SCOMM

#50:32

STATE OF ALASKA 1986 LEGISLATIVE SESSION
FISCAL NOTE

Revision Date : 01/28/86

REQUEST

Bill Resolution No. : HB 479
Title : An Act Relating to Biomass Fuel Systems

Sponsor : Representative Duncan
Requestor : House Labor & Commerce
Date of Request :

FISCAL DETAIL

Agency Affected : Commerce & Economic Dev.
BRU : Investments

Components : Economic Development

EXPENDITURES/REVENUES : (Thousands of Dollars)

OPERATING	FY 86	FY 87	FY 88	FY 89	FY 90	FY 91
PERSONAL SERVICES						
TRAVEL						
CONTRACTUAL						
SUPPLIES						
EQUIPMENT						
LAND & STRUCTURES						
GRANTS, CLAIMS						
MISCELLANEOUS						
TOTAL OPERATING	-0-	-0-	-0-	-0-	-0-	-0-
CAPITAL	-0-	-0-	-0-	-0-	-0-	-0-
REVENUE	-0-	-0-	-0-	-0-	-0-	-0-

FUNDING : (Thousands of Dollars)

GENERAL FUND						
FEDERAL FUNDS						
OTHER						
TOTAL						

POSITIONS :

FULL-TIME						
PART-TIME						
TEMPORARY						

ANALYSIS : Attach a separate page if necessary

It is anticipated that any new loan demand created as a result of HB 479 will be absorbed within the existing funding available under the Alternative Energy Loan Program. New loan application processing will also be absorbed by existing staff within the division.

Paul B. Arnoldt

Prepared by : Paul B. Arnoldt, Director Phone : 465-2510
Division : Investments Date : 1/28/86

Approved by Commissioner : for Loren H. Lounsbury Date : 1/28/86
Agency : Commerce & Economic Development

Distribution (by Agency preparing fiscal note) :
- Legislative Finance
- Legislative Sponsor
- Requestor
- Office of Management and Budget
- Impacted Agency(ies)

10 25 85

Utermohle
1/29/86

Original sponsor: Duncan

IN THE HOUSE

BY THE LABOR AND COMMERCE COMMITTEE

CS FOR HOUSE BILL NO. 479 (L&C)

IN THE LEGISLATURE OF THE STATE OF ALASKA

FOURTEENTH LEGISLATURE - SECOND SESSION

A BILL

For an Act entitled: "An Act relating to biomass fuel systems."

BE IT ENACTED BY THE LEGISLATURE OF THE STATE OF ALASKA:

* Section 1. AS 45.88.500(a) is amended to read:

(a) In this chapter, "alternative energy system"

(1) means a source of thermal, mechanical, or electrical energy which is not dependent on oil or gas or a nuclear fuel for the supply of energy for space heating and cooling, refrigeration and cold storage, electrical power, mechanical power, or the heating of water;

(2) includes

(A) an alternative energy property as defined by 26 U.S.C. 48 (1)(3)(A), (Sec. 301, P.L. 95-618, Internal Revenue Code);

(B) a method of architectural design and construction which provides for the collection, storage, and use of direct radiation from the sun;

(C) a woodstove with a catalytic converter, [OR] a catalytic converter for a wood stove, or a catalytic fireplace insert; [AND]

(D) a steam, hot water, or ducted hot air central heating system that uses wood or coal for fuel; and

(E) a stove or furnace that uses biomass fuel produced from any organic matter that is available on a renewable basis, including agricultural crops and agricultural waste and residue, wood waste residue, animal waste, municipal waste, and aquatic plants;

(3) does not include, unless described in (2)(C) of this subsection,

(A) a stove that uses only firewood [WOOD], coal, or oil for fuel; or

(B) a fireplace or fireplace insert.

HB 475, cont'd

Introduced Jan. 15, and referred to the State Affairs and Finance Committee.

Insurance Rate Hike (notice)

HOUSE BILL 476, by Rep. M.M. Miller by request. Requires an insurer who increases premium or adds a surcharge to an auto insurance policy because of an accident in which the insured or a person covered by the policy was at fault to give written notice of the increase or surcharge at least 15 days before it takes effect, stating the reason for the change and the right of appeal.

Introduced Jan. 15, and referred to the Community and Regional Affairs and Judiciary Committees.

Energy Funding

HOUSE BILL NO. 477, by the Rules Committee by request of the Governor. See SENATE BILL 347, page 14, identical.

Introduced Jan. 15, and referred to the House Special Loans and Finance Committees.

Moose Hunting (stamp)

HOUSE BILL NO. 478, by Martin. Requires the Dept. of Revenue to establish a moose habitat conservation stamp program similar to the one established for waterfowl, and to set aside receipts in the fish and game fund to be used for enhancement and maintenance of moose habitat in the state.

Introduced Jan. 15 and referred to the Resources and Finance Committees.

Energy Loans

HOUSE BILL NO. 479, by Rep. Duncan. Adds to those alternative energy and heating systems which are eligible for alternative energy loans systems which use biomass fuel produced from any organic matter that is available on a renewable basis, such as agricultural crops, waste and residue, animal waste, municipal waste and acquatic plants.

Introduced Jan. 16 and referred to the Labor and Commerce, Loans and Finance Committees.

Corporal Punishment (prohibited)

HOUSE BILL NO. 480, by Reps. Koponen and Davis. Prohibits anyone employed by a private or public school from inflicting corporal punishment or bodily pain on a student; permits the use of reasonable and necessary restraint on a student to protect the student or others from physical harm, to obtain possession of a dangerous weapon or object, or to protect property from serious harm.

Introduced Jan. 16, and referred to Health, Education & Social Services and State Affairs Committees.

ıot know it. It's real easy nd with blasting caps," he

caps are small metalic few inches in length, usu- :d to a length of electrical red is suggesting Juneau :p an eye open for such heir homes. If a blasting d, Windred recommends police to remove it.

led police to several sting caps and containers dynamite stored in the d Windred. Other explosive material was found following a search of a suspect's bedroom, he said.

According to Windred, the stolen blasting caps may be linked to a series of unexplained explosions in recent months. On Dec. 29, a door at Floyd Dryden Middle School was blown open with blasting caps. Several area mail boxes may also have been blown up with the stolen material, he said.

Police are investigating possible violations of laws regulating storage of explosives at the suspect contractor's work site. Police will not release the name of the contractor under investigation until charges are filed, Windred said.

Meanwhile, two Juneau teenagers are expected to be charged with misconduct involving a weapon in the first degree following the investigation into last Friday's bomb threat at the high school.

According to police, a 14-year-old student allegedly brought the explosive materials to the school to sell or give to a 17-year-old male student. Police have not identified the person who made the threat.

"Quite a few kids knew this transaction was going to take place," said Windred.

The threat resulted in the closure of the high school and adjoining Marie Drake Middle School. Students were sent home after a search located a bag containing four blasting caps and a two-and-a-half pound container of gelatine dynamite in an unassigned high school locker.

The material was removed from the school without incident.

ASSOCIATED PRESS

ɜion may be cut short.

launch window of only a nents of the current mis- mbitious schedule of 15

Please turn to Page 14

New law allows use of some wood stoves during air alert

Ordinance changes how burning bans are called

By BETSY LONGENBAUGH
THE JUNEAU EMPIRE

There's new hope on the horizon for local residents who want to keep their wood stoves burning all winter.

Beginning Wednesday, local residents who own stoves that meet Juneau City-Borough emission standards may keep their fires burning during wood smoke alerts.

In the belief that the approved stoves won't let smoke get in your eyes, the Juneau City-Borough Assembly recently approved an ordinance that allows the stoves to burn and sets up new criteria for declaring wood smoke bans.

That new criteria calls for two types of wood smoke bans – a wood smoke alert and a wood smoke emergency. Under an alert, owners of approved wood stoves who have municipal permits may continue to burn. Under an emergency, no wood stoves are allowed to burn.

Steve Gilbertson, the municipal lands and resources manager, is in charge of monitoring the air quality of Mendenhall Valley and enforcing the new ordinance. He said Friday he hopes that only air alerts will occur in the future, with air emergencies necessary in the event of extreme pollution in the valley.

"I think people have to realize this is at an experimental stage," he added.

Gilbertson also said his office now has applications for people who own approved wood stoves. In order to use those stoves during alerts, they must have permits

Please turn to Page 14

Lemon Creek vicinity to be monitored for wood smoke

THE JUNEAU EMPIRE

Lemon Creek residents may want to buy warm slippers for next winter, as their neighborhood will probably end up being subject to its own wood stove bans.

The Lemon Creek area is one place that will feel the impact of a comprehensive ordinance regulating wood stove use that was approved by the Juneau City-Borough Assembly several weeks ago.

At the urging of some assembly members, municipal staff agreed to begin monitoring the Lemon Creek area with an eye to regulating wood stove use. This winter, however, there isn't the necessary equipment in the area to effectively measure wood smoke pollution.

In next year's municipal budget, staff will be seeking $25,000 to buy a wood smoke monitor for the area. Once installed, the device will allow municipal officials to call for wood smoke bans in Lemon Creek, as well as the Mendenhall Valley.

Steve Gilbertson, lands and resources manager, said he expects the municipality may call separate wood smoke bans in each area, depending on weather conditions. He said it is now impossible to predict how often bans may be necessary in Lemon Creek.

"We do not have a lot of data for the area," said Gilbertson.

He added, however, that his office has received a lot of calls from Lemon Creek area residents who complained of wood smoke pollution.

The new proposed smoke alert area in Lemon Creek extends from the Juneau Christian School, including

Please turn to Page 14

WEATHER

Rain showers continuing through Tuesday, Page 14

Juneau Empire 1-13-86

!NCIL

ard of trustees of Juneau Arts nities Council will meet at 7:30 Northern Light United Church. mbers and interested persons to attend.

STAR

ineau Lodge No. 147, F. and meet at 7:30 tonight. All Masons are urged to attend.

D

ins of practically any skill level re enthusiastic about forming a of Alaska-Juneau pep band are ontact the UAJ office of student t 789-4528.

RESSURE

ood pressure testing will be con- the Mountain View Senior Cen- 1:30 a.m. to 1:30 p.m. Tuesday. ment is necessary. Call 586-3736 formation.

S

g set off in the Cedar Park area. ere set on fire.

tip

irefighters are reminding resi- every home should have at least xtinguisher and everyone in the uld know how to use it. The Gla- nteer Fire Department offers s on use of fire extinguishers. ation, call 789-7554.

ance calls

Volunteer Fire Department services teams responded to ver the weekend:

cal call: At 9:49 a.m. Friday, itient, stable, transported to morial Hospital.

vehicle accident: At 10:06 p.m. gan Drive and the Mendenhall , injuries minor, both patients nsport.

na calls: At 2:29 a.m. Saturday, , no transport; at 11:51 a.m. ild choking, mother dislodged the child was stable and taken ital by the family; at 2:01 a.m. or cuts, patient taken to the hos-

Volunteer Fire Department services teams responded to er the weekend:

al calls: At 9:34 a.m. Friday, a ient, stable, transported to the t 11:48 a.m. Sunday, no details . patient stable, transported to il; at 2:50 p.m. Sunday, patient minal pain, stable condition, d to hospital.

Woodsmoke...

Continued from Page 1

from the city. The free permits are good for two years.

Gilbertson said the approved wood stoves have two things in common – very low emission standards and certification from Oregon.

Because the municipality is basing its new ordinance on a similar law in Oregon, it is accepting that state's testing procedures for wood stoves.

Many of the approved stoves – there are now 10 on the list – have catalytic converters. Others use pellet fuel to reach the low emission standards.

Gilbertson said at least four other stoves, some of which are for sale locally, have gone through the tests, but are not yet certified. He said he expects a new list from Oregon by the end of this month.

Until then, he said he can only recommend the 10 stoves on the approved list. They are:

- Blaze King "King," a catalytic converter stove.
- Earth Stove 1000-C, a catalytic converter stove.
- Turbo 10, a catalytic converter stove.
- Fisher Tech IV, a catalytic fireplace insert.
- Timber Eze 477, a catalytic wood stove.
- Vista 640, a non-catalytic wood stove.
- Pellefier FS-1, a non-catalytic stove that burns pellet fuel.
- Whitfield, a non-catalytic stove that burns pellet fuel.
- Collins Hopper, an add-on devise that burns pellet fuel.

Those wood stoves that are on this list and sell locally cost about $1,000, not including installation.

The assembly hopes to eventually have all stoves in the city-borough meet the emission standards. To meet this goal, the new ordinance calls for all wood stoves installed and sold in Juneau to meet the Oregon emission standards beginning Aug. 1.

Gilbertson expects the most successful enforcement of this new regulation to come from the building department, which issues permits for wood stove installations.

Steve Shows, who assigns building inspections, said a building permit is required for any new installation, including replacement of an existing stove. The permits and their accompanying inspections are free and are designed to make sure wood stoves are safely installed, he said.

"Home owners are sometimes not getting a building permit and installing a stove, sometimes properly, sometimes not," he said.

During the past year, the municipality has been aided in its inspection effort by some insurance companies who now require proof of wood stove inspections before offering insurance, said Shows.

"This is the greatest plus we have seen," he said.

Shows said that "nine times out of 10," wood stoves that are inspected were installed incorrectly.

He said that currently he is able to schedule inspections with a day's notice. Those who want inspections should call a 24-hour recording phone 586-1703, before 7:30 a.m. on the day they want an inspection.

To receive a permit, they should come into the municipal building department and fill out a form. They will also receive a brochure on proper stove installation.

Lemon Creek...

Continued from Page 1

Sunny Point, back to Lemon Creek basin and to Vanderbilt Hill.

Gilbertson also said many Juneau residents remain unclear about where the boundaries are for the Mendenhall Valley wood smoke alert area.

They could be described as having a southern boundary of the airport area, an north boundary of the glacier recreational area, an east boundary running along the base of Thunder Mountain and a west boundary that bisects the Mendenhall Peninsula.

Not included in the ban are the Auke Lake area and Fritz Cove Road.

Shuttle...

Continued from Page 1

The flight plan today was devoted mainly to astronomy, and Steve Hawley spent the morning pointing two ultraviolet telescopes at star targets in a search for luminous clouds of ultraviolet radiation.

Mission Control awakened the astronauts today with the theme song from the movie "Animal House." The control center said several of the astronauts were fans of the movie, and commander Robert Gibson responded, "It sounds like our secret is out."

Columbia shed its postponement jinx with a spectacular predawn liftoff Sunday, and 9½ hours later the crew launched the world's most powerful commercial communications satellite, RCA's $50 million Satcom KU-1.

"It's on its way," Mission Control radioed after a rocket engine ignited to propel the satellite toward stationary orbit 22,300 miles above the Earth.

RCA, which paid the National Aeronautics and Space Administration $14.2 million for the delivery, said Satcom will be capable of providing video and audio communications for all of the United States except Alaska, transmitting a signal powerful enough to be received by dish antennas as small as three feet.

Nelson and Hawley will have an exclusive view of the comet as it nears the sun on its once-every-76-years swing through this part of the solar system.

"You can't observe Halley's from the ground as it makes its closest approach to the sun in January because of the sun's brightness," explained S. Alan Stern of the University of Colorado, who is principal investiga-

Nelson, who will operate the CHAMP cameras, said in an interview before the flight, "We'll be taking some photographs and spectral measurements for the purpose of documenting the comet, and we'll be doing it from above the atmosphere where we can get a real clear look at it. We're going to use the apparatus over the course of three flights, so we should be able to get a good consistent set of data on Halley's."

Stern said the instruments "primarily will be looking at water. The comet is basically an ice ball, and when the sun melts the ice, it breaks the water down into constituents. We'll study these to learn about the comet's atmosphere."

Hawley will use two telescopes to search the universe for sources of luminous clouds of ultraviolet radiation.

"Only in the last 10 years have we begun to look at the universe in the ultraviolet wavelength," he said before the mission. "The reason for that is that the observatories on Earth being beneath the atmosphere are not able to observe these wavelengths because the atmosphere is opaque to UV radiation. So we'll be getting some very fundamental data and will be dealing with questions as to where the UV emission comes from."

He said the knowledge would help astronomers mask out the UV background and thus improve the data from the $1.2 billion Hubble Space Telescope, which will be launched from a shuttle next October.

One of the telescopes also will be trained on the comet.

Rep. Bill Nelson, a Florida Democrat riding as a con-

RECEIVED
JAN 6 1986

January 3, 1986

Senator Bill Ray
Representative Duncan
Representative Miller
P.O. Box V
State Capitol
Juneau, Alaska 99811

Re: State of Alaska
Alternative energy Loans

Dear Senator and Representatives:

We are soon providing an alternative to wood burning stoves in the Juneau area and I understand that this is presently available in Anchorage.

Our product is a pelletized wood and other fuel which burns in specially constructed stoves and burns smoke free.

I am enclosing a couple of articles for your further information.

To meet new ordinances in Juneau, many people will have to replace their wood burning stoves.

I understand that under present law, Alternative Energy Loans are available for catalytic equipped wood stoves, or catalytic converters.

Therefore it would be appreciated if the present law could be amended to authorize loans for biomass pellet fuel burning stoves or furnaces.

Steve Gilbertson, Juneau's Air Quality Control Officer, advised me that he and D.E.C. officials are in favor of this amendment.

I believe the law in question is included in A.S.45.88.010:500.

If you would like further information regarding this, I will be happy to discuss what I have with you.

Thanking you in advance for your consideration.

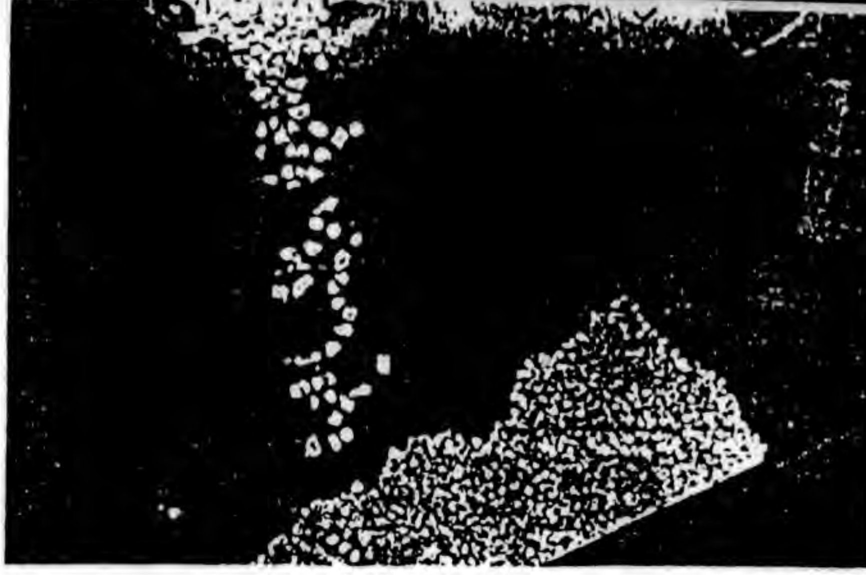
Very truly yours,

Larry Traeger

Larry Traeger
546 Hemlock
Juneau, Alaska 99801

Phone: 586 3250

Heating homes with pellets



Mount Angel manufacturer designs and sells innovative, affordable furnaces

By DALE STOWELL
Of the Independent

MOUNT ANGEL — Randy Traeger shrugs as he considers the complexity of his pelletized wood burning furnace designs.

"To me, it don't look like nothing super," he says. "Once you've horsed around with it for 15 years, it doesn't seem like that much."

But he seems to know he's on to something as he cites statistics that indicate his wood furnaces burn cleaner than do natural gas or oil furnaces for as little as half the cost for fuel.

Traeger, owner and president of Traeger Industries, has been designing woodstoves and furnaces for more than 20 years and is optimistic that his latest design will catch on.

The fuel source is the most novel aspect of the new furnaces, which have been on the market since fall. Biomass pellets, produced from waste products such as pine shavings or rye stubble, are what the newly designed heating devices consume.

One ton of pellets, which costs about $100, produces as much heat as two cords of wood but leaves substantially less waste. About 6 of one percent of the pellets remain as ash — approximately two gallons of ash per ton of fuel.

During cold weather, the average home requires about one 50 pound bag per day, Traeger estimated. Average yearly consumption would be in the neighborhood of four tons, he added.

Traeger's thermostatically-controlled stove and furnace designs also attempt to transfer all of the heat produced in the units to the space in the home to be heated.

And Traeger points out another advantage to the pellet-burning systems. "They burn clean. There isn't any smoke. You can stick your nose right in the (smoke)stack."

The major drawback is availability of fuel. Traeger has several hundred tons of it stockpiled to meet the needs of customers who have purchased pellet-burning equipment. It isn't readily available anywhere else in the area.

The fuel, which resembles rabbit food pellets, has existed for several decades, Traeger said. But companies producing it have come and gone due to a lack of demand.

Randy Traeger (above) has designed and is marketing heating systems which burn pine pellets (top photo). Traeger says the new heating units burn cleaner than gas or oil at nearly half the cost for fuel. (Photos by Dale Stowell)

"There's been several plants that have been around and gone broke," he said. "There's the concept of making pelletized fuel. That's fine. But you've got to have something to burn it in. Most of them are looking at commercial applications, but a commercial application can dry up on you very quickly — just a little change in price and they'll switch from one (fuel) to the other."

Before Traeger's design, availability of fuel wasn't the only problem in home-heating pellet applications. In earlier designs, the pellets didn't burn completely, and the furnace fire would sometimes burn back into the fuel [illegible]

Traeger cured the problems without kno[illegible] what caused them in other furnaces. "I really didn't look at anybody's design," he said. "I never paid any attention to them. There's no use in reinventing the wheel over again. It was a matter of taking it apart and putting it together again, taking it apart and putting it together again."

After Traeger put it together again, and it worked to his satisfaction, he began developing different home heating uses. His designs range from an indoor furnace that produces nothing but home heat, to an outdoor "pellet pump" that will provide heat for home, hot water and even clothes drying. All of the Traeger Industries products are built at the company shop in Mount Angel.

The furnaces are also outside of Department of Environmental Quality regulations that apply to woodstoves. Traeger predicts that many wood stove manufacturers will be forced out of business by continued tightening of regulations for testing and emissions. However, he added, pellet-burning furnaces would pass even the most stringent DEQ requirements.

Traeger knows of only five other pelletized-fuel furnace manufacturers in the country, but believes that the heat-producing devices will increase in popularity in time.

He points to the state of Minnesota as an example of forward thinking about the new heating concept. Traeger, as well as other pelletized-fuel furnace manufacturers, recently donated equipment to the state as part of a Minnesota low-income heating assistance program. The state will pay for installation of the furnaces.

"The concept is, if they give people pelletized fuel, they can heat twice as many homes for the same cost as supplying them money to buy natural gas or oil," Traeger said.

According to Traeger, Minnesota also has state funds available for research and development of pelletized-fuel manufacturing and use. "They're just out after it," he said. "They're way ahead of everyone else."

Back home, Traeger said sales of the new furnaces have been good — almost better than he's wanted them to be. "I really want to go through the winter just testing it, getting a few out," he said. "It's kind of run away from us. It's been super good."

RECEIVED
JAN 1? 1987

STATE OF ALASKA
THE LEGISLATURE

POUCH Y STATE CAPITOL
JUNEAU, ALASKA 99811
907 465 3800

LEGISLATIVE AFFAIRS AGENCY

M E M O R A N D U M January 13, 1986

SUBJECT: Alternative energy loans for biomass fuel stoves (Work Order 14-1546)

TO: Representative Jim Duncan

FROM: George Utermohle
Legislative Counsel

I.

The draft bill that you requested is attached. The bill amends the definition of "alternative energy system" to expressly include stoves and furnaces that use biomass fuels. The effect of this amendment is to allow the Alternative Energy Revolving Loan Fund to make loans for the purchase of biomass fuel stoves and furnaces.

II.

You also asked whether the Alaska Industrial Development Authority (A.I.D.A.) can aid processors of biomass fuels.

In brief, A.I.D.A. does have the power to make loans, to insure loans, and to assist private lenders to make loans to processors of biomass fuels.

A.I.D.A. was created to provide means of financing and means of facilitating financing for

> the establishment, operation, and development of industrial, manufacturing, and business enterprises, including, without limitation, facilities for transportation, facilities for pollution control and waste disposal, facilities for the local furnishing of gas, facilities for water, facilities for industrial parks, mass commuting vehicles, facilities for local district heating or cooling, parking facilities, or a storage or training facility relating to a plant or facility. (AS 44.88.010(a)(5))

The list of facilities eligible for assistance is only illustrative and in no way restricts the kinds of projects that A.I.D.A. can support.

Provided that a project is located in Alaska and will generate additional employment, A.I.D.A. has the authority to insure loans, to make loans, or to assist private lenders in making loans for the project (AS 44.88.080(12),(13), and (15)). A.I.D.A. defines "project" to include

(A) a plant or facility used or intended for use

(i) in connection with making, processing, preparing, or producing in any manner, goods, products or substances of any kind or nature or in connection with developing or utilizing a natural resource, or extracting, smelting, transporting, converting, assembling or producing in any manner, minerals, raw materials, chemicals, compounds, alloys, fibers, commodities and materials, products or substances of any kind or nature;

(ii) as an industrial park; in connection with transportation; for the prevention, limitation or control of pollution; for the disposal of sewage or solid waste; for the local furnishing of gas; for the furnishing of water; as or in connection with mass commuting vehicles; for local district heating or cooling; as a parking facility; or as a storage or training facility directly related to a plant or facility described in this paragraph;

(B) a plant or facility used or intended for use in connection with a business enterprise;

(C) commercial activity by a small enterprise; (AS 44.88.220(8))

This definition is broad enough to cover the facilities and equipment necessary to manufacture or produce any form of biomass fuel.

Therefore, processors of biomass fuels are eligible to apply for loans from A.I.D.A. No amendment of the Alaska Industrial Development Authority statutes is necessary.

GU:mkr
M2:020
Enclosure

APPENDIX 1

OREGON DEPARTMENT OF ENVIRONMENTAL QUALITY

STANDARD METHOD FOR MEASURING THE EMISSIONS AND EFFICIENCIES OF RESIDENTIAL WOODSTOVES

June 8, 1984

85-7-

TABLE OF CONTENTS

SECTION 1: SCOPE AND PURPOSE

1.1 SCOPE

1.1.1 This document prescribes a standard method of testing woodstoves to obtain particulate emission factors based on useful heat output for appliances that produce less than 1.5 x 10^5 Btu/hr.

1.1.2 A woodstove is defined as a woodfired appliance with a closed fire chamber which maintains an air/fuel ratio of less than 30 during the burning of 90 percent or more of the fuel mass consumed in the low firing cycle. The low firing cycle means less than or equal to 25 percent of the maximum burn rate achieved with doors closed or the minimum burn achievable, whichever is greater.

1.2 PURPOSE

1.2.1 The purpose of this document is to:

a. Establish a uniform procedure for appliance operation to be used in conjunction with a standardized test method for obtaining woodstove emission and efficiency performance data.

b. Specify the types of test equipment and establish standard performance requirements for the equipment used for performing such tests.

c. Specify data required and calculations to be used.

1.3 METHOD FOR USING THIS STANDARD

1.3.1 Determine from Section 1.1.1 and 1.1.2 whether this standard is applicable for the appliance to be tested.

1.3.2 Verify that the test facility and equipment is in accordance with Sections 2 and 3.

1.3.3 Test and calculate results in accordance with Sections 5, 6, and 7.

SECTION 2: TEST FACILITY AND APPLIANCE INSTALLATION

2.1 DESCRIPTION OF TEST FACILITY

2.1.1 The testing will be conducted in an area with a height for atmospheric discharge of flue effluent at 15 ± 1 foot (4.6 ± 0.3m) above the top surface of the scale.

2.1.2 The flue exit shall freely communicate with the laboratory, that is, the area shall have essentially the same pressure such that no artificial draft is imposed on the appliance.

2.1.3 The test chamber room temperature shall be maintained between 65° F and 90° F (18° C and 32° C) during the course of any test.

2.1.4 Air velocities within 2 feet (0.6m) of the test appliance and exhaust system shall be less than 50 feet/minute (0.25 m/s) without a fire in the unit.

2.1.5 All calorimeter rooms must meet the specific criteria in the June, 1982 Wood Heating Alliance document, Standard for Testing the Heating Performance of Wood-Fired Closed Combustion Chamber Heating Appliances, for accuracy verification and calibration procedures before conducting appliance performance testing.

2.2 APPLIANCE INSTALLATION FOR FREE STANDING STOVES

2.2.1 Unless specified differently by the manufacturers, the flue pipe shall be made of No. 24 gauge black steel and shall have an insulated metal solid pack type chimney above the particulate and combustion gas sample probe port locations with a minimum 1 inch (2.5 cm) solid pack material.

2.2.2 The flue shall extend to 15 ± 1 feet (4.6 ± 0.3m) above the platform scale on which the appliance is located. All flue pipe cracks or joints shall be sealed.

