessary.

*DISTRIBUTIONS SYSTEM 301-1.15***forced-air and gravity systems**
301-1.15a

Clean dirty blower motors, fans and belts. Inspect the blower for excessive free play and correct as necessary. Inspect the pulleys and drive assembly for wear, alignment and proper tension and correct as necessary. Inspect the motor bracket for tightness and alignment and correct as necessary. Lubricate the motor and motor bearing cups if necessary.

fan control
301-1.15b

Test the fan control to ensure that it is functioning properly. Set the fan "on" control to 110° F and the fan "off" control to 90° F after determining that the customer's life-style or this particular installation will permit these settings. Replace defective fan controls.

supply ducts
301-1.15c

Repair or replace any missing, loose fitting, blocked, leaky, or unsealed plenum or supply air ducts and seal with compatible duct sealing materials.

Repair or replace any missing, loose fitting, blocked, leaky, or unsealed blower compartment or return air ducts and seal with compatible duct sealing materials.

return ducts
301-1.15d

Install or replace missing or dirty return air filters. Instruct the customer on filter replacement.

air filters
301-1.15e

Insulate uninsulated duct work passing through non-conditioned areas so that the duct is completely covered and the insulation is not compressed. Terminate duct insulation at the floor register boots in such a manner that the register boot is completely covered and the duct insulation fits snugly against the floor. Secure sections of duct insulation with staples, straps, or wires and tape any exposed fiberglass.

insulate ducts
301-1.15f

Vacuum the heat transfer fins on electric baseboard units.

electric baseboard
301-1.15g

CEE

BOILER SYSTEMS 301-1.16

Repair any water leaks in the system.

water leaks
301-1.16a

Verify that the water circulation pump is properly activated by the aquastat. Set the pump “on” and “off” temperature according to manufacturer's recommendations.

aquastat
301-1.16b

Insulate supply and return water lines passing through non-conditioned areas with pipe insulation, ensuring that the pipes are completely covered. Secure pipe insulation with mechanical fasteners or tape.

insulate water lines
301-1.16c

Bleed any air from the distribution system. Assure that air vents and steam traps are properly functioning. Repair or replace defective vents or traps.

vents or traps
301-1.16d

Ensure that thermostatically-controlled zone valves are functioning properly. Repair or replace defective valves.

zone valves
301-1.16e

Adjust the aquastat high limit and pump control in accordance with manufacturer's recommendations. The maximum high limit setting is 250° F for steam and 200° F for hot water units.

aquastat high limit
301-1.16f

pump motor
301-1.16g

Lubricate the water circulating pump motor if necessary.

pressure relief valve
301-1.16h

Verify the presence and proper functioning of a pressure relief valve and repair, replace, or add one if necessary.

heat transfer fins
301-1.16i

Vacuum and clean heat transfer fins or radiators.

compression tank
301-1.16j

Check the compression tank for sufficient air pressure. Replace defective tanks.

CERTIFICATION 301-1.17

identification sticker
301-1.17

Once the unit has been serviced, the installer must place a sticker on the heating unit, in plain view, certifying that the system has been properly serviced. The sticker shall indicate the date of service, name of the service contractor and the phone number of the service contractor.