เอกสารผลงานที่เสนอให้ประเมินเพื่อแต่งตั้งให้ดำรงตำแหน่ง
บรรณารักษ์ 6 ว

เรื่องที่ 1

คู่มือการค้นหาวิธีทดสอบ (Test Method) ของหน่วยงาน Environmental Protection Agency (EPA) จากเอกสาร Code of Federal Regulations (CFR)

โดย

นางจารุนี ฉัตรกิติพรชัย
บรรณารักษ์ 5

ฝ่ายสารนิเทศสิทธิบัตร มาตรฐาน
กองสนเทศวิทยาศาสตร์ และเทคโนโลยี
กรมวิทยาศาสตร์บริการ

บทคัดย่อ

เป็นเอกสารคู่มือการค้นหาวิธีทดสอบ (Test method) ของหน่วยงาน Environmental Protection Agency (EPA) จากเอกสาร Code of Federal Regulations (CFR) ที่มีให้บริการที่ห้องสมุด (กองสนเทศวิทยาศาสตร์และเทคโนโลยี) ให้ข้อมูล บัญชีรายชื่อวิธีทดสอบ ดรรชนีช่วยค้นหาหมายเลขเอกสารมาตรฐาน และเรื่องที่ต้องการ วิธีการใช้คู่มือ และสัญลักษณ์ตัวอักษรย่อที่ใช้

คำนำ

เอกสารมาตรฐานที่เป็นวิธีทดสอบ (Test method) ทางด้านสิ่งแวดล้อมมีความจำเป็นที่จะต้องถูกนำมาใช้ในการตรวจวัดหาค่าต่างๆทั้งทางเคมี และทางฟิสิกส์ ที่มีผลทำให้เกิดมลพิษ และยังเป็นวิธีที่ใช้ประเมินสมบัติต่างๆของสารเคมี เช่น ความเป็นพิษของสารเคมี หรือตรวจวัดหาผลกระทบที่จะเกิดขึ้นในการใช้สารเคมีภายใต้เงื่อนไข หรือปัจจัยต่างๆได้

Environmental Protection Agency (EPA) Test Method เป็นวิธีทดสอบที่พบว่ามีการอ้างอิงและถูกนำไปใช้งานมาก จะเห็นได้จากผู้ขอรับบริการมีความต้องการใช้เอกสารเหล่านี้ ซึ่งคำถามส่วนมากที่พบคือ “ต้องการวิธีทดสอบของหน่วยงานEPAหมายเลข........?“ หรือมาด้วยคำถาม “ต้องการหาวิธีทดสอบเรื่อง........?ของหน่วยงาน EPA “ ซึ่ง Code of Federal Regulations (CFR) Index มิได้จัดทำ Test Method Index ให้สามารถตรวจสอบได้อย่างละเอียด ทำให้เกิดปัญหาและอุปสรรคในการให้บริการ จึงได้รวบรวม EPA Test Methods ที่เผยแพร่ใน CFR ขึ้นและได้จัดทำดรรชนีให้สามารถค้นหาเรื่องที่ต้องการได้สะดวกและรวดเร็ว จะทำให้สามารถให้บริการได้อย่างมีประสิทธิภาพ

(นางจารุนี ฉัตรกิติพรชัย)
บรรณารักษ์ 5

สารบัญ

ภาคผนวก

บทที่ 1

ความเป็นมาและขั้นตอนการดำเนินการ

1.1 ความเป็นมา

ปัจจุบันปัญหาทางด้านสิ่งแวดล้อมนับวันจะทวีความรุนแรงมากขึ้น ไม่ว่าจะเป็นมลพิษทางอากาศ น้ำ ดิน ซึ่งมีผลกระทบต่อชีวิต สุขภาพอนามัย และความเป็นอยู่ของประชาชน จึงเป็นสาเหตุที่ทำให้ภาครัฐ ต้องเข้ามากำกับดูแลในเรื่องของสิ่งแวดล้อมเพื่อหาแนวทางการป้องกันไม่ให้สิ่งแวดล้อมถูกทำลายมากขึ้น จึงมีการตราพระราชบัญญัติส่งเสริมและรักษาคุณภาพสิ่งแวดล้อมขึ้น ซึ่งได้มีการใช้ และอ้างอิงมาตรฐานของหน่วยงาน EPAในการกำหนดกฎระเบียบข้อบังคับ ดังจะเห็นได้ว่ามีประกาศกระทรวงที่ออกมากำกับดูแลทางด้านสิ่งแวดล้อมภายใต้พระราชบัญญัตินี้ เช่น