2.2.3 The appliance and parts shall be assembled and installed in conformance with the manufacturer's published installation instructions.

2.3 APPLIANCE INSTALLATION FOR FIREPLACE INSERTS

2.3.1 Fireplace inserts shall be installed on the platform scale with R 12 insulation applied to all surfaces not normally exposed to the room to be heated. The appliance parts and exhaust system shall be assembled and installed in conformance with the manufacturer's published installation instructions.

2.3.2 The flue pipe shall consist of an insulated metal solid pack type chimney positively connected from the appliance flue outlet, extending to the particulate and combustion gas sample probe port locations with a minimum 1 inch (2.5 cm) solid pack material.

SECTION 3: TEST EQUIPMENT AND INSTRUMENTATION

3.1 TEST EQUIPMENT SET-UP

3.1.1 The equipment to be used for emissions and efficiency testing is illustrated in Figure 3.1 and described below.

3.2 TEST FUEL WEIGHT

3.2.1 The balance used to weigh the fuel shall be accurate to ± 0.1 pound (0.05 kg).

3.2.2 The appliance to be tested shall be centrally placed on a platform scale. The scale shall have a monitor or other feature such that the weight change of the fuel loads may be continuously displayed. The scale shall be capable of reading weights to 0.1 pound (0.05 kg) and shall have a tare feature.

3.3 FLUE GAS TEMPERATURES

3.3.1 Flue gas temperatures shall be determined with a thermocouple or other temperature sensing device at a height of 8 to 9 feet (2.4 - 2.7 m) from the top surface of the scale. The temperature sensing device shall be located in the center of the flue gas stream.

3.3.2 The temperature sensor and associated display and recording equipment shall have a resolution of 1°F (0.5°C).

3.4 STOVE SURFACE TEMPERATURES

3.4.1 Stove surface temperatures shall be determined with a shielded temperature sensing device placed at 5 locations on the appliance's exterior surfaces. Temperature locations shall be centrally positioned on the top, two sidewall, bottom and back combustion chamber surfaces (not on heat shields) if these surfaces are exposed while testing. Surface temperature locations for unusual design shapes (spherical, etc.) shall be positioned to conform to the intent of the locations described.

3.4.2 The temperature sensing device and associated display shall have a resolution of 1°F (0.5°C).

3.5 STOVE COMBUSTION TEMPERATURES

3.5.1 Radiation shielded thermocouple(s) or other equivalent temperature sensing device(s) shall be located in the primary and secondary (if applicable) combustion chambers to measure gas temperatures at a location where direct flame impingement on the sensing device does not normally occur. If a catalytic combustor is part of the stove's combustion features, an additional thermocouple must be located in the permanent temperature monitoring port required in Section 8.4.1.

3.5.2 The temperature sensing devices and associated display shall have a resolution of 1°F (0.5°C).

3.6 FLUE GAS COMPOSITION

3.6.1 Dry flue gas composition shall be measured with continuous combustion gas analyzers to include percent by volume (dry basis) carbon monoxide, carbon dioxide, and oxygen. Samples shall be extracted at the same height as flue gas temperature measurements and withdrawn through a probe and tubing made of inert materials. The probe shall be bent into the flow of the flue gases.

3.6.2 A gas stream sample conditioner using a glass fiber filter is required in line before the analyzer. The sample conditioner shall include two impingers encased in an ice bath, one water trap and a silica gel trap in sequence.

3.6.3 Minimum performance specifications for accuracy and precision for the combustion gas analyzers and recorders include:

Drift $\leq$ ± 1% of full scale per 8 hours
Repeatability ± 1% of full scale
Resolution: 0.1% for CO_2 and O_2; 0.01% for CO by volume
Accuracy: ± 1% of scale

3.7 TRACER GAS DETECTOR

3.7.1 Minimum performance specifications for accuracy and precision for the tracer gas analyzer include:

Drift $\leq$ ±5% of full scale per 8 hours
Repeatability ± 2 percent of full scale
Accuracy ± 3% of scale

3.8 FLUE MOISTURE CONTENT DETERMINATION

3.8.1 A wet bulb-dry bulb technique shall be used to determine the water vapor present in the flue gases for on-line sampling purposes to maintain proportional sampling and appropriate weighting of enthalpy losses during burn cycle. A wet bulb temperature sensor shall be placed at the same location as the flue gas dry bulb temperature sensor. The wet bul sensor shall consist of a thermocouple or other temperature sensing device with a cloth sock placed at the sensor end and saturated with water. The wet bulb sensor shall be placed in the center of the flue gas stream until the temperature reaches a steady state. The wet bulb temperature must be taken while the sock is saturated with water. The appropriate water vapor content is determined using psychometric charts (See Oregon Source Sampling Method 4, Appendix 1).

3.9 DRAFT

3.9.1 The draft or static pressure (in inches of water) shall be measured in the flue at a location no greater than 1 foot (30.5 cm) above the flue connector at the stove outlet.

3.10 RELATIVE HUMIDITY

3.10.1 The test facilities ambient relative humidity shall be measured and recorded prior to and at the completion of each test cycle.

3.11 DATA RECORDING INTERVALS

3.11.1 Data recording shall commence upon charging of the test fuel load and all measurements shall be recorded either manually or automatically at least at every 5 minute interval for the entire test period. In addition, appliance surface and combustion chamber temperatures are also required at every five minute interval one hour prior to the test cycle.

3.12 INSTRUMENT CALIBRATION

3.12.1 Notwithstanding any standard calibration procedures designed to assure and maintain the accuracy of standard source testing equipment, the following calibration and testing methods must be utilized on the auxiliary equipment when testing woodstoves for air emissions.

3.12.2 Continuous gas analyzer(s) calibration

Upon receipt of equipment or any time the single point audit described below fails, a multipoint calibration of the analyzer must be completed before the instrument is put into service.

a) Set up the instrument and allow it to operate for a sufficient time to stabilize as recommended by the manufacturer's published operating procedure.

b) Introduce zero gas into the instrument at the normal sample flow being careful not to pressurize the sample stream. Normally, this will be accomplished by allowing the zero gas to flow into a three port vessel at a rate of at least twice the instrument sample rate and withdrawing sample from another port on the vessel while the third port is allowed to vent to the atmosphere.

c) Introduce consecutively in the same manner as b) three certified calibration gases in artificial air noting the instrument response of each. The gases should represent approximately 20%, 50% and 80% of the instruments' full scale concentration.

d) Construct a calibration curve using the data collected in b) and c).

3.12.3 Continuous gas analyzer(s) audit

Before and after each test, conduct a single point audit of the instrument as described below. It is highly recommended that a single point audit of the instrument be conducted at intervals not to exceed 2 hours during the test periods.

a) Disconnect the instrument sample line from the sample source at a point upstream of all sample conditioning equipment (dryers, scrubbers, etc.).

b) Being certain to avoid pressurizing the system, introduce a certified reference gas into the analyzer through all sample conditioning equipment. The sample gas should be in the range of 20% to 80% of full scale of the instrument.

c) If the instrument response to the audit gas differs by more than 5% from the calibration curve, disregard all data collected with the instrument since the last successful audit and perform a multipoint calibration.

d) Before and after each test, leak check the system by plugging the inlet and watching the sample flow rotometer.

3.12.4 Platform scale auditing

a) Upon installation of the scale, a multipoint calibration must be performed using NBS traceable weights. This function will normally be performed by the scale manufacturer. As soon as practicable after the calibration, one or more weights may be weighed for use as a calibration traceable standard weight for audit purposes. The weight should be constructed from a weight stable (non-oxidizable and non-hydroscopic) material and maintained in such a way that its weight integrity is assured.

b) Before and after each series of tests, the scale must be audited by first zeroing and then weighing at least one calibration traceable weight that corresponds to 20% to 80% of the expected charge load of the stove to be tested. If the scale does not reproduce the value of traceable weight within ± 0.4 lbs, the scale shall be recalibrated before use and void previous results.

3.12.5 Tracer gas flow measurement

a) All rotometers used in conjunction with tracer gas injection flow measurement techniques must be calibrated with the intended gas using either a calibrated volume measurement device such as a dry or wet gas meter or an accurate volume (displacement).

b) The tracer gas detector must be calibrated at the beginning and end of each set of tests by introduction of a certified reference gas. The gas must be introduced through all normal gas conditioning devices and in such a way as to prevent system pressurization.

SECTION 4: TEST FUEL REQUIREMENTS

4.1 FUEL PROPERTIES

4.1.1 The test fuel shall be untreated, air dried Douglas fir lumber. Kiln dried lumber is not allowed. To insure positive identification of Douglas fir, species type is stamped D.F. on the lumber by the certified lumber grader at the mills. The oven-dried density range shall be 28.7-37.4 pounds per cubic foot (.46-0.60 gm/cm^3). The density shall be determined and reported for certification purposes.

4.1.2 The test fuel shall have a moisture content range between 16% and 20% on the wet basis (19-25% dry basis). Moisture content shall be determined by measurements made with a calibrated electrical resistance type moisture meter or other equivalent performance type meter. Note: To convert moisture meter readings from the dry basis to the wet basis: (100)(% dry reading) ÷ (100 + % dry reading).

4.1.3 Minimum performance specifications for accuracy of the moisture meter shall be ± 3% of reading.

4.1.4 Moisture content determination per load shall be an average of a minimum of three readings for each fuel piece measured parallel to the grain of the wood on three sides (end readings excluded). If an electrical resistance type meter is used, electrode penetration shall be to a one inch depth using insulated pins. Moisture content measurements shall be made within a four hour period prior to testing, and the test fuel shall be at room temperature.

4.1.5 No wetting of previously dried wood is allowed. It is recommended that the test fuel be stored in a temperature and humidity controlled room.

4.1.6 The test fuel shall be essentially free of knots, and free of any rotted or molded areas or other defects such as pitch seams.

4.1.7 The higher heat value of the fuel shall be determined by bomb calorimetry using ASTM Method D 3286-77 or D 2015-77. A composite sample from each piece of the test charge shall be analyzed and reported for each test fuel load.

4.2 TEST FUEL PIECES

4.2.1 The dimension of each piece of fuel (flanged lumber) shall conform to the nominal measurements of 2x4 and 4x4 lumber (1-1/2 x 3-1/2 and 3-1/2 x 3-1/2 in).

4.2.2 The flanged lumber dimensions will vary according to the appliance's firebox volume as indicated below:

Usable firebox volume (ft^3)	Flanged lumber piece size (nominal inches)
≤ 1.5	2x4
1.5 ≤ 3	2x4 approximately 1/2 weight of test fuel load 4x4 approximately 1/2 weight of test fuel load
>3	4 x 4

4.2.3 Each flanged piece shall be constructed in a configuration to conform to the following requirement for spacer dimensions and spacing intervals: Spacers will be constructed from air dried Douglas fir lumber (meeting the fuel specifications in Section 4.1) 5 inches in length, 1-1/2 inches in width, and 3/4 inches in height (12.7 x 3.8 x 1.9 cm). The spacers are to be attached by uncoated ungalvanized nails or staples to the lumber flush with the ends of each piece such that a 3/4 inch (1.9 cm) extension of the spacer occurs at the width of each end of the log as illustrated in Figure 4.2-A.

4.2.4 An optional acceptable flanged fuel configuration has identical spacing intervals as indicated in 4.2.3, but with a greater spacer dimension in height as depicted in Figure 4.2-A. The optional spacer configuration must conform to the conditions specified in 4.2.3 and meet the 5 inches in length, 1-1/2 inches in width and 1-1/2 inches in height (12.7 x 3.8 x 3.8 cm).

4.2.5 The length of each piece of test fuel shall be of equal length and shall closely approximate 5/6 the length of the longest usable dimension of the firebox. (See 4.3.2)

4.2.6 Test fuel pieces shall be arranged in the firebox in conformance with the manufacturers published written instructions and in a configuration which maintains air space intervals between the logs. The fuel shall be positioned so that the flanges are flat (parallel) to the floor of the firebox, with the flanged edges in contact (abutting each other). If loading difficulties result, some fuel pieces may be placed on edge. If the usable firebox volume is between 1.5 and 3.0 ft^3, alternating the piece sizes in vertical stacking layers is required to the extent possible. For example, 2x4's shall be placed on the bottom layer in direct contact with the coal bed and 4x4's on the next layer, etc. (See Figure 4.2-B). Photo documentation of the loading configuration for each test cycle shall be provided to the DEQ for certification purposes.

4.2.7 Appliances of unusual or unconventional firebox design shall load the fuel in a configuration which maintains air space intervals between the flanged lumber and is in conformance with the manufacturers published written instructions. Any appliance that will not accommodate the loading configuration specified in 4.2.6, must obtain DEQ loading configuration approval prior to testing for certification purposes.

4.2.8 Appliances that are designed to provide continuous feed pelletized or chipped fuel must prearrange an equivalent test criteria agreement with the DEQ prior to testing for certification purposes.

4.3 LOAD SIZE

4.3.1 The initial fuel load and the test fuel charge shall be based on weight per usable firebox volume. The fuel loads shall be equivalent to seven pounds of fuel as fired per cubic foot (112 kg/m^3) of usable firebox volume ± 10 %.

4.3.2 To avoid stacking difficulties, or when a whole number of fuel pieces does not result, all piece lengths may be adjusted uniformly to remain within the specified loading density.

4.3.3 Usable firebox volume means the entire volume of the (primary) combustion chamber less any volume where firewood could not reasonably be placed, such as areas restricted by baffles or firebrick. (see Figure 4.3)

SECTION 5: APPLIANCE OPERATING PROCEDURE

5.1 PRETEST START UP

5.1.1 The pretest startup phase is designed to bring the stove up to a stabilized operating temperature that is reflective of the heat output range required for the following test cycle.

5.1.2 Pretest start up will begin with ignition of kindling from a cold start with no charcoal residue in the firebox. A layer of cold wood ashes spread to a uniform depth of up to one inch in depth (2.54 cm) on the floor of the firebox or ash pan is optional. The kindling load shall consist of between 4-8 pounds (1.8 - 3.6 kg) of finely split Douglas fir with a moisture content range up to 20% on the wet basis. Crumpled newspaper balls loaded with the kindling shall be used to help attain ignition. The air supply controls may be adjusted per the manufacturer's published instructions for the kindling start up phase.

5.1.3 After 50 - 75% of the kindling by weight has been consumed, a pretest fuel load shall be added. The pretest fuel load shall meet the same fuel species and moisture content specifications as the test load. The pretest fuel load shall consist of whole 2x4 lumber pieces, without flanges, that are no less than 1/3 the length of the test fuel. Additional fuel may be added provided it meets the above requirements and that uniform charcoalization and weight specifications are adhered to before the test cycle begins.

5.1.4 The air inlet supply setting may be set at any position desired which will maintain combustion of the pretest fuel load. It is recommended that the air inlet supply setting be set at the position necessary to achieve the lowest heat output level of the following test cycle and be set at least one hour prior to addition of the test fuel load.

5.1.5 To document stabilized appliance heat storage effects and to control heat output levels, surface temperatures shall be recorded at each 5 minute interval during the one hour period prior to charging the test fuel.

5.1.6 No emissions or efficiency measurements are required during this pretest startup phase.

5.2 TEST CYCLE OPERATION

5.2.1 All stove surface temperatures shall be averaged and compared to those recorded at the beginning and the end of each test cycle. To approximate thermal equilibrium, the averaged beginning and ending test cycle stove surface temperatures must be within 125°F (51.7°C) of each other. For all appliances, a correction factor shall be made to correct for heat storage effects. The correction factor shall be 0.12 Btu/lb °F multiplied by the averaged surface temperature difference in °F obtained from the beginning and ending temperatures of each test cycle. Some stoves (e.g., high mass stoves) may require more than one pretest fuel load to stay within the required averaged temperature range at the beginning and at the end of the test cycle.

5.2.2 An appliance may be tested in one continuous testing period that encompasses discrete test cycles for each of the four specified heat output levels (see 5.8) provided that a one hour minimum interval between each discrete test cycle occurs. The interval between test cycles provides time to reposition the air supply adjustment to the appropriate setting, re-establish and maintain the required coal bed, and meet the surface temperature requirements for the next desired heat output level.

5.3 TEST FUEL LOADING

5.3.1 When the kindling and pretest fuel load has been consumed to leave a weight equal to 20-25 percent of the test fuel load, the test fuel load shall be charged. Manipulation of the hot coal bed prior to charging the test fuel load shall conform to the manufacturer's published written instructions. In the absence of written instructions, breaking up, raking and uniform spreading of the embers or hot coal bed is required prior to addition of the test fuel load. No manipulation or rearrangement of the test fuel load configuration is allowed during any portion of the test cycle.

5.3.2 Additional fuel may be added between the test cycle intervals, provided it meets the fuel species and moisture content specifications. Whole 2x4 lumber pieces, without flanges, no less than 1/3 the length of the test fuel may be used, provided proper re-establishment of the hot ember bed is controlled to the specified weight criteria and uniform charcoalization of the ember bed is adhered to.

5.4 AIR SUPPLY CONTROL

5.4.1 Adjustment of the primary air supply controls or holding the fuel loading door open up to the first 5 minute phase of the test cycle is allowed to insure good ignition of the test charge and catalyst if so equipped. Adjustments should be conducted per the manufacturer's published written instructions. Immediately thereafter, the primary inlet air supply control(s), either manual or automatic, shall be set to the position necessary to achieve the required heat output level. No additional adjustments of the air supply controls or opening the loading door will be allowed during the remainder of each test cycle.

5.4.2 Maximum heat output shall be achieved by operating the appliance with the primary air supply inlet controls fully open during the entire fuel load cycle unless the manufacturer's published written instructions specify that maximum heat output occurs at another setting.

5.4.3 All other heat output levels shall be achieved by operating the appliance with the primary air supply inlet control or other mechanical control device set in a predetermined position necessary to obtain average heat output levels specified in 5.8 during the entire test cycle.

5.4.4 If the primary air supply inlet control(s) cannot be adjusted to obtain variable burn rates or variable heat output levels, the appliance shall be tested at the fixed air supply setting.

5.4.5 Secondary or tertiary air supply may be adjusted one time only during each test cycle following the manufacturer's published written instructions.

5.5 TEST CYCLE COMPLETION

5.5.1 A test cycle ends when the entire weight ± 0.1 lb (.045 kg) of the test fuel load has been consumed, (i.e., when a bed of coals equal to the beginning coal bed weight remains).

5.6 BLOWERS, FANS

5.6.1 The use of blowers for heat exchange is optional. Beginning with the start of the test cycle, blower speed may be positioned at a recommended setting but no changes in setting will be allowed throughout the entire test period and the position setting shall be recorded at the time positioning occurs.

5.7 OTHER APPURTENANCES

5.7.1 Shaker grates, by-pass handles, or other appurtenances (not primary air supply controls) may be adjusted one time only during each test cycle in accordance with the manufacturer's written published instructions, and all adjustments shall be recorded.

5.8 NUMBER OF TESTS REQUIRED

5.8.1 Simultaneous emissions and efficiency tests are required during an entire test cycle within each of four discrete heat output ranges as indicated below.

Test Cycle Heat Output

(Average Btu/hr)

Category 1.	Category 2.	Category 3.	Category 4.
< 10,000	10-15,000	15-25,000	Maximum heat output

5.8.2 If the lowest sustainable burn rate produces an average heat output greater than the first category, then two tests must be conducted near the low and high end of the second category plus tests at the remaining categories. A total of four test cycles are required.

5.8.3 If the lowest sustainable burn rate produces an average heat output greater than the second category, then two tests must be conducted near the low and high end of the third category plus a test at the remaining category. A total of three test cycles are required.

5.8.4 If the lowest sustainable burn rate produces an average heat output greater than the third category, three tests must be conducted, one at the lowest sustainable burn rate, one at the maximum heat output level and one at an intermediate level between the lowest and maximum level. A total of three test cycles are required.

5.8.5 If lowest sustainable burn rate is greater than 10,000 Btu/hr then documentation shall be submitted to demonstrate the actual burn rate is the lowest sustainable. This documentation can be in the form of proof that the appliance was run at its lowest permanent air supply setting or test data that demonstrates the burn rate approaches zero (less than 0.1 kg/hr) within the area of 1 to 1.1 times the lowest sustainable burn time and when greater than 90% of the test charge has been consumed. Such test data shall be collected by following all the stove operating procedures specified in this document.

5.8.6 If an appliance has a fixed air supply setting, two replicate tests shall be conducted at the "on" firing mode setting. A total of two test cycles are required.

5.8.7 If an appliance is unable to achieve an average heat output level of 25,000 Btu/hr at its maximum heat output, four tests must be conducted. One test must be conducted at the first category, one at the second category and two tests at the third category, one conducted near the low end of the range and one at the maximum heat output. A total of four test cycles are required.

SECTION 6: TEST METHODOLOGY AND CALCULATIONS

6.1 EMISSION TESTING

6.1.1 Particulate emission testing shall be conducted in conformance with Oregon Source Sampling Methods 5 and 7 (Attachments 2 and 3) with the following exceptions: 1) no traverse of the flue is necessary, 2) sample extraction shall occur in the center of the flue at a height of eight to nine feet above the top surface of the scale, 3) on-line stack gas velocity and volumetric flow rate determination will be made using an alternate method (Section 6.3). Total volume and average flow rates for the test period will be calculated using a simultaneous stoichiometric carbon, hydrogen and oxygen balance method (Section 6.2.1). Sample extraction rates shall be maintained at or proportional to the flue gas velocity as determined by the measured concentration of a tracer gas injected into the stack gases to determine dilution rate and thus, total flow. Adjustments to the sampling rate will be made at each five minute interval during the entire test period.

6.2 PROCEDURES FOR DETERMINING EQUIVALENCE BETWEEN CANDIDATE METHODS AND THE REFERENCE METHOD FOR WOODSTOVE EMISSION TESTING

6.2.1 Determination of Equivalence

The test procedures outlined in this section shall be used to determine if a candidate method is equivalent to the reference method when both methods measure particulate emissions from woodstoves. Equivalence is shown for the methods when the differences between the measurements made by a candidate method and the measurements made simultaneously by the reference method are less than or equal to the precision and consistency values specified below.

5.8.6 If an appliance has a fixed air supply setting, two replicate tests shall be conducted at the "on" firing mode setting. A total of two test cycles are required.

5.8.7 If an appliance is unable to achieve an average heat output level of 25,000 Btu/hr at its maximum heat output, four tests must be conducted. One test must be conducted at the first category, one at the second category and two tests at the third category, one conducted near the low end of the range and one at the maximum heat output. A total of four test cycles are required.

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The test procedures outlined in this section shall be used to determine if a candidate method is equivalent to the reference method when both methods measure particulate emissions from woodstoves. Equivalence is shown for the methods when the differences between the measurements made by a candidate method and the measurements made simultaneously by the reference method are less than or equal to the precision and consistency values specified below.

Specifications For Woodstove Emission Test Methods

Parameter	Units	Limits
Emission rate range	g/hr	1.0-45.0
Minimum number of test runs		16
Minimum number of simultaneous samples per test run		4
(Candidate method)		(2)
(Reference method)		(2)
Maximum analytical precision (individual test runs)	%	18
Maximum analytical precision (standard deviation)	%	10
Maximum difference in consistent relationship (weighted averages)	%	20

6.2.2 Test Conditions

The woodstove burn rate and operating cycle shall be in accordance with procedures specified by DEQ. Testing procedures and schedules shall be approved by DEQ at least 60 days prior to testing. All test measurements or samples shall be taken in such a way that both the candidate method and the reference method receive stack gas samples that are homogenous or as nearly identical as practical.

Collect simultaneous and duplicate samples of woodstove emissions with both the reference and candidate methods until at least 16 quadruple samples (duplicate pairs of both candidate and reference methods) have been obtained. The 16 quadruple samples should represent 16 full test runs, four test runs on each of four stoves. The tests on each stove shall be in each of the four heat output ranges specified in the certification procedures and 5.8.1 of this document. Calculate the emission rates as determined by the candidate and reference methods for each test run. For the reference method, calculate the average particulate emissions for each test run by averaging the results calculated from the duplicate analyses (A and B):

$$R_i \text{ ave} = \frac{R_{iA} + R_{iB}}{2} \qquad 6.2.2.a$$

where R denotes results from the reference method and where i is the sample number. Disregard all quadruple samples for which the particulate emission rate as determined by the average of the duplicate reference method analyses falls outside the range of 1.0 to 45.0 grams per hour (g/hr). All remaining quadruple samples must be subjected to the following test for precision (in 6.2.3).

Calculate the weighted emission rates, using the procedures specified in OAR 340-21-120(5), as determined by the candidate and reference methods for each of the four woodstoves tested. For the reference method, calculate the average weighted emission rate for each woodstove tested by averaging the results calculated from the duplicate analysis (A and B). One woodstove weighted emission rate (average of duplicate reference method analysis) must be within each of the following ranges for the procedure to be valid: Less than 5.0 g/hr, 5.0 to 10.0 g/hr, 10.0 to 15.0 g/hr, and greater than 15.0 g/hr. All weighted emission rates must be subjected to the consistent relationship test (in 6.2.4 following).

6.2.3 Test For Precision

Calculate the precision (P) of the analysis (in percent) for each duplicate sample and for each method, as the maximum minus the minimum divided by the average of the duplicate analyses, as follows:

$$P_{Ri} = \frac{R_{i\ max} - R_{i\ min}}{R_{i\ ave}} \times 100\% \qquad 6.2.2.b$$

$$P_{Ci} = \frac{C_{i\ max} - C_{i\ min}}{C_{i\ ave}} \times 100\% \qquad 6.2.2.c$$

where C denotes results from the candidate method, R denotes results from the reference method, and i indicates the sample number.

Calculate the standard deviation (SD) of the reference and candidate precision analyses as follows:

$$SD_R = 1.77 \times P_{R\ ave} \qquad 6.2.2.d$$
$$SD_C = 1.77 \times P_{C\ ave} \qquad 6.2.2.e$$

where $P_{r\ ave}$ is the average of the absolute values of P_{Ri}; and $P_{C\ ave}$ is the average of the absolute values of P_{Ci}.

If any reference method precision value (P_{Ri}) exceeds 18 percent or if the standard deviation (SD_R) exceeds 10 percent, the precision of the reference method analytical procedure is out of control. Corrective action must be taken to determine the sources(s) of imprecision and the reference method determinations must be repeated, or the entire test procedure must be repeated.

The candidate method passes this test if the precision values of the candidate method (P_{Ci}) are less than or equal to 18 percent and the standard deviation (SD_C) is less than or equal to 10 percent.

6.2.4 Test For Consistent Relationship

For each of the four woodstoves tested, calculate the weighted average emission using DEQ procedure specified in OAR 340-21-120(5).

For each quadruple sample, calculate all four possible percent differences (D) between the reference and candidate methods, using all four possible combinations of the duplicate determinations (A and B) for each method, as:

$$D_{in} = \frac{C_{ij} - R_{ik}}{R_{ik}} \times 100\% \qquad 6.2.2.f$$

where i is the woodstove model tested and n numbers from 1 to 4 for the four possible difference combinations for the duplicate determinations for each method (j = A, B, candidate; k = A, B, reference).

If the candidate method is to include dual units and averaging of test results, then calculate the differences (D) between the reference and candidate methods as follows:

$$D_i = \frac{C_i - R_i}{R_i} \times 100\% \qquad 6.2.2.g$$

where i is the woodstove model tested, C is the average of the dual candidate results, and R is the average of the dual reference results.

The candidate method passes this test if the absolute values of all of the applicable differences (D) are less than or equal to 20 percent.

6.2.5 Test For Equivalence

The candidate method must pass both the precision test and the consistent relationship test to qualify for designation by DEQ as an equivalent method. DEQ may require dual units and precision criteria between dual units, or other conditions in the designation as an equivalent method.

6.2.6 Verification Testing

DEQ may conduct verification testing of the candidate method. If DEQ testing does not verify the precision and consistent relationship of the candidate method then the candidate method will not be approved as an equivalent method.

6.3 TRACER GAS DILUTION METHOD

6.3.1 This method is used for on-line measurement of stack gas flows during the test period. Other techniques that can provide equivalent results may be accepted, provided prior approval by DEQ has been made before testing for certification purposes commences.

a) Tracer Gas Dilution Method

A pure tracer gas (sulfur dioxide or equivalent, or approved performance gas) is metered through a calibrated rotometer for injection into the flue pipe. Injection shall be made through a stainless steel multi-perforated tube loop located inside the stack at four flue diameters downstream from the particulate and gas sampling port. A downstream diluted sample extraction probe shall be located 8 flue diameters downstream from the injection loop. The dilution sample gas stream shall be processed through a sample conditioner consisting of a combustion tube furnace, and in series, a glass fiber filter and three impingers encased in an ice bath. Impingers one and two shall be empty for water collection and the third shall contain silica gel.

