3/16/1984

OREGON
ENVIRONMENTAL QUALITY
COMMISSION MEETING
MATERIALS

DEQ

State of Oregon
Department of Environmental Quality

VICTOR ATIYEH
GOVERNOR

Environmental Quality Commission
Mailing Address: BOX 1760, PORTLAND, OR 97207
522 SOUTHWEST 5th AVENUE, PORTLAND, OR 97204 PHONE (503) 229-5696

SPECIAL MEETING

The Environmental Quality Commission (EQC) will hold a special meeting by conference telephone call at 8:00 am, Friday, March 16, 1984 to consider a request by the Department of Environmental Quality (DEQ) to conduct public hearings on woodstove certification rules, OAR 340-21-100 through 340-21-166, as a revision to the State Implementation Plan.

The public and press will be able to listen to the conference call meeting in room 1400 of the DEQ offices at 522 S. W. Fifth Avenue, Portland.

Testimony will only be taken on whether or not to authorize the holding of public hearings.

This meeting is scheduled pursuant to the Public Meetings Law, ORS 192.640.

###

THESE MINUTES ARE NOT FINAL UNTIL APPROVED BY THE EQC

MINUTES OF A SPECIAL MEETING OF THE OREGON ENVIRONMENTAL QUALITY COMMISSION

March 16, 1984

On Friday, March 16, 1984, the Environmental Quality Commission convened a special conference call meeting at 8:00 am. Connected by conference call telephone were Chairman James Petersen in Bend, Vice-Chairman Fred Burgess in Corvallis, Commissioner Mary Bishop in Portland, Commissioner Wallace Brill in Medford, and Commissioner Arno Denecke in Salem. Present by conference telephone call on behalf of the Department were it's Director, Fred Hansen, and several members of the Department staff.

The topic of this special meeting was a request by the Department for the Commission to authorize public hearings on proposed woodstove certification rules, OAR 340-21-100 through 340-21-166, as a revision to the State Implementation Plan.

Director's Recommendation

Based on the summation in the staff report, it is recommended that the Commission authorize a public hearing to take testimony on the woodstove certification rules.

It was MOVED by Commissioner Bishop, seconded by Commissioner Brill, and passed unanimously that the Director's recommendation be approved.

There being no further business, the meeting was adjourned.

Respectfully submitted,

Carol A. Splettstaszer

Carol A. Splettstaszer
EQC Assistant

VICTOR ATIYEH
GOVERNOR

Environmental Quality Commission

Mailing Address: BOX 1760, PORTLAND, OR 97207
522 SOUTHWEST 5th AVENUE, PORTLAND, OR 97204 PHONE (503) 229-5696

MEMORANDUM

To: Environmental Quality Commission

From: Mike Downs, Acting Administrator, Air Quality Division

Subject: Correction Page for DRAFT RULES FOR WOODSTOVE CERTIFICATION
Chapter 340, Division 21, Sections 100-166

Please replace the Revised Page 6 (enclosed) of the DRAFT RULES for Woodstove Certification, Chapter 340, Division 21, Section 100-166.

The revisions are:

(1) (a) 15 grams per hour for a non-catalytic woodstove; or
(b) 6 grams per hour for a catalyst-equipped woodstove.

and

(2) (a) 7 grams per hour for a non-catalytic woodstove; or
(b) 3 grams per hour for a catalyst-equipped woodstove.

Please excuse this oversight.

Attachment: Revised Page 6

J. KOWALCZYK:a
AA4253
229-6459
3/13/84

(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/hr advertised for sale, offered for sale, or sold in the State of 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 340-21-130.

(a) 7 grams per hour for a non-catalytic woodstove or

(b) 3 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 the State of 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 340-21-130.

(4) The Department will certify a woodstove as meeting the applicable woodstove emission standard after July 1, 1984 in accordance with procedures in OAR 340-21-140.

CORRECTED PAGE

STATE OF OREGON
1859
VICTOR ATIYEH
GOVERNOR

Environmental Quality Commission

Mailing Address: BOX 1760, PORTLAND, OR 97207
522 SOUTHWEST 5th AVENUE, PORTLAND, OR 97204 PHONE (503) 229-5696

MEMORANDUM

To: Environmental Quality Commission

From: Director

Subject: Agenda Item No. A, March 16, 1984, EQC Meeting

Request for Authorization to Conduct a Public Hearing on Woodstove Certification Rules, OAR 340-21-100 through 340-21-166, as a Revision to the State Implementation Plan

Background and Problem Statement

Emissions from residential wood heating have risen rapidly since the energy crisis of the mid-1970's. Today, residential wood heating emissions represent the greatest air quality problem in the State. Residential wood heating is a major contributor to violations of State and Federal particulate air quality standards in many locations, most notably the Portland and Medford airsheds. Violations of the carbon monoxide air quality standard have also been measured in residential areas which have been solely attributed to wood heating. Additionally, severe nuisances and visibility loss, as well as extensive use of airshed space previously available for growth and development, has resulted from woodstove smoke throughout the State.

The Department has recognized that substantial reductions in wood heating emissions are necessary to meet air quality standards and to provide airshed space for growth and development. Short and long range control strategies have been developed to deal with this problem to some extent, ranging from public education on cleaner burning practices and weatherization requirements, to local ordinances requiring curtailment of stove use during pollution episodes.

A long-term strategy that has been recognized as a very effective way to deal with the air quality problem created by wood heating is a program to restrict the sale of new stoves to only the cleanest burning appliances. The particulate control strategy for the Medford/Ashland airshed showed that, in addition to all other control strategies, existing stoves would have to be replaced with new appliances which are about 80% cleaner than conventional models if compliance with secondary particulate air quality standards are to be achieved by the year 2000. Analysis of the Portland airshed showed a similar needed reduction.

The Department introduced a woodstove certification bill in the 1983 Oregon Legislature. After long and heated debates, great resistance from much of the wood stove industry, and support from many other interest groups including the Oregon Environmental Council and Associated Oregon Industries, the Oregon Legislature passed HB2235 (Attachment 1) which requires the Commission to adopt rules before July 1, 1984 which establish a woodstove certification program. HB 2235 requires the Commission to adopt rules that establish 1) criteria and procedures for testing stoves, 2) an emission standard, 3) a labelling program to reflect stove emission and efficiency performance, 4) a program to certify that stoves meet the applicable emissions standard, and 5) a fee system to cover costs of the program. Voluntary labelling was provided for from July 1, 1984 to June 30, 1986 after which only certified stoves could be offered for sale or sold in the State.

HB2235 allowed the Commission to establish an advisory committee to aid and assist the Commission in development of rules. On August 1, 1983, the Commission appointed a nine member advisory committee and two non-voting medical advisors to the committee. The committee was composed of the following:

Dr. Graig Spolek, Mechanical Engineering Professor at Portland State University (selected Chairman)

Bruce Chinnock, Deputy State Fire Marshall (selected Vice-Chairman)

Tom Engle*, Fisher Century Corporation, Eugene (representing large stove manufacturers)

Paul Runquist, Genesis Systems, Ashland (representing small stove manufacturers)

Bette Hume, Klickitat Enterprises, Portland (representing stove retailers)

Paul Tiegs, OMNI Environmental Services, Inc., Beaverton (representing a stove testing laboratories)

Keith Cochran, Ch-Chimney Sweeps, Beaverton (representing Oregon Chimney Sweeps Association)

Denis Heidtmann, Textronix, Beaverton (representing Oregon Environmental Council)

Paul Willhite, Lane Regional Air Pollution Authority, Eugene (representing the Air Pollution Control Association, Pacific Northwest-International Section)

---

*Replaced by Dick Sparwasser, Arrow Woodstoves, Tualatin, upon resignation of Mr. Engle from the Advisory Committee and retirement from Fisher Century in December, 1983.

Five of the Advisory Committee members were affiliated with the national Wood Heating Alliance (Hume, Cochran, Tiegs, Engle, and Sparwasser).

Non-voting medical advisors appointed were:

Dr. Charles Schade, Multnomah County Health Officer

Dr. Douglas Campbell, Oregon State Health Division

The Department has worked extensively with the Advisory Committee from August, 1983 to February, 1984 to develop Certification Program Rules. More than 20 meetings were held to review a wealth of information supplied by the Department and other interested parties. Extremely close contact was maintained throughout the process with the representatives of the national woodstove industry. Two major meetings were held in Portland with the Department, Woodstove Advisory Committee, and dozens of out-of-state representatives of the national woodstove industry, including officials of the national Wood Heating Alliance (WHA). Parties interested in the rule development process were kept fully informed of activities through extensive weekly mailings of Committee reports. Opportunity was provided at each Advisory Committee meeting for public comment from the audience and written comments from others.

Draft rules have been developed and are included as Attachment 4. These rules were, for the most part, unanimously supported by the Woodstove Advisory Committee with the exception of the emission standard. The Department had not made a recommendation or commented on the Advisory Committee's recommendation on an emission standard at the time the Committee completed its work.

A Statement of Need for rulemaking is included as Attachment 2 and a Hearings Notice is included as Attachment 3.

Alternatives and Evaluation

Testing Procedure

The Department's original test procedure used in earlier research testing consisted of two replicate tests at a moderate burn rate, initiating the test cycle from a cold start with Douglas fir cordwood, using modified EPA Method 5 for particulate emissions sampling, and using the stack loss method for measuring heating efficiency.

In consideration of work done by the national wood heating industry and in an attempt to improve precision of the test procedure, as well as identify emission performance of woodstoves at low burn rates, the Department conducted extensive testing of some woodstoves during the spring of 1983 using Douglas fir lumber as a test fuel. The test cycle was begun from a hot start and the calorimeter room method as well as the stack loss heating efficiency method was utilized.

The results of this testing indicated hot starts with fir lumber substantially improved precision of the test results, while maintaining emission levels in the range of those measured with cordwood. Emissions were found to substantially increase at lower burn rates. These burn rates were found to be more typical of those used in Oregon's moderate climate. The calorimetry room efficiency method was found to be equivalent to stack loss heating efficiency measurements.

Representatives of the national wood heating industry represented by the national Wood Heating Alliance (WHA) made a strong plea to the Advisory Committee and Department to adopt a test procedure that conducted four separate tests over the full range of stove operating conditions. They argued that such information could be universally used throughout the country, eliminating the need for manufacturers to conduct additional tests and pay additional testing costs in other areas. Many members of the WHA and industry members of the Advisory Committee indicated a willingness to pay more for testing using the Oregon procedure with the idea that in the long run it would save them money.

The recommended test procedure consists of four tests over a range of burn rates. It also recommends using air dried (16%-20% moisture) fir lumber (2x4 and 4x4's), utilizes a hot start, and recognizes the calorimeter room heating efficiency method as equivalent to the stack loss method. The Advisory Committee has unanimously supported virtually all components of the finalized test procedure. The cost of the procedure is estimated to be in the $6,000 range per stove model versus about $3,000 for the original Department procedure. This compares to about a $3,000 cost estimate for the WHA's heating efficiency rating program which was begun a few years ago but is no longer in use because of some technical problems and because of a lack of industry participation.

The Department's recommended test procedure will not only provide manufacturers with a complete profile of appliance heating efficiency and heat output, it will also provide a profile of smoke emissions, heat transfer, and combustion efficiency . This information will provide woodstove manufacturers with a great deal of information they need for sales and stove design purposes, as well as provide the Department with information necessary to conduct an effective certification program.

The national woodstove industry views of the test procedure, in some cases, have not been consistent, substantiated with data, or unanimous. The Department and Advisory Committee have done their best to develop a test procedure which is believed to be very responsive to the perceived concerns of the national industry. Despite these efforts, concerns still expressed by some members of the national industry include spacing of the test fuel (they favor 3/4" versus proposed 1-1/2"), use of the modified EPA Method 5 particulate sampling system, overall realism of the test procedure, and testing costs.

The Department has explored options to the modified EPA Method 5 particulate sampling procedure for use in regulating woodstove emissions including measuring combustion efficiency, carbon monoxide, and total hydrocarbons. The Department has found these to be inappropriate and inaccurate to address the smoke problem caused by woodstoves. A simple particulate sampling train manufactured by the Condar Company has also been evaluated and found to not meet equivalency criteria developed by the Department and agreed to by the WHA. It is not considered accurate enough for use as a certification method. This device, however, produces results relatively close to modified EPA Method 5 and the Department believes it is a good research and screening tool that can be used by manufacturers in their factories at relatively low cost to evaluate development work on clean burning appliances.

The Woodstove Advisory Committee and Wood Heating Alliance recommended that the Department conduct an extensive confirmation testing program using the recommended test procedure to insure its accuracy and workability. This was done in December 1983. Results from this test program confirmed the precision, accuracy, realism, and fairness of the test procedure. A recommended test procedure is appended to the draft rules contained in Attachment 4.

Labelling

Wood Heating Alliance members strongly recommended that an emission and efficiency profile over the full range of appliance heat outputs be placed on a permanent stove label so that the label information will be useful in areas outside of Oregon. The Department and Advisory Committee considered this a reasonable request and a label format was developed and unanimously approved by the Advisory Committee (see Attachment 5). In order to provide specific information to Oregon consumers about stove performance with respect to Oregon's emission standard and to provide necessary information to conduct an effective enforcement program at the retail level, a point-of-sale removable label was also developed (Attachment 6). This label also received unanimous approval of the Advisory Committee.

