Data Collection
RESIDENTIAL AIR QUALITY ASSESSMENT

It is the intent of this procedure to thoroughly evaluate the residence where Carbon Monoxide levels are suspected of being present. Upon identifying potential problems when reviewing the worksheet results, it is then necessary to correct all of the potential sources in a professional manner.

Identified sources of elevated Carbon Monoxide levels originating from an appliance need to be reduced to minimal levels when measured within the flue pipe. Problems originated by the negative pressure condition of Backdrafting need to be eliminated entirely within the residence. If actual dedicated combustion air supplies do not exist to the appliances then adequate piping must be installed for this purpose.

Vent system problems which are identified within the worksheet must be repaired at once. The same priority must be attached to resolving problems identified as a result of negative pressures pulling combustion byproducts into the residence. Problems identified as being caused by leakage within the return air ductwork should also be promptly corrected as it may create a negative pressure condition.

Excess levels of Carbon Monoxide can be reduced within combustion producing appliances by cleaning and adjusting the burners to within 2% of the appliance rating plate.

If the procedure is above the dealers capabilities then a specialist who is trained and equipped for a total indoor air quality evaluation should be consulted to complete the study. It is hoped that a speedy qualified site evaluation will be made after having obtained the factual details of the outlined report. Do not assume that the problem lies within the furnace without having completed the thorough evaluation. To conclude incorrectly may result in the replacement of a good furnace prematurely.

Remember that when exposure to carbon monoxide is suspected the true effects on the occupants can only be measured accurately by requesting that they submit to a blood hemoglobin test to access the true level of exposure.

POTENTIAL CONTRIBUTORS TO CARBON MONOXIDE PROBLEMS

What is Carbon Monoxide? Carbon Monoxide is an invisible, odorless, tasteless, colorless gas created when fossil fuels burn incompletely. In the home, heating and cooking equipment are possible sources of carbon monoxide. Vehicles running in an attached garage could also produce dangerous levels of Carbon Monoxide.

The levels of pollutants from individual sources may not pose a significant risk to health by themselves. But most homes have more than one source that contributes to indoor air pollution. There can be a serious risk from the cumulative effects these sources. Fortunately, however, there are steps that most households can take both to reduce the risk from the existing sources and to prevent new problems from occurring.

Two related failures are required for carbon monoxide poisoning to occur:

First - Carbon monoxide must be produced at inappropriate levels.

Second - Carbon Monoxide disperses into the house instead of vent system.

Many things contribute to improper combustion and poor venting. Often heating systems have poor combustion or poor venting, but not both. Poor venting allows hazardous products of combustion into the living area AND MUST BE CORRECTED. Combustion products, including carbon dioxide, nitrogen dioxide, carbon monoxide, particulate matter, polycyclic aromatic hydrocarbons, and water vapor, if vented into the home, can cause health and moisture problems.

HEATING SYSTEM PROBLEMS.....

Dirty burner rust and dirt (producing large amounts of CO).
Poorly adjusted burner (producing large amounts of CO).
Opening to burner blocked.
Draft diverter knocked out of position on water heater.
Cracked or rusted out heat exchanger.
Improper orifice sizes for LP or natural gas.
Low flame, sooting conditions on burner.
Blocked flue passages in boiler, or other appliance.
Space heating with unvented appliance or other appliance.
Backdrafting of fireplace.
Excess manifold gas pressure, overfired condition with insufficient combustion air.

POTENTIAL CONTRIBUTORS CONTINUED

HOUSE AND FURNACE DEPRESSURIZATION.....

Kitchen exhaust fan — Bathroom exhaust fan
Leaky ceiling joints — Recessed ceiling lights
Fireplace — Furnace and water heater
Downdraft island cooking surface — Leaky air returns in furnace room
Too much return in basement — Open air return in furnace room
"Wild" returns to furnace open to furnace, (poor or incomplete ductwork).
Whole house fan — Attic Exhaust Fan

INSUFFICIENT COMBUSTION AIR TO FURNACE.....