- ประกาศกระทรวงวิทยาศาสตร์ เทคโนโลยีและสิ่งแวดล้อม เรื่อง กำหนดมาตรฐานควบคุมการปล่อยทิ้งอากาศเสียจากโรงงานเหล็ก [จากราชกิจจานุเบกษา เล่ม 118 ตอนที่ 37 ง (8 พ.ค. 44) หน้า 9 – 12] ซึ่งรายละเอียดในประกาศจะกล่าวถึงปริมาณของอากาศเสียที่ปล่อยทิ้งจากโรงงานเหล็กออกสู่สิ่งแวดล้อมได้ และการตรวจวัดอากาศเสียที่ปล่อยทิ้งจากโรงงานเหล็กโดยมีการอ้างถึงวิธีทดสอบ (Test Method) ของ EPA ดังนี้
  - •• การตรวจวัดค่าก๊าซซัลเฟอร์ไดออกไซด์ให้ใช้วิธี Determination of sulfur dioxide emission from stationary sources หรือวิธี Determination of sulfuric acid mist and sulfur dioxide emissions from stationary sources ที่องค์การพิทักษ์สิ่งแวดล้อมแห่งประเทศสหรัฐอเมริกา (United States Environmental Protection Agency : EPA) กำหนดไว้
  - •• การตรวจวัดค่าก๊าซออกไซด์ของไนโตรเจน ซึ่งคำนวณผลในรูปของก๊าซไนโตรเจนไดออกไซด์ ให้ใช้วิธี Determination of nitrogen oxide emissions from stationary sources ที่องค์การพิทักษ์สิ่งแวดล้อมแห่งประเทศสหรัฐอเมริกา (United States Environmental Protection Agency : EPA) กำหนดไว้
  - •• การตรวจวัดฝุ่นละออง ให้ใช้วิธี Determination of particulate emissions from stationary sources ที่องค์การพิทักษ์สิ่งแวดล้อมแห่งประเทศสหรัฐอเมริกา (United States Environmental Protection Agency : EPA) กำหนดไว้ เป็นต้น

- ประกาศกระทรวงวิทยาศาสตร์ เทคโนโลยีและสิ่งแวดล้อม เรื่อง กำหนดมาตรฐานควบคุมการปล่อยทิ้งไอน้ำมันเบนซินจากคลังน้ำมันเชื้อเพลิง [จากราชกิจจานุเบกษา เล่ม 118 ตอนพิเศษ 58 ง (20 มิ.ย. 44) หน้า 3 – 6] ซึ่งรายละเอียดในประกาศจะกล่าวถึงมาตรฐานค่าเฉลี่ยไอน้ำมันเบนซินที่ปล่อยทิ้งจากคลังน้ำมันเชื้อเพลิงออกสู่สิ่งแวดล้อมในเวลา 1 ชั่วโมง และการตรวจวัดและเครื่องมือตรวจวิเคราะห์หาค่าเฉลี่ยไอน้ำมันเบนซิน โดยมีการอ้างถึงวิธีทดสอบ (Test Method) ของ EPA ดังนี้
  - •• การวัดก๊าซที่ปล่อยทิ้งในรูปของสารประกอบอินทรีย์ด้วยวิธีก๊าซโครมาโตกราฟฟี่ ให้ใช้วิธีตรวจวัดที่ 18 (Method 18 : Measurement of gaseous organic compound emission by gas chromatography) ตามที่องค์การพิทักษ์สิ่งแวดล้อมแห่งประเทศสหรัฐอเมริกา (United States Environmental Protection Agency : EPA) กำหนด หรือ
  - •• การวัดความเข้มข้นของก๊าซในรูปสารประกอบอินทรีย์ทั้งหมด ด้วยเครื่องตรวจวัดแบบ เฟลมไอออนไนเซชั่น ให้ใช้วิธีการตรวจวัดที่ 25 เอ (Method 25A : Determination of total gaseous organic concentration using a Flame Ionization Analyzer) ที่องค์การพิทักษ์สิ่งแวดล้อมแห่งประเทศสหรัฐอเมริกา (United States Environmental Protection Agency : EPA) กำหนด หรือ
  - •• การวัดความเข้มข้นของก๊าซที่อยู่ในรูปสารประกอบอินทรีย์ทั้งหมด ด้วยเครื่องตรวจวัดแบบนันดีสเปอร์ซีฟอินฟราเรด ให้ใช้วิธีการตรวจวัดที่ 25 บี (Method 25B : Determination of total gaseous organic concentration using a Nondispersive Infrared Analyzer) ที่องค์การพิทักษ์สิ่งแวดล้อมแห่งประเทศสหรัฐอเมริกา (United States Environmental Protection Agency : EPA) กำหนดไว้เป็นต้น

