PM Speciation Profiles for Residential Wood Combustion

—PM426

October 14, 2025

California Air Resources Board
1001 I Street
Sacramento, California 95814

Table of Contents

List of Tables

I. Introduction

Residential wood combustion (RWC) refers to the use of wood-burning appliances for home heating, including fireplaces, wood stoves, fireplace inserts, and pellet stoves. These sources are a significant contributor to particulate matter (PM) emissions in California.

CARB's existing PM profile, PM424, has been used for decades to characterize emissions from fireplaces and wood stoves [1]. It was originally developed based on the 1989 OMNI study and assumes that 93.5% of total particulate matter (TPM) is PM10, and 90.01% is PM2.5.

A recent study by Environment and Climate Change Canada (ECCC) provides updated emission factors for PM2.5 and TPM across a range of RWC appliance types, reflecting advancements in technology and emission controls [2]. Meanwhile, CARB has developed a new set of Emission Inventory Codes (EICs) to better represent the diversity of RWC technologies and control levels. As a result, it is timely to update the existing PM profile to more accurately reflect current RWC emissions.

This document outlines the development of a new PM speciation profile for RWC:

- PM426: Fireplaces and wood stoves (2025 update)

II. Methodology

A. Size Fractions

The ECCC Residential Wood Combustion Study v2.1 (2025) [2] measured PM2.5 and TPM emissions from seven appliance types: open fireplaces, conventional wood stoves, EPA pre-2020 non-catalytic stoves, fireplace heaters, EPA 2020 catalytic stoves, EPA 2020 non-catalytic stoves, and pellet stoves. A standardized fueling protocol and dilution tunnel sampling method were used to ensure comparability. Tests included variations in wood type (hardwood, softwood, mixed) and wood moisture content (10% to 40%).

The study found that PM2.5 constitutes a larger fraction of TPM than previously assumed, with PM2.5/TPM ratios ranging from 97.4% (fireplace Insert) to 100% (fireplaces and catalytic stoves). These findings suggest that the current PM2.5 fraction of 90.01% underestimates emissions for most RWC sources. Additionally, the U.S. EPA's Wagon Wheel Tool uses identical emission factors for PM2.5 and PM10 [3].

Based on this evidence, we propose updated size fractions for the new PM426 profile:

- PM10/TPM = 100%
- PM2.5/TPM =100%

B. Chemical Speciation

The chemical speciation profile from PM424 will be retained for PM426. Detailed speciation information is provided in Appendix Table 1.

III. Summary

The new PM426 profile incorporates updated size fractions based on the recent emissions testing, while retaining the chemical speciation from PM424. PM426 will be assigned to all CARB RWC EICs, including the newly added nine EICs and the existing three EICs (See Appendix Table 2).

References:

1. *California Air Resources Board Main Speciation Profiles*. 2025, California Air Resources Board.
2. *Residential Wood Burning Appliances Pollutant Emissions Testing: Summary of Study Purpose, Design and Results*. 2025, Environment and Climate Change Canada: Gatineau, Quebec.
3. *NEI 2020 Wagon Wheel Emission Factors*. 2023, U.S. Environmental Protection Agency.

IV. Appendix

Table 1. Profile PM426: Fireplaces and wood stoves (2025 update)

Species Name	CARB-SAROAD	TPM Weight Percentage (%)	PM10 Weight Percentage (%)	PM2.5 Weight Percentage (%)
elemental carbon (EC)	12116	22.0351	20.7016	17.4252
organic carbon (OC)	11102	52.4014	48.6306	53.5706
non-carbon organic matter (NCOM)	11103	21.4645	26.7406	25.1460
aluminum	12101	0.0014	0.0041	0.0014
antimony	12102	0.0008	0.0013	0.0015
arsenic	12103	0.0003	0.0002	0.0001
barium	12107	0.0106	0.0120	0.0070
bromine	12109	0.0045	0.0045	0.0044
cadmium	12110	0.0004	0.0009	0.0004
calcium	12111	0.1237	0.0736	0.0327
cobalt	12113	0.0001	0.0002	0.0001
copper	12114	0.0002	0.0001	
chlorine	12115	0.8116	0.7987	0.7830
iron	12126	0.0012	0.0009	0.0007
lead	12128	0.0011	0.0015	0.0014
indium	12131	0.0001	0.0003	0.0001
manganese	12132	0.0025	0.0017	0.0010
lanthanum	12146	0.0104	0.0128	0.0070
palladium	12151	0.0001	0.0002	
selenium	12154	0.0001	0.0001	0.0001
tin	12160	0.0009	0.0004	
titanium	12161	0.0003	0.0001	0.0003
vanadium	12164	0.0001	0.0001	0.0002
silicon	12165	0.0016	0.0002	
silver	12166		0.0003	0.0003
zinc	12167	0.0554	0.0548	0.0560
strontium	12168	0.0009	0.0005	0.0002
rubidium	12176	0.0020	0.0018	0.0018
sodium	12184	0.0674	0.0617	0.0629
ammonium	12301	0.0553	0.0586	0.0564
nitrates	12306	0.2220	0.2228	0.2214
sulfate	12403	0.7473	0.7459	0.7410

Species Name	CARB-SAROAD	TPM Weight Percentage (%)	PM10 Weight Percentage (%)	PM2.5 Weight Percentage (%)
non-sulfate sulfur	12404	0.0191	0.0181	0.0128
carbonate ion	12501	0.0378	0.0045	0.0028
potassium ion	65312	1.9198	1.8443	1.8612
Total		100.0000	100.0000	100.0000

Table 2. Mapping of PM426 to RWC categories

EIC	EIC Name
61060002300132	Residential Wood Combustion – Wood Stoves – Wood Stoves (Uncertified)
61060002300133	Residential Wood Combustion – Wood Stoves – Wood Stoves (Certified-Catalytic)
61060002300134	Residential Wood Combustion – Wood Stoves – Wood Stoves (Certified-Non-Catalytic)
61060002300137	Residential Wood Combustion – Wood Stoves – Fireplace Inserts (Uncertified)
61060002300138	Residential Wood Combustion – Wood Stoves – Fireplace Inserts (Certified-Catalytic)
61060002300139	Residential Wood Combustion – Wood Stoves – Fireplace Inserts (Certified-Non-Catalytic)
61060202300135	Residential Wood Combustion – Fireplaces – Cordwood
61060202300136	Residential Wood Combustion – Fireplaces – Manufactured Logs
61060302300000	Residential Wood Combustion – Pellet Stoves
61060002300000	Residential Wood Combustion – Wood Stoves
61060202300000	Residential Wood Combustion – Fireplaces
61060402300000	Residential Wood Combustion – Unspecified