Laboratory Accreditation

The Department originally contemplated, and HB2235 requires, stove testing to be conducted by independent testing laboratories. Several laboratories that conduct woodstove safety testing have expressed interest in also providing emission and efficiency testing services.

A rigorous lab accreditation process is believed necessary to insure accurate and equitable rating of stove performance. Lab accreditation rules have been developed which will require labs to document and demonstrate their ability to conduct testing according to the Oregon test procedure. A system is proposed to revoke accreditation or to levy civil penalties to labs for unacceptable performance.

HB2235 does not allow the Department to collect fees from labs for accreditation. Costs for such work can be recovered from stove certification applicants. It is expected that some out-of-state labs will apply for accreditation. The Department would prefer to restrict accreditation to Oregon labs. However, Federal antitrust laws prevent this approach. The Department is proposing to conduct lab accreditation for in-state and out-of-state labs. If the accreditation workload becomes too great, the Department will explore other ways of handling this job, such as contracting with an appropriate independent firm to conduct the accreditation program or contracting with two or three labs to perform the testing. Both of these alternatives have been explored to some extent and many significant problems have been identified which would have to be resolved.

Laboratory accreditation rules have been drafted and are contained in Attachment 4. The Advisory Committee had no major concerns with the accreditation rules.

Certification Procedure and Fees

The Department has developed a woodstove certification procedure similar to its procedure for air permits and plan reviews. In fairness to certification applicants, the Department is proposing time constraints which will insure timely processing of applications. The applicant must be notified by the Department within 30 days of receipt of the application of any deficiencies in the application. The Department also must notify the applicant within 60 days of receipt of a completed application whether certification is granted or denied.

The Department has estimated that it will take about 40 to 50 hours to process certification applications. This time is necessary to review applications, check test data, and administer a label control program. Since laboratories cannot be directly charged for accreditation services, the Department believes each manufacturer should be assessed a one time additional 25 hours of work to provide for Department costs incurred in accrediting labs. The above estimates of time translates to an initial $1,600 certification fee and $800 fee thereafter per model per manufacturer. The Advisory Committee felt the costs may be overestimated. The Department indicated records will be kept of actual time spent and fees can be adjusted at some future date when better information is available. Draft certification process rules are contained in Attachment 4.

Emission Standard

The Department's analysis of particulate control strategies for the Portland and Medford airsheds indicate that reductions in woodstove emissions in the range of 80% are needed from a woodstove certification program to fully meet air quality standards. If other strategies such as local weatherization ordinances,or backyard burning restrictions do not accomplish their goals, then stove certification would have to accomplish an even higher particulate emission reduction.

Medical advisors to the Advisory Committee reviewed pertinent air quality and health information and recommended that the certification program should be targeted at the 80% emission reduction level.

The emission standard issue was discussed with the Advisory Committee since September 1983. During most of the time, most Advisory Committee members and other representatives of industry argued for a staged standard to allow industry more time to adjust to the stringent legislation and to provide time and an incentive to develop cleaner non-catalytic stoves.

Considerable discussion was also held on catalyst equipped stoves with questions raised about catalytic life, consumer maintenance habits, and overall actual in-home effectiveness of catalysts. It was generally agreed by the Department and Advisory Committee that any emission standard that is developed should differentiate between catalysts and non-catalysts so that catalyst performance degradation over its lifetime would be reflected. After results of confirmation testing were reviewed, four major emission standard alternatives were considered. These alternatives were expressed as a non-catalyst/catalyst emission standard which would produce equivalent performance for each technology considering the life of the catalyst. These alternatives were 15/6, 12/5, 9/4, and 7/3 grams of particulate emitted per hour. These alternative standards would translate to an approximate 50%, 60%, 70%, and 80% particulate emission reduction respectively, compared to conventional stoves. Carbon monoxide emissions are expected to be similarly reduced.

The Department told the legislature that a woodstove certification program could enable attainment of air quality standards for particulate and carbon monoxide where woodstoves were the major contributors to nonattainment. The Department also indicated the program could provide significant airshed space for growth and development. It was indicated that about a 75% reduction in emissions could be achieved through application of the best available non-catalyst and catalyst technology.

Confirmation test results using the recommended procedure indicated non-catalyst technology did not perform as well as expected at lower burn rates while catalytic technology showed better than expected performance. The most advanced dual combustion chamber non-catalyst stove generally emitted in the 12 to 14 grams/hour range with the lowest value approaching 9. Two simple, small firebox non-catalyst stoves, one selling for $74, were tested under separate programs and found to emit in the 11 to 12 grams/hour range. Available catalytic technology was demonstrated to achieve a 1.5 grams/hour performance. Thus, best available non-catalytic technology appeared capable of only providing a 60% reduction in emissions while catalytic technology could provide up to a 90% reduction.

The Advisory Committee recommended, after extensive debate, a 15/6, 9/4 staged standard with the second stage becoming effective on July 1, 1988. The vote was 7 to 0 with 1 abstension and 1 absence. It is believed the Advisory Committee did not support a 7/3 standard because the industry claims that it would totally rule out non-catalyst stoves.

The Department has given extensive thought to the emission standard issue and concluded it would be preferable to have a single stage standard for among other reasons, to reach air quality objectives as soon as possible and avoid the possibility of being prevented from implementing the second stage, as has happened in past experience with veneer dryer rules and aluminum plant rules.

The 7/3 standard is the only one that appears to insure achievement of the needed 80% airshed emission reductions. However, it is not a practical standard to implement on the legislatively mandated date of July 1, 1986 for two reasons. First, non-catalytic technology has not been developed to meet this emission performance and two years is likely not enough time to develop it. Secondly, only a few catalytic stoves are capable of meeting the 3 gram/hour standard at this time; and, it is unlikely this condition would change dramatically in less than two years' time. Consumers, thus would initially have a very small selection of stove types to choose from when the certification program becomes mandatory. A 9/4 single stage standard might achieve air quality objectives but only if most consumers purchase and maintain stoves that achieve significantly cleaner emission performance than required by a 9/4 standard. Here again there would likely not be significant number of non-catalytic stove types available by July 1, 1986 and catalytic technology may not be widely available at this time. A 9/4 standard also might not provide any or minimal airshed space for growth and development in certain areas.

Since catalytic technology is now available on a limited basis to meet a 7/3 standard, it is reasonable to expect that the industry would be able to provide a good selection of models with this technology within a four year time by July 1, 1988. A 7/3 standard by July 1, 1988 would provide a goal for non-catalytic manufacturers to reach and a reasonable time to reach it while not totally closing them out of the market in July, 1986 when the certification program sales restrictions go into place. If non-catalytic technology is not developed to achieve the emission reduction needs for Oregon airsheds by July 1, 1988 then catalytic technology should be widely available, well developed and well proved by then to be fully relied upon as a technology to completely meet airshed and consumer needs in Oregon.

If a two stage standard is pursued, the Department believes legislative intent and some consumer flexibility could be met with a 15/6 or possibly even a 12/5 standard. A 12/5 standard would probably restrict non-catalytic stove selection to those with small fireboxes. The 15/6 standard should provide some additional opportunity for medium-size conventional stoves to be certified. The 15/6 standard representing a 50% reduction in emissions may not be perceived as a stringent enough first step in the certification program; but, substantially more than half of the presently available conventional stoves should be taken off the Oregon market by such a standard.

A staged standard could delay achieving airshed reduction goals by a few years. Considering full program effectiveness is not expected for 10-20 years, which is the estimated turn around time for the major part of the existing stove population, the short time delay should not be serious. If consumer activity is accelerated during the four year period prior to the second stage program and if consumers buy only the units certified as meeting the first stage, there may be some longer delay in reaching the final emission reduction objective. There may also be some consumers dissatisfied that their certified stoves did not perform as cleanly as expected. Stoves that achieve a 50% reduction in emissions will still have significant visible smoke, odor, and creosote deposits.On the other hand, some stoves should be certified and marketed beginning in 1984 that meet a stringent second stage standard; and, hopefully, through consumer education and perceived merit, many will buy them. Surveys tend to strongly support this happening. Thus, reaching the program objective may not be significantly delayed by a dual stage standard.

Major alternative emission standards in order of perceived stringency include the following:

Alternative Standards		Expected Emission Reduction
15/6, 9/4*	(dual stage)	50%, 70%
12,5, 9/4	(dual stage)	60%, 70%
9/4**	(single stage)	70%
15/6, 7/3	(dual stage)	50%, 80%
12/5, 7/3	(dual stage)	60%, 80%

---

*Advisory Committee Recommendations
**Oregon Environmental Council Recommendations

The Department believes the most appropriate emission standard would be a 15/6, 7/3 staged standard. This would appear the most desirable standard from the standpoint that the Advisory Committee and woodstove industry's views would be partially recognized by a staged standard and a first stage of 15/6, while the Department's ultimate air quality objective of reaching an 80% reduction in emissions would be met.

Regardless of the actual emission standard selected, the Department sees the industry heavily committed toward catalytic technology to achieve clean burning stoves. The Department has extensively researched this technology and believes that several key areas must be addressed to provide the greatest assurance that catalytic technology will work effectively in field applications.

Catalyst longevity has been a major concern. Original catalysts were expected to have a life of about 6,000 hours which equates to about two to three years of supplemental heating or one year as a sole heating source. Replacement of the catalyts is cost-effective and should be attractive to the consumer as it will save more than its cost in fuel and provide for less creosote production, potentially less frequent chimney cleaning, and greater safety against chimney fires. A new catalyst has just been marketed which is warranted for six years, with a two full year free replacement and four year pro-rated warranty. For Oregon certified stoves, the manufacturer has extended the full free replacement portion of the warranty to three years. This will greatly alleviate concerns about longevity as well as further increase the cost-effectiveness incentive for consumers to purchase replacement catalysts.

The Department is recommending a condition in the test procedure that requires catalyst stove models to be proven in longevity testing to last at least 5,000 hours. As an alternative, a two year warranty can be provided. This is to protect the consumer against poor quality, short life-span catalysts being certified under the Oregon program.

The Department has also felt that consumers should have a feedback mechanism to let them know when the catalyst is inactive or worn out and in need of replacement. The Department has written a requirement into the test procedure that specifies stoves must be equipped with provisions to add commercially available catalytic activity temperature monitors. These monitors range in price of $15 to $30. A drop in catalyst temperature would indicate to the consumer that it is time to replace the catalyst.

Catalytic model stoves are estimated to cost about $100 to $300 more than existing conventional stoves but payback should occur in a few years due to the higher energy efficiency (up to 1/3 savings in firewood) and less frequent chimney cleaning due to less creosote buildup in cleaner burning stoves. Costs of non-catalytic technology to meet the first stage standard may actually go down if a smaller firebox technology is widely employed. Cost of non-catalytic technology meeting a second stage 7/3 standard is unknown.

If all stoves were ultimately replaced with stoves meeting a 7/3 grams per hour emission standard, the Department estimates that 30,000 tons per year of particulate emissions will be removed from Oregon's airsheds and 200,000 cords of firewood will be saved because of higher efficiency appliances. Fire safety should also be improved and property damage losses reduced. Local nuisances and visibility loss in many communities in Oregon would also be substantially reduced.

Summation

1. Emissions from residential woodheating have become a major cause of violations of State and Federal particulate air quality standards in Oregon. These emissions are also causing violations of State and Federal carbon monoxide standards in some residential areas and creating severe visibility loss and public nuisances in many communities in the State.

2. Numerous short and long range strategies have been developed to deal with the air quality problems created by wood heating. These range from education and mandatory weatherization to mandatory stove curtailment programs during high pollution episodes.

3. One of the most effective and publicly acceptable long-range strategies to deal with the wood heat emission problem is a program to limit the sale of new woodstoves to only those which produce low emissions. The 1983 Oregon Legislature adopted HB2235 which requires the Commission to adopt rules before July 1, 1984 which would establish a woodstove certification program.

4. HB2235 directs the Commission to adopt: a) criteria and procedures for testing woodstoves, b) emission standards, c) a program to certify that woodstoves meet the emission standards, and d) a labelling requirement which would specify emission and heating efficiency performance. HB2235 also authorizes the Department to collect fees for certification and allows establishment of an Advisory Committee to aid the Commission in adopting rules. Only new stoves certified as meeting the emission standard would be allowed to be sold in the State after June 30, 1986.

5. On August 1, 1983, the Commission appointed a Woodstove Advisory Committee composed of nine members who primarily represented the Oregon woodstove industry. Two non-voting medical advisors to the Committee representing the State and local health officers were also appointed.

6. The Woodstove Advisory Committee has held over 20 meetings during which extensive information presented by the Department and representatives of local & national wood heating industry was considered.

7. The Department and the Advisory Committee have reached unanimous consensus on the recommended woodstove test procedures.

8. The recommended woodstove test procedure reflects substantial changes and increased testing from the Department's original proposed test procedure. Such changes were made primarily in an attempt to address the national wood heating industry's desire for a more accurate, precise, realistic, fair, and universally applicable test procedure. The finalized test procedure has undergone extensive confirmation testing and has been proven to meet the aforementioned criteria.

9. Views of representatives of the national wood heating industry regarding the test procedure have not been unanimous, consistent, or substantiated with data, making resolution of some concerns impossible. Areas of continued concern deal with spacing of the dimensional test fuel, use of the modified EPA Method 5 sampling train, realism of the testing, and testing costs.