ซึ่งในส่วนของภาคเอกชนต้องเข้ามามีส่วนร่วมในการให้ความร่วมมือ และปฏิบัติตามที่กฎหมายกำหนด เพื่อเป็นการป้องกัน และควบคุมไม่ให้เกิดมลพิษ

จากความต้องการใช้เอกสารมาตรฐานที่เกี่ยวกับวิธีทดสอบ (Test Method) ที่กำหนดโดยองค์การพิทักษ์สิ่งแวดล้อมแห่งประเทศสหรัฐอเมริกา (The Environment Protection Agency : EPA) จึงทำให้เกิดการศึกษาการค้นหาสารนิเทศทางวิทยาศาสตร์ และเทคโนโลยีที่เกี่ยวกับวิธีทดสอบ (Test Method) ของหน่วยงาน EPA ขึ้นเพื่อช่วยให้สามารถบริการข้อมูลวิธีทดสอบ (Test Method) ของหน่วยงาน EPA ที่มีอยู่ในเอกสารชุด Code of Federal Regulations แก่ผู้ขอรับบริการได้อย่างมีประสิทธิภาพ และเกิดประโยชน์สูงสุด

สำหรับการติดตามข้อมูลที่ทันสมัยสามารถตรวจสอบได้จาก Website ของ EPA : http://www.epa.gov

1.2 ขั้นตอนการดำเนินการ

1.2.1 ศึกษาวิธีการสืบค้นและรวบรวมข้อมูลที่เกี่ยวกับวิธีทดสอบของ EPA ที่มีอยู่ใน CFR

จากการศึกษาวิธีการสืบค้นหาวิธีทดสอบของ EPA ในเอกสารชุด Code of Federal Regulations พบว่า การที่จะค้นหาสารนิเทศในเอกสารชุดนี้จะต้องตรวจสอบจากคู่มือ CFR Index and Finding Aids และถ้าต้องการค้นหาข้อมูลของหน่วยงาน EPA จะต้องค้นภายใต้ชื่อของหน่วยงาน " Environmental Protection Agency" หรือ "Environmental Protection" ซึ่งจะได้ข้อมูลส่วนใหญ่ที่กำหนดโดยหน่วยงาน EPA (ซึ่งอยู่ใน Title 40) หรืออาจจะค้นด้วยหัวเรื่องที่เกี่ยวข้อง เช่น "Air pollution control" "Noise control" "Water pollution control" เป็นต้น

ตัวอย่างที่ 1 : Environmental Protection
See also Air pollution control
Noise control
Water pollution control

ตัวอย่างที่ 2 : Environmental Protection Agency
Air pollution control
Ambient air quality standards, National primary and secondary, 40 CFR 50

ตัวอย่างที่ 3 : Air pollution control
See also Motor vehicle pollution
Ambient air quality standards, National primary and secondary, 40 CFR 50

หมายความว่า : เรื่อง Ambient air quality standards, National primary and secondary อยู่ในเอกสารชุด Code of Federal Regulations Title 40 (Environmental Protection Agency) Part 50 (National Primary and Secondary Ambient Air Quality Standards)
(ตามเอกสารแนบ 1)

รวบรวมข้อมูลที่เกี่ยวกับวิธีทดสอบของหน่วยงาน EPA ที่มีอยู่ในเอกสาร Code of Federal Regulations (CFR) Title 40 ที่มี Method Number กำกับ และที่ไม่มี Method Number กำกับ รวมทั้ง Performance Specification และ Procedure ที่เกี่ยวข้อง

1.2.2 ร่างและวางเค้าโครงเรื่อง

จัดทำร่างข้อมูลที่เกี่ยวกับวิธีทดสอบของหน่วยงาน EPA ที่รวบรวมได้และออกแบบรูปแบบการนำเสนอข้อมูล (ตาราง) เพื่อจัดพิมพ์ต่อไป

1.2.3 จัดพิมพ์และปรับแต่งข้อมูล

ในการพิมพ์งานใช้โปรแกรม Microsoft Word 97 และโปรแกรม Microsoft Excel 97 ในส่วนของการนำเสนอเนื้อหาในรูปตารางตามที่กำหนดไว้ โดยจัดทำดรรชนีออกเป็น 2 ตอน คือ