The tracer gas content of the diluted gas sample stream shall be determined with an appropriate calibrated analyzer. Downstream tracer gas concentrations should not exceed 0.5% of the total flue gas volume. The tracer gas shall be as non-reactive with other flue gas constituents as possible and measurable by instrumentation capable of obtaining an accuracy of $\pm$ 1% of the instrument scale reading. Instrument calibrations shall be performed and recorded before and after each test run.

Stack gas volumetric flow rates shall be calculated using the following equations:

$$\text{Flow (cfm)} = \frac{Ir}{Dc} \times \frac{1}{60} \times \frac{Tr}{Pr \times 17.65^{o}} \qquad 6.3.1.a$$

Where: Ir = Tracer gas injection rate (ft^3/hour)

Dc = Downstream tracer gas concentration ($ppm \times 10^{-6}$)

Tr = Injection gas temperature (°R) at the rotometer

Pr = Injection gas pressure (inches Hg)
ρ = Density specific for SO_2

Other tracer gases such as helium may be substituted for sulfur dioxide provided prior written agreement has been made with the DEQ.

6.4 STOICHIOMETRIC CARBON, HYDROGEN AND OXYGEN BALANCE METHOD

6.4.1 A carbon, hydrogen and oxygen mass balance will be used for determining overall flue gas volume--not for on-line measurements during the test period.

a) The carbon, hydrogen and oxygen balance method for volumetric flow rates is based on the following basic combustion equation and will be determined and reported for every five minute interval.

$$\theta[C_xH_yO_z + pH_2O] + Tsg(1-k)(a)[O_2 + 3.785N_2 + mH_2O] \quad 6.4.1.a$$
$$Tsg[(1-k)(dCO_2 + eCO + gO_2 + hN_2) + jH_2O + kCH_4]$$

Where θ = Dry weight of fuel burned (lbs)
x = Moles of carbon per lb of dry fuel (assumed 0.0425)
y = Moles of hydrogen per lb of dry fuel (assumed 0.073)
z = Moles of oxygen per lb of dry fuel (assumed 0.0256)
p = Moles of H_2O per lb of dry fuel
= Dry basis moisture (free and combined) ÷ 1800
a = Mole fraction of oxygen in air supply
= Moles O_2 supplied per mole of stack gas
d = Mole fraction of CO_2 in stack gas
e = Mole fraction of CO in stack gas
g = Mole fraction of O_2 in stack gas
h = Mole fraction of N_2 in stack gas
j = Mole fraction of H_2O in stack gas
k = Mole fraction of unburned hydrocarbon in stack gas (as CH_4).
m = Mole fraction of H_2O in supply air (mole H_2O per mole of supply oxygen)
Tsg = Total moles of stack gas (dry)

b) Mass balance equations for the combustion of θ lbs of wood are as follows:

Carbon:	$x\theta = Tsg[(1-k)(d+e)+k]$	6.4.1.b
Hydrogen:	$\theta(2p + y) + Tsg(1-k)(a)(2m) = Tsg(2j + 4k)$	6.4.1.c
Oxygen:	$\theta(p+z) + Tsg(1-k)(a)[2+m] = Tsg[(1-k)(2d + e + 2g) + j]$	6.4.1.d
Nitrogen:	$3.785(a) = h$	6.4.1.e

Stack gas total as measured by combustion gas analyzers:

$$1 = (d + e + g + h) \qquad 6.4.1.f$$

The stack gas composition equation can be solved for "h" which will then provide a solution for "a" in the nitrogen balance equation. The remaining unknown values for "θ", "p", and "k" are determined by simultaneously solving the carbon, hydrogen, and oxygen balance equations.

c) Two calculation runs of the simultaneous equation set are performed for each set (5 minute test segment) of data collected. The first run is performed to determine an average weighted "θ" for the test burn. This first run "θ" is then used to determine a corrected Tsg for the second run as follows:

$$Tsg'(\text{corrected}) = Tsg\ (\text{tracer gas}) \frac{\theta\ (\text{actual})}{\theta\ (\text{calculated first run})} \qquad 6.4.1.g$$

Where: θ(actual) = Dry weight burn rate for test burn (lb/hour)

d) "Tsg" is converted to a flow rate by the following equation:

$$\text{Flow (cubic feet per minute)} = \frac{Tsg \times 386.2}{60} \qquad 6.4.1.h$$

This calculation procedure is necessary for each five minute test period segment, therefore a computer program is recommended.

6.5 EFFICIENCY TESTING AND CALCULATIONS

6.5.1 If a calorimeter room is used to measure appliance efficiency, combustion gas analyzers must be included to determine and report appliance combustion and heat transfer efficiencies for each heat output level required.

6.5.2 Efficiency values shall be determined based on the following stack loss method. The approach shall include determination for each heat output level for combustion, heat transfer, and overall efficiency.

a) Combustion Efficiency

Combustion efficiencies are calculated as the percentage represented by the actual heat produced in the firebox relative to the total heat production potential for the fuel consumed. Actual heat production in the firebox is calculated as the difference between the heat of combustion of the incompletely combusted stack gas constituents (carbon monoxide and unburned hydrocarbon equivalents) and the gross caloric content of the fuel burned. The basic equation used for combustion efficiency is as follows:

$$\text{Combustion Efficiency} = \frac{Thi - Clo}{Thi} (x\ 100) \qquad 6.5.2.a$$

Where: Thi = Total heat content of the fuel consumed
Clo = Combustible losses out stack

b) The total heat content of the fuel consumed shall be calculated using the following equation:

$$Thi = Gcvf \times Wfc \qquad 6.5.2.b$$

Where : Gcvf = Gross caloric value of the fuel (use HHV determined from bomb calorimetry analysis)
Wfc = Weight of fuel consumed (lbs) dry weight

c) The heat content of the combustible losses are calculated using the following equation:

$$Clo = Tsg\ [(e \times Hco) + (k \times Huh)] \qquad 6.5.2.c$$

Where: Hco = Heat of combustion for carbon monoxide
= 128,000 Btu/mole
Huh = Heat of combustion for unburned hydrocarbons
= 181,000 Btu/mole (estimated)

This calculation procedure is necessary for each five minute test period segment.

d) Heat Transfer Efficiency

Heat transfer efficiencies are calculated as the percentage represented by the useful heat released to the room relative to the actual heat produced in the firebox. The useful heat released to the room (Uhr) is calculated as the difference between the actual heat produced in the firebox (Ahf or Thi-Clo), and the sensible and latent heat losses out the stack (Sllo). The basic equation for heat transfer efficiency is as follows:

Heat Transfer Efficiency

$$= \frac{Uhr}{Ahf} = \frac{Ahf-Sllo}{Ahf} = \frac{(Thi-Clo)-Sllo}{(Thi-Clo)} (x\ 100) \qquad 6.5.2.d$$

Where: Sllo = Sensible and latent heat losses
= (To - Ti) [Tsg(d$CpCO_2$ + eCpCO + gCpO_2 + hCpN_2 + jC_pH_2O)] + (j-m)LH_2O

Where: To = Temperature of stack gases out
Ti = Temperature of inlet air and fuel

C_pCO_2 = Specific heat of CO_2 = 9.3 Btu/mole
C_pCO = Specific heat of CO = 7.0 Btu/mole
C_pO_2 = Specific heat of O_2 = 7.1 Btu/mole
C_pN_2 = Specific heat of N_2 = 7.0 Btu/mole
C_pH_2O = Specific heat of water = 8.3 Btu/mole
LH_2O = Latent heat of evaporation of water = 18,810 Btu/mole

This calculation procedure is necessary for each five minute test period segment.

e) Overall Efficiency

Overall average efficiency is calculated as the percentage represented by the heat released to the room relative to the total heat production potential of the fuel consumed. The overall efficiency is calculated as the product of the combustion efficiency and the heat transfer efficiency as follows:

Overall Efficiency = Combustion Efficiency x Heat Transfer Efficiency

$$= \frac{Ahf}{Thi} \times \frac{Uhr}{Ahf} = \frac{Uhr}{Thi} \qquad 6.5.2.e$$

6.5.3 A corrected flue gas moisture content for each five minute interval must be determined as follows:

Final flue moisture determination shall be made by calculating a corrected flue gas moisture content for each data interval taken during the test cycle. The average wet bulb-dry bulb moisture measurement must be weighted by the volumetric flow rate for that 5 minute interval. The correction factor which is applied to each 5 minute moisture determination is calculated as the ratio between the average wet bulb-dry bulb measurement and the Oregon Source Sampling Method 4 (Attachment 1) measurement (condensate catch) for the entire burn cycle.

6.6 EQUIVALENCE BETWEEN CANDIDATE METHODS AND THE REFERENCE METHOD FOR WOODSTOVE EFFICIENCY TESTING

6.6.1 Candidate methods for woodstove efficiency testing must demonstrate consistent relationship to the reference method (stack loss) comparable to the consistent relationship between the reference method (stack loss) and the calorimeter room method as described in the DEQ's Confirmation Testing Summary, Section 18, Part C, Table 1: Comparison of Calorimeter Room Method vs. Stack Loss Method, 1984.

6.6.2 DEQ may conduct verification testing of the candidate method. If DEQ testing does not verify equivalence of the candidate method to the reference method (stack loss), then the candidate method will not be approved as an equivalent method.

SECTION 7: TEST DATA

7.1 DATA TO BE REPORTED

7.1.1 All raw and reduced test data must be included in the material sent to DEQ for appliance certification. Reduced test data shall be tabulated as indicated in Sections 7.1.2 through 7.1.10.

7.1.2 Particulate Emissions For Each Test Cycle

a) Concentration: total grains/dscf, total grams/m^3
b) Emission rate: grams/hr
c) Emission factor: grams/kg (dry fuel weight basis)
d) Emission process rate: grams/10^6 joule useful heat output
e) Front half catch: % of total
f) Total mass captured: front and back catch, mg

7.1.3 Average Efficiency Values For Each Test Cycle

a) Overall appliance efficiency %
b) Combustion efficiency %
c) Heat transfer efficiency %

7.1.4 Heat Output For Each Test Cycle

a) Btu/hr average over entire test

7.1.5 Burn Rate For Each Test Cycle

The average values (kg/hr wet and dry basis) over the entire test cycle and an hourly average over the entire test cycle at each heat output level.

7.1.6 Average Fuel Moisture Content For Each Test Cycle

a) Kindling (wet basis) %
b) Test fuel (wet basis) %

7.1.7 Air/Fuel Ratio

Mass of combustion air to the mass of fuel over 90% or more of each test cycle (lbs air/lbs fuel).

7.1.8 Average Stack Gas Composition For Each Test Cycle

a) Carbon dioxide %
b) Carbon monoxide %
c) Oxygen %
d) Excess air %
e) Moisture %

7.1.9 Average Stack Gas Flow and Draft For Each Test Cycle

a) Average flow rate cfm
b) Stack flow rate dscf/min (tracer gas and CHO balance)
c) Draft, inches H_2O

7.1.10 Average Stack Gas Emission Factors and Process Rates For Each Test Cycle
a) Carbon monoxide: grams/kg, and grams/10^6 joule (measured)
b) Hydrocarbons: grams/kg, and grams/10^6 joule (calculated)

7.1.11 Average Temperatures For Each Test Cycle

a) Stack gas ^oF
b) Primary combustion chamber gas ^oF
c) Secondary combustion chamber gas (if applicable) ^oF
d) Above catalyst gas (if applicable) ^oF
e) Stove top surface ^oF
f) Stove sidewall surfaces ^oF
g) Stove back surface ^oF
h) Stove bottom surface ^oF

7.1.12 Fuel Load Weight and Burn Cycle Period For Each Test Cycle

a) Coal bed weight, lbs

b) Test fuel load weight, lbs

c) Total burn cycle time period, minutes

SECTION 8: CATALYTIC COMPONENT CERTIFICATION REQUIREMENTS

8.1 CATALYTIC COMBUSTOR DESIGN CRITERIA

8.1.1 To insure equivalent performance of catalytic combustors used in testing versus production model stoves, a combustor model number for every catalytically equipped stove evaluated for certification shall be supplied. The model number will serve to identify catalytic combustor types by brand (manufacturer), dimensions, and design (substrate and coating material). The model number must be imprinted or inscribed on a readily visible surface (such as a metal sleeve or canned surface). This will allow DEQ field verification monitoring. Any change in combustor brand, size and design type will require retesting of the appliance with the new combustor model for performance change unless test data or sufficient information can be provided demonstrating equivalent or improved performance.

8.2 CATALYTIC COMBUSTOR AGING CRITERIA

8.2.1 Any appliance that contains a catalytic combustor must use a pre-aged combustor when testing for certifiation purposes. The combustor aging process will consist of burning Douglas fir dimensional lumber or cordwood with a moisture content range on the wet basis of 15-25% in a woodstove specifically designed for an internal catalytic combustor. The stove must be operated at its medium burn rate with a new catalytic combustor in place and in operation for a period of 50 hours. The accredited testing laboratory must document and provide combustor temperature data, hours of aging operation and certify to the DEQ that each catalytic appliance tested for certification purposes has met this provision.

8.3 CATALYTIC COMBUSTOR LONGEVITY CRITERIA

8.3.1 All catalytic combustor manufacturers must submit to the DEQ evidence in the form of test data that each combustor design type, identified by model number, has been longevity tested for 5000 hours and document that the percent reduction in particulate emissions from the new state is no less than 70%. Three test conditions are required: 1) unused (0 hours), 2) 250 hours, and 3) 5000 hours. Testing must be performed by a DEQ accredited laboratory. In lieu of this requirement, the manufacturer may substitute a 24 month non pro-rated combustor replacement warranty.

8.4 CATALYTIC COMBUSTOR TEMPERATURE MONITORING PROVISION

8.4.1 In order to qualify for DEQ certification, catalytically equipped woodstoves must be equipped with a permanent provision to accommodate a commercially available temperature sensor which can monitor combustor gas stream temperatures within or immediately downstream (within 1.0 inch or 2.5 cm) of the combustor surface.

EXAMPLE OF TEST EQUIPMENT SET-UP FOR FREE STANDING WOODSTOVES

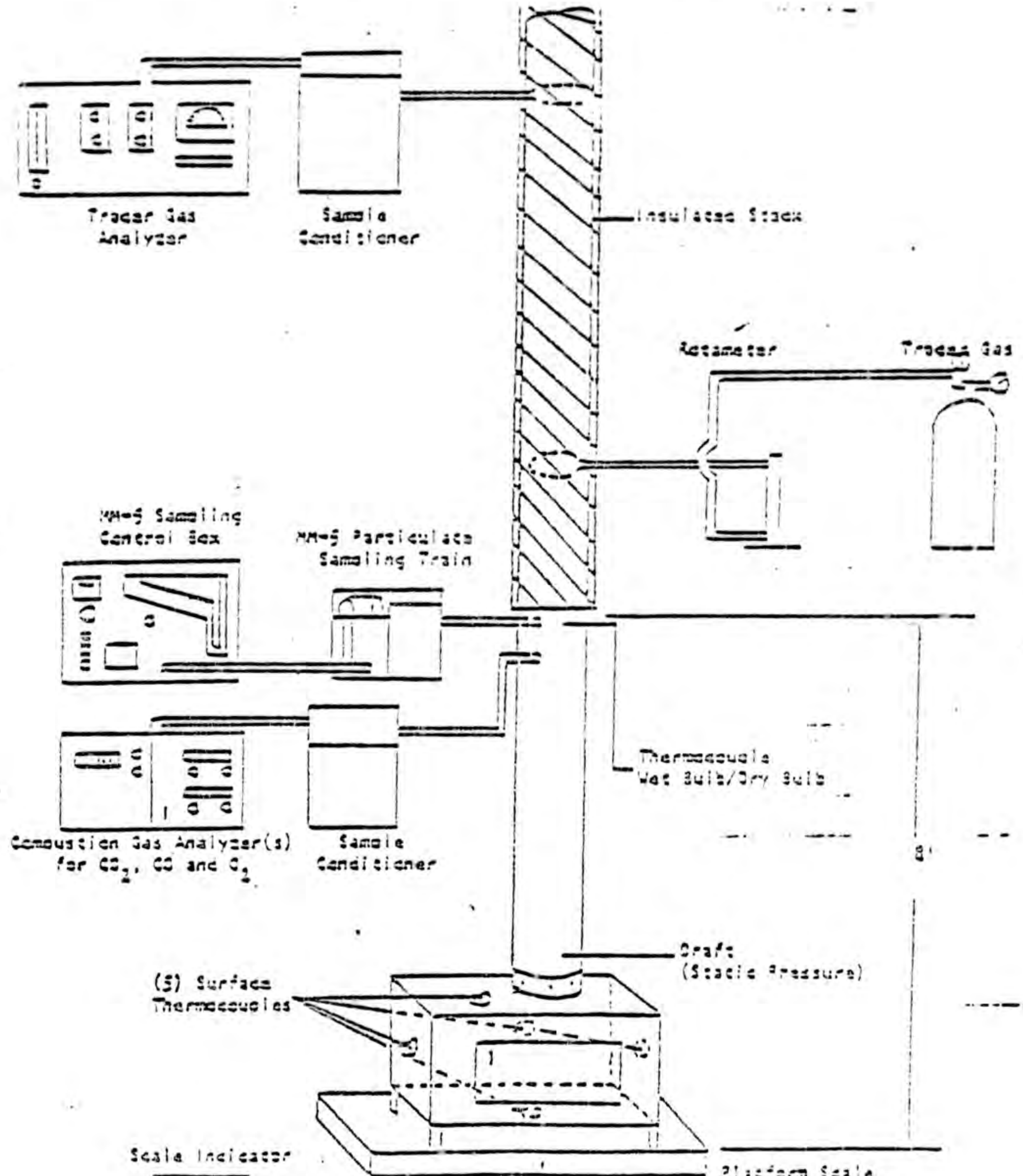
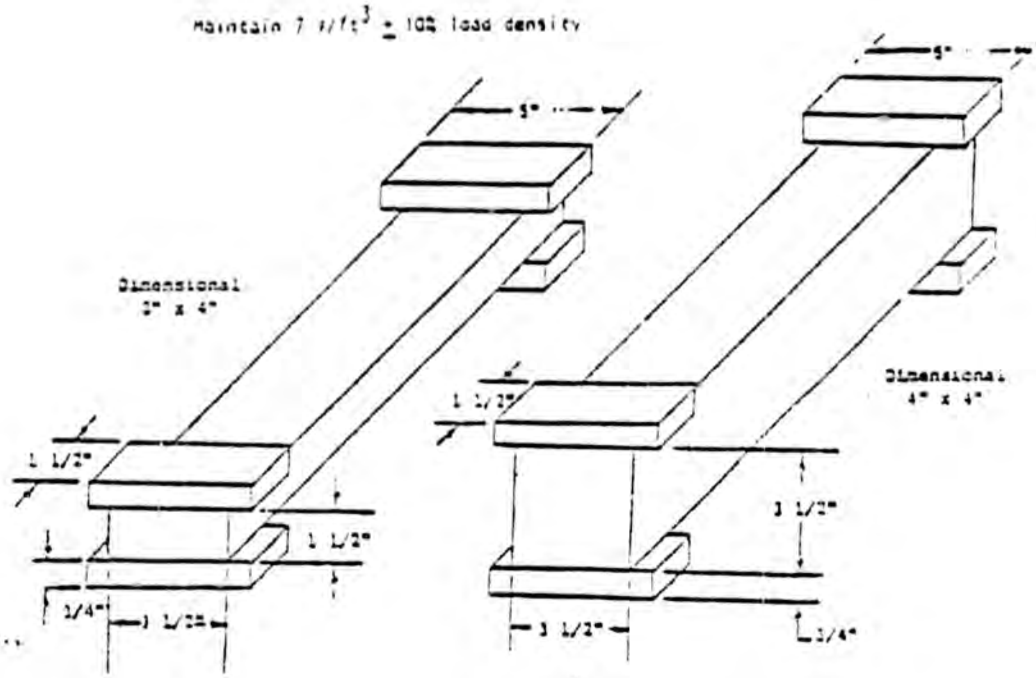


Figure C.1

Test Fuel Size

Usable Firebox Volume (ft^3)		Size - Flanged Wood (Nominal Inches)
≤ 1.5		2 x 4
$> 1.5 \leq 3$	Combination	2x4 approximately ½ weight of test fuel load; 4x4 approximately ½ weight of test fuel load
> 3		4 x 4

Maintain 7 #/ft^3 ± 10% load density



Scale 1/4" = 1"

* Length will vary depending on length of firebox

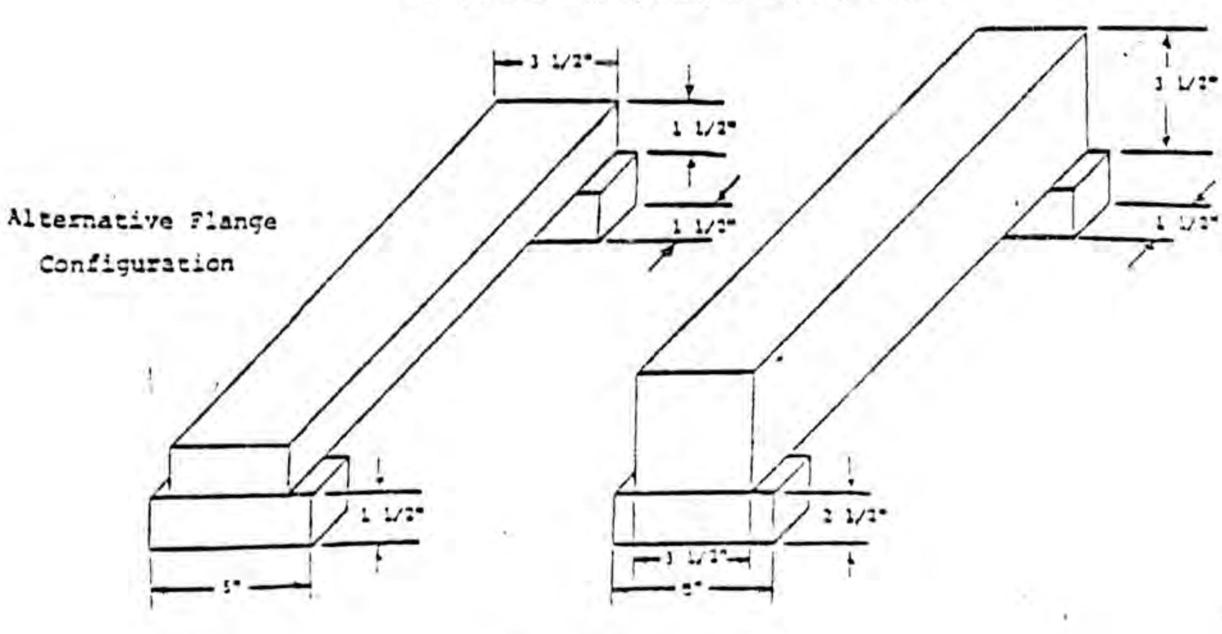
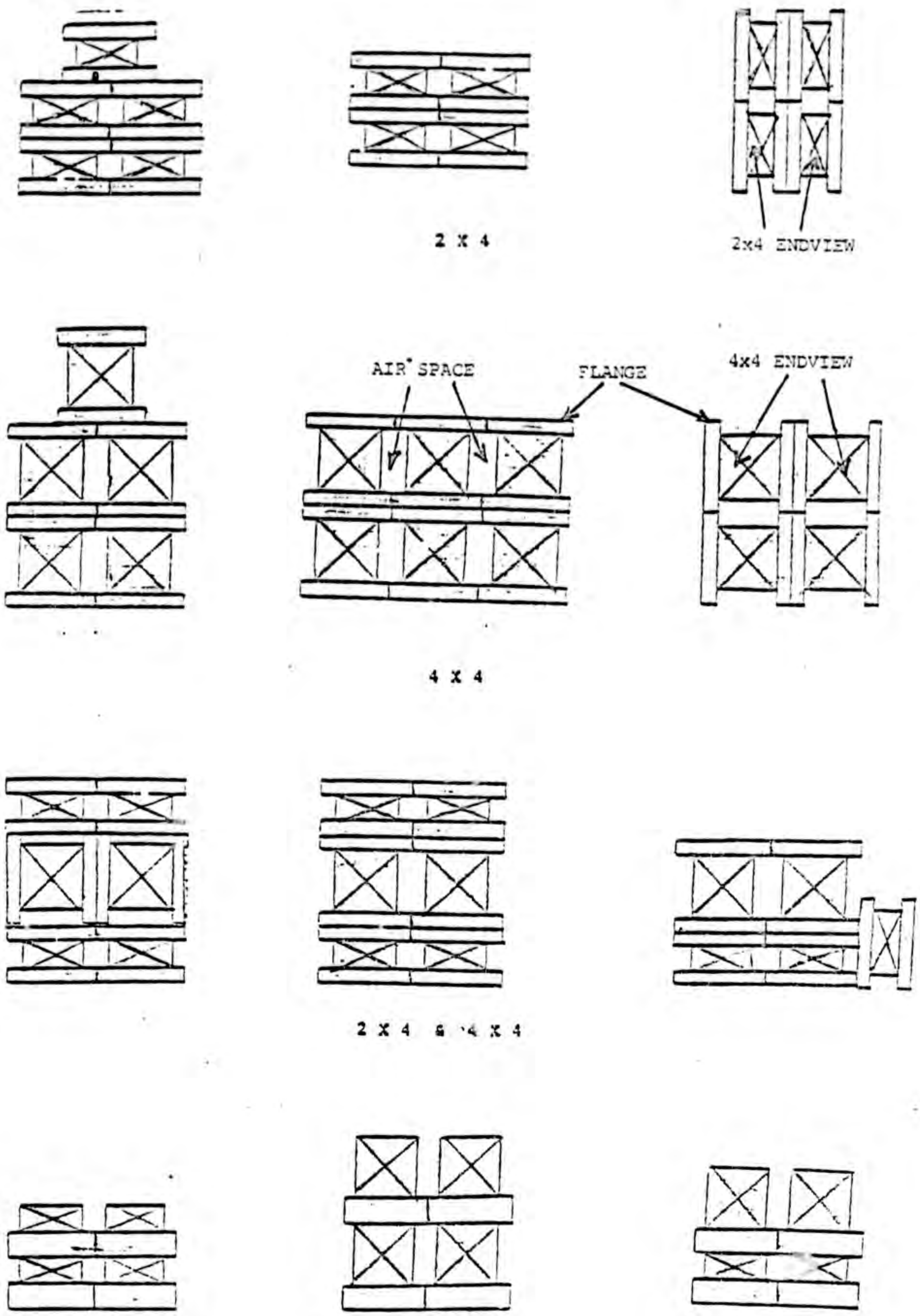


Figure 4.2-A



Woodstove Stacking & Loading Examples

Figure 4.2-B

EXAMPLES OF

USABLE FIREBOX VOLUME

(Designated by Shaded Area)

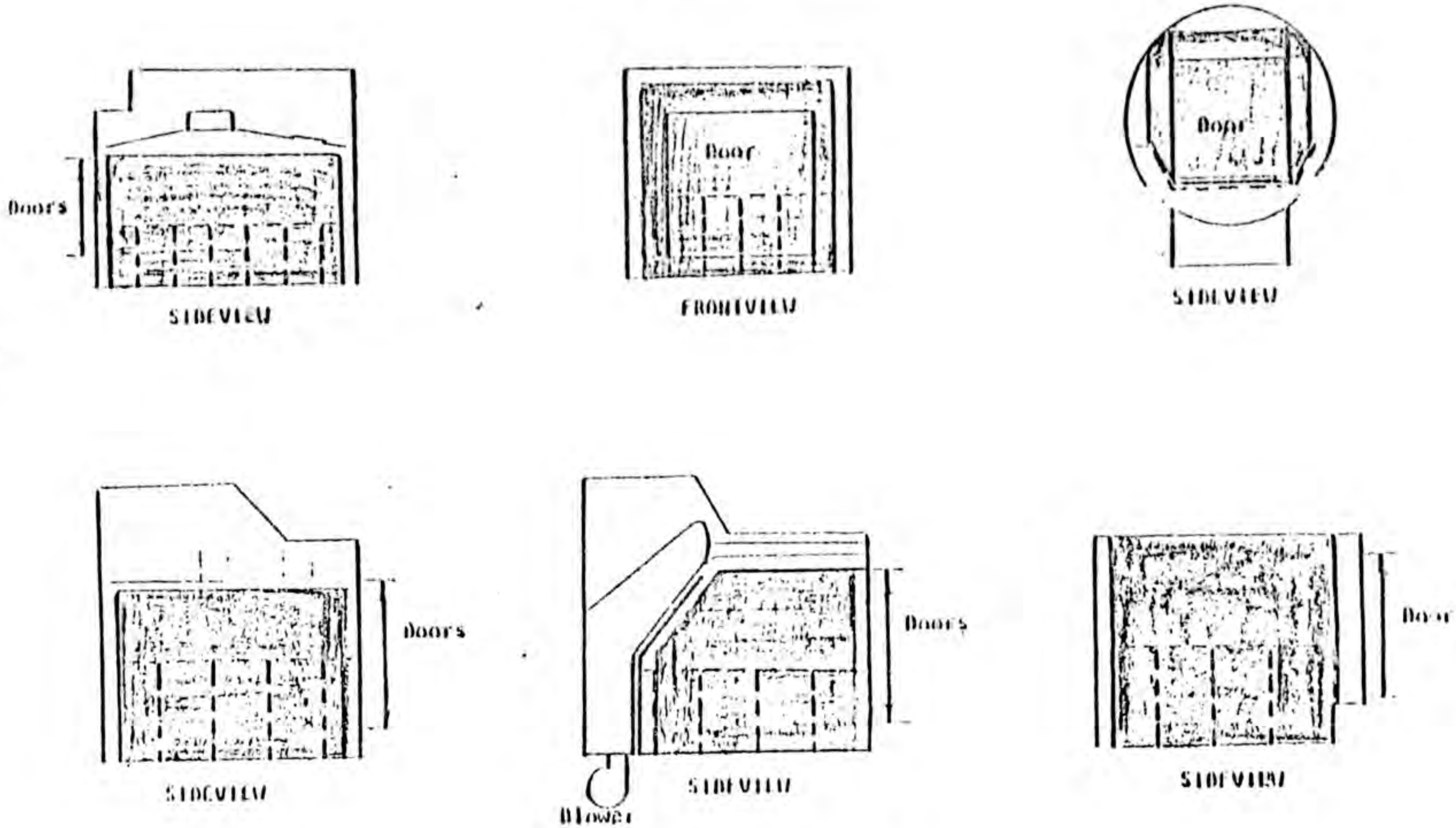


Figure 4.3

STATE OF OREGON

DEPARTMENT OF ENVIRONMENTAL QUALITY

Source Sampling Method 4

Determination of Moisture Content of Stack Gases

1. Principle and Applicability

1.1 **Principle.** A gas sample is extracted from the flowing gas stream and its moisture removed and measured either volumetrically or gravimetrically. Alternately, the moisture can be estimated by less accurate techniques for the purpose of setting the nomograph for isokinetic sampling. A wet bulb-dry bulb technique is discussed.