Attic combustion air to closet furnace blocked off / obstructed.
Furnace within a closet with insufficient louvered door openings.
Furnace within a closet with solid door installed and no air ducts.
Combustion air openings not located high and low.
Combustion air openings (and make-up air) not sufficient in capacity.
Combustion air openings affected by wind and ineffective - or detrimental.
Combustion air openings not large enough to meet code.
(Minimum requirement is 2 holes equal to 100 sq inches).

DEFECTIVE VENT.....

Holes rusted through vent pipe.
Single wall vent pipe used where double wall needed.
Missing vent termination.
Disconnected Vent pipe

POTENTIAL CONTRIBUTORS CONTINUED

DEFECTIVE INSTALLATION OF VENT.....

Vent pipe too small. Vent pipe too large.
Insufficient rise Insufficient height
Insufficient distance above roof.
Reverse slope on vent Too much slope on manifold
Common vent interconnection too small.
Combined vents used when individual vents are better suited.
Connector length too long Offset length too long.
Available headroom not used effectively. Too many elbows.
Single wall vent up outside of house.
Double wall vent up outside of house.
Masonry chimney up outside of house.
Water heater alone in large vent or large brick chimney...oversized.
Unlined masonry chimney with failed mortar joints.....potential for leakage.
Improperly installed Type B vent.
Untaped seams on fan-forced vent systems.
Single vent for water heater and furnace when dedicated venting required.

IMPROPER LOCATION OF VENT:

on sidewall- under eave-
under deck next to combustion air
adjacent to fireplace chimney
on side of house which is in a high pressure area
on side of house which is against an adjoining building- -

POTENTIAL CONTRIBUTORS CONTINUED

VENTING PROBLEMS.....

Vented appliance not connected to vent.
Vent pipe pulled apart in basement, wall, or attic.
Vent pipe disconnected in remodeling and not reconnected.
Vent pipe blocked by new liner (new furnace and liner for masonry chimney, water heater on opposite side of chimney blocked).
Brick divider in brick chimney collapsed, blocked furnace vent.
Bird nest or animal in chimney.
Rust fell to bottom of vent, blocked furnace vent.
Debris fell to bottom of chimney, built up to level furnace vent creating blockage.

APPLIANCE PROBLEMS.....

Dirty standing pilot on gas stove / oven / water heater / furnace.
Gas stove operation without use of vented range hood.
Range hood vent blocked off and or never completed.
Space heating with oven.

OTHER POTENTIAL CAUSES.....

Automobile operating in attached garage.
Indoor use of charcoal grill.
Kerosene Heater use

COMMON SYMPTOMS AND EFFECTS OF CARBON MONOXIDE *

Headaches

Visual Problems

Temporary or permanent blindness

Dizziness

Trouble thinking

Speech disturbances

Memory impairment

Loss of consciousness

Gait disturbances

Hearing Loss

Minics flu-like viral illness

Shortness of breath

Weakness

Abdominal cramps

Symptoms are often vague and dependent on CO concentration, as well as the age, health, and gender of the person being affected.

Cell death from hypoxia and interference with cellular respiration

Disability or death from effects on the central nervous system.

Measurement of carboxyhemoglobin blood test needs to be sampled at the earliest opportunity to identify the potential effects of CO exposure.

RESIDENTIAL AIR QUALITY ASSESSMENT

The intent of this procedure is to establish worst-case conditions within the site and to assess possible sources of air contamination including gas fired appliances.

(Before proceeding verify that the following conditions have been set)

Conditions;

(1) Close all windows & doors external to the site / home.
(2) Close all interior doors
(3) Turn on all exhaust fans, kitchen & bathroom, clothes dryers, attic and whole-house fans along with the furnace fan.
(4) Shut off combustion appliances to allow flue(s) to cool to minimize draft then relight immediately prior to test.

STEP: A

(1) Administer some form of smoke into the appliances draft hoods and detail the results. Repeat the same smoke test near fireplaces, woodstoves, kerosene heaters, and barometric dampers recording results and observations for reference while evaluating conditions.

STEP: B

Measure and record Ambient Carbon Monoxide Level within site / home.

(1) Zero test equipment outside of home before entering to record data.
(2) Measure levels in all living areas, kitchen and appliance rooms / locations with all appliances in operation..
(3) Investigate CO levels above 2 PPM. Outside street traffic or location may be a source.

STEP: C

Survey Combustion Appliances within site / home.