10. The Department and the Advisory Committee have reached unanimous consensus on the labelling program for woodstoves. A permanent label containing the full range of appliance emission and efficiency

performance has been recommended which can be utilized in other states as well. A removable label for Oregon consumers only has also been recommended to give consumers information on the performance of the appliance with respect to Oregon's emission standard.

11. An extensive testing laboratory accreditation rule has been developed and supported by the Advisory Committee to insure high quality test results from all labs that may choose to participate in the program.

12. A $1,600 woodstove certification fee is proposed to cover costs of certification, retail level compliance checks, and lab accreditation. The fee is reduced to $800 per model for subsequent models submitted for certification by one manufacturer.

13. Separate emission standards are recommended for catalyst and non-catalyst stoves to provide for equivalent performance by recognizing the degradation of catalyst performance over its useful life.

14. Particulate emission standards for non-catalyst/catalysts woodstoves of 15/6, 12/5, 9/4, and 7/3 grams per hour have been intensively considered. These standards are estimated to reduce conventional woodstove particulate emission rates in the range of 50%, 60%, 70%, and 80%, respectively.

15. The Advisory Committee recommended that a staged non-catalyst/catalyst emission standard of 15/6 grams/hour (50% reduction in emissions) should be adopted and reduced to 9/4 (70% reduction in emissions) on July 1, 1988. Their vote was 7 yes, 1 abstention, 1 absence. It is believed the Advisory Committee did not support a 7/3 standard because the industry claimed it would totally rule out non-catalytic technology.

16. Department control strategy analyses indicate that woodstove certification must reduce emissions by about 80% to fully meet air quality standards. Medical advisors to the Committee indicated that an 80% emission reduction should be the target of the certification program. Catalytic technology is available to meet this 80% reduction goal. Available non-catalytic technology appears capable of achieving about a 60% reduction at this time.

17. Although the Department would prefer a single stage standard, the Department believes a practical and justifiable approach is a staged standard with a non-catalytic/catalytic first stage standard of 15/6 (50% emission reduction) and a second stage standard of 7/3 grams per hour (80% emission reduction) to become effective July 1, 1988. This will: a) address most concerns of the industry, b) insure adequate selection of stove models for consumers, and c) provide the greatest assurance that air quality objectives will be met.

18. Stoves which will qualify for certification will cost in some cases about $100 to $300 more than conventional stoves and require in some cases replacement of parts (catalysts); however, because these appliances will have higher efficiencies, they will save consumers more money in fuel cost and chimney cleaning than their initial additional costs. They will also provide increased fire safety.

19. The Certification Program as proposed should ultimately result in an 80% or 30,000 tons per year reduction in smoke from woodstoves in the State and a 200,000 cord per year savings in firewood (about 20% to 30% savings per household) due to the higher efficiency of clean burning appliances. The program should also reduce fire hazards by providing appliances that reduce stovepipe creosote formation.

Recommendation

Based on the Summation, it is recommended that the Commission authorize a public hearing to take testimony on the woodstove certification rules, OAR 340-21-100 through OAR 340-21-166.

Michael Downs
for
Fred Hansen

Attachments:

1. HB2235
2. Draft Statement of Need for Rulemaking
3. Draft Hearing Notice
4. Draft Rules OAR 340-21-100 through 166
5. Permanent Label Example
6. Removable Label Example

J.F. Kowalczyk:ahe
229-6459
March 9, 1984
AZ593

ATTACHMENT 1

62nd OREGON LEGISLATIVE ASSEMBLY–1983 Regular Session

Enrolled

House Bill 2235

Ordered printed by the Speaker pursuant to House Rule 12.00A (5). Presession filed (at the request of Department of Environmental Quality)

CHAPTER 333

AN ACT

Relating to air pollution; creating new provisions; and amending ORS 468.275 and 468.290.

Be It Enacted by the People of the State of Oregon:

SECTION 1. ORS 468.275 is amended to read:

468.275. As used in [*ORS 448.305, 454.010 to 454.040, 454.205 to 454.255, 454.405, 454.425, 454.505 to 454.535, 454.605 to 454.745 and*] this chapter, unless the context requires otherwise:

(1) "Air-cleaning device" means any method, process or equipment which removes, reduces or renders less noxious air contaminants prior to their discharge in the atmosphere.

(2) "Air contaminant" means a dust, fume, gas, mist, odor, smoke, vapor, pollen, soot, carbon, acid or particulate matter or any combination thereof.

(3) "Air contamination" means the presence in the outdoor atmosphere of one or more air contaminants which contribute to a condition of air pollution.

(4) "Air contamination source" means any source at, from, or by reason of which there is emitted into the atmosphere any air contaminant, regardless of who the person may be who owns or operates the building, premises or other property in, at or on which such source is located, or the facility, equipment or other property by which the emission is caused or from which the emission comes.

(5) "Air pollution" means the presence in the outdoor atmosphere of one or more air contaminants, or any combination thereof, in sufficient quantities and of such characteristics and of a duration as are or are likely to be injurious to public welfare, to the health of human, plant or animal life or to property or to interfere unreasonably with enjoyment of life and property throughout such area of the state as shall be affected thereby.

(6) "Area of the state" means any city or county or portion thereof or other geographical area of the state as may be designated by the commission.

(7) "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.

SECTION 2. ORS 468.290 is amended to read:

468.290. Except as provided in this section and in ORS 468.450, 476.380 and 478.960, the air pollution laws contained in this chapter do not apply to:

(1) Agricultural operations and the growing or harvesting of crops and the raising of fowls or animals, except field burning which shall be subject to regulation pursuant to ORS 468.140, 468.150, 468.455 to 468.480 and this section;

(2) Use of equipment in agricultural operations in the growth of crops or the raising of fowls or animals, except field burning which shall be subject to regulation pursuant to ORS 468.140, 468.150, 468.455 to 468.480 and this section;

(3) Barbecue equipment used in connection with any residence;

(4) Agricultural land clearing operations or land grading;

(5) Heating equipment in or used in connection with residences used exclusively as dwellings for not more than four families, **except woodstoves which shall be subject to regulation under sections 4 to 10 of this 1983 Act and this section**;

(6) Fires set or permitted by any public agency when such fire is set or permitted in the performance of its official duty for the purpose of weed abatement, prevention or elimination of a fire hazard, or instruction of employes in the methods of fire fighting, which in the opinion of the agency is necessary; or

(7) Fires set pursuant to permit for the purpose of instruction of employes of private industrial concerns in methods of fire fighting, or for civil defense instruction.

SECTION 3. Sections 4 to 10 of this Act are added to and made a part of ORS chapter 468.

SECTION 4. In the interest of the public health and welfare it is declared to be the public policy of the state to control, reduce and prevent air pollution caused by woodstove emissions. The Legislative Assembly declares it to be the public policy of the state to reduce woodstove emissions by encouraging the Department of Environmental Quality to continue efforts to educate the public about the effects of woodstove emissions and the desirability of achieving better woodstove emission performance and heating efficiency.

SECTION 5. Before July 1, 1984, the commission shall establish by rule:

(1) Emission performance standards for new woodstoves;

(2) Criteria and procedures for testing a new woodstove for compliance with the emission performance standards;

(3) A program administered by the department to certify a new woodstove that complies with the emission performance standards when tested by an independent testing laboratory, according to the criteria and procedures established in subsection (2) of this section;

(4) A program, including testing criteria and procedures to rate the heating efficiency of a new woodstove;

(5) The form and content of the emission performance and heating efficiency label to be attached to a new woodstove; and

(6) The application fee to be submitted to the department by a manufacturer, dealer or seller applying for certification of a woodstove.

SECTION 6. To aid and advise the commission in the adoption of emission performance standards and testing criteria, the commission may establish an advisory committee. The members of the advisory committee shall include, but need not be limited to, representatives from Oregon woodstove manufacturers.

SECTION 7. (1) After July 1, 1984, a woodstove manufacturer or dealer may request the department to evaluate the emission performance of a new woodstove.

(2) The commission shall establish by rule the amount of the fee that a manufacturer or dealer must submit to the department with each request to evaluate a woodstove.

(3) A new woodstove may be certified at the conclusion of an evaluation and before July 1, 1986, if:

(a) The department finds that the emission levels of the woodstove comply with the emission standards established by the commission; and

(b) The woodstove manufacturer or dealer submits the application for certification fee established by the commission under section 5 of this 1983 Act.

(4) As used in this section, "evaluate" means to review a woodstove's emission levels as determined by an independent testing laboratory, and compare the emission levels of the woodstove to the emission standards established by the commission under section 5 of this 1983 Act.

SECTION 8. On and after July 1, 1986, a person may not advertise to sell, offer to sell or sell a new woodstove in Oregon unless:

(1) The woodstove has been tested to determine its emission performance and heating efficiency;

(2) The woodstove is certified by the department under the program established under section 5 of this 1983 Act; and

(3) An emission performance and heating efficiency label is attached to the woodstove.

SECTION 9. (1) The provisions of this 1983 Act do not apply to a used woodstove.

(2) As used in this section, "used woodstove" means any woodstove that has been sold, bargained, exchanged, given away or has had its ownership transferred from the person who first acquired the woodstove from the manufacturer or the manufacturer's dealer or agency, and so used to have become what is commonly known as "second hand" within the ordinary meaning of that term.

SECTION 10. The commission shall use a portion of the net emission reductions in an airshed achieved by the woodstove certification program to provide room in the airshed for emissions associated with commercial and industrial growth.

Approved by the Governor July 5, 1983.
Filed in the office of Secretary of State July 6, 1983.

Attachment 2

RULEMAKING STATEMENTS

for

Proposed Adoption of Woodstove Certification Rules

Pursuant to ORS 183.335, these statements provide information on the intended action to amend a rule.

STATEMENT OF NEED:

Legal Authority

This proposal would add rules to OAR Chapter 340, Division 21, Sections 100-166, Woodstove Certification.

It is proposed under authority of ORS Chapter 468.655.

Need for the Rule

A woodstove certification program is needed to control, reduce and prevent air pollution caused by woodstove emissions. It is needed in urban areas of the state to reduce violations of particulate and carbon monoxide air quality standards designed to protect against adverse health and welfare impacts. Such impacts are also threatening growth and development by using up airshed capacity considered available for other growth. This program is needed to reduce severe nuisance impacts, visibility loss and odor problems throughout the state.

Principal Documents Relied Upon

1. DEQ Legislative Concepts for Residential Wood Heating, dated May 4, 1982.
2. DEQ/Oregon Woodstove Advisory Committee Reference Notebooks, Volumes I and II, dated August 12, 1983 through February 21, 1984.
3. DEQ Woodstove Air Pollution Control Alternatives (a Table), dated Spring 1983.
4. HB 2235, 1983 Oregon Legislature.

FISCAL AND ECONOMIC IMPACT ON SMALL BUSINESS:

The small business impact could be adverse, insignificant, or beneficial depending on the particular business and buying patterns of consumers. Most of the businesses affected by this program are classified as small businesses with fewer than 50 employees. Woodstove retailers and manufacturers are the businesses that would be most significantly affected by this program. Assuming there would be no decrease in stove sales, and assuming that cleaner burning appliances would cost $100-$300 more than present generation appliances, there could be the benefit of an overall increase in dollar sales for the industry. A proportion of the total industry income could shift from businesses that don't provide certifed clean burning stoves, to businesses that do provide certified clean burning appliances. Demand for Oregon certified stoves in other areas of the country or world could also increase business. Each appliance manufacturer would incur an additional $6000-$7000 cost per model for emission and efficiency testing. A $1600.00 certification fee for the first model submitted for certification by a manufacturer, and $800.00 for each additional model would also be incurred. Certification fees would be used to offset costs incurred by the DEQ to administer the program.

Chimney sweeps may have less business in chimney cleaning.

Independent testing laboratories in the State that gain accreditation to participate in the program would be beneficially affected as appliance manufacturers test woodstoves to gain certification.

Commercial wood fuel suppliers could experience a 20%-30% decrease in business because the clean-burning stoves are generally 20%-30% more efficient than the present "average" stove. Thus, less wood is required to heat a home. However, burners are shifting from cutting and hauling wood themselves to buying wood from local commercial wood suppliers. Woodstove sales are projected to increase, in proportion to the general population growth in the State, at an approximate rate of 2%/yr. This sales projection does not assume potential increases in residential energy prices. These increases in the volume of customers might offset the decrease in the size of each sale.

Reduction in particulate pollution violations should help to increase the airshed capacity that would be available for growth and development, resulting in establishment of industries with a potential of 19,000-24,000 new jobs in the State by the year 2000.

FISCAL AND ECONOMIC IMPACT ON OTHERS:

About 20,000-30,000 households per year are expected to add or replace a wood heating appliance. An adverse affect on these consumers would be an average initial increase in cost that may range from $100.00-$300.00. If a catalytic stove is used, an additional average annual cost of $20-$50 will be incurred for catalyst replacement. However, both of these costs should decrease as market demands expand, competition amongst the remaining stove retailers increases, and woodstove industry research increases the useful lifetime of stoves and catalytic combustors. The economic beneficial effect of energy or wood savings to the consumer, because of better combustion conditions in cleaner burning appliances, should be about $50-$100 per year. This amount would offset increased appliance and replacement part costs in a few years. Cleaner burning woodstoves produce less creosote in chimneys. Thus, consumers will gain the added benefit of fire-safety improvement and less chimney cleaning.