1.2 Applicability. The reference method is applicable for the determination of moisture in exhaust gases from stationary sources. The alternate method is to be used only for estimating the moisture content for the purpose of setting the nomograph unless otherwise specified.

2. Reference method

2.1 The method employed is essentially the same as used in the particulate determination source sampling method 5 and will not be discussed here.

3. Alternate method

3.1 Theory. The water vapor in a non-saturated gas stream causes a depression of the wet bulb temperature which is proportional to the fraction of moisture present.

3.2 Procedure

3.2.1 Measure the dry bulb temperature in the conventional way using either a thermometer or thermocouple.

3.2.2 Insert the end of the temperature measuring device in a cloth sock and saturate the sock with water. Inset the sock into the flowing gas stream and allow the temperature to reach a steady state. Caution: after the water on the sock has evaporated, the temperature will rise to the dry bulb temperature. (Figure 4-1). The wet bulb temperature must be taken while the sock is saturated with moisture.

3.2.3 Apply the wet bulb and dry bulb readings to the appropriate graph (Figure 4-2, 4-3, or 4-4) and determine the approximate water vapor content if the barometric pressure is near 29.92 in. Hg.

3.2.4 Alternately apply the wet bulb and dry bulb readings to equation 4-1 in Figure 4-5.

4. Interferences

4.1 The following conditions may drastically change the wet bulb reading causing erroneous results:

4.1.1 The presence of acid gases in the gas stream, i.e. SO_2, SO_3, HCl.

4.1.2 The presence of hydrocarbons in the gas stream.

4.1.3 Marked differences from atmospheric pressure (29.9 in. Hg) of the gas stream (if the graphs are used).

4.2 Should any of the above interferences be present, the tester should consider another approach to determining moisture content.

4.3 Additionally, the following conditions can lead to difficulties.

4.3.1 Very high dry bulb temperature (in excess of 500°F).

4.3.2 Very high or very low gas velocities.

4.3.3 High concentration of particulate matter which may adhere to the wet sock.

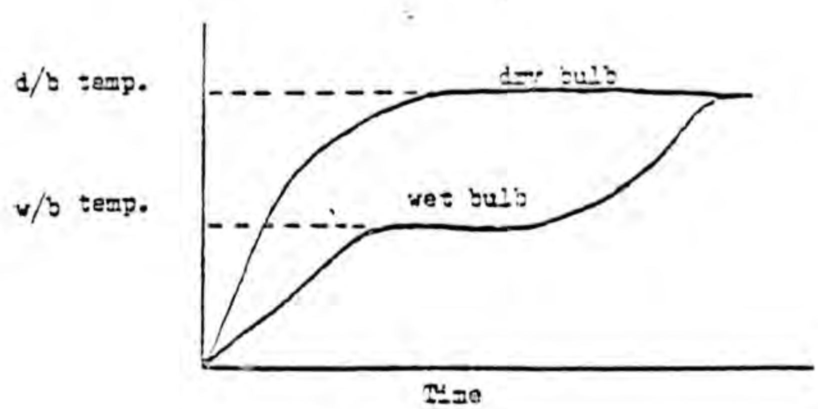


Figure 4-1

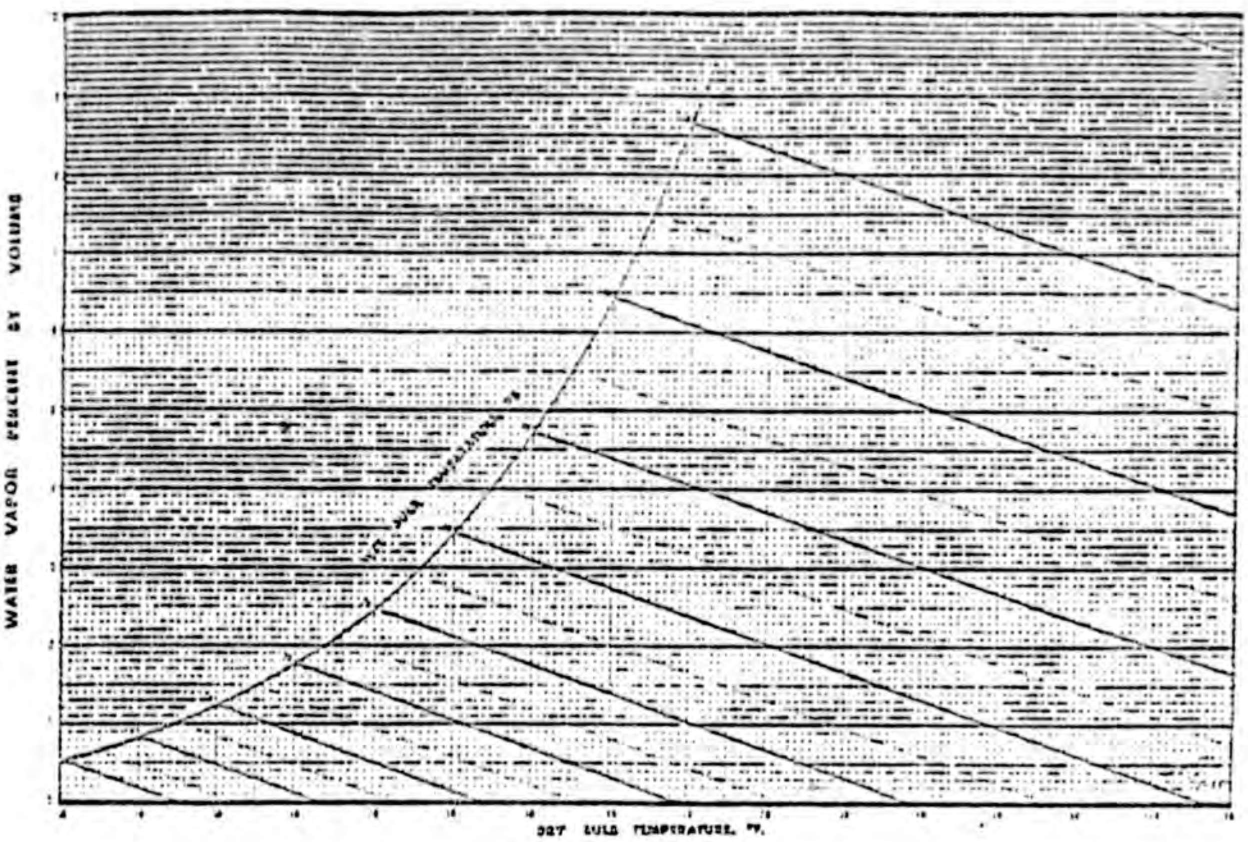


FIGURE 4-2

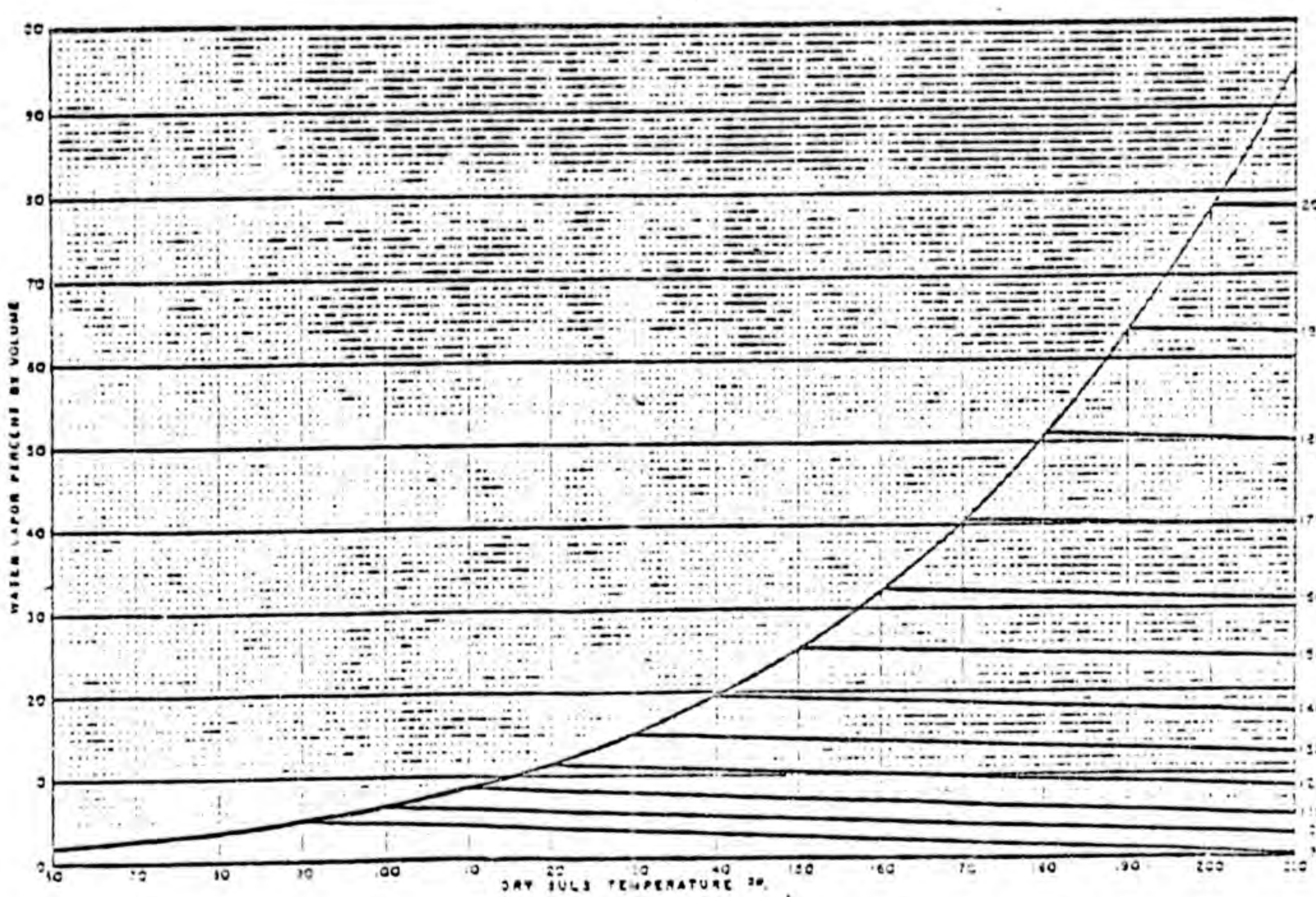


FIGURE 4-3

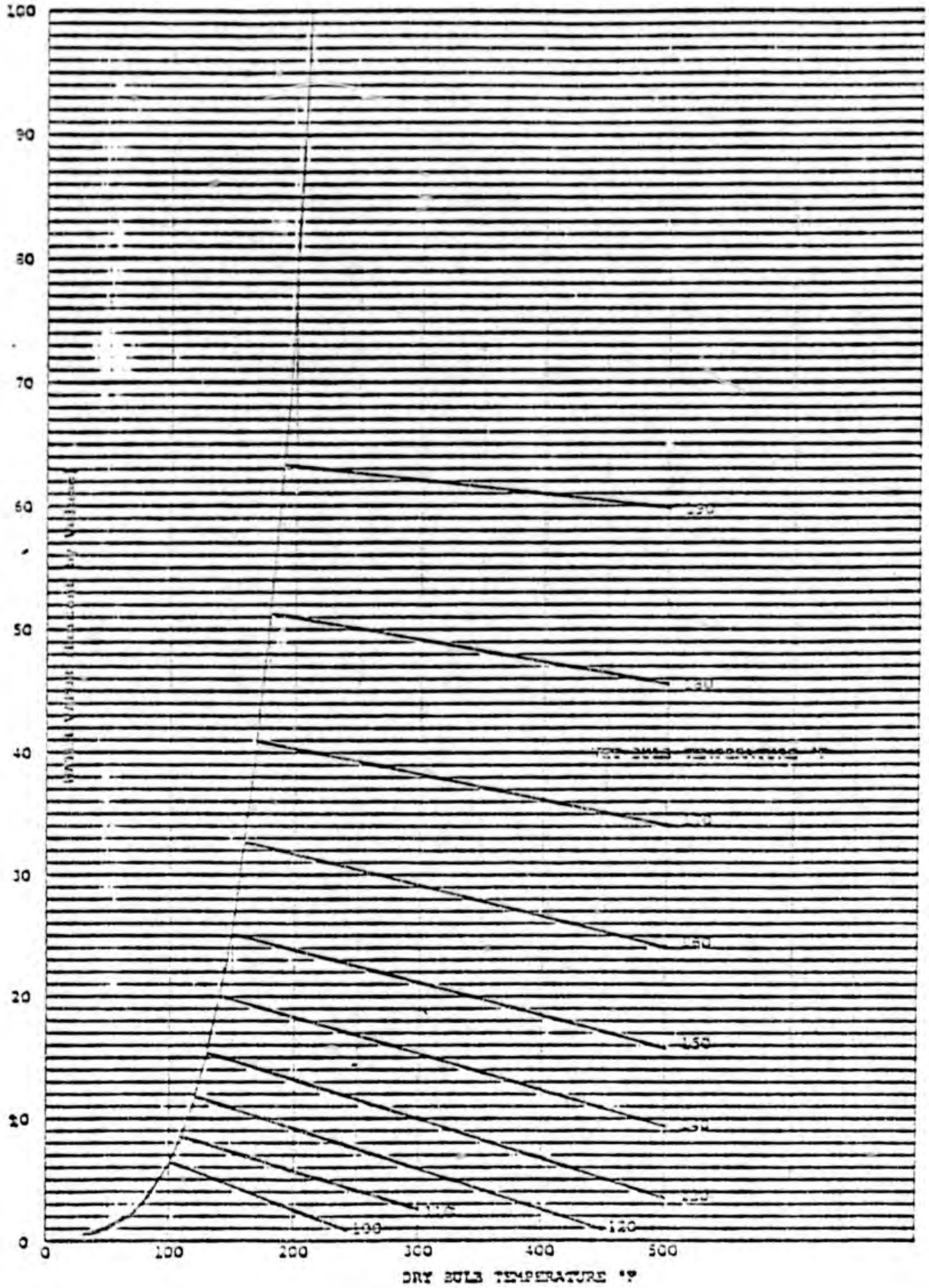

100
90
80
70
60
50
40
30
20
10
0
0
100
200
300
400
500
DRY BULB TEMPERATURE °F
100
120

Figure 4-4

$$\% H_2O = \frac{e'' - \dfrac{(P_a - e'')(t_d - t_w)}{2800 - 1.3\,t_w}}{P_a} \times 100 \qquad (4\text{-}1)$$

Where:

e'' = Vapor pressure of H_2O @ t_w, in. Hg (See Figure 4-5)

P_a = Absolute barometric pressure, in. Hg

t_d = Dry bulb temperature, $^{\circ}F$

t_w = Wet bulb temperature, $^{\circ}F$

VAPOR PRESSURES OF WATER AT SATURATION*

(Inches of Mercury)

Temp. Deg. F.	0	1	2	3	4	5	6	7	8	9
—20	.0126	.0119	.0112	.0106	.0100	.0095	.0089	.0084	.0080	.0075
—10	.0222	.0209	.0199	.0187	.0176	.0168	.0158	.0150	.0142	.0134
—	.0376	.0359	.0343	.0324	.0306	.0289	.0275	.0260	.0247	.0233
0	.0376	.0398	.0417	.0463	.0441	.0489	.0517	.0541	.0571	.0598
10	.0631	.0660	.0696	.0728	.0768	.0810	.0846	.0892	.0932	.0982
20	.1025	.1080	.1127	.1186	.1248	.1302	.1370	.1429	.1502	.1567
30	.1647	.1716	.1803	.1878	.1955	.2035	.2118	.2203	.2292	.2383
40	.2478	.2576	.2677	.2782	.2891	.3004	.3120	.3240	.3364	.3493
50	.3629	.3754	.3906	.4052	.4203	.4359	.4520	.4686	.4858	.5035
60	.5218	.5407	.5601	.5802	.6009	.6222	.6442	.6669	.6903	.7144
70	.7392	.7648	.7912	.8183	.8462	.8750	.9046	.9352	.9666	.9989
80	1.032	1.066	1.102	1.138	1.175	1.213	1.253	1.293	1.335	1.378
90	1.422	1.467	1.513	1.561	1.610	1.660	1.712	1.765	1.819	1.875
100	1.932	1.992	2.052	2.114	2.178	2.243	2.310	2.379	2.449	2.521
110	2.596	2.672	2.749	2.829	2.911	2.995	3.081	3.169	3.259	3.351
120	3.446	3.543	3.642	3.744	3.848	3.954	4.063	4.174	4.289	4.406
130	4.525	4.647	4.772	4.900	5.031	5.165	5.302	5.442	5.585	5.732
140	5.881	6.034	6.190	6.350	6.513	6.680	6.850	7.024	7.202	7.384
150	7.569	7.759	7.952	8.150	8.351	8.557	8.767	8.981	9.200	9.424
160	9.652	9.885	10.12	10.36	10.61	10.86	11.12	11.38	11.65	11.92
170	12.20	12.48	12.77	13.07	13.37	13.67	13.98	14.30	14.62	14.96
180	15.29	15.63	15.98	16.34	16.70	17.07	17.44	17.82	18.21	18.61
190	19.01	19.42	19.84	20.27	20.70	21.14	21.59	22.05	22.52	22.99
200	23.47	23.96	24.46	24.97	25.48	26.00	26.53	27.07	27.62	28.18
210	28.75	29.33	29.92	30.52	31.13	31.75	32.38	33.02	33.67	34.33
220	35.00	35.68	36.37	37.07	37.78	38.50	39.24	39.99	40.75	41.52
230	42.31	43.11	43.92	44.74	45.57	46.41	47.27	48.14	49.03	49.93
240	50.84	51.76	52.70	53.65	54.62	55.60	56.60	57.61	58.63	59.67

*Methods for Determination of Velocity, Volume, Dust, and Mist Content of Gases, Bulletin WP-50, Western Precipitation Corp., Los Angeles, Calif.

Figure 4-5

STATE OF OREGON

DEPARTMENT OF ENVIRONMENTAL QUALITY

Source Sampling Method 5

Sampling Particulate Emissions From Stationary Sources

1. Principle and Applicability

1.1 Principle. Particulate matter including condensible gases are withdrawn isokinetically from a flowing gas stream. The particulate matter is determined gravimetrically after removal of combined water.

1.2 Applicability. This method is applicable to the determination of particulate emissions from stationary sources except those sources for which specified sampling methods have been devised and are on file with the Department.

2. Acceptability. Results of this method will be accepted as demonstration of compliance (or non-compliance) provided that the methods included or referenced in this procedure are strictly adhered to and a report containing at least the minimum amount of information regarding the source is included as described in Sections 15 & 16. Deviations from the procedures described herein will be permitted only if permission from the Department is obtained in writing in advance of the tests.

3. Sampling Apparatus (Figure 5-1)

3.1 Probe - With heating system capable of maintaining sample gas temperature at 250° F at its exit end during sampling. Probes which are to be used at temperatures of 600° F or less may have liners constructed of seamless 316 stainless steel, Pyrex Glass or Incoloy 825[1]. Probes for temperatures in excess of 600° F may be constructed of Borosilicate glass (limit 900° F) or Quartz glass (limit 1650° F). Probes for temperatures in excess of 1650° F must be approved by the Department before use. Testing in corrosive atmospheres may require a special probe liner to prevent contamination of the sample.

3.2 Probe Nozzle - Constructed of stainless steel (316) with an external taper 30° or less to a sharp leading edge. The inside diameter of the nozzle shall be constant throughout the length of the nozzle. The wall thickness of the nozzle shall be less than or equal to 0.063 in. and a straight run of at least two times the internal diameter shall be provided between the leading edge and the first bend or point of disturbance. The nozzle shall be connected to the probe liner in such a way as to provide an airtight seal with no exposed threads or gaps to collect particulate matter. Calibration of the nozzle is covered in Section 13.3.

[1] Trade Name

3.3 Pitot tube - Type S or equivalent attached to the probe. The probe nozzle and face openings of the pitot tube shall be adjacent and parallel to each other (not necessarily in the same plane) and the free space between the nozzle and the pitot tube shall be at least 0.5 in. Calibration of the pitot tube is covered in Section 3, Source Sampling Method 2 .

3.4 Differential pressure gauges - Inclined or vertical fluid manometer capable of measuring the pressure differential to within 10% of the minimum measured value. Below 0.1 in. H_2O gauge, micromanometers with sufficient sensitivities shall be used. Other differential pressure measuring devices may be used provided they are calibrated against a fluid manometer and are adequately sensitive.

3.5 Cyclone (optional) - Miniature glass cyclone used when heavy concentrations of particulate are expected. The cyclone will extend the time a filter can be used before plugging.

3.6 Filter holder - Pyrex [1] glass with a glass frit filter support and silicone rubber gasket. The holder shall provide a positive seal against leakage from the outside or around the filter.

3.7 Filter heating system - Capable of maintaining a temperature of 250° F around the filter holder. A temperature gauge shall be provided to monitor this temperature.

3.8 Impingers - Greenburg-Smith design. The first, third and fourth may be modified by replacing the tip with a 1/2 inch ID glass tube extending to withint 1/2 inch of the bottom of the flask. The second impinger shall have the standard tip installed.

> Note: All connections between the probe and last impinger shall be made with glass ball joints.

3.9 Metering system - Vacuum gauge, leak-free pump, thermometers capable of measuring temperature to within 5° F dry gas meter accurate to within ± 1% and flow measuring device (orifice or rotometer) enabling isokinetic sampling to be maintained.

3.10 Barometer - Mercury, aneroid or other type capable of measuring atmospheric pressure to within 0.1 in. Hg. If the barometric pressure is to be obtained from a nearby weather bureau station, the true station pressure (not corrected for elevation) must be obtained and an adjustment for elevation differences between the station and sampling site must be applied.

3.11 Temperature and pressure measurement equipment - As described in Source Sampling Method 2.

3.12 Gas analyzer - As described in Source Sampling Method 3.

3.13 Nomograph

3.14 Timer - Integrating type, accurate, readable to the nearest 5 seconds per hour.

[1] Trade Name

4. Sample Recovery Apparatus

4.1 Probe brush and nozzle brush - nylon bristle or equivalent at least as long as the probe liner and the nozzle respectively.

4.2 Wash bottles - inert to the solvent used in them (usually acetone).

4.3 Sample storage containers - glass with glass or Teflon[1] lined cap or other material which is leak tight, resistant to chemical attack from acetone and allows complete recovery of particulate matter.

4.4 Petri dishes - for filter samples, glass or plastic. Alternately, individual paper envlopes with waxed paper liners may be used, but tare and final weights should not be included in the weight of the envelope or liner.

4.5 Graduated cyliner and/or balance - to measure condensed moisture to within 1 ml or 1 g. Graduate cylinders shall have subdivisions of 2 ml or less and balances shall be sensitive to 1 g.

4.6 Plastic storage containers - air tight containers to store silica gel unless it is weighed at the sampling site or transported to the laboratory in the impinger.

4.7 Rubber policeman - to aid in recovering sample from the train previous to the filter.

4.8 Dessicator - laboratory type using Drierite [1], indicating dessicant or equivalent.

4.9 Analytical balance - accurate and sensitive to ± 0.1 mg.

5. Reagents

5.0 Separating funnel - 500-1000 ml with Teflon [1] stopcock and plug.

5.1 Beakers - 250 ml & 400 ml Pyrex[1] or equivalent.

5.2 Filters - glass fiber filters, without organic binder, of near neutral pH, free of pinhole leaks, and exhibiting at least 99.95% efficiency on 0.3 micron DOP smoke particles. MSA-1160BH or equivalent, individually numbered for identification and pre-weighed as described in Section 6.1.

5.3 Silica gel - indicating type 6-16 mesh, dried at 175°C (350°F) for 2 hours if previously used.

5.4 Water - distilled, with a maximum total residue content of 0.001%. (0.01 mg/ml).

5.5 Acetone - reagents grade with a maximum total residue content of 0.001%. (0.01 mg/ml)

5.6 Crushed ice - any grade, crushed fine enough to provide efficient cooling for the impingers.

5.7 Stopcock grease - acetone resistant, heat stable, silicone grease.

5.8 Diethyl ether - reagent grade with a maximum total residue content of 0.001%. (0.01 mg/ml)

5.9 Chloroform - reagent grade with a maximum residue content of 0.001%. (0.01 mg/ml)

6. Sampling Train Preparation

6.1 Weigh numbered glass fiber filter paper to the nearest 0.1 mg on an analytical balance after dessication over Drierite for 24 hours or more.

6.2 Insert the filter into the filter holder and assemble taking care not to tear or bend the filter. Tighten the filter holder sufficiently to prevent leaks.

6.3 Add 100 ± 1 ml of distilled water to each of the first two impingers.

6.4 Add approximately 200 g of accurately weighed silica gel (± 1 g) to the fourth impinger.

6.5 Alternately after charging each of the impingers with the appropriate material, weigh the impinger and contents on balance to the nearest 1 g.

6.6 Assemble the train as shown in Figure 5-1 and check for leaks as in Section 8.

6.7 Seal the train with aluminum foil, a blanked connector or some other means to prevent contamination.

7. Pretest Preparations

7.1 Select a sampling site and the minimum number of traverse points as described in <u>Source Sampling Method 1</u>.

7.2 Determine the approximate moisture content as described in <u>Source Sampling Method 4</u>.

7.3 Make a preliminary pitot traverse to determine the maximum, minimum, and average pitot reading, duct temperature, and static pressure as described in <u>Source Sampling Method 2</u>.

7.4 Choose a nozzle size based on the range of pitot readings as described in Section 12 such that it is not necessary to change the nozzle size in order to maintain the isokinetic sampling rates for all traverse points.

7.5 Clean the chosen nozzle and probe (the shortest available which will reach all the traverse points), assemble and seal each end with aluminum foil to prevent contamination.

7.6 Attach the probe to the sample case, attach the electrical and hose connections, and turn on the probe and filter heating system. Adjust the heater controls to maintain the appropriate temperatures.

8. Leak Check

8.1 Plug the inlet to the filter.

8.2 With the fine flow adjustment (bypass) completely open, open the coarse flow adjustment completely and adjust to a vacuum of 15 in. Hg by closing the fine flow adjustment.

8.3 After sufficient time has elapsed for stabilization, measure the leakage rate for 1 minute or more and record. A leakage rate of less than 0.02 cfm at 15 in. Hg is acceptable. Use acetone resistant stopcock grease on impingers and ball joints if necessary to seal against leaks.

8.4 Slowly remove the plug from the filter inlet and immediately close the coarse flow adjustment.

9. Particulate Train Operation

9.1 Each point should be sampled a minimum of 2 minutes and a complete set of data readings should be taken at every point. If each point is sampled more than 5 minutes, a complete set of data readings should be taken at equal intervals during the sampling of every point but not less frequent than every five minutes.