Furnaces, water heaters, fireplaces, woodstoves, auxillary heaters, dryers, cooking stoves and ovens.

Detail and record the following information per each combustible appliance:

(1) Location, type & input of appliance.
(2) Presence of gas leaks, signs of spillage or flame roll-out.
(3) Location, size, operable condition of combustion air supply.
(4) Evidence of rusted interior surface of HX's.

STEP: D

Survey of Exhaust Fans.

(1) Location, type, systems, rated cfm.
(2) Location of vents termination.

STEP: E

Spillage test, checking for the existence of combustible byproduct spillage.

(1) With house set-up in worst case depressurization conditions, fire up each combustion appliance.

(2) If appliances are common vented, conduct test on smallest input appliance first, then test with both appliances running.

(3) When burner lights, check for flame rollout while standing away from burner.

(4) After 30 seconds of operation check spillage with smoke.

(5) **If spillage occurs, recheck for spillage every 60 seconds up to 5 minutes of operation.**

(6) **If spillage continues beyond 5 minutes, remove negative pressure in combustion room by opening a window or house exterior door.**

(7) **Re-check for spillage. If spillage stops, there is a pressure induced spillage problem. If spillage continues, check flue and chimney for obstructions, and check compatability of appliance BTU input with chimney size.**

WARNING:

Spillage of combustion products for more than 30 seconds is unsatisfactory.
If the problem is a blocked flue or chimney, or inadequately sized flue or chimney, consult a professional heating contractor.
If the problem is pressure induced, provide pressure relief. Re-check for spillage following attempt to add pressure relief.
If spillage continues, contact a professional heating contractor.

STEP: F

Combustion Safety Test after reviewing data from STEP B.

reviewing potential causes by checking for;

(1) Blocked or partially blocked chimneys
(2) Improper equipment installation
(3) Cracked heat exchangers
(4) Leaks in the venting system
(5) Leaks in the return air ductwork causing a negative pressure on the structure.
(6) Low stack temperatures
(7) Combustion appliance zone depressurization.
(8) Lack of adequate make-up combustion air.

STEP: G

Carbon Monoxide Test - Appliances

(1) After placing each gas fired appliance into operation for 5 minutes, measure the CO level in the flue. Repeat for each appliance.
(2) CO should be measured before appliance draft diverter / damper.
(3) For gas stoves, measure CO level over oven exhaust port, and 3 feet above all functioning burners. CO level should be below 50 PPM.
(4) If abnormal CO level is found in area of the stove, continue to remeasure CO level at 10 minute intervals until CO level reaches a stabilizing level.
(5) **Recheck all appliances after shutting off all exhaust fans and opening all interior doors for a comparison check versus the results with the fans on and doors shut.**

The presence of CO and spillage requires immediate remedial action.

STEP: H

Heat Exchanger Integrity Test

This test is used to determine if a crack or hole is present in the furnace heat exchanger. A crack or hole could allow products of combustion into the house, and / or promote carbon monoxide production through flame distortion and impingement.

(1) **Flame distortion test**

This test involves watching the furnace flame when the furnace blower initially starts. Any distortion of the flame indicates a hole or crack in the heat exchanger or the seal between the HX and the cell panel. Another method for conducting a flame distortion test is to slowly extend a match in and out of each combustion chamber with the burner off and the blower fan in operation, watching for movement of the flame head.

(2) **Blocked flue test**

With the furnace off, block the flue ports leading from the combustion chamber to the draft diverter or flue. Induce smoke into the combustion chamber and turn the blower motor on. Movement by the smoke would indicate a hole or crack in the heat exchanger.

(3)**Tracer Gas test**

A number of testing procedures exist for injecting a tracer gas into the combustion chamber with the furnace blower off and then measuring or detecting the tracer gas external to the heat exchanger. One such test method is the GRI (Gas Research Institute) 84 / 0162 documented method.

When administering this test to an induced draft appliance note;

"A method for detecting flue gas leakage through a furnace heat exchanger should not be administered at a pressure higher than is found under normal operating conditions." To do so may actually create a positive pressure within the HX while in normal operation the HX is under a constant negative pressure from the induced draft design.