There should be little long-term fiscal impact on the Department of Environmental Quality as the program is to be self-sufficient through certification fees.

Local fire districts should experience a substantial decrease in woodstove related housefires, thus reducing costs associated with the number of housefire calls.

LAND USE CONSISTENCY STATEMENT:

The proposed rule appears to affect land use and appears to be consistent with the Statewide Planning Goals.

With regard to Goal 6 (air, water, and land resources quality) the rules are designed to enhance and preserve air quality in the affected area and are considered consistent with the goal. Airshed capacity for growth and development will be regained which might make room for about 19,000-24,000 jobs in the State.

Goal 11 (public facilities and services) is deemed unaffected by the rule. The rule does not appear to conflict with other goals.

With regard to Goal 13 (energy conservation), the rules would beneficially affect the use of a renewable energy source (biomass: firewood) in that it is estimated 200,000 cords per year (or about 80 megawatt equivalents) of firewood will be conserved by the year 2000 if cleaner burning, more efficient stoves were in use.

Public comment on any land use issue involved is welcome and may be submitted in the same way indicated for testimony in this notice.

It is requested that local, state, and federal agencies review the proposed action and comment on possible conflicts with their programs affecting land use and with Statewide Planning Goals within their expertise and jurisdiction.

The Department of Environmental Quality intends to ask the Department of Land Conservation and Development to mediate any apparent conflict brought to our attention by local, state, or federal authorities.

land use and with Statewide Planning Goals within their expertise and jurisdiction.

The Department of Environmental Quality intends to ask the Department of Land Conservation and Development to mediate any apparent conflict brought to our attention by local, state, or federal authorities.

Attachment 3

Proposed Adoption of Woodstove Certification Rules
Notice of Public Hearing

Date Prepared: March 5, 1984
Hearing Dates: May 1, May 2, & May 3, 1984
Comments Due: May 4, 1984

WHO IS AFFECTED:

1. Residents of the State of Oregon who may buy a new woodstove in the future;
2. woodstove retailers and dealers who intend to sell new woodstoves in the State of Oregon;
3. woodstove manufacturers who manufacture with the intent of having their woodstoves sold in the State of Oregon; and
4. independent testing laboratories.

WHAT IS PROPOSED

The Department of Environmental Quality is proposing rules to be added to OAR, Chapter 340, Division 21, Sections 100-166, Woodstove Certification, that would be used to administer the Oregon Woodstove Certification Program which was authorized by the 1983 Oregon Legislature.

WHAT ARE THE HIGHLIGHTS:

The Department of Environmental Quality (DEQ) is proposing to establish emission standards and test procedures for certification of new woodstoves sold in Oregon after July 1, 1986. Interested parties should request a copy of the complete proposed rule package. Some highlights are:

1. Emission performance standards would be established for new woodstoves offered for sale or sold during the period:
   - A. July 1, 1986 - June 30, 1988 - 15 grams of smoke emitted per hour (grams/hour) for non-catalytic woodstoves; 6 grams/hour for catalytic equipped woodstoves. This represents about a 50% reduction in smoke compared to conventional stoves.
   - B. July 1, 1988 - on - 7 grams/hour for non-catalytic woodstoves; 3 grams/hour for catalytic equipped woodstoves. This represents about an 80% reduction in smoke from conventional stoves.

2. Criteria and procedures would be established for testing new woodstoves for efficiency and for compliance with the emission performance standard.

3. Two labels would be required for each certified woodstove:

   A. A permanent label that would describe the tested emissions and efficiency of the stove over the range of tested heat outputs.

   B. A removable point-of-sale label that would describe the average emission and efficiency of the stove, the range of tested heat outputs, and would compare the stove's performance to the Oregon emission standard.

4. Criteria and procedures would be established to accredit independent testing laboratories to test new woodstoves for emissions and efficiency.

5. A certification fee schedule would be established:

   A. $1600.00 fee for the first model a manufacturer submits for certification.

   B. $ 800.00 fee for each additional stove a manufacturer submits for certification.

6. Criteria and procedures would be established for enforcement of the program.

HOW TO COMMENT:

Copies of the complete proposed rule package may be obtained from the DEQ Public Affairs Section in Portland (522 S.W. Fifth Avenue) or the regional office nearest you. For further information contact Margaret McCue at 229-6488.

A public hearing will be held before a hearings officer at:

City	Time	Date	Location
Portland	2:00 p.m. and 7:00 p.m.	Tuesday, May 1, 1984	To Be Arranged
Bend	2:00 p.m. and 7:00 p.m.	Thursday, May 2, 1984	To Be Arranged
Eugene	2:00 p.m. and 7:00 p.m.	Thursday, May 3, 1984	To Be Arranged
Medford	2:00 p.m. and 7:00 p.m.	Thursday, May 3, 1984	To Be Arranged
Pendleton	2:00 p.m. and 7:00 p.m.	Thursday, May 3, 1984	To Be Arranged

DEQ staff will be available for one hour prior to each hearing to clarify any questions about the rules. Oral and written comments will be accepted at the public hearing. Written comments may be sent to the DEQ Public Affairs Section, P.O. Box 1760, Portland, OR 97207, but must be postmarked by no later than May 4, 1984.

WHAT IS THE NEXT STEP:

After public hearing the Environmental Quality Commission may adopt rules identical to the proposed rules, adopt modified rule on the same subject matter, or decline to act. The adopted rules will be submitted to the U. S. Environmental Protection Agency as part of the State Clean Air Act Implementation Plan. The Commission's deliberation should come on June 8, 1984 at a specially scheduled Commission meeting in Portland.

A Statement of Need, Fiscal and Economic Impact Statement, and Land Use Consistency Statement are attached to this notice.

Attachment 4

(DRAFT RULES)

WOODSTOVE CERTIFICATION
Chapter 340, Division 21, Sections 100-166

(DRAFT RULES)

WOODSTOVE CERTIFICATION
Chapter 340, Division 21, Sections 100-166

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

(6) "Heat output" means the heat output (Btu/hour) of a woodstove during one test run, measured under test conditions prescribed by OAR 340-21-130.

(7) "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.

(8) "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.

(9) "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 340-21-120(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.

(10) "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 340-21-130 and calculated according to procedures specified in OAR 340-21-120(5).

(11) "Weighted average" means the weighted average of the test results to the distribution of home heating needs in Oregon. (Refer to OAR 340-21-120(5)).

(12) "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.

Requirements for Sale of New Woodstoves in Oregon

340-21-110(1) On and after July 1, 1986, a person shall not advertise to sell, offer to sell, or sell a new woodstove in the State of 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 340-21-130; and

(b) The woodstove is certified by the Department in accordance with procedures in OAR 340-21-140 as meeting the emission performance standards specified in OAR 340-21-120; and

(c) The woodstove is labelled for emission performance and heating efficiency as specified in OAR 340-21-150.

(2) No manufacturer or dealer shall alter either the permanent or removable label in any way from the label approved by the Department pursuant to OAR 340-21-156.

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

Exemptions

340-21-115 (1) Wood-fired appliances that are not suitable for heating equipment in or used in connection with residences or commercial installations are excluded from 340-21-110. 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 340-21-110.

Emission Performance Standards and Certification

340-21-120 (1) New woodstoves with minimum "heat output" of less than 40,000 Btu/hr advertised for sale, offered for sale, or sold in the State of 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 340-21-130.

(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/hr advertised for sale, offered for sale, or sold in the State of 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 340-21-130.

(a) 7 grams per hour for a non-catalytic woodstove or

(b) 3 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 the State of 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 340-21-130.

(4) The Department will certify a woodstove as meeting the applicable woodstove emission standard after July 1, 1984 in accordance with procedures in OAR 340-21-140.

(5) The weighted average particulate emission shall be calculated as follows:

$$\bar{E} = \frac{K_1E_1 + K_2E_2 + K_3E_3 \ldots + K_nE_n}{K_1 + K_2 + K_3 \ldots + K_n}$$

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 1 for the heat output measured during each test run, $P_o = 0$, and $P_{n+1} = 1$.

Table 1
(OAR 340-21-120)

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

Heat Output (Btu/hr)	Cumulative Probability (P)
0	0.02640
600	0.03071
1,200	0.03503
1,800	0.04130
2,400	0.04888
3,000	0.05863
3,600	0.06879
4,200	0.08122
4,800	0.09837
5,400	0.11586
6,000	0.13522
6,600	0.15803
7,200	0.18394
7,800	0.21615
8,400	0.24867
9,000	0.28798
9,600	0.32621
10,200	0.37040
10,800	0.41575
11,400	0.46226
12,000	0.50831
12,600	0.55778
13,200	0.60326
13,800	0.64770
14,400	0.68572
15,000	0.72483
15,600	0.75743
16,200	0.78883
16,800	0.81816
17,400	0.84386
18,000	0.86822
18,600	0.88951
19,200	0.90667
19,800	0.92228
20,400	0.93620
21,000	0.94720
21,600	0.95545
22,200	0.96158
22,800	0.96699
23,400	0.97151
24,000	0.97515
24,600	0.97873
25,200	0.98256
25,800	0.98540
26,400	0.98713
27,000	0.98972
27,600	0.99096
28,200	0.99237
28,800	0.99316
29,400	0.99408
30,000	0.99472
30,600	0.99506
31,200	0.99526
31,800	0.99563
32,400	0.99589
33,000	0.99679
33,600	0.99711
34,200	0.99745
34,800	0.99774
35,400	0.99787
36,000	0.99817
36,600	0.99837
37,200	0.99851
37,800	0.99858
38,400	0.99882
39,000	0.99899
39,600	0.99915
40,200	0.99933
40,800	0.99945
41,400	0.99958
42,000	0.99968
42,600	0.99974
43,200	0.99986
43,800	0.99992
44,400	0.99995
45,000	0.99996
45,600	0.99999
46,200	1.00000
46,800	1.00000
47,400	1.00000
48,000	1.00000
> 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).

Testing Criteria and Procedures

340-21-130 (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 Woodstoves dated March 8, 1983, and incorporated herein by reference and on file at the Department.

(2) All testing for certification purposes shall be conducted by a 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.

General Certification Procedures

340-21-140 (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 340-21-130 and that it meets the emission performance standard specified in OAR 340-21-120.

(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) $1600.00 for a manufacturer's first model seeking certification, and

(b) $ 800.00 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 below.

(4) When all the preceeding requirements have been met, the Department will issue 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 than 5 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.

Changes in Woodstove Design

340-21-145 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.

Labelling Requirements

340-21-150 Woodstoves which must be labelled pursuant to OAR 340-21-110 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.

340-21-151 All woodstoves certified by the Department from July 1, 1984 on, shall be labelled with a permanent and a removable label.

Permanent Label

340-21-152 (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

y = particulate emissions (grams/hour)
x = heat output (Btu/hour)
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

y = overall efficiency (%)
x = heat output (Btu/hour)
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 340-21-156.

(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 340-21-156. 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 (340-21-152(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 (340-21-152(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 (340-21-152(6)(a) and (b)). For instance, the label may be riveted, screwed, or bolted onto the appliance.

Removable Label

340-21-154 (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.

Label Approval

340-21-156 (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 (b), 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 (b), 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 1 month of receiving the labels from the printer.

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 340-21-161 are met. In addition, the laboratory must demonstrate stove testing proficiency pursuant to OAR 340-21-162, in order to qualify for accreditation.

Accreditation Criteria

340-21-161 (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 is 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 or its owners or operators shall be certified by any association or are members of any association that discriminates by business or management practices against any person or business because of race, creed, color, religion, sex, age, or national origin.

Application for Laboratory Accreditation

340-21-162 (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 340-21-161 at the time of application, and how they will continue to meet the criteria and standards on an on-going 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 340-21-161.

(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 revolved. 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.

On-Site Laboratory Inspection and Stove Testing Proficiency Demonstration

340-21-163 (1) An on-site inspection will be conducted by a Department representative after all laboratory information required by OAR 340-21-161, 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 applies for accreditation renewal.

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

(a) Observe the Stove Testing Proficiency Demonstration specified in OAR, 340-21-162(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 340-21-130 and 340-21-162(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 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 be:

(a) 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) Required to test the stove in accordance with testing criteria and procedures specified in OAR 340-21-130.

(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.

Accreditation Application Deficiency, Notification and Resolution

340-21-164 (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 deficiencies in the test data and/or results may result in subsequent proficiency tests being required at the laboratory with a Department representative present.

Final Department Administrative Review and Certificate of Accreditation

340-21-165 (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 340-21-161, -162, and -163.

(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 340-21-162, and demonstrates compliance with OAR Chapter 340-21-161 and 163.

(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.

Civil Penalties, Revocation, and Appeals

340-21-166 (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 would be handled as contested cases pursuant to OAR Chapter 340, Division 11.

APPENDIX 1

OREGON DEPARTMENT OF ENVIRONMENTAL QUALITY

STANDARD METHOD FOR MEASURING THE EMISSIONS AND EFFICIENCIES OF WOODSTOVES

REVISED DRAFT

March 8, 1984

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 an appliance having an air/fuel ratio by weight 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.

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 be certified as having met the specific criteria in the June, 1982 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 part 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 FLUE MOISTURE CONTENT DETERMINATION

3.7.1 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 bulb 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).

3.8 DRAFT

3.8.1 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.

3.9 RELATIVE HUMIDITY

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

3.10 DATA RECORDING INTERVALS

3.10.1 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.