9.2 Pack crushed ice around the impingers, turn on the probe heater and adjust so that the gases leaving the probe are 250°F. Add ice occasionally during the test in order to keep the temperature of the gas leaving the train at 70°F or less.

9.3 Position the probe nozzle at the first traverse point (taking care not to allow the nozzle to touch the stack walls) and block off the openings around the probe. Record the initial gas meter reading, temperatures, static pressure and pitot reading on the Particulate Field Data Sheet (Figure 5-5).

> Note: The probe should never be left in the stack when not sampling as particulate will be collected in the nozzle.

9.4 Calculate (as described in Section 12) and record the desired orifice setting, open the coarse flow adjustment and immediately start the timer.

9.5 As rapidly as possible, adjust the orifice reading using the coarse and fine flow adjustments to the desired reading.

9.6 At the end of the first sampling point (or not more than 30 seconds before) reposition the probe nozzle at the next sampling point.

Note the gas meter reading exactly at the end of the first time interval.

9.7 After the pitot readings have stablized, note the pitot reading, calculate the desired orifice setting, and adjust with the fine and coarse flow adjustments to the new setting. This should be done as rapidly as possible to avoid anisokinetic sampling.

9.8 Continue the above steps until all traverse points have been sampled an equal interval of time (except adjusted traverse points as described in Source Sampling Method 1.)

9.9 At the conclusion of the run, close the coarse flow adjustment, note the final gas meter reading and temperatures and withdraw the probe completely.

9.10 Seal the nozzle with aluminum foil as soon as it cools sufficiently to do so, disconnect the probe from the sample case, seal all other openings and transport to the cleanup (or storage) area.

9.11 Throughout the sample run, collect an integrated gas sample for composite analysis as described in Source Sampling Method 3.

9.12 Under no circumstances disconnect or loosen any part of the airtight train until the probe has been completely removed from the stack.

10. Particulate Train Cleanup

10.1 Cleanup should be performed in an area free of wind and airborne dust which may contaminate the sample or cause sample loss. If possible, the train should be cleaned in a laboratory.

10.2 After the probe and nozzle have cooled, remove the end seals and brush while rinsing with acetone into a suitable container (labelled).

Note: Exercise caution so that none of the rinse is lost and no extraneous material enters the rinse (such as from the pitot tubes).

10.3 Should it be necessary to clean the train in the field, use the following procedure:

10.3.1 Rinse all sample exposed surfaces prior to the filter (including the front half of the filter holder) with acetone. Remove any adhering particles with the aid of a rubber policeman. Place the rinsings in the probe rinse bottle.

10.3.2 Remove the filter without disturbing the particulate cake, place in a petri dish and seal.

10.3.3 Measure and record the volume (or weight) increase of the first three impingers and transfer their contents into a labelled container. Rinse the impingers and interconnects with distilled water and add to the container.

10.3.4 Rinse all sample exposed glassware between the filter (excluding the glass frit filter support) and the fourth impinger with acetone and store in a suitable marked container.

10.3.5 Determine the weight gain of the silica gel in the fourth impinger and record. Alternately transfer the silica gel quantitatively to an airtight container to be weighed in the laboratory.

10.3.6 Collected samples should be analyzed within one week of collection in order to prevent any possibility of biological or chemical degeneration.

11. Analysis

11.1 Dessicate the filter (in the field container) for 24 hours and weigh to constant weight.

11.2 Transfer the acetone rinse (Section 10.3.1) into a tared beaker or evaporating dish. Be sure all particulate is removed from the container. Evaporate the solvent at laboratory temperature and pressure, dessicate for 24 hours and weigh to constant weight ($\pm$ 0.5 mg change in 6 hours or more).

11.3 Transfer the acetone rinse from the back-half (Section 10.3.4) to a tared beaker or weighing dish. Evaporate as in 11.2 and weigh to constant weight.

11.4 Transfer the water in the impingers to a separatory funnel (Teflon[1] stoppered). Rinse the container with distilled water and add to the separatory funnel. Stopper and vigorously shake the separatory funnel 1 minute, let separate and transfer the chloroform (lower layer) into a tared beaker or evaporating dish. Repeat twice more. Repeat the above procedure using three 25 ml portions of diethyl ether in place of the chloroform.

11.5 Transfer the remaining water in the separatory funnel to a tared beaker or evaporating dish and evaporate at 105° C. Dessicate for 24 hours and weigh to constant weight.

11.6 Evaporate the combined impinger water extracts from Section 11.4 at laboratory temperature and pressure, dessicate for 24 hours and weigh to constant weight.

11.7 Evaporate portions of the solvents used in a manner similar to the sample evaporation to determine the solvent blanks.

11.8 Record all laboratory data on the Laboratory Data Reporting Sheet, Figure 5-9.

12. Nomograph Operation

12.1 Correction factor

12.1.1 Determine $\Delta H@$ for the orifice as described in the calibration Section 13.1

12.1.2 Estimate the probable meter temperature, Tm, often 20° F above ambient temperature, H_2O in stack gas, and Ps/Pm (ratio of absolute stack pressure to absolute meter pressure) as described in Section 7.

12.1.3 Determine the correction factor "C" using the correction factor nomograph, Figure 5-2a, as described on the nomograph. Correction of the factor "C" for a pitot Cp other than 0.85 can be made using the following equation:

$$C(\text{corrected}) = C \frac{C_p^2}{(0.85)^2}$$

12.2 Operating Nomograph

12.2.1 Adjust the sliding scale on the operating nomograph, Figure 5-2b, such that the "C" factor determined in Section 12.1.3 is opposite Reference Point A.

12.2.2 Using the preliminary pitot traverse data and duct temperature determined in Section 7, draw a line from T_s to the values of ΔP and select a suitable D (nozzle diameter) from the probe tip diameter scale.

12.2.3 Draw a line from T_s through D (actual diameter of nozzle to be used) and note where the line crosses the ΔP scale.

12.2.4 Draw a line from the ΔP obtained in 12.2.3 to Reference Point B on the ΔH scale and note where the line crosses the K factor scale. This point should be marked for future reference.

12.2.5 During sampling, align the pitot reading, ΔP, with the K factor setting, Section 12.2.4, to obtain the desired ΔH.

12.2.6 If T_s (absolute) changes by more than 50° F the K factor should be recalculated starting with 12.2.3.

13. Calibration

13.1 Orifice and dry gas meter

13.1.1 Connect the components as shown in Figure 5-3. The wet test meter is a 1 cf per revolution with ± 1% accuracy and capable of operating at a rate comparable to the expected sampling rate.

13.1.2 Run the pump about 15 minutes at an orifice reading of about 0.5 in. H_2O to allow the dry gas meter and pump to warm up and to wet all interior surfaces of the wet test meter.

13.1.3 Gather the information as required in Figure 5-4.

13.1.4 Calculate γ and $\Delta H@$ as described in Figure 5-4. If an average γ of 1.00 ± 0.01 is not obtained, the dry gas meter must be adjusted. If an average $\Delta H@$ of 1.84 ± 0.25 is not obtained, the orifice opening should be enlarged or replaced. Additionally the $\Delta H@$ should not vary more than ± 0.15 over the range of operation of 0.5 to 2 inches of H_2O.

13.1.5 Calibrate the orifice and dry gas meter every month or after every 5 tests whichever occurs first.

13.2 Temperature gauges

13.2.1 Check temperature gauges against mercury-in glass thermometers of certified accuracy or against suitable temperature standards (boiling or freezing points) at least yearly.

13.3 Probe Nozzle

13.3.1 Measure the inside nozzle diameter on at least 10 different diameters - to the nearest 0.001 inch using a micrometer or caliper. The nozzle diameter is the average of these readings to the nearest 0.001 inches.

13.3.2 The largest deviation from the average should not exceed ± 1% of the average diameter.

13.3.3 Calibrate the nozzle at least before every test.

14. Calculations

14.1 Gas velocity

14.1.1 Calculate the average gas velocity, V_s, from the pitot tube readings and gas temperatures using equation 5-2

$$(V_s)_{avg} = \frac{K_p C_p}{\sqrt{P_s M_s}} \sqrt{(\Delta P_s T_s)}_{avg} \qquad (5\text{-}2)$$

Where the symbols and units are the same for equation 2-2 in Source Sampling Method 2.

14.2 Gas volumetric flow rate

14.2.1 Calculate the volumetric flow rate of the gas from the duct area and the average gas velocity using equation 5-3

$$q_s = \frac{0.123 A_s \,(V_s)_{avg}\,(1-Bwo) P_s}{T_s} \qquad (5\text{-}3)$$

where the symbols and units are the same as equation (2-3) in Source Sampling Method 2.

14.3 Dry gas volume

14.3.1 Calculate the volume of gas sampled using equation 5-4

$$Q_d = \frac{17.65 Q_m \left(P_o + \frac{\Delta H}{13.6}\right)}{T_m} \qquad (5\text{-}4)$$

where Q_d = volume of gas sample, SDCF

Q_m = volume of gas through meter (meter conditions), CF

P_o = barometric pressure, absolute, in. Hg.

ΔH = average pressure drop across the orifice, in. H_2O

T_m = average dry gas meter temperature, ^oR

14.3.2 In the event the gas passing through the dry gas meter was not dry, the above equation must be multiplied by $(1-B_{wm})$ where B_{wm} is the volume fraction of water in the metered gas (assume saturation at the temperature of the last impinger).

14.4 Moisture content of duct gas

14.4.1 Calculate the moisture content of the duct gas from the total volume of water vapor condensed using equations (5-5), (5-6), and (5-7).

$$Q_v = 0.0474\ V_v \qquad (5\text{-}5)$$

where Q_v = volume occupied by water vapor, SCF
V_v = volume of water condensed in impingers and on silica gel, g or ml.

$$m_v = \frac{100\ Q_v}{Q_d + Q_v} \qquad (5\text{-}6)$$

where mv = volume percent of moisture in the sampled gas.

$$m_d = \frac{Q_d}{Q_d+Q_v} = 1-\frac{m_v}{100} \qquad (5\text{-}7)$$

where m_d = volume fraction of dry gas in the sampled gas

14.5 Calculate the molecular weight of the wet gas using the volume fraction of dry gas and the dry molecular weight using equation 5-8.

$$M_s = m_d M_d + 18\ (1-m_d) \qquad (5\text{-}8)$$

where M_s = molecular weight of the wet stack gas, lb/lb mole

M_d = molecular weight of the dry stack gas as defined in Source Sampling Method 3, equation (3-2)

14.6 Calculate the total particulate grain loading and correct to 12% carbon dioxide (when necessary) from the volume of gas sampled, the total weight of particulate sample and the % CO_2 using equation 5-9, and 5-10.

$$C_g = \frac{0.0154\ W}{Q_d} \qquad (5\text{-}9)$$

where C_g = total particulate grain loading, gr/sdcf

W = weight of particulate sample, mg

$$C_g' = \frac{12\ C_g}{\%\ CO_2} \qquad (5\text{-}10)$$

where C'_g = total particulate grain loading corrected to 12% CO_2, gr/sdcf @ 12 % CO_2

%CO_2 = percent by volume carbon dioxide as determined in Source Sampling Method 3.

14.7 Calculate the total particulate emission rate from the total particulate grain loading and the volumetric flow rate using equation 5-11

$$C_t = 0.00857 \; C_g q_s \qquad (5\text{-}11)$$

where C_t = total particulate emission rate, lbs/hr

q_s = Volumetric flow rate in duct, DSCFM as determined in Source Sampling Method 2.

14.8 Calculate the percent of isokinetic sampling rate from equation 5-12.

$$I = \frac{1039 \; T_s Q_d}{V_s P_s m_d D_n^4 \; t} \qquad (5\text{-}12)$$

where I = Percent of isokinetic sampling rate

T_s = Average stack temperature, °R

P_s = Average stack absolute pressure, in. Hg

D_n = Average nozzle inside diameter, in.

t = Total sampling time, min.

Q_d = Volume of gas sampled, SDCF

V_s = Average gas velocity, FPM

m_d = Volume fraction of dry gas

15. Minimum Acceptable Test Requirements

15.1 In order for a source test by this method to be acceptable as sufficiently accurate, the following requirements must be met unless otherwise indicated by the Department in writing:

15.1.1 A minimum sample volume of 60 SDCF of gas per run must be sampled.

15.1.2 A minimum run time of 60 minutes on continuous operations or one complete cycle covering at least 60 minutes on cyclic operations. A minimum of two runs per test is required.

15.1.3 The Department is notified in advance of all source tests so that it may have an observer present if desired.

15.1.4 All equipment used in the test shall be as specified in Section 3, 4, and 5.

15.1.5 All equipment used in the test shall be calibrated at the specified interval or more often and the calibration data and results included in the test report.

15.1.6 Accurate description of the sampling site including photographs.

15.1.7 Sufficient data to confirm that the sampling rate was within ± 10% of isokinetic.

16. Minimum Test Report Information - the following information concerning the source shall be included in the source test report.

16.1 Boilers

16.1.1 Name of manufacturer, nameplate capacity, and installation date of boiler and associated control equipment.

16.1.2 Control equipment on boiler (including cinder reinjection equipment).

16.1.3 Steam production rate, steam pressure and range of steam flow where possible. Use of a steam flow integrater is desirable.

16.1.4 Fuel composition (including estimated moisture content where applicable).

16.1.5 Opacity readings during or immediately after test by a certified reader.

16.2 Asphalt Plants (See Note 1)

16.2.1 Type, location and capacity of plant.

16.2.2 Control Equipment present.

16.2.3 Pressure drop across control equipment, water pressure on scrubber nozzles when present.

16.2.4 Production rate and type of mix during test.

16.2.5 Dryer fuel and firing rate.

16.2.6 Mix temperature (on drum mix plants)

16.2.7 Fines content of total aggregate feed.

16.2.8 Opacity readings during or immediately after test by a certified observer.

16.2.9 Photographs of plant in operation including plume after steam dissipation.

16.2.10 Special testing or production problems encountered.

NOTE 1: The source test requirements for asphalt plants constructed or modified after June 11, 1973 differ from this method in that only the particulate collected in the front half of the train (from the probe to the filter inclusive) is used for compliance evaluation. The impinger catch, however, must still be reported.

16.3 Incinerators

16.3.1 Manufacturer and capacity of incinerator.

16.3.2 Control equipment present.

16.3.3 Type and quantity of material incinerated.

16.3.4 Charging and stoking times.

16.3.5 Auxiliary fuel used and quantity consumed during test (measured).

16.3.6 Opacity readings during test by a certified observer.

16.3.7 Photographs of incinerator in operation including plume.

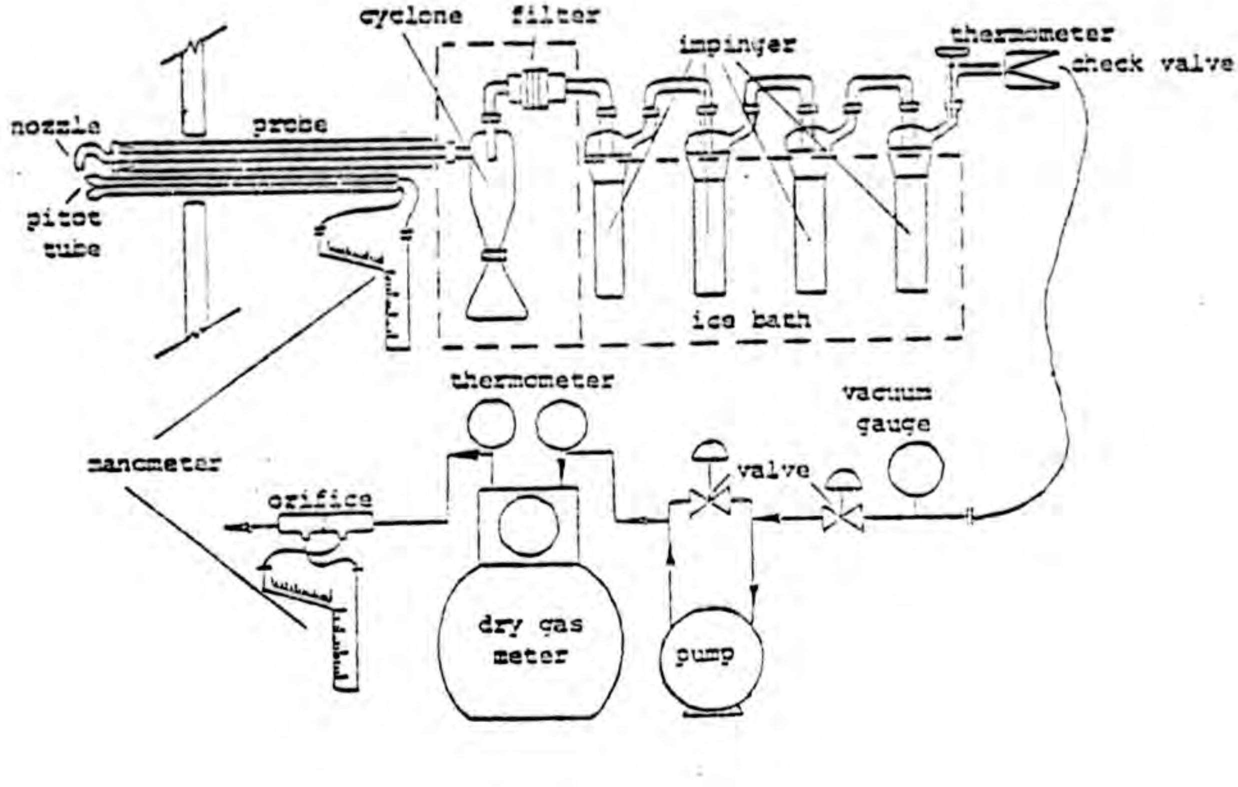

cyclone
filter
impinger
thermometer
check valve
nozzle
probe
pitot
tube
ice bath
thermometer
vacuum
gauge
manometer
valve
orifice
dry gas
meter
pump

FIGURE 5-1

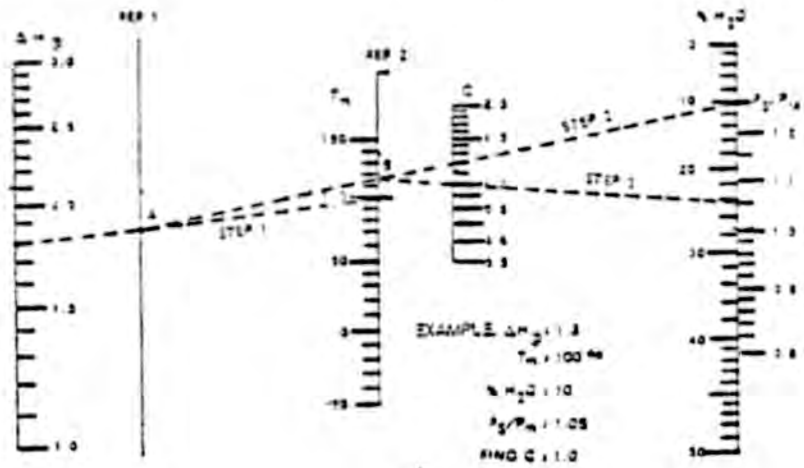


Figure 5-2(a)

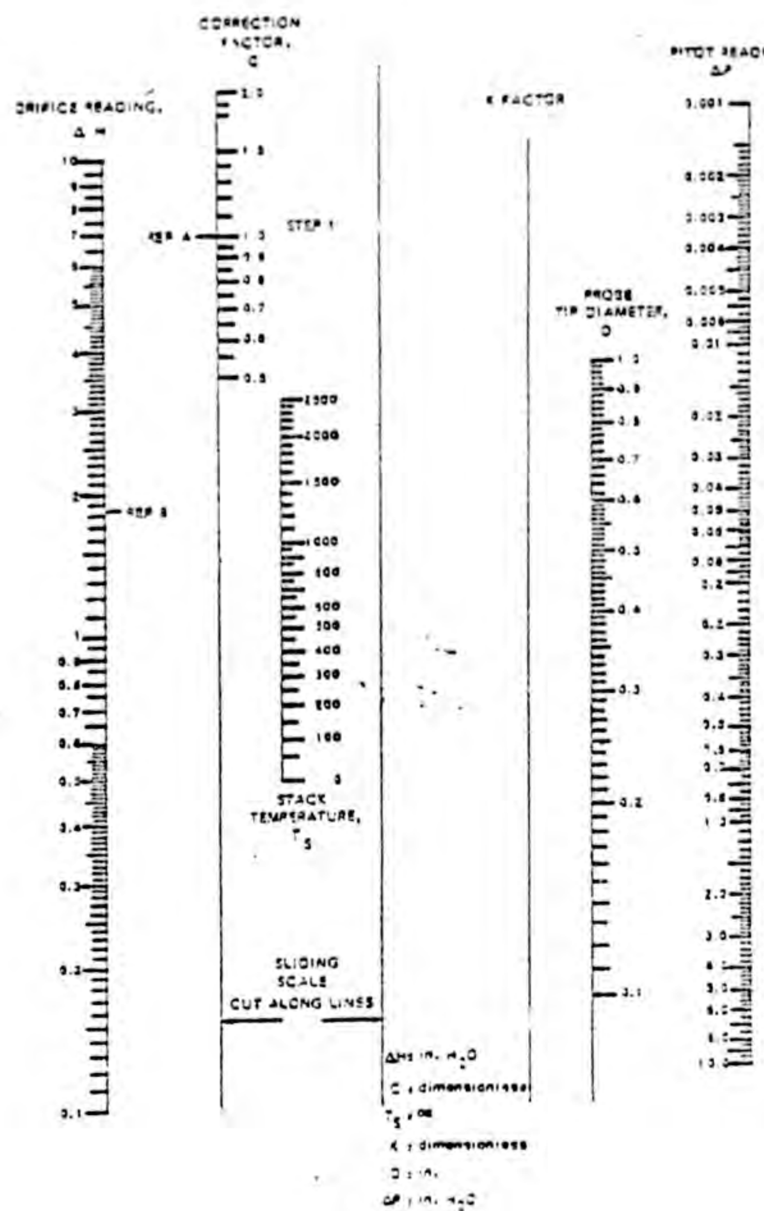


Figure 5-2(b)

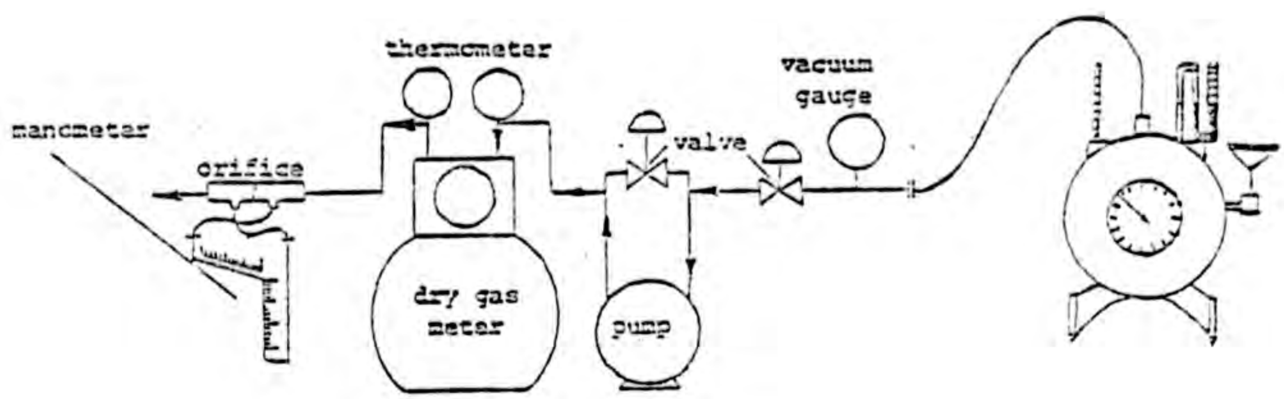

thermometer
vacuum
gauge
manometer
valve
orifice
dry gas
meter
pump

Figure 5-3

CALIBRATION SHEET

Figure 5-4

Orifice Gas Meter Date Barometric Pressure Pb:

Orifice Manometer ΔH in. H_2O	GAS VOLUME: Wet Test Meter V_w, cf	GAS VOLUME: Dry Gas Meter V_d, cf	TEMPERATURE: Wet Test Meter t_w, °F	TEMPERATURE: Dry Gas Meter Inlet t_{di}, °F	TEMPERATURE: Dry Gas Meter Outlet t_{do}, °F	TEMPERATURE: Dry Gas Meter Average t_d, °F	TIME θ, min.	RESULTS: Y	RESULTS: ΔH@
							Average		

$$Y = \frac{V_w P_b (t_d + 460)}{V_d \left(P_b + \frac{\Delta H}{13.6}\right)(t_w + 460)}$$

$$\Delta H@ = \frac{0.0317\ \Delta H}{P_b (t_{do} + 460)} \left[\frac{(t_w + 460)\theta}{V_w}\right]^2$$

Probe Nozzle Date

D_n, in.	D_n, in.	D_n, in.	
			Averages

Pitot Tube Date

Forward: ΔP_s	Forward: ΔP_{std}	Forward: C_p	Reverse: ΔP_s	Reverse: ΔP_{std}	Reverse: C_p	
						Average

$$C_p = 0.99 \left[\frac{\Delta P_{std}}{\Delta P_s}\right]^{\frac{1}{2}}$$

SOURCE SAMPLING FIELD DATA SHEET

Figure 5-5a

Plant ______________________

Address ______________________

Source ______________________

Date __________ Run __________

Train No. __________ Box No. __________

Probe Length ______ Probe material ______

Pitot C_p __________

Rinsings:

Other Samples:

Sketch of Sampling Site

DB Temp. ______ WB Temp. ______

Assumed Moisture ______ P. baro ______

Static Pressure ______ ΔH@ ______

"C" Factor ______ Nozzle ______

Stack Dimensions ______________________

Train Operator ______________________

Box Operator ______________________

Orsat

CO_2				
O_2				
CO				

Remarks:

AQ-602

						Orifice ΔH		Gas Meter				
Point	Distance	Clock	Meter Vol.	Pitot ΔP	Stack Ts	Calc.	Act	T In	T out	Vac.	Box T	Imp. T.

Figure 5-5b

Figure 5-6

VELOCITY DATA AND CALCULATIONS

Run No.__________ Date______________

Plant______________________________

Sampling Location__________________

Point No.	Stack Pressure Ps in. Hg gauge	Stack Temp. ts °F	Ts °R	Vel. Head ΔP in. H_2O	$(\Delta P \times Ts)$	$S=\sqrt{\Delta P \times Ts}$
Avg.						

Ps = absolute pressure - Ps + Po = ______ in. Hg

Ambient temp. = ________ °F

Ambient press.= ________ inches of Hg

STACK TEMP. Dry Bulb ________ °F

Wet Bulb ________ °F

CONST. C = ________

DEPARTMENT OF ENVIRONMENTAL QUALITY
AIR QUALITY DIVISION
VELOCITY DATA AND CALCULATIONS

Run No. ______________ Date __________

Plant ______________________________

Sampling Location ________________

Point No.	Distance Inches	Stack Temp. Ts °F	Ts °R	Vel. Head ΔP in H_2O	$(\Delta P \times Ts)$	$S = \sqrt{\Delta P \times Ts}$
Avg.						