WARNING

If any of the above heat exchanger tests provides a positive indication for a cracked heat exchanger, immediate action should be taken to notify the residents of the potential danger, and a professional heating contractor should be contacted.

STEP: I

Turn off fans and return appliance controls to original settings upon evaluations completion.

EVALUATION OF DATA FOR RESOLUTION

(WORKSHEET)

(1) **Detail results of smoke test as administered to appliances from Step A .**

	Good Draft	Poor Draft	No Draft
Furnace:	_____	_____	_____
Boiler:	_____	_____	_____
Water heater:	_____	_____	_____
Stove Burners:	_____	_____	_____
Oven:	_____	_____	_____
Fireplace:	_____	_____	_____
Woodstove:	_____	_____	_____
Kerosene Heater:	_____	_____	_____
Space Heater:	_____	_____	_____
Barometric Dampers	_____	_____	_____

(2) **Detail amounts measured as a result of Ambient Carbon Monoxide Level monitoring within all living areas within site / home as described in Step B.**

Individual Bedrooms:
(A).....
(B).....
(C).....
(D).....
Kitchen:.....
Living room:.....
Dining Room:.....
Bathrooms:.....
Appliance Rooms:.....
Makeup Combustion Air Piping:.....
Additional Room..Specify.....
Additional Room..Specify.....
Additional Room..Specify.....

(3) **Detail visual observations of each appliance per Step C.**

	Leaks	Rust	Spillage	Rollout

Furnace:	_____	_____	_____	_____
Boiler:	_____	_____	_____	_____
Water heater:	_____	_____	_____	_____
Stove Burners:	_____	_____	_____	_____
Oven:	_____	_____	_____	_____
Fireplace:	_____	_____	_____	_____
Woodstove:	_____	_____	_____	_____
Kerosene Heater:	_____	_____	_____	_____
Space Heater:	_____	_____	_____	_____
Barometric Dampers:	_____	_____	_____	_____

(4) **Detail all Exhaust Fans per Step D.**

(A)
(B)
(C)
(D)

(5) **Detail initial spillage tests conducted on all appliances per Step E**

	Spillage Detected	**No Spillage**
Furnace:	_____	_____
Boiler:	_____	_____
Water heater:	_____	_____
Stove Burners:	_____	_____
Oven:	_____	_____
Fireplace:	_____	_____
Woodstove:	_____	_____
Kerosene Heater:	_____	_____
Space Heater:	_____	_____
Barometric Dampers:	_____	_____

(6) **Detail any re-check testing conducted on any appliance that required a second test with the site / home opened to eliminate DEPRESSURIZATION of the structure undoing sequence in Step A , (1-3).**

Furnace: _____

Boiler: _____
Water heater: _____
Stove Burners: _____
Oven: _____
Fireplace: _____
Woodstove: _____
Kerosene Heater: _____
Space Heater: _____
Barometric Dampers: _____

(7) **Detail any potential CO causes found in Step F along with noting corrective action taken or planned.**

(A) Blocked or partially blocked chimneys

(B) Improper equipment installation

(C) Cracked heat exchangers

(D) Leaks in the venting system and or chimney

(E) Leaks in the return air ductwork causing a negative pressure on the structure.

(F) Low stack temperatures

(G) Combustion appliance zone DEPRESSURIZATION.

(H) Lack of adequate make-up combustion air.

(8) **Detail results of each appliance's Carbon Monoxide Test performed in Step G.**

Furnace: _____
Boiler: _____
Water heater: _____

Stove Burners: _____
Oven: _____
Fireplace: _____
Woodstove: _____
Kerosene Heater: _____
Space Heater: _____
Barometric Dampers: _____

(9) **Detail results of each appliance's Carbon Monoxide Test performed in Step G without exhaust fans operating or inner doors opened.**

Furnace: _____
Boiler: _____
Water heater: _____
Stove Burners: _____
Oven: _____
Fireplace: _____
Woodstove: _____
Kerosene Heater: _____
Space Heater: _____
Barometric Dampers: _____

(10) **Detail results of the furnace or boiler Heat Exchanger Integrity test as explained in Step H (1-3).**

(A) Flame Distortion Test Observations

(B) Blocked Flue Test

(C) Tracer Gas Test