3.11 INSTRUMENT CALIBRATION

3.11.1 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.

3.11.2 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).

3.11.3 Continuous gas analyzer(s) audit

Before and after each test and at intervals not to exceed 2 hours during the test, conduct a single point audit of the instrument as described below.

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.

3.11.4 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 must be recalibrated before use and discount previous results.

3.11.5 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 begining 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 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.

Specifications For Woodstove Emission Test Methods

Parameter	Units	Limits
Emission rate range	g/hr	1.0-20.0
Minimum number of test runs		5
Minimum number of simultaneous samples per test run		4
(Candidate method)		(2)
(Reference method)		(2)
Maximum analytical precision	%	18
Maximum difference in consistent relationship	%	24

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 12 quadruple samples (duplicate pairs of both candidate and reference methods) have been obtained. The 12 quadruple samples should represent 12 full test runs.

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):

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

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 20.0 grams per hour (g/hr). All remaining quadruple samples must be subjected to both of the following tests for precision and consistent relationship. At least five samples (average of duplicate reference method analyses) must be within the 1.0 to 20.0 g/hr range and at least one sample within each of the 1.0 to 5.0, 5.0 to 10.0, 10.0 to 15.0, and 15.0 to 20.0 g/hr ranges for the test to be valid.

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.

If any reference method precision value (P_{Ri}) exceeds 18 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.

6.2.4 Test For Consistent Relationship

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:

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

where i is the filter number, 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).

The candidate method passes this test if the absolute values of all of the differences (D) are less than or equal to 24 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 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 ± 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:

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

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

Dc = Downstream tracer gas concentration (ppm x 10^{-6})
Tr = Injection gas temperature (^{o}R) at the rotometer
Pr = Injection gas pressure (inches Hg)
* = 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.

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

Where @ = 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 @ lbs of wood are as follows:

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

Stack gas total as measured by combustion gas analyzers:

$$1 \cong (d + e + g + h) \quad 6.4.1.f$$

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 "@", "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 "@" for the test burn. This first run "@" is then used to determine a corrected Tsg for the second run as follows:

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

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

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

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

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 effiencies 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:

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

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:

$$\text{Thi} = \text{Gcvf x Wfc} \qquad 6.5.2.\text{b}$$

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:

$$\text{Clo} = \text{Tsg } [(\text{e x Hco}) + (\text{k x Huh})] \qquad 6.5.2.\text{c}$$

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:

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

Where: Sllo = Sensible and latent heat losses
$= (T_o - T_i)\ [\text{Tsg}(dCpCO_2 + eCpCO + gCpO_2 + hCpN_2 + (j)C_pH_2O)] + (j-m)LH_2O$

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.

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

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

7.1.12 Fuel Load Weight and Burn Cycle Period (Minutes)

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 have the combustor pre-aged before emission performance testing to a specified aging process. The aging process will consist of the catalytic combustor tested in a woodstove (specifically designed for an internal catalytic combustor) for a continuous period of 50 hours. The test fuel shall consist of Douglas fir dimensional lumber or cordwood with a moisture content range between 16-20% wet basis. The accredited testing laboratories must provide combustor temperature data and certify to the DEQ that each catalytic appliance tested for emissions and efficiency performance 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

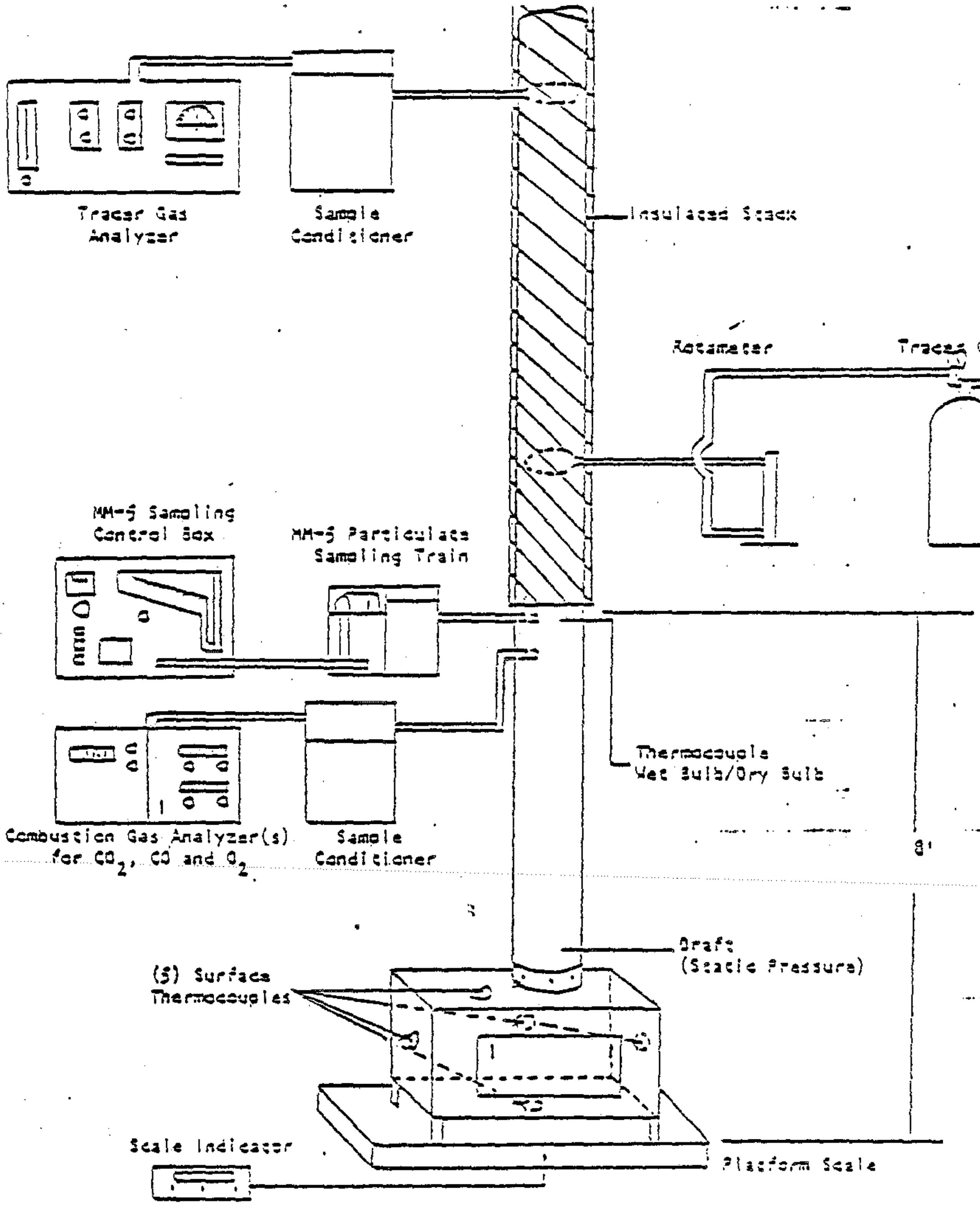


Figure 5.1

EXAMPLES OF
USABLE FIREBOX VOLUME

(Designated by Shaded Area)

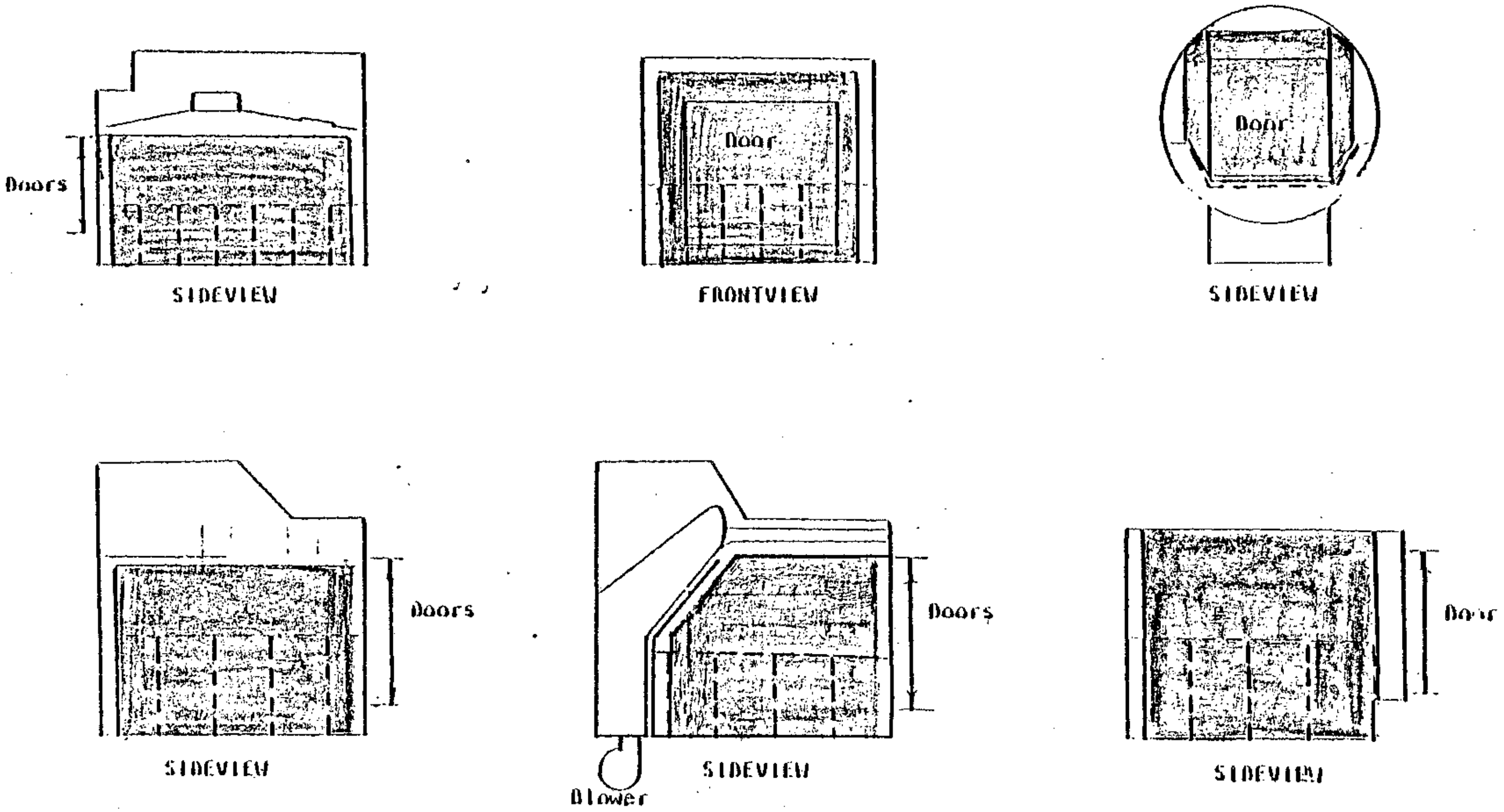
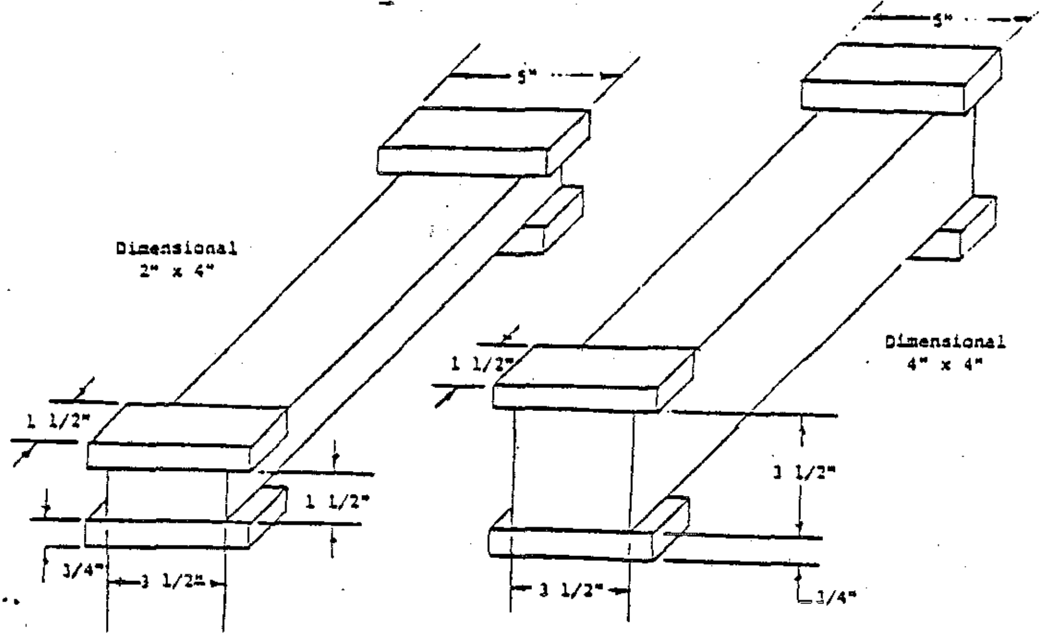


Figure 4.3

Test Fuel Size

Usable Firebox Volume (ft³)		Size - Flanged Log (Nominal Inches)
≤1.5		2 x 4
>1.5 ≤ 3	Combination	2x4 approximately ½ weight of test fuel load 4x4 approximately ½ weight of test fuel load
>3		4 x 4