Static Pressure, Ps ______________ in. H_2O

Atmospheric Pressure, Pb ________ in. Hg

Stack Pressure, Ps ______________ in. Hg

Dry Bulb Temp. ________ °F

Wet Bulb Temp. _______ °F

Moisture ________ %

Figure 5-6 (Revised)

Figure 5-7

COMBUSTION GAS ANALYSIS DATA SHEET

Source ______________________________ Date ____________

Sampling Point Location ______________________________

RUN ____

	CO_2	O_2	CO	N_2
Analysis 1				
Analysis 2				
Analysis 3				
Average				

Time ____________

Test conditions: ____

____ CO_2 Atomic Wt. (44) O_2 Atomic Wt. (32) CO Atomic Wt. (28) N_2 Atomic Wt. (28)

______ + ______ + ______ + ______ = Total Atomic Wt.

RUN ____

	CO_2	O_2	CO	N_2
Analysis 1				
Analysis 2				
Analysis 3				
Average				

Time ____________

Test conditions: ____

CO_2 Atomic Wt. (44) O_2 Atomic Wt. (32) CO Atomic Wt. (28) N_2 Atomic Wt. (28)

______ + ______ + ______ + ______ = Total Atomic Wt.

PARTICULATE SAMPLING CALCULATIONS

Plant ______________________ Sampling Location ______________________

Date of Test ______________________ FIGURE 5-3

PARAMETERS TO BE CALCULATED			RESULTS			
Symbol	Definition, Units	Calculating Equation	Run__	Run__	Run__	Avg.
Qm	Sample gas volume at meter conditions, $ft.^3$	Avg. from field data sheet				
H_2O	% H_2O	Moisture escaping last impinger				
tm	Gas meter temp., °F	Avg. fr. field data sheet				
H	Orifice pressure drop in H_2O	Avg. fr. field data sheet				
Po	Barometric pressure (in. Hg)	Field data sheet				
Vv	Tot. vol. of condensed water	Total fr. lab data sheet				
Md	Molecular weight of dry gas	Gas analysis-Atomic Wt.				
Ps	Stack pressure in Hg abs	$.07355 \times Ps' + Po$				
S	$\sqrt{P \times Ts}$	Avg fr. Vel calc. sheet				
C_p	Pitot Tube Coeff.	From Calibration Data				
As	Stack area ($in.^2$)	Field data sheet				
Ts	Stack temp., °R	Avg. fr. field data sheet				
Dn	Nozzle diameter (in.)	Field data sheet				
t	Total sampling time, min.	Total fr. field data sheet				
W	Wt. of particulate sample, mg	Total fr. lab data sheet				
$\%CO_2$	% CO_2	CO_2 analyzer				
Qd	Dry gas sample vol. at std. cond., scf.	$Qd = \frac{17.65\ (Qm)}{(tm+460)} \left[Po + \frac{\Delta H}{13.6} \right]$				
Qv	Tot. vol. of condensed water vapor @ std cond. (scf)	$Qv = 0.0474Vv$				
mv	% moisture in stack gas	$mv = \frac{100\ Qv}{Qv + Qd}$				
md	Mole fraction of dry gas	$md = \frac{Qd}{Qv + Qd}$				
Ms	Molecular wt. of stack gas	$Ms = mdMd + 18\ (1-md)$				
Vs	Stack velocity at stack, fpm	$Vs = 5129(Cp)(S) \left[\frac{1}{PsMs} \right]^{\frac{1}{2}}$				
qs	Stack flowrate at standard cond., scfm	$qs = \frac{0.123\ (Vs)(As)(md)(Ps)}{Ts}$				
I	Percent Isokinetic	$I = \frac{1039\ TsQd}{(Vs)(Ps)(md)(D_n2)(\Delta t)}$				
Cg	Total particulate grain load., gr/scf	$Cg = \frac{0.0154W}{Qd}$				
Cg'	Grain load. at 12% CO_2 gr/scf	$Cg' = Cg \times \frac{12}{(\%\ CO_2)}$				
Ct	Total particulate emission lb/hr.	$Ct = .00857\ (Cg)(qs)$				

AQ-605

Figure 3-8 (Revised)

DEPARTMENT OF ENVIRONMENTAL QUALITY
AIR QUALITY CONTROL DIVISION

PARTICULATE SAMPLING CALCULATIONS

Plant______________________________ Sampling Location______________________________

Date of Test_________________________

Symbol	Definition, Units	Calculating Equation	Run__	Run__	Run__	Avg.
Qm	Sample gas volume at meter conditions, $ft.^3$	Avg. from field data sheet				
tm	Gas meter temp., ^{o}F	Avg. from field data sheet				
H	Orifice pressure drop in H_2O	Avg. from field data sheet				
Po	Barometric pressure (in. Hg)	Field data sheet				
Vv	Tot. vol. of condensed water	Total fr. lab data sheet				
Md	Molecular weight of dry gas	Gas analysis-Atomic Wt.				
Ps	Stack pressure in Hg abs	$.07355 \times P\acute{s} + Po$				
S	$\sqrt{P \times Ts}$	Avg. fr. Vel. calc. sheet				
C_p	Pitot Tube Coeff.	From calibration data				
As	Stack area ($in.^2$)	Field data sheet				
Ts	Stack temp., ^{o}R	Avg. fr. field data sheet				
Dm	Nozzle diameter (in.)	Field data sheet				
Δt	Total sampling time, min.	Total fr. field data sheet				
W	Wt. of particulate sample, mg.	Total fr. lab data sheet				
$\%CO_2$	$\% \ CO_2$	CO_2 analyzer				
Qd	Dry gas sample vol. at std. cond., scf	$Qd = \frac{17.65(Qm)}{(tm+460)}\left[Po + \frac{\Delta H}{13.6}\right]$				
Qv	Tot. vol. of condensed water vapor @ std. cond. (scf)	$Qv = 0.0474\ Vv$				
mv	% moisture in stack gas	$mv = \frac{100\ Qv}{Qv + Qd}$				
md	Mole fraction of dry gas	$md = \frac{Qd}{Qv + Qd}$				
Ms	Molecular wt. of stack gas	$Ms = mdMd + 18\ (1-md)$				
Vs	Stack velocity at stack, fpm	$Vs = 5129(Cp)(S)\left[\frac{1}{PsMs}\right]^{\frac{1}{2}}$				
qs	Stack flowrate at standard cond., scfm	$qs = \frac{0.123(Vs)(As)(md)(Ps)}{Ts}$				
I	Percent Isokinetic	$I = \frac{1039\ TsQd}{(Vs)(Ps)(md)(Dn^2)(\Delta t)}$				
Cg	Total particulate grain load., gr/scf	$Cg = \frac{0.0154W}{Qd}$				
$C\acute{g}$	Grain load. at 12% CO_2 gr/scf	$C\acute{g} = Cg \times \frac{12}{(\%\ CO_2)}$				
Ct	Total particulate emission lb/hr	$Ct = .00857\ (Cg)(qs)$				

Figure 5-9

SOURCE SAMPLING-LABORATORY ANALYSIS OF PARTICULATE SAMPLE

Test ______________________________

Date of Test ______________________________

CONDENSED WATER DETERMINATION

Run No.	Impinger:	#1	#2	#3	#4	Total Condensate
	Final weight					
	Initial weight					
	Net weight					
	Final weight					
	Initial weight					
	Net weight					
	Final weight					
	Initial weight					
	Net weight					

GRAVIMETRIC RESULTS

Run No.	Contents	Filters	Probe & Filter Holder	Impinger Rinse	Impinger Extract	Impinger Water	Total Wt.
	Beaker No./Vol.						
	Gross wt.						
	Tare wt.						
	Net wt.						
	Blank wt.						
	Final wt.						
	Beaker No./Vol.						
	Gross wt.						
	Tare wt.						
	Net wt.						
	Blank wt.						
	Final wt.						
	Beaker No./Vol.						
	Gross wt.						
	Tare wt.						
	Net wt.						
	Blank wt.						
	Final wt.						

Sample Preparation: Volatiles evaporated at ________ C, Duration _____ hrs
Water evaporated at __________ C, Duration _____ hrs
Desicated at ______________ C, Duration _____ hrs
Laboratory Balance Type ____________________

Q-606

STATE OF OREGON

DEPARTMENT OF ENVIRONMENTAL QUALITY

Source Sampling Method 7

Sampling Condensible Emissions From Stationary Sources

1. Principle and Applicability

   1.1 Principle: Particulate matter including condensible gases is withdrawn isokinetically from a flowing gas stream. The particulate matter is determined gravimetrically after extraction with organic solvents and evaporation.

   1.2 Applicability: This method is applicable to stationary sources whose primary emissions are condensible gases. It should be considered a modification of Source Sampling Method 5 and applied only when directed to do so by the Department.

2. Sampling Apparatus (Figure 7-1)

   2.1 The probe, sampling train, and metering system are the same as outlined in 3. Sampling Apparatus of Source Sampling Method 5 with the following exceptions:

      2.1.1 The heated filter and cyclone are optional, but should be used if significant quantities of solid particulate are present.

      2.1.2 An unheated glass fiber filter is placed between the third and fourth impingers.

3. Sample Recovery Apparatus

   3.1 The sample recovery apparatus is the same as outlined in 4. Sample Recovery Apparatus of Source Sampling Method 5.

4. Reagents

   4.1 The reagents are the same as outlined in 5. Reagents of Source Sampling Method 5.

5. Sampling Train Preparation

   5.1 The sampling train preparation is the same as outlined in 6. Sampling Train Preparation of Source Sampling Method 5 with the following exception:

      5.1.1 Insert numbered and weighed filters into each of the front (if used) and rear filter holders.

6. Pretest Preparations and Leak Check

6.1 The pretest preparations and leak check are the same as outlined in Sections 7 and 8 of Source Sampling Method 5.

7. Condensible Particulate Train Operations

7.1 The train operation is the same as outlined in Section 9 of Source Sampling Method 5. It is important to note that the gas temperature leaving the last impinger must not exceed 70°F as temperatures above this may cause loss of condensible material by revolatilization.

8. Condensible Particulate Train Cleanup

8.1 Cleanup should be performed in an area free of wind and airborne dust which may contaminate the sample or cause sample loss. If possible, the train should be cleaned in a laboratory.

8.2 After the probe and nozzle have cooled, remove the end seals and brush while rinsing with acetone into a suitable marked container.

Note: Exercise caution so that none of the rinse is lost and no extraneous material enters the rinse (such as from the pitot tubes or condensed material from the outside of the nozzle).

8.3 Should it be necessary to clean the train in the field, use the following procedure:

8.3.1 Thoroughly rinse all sample exposed surfaces prior to the front filter support, with acetone. Remove any adhering particles with the aid of a rubber policeman. Place the rinsings in the probe rinse bottle. If the front filter is not used, all sample exposed surfaces prior to the first impinger should be included in this rinse.

8.3.2 Remove the front (if used) and rear filters, place in a petri dish and seal. Since a heavy loading of condensible material on the rear filter may leave a residue in the filter container which would necessitate removal with solvent, glass petri dishes are preferred.

8.3.3 Measure and record the volume (or weight) increase of the first three impingers to the nearest 1 ml (or 1 g) and transfer their contents to a labeled container. Rinse the impingers and interconnects with distilled water and add to the container.

8.3.4 Rinse all sample exposed glassware between the front filter (if used) or the first impinger (if the front filter is not used) and the fourth impinger (including glass filter frits) with acetone and place in a suitable marked container. If the moisture condensate in Section 8.3.3 was determined by use of a graduated container, it should also be rinsed with acetone and the rinse added to the impinger rinse container.

8.3.5 Determine the weight gain of the silica gel in the fourth impinger and record. Alternately transfer the silica gel quantatively to an air tight container to be weighed in the laboratory.

8.3.6 Collected samples should be analyzed within one week of collection in order to prevent any possibility of biological or chemical degradation.

9. Analysis

9.1 Desiccate the filter(s) at 70°F or less in the field container for 24 hours and weigh .

Note: In some cases, desiccation may give rise to a slow vaporization of the condensible material. Therefore it is not recommended that an attempt to weigh to constant weight be made.

9.2 Transfer the acetone rinse (Section 8.3.1) into a tared beaker or evaporating dish. Rinse the container with acetone (police to remove particulate) and add the rinse to the beaker. Evaporate the solvent at 70°F or less and laboratory pressure, desiccate 24 hours and weigh . See note in Section 9.1.

9.3 Transfer the acetone rinse from the impingers (Section 8.3.4) to a tared beaker or evaporating dish and treat as in Section 9.2.

9.4 Transfer the water (Section 8.3.3) to a separatory funnel. Rinse the container with distilled water and add to the separatory funnel. Add 25 ml of chloroform to the separatory funnel, stopper and vigorously shake 1 minute, let separate and transfer the chloroform (lower layer) into a tared beaker or evaporating dish. Repeat twice more. Repeat the above extraction using three 25 ml portions of diethyl ether in place of the chloroform. Transfer the ether (upper layer) to the same container as used to contain the chloroform.

Note: It is necessary to rinse the field container for water (if used) with solvent. This rinse may be made using the extracting reagents in which case it is added to the impinger extract container or with acetone in which case it is added to the container in Section 9.3.

9.5 Transfer the remaining water from the separatory funnel to a tared beaker or evaporating dish and evaporate at 105°C . Desiccate for 24 hours and weight.

9.6 Evaporate the combined impinger water extracts from Section 9.4 at 70°F or less and laboratory pressure, desiccate for 24 hours and weigh . See note in Section 9.1.

9.7 Evaporate portions of the solvents used in a manner similar to the sample evaporations to determine the solvent blanks.

9.8 Record all laboratory data in the Laboratory Data Reporting Sheet, Figure 5-9, Source Sampling Method 5.

10. Calculations

10.1 The calculations are the same as outlined in 14. Calculations of Source Sampling Method 5.

11. Minimum Acceptable Test Requirements

11.1 The minimum acceptable test requirements are the same as outlined in 15. Minimum Acceptable Test Requirements of Source Sampling Method 5.

12. Minimum Test Report Information

12.1 The test report should contain sufficient information about the source to accurately define its operation during the test. Also sufficient data and calculations shall be included to document the source test results.

Appendix 1 - Errata (12-12-84)

1. Subsection 3.4.1, page 3; delete "shielded" in first sentence.

2. Subsection 3.10.1, page 5; replace "relative humidity" with "wet and dry bulb temperatures and barometric pressure."

3. Subsection 3.12.5(a), page 7; "rotometer" is misspelled in the first sentence. The correct spelling is "rotameter."

4. Subsection 3.12.5(a), page 7; replace "such as a dry or wet gas meter or an accurate volume (displacement)" with "(dry gas meter) or an accurate volume displacement device (wet test meter)."

5. Subsection 6.3.1(a), page 18: "rotometer" is misspelled in the first sentence.

6. Subsection 6.3.1(a), page 18; the third impinger should not contain silica gel, therefore, the last sentence in the first paragraph, should read "Impingers one, two and three shall be empty for water collection."

7. Equation 6.3.1(a), page 18;

   $$\text{"Flow(cfm)} = \frac{Ir}{Dc} \times \frac{1}{60} \times \frac{Tr}{Pr \times 17.65^{*}}\text{"}$$

   should read:

   $$\text{"Flow(dscfm)} = \frac{Ir}{Dc} \times \frac{1}{60} \times \frac{Pr \times 17.65}{Tr}\text{"}$$

8. Equation 6.3.1(a), page 18; "rotometer" is misspelled on the last line.

9. Footnotes to equation 6.3.1(a), page 19; "*=Density specific for SO_2" should be deleted.

10. Equation 6.4.1(a), page 19; "= % Dry basis moisture (free and combined) -1800" should read "= % Dry basis moisture (free and combined) - 1800."

11. Equation 6.4.1(a), page 19; "a = Mole fraction of oxygen in air supply" is replaced by "a = Moles O_2 supplied per mole of stack gas."

12. Equation 6.4.1(h), page 20;

    $$\text{"}\frac{TSG \times 386.2}{60}\text{"} \quad \text{should read} \quad \text{"}\frac{TSG' \times 386.2}{60}\text{"}$$

13. Equation 6.5.2(c), page 21; the heat of combustion for carbon monoxide should read "= 121,716 Btu/mole."

14. Equation 6.5.2(d), page 22; all expressions for specific heat appearing as "Btu/mole" where the definition starts with C_pCO_2 should read "Btu/mole°F."

15. Subsection 7.1.5, page 23; delete "and an hourly average over the entire test cycle at each heat output level."

16. Subsection 7.1.9(a), page 24, "Average flow rate cfm" is deleted.

17. Subsection 7.1.10(b), page 24, "Hydrocarbon: grams/kg, and grams/10^6 joule (calculated)" is deleted.

18. Subsection 8.2.1, page 25; "certifiation" is mispelled in the first sentence. The correct spelling is "certification."

19. Dicholoromethane should be substituted for chloroform or diethyl ether for the Method 7 analysis.

Note for Clarification only: All catalytic combustor aging procedures must be conducted by a DEQ accredited test laboratory for stove certification purposes.

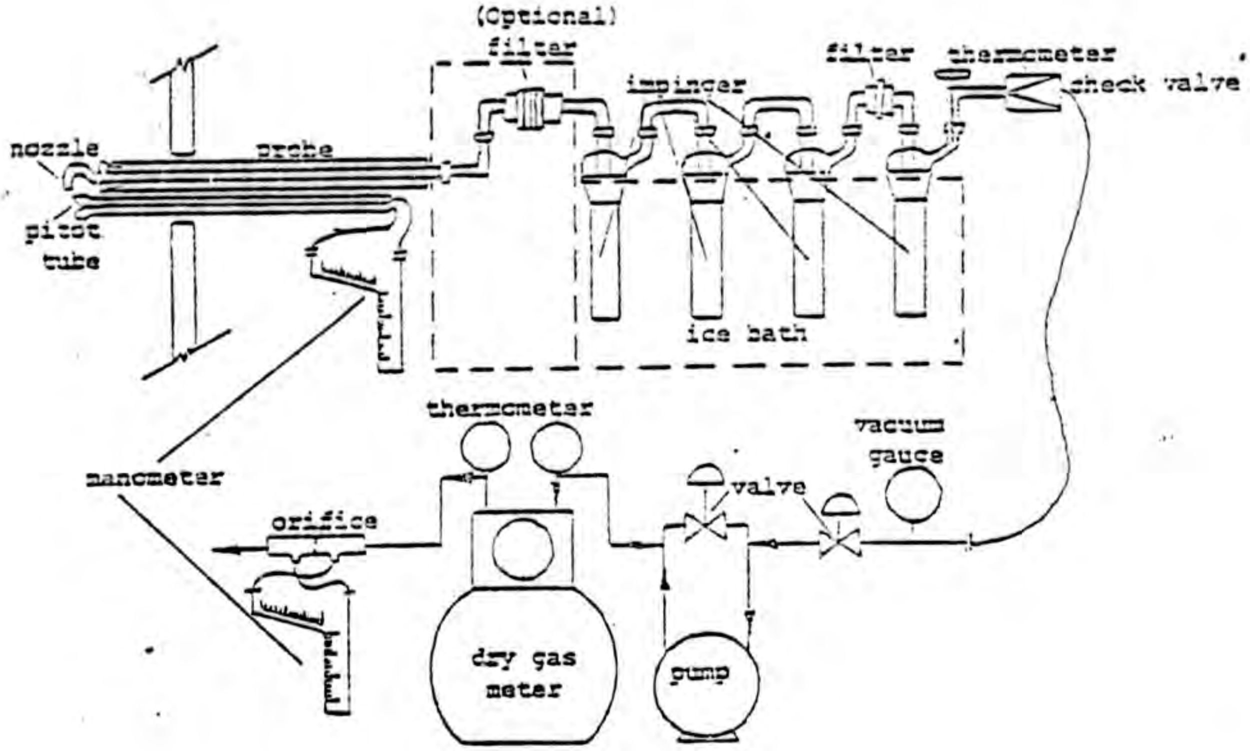

(Optional)
filter
filter
thermometer
check valve
impinger
nozzle
probe
pitot
tube
ice bath
thermometer
vacuum
gauge
manometer
valve
orifice
dry gas
meter
pump

Figure 7-1

Scheduled Maintenance

340-21-070 (1) In the case of shutdown of air pollution control equipment for necessary scheduled maintenance, the intent to shutdown such equipment shall be reported to the Department at least twenty-four (24) hours prior to the planned shutdown. Such prior notice shall include, but is not limited to the following:

(a) Identification of the specific facility to be taken out of service;

(b) The expected length of time that the air pollution control equipment will be put out of service;

(c) The nature and quantity of emissions of air contaminants likely to occur during the shutdown period;

(d) Measures, such as the use of offshift labor and equipment, that will be taken to minimize the length of the shutdown period, and where practical, minimize air contaminant emissions;

(e) The reasons that it would be impractical to shut down the source operation during the maintenance period.

(2) Additionally, in the case of maintenance scheduled more frequently than one time in a 90-day period, requiring shutdown of air pollution control equipment, or for any maintenance requiring shutdown of air pollution control equipment for a time period longer than 48 hours, prior approval of the maintenance program may be required by the Department. Application for approval shall be submitted in writing within 30 days after a request by the Department and shall include, in addition to subsections (a) through (e) in section (1) of this rule, specific information as to the frequency and the necessity of the scheduled maintenance. Approval of the program by the Department shall be based upon a determination that the proposed maintenance schedule is necessary and that all reasonable precautions have been taken to minimize the extent and frequency of air contaminant emissions in excess of applicable standards.

(3) No scheduled maintenance resulting in the emission of air contaminants in violation of applicable standards shall be performed during any period in which Air Pollution Alert, Air Pollution Warning, or Air Pollution Emergency has been declared.

Stat. Auth.: ORS Ch. 468
Hist.: DEQ 37, f. 2-15-72, ef. 3-1-72

Malfunction of Equipment

340-21-075 In the event that any emission source, air pollution control equipment or related facility malfunctions or breaks down in such a manner as to cause the emission of air contaminants in violation of applicable standards, the person responsible for such equipment shall:

(1) Notify the Department, by telephone or in person, of such failure or breakdown within one (1) hour of the occurrence, or as soon as is reasonably possible, giving all pertinent facts including the estimated duration of the breakdown.

(2) With all practicable speed, initiate and complete appropriate action to correct the conditions, and to reduce the frequency of such occurrences.

(3) Cease or discontinue operation of the equipment or facility no later than 48 hours after the beginning of the breakdown or upset period if the malfunction is not corrected within that time. The Director may, for good cause shown, which shall include but not be limited to, equipment availability, difficulty of repair or installation, and nature and amount of the emission, authorize the extension of the operation period beyond 48 hours under this section for a reasonable period of time as determined by him to be necessary to correct the malfunction or breakdown.

(4) In the event an Air Pollution Alert, Air Pollution Warning, or Air Pollution Emergency is declared, or in the event the nature or magnitude of emissions from malfunctioning equipment is deemed by the Department to present an imminent and substantial endangerment to health, immediately proceed to cease or discontinue operation of the equipment or facility.

(5) Notify the Department when the condition causing the failure or breakdown has been corrected, and upon request, submit a written statement of the causes and the action taken to prevent future similar upset or breakdown conditions.

Stat. Auth.: ORS Ch. 468
Hist.: DEQ 37, f. 2-15-72, ef. 3-1-72

Woodstove Certification

Definitions

340-21-100 Unless otherwise required by context, as used in this Division:

(1) "Accredited" means a woodstove testing laboratory holds a valid certificate of accreditation issued by the Department.

(2) "Audit test" means a test conducted by the Department to verify a laboratory's certification test results.

(3) "Catalyst-equipped" means a woodstove with a catalytic combustor that is an integral component of the design and manufacture of a woodstove.

(4) "Certify" means the Department has acknowledged in writing that a woodstove meets Department emission standards when tested by an independent laboratory according to Department test procedures.

(5) "Consumer" means any person who buys a woodstove for personal use.

(6) "Dealer" means any person engaged in selling woodstoves to retailers or other dealers for resale. A dealer which is also an Oregon retailer shall be considered to be only a retailer for purposes of these rules.

(7) "Fixed air supply" means an air supply system on a woodstove which has no adjustable or controllable air inlets.

(8) "Heat output" means the heat output (Btu/hour) of a woodstove during one test run, measured under test conditions prescribed by OAR 340-21-120.

(9) "Informal Departmental conference" means a meeting of a manufacturer, dealer, retailer, or laboratory representative and a representative of the Department to discuss certification or accreditation denial or revocation, or civil penalties. An informal Departmental conference is not part of a judicial process or the formal hearing process as described in Oregon Administrative Rules Chapter 340, Division 11.

(10) "Manufacturer" means any person who constructs a woodstove or parts for woodstoves.

(11) "New Woodstove" means any woodstove that has not been sold, bargained, exchanged, given away or has not had its ownership transferred from the person who first acquired the woodstove from the manufacturer's dealer or

agency, and has not been so used to have become what is commonly known as "second hand" within the ordinary meaning of that term.

(12) "Overall efficiency (%) over the range of heat outputs tested" means the weighted average combustion efficiency (%) multiplied by the weighted average heat transfer efficiency (%) measured under test conditions (range of heat outputs) and calculated according to specific procedures prescribed by OAR 340-21-115(5). This definition is applicable to the Stack Loss Methodology. For the Calorimeter Room Method, the weighted average overall efficiency means the useful heat output released to the room, divided by the total heat potential of the fuel consumed.

(13) "Retailer" means any person engaged in the sale of woodstoves directly to consumers.

(14) "Smoke emission rate (grams/hour) over the range of heat outputs tested" means the weighted average particulate emissions (grams/hour) that are produced by a woodstove under test conditions (range of heat outputs) specified in OAR 340-21-120 and calculated according to procedures specified in OAR 340-21-115(5).

(15) "Weighted average" means the weighted average of the test results to the distribution of home heating needs in Oregon. (Refer to OAR 340-21-115(5)).

(16) "Woodstove" means a wood fired appliance with a closed fire chamber which maintains an air-to-fuel ratio of less than 30 during the burning of 90 percent or more of the fuel mass consumed in the low firing cycle. The low firing cycle means less than or equal to 25 percent of the maximum burn rate achieved with doors closed or the minimum burn achievable, whichever is greater.

Stat. Auth.: ORS Ch. 468
Hist.: DEQ 11-1984, f. & ef. 6-26-84

Requirements for Sale of New Woodstoves in Oregon

340-21-105 (1) On and after July 1, 1986, a person shall not advertise to sell, offer to sell, or sell a new woodstove in Oregon unless:

(a) The woodstove has been tested to determine its emission performance and heating efficiency in accordance with criteria and procedures specified in OAR 340-21-120; and

(b) The woodstove is certified by the Department in accordance with procedures in OAR 340-21-125 as meeting the emission performance standards specified in OAR 340-21-115; and

(c) The woodstove is labelled for emission performance and heating efficiency as specified in OAR 340-21-135; provided, however, that section (1) of this rule shall not apply to any sale from any manufacturer or dealer: to any Oregon manufacturer or dealer: or to any out-of-state manufacturer, dealer or retailer; or to any offer or advertisement for such sale directed only to such a manufacturer, dealer or out-of-state retailer.

(2) No manufacturer, dealer or retailer shall alter either the permanent or removable label in any way from the label approved by the Department pursuant to OAR 340-21-155.

(3) Violators of any of the above rules may be subject to civil penalties pursuant to OAR Chapter 340, Divisions 11 and 12 or other remedies prescribed by rule or statute.

Stat. Auth.: ORS Ch. 468
Hist.: DEQ 11-1984, f. & ef. 6-26-84

Exemptions

340-21-110 (1) Wood-fired appliances that are not suitable for heating equipment in or used in connection with residences or commercial installations are excluded from 340-21-105. For example, portable camping stoves.

(2) Wood-fired forced air furnaces that primarily heat living space or water through indirect heat transfer using forced air duct work or pressurized water systems are excluded from 340-21-105.

Stat. Auth.: ORS Ch. 468
Hist.: DEQ 11-1984, f. & ef. 6-26-84

Emissions Performance Standards and Certification

340-21-115 (1) New woodstoves with minimum "heat output" of less than 40,000 Btu/hr advertised for sale, offered for sale, or sold in Oregon within the period July 1, 1986 to June 30, 1988, shall not exceed the following weighted average particulate emission standards when tested to procedures in OAR 340-21-120:

(a) 15 grams per hour for a non-catalytic woodstove; or

(b) 6 grams per hour for a catalyst-equipped woodstove.

(2) New woodstoves with minimum "heat output" of less than 40,000 Btu per hour advertised for sale, offered for sale, or sold in Oregon on or after July 1, 1988 shall not exceed the following weighted average particulate emission standard when tested and measured according to test procedures in OAR 340-21-120:

(a) 9 grams per hour for a non-catalytic woodstove; or

(b) 4 grams per hour for a catalyst-equipped woodstove.

(3) New woodstoves with a minimum "heat output" of greater than 40,000 Btu per hour, advertised for sale, offered for sale, or sold in Oregon after July 1, 1986 shall not exceed an average particulate emission standard equal to the sum of 8.0 grams per hour plus 0.2 grams per hour for each thousand Btu per hour heat output when tested to procedures in OAR 340-21-120.

(4) The Department will certify a woodstove as meeting the applicable woodstove emission standard after July 1, 1984 in accordance with procedures in OAR 340-21-125.

(5) The weighted average particulate emission shall be calculated as set out in Exhibit 1.

Stat. Auth.: ORS Ch. 468
Hist.: DEQ 11-1984, f. & ef. 6-26-84

Testing Criteria and Procedures

340-21-120 (1) To be considered eligible for certification, a woodstove must be tested in strict conformance with criteria and procedures contained in the document **Standard Method for Measuring the Emissions and Efficiencies of Residential W[illegible]dstoves** dated June 8, 1984, and incorporated herein by re[illegible]nce and on file at the Department.

(2) A[illegible]ing for certification purposes shall be conducted by [illegible]stove testing laboratory accredited by the Department in accordance with procedures specified in OAR 340-21-160.

(3) The Department may permit minor changes in the testing criteria and procedures which the Department believes does not affect its accuracy with respect to compliance with the emission standard providing such changes are approved in writing by the Department prior to the actual conducting of such tests.

[Publications: The publication(s) referred to or incorporated by reference in this rule are available from the office of the Department of Environmental Quality.]

Stat. Auth.: ORS Ch. 468
Hist.: DEQ 11-1984, f. & ef. 6-26-84

General Certification Procedures

340-21-125 (1) Any woodstove manufacturer, or dealer, wishing to obtain certification of a woodstove shall file an application with the Department.

(2) An application for certification must include:

(a) An appliance description which includes the woodstove model name and design number, a copy of the appliance's operating manual and a photograph of the stove.

(b) Design plans of the woodstove, identified by design number, which include overall dimensions of the appliance and all dimensions and specifications of components critical to emission control and heating efficiency performance. These components shall include combustion chamber configurations, all air inlet controls, heat exchanger design and make and model numbers of applicable purchased parts.

(c) All test data and support documentation showing that the woodstove has been tested in accordance with OAR 340-21-120 and that it meets the emission performance standard specified in OAR 340-21-115.

(d) A non-refundable certification fee, payable to the Department at the time the application is submitted to the Department, is required for each stove model seeking certification. The fee is:

(A) $1600 for a manufacturer's first model seeking certification: and

(B) $ 800 for each additional model submitted by the manufacturer.

(3) The Department will promptly review an application for certification and:

(a) Notify the applicant in writing within 30 days of receipt of the application, of any deficiencies in the application that cause the application to be incomplete,

(b) Notify the applicant within 60 days of receipt of a completed application whether certification is granted or denied pursuant to sections (4) and (7) of this rule.

(4) When all the preceeding requirements have been met, the Department will issue or deny a certification document to the manufacturer or dealer for the specified woodstove.

(5) If the Department grants certification, the certification status shall be effective for no longer that five years unless extended or terminated by rule or order.

(6) An application for a new document of certification shall be made by submitting a completed application including retests and fees at least 60 days prior to expiration of certification. The Department may waive the retest and fees if the applicant demonstrates the previous evidence used to certify the woodstove has not changed and remains reliable and applicable.

(7) If the Department denies certification of a woodstove, the Department will notify the manufacturer or dealer in writing of the opportunity for a hearing pursuant to OAR Chapter 340, Division 11.

Stat. Auth.: ORS Ch. 468
Hist.: DEQ 11-1984, f. & ef. 6-26-84

Changes in Woodstove Design

340-21-130 Certification of woodstoves shall be valid for only the specific model, design, plans and specifications which were originally submitted, tested and approved for certification. Any modification to the model, design, plans or specifications shall cause the certification to be ineffective and any so modified woodstoves to be uncertified, unless prior to making such modification the certification holder submits the proposed modification to the Department for approval, and the Department approves it. The Department may approve the proposed modification if the holder demonstrates and the Department finds that the proposed modification would not affect emission performance or heating efficiency.

Stat. Auth.: ORS Ch. 468
Hist.: DEQ 11-1984, f. & ef. 6-26-84

Labelling Requirements

340-21-135 Woodstoves which must be labelled pursuant to OAR 340-21-105 and shall have affixed to them:

(1) A permanent label, that has been previously approved by the Department in writing as to form, content and location, that shows the test emissions and heating efficiency for the range of heat outputs tested.

(2) A point-of-sale removable label that verifies certification and shows how the appliance's emission test results compare with the Oregon emission performance standard; and shows the heating efficiency and heat output range of the appliance. The label shall be affixed to the appliance at the point-of-sale near the front and top of the stove and remain affixed until sold and delivered to the consumer.

Stat. Auth.: ORS Ch. 468
Hist.: DEQ 11-1984, f. & ef. 6-26-84

Permanent Label

340-21-140 All woodstoves certified by the Department from July 1, 1984 on, shall be labelled with a permanent and a removable label.

Stat. Auth.: ORS Ch. 468
Hist.: DEQ 11-1984, f. & ef. 6-26-84

Contents of Permanent Label

340-21-145 (1) The permanent label, or "Certified Test Performance" label, shall contain the following information:

(a) Testing laboratory;

(b) Date tested;

(c) Test procedure used;

(d) Manufacturer of appliance;

(e) Model;

(f) Design number;

(g) The statement: "Performance may vary from test values depending on actual home operating conditions";

(h) A graph showing:

(A) Smoke emission rates, in grams/hour, over the range of heat outputs tested.

(B) Overall efficiency over the range of heat outputs tested.

(2) The axis of the graph shall be identified as follows:

(a) Vertical axis, left side: "Smoke – grams/hour", with a scale of 0 to a maximum of 20, bottom to top.

(b) Vertical axis, right side: "Efficiency - %", with a scale of a minimum of 50 to a maximum of 90, bottom to top.

(c) Horizontal axis, bottom: "Heat Output - Btu/hour", with a scale from 0 to a maximum of 5,000 Btu/hour higher than the highest tested heat output.

(3) Curves describing emissions and efficiency at various heat outputs shall be printed on the graph, and will be developed by the Department as follows:

(a) The emissions curve will be developed by the Department by fitting the emission test data to the quadratic equation:

$$y = a_0 + a_1x + a_2x^2$$

where:

(A) y = particulate emissions (grams/hour).

(B) x = heat output (Btu/hour).

(C) a_0, a_1, a_2 = regression coefficients.

(b) The overall efficiency curve shall be developed by the Department by fitting the efficiency test data to the quadratic equation:

$$y = a_0 + a_1x + a_2x^2$$

where:

(A) y = overall efficiency (%).

(B) x = heat output (Btu/hour).

(C) a_0, a_1, a_2 = regression coefficients.

(4) For woodstoves with a fixed air supply which have only two data points for emissions and two data points for overall efficiency the Department will:

(a) Develop the emission performance description by averaging the two emission data points and describe the performance on the graph with a single point representing the average.

(b) Develop the overall efficiency performance description by averaging the two efficiency data points and describe the performance on the graph with a single point representing the average.

(5) The curves or single points will be developed and fit on the graph by the Department and transmitted to the appliance manufacturer for printing on the label. Changes from the above criteria may be made by the Department as necessary to insure readability. Approval of the label design, layout, and location on the woodstove will be made by the Department and shall be obtained pursuant to OAR 340-21-155.

(6) The label shall be permanently secured or fixed to the appliance so that it is visibly located on the appliance and legible, and meets the following criteria:

(a) A permanent label shall be a label that cannot be removed from the appliance without damage to the label. The label shall remain legible for the maximum expected useful life of the appliance in normal operation.

(b) A label shall be readily visible after installation. Approval of the location of the label on a woodstove will be made by the Department and shall be obtained pursuant to OAR 340-21-155. The label may be located on:

(A) Any visible exterior surface except the bottom of the appliance; or on

(B) Any interior surface of the appliance, within stove compartments, or under overlapping covers or doors, or at another interior location, if the label can be seen after installation and will remain legible for the life of the stove.

(c) A legible label shall be quickly and easily read.

(d) It shall be acceptable to combine the permanent label with another label, such as a safety label, if the design and integrity of the permanent label is not compromised, and if the combination label meets the approval of the Department.

(7) Physical and Material Specifications:

(a) The minimum dimensions of the label shall be at least 3-1/2" long by 2" wide.

(b) The graph on the label shall be at least 3" long by 1-1/2" wide; and any enlargement of the graph shall maintain a proportion represented by the length to width ratio of 2:1.

(c) The label must be made of a material that will satisfy the permanency rule (340-21-145(6)(a)). For instance, it may be made of aluminum, brass, galvanized steel, or another metal, and of a thickness that will ensure permanence of the label.

(d) The information on the label shall be applied to the label in a way that will satisfy the permanency and legibility rules (340-21-145(6)(a) and (c)). For instance, the information may be etched, silk-screened, or die-stamped onto the label.

(e) The label shall be secured to the appliance in a way that it will satisfy the permanency and visibility rules (340-21-145(6)(a) and (b)). For instance, the label may be riveted, screwed, or bolted onto the appliance.

Stat. Auth.: ORS Ch. 468
Hist.: DEQ 11-1984, f. & ef. 6-26-84

Removable Label

340-21-150 (1) The point-of-sale removable label, or "Emissions and Efficiency Performance" label, shall contain the following information:

(a) "Smoke (Ave.) ________grams/hour", weighted average of tested values.

(b) "Efficiency (Ave.) ________%", weighted average of tested values.

(c) Summary of the applicable emissions standard.

(d) Heat output range, tested values.

(e) Manufacturer of appliance.

(f) Model of appliance.

(g) Design number of model.

(h) A statement verifying certification.

(i) The statement "Performance may vary from test values depending on actual home operating conditions".

(2) The label shall be visibly located on the appliance when the appliance is available for inspection by consumers.

(3) This label may not be combined with any other label or with other information.

(4) The label shall be attached to the appliance in such a way that it can be easily removed by the consumer upon purchase. For instance, the label may be attached by adhesive, wire, or string.

Stat. Auth.: ORS Ch. 468
Hist.: DEQ 11-1984, f. & ef. 6-26-84

Label Approval

340-21-155 (1) Permanent label:

(a) The Department will provide guidance on the design of labels by supplying information that shall be placed on the label at the time certification is granted.

(b) The manufacturer or dealer shall submit to the Department:

(A) The name, phone number and address of the label manufacturer.

(B) A proof copy of the label, printed on a representative sample of the label stock, shall be submitted to the Department, if practical; if not, a sample of the label stock shall be submitted for review with a proof copy of the label. The copy shall be as representative of the intended final printed label as practical. The copy shall be actual size; and shall show the proposed label design; layout; artwork; print size, style and color; and shall show all the information required on the label, including curves or points.

(C) A drawing, diagram, or photograph that identifies the location of the permanent label on the woodstove.

(D) Information that describes or shows how the permanent label will be affixed to the woodstove. For instance, it may be a description of an adhesive type, adhesive manufacturer, and performance characteristics; or rivet type, rivet manufacturer, and performance characteristics.

(c) Within 14 days of receipt of all information required in subsection (b) of this section, the Department will approve or deny use of the proposed label.

(2) Removable label:

(a) The Department will provide the manufacturer or dealer, at the time of certification with:

(A) A copy of the standardized printed removable label, with all printing specifications; and

(B) The specific information that shall be printed in the spaces on the label by the manufacturer.

(b) The manufacturer or dealer shall submit to the Department for review:

(A) A proof copy of the proposed label with the required information printed on the labels.

(B) The method of attaching the removable label to the woodstove.

(C) The name, telephone number, and address of the label printer.

(c) Within 14 days of receipt of all the information required in subsection (b) of this section, the Department will approve or deny use of the proposed label.

(3) The manufacturer shall submit to the Department three final printed permanent, and three final printed removable labels within one month of receiving the labels from the printer.

Stat. Auth.: ORS Ch. 468
Hist.: DEQ 11-1984, f. & ef. 6-26-84

Laboratory Accreditation Requirements

340-21-160 A laboratory submitting test data pursuant to requirements in this rule shall have a valid certificate of accreditation issued by the Department. A laboratory may initiate application for an accreditation certificate by submitting written documentation to the Department that accreditation criteria contained in OAR 340-21-165 are met. In addition, the laboratory must demonstrate stove testing proficiency pursuant to OAR 340-21-170, in order to qualify for accreditation.

Stat. Auth.: ORS Ch. 468
Hist.: DEQ 11-1984, f. & ef. 6-26-84

Accreditation Criteria

340-21-165 (1) All laboratories shall meet the following criteria and standards at the time of application and shall continue to meet these criteria as a condition of maintaining accreditation:

(a) The laboratory shall be an independent third-party testing organization with no organizational, managerial, or financial affiliation with any manufacturer, supplier or vendor of any woodstove covered under its testing programs. For example:

(A) The laboratory shall not be owned by any manufacturer or vendor, or own any manufacturer or vendor of woodstoves.

(B) The management of the laboratory shall not control or be controlled by any manufacturer or vendor.

(C) The laboratory shall not be engaged in the promotion or design of the woodstove being evaluated or tested.

(D) The laboratory shall have sufficient diversity of clients or activity so that the loss or award of a specific contract regarding testing would not be a determinative factor in the financial well being of the laboratory.

(E) The employment security status of the personnel of the laboratory shall be free of influence or control of any one or more manufacturers or vendors of woodstoves tested.

(b) The laboratory shall be operated in accordance with generally accepted professional and ethical business practices. For example:

(A) The laboratory shall accurately report values that reflect measured data.

(B) The laboratory shall limit certification program test work to that for which it can perform competently.

(C) The laboratory shall immediately respond and attempt to resolve every complaint contesting test results.

(c) The laboratory shall be staffed by personnel competent to perform the test procedures for which accreditation is sought. for example:

(A) The laboratory shall assure the competency of its staff through the observation or examination or both of each relevant staff member in the performance of tests, examinations, and inspections that each member is assigned to perform. The observations must be conducted at intervals not exceeding one year by one or more individuals judged qualified by the person who has technical responsibility for the operation.

(B) The laboratory shall make available the description of its training program for assuring that new or untrained staff will be able to perform tests and inspections properly and uniformly to the requisite degree of precision and accuracy.

(C) The laboratory shall maintain records, including dates of the observation or examination of performance of all personnel.

(d) The laboratory shall be equipped with the necessary instrumentation and equipment to test all appliances in accordance with the Department's test procedures.

(e) The laboratory must have in place and maintain a viable record keeping system. This means that records must be easily accessible, in some logical order and contain complete information on the subject. Records covering the following items are required and will be physically reviewed during the on-site assessment either in total or by selected sampling:

(A) Measuring equipment: each instrument name and description, name of manufacturer, model, style and serial number. Specifications on range or level of precision, date and documentation of calibration, record of maintenance and frequency of calibration.

(B) Data systems: samples of raw and reduced data sheets, test report format, method (manual or automated) of data recording, analysis and reporting.

(C) Staff training dates and results.

(D) Staff competency review dates and results.

(E) Equipment calibration (or verification) records shall include the following: equipment name or description; model, style, serial number; manufacturer; notation of all equipment variables requiring calibration or verification; the range of calibration/verification; the resolution of the instrument and allowable error tolerances; calibration/verification date and schedule; date and result of last calibration; identity of the laboratory individual or external service responsible for calibration; source of reference standard and traceability.

(F) Test data and reports, including emissions and efficiency calculations fully documented and all other items required by the specific test method.

(G) Sample tracking and logging records shall trace the movement of each stove through the laboratory from its receipt through all the tests performed to the final test report. Dates, condition of sample, and laboratory personnel involved should be included.

(f) The laboratory shall maintain a quality control system to help assure the accuracy and technical integrity of its work consisting of the following:

(A) The laboratory's quality control system must include a quality control manual containing written procedures and information in response to the applicable requirements of the test procedures. The procedures and information may be explicitly contained in the manual or may be referenced so that their location in the laboratory is clearly identified. The written procedures and information must be adequate to guide a testing technician and inspector in conducting the tests and inspections in accordance with the test methods and procedures required for the stove testing for which accreditation is sought.

(B) The laboratory shall have a current copy of its quality control manual or laboratory operations control manual available in the laboratory for use by laboratory personnel and shall make the manual available to the Department for review and audit.

(C) The quality control manual shall consist of general guidelines for the quality control of the laboratory's method of operation. Specific information shall be provided for portions of individual test methods whenever specifics are needed to comply with the criteria or otherwise support the laboratory's operations.

(g) The laboratory shall maintain an emissions and efficiency computer program that produces reasonably the same results to the Department's, using a standard data set provided by the Department.

(h) Neither the laboratory owners or business affiliates shall discriminate in management or business practices against any person or business because of race, creed, color, religion, sex, age, or national origin. In addition, neither the laboratory nor its owners or operators shall be certified by any association or are members of any association that discriminates by business or managmeent practices against any person or business because of race, creed, color, religion, sex, age, or national origin.

Stat. Auth.: ORS Ch. 468
Hist.: DEQ 11-1984, f. & ef. 6-26-84

Application for Laboratory Accreditation

340-21-170 (1) A laboratory applying for accreditation shall state in writing and demonstrate by providing documentation, that they comply with the criteria and standards in OAR 340-21-165 at the time of application, and how they will continue to meet the criteria and standards on an ongoing basis.

(2) The laboratory shall notify the Department in writing within 30 calendar days should it become unable to conform to any of the criteria and standards in OAR 340-21-165.

(3) The laboratory shall demonstrate to the Department that the laboratory's emission and efficiency computer program produces reasonably the same results to the Department's, using a standard data set provided by the Department.

(4) Deficiency in the application will be identified by the Department in writing, and must be resolved by the laboratory before further processing occurs.

(5) The application will not be considered complete for further processing until the laboratory certifies in writing that the deficiencies have been resolved. The application will be considered withdrawn if the applicant fails to certify resolution within 90 days of postmark of notification by the Department.

(6) When the application is approvable, the Department will inform the laboratory in writing and schedule an on-site laboratory inspection.

Stat. Auth.: ORS Ch. 468
Hist.: DEQ 11-1984, f. & ef. 6-26-84

On-Site Laboratory Inspection and Stove Testing Proficiency Demonstration

340-21-175 (1) An on-site inspection will be conducted by a Department representative after all laboratory information required by OAR 340-21-165, has been provided by the laboratory, reviewed and approved by the Department. The on-site visit will be conducted when a laboratory initially applies for accreditation and when the laboratory reapplies for a new certificate of accreditation.

(2) During the on-site inspection, the Department representative will:

(a) Observe the Stove Testing Proficiency Demonstration specified in OAR 340-21-170(3).

(b) Meet with management and supervisory personnel responsible for the testing activities for which the laboratory is seeking accreditation.

(c) Review representative samples of laboratory records. To facilitate examination of personnel competency records, the laboratory should prepare a list of names of staff members who perform the tests.

(d) Observe test demonstrations and talk with laboratory personnel to assure their understanding of the test procedures. Refer to OAR 340-21-120 and 340-21-170(3).

(e) Physically examine selected equipment and apparatus.

(f) At the conclusion of the on-site visit, the Department will discuss observations with responsible members of the

TABLE 2
(340-21-115)

CUMULATIVE PROBABILITY FOR A GIVEN HEAT OUTPUT
DEMAND BASED ON OREGON CLIMATE (POPULATION WEIGHTED*)

Heat Output (Btu/hr)	Cumulative Probability (P)	Heat Output (Btu/hr)	Cumulative Probability (P)
0	0.02640	24,600	0.97873
600	0.03071	25,200	0.98256
1,200	0.03503	25,800	0.98540
1,800	0.04130	26,400	0.98713
2,400	0.04888	27,000	0.98972
3,000	0.05863	27,600	0.99096
3,600	0.06879	28,200	0.9923[illegible]
4,200	0.08122	28,800	0.99316
4,800	0.09837	29,400	0.99408
5,400	0.11586	30,000	0.99472
6,000	0.13522	30,600	0.99506
6,600	0.15803	31,200	0.99526
7,200	0.18394	31,800	0.99563
7,800	0.21615	32,400	0.99589
8,400	0.24867	33,000	0.99679
9,000	0.28798	33,600	0.99711
9,600	0.32621	34,200	0.99745
10,200	0.37040	34,800	0.99774
10,800	0.41575	35,400	0.99787
11,400	0.46226	36,000	0.99817
12,000	0.50831	36,600	0.99837
12,600	0.55778	37,200	0.99851
13,200	0.60326	37,800	0.99858
13,800	0.64770	38,400	0.99882
14,400	0.68572	39,000	0.99899
15,000	0.72483	39,600	0.99915
15,600	0.75743	40,200	0.99933
16,200	0.78883	40,800	0.99945
16,800	0.81816	41,400	0.99958
17,400	0.84386	42,000	0.99968
18,000	0.86822	42,600	0.99974
18,600	0.88951	43,200	0.99986
19,200	0.90667	43,800	0.99992
19,800	0.92228	44,400	0.99995
20,400	0.93620	45,000	0.99996
21,000	0.94720	45,600	0.99999
21,600	0.95545	46,200	1.00000
22,200	0.96158	46,800	1.00000
22,800	0.96699	47,400	1.00000
23,400	0.97151	48,000	1.00000
24,000	0.97515	> 48,000	1.00000

* Based on ambient temperature data during October through April, 1967-73 with population weighting from eight Oregon locations (Portland, Medford, Pendleton, Astoria, Burns, North Bend, Redmond, and Salem).

laboratory management pointing out any deficiencies uncovered.

(3) In order to be accredited and as a part of each on-site laboratory inspection, each laboratory must demonstrate to the Department's representative its ability to successfully and proficiently conduct and report a woodstove emission and efficiency test. Each laboratory will:

(a) Be required to test one woodstove provided by the Department. Costs for all stove shipping, catalytic combustors, or other necessary parts will be paid by the laboratory.

(b) Be required to test the stove in accordance with testing criteria and procedures specified in OAR 340-21-120.

(c) Conduct the actual emission and efficiency testing in the presence of a Department observer.

(d) Submit all test data, observations and test results to the Department for technical evaluations.

Stat. Auth.: ORS Ch. 468
Hist.: DEQ 11-1984, f. & ef. 6-26-84

Accreditation Application Deficiency, Notification and Resolution

340-21-180 (1) Any deficiencies noted during the on-site inspection and/or in the test data and test results submitted from the stove testing proficiency demonstration will be specifically identified in writing and mailed to the laboratory within 30 days of the on-site visit.

(2) The laboratory must respond in writing within 30 days of the date of postmark of the notification by the Department and provide documentation that the specified deficiencies have been corrected. All deficiencies must be corrected prior to accreditation being granted.

(3) Deficiencies noted for corrective action will be subject to thorough review and verification during subsequent on-site visits and technical evaluations.

(4) Any deficiences in the test data and/or results may result in subsequent proficiency tests being required at the laboratory with a Department representative present.

Stat. Auth.: ORS Ch. 468
Hist.: DEQ 11-1984, f. & ef. 6-26-84

Final Department Administrative Review and Certificate of Accreditation

340-21-185 (1) When all application material has been received, including the on-site inspection and the stove testing proficiency evaluation, and there has been time for all deficiencies to be resolved, the Department will grant or deny accreditation.

(2) Accreditation can be denied for failure to comply with or fulfill any of the criteria in OAR 340-21-165, -170, and -175.

(3) When accreditation is approved, a certificate of accreditation will be issued to the laboratory. Accreditation will be granted for a period of three years (36 months) subject to rule change or revocation for cause, pursuant to OAR 340, Division 11.

(4) A certificate of accreditation is not renewable. A holder may obtain a new certificate of accreditation by completing the application procedure in OAR Chapter 340-21-170, and demonstrating compliance with OAR 340-21-165 and 340-21-175.

(5) The Department may select and audit test one stove tested by the laboratory during its accredited status to verify certification test results. Any discrepancies noted will be communicated to the laboratory by certified or registered mail. The laboratory must respond in writing within 30 days of postmark of notification and provide documentation or certification by an authorized member of the laboratory management that the specified discrepancies have been corrected or the laboratory may be subject to civil penalties or revocation of accreditation.

(6) A laboratory may voluntarily terminate its accreditation by written request at any time. The certificate of accreditation must be returned with the request.

Stat. Auth.: ORS Ch. 468
Hist.: DEQ 11-1984, f. & ef. 6-26-84

Civil Penalties, Revocation, and Appeals

340-21-190 (1) Violation of any of these rules shall constitute cause to revoke the manufacturer or dealer's woodstove certification or laboratory's certificate of laboratory accreditation, and also may be subject to civil penalties and other remedies pursuant to rule or statute.

(2) Certification of a woodstove may be revoked if the woodstove was tested at a laboratory that was found to be in violation of accreditation criteria and rules at the time the woodstove was tested for certification.

(3) When certification or accreditation has been revoked, the holder shall return the certification or accreditation document to the Department and cease to use mention of Department certification or accreditation of the stove model or laboratory on any of its test reports, correspondence or advertising.

(4) Stove certification and lab accreditation revocation shall be handled as contested cases pursuant to OAR Chapter 340, Division 11.

Stat. Auth.: ORS Ch. 468
Hist.: DEQ 11-1984, f. & ef. 6-26-84

EXHIBIT 1
(340-21-115)

Calculating Weighted Average
Particulate Emission

$$\bar{E} = \frac{K_1E_1 + K_2E_2 + K_3E_3 \ldots + K_nE_n}{K_1 + K_2 + K_3 \ldots + K_n}$$

where: $\bar{E}$ is the weighted average particulate emission rate in grams per hour; E_1, E_2, $E_3 \ldots E_n$ are the particulate emission rates in grams per hour from test runs 1 through n in order of increasing heat output; and K_1, K_2, $K_3 \ldots K_n$ are the weighting factors for test runs 1 through n. The weighting factors (K_i) are calculated as follows:

$$K_i = P_{i+1} - P_{i-1}$$

where P_i is the cumulative probability from Table 2 for the heat output measured during each test run, $P_o = 0$, and $P_{n+1} = 1$.

OREGON DEQ CERTIFIED WOODSTOVES AND THEIR MANUFACTURERS

Manufacturers	Woodstoves
Timber-Eze, Inc. Route 5, Box 22 Millersburg, OH 44654 Contact: Paul Weaver (216) 893-2971	Model: Timber-Eze 477 Design #: Ultra 1 Catalytic; Freestanding
Kent Heating, Ltd. 59 Tidal Road Mangere PO Box 23-340 Papatoetoe Auckland, New Zealand Contact: Betty Hume Klickitat Enterprises, Inc. 1801 NW Upshur Portland, OR 97209 (503) 295-0121	Model: Tile Fire Mark II LPE Design #: 566410 Noncatalytic; Freestanding
The Stack Manufacturing Company, Ltd. PO Box 9354 Newmarket Auckland, New Zealand Contact: Daniel Melcon 0400 SW Custer Way Portland, OR 97219 (503) 245-5546	Model: Vista Design #: #640 Noncatalytic; Freestanding
Osburn Industries 6691 Mirah Road, RR #3 Victoria, British Columbia Canada V8X 3X1 Contact: David Linkletter (604) 652-3963	Model: Regent 1000 Design #: 2 Noncatalytic; Freestanding
Arrow Tualatin, Inc. PO Box 1299 Tualatin, OR 97062 Contact: Dick Sparwasser (503) 692-1500	Model: ATS-II Design #: 5000 Catalytic; Freestanding
Earth Stove, Inc. Bldg C-7 9775 SW Commerce Circle Wilsonville, OR 97070 Contact: John McIntire (503) 682-3384	Model: 1000C Design #: E.S. 01 Catalytic, Freestanding

OREGON DEQ CERTIFIED WOODSTOVES AND THEIR MANUFACTURERS

Manufacturers	Woodstoves
Woodcutters Manufacturing, Inc. 3301 East Isaacs Walla Walla, WA 99362 Contact: Larry Canaday (509) 529-9820	Model: Blazeking 'King' Design #: KEJ-1101 Catalytic; Freestanding
Lopi International Ltd. 10850 117th Place, NE Kirkland, WA 98033 Contact: Allan Atemboski (206) 827-9505	Model: Answer Design #: A-1, A-2, A-3 Noncatalytic; Freestanding and Insert
Brugger Industries, Ltd. Private Bag Wainuiomata Wellington, New Zealand Contact: Neil Martin 8651 West Park Street Boise, ID 83704 (208) 322-0479	Model: BOSCA Design #: FS 500, TM 500 Noncatalytic; Freestanding
Martenson Industries, Inc. 24430 S. Highway 99-E Canby, OR 97013 Contact: Don Martenson (503) 266-2026	Model: Rawhide I Design #: RH861 Noncatalytic; Freestanding
Collins Bio-Energy Company 4804 SW 112th Street Tacoma, WA 98499 Contact: Bruce Collins (206) 582-0470 (206) 582-4327	Model: Pellefier Design #: FS 1 Noncatalytic; Freestanding; Continuous feed pellet burner
CESCO Industries, Inc. PO Box 9948 Greensboro, NC 27480 Contact: Patricia Bickley CESCO Industries, Inc. PO Box 7817 Roanoke, VA 24019 (703) 366-7118	Model: Fisher Design #: Tech IV Catalytic, Insert

OREGON DEPARTMENT OF ENVIRONMENTAL QUALITY [illegible]

revised October 16, 1985

MEETS 1988 STANDARD

Oregon Smoke Standard: (Particulate Emissions)

After June 30, 1986: 15 grams/hr non-catalytic, 6 grams/hr catalytic
After June 30, 1988: 9 grams/hr non-catalytic, 4 grams/hr catalytic

odel, Design Number Manufacturer	Type (1)	Date Certified	Average (2) Smoke (grams/hr)	Average (2) Overall Efficiency (%)	Heat Output (3) Range (Btu/hr)	Burn Time Between Refueling (4) (hours) Low	High	Average Weight of (3) Test Fuel [lbs]	Average (5) Draft (inches H_2O)
laze King 'King,' FJ-1101 oodcutters Mfg.	C, FS, SL	12-21-84	1.6	76.9	9,510 to 35,200	16.2	4.4	29.2	.021 to .052
OSCA FS 500 rugger Industries Ltd.	NC, FS, SL	12-21-84	13.5	64.8	9,832 to 35,307	3.8	1.0	9.1	.032 to .070
NSWER A1 opi International, Ltd.	NC, FS, WO, SL	01-22-85	14.8	62.1	4,887 to 43,350	6.3	0.75	8.3	.023 to .070
NSWER A2 opi International, Ltd.	NC, H, WO, SL	01-22-85	14.8	62.1	4,887 to 43,350	6.3	0.75	8.3	.023 to .070
awhide I RH861 artenson Industries	NC, FS, W, SL	01-30-85	13.8	59.8	20,707 to 34,512	2.4	1.1	11.9	.051 to .069
isher TECH IV ESCO Industries	I, C, SL	03-01-85	2.5	79.1	18,033 to 31,794	5.6	2.8	17.2	.050 to .061
ellefier FS-1 ollins Bio-Energy Co.	FS, NC, PF,	03-01-85	0.7	79.4	9,455 to 29,630	N/A	N/A	N/A	.009 to .015
imber Eze 477 imber Eze, Inc.	C, FS, SL	03-01-85	2.0	75.8	8,660 to 21,860	11.4	3.4	17.5	.027 to .050
ista 640 he Stack Mfg. Co., Ltd.	NC, FS, SL	03-14-85	5.4	61.8	20,839 to 60,104	1.8	0.6	8.6	.064 to .093

) C=Catalytic, NC=Noncatalytic, W=Tested with optional blower, WO=Tested without optional blower, SL=Safety Listed, FS=Free Standing, I=Insert, (All inserts are tested with a direct flue connection and full length insulated chimney.), H=Hearth, PF=Pellet Fuel

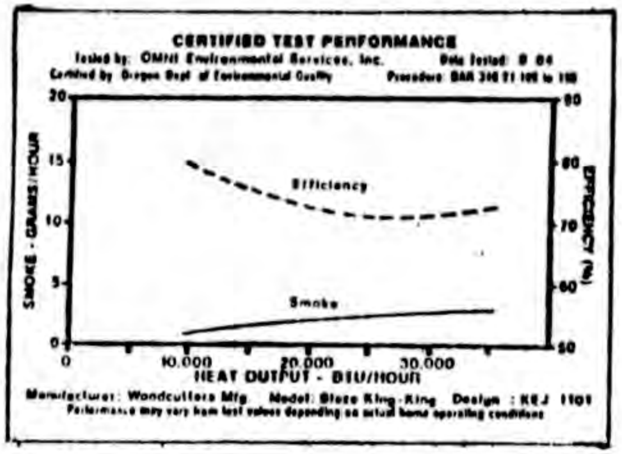
) Average performance based on average Oregon heating load (approximately [illegible]3,000 Btu/hr)

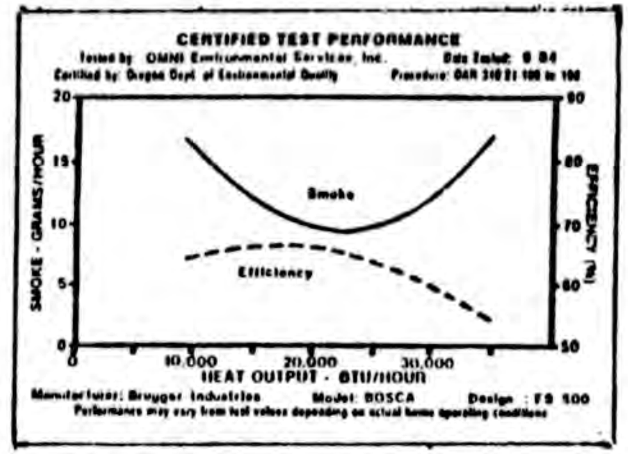
) Based on consumption of a test charge of Douglas fir at 16 - 20 percent moisture and loading density of 7 lbs wood/cubic foot of firebox volume. Stoves tested at heat output less than 10,000 Btu/hr may be capable of operating at lower than stated values. Minimum stated heat output over 10,000 Btu/hour represent the minimum heat output achievable during certification testing. Heat output may vary depending on type and quantity of fuel used.