Maintain 7 #/ft³ ± 10% load density



Scale 1/4" = 1"

* Length will vary depending on length of firebox

Alternative Flange Configuration

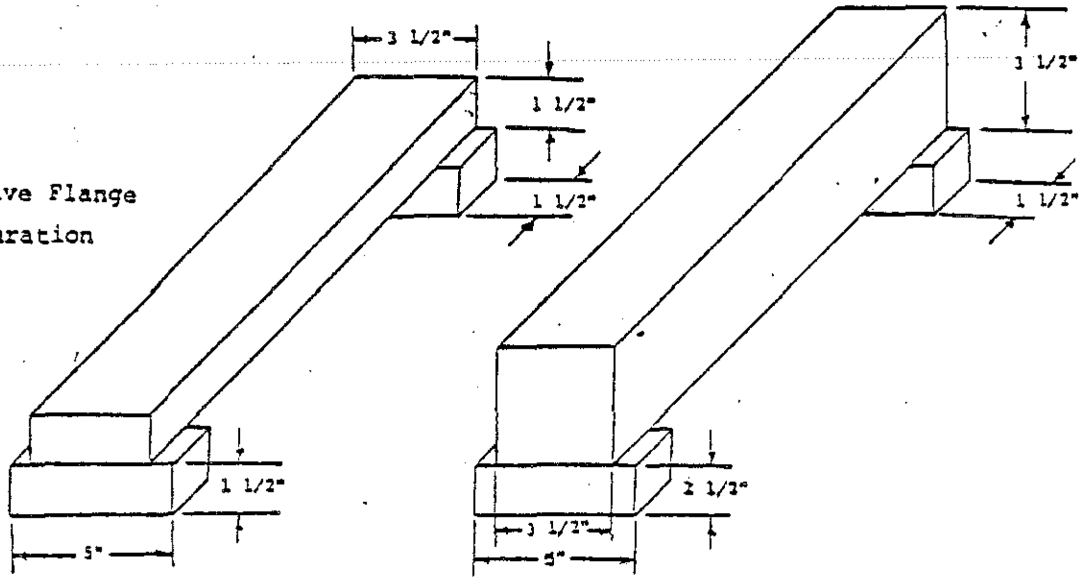
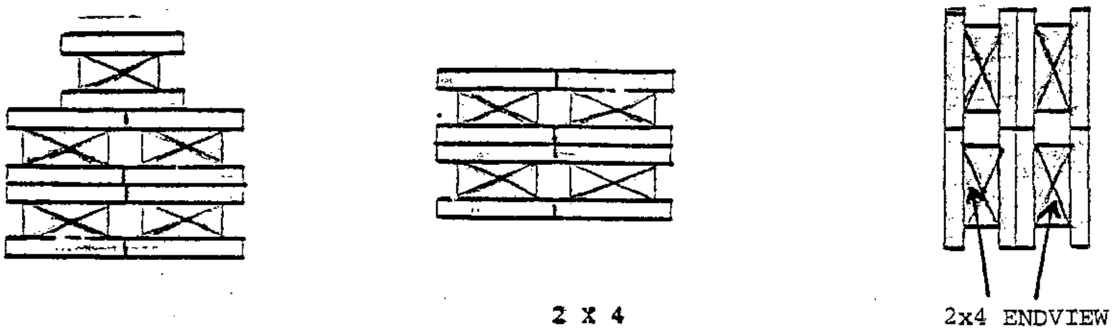
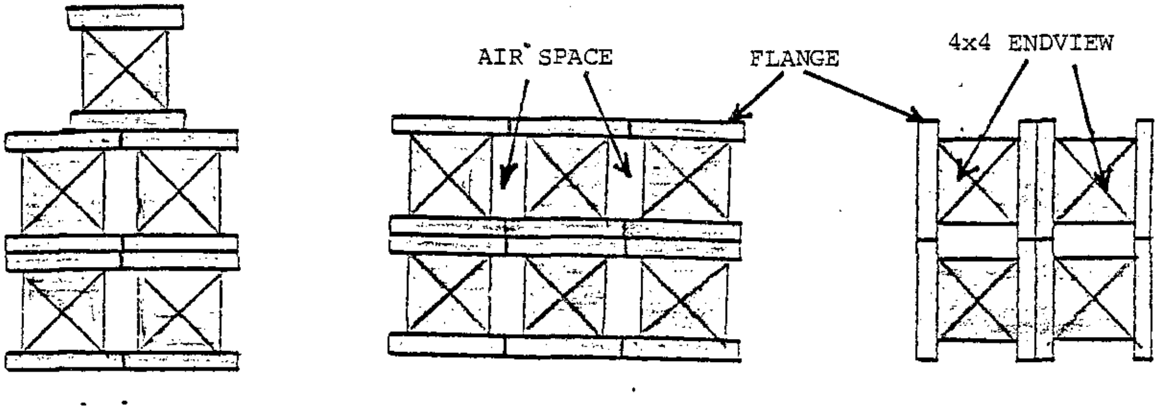


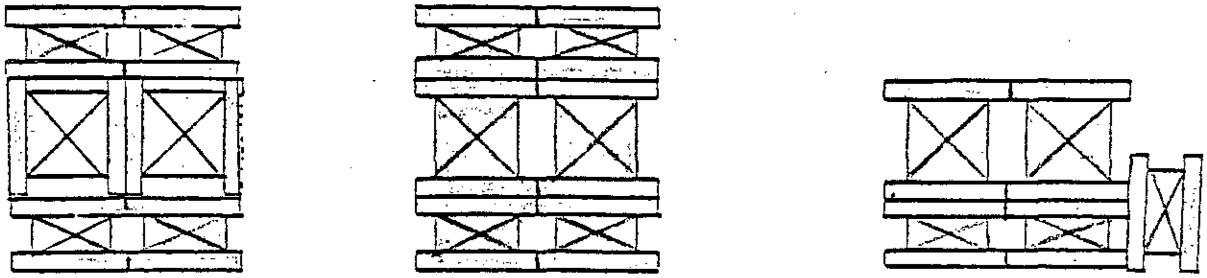
Figure 4.2-A



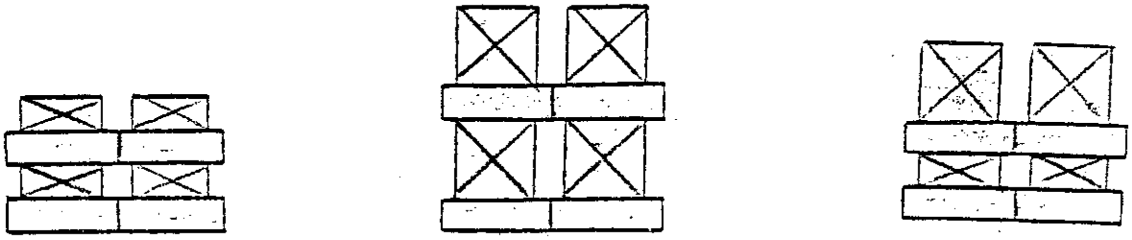
2 X 4



4 X 4



2 X 4 & 4 X 4



Alternative Flange Configuration

Woodstove Stacking & Loading Examples

Figure 4.2-B

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.

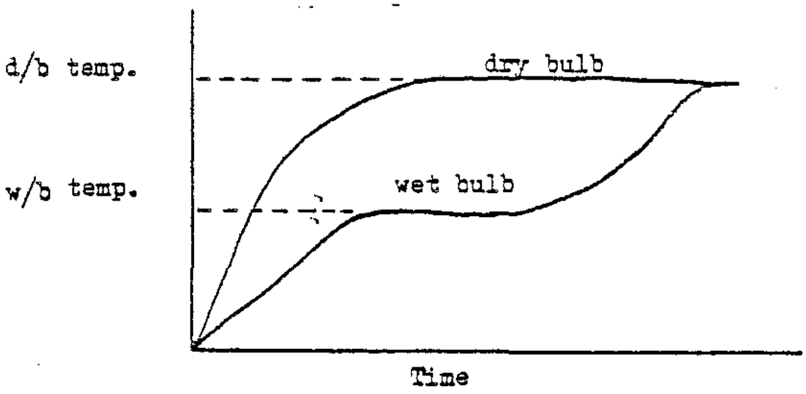


Figure 4-1

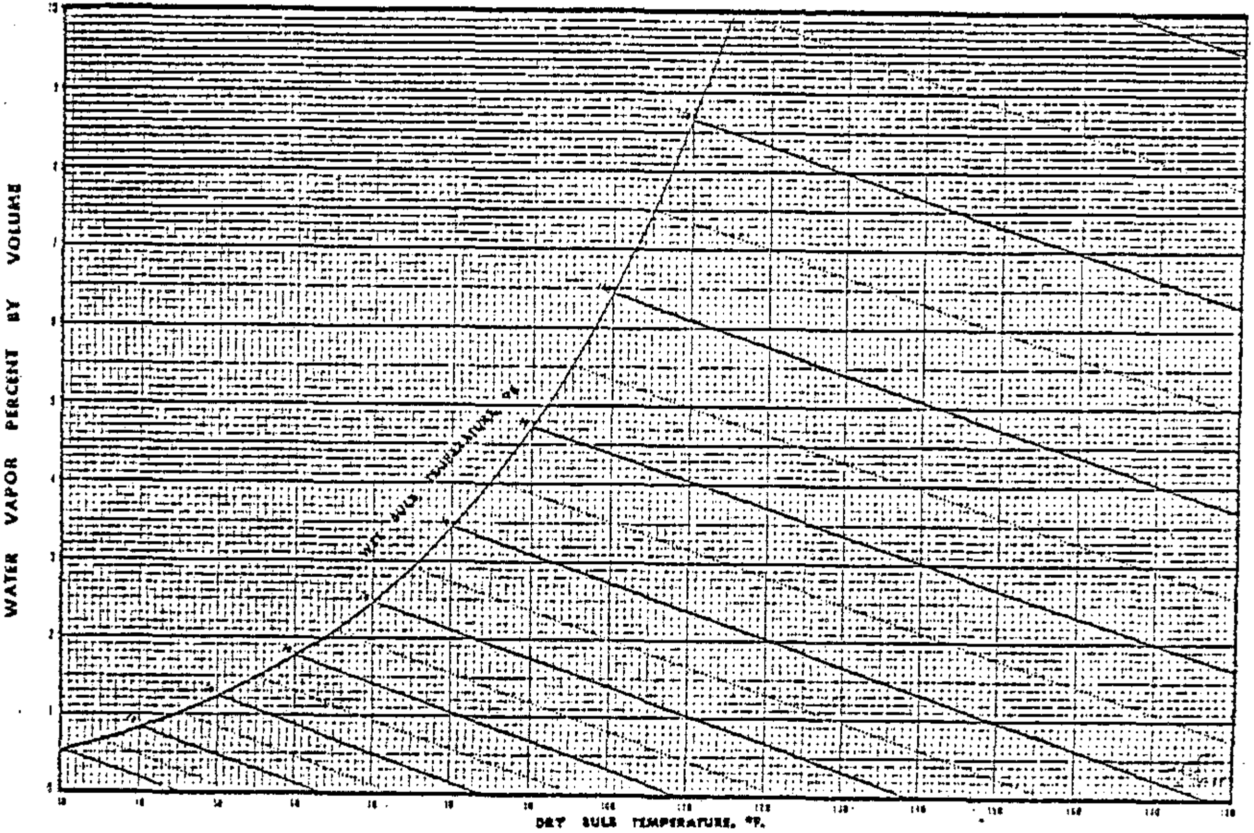


FIGURE 4-2

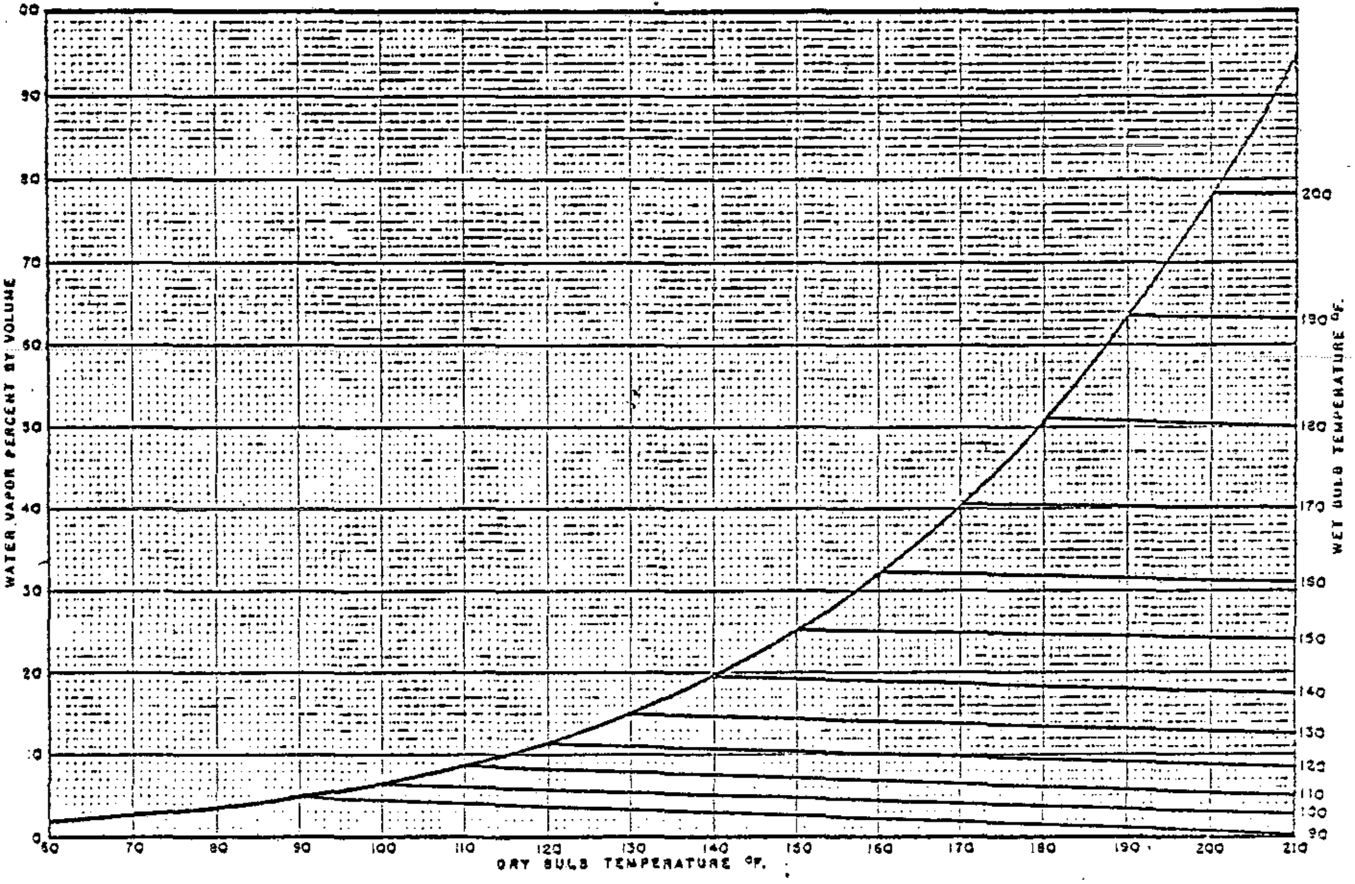


FIGURE 4-3

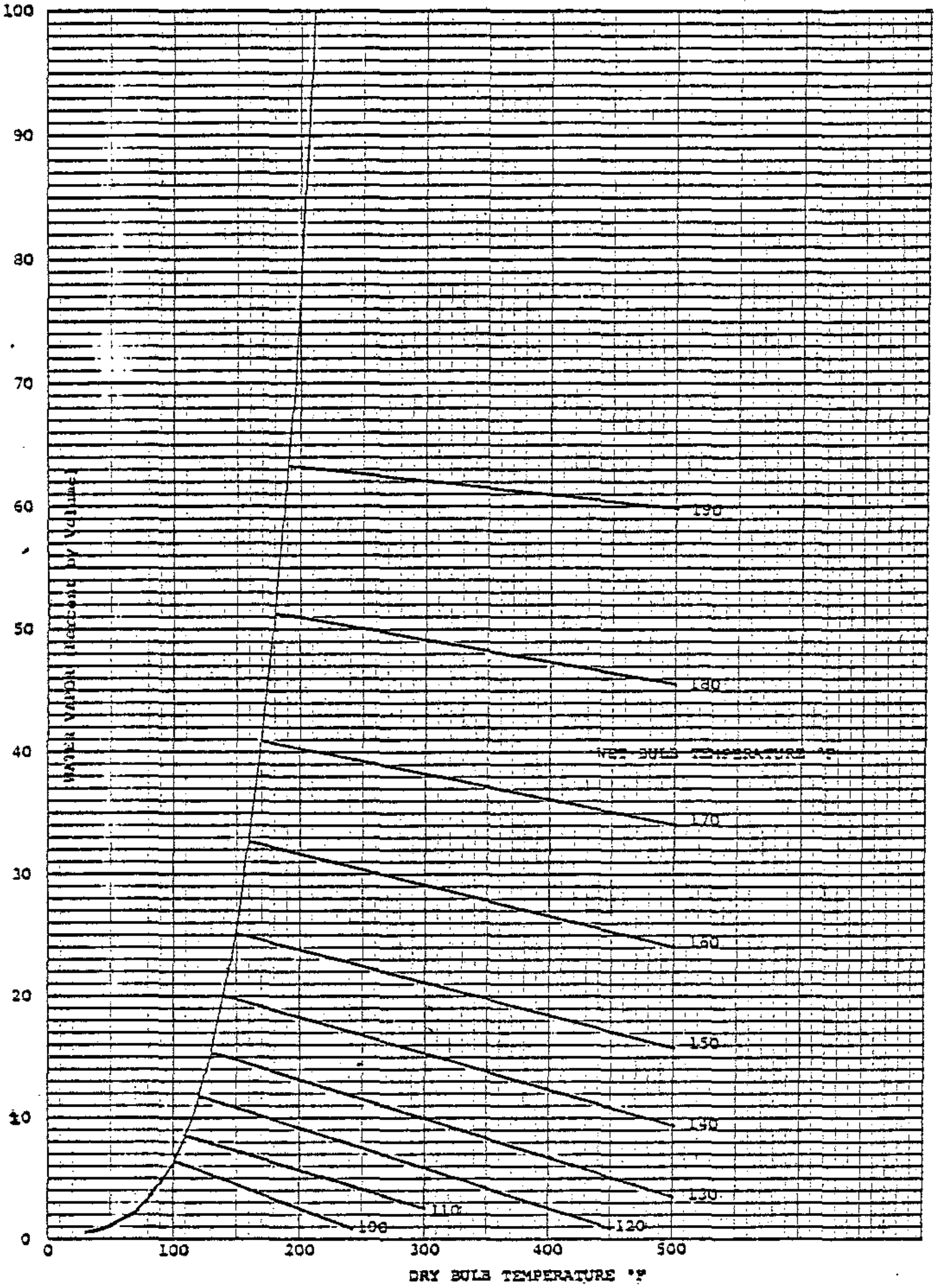

WATER VAPOR (Percent by Volume)
100
90
80
70
60
50
40
30
20
10
0
0
100
200
300
400
500
DRY BULB TEMPERATURE °F
WET BULB TEMPERATURE °F
190
180
170
160
150
140
130
120
110
100

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, °F

t_w = Wet bulb temperature, °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	.0339	.0324	.0306	.0289	.0275	.0259	.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	.3626	.3764	.3906	.4052	.4203	.4359	.4520	.4586	.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	21.50	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	47.37	48.14	49.03	49.93
240	50.84	51.78	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

Attachment 2
of Appendix 1

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 0.065 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).

   <u>Note</u>: 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 8 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

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

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

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 <u>Source Sampling Method 2</u>.

14.3 Dry gas volume

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

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

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, °R

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 <u>Source Sampling Method 3</u>, 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 <u>Source Sampling Method 3</u>.

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

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

where C_t = total particulate emission rate, lbs/hr

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

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

$$I = \frac{1039\ T_s Q_d}{V_s P_s m_d D_n^2\ t} \qquad (5\text{-}12)$$

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.

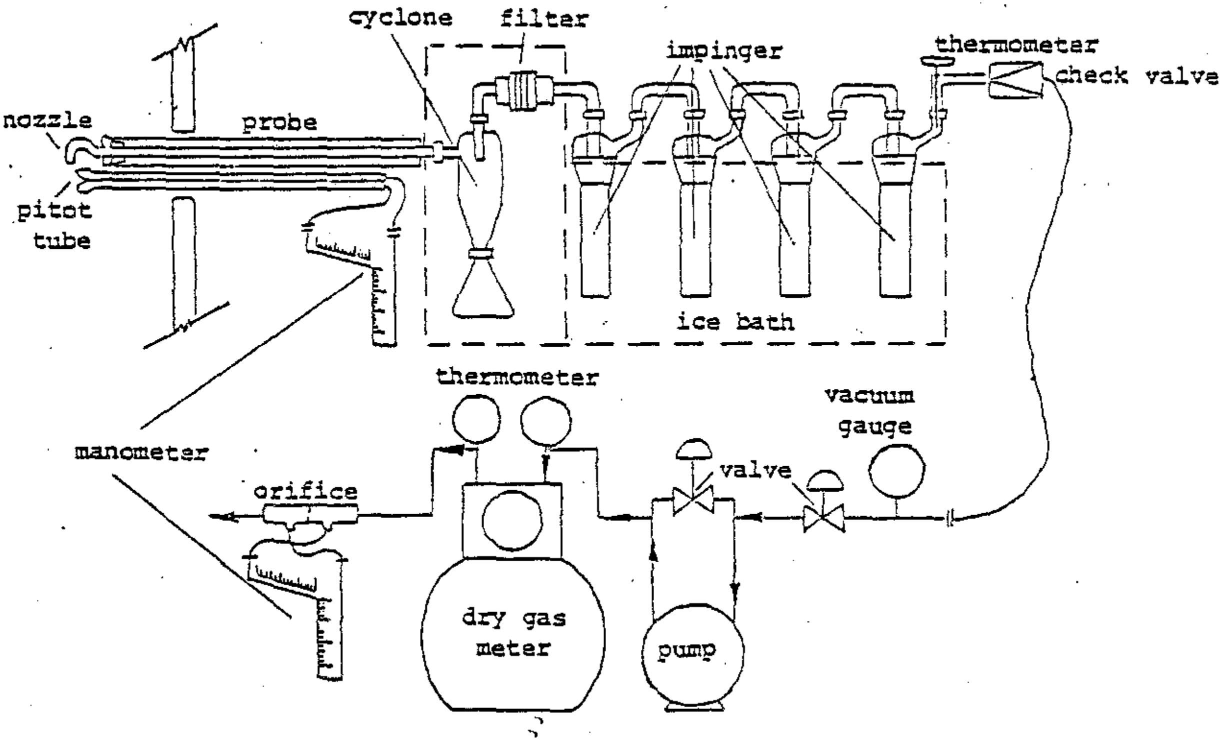

cyclone
filter
impinger
thermometer
check valve
nozzle
probe
pitot tube
ice bath
thermometer
vacuum gauge
manometer
valve
orifice
dry gas meter
pump

FIGURE 5-1

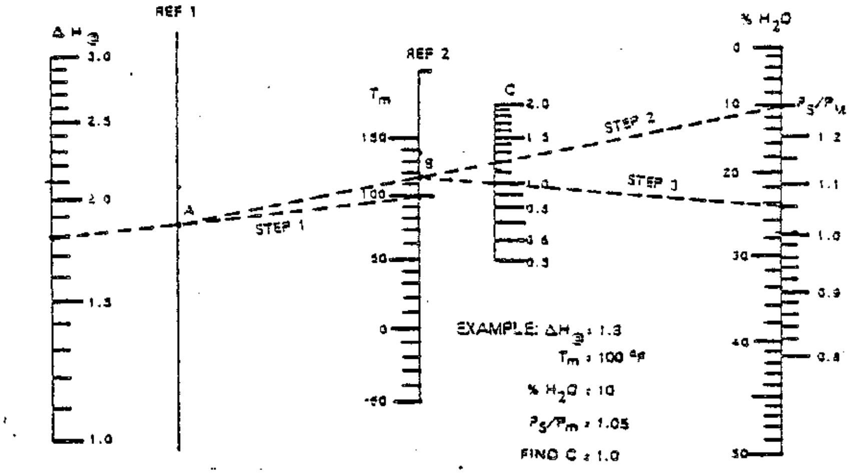


Figure 5-2(a)

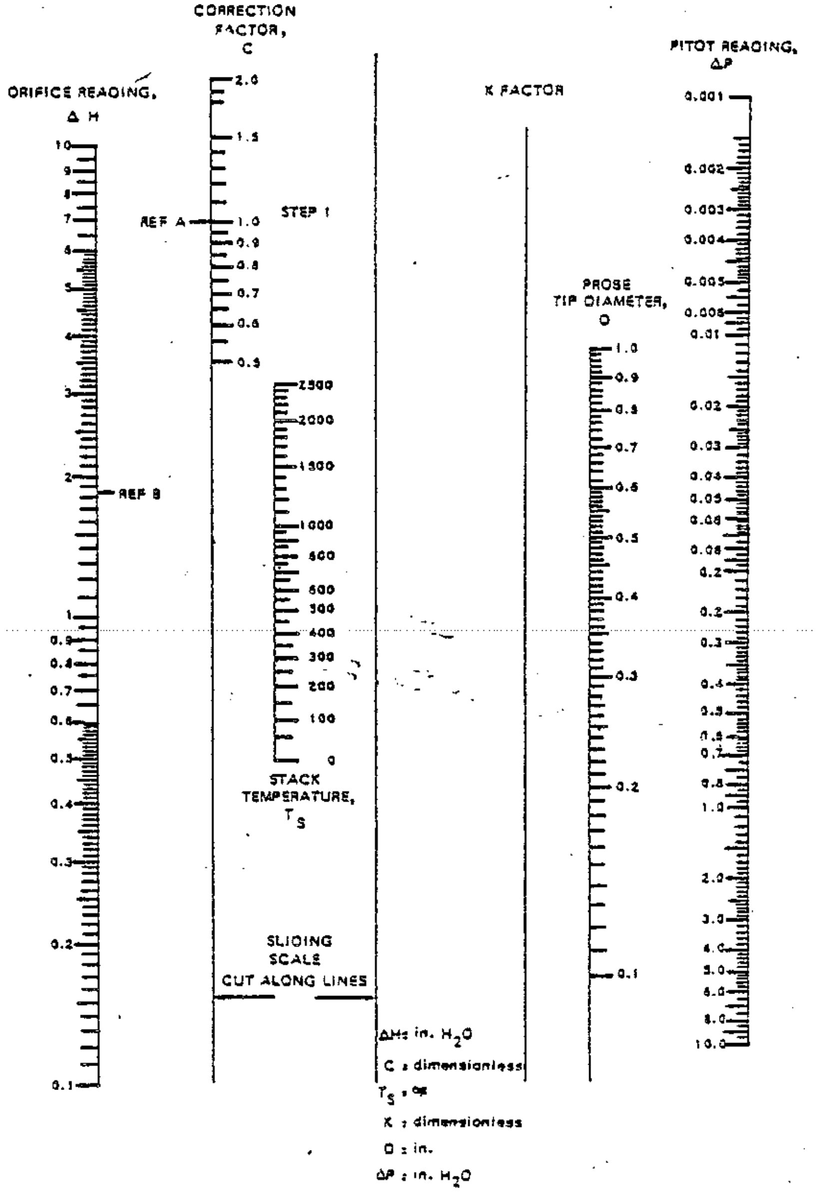


Figure 5-2(b)