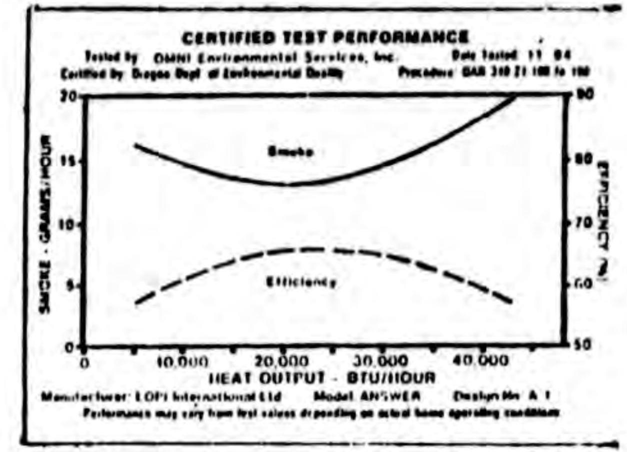
) Time between refueling during certification test at low and highest heat output (refueling occurs when an entire test charge of fuel has been consumed, with a hot coal bed remaining).

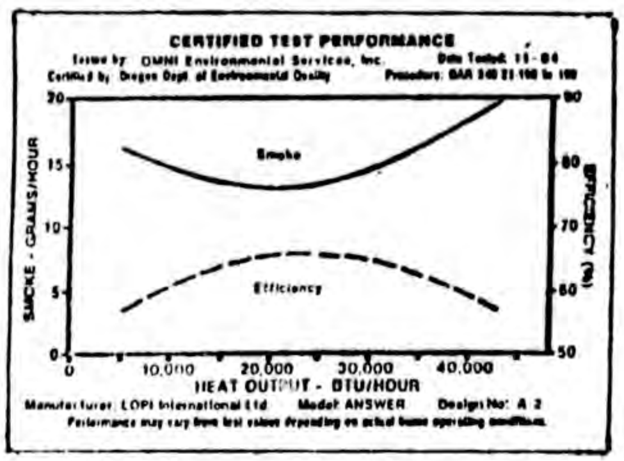
) Measured within 1 foot of stove's flue connection. Values shown are averaged over an entire test cycle; both low and high heat output tests are displayed.

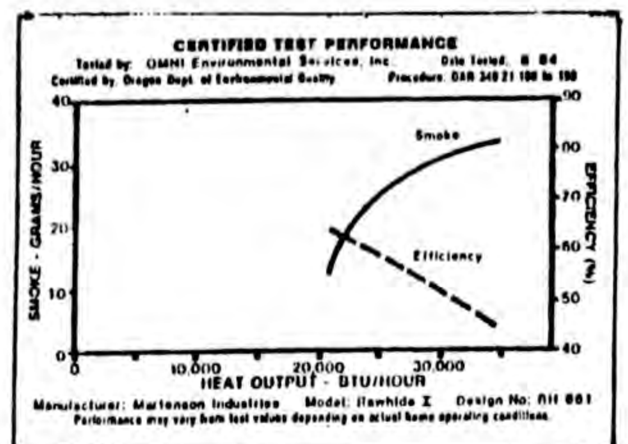
r more information write: Oregon Department of Environmental Quality, PO Box 1760, Portland, Oregon 97207, or call (503) 229-6488; in Oregon, toll-free 1-800-452-4011

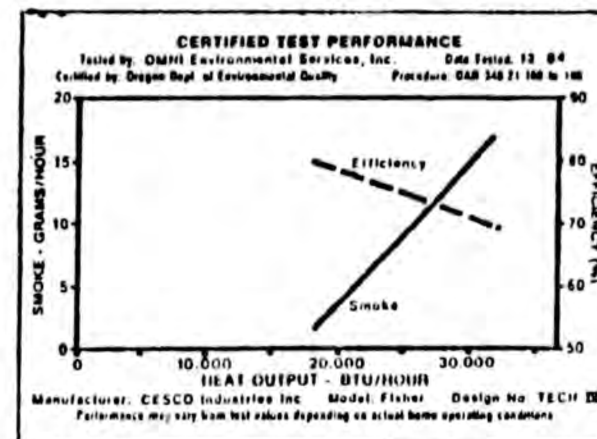

CERTIFIED TEST PERFORMANCE
Tested by: OMNI Environmental Services, Inc.
Date Tested: 8 84
Certified by: Oregon Dept. of Environmental Quality
Procedure: OAR 340 21 100 to 190
SMOKE - GRAMS/HOUR
EFFICIENCY (%)
Efficiency
Smoke
HEAT OUTPUT - BTU/HOUR
10,000
20,000
30,000
Manufacturer: Woodcutters Mfg.
Model: Blaze King-King
Design: KEJ 1101
Performance may vary from test values depending on actual home operating conditions

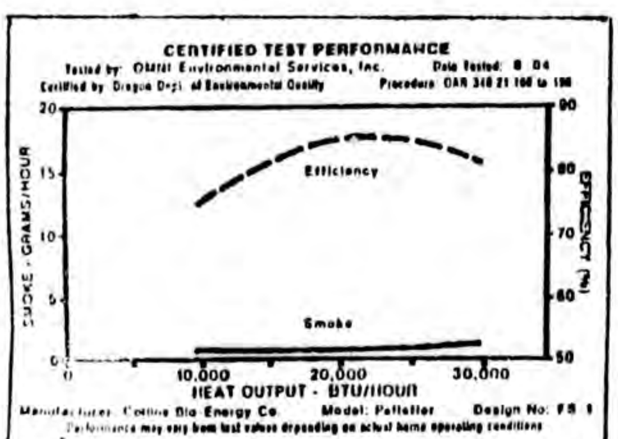

CERTIFIED TEST PERFORMANCE
Tested by: OMNI Environmental Services, Inc.
Date Tested: 8 84
Certified by: Oregon Dept. of Environmental Quality
Procedure: OAR 340 21 100 to 190
SMOKE - GRAMS/HOUR
EFFICIENCY (%)
Smoke
Efficiency
HEAT OUTPUT - BTU/HOUR
10,000
20,000
30,000
Manufacturer: Brugger Industries
Model: BOSCA
Design: FS 500
Performance may vary from test values depending on actual home operating conditions

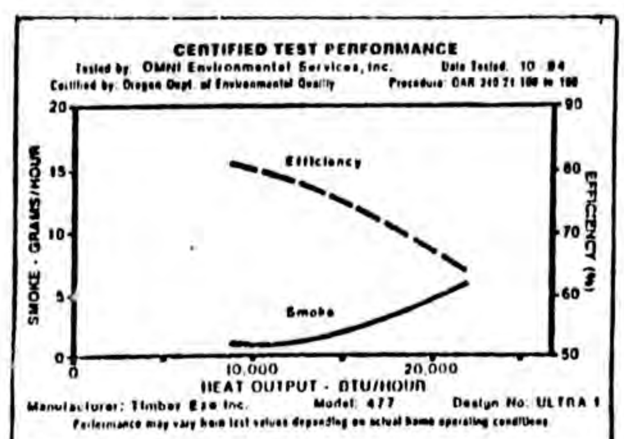

CERTIFIED TEST PERFORMANCE
Tested by: OMNI Environmental Services, Inc.
Date Tested: 11 84
Certified by: Oregon Dept. of Environmental Quality
Procedure: OAR 340 21 100 to 190
SMOKE - GRAMS/HOUR
EFFICIENCY (%)
Smoke
Efficiency
HEAT OUTPUT - BTU/HOUR
10,000
20,000
30,000
40,000
Manufacturer: LOPI International Ltd
Model: ANSWER
Design No: A 1
Performance may vary from test values depending on actual home operating conditions

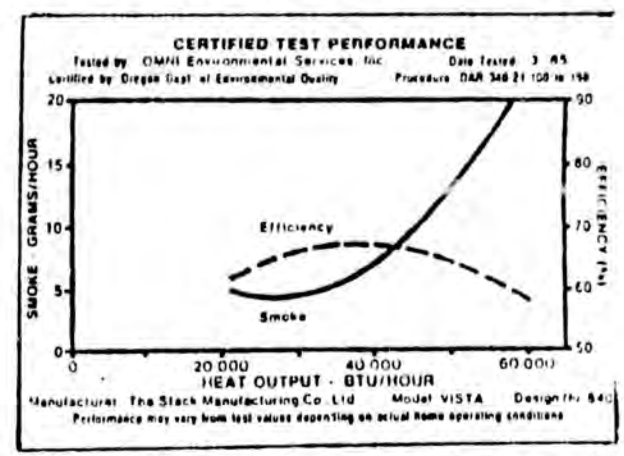

CERTIFIED TEST PERFORMANCE
Tested by: OMNI Environmental Services, Inc.
Date Tested: 11 - 84
Certified by: Oregon Dept. of Environmental Quality
Procedure: OAR 340 21 100 to 190
SMOKE - GRAMS/HOUR
EFFICIENCY (%)
Smoke
Efficiency
HEAT OUTPUT - BTU/HOUR
10,000
20,000
30,000
40,000
Manufacturer: LOPI International Ltd
Model: ANSWER
Design No: A 2
Performance may vary from test values depending on actual home operating conditions.


CERTIFIED TEST PERFORMANCE
Tested by: OMNI Environmental Services, Inc.
Date Tested: 8 84
Certified by: Oregon Dept. of Environmental Quality
Procedure: OAR 340 21 100 to 190
SMOKE - GRAMS/HOUR
EFFICIENCY (%)
Smoke
Efficiency
HEAT OUTPUT - BTU/HOUR
10,000
20,000
30,000
Manufacturer: Martenson Industries
Model: Rawhide I
Design No: RH 881
Performance may vary from test values depending on actual home operating conditions.


CERTIFIED TEST PERFORMANCE
Tested by: OMNI Environmental Services, Inc.
Date Tested: 12 84
Certified by: Oregon Dept. of Environmental Quality
Procedure: OAR 340 21 100 to 190
SMOKE - GRAMS/HOUR
EFFICIENCY (%)
Efficiency
Smoke
HEAT OUTPUT - BTU/HOUR
10,000
20,000
30,000
Manufacturer: CESCO Industries Inc
Model: Fisher
Design No: TECH IX
Performance may vary from test values depending on actual home operating conditions


CERTIFIED TEST PERFORMANCE
Tested by: OMNI Environmental Services, Inc.
Date Tested: 8 84
Certified by: Oregon Dept. of Environmental Quality
Procedure: OAR 340 21 100 to 190
SMOKE - GRAMS/HOUR
EFFICIENCY (%)
Efficiency
Smoke
HEAT OUTPUT - BTU/HOUR
10,000
20,000
30,000
Manufacturer: Collins Bio Energy Co.
Model: Pelletier
Design No: FS 1
Performance may vary from test values depending on actual home operating conditions


CERTIFIED TEST PERFORMANCE
Tested by: OMNI Environmental Services, Inc.
Date Tested: 10 84
Certified by: Oregon Dept. of Environmental Quality
Procedure: OAR 340 21 100 to 190
SMOKE - GRAMS/HOUR
EFFICIENCY (%)
Efficiency
Smoke
HEAT OUTPUT - BTU/HOUR
10,000
20,000
Manufacturer: Timber Eze Inc.
Model: 477
Design No: ULTRA 1
Performance may vary from test values depending on actual home operating conditions


CERTIFIED TEST PERFORMANCE
Tested by: OMNI Environmental Services, Inc.
Date Tested: 3 85
Certified by: Oregon Dept. of Environmental Quality
Procedure: OAR 340 21 100 to 190
SMOKE - GRAMS/HOUR
EFFICIENCY (%)
Efficiency
Smoke
HEAT OUTPUT - BTU/HOUR
20,000
40,000
60,000
Manufacturer: The Stack Manufacturing Co. Ltd
Model: VISTA
Performance may vary from test values depending on actual home operating conditions

OREGON DEPARTMENT OF ENVIRONMENTAL QUALITY CERTIFIED WOODSTOVES

revised October 16, 1985

MEETS 1988 STANDARD

Oregon Smoke Standard: (Particulate Emissions) — After June 30, 1986: 15 grams/hr non-catalytic, 6 grams/hr catalytic; After June 30, 1988: 9 grams/hr non-catalytic, 4 grams/hr catalytic

Model, Design Number, Manufacturer	Type (1)	Date Certified	Average (2) Smoke (grams/hr)	Average (2) Overall Efficiency (%)	Heat Output (3) Range (Btu/hr)	Burn Time Between Refueling (4) (hours) Low	High	Average Weight of (3) Test Fuel (lbs)	Average (5) Draft (inches H_2O)
Tile Fire Mark II LIE 566410 Kent Heating, Ltd.	NC, FS SL	03-14-85	14.2	64.5	8,966 to 30,062	5.0	1.6	10.2	.035 to .076
ANSWER A3 Lopi International, Ltd.	NC, I, WO, SL	04-09-85	14.8	62.1	4,887 to 43,350	6.3	0.75	8.3	.023 to .070
Regent 1000 2 Osburn Industries	NC, FS, SL	06-26-85	12.5	65.2	6,259 to 40,991	6.5	1.0	9.3	.028 to .072
BOSCA TM 500 Brugger Industries Ltd.	NC, I, SL	07-23-85	13.5	64.8	9,832 to 35,307	3.8	1.0	9.1	.032 to .070
ATS-II 5000 Arrow Tualatin, Inc.	C, FS, SL	09-13-85	2.5	75.6	9,055 to 31,838	6.5	1.8	11.0	.031 to .051
1000C E.S. 01 The Earth Stove, Inc.	C, FS, SL	10-16-85	3.5	74.9	10,873 to 24,418	7.3	3.0	15.1	.028 to .053

(1) C=Catalytic, NC=Noncatalytic, W=Tested with optional blower, WO=Tested without optional blower, SL=Safety Listed, FS=Free Standing, I=Insert, (All inserts are tested with a direct flue connection and full length insulated chimney.), H=Hearth, PF=Pellet Fuel

(2) Average performance based on average Oregon heating load (approximately 13,000 Btu/hr)

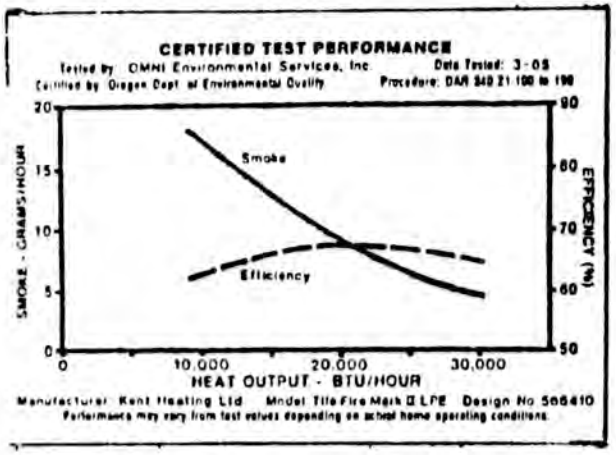
(3) Based on consumption of a test charge of Douglas fir at 16 - 20 percent moisture and loading density of 7 lbs wood/cubic foot of firebox volume. <u>Stoves tested at heat output less than 10,000 Btu/hr may be capable of operating at lower than stated values</u> Minimum stated heat output over 10,000 Btu/hour represent the minimum heat output achievable during certification testing. Heat output may vary depending on type and quantity of fuel used.

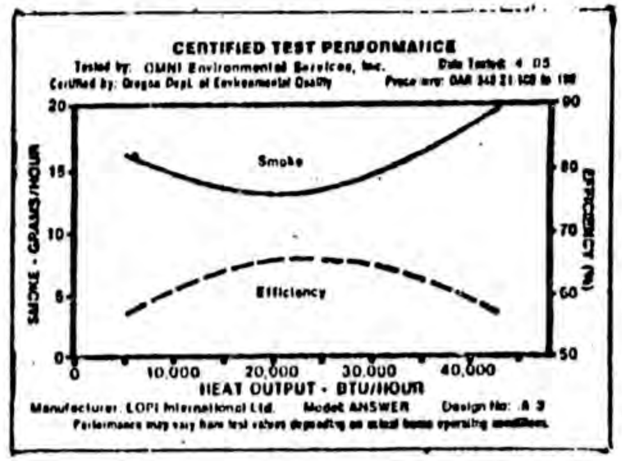
(4) Time between refueling during certification test at low and highest heat output (refueling occurs when an entire test charge of fuel has been consumed, with a hot coal bed remaining).

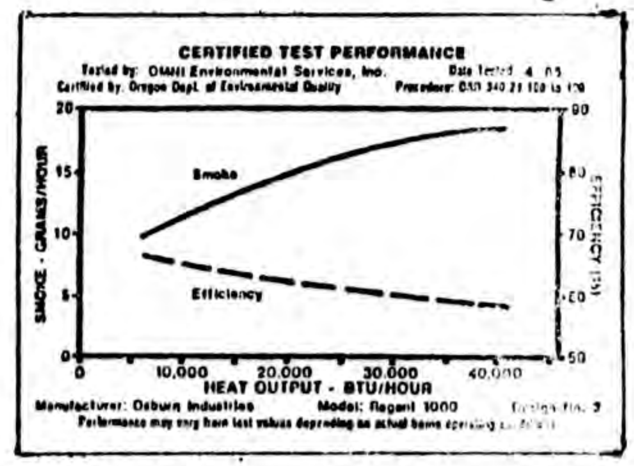
(5) Measured within 1 foot of stove's flue connection. Values shown are averaged over an entire test cycle; both low and high heat output tests are displayed.

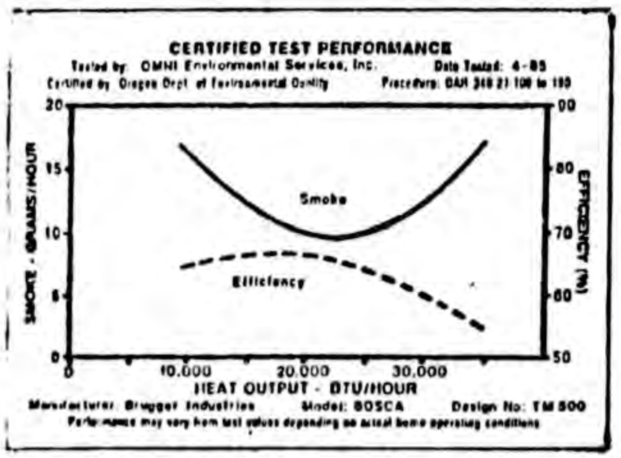
For more information write: Oregon Department of Environmental Quality, PO Box 1760, Portland, Oregon 97207, or call (503) 229-6488; in Oregon, toll-free 1-800-452-4011

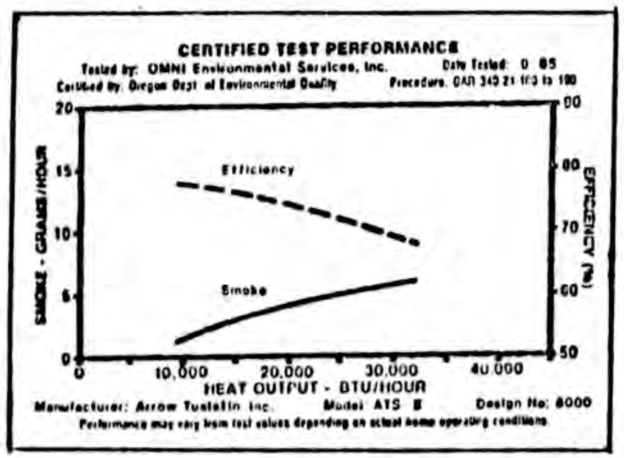
AS938.B

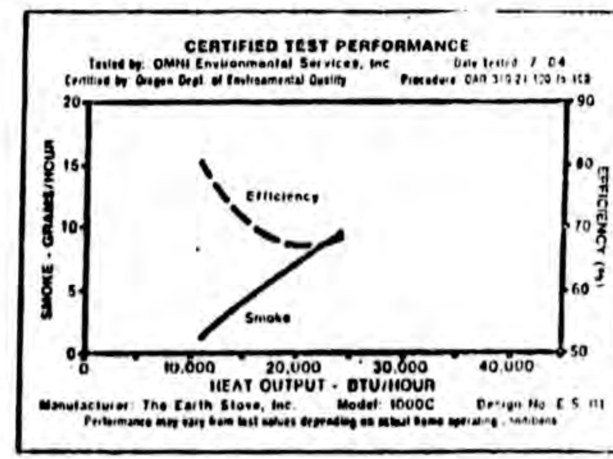

CERTIFIED TEST PERFORMANCE
Tested by: OMNI Environmental Services, Inc.
Date Tested: 3-85
Certified by: Oregon Dept. of Environmental Quality
Procedure: OAR 340 21 100 to 190
SMOKE - GRAMS/HOUR
EFFICIENCY (%)
Smoke
Efficiency
HEAT OUTPUT - BTU/HOUR
0
10,000
20,000
30,000
0
5
10
15
20
50
60
70
80
90
Manufacturer: Kent Heating Ltd
Model: Tile Fire Mark II LPE
Design No 566410
Performance may vary from test values depending on actual home operating conditions.


CERTIFIED TEST PERFORMANCE
Tested by: OMNI Environmental Services, Inc.
Date Tested: 4 85
Certified by: Oregon Dept. of Environmental Quality
SMOKE - GRAMS/HOUR
EFFICIENCY (%)
Smoke
Efficiency
HEAT OUTPUT - BTU/HOUR
0
10,000
20,000
30,000
40,000
0
5
10
15
20
50
60
70
80
90
Manufacturer: LOPI International Ltd.
Model: ANSWER
Design No: A 3
Performance may vary from test values depending on actual home operating conditions.


CERTIFIED TEST PERFORMANCE
Tested by: OMNI Environmental Services, Inc.
Certified by: Oregon Dept. of Environmental Quality
SMOKE - GRAMS/HOUR
Smoke
Efficiency
HEAT OUTPUT - BTU/HOUR
0
10,000
20,000
30,000
40,000
0
5
10
15
20
50
70
90
Manufacturer: Osburn Industries
Model: Regent 1000


CERTIFIED TEST PERFORMANCE
Tested by: OMNI Environmental Services, Inc.
Date Tested: 4-85
Certified by: Oregon Dept. of Environmental Quality
Procedure: OAR 340 21 100 to 190
SMOKE - GRAMS/HOUR
EFFICIENCY (%)
Smoke
Efficiency
HEAT OUTPUT - BTU/HOUR
0
10,000
20,000
30,000
0
5
10
15
20
50
60
70
80
90
Manufacturer: Brugger Industries
Model: BOSCA
Design No: TM 500
Performance may vary from test values depending on actual home operating conditions


CERTIFIED TEST PERFORMANCE
Tested by: OMNI Environmental Services, Inc.
Certified by: Oregon Dept. of Environmental Quality
SMOKE - GRAMS/HOUR
EFFICIENCY (%)
Efficiency
Smoke
HEAT OUTPUT - BTU/HOUR
0
10,000
20,000
30,000
40,000
0
5
10
15
20
50
60
70
80
90
Manufacturer: Arrow Tualatin Inc.
Design No: 8000
Performance may vary from test values depending on actual home operating conditions


CERTIFIED TEST PERFORMANCE
Tested by: OMNI Environmental Services, Inc
Certified by: Oregon Dept. of Environmental Quality
SMOKE - GRAMS/HOUR
EFFICIENCY (%)
Efficiency
Smoke
HEAT OUTPUT - BTU/HOUR
0
10,000
20,000
30,000
40,000
0
5
10
15
20
50
60
70
80
90
Manufacturer: The Earth Stove, Inc.
Model: 1000C

CITY AND BOROUGH OF JUNEAU, ALASKA
CERTIFIED WOODSTOVES WHICH WOULD MEET THE
PROPOSED WOODSMOKE REGULATIONS
Revised January 17, 1986

Model	Type	Average Smoke (grams/hr.)	Average Overall Efficiency	Output Heat (BTU/hr.)	Burn Time Between Refueling (hours) Low	High
Blaze King "King"	Catalytic	1.6	76.9	9,510 to 35,200	16.2	4.4
Fisher Tech IV	Fireplace Insert (Catalytic)	2.5	79.1	18,033 to 31,794	5.6	2.8
Timber Eze 477	Catalytic	2.0	75.8	8,660 to 21,860	11.4	3.4
Vista 640	Non-Catalytic	5.4	61.8	20,839 to 60,104	1.8	0.6
Earth Stove 1000-C	Catalytic	3.5	74.9	10,873 to 24,418	7.3	3.0
Arrow ATS II	Catalytic	2.5	75.6	9,055 to 31,838	6.5	1.8
Turbo 10	Catalytic	3.1	76.0	12,662 to 35,427	6.5	2.2
*Pellefier FS-1	Non-Catalytic	0.7	79.4	9,455 to 29,630	NA	NA
*Whitfield	Non-Catalytic	0.9	79.4	9,499 to 26,638	NA	NA
*Collins Hopper	Add-on Device	2.6	73.4	6,932 to 56,196	NA	NA
Earthstove 1002-0 (This model with the air supply stop is the only model that has been approved)	Non-Catalytic	5.6	68.7			
Sweethome Stove Works Catalytic Fir AK-18	Catalytic	2.0	76.2			
ORLEY'S Leopard U246 Free Standing Model	Catalytic	2.5	73.0			
ORLEY'S Panther F246 Hearth Model	Catalytic	2.5	73.0			
**Jotul 3C	Catalytic	3.9	73.0			
**Jotul 8C	Catalytic	6.0	75.0			

*Burns Pellet Fuel
**Only certified for the rear vent application