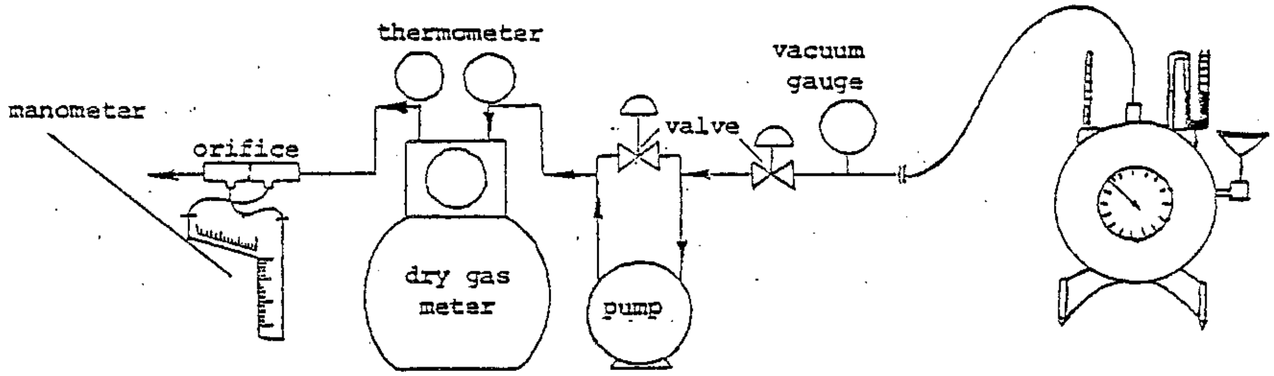

thermometer
vacuum gauge
manometer
valve
orifice
dry gas meter
pump

Figure 5-3

CALIBRATION SHEET

Figure 5-4

Orifice Gas Meter Date Barometric Pressure Pb:

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

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

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

Probe Nozzle Date

D_n, in.	D_n, in.	D_n, in

Averages

Pitot Tube Date

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

						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 P's in. Hg gauge	Stack Temp.		Vel. Head ΔP in. H_2O	(ΔP x Ts)	$S=\sqrt{\Delta P \times Ts}$
		ts °F	Ts °R			
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.		Vel. Head ΔP in H_2O	$(\Delta P \times Ts)$	$S=\sqrt{\Delta P \times Ts}$
		Ts °F	Ts °R			
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	O_2	CO	N_2
	Atomic Wt. (44)	Atomic Wt. (32)	Atomic Wt. (28)	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	O_2	CO	N_2
Atomic Wt. (44)	Atomic Wt. (32)	Atomic Wt. (28)	Atomic Wt. (28)

________ + ________ + ________ + ________ = Total Atomic Wt.

PARTICULATE SAMPLING CALCULATIONS

Plant____________________ Sampling Location____________________

Date of Test____________________ FIGURE 5-8

PARAMETERS TO BE CALCULATED			RESULTS			
n-bol	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				
Cp	Pitot Tube Coeff.	From Calibration Data				
As	Stack area ($in.^2$)	Field data sheet				
Ts	Stack temp., °R	Avg. fr. field data sheet				
Dm	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 5-8 (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., °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	$.07355 \times Ps' + Po$				
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				
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	$I = \frac{1039 \ Ts \ Qd}{(Vs)(Ps)(md)(D_n 2)(\Delta t)}$				
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	$Ct = .00857 \ (Cg)(qs)$				

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 ______________________

Attachment 3

of Appendix 1

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 <u>3. Sampling Apparatus</u> of <u>Source Sampling Method 5</u> 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 <u>4. Sample Recovery Apparatus</u> of Source Sampling Method 5.

4. Reagents

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

5. Sampling Train Preparation

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

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

k

6. Pretest Preparations and Lead Check

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

7. Condensible Particulate Train Operations

7.1 The train operation is the same as outlined in Section 9 of <u>Source Sampling Method 5</u>. 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 <u>14. Calculations</u> of Source Sampling Method 5.

11. Minimum Acceptable Test Requirements

11.1 The minimum acceptable test requirements are the same as outlined in <u>15. Minimum Acceptable Test Requirements</u> 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.

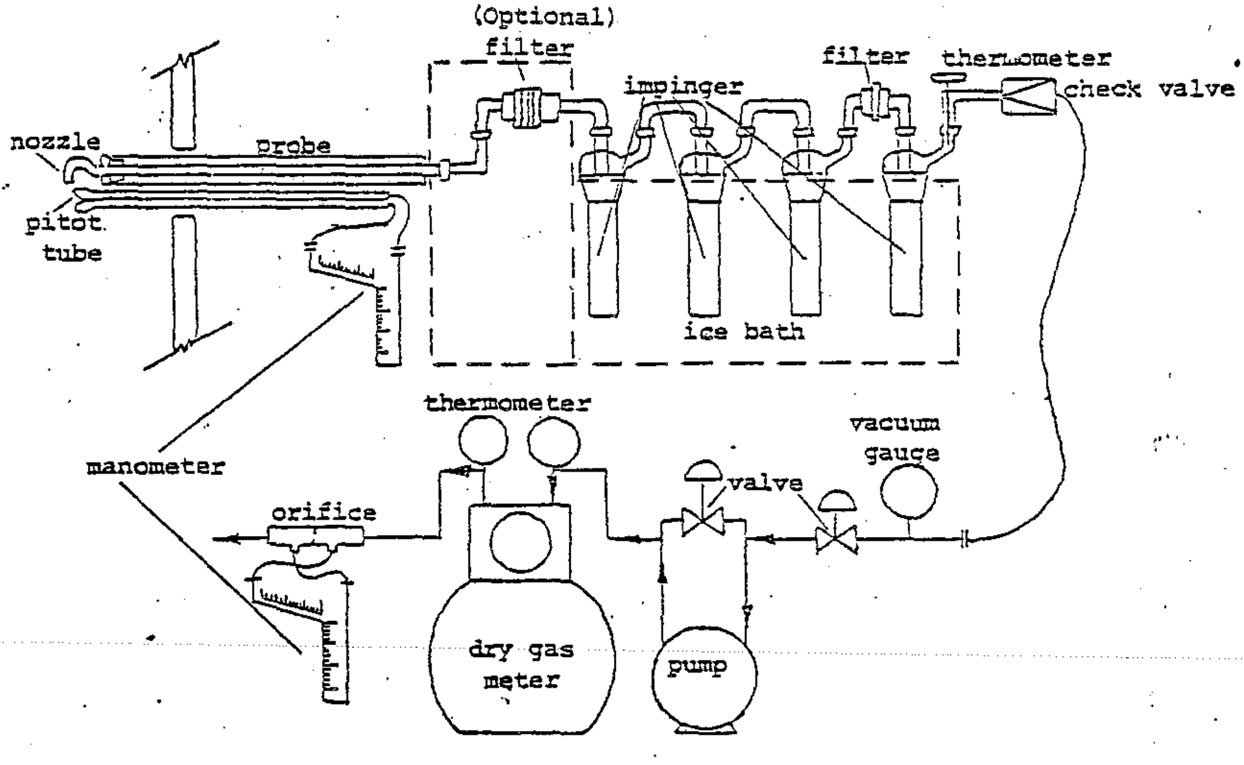
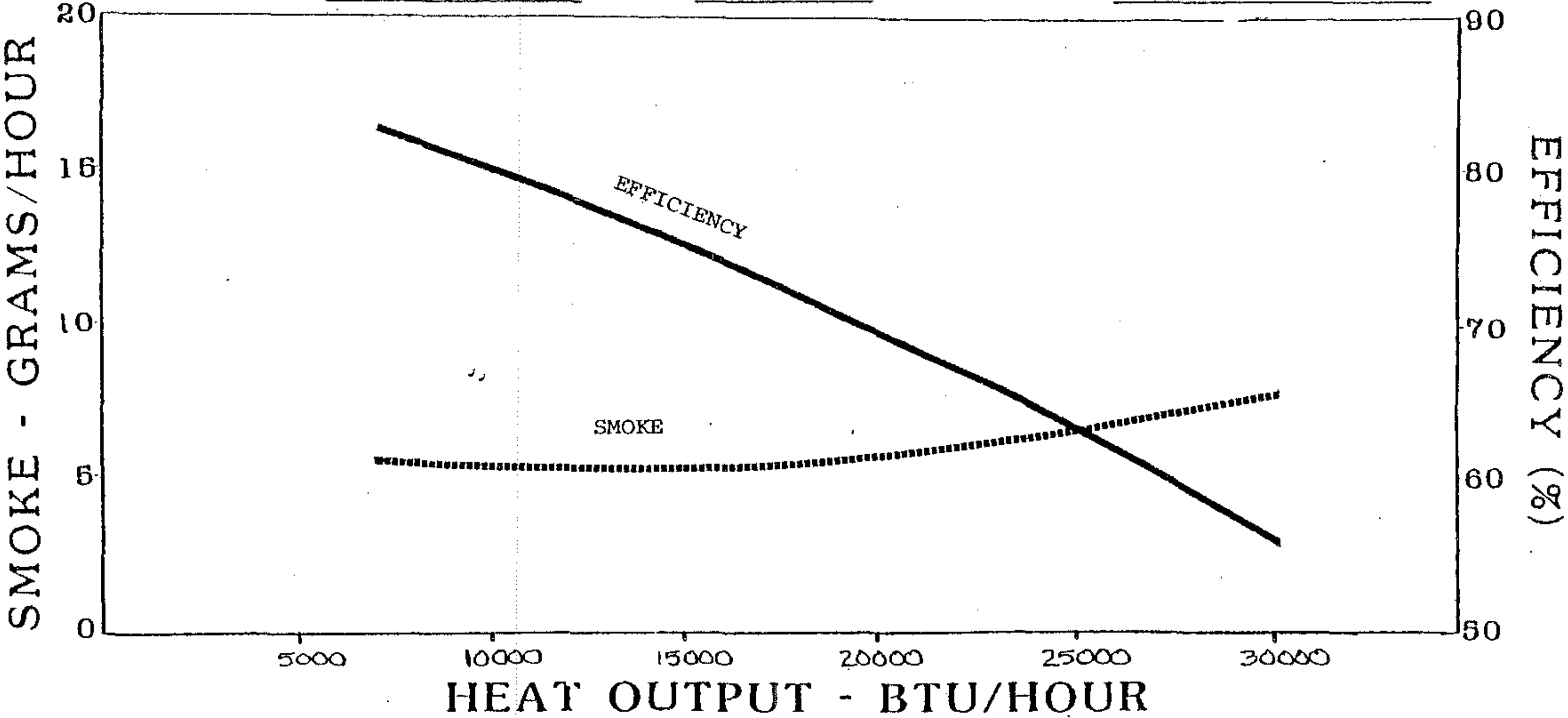

(Optional)
filter
impinger
filter
thermometer
check valve
nozzle
probe
pitot tube
ice bath
thermometer
vacuum gauge
valve
manometer
orifice
dry gas meter
pump

Figure 7-1

CERTIFIED TEST PERFORMANCE

Tested by:_______________ Date:___________ Procedure:___________________



Manufacturer:________________________ Model:_____________ Design #:__________

Performance may vary from test values depending on actual home operating conditions

EXAMPLE
PERMANENT LABEL

ATTACHMENT 5

ATTACHMENT 6

EXAMPLE ONLY

*POINT OF SALE REMOVABLE LABEL

FOR NON-CATALYTIC STOVES MEETING THE 7/1/86 STANDARD (ONLY)

EMISSIONS AND EFFICIENCY PERFORMANCE

Smoke __________ grams/hour (DEQ Non-catalytic Standard : 15 until 07/88, 7 after 07/88)

Efficiency __________ % (No DEQ Standard)

HEAT OUTPUT RANGE

____________ to ____________ BTU's/hour

Manufacturer: _______________ Model: ___________ Design #: ________
Name Name Number

(Performance may vary from test values depending on actual home operating conditions)

Pursuant to OAR 340-21-100 -166, this unit has been certified as meeting Oregon Department of Environmental Quality emission standards and has been approved for sale in the State of Oregon until July 1, 1988.