- จัดเรียงตาม Method Number (METHOD NUMBER INDEX TO EPA TEST METHODS IN CFR)
- จัดเรียงตามชื่อสารเคมี / ชื่อวิธีทดสอบ (CHEMICAL or METHOD NAME INDEX TO EPA TEST METHODS IN CFR)

1.2.4 ตรวจสอบความถูกต้อง / แก้ไข และเข้ารูปเล่ม

1.3 <u>ประโยชน์ที่จะได้รับ</u>

1. ใช้เป็นคู่มือสำหรับบรรณารักษ์ / เจ้าหน้าที่ ในการให้บริการตรวจสอบ และค้นหาข้อมูลที่เกี่ยวกับวิธีทดสอบ(Test Method) ของหน่วยงาน EPA ในเอกสาร Code of Federal Regulations (CFR) แก่ผู้ที่ต้องการใช้ข้อมูล
2. ใช้เป็นคู่มือสำหรับผู้ขอรับบริการในการตรวจสอบและค้นหาข้อมูลที่ต้องการเกี่ยวกับวิธีทดสอบ (Test Method) ของหน่วยงาน EPA ในเอกสาร Code of Federal Regulations (CFR) ได้ด้วยตนเอง
3. มีคู่มือที่รวบรวมเกี่ยวกับวิธีทดสอบ(Test Method) ของหน่วยงาน EPA ในเอกสาร Code of Federal Regulations (CFR) เพื่อช่วยให้สามารถบริการข้อมูลที่มีอยู่ได้อย่างสะดวกและรวดเร็วขึ้นเป็นการเพิ่มประสิทธิภาพในการให้บริการ

บทที่ 2

คู่มือการค้นหาวิธีทดสอบ (Test Method) ของหน่วยงาน Environmental Protection Agency (EPA) จากเอกสาร Code of Federal Regulations (CFR)

2.1 วิธีทดสอบ(Test Method) ของ EPA

วิธีทดสอบ(Test Method) ของ EPA กำหนดโดย**องค์การพิทักษ์สิ่งแวดล้อมแห่งประเทศสหรัฐอเมริกา** (United States Environmental Protection Agency : EPA) ซึ่งก่อตั้งขึ้นในปี 1970 ทำหน้าที่ในการกำหนดนโยบาย และการวางแผน และกำหนดแนวทางในการส่งเสริม อนุรักษ์และแก้ไขปัญหาสิ่งแวดล้อมนอกจากนี้ยังทำหน้าที่สอดส่องดูแล กำหนดมาตรฐาน และกฎระเบียบให้ใช้ร่วมกัน ให้คำแนะนำแก่ส่วนราชการรัฐวิสาหกิจ และภาคเอกชนโดยทั่วไป เป็นต้น

EPA กำหนดมาตรฐานและกฎระเบียบข้อบังคับต่างๆประกาศใช้โดยเผยแพร่อยู่ใน**เอกสารชุด** Code of Federal Regulations (CFR) ซึ่งเป็นเอกสารที่พิมพ์เผยแพร่เกี่ยวกับกฎระเบียบข้อบังคับ ข้อกำหนดต่างๆ ที่กำหนดขึ้นโดยหน่วยงานของรัฐบาลแห่งประเทศสหรัฐอเมริกา เช่น Environmental Protection Agency (EPA), Food and Drug Administration (FDA) เป็นต้น ซึ่งจัดพิมพ์โดย The Office of the Federal Register. National Archives and Records Administration. มีทั้งหมด 50 Title และมีดรรชนีสำหรับค้น ออกเป็นรายปี ในระหว่างปีหากมีการเปลี่ยนแปลงแก้ไข เพิ่มเติม ยกเลิก จะประกาศและจัดพิมพ์เผยแพร่ใน Federal Register ซึ่งกำหนดออกรายวัน ในส่วนของ EPA อยู่ใน Title 40 : Protection of Environment มีทั้งหมด 16 เล่ม จากการศึกษาและรวบรวมข้อมูลเกี่ยวกับมาตรฐานวิธีทดสอบ (Test Method) ในเอกสารชุด CFR ทำให้ทราบว่า EPA เผยแพร่มาตรฐานวิธีทดสอบ (Test Method) บางส่วนเท่านั้น และยังพบว่าได้มีการเผยแพร่วิธีทดสอบที่ไม่ปรากฏในเอกสารชุด CFR ในสิ่งพิมพ์อื่น รวบรวมเฉพาะเรื่องและตีพิมพ์เป็นรูปเล่ม เช่น

- Test Methods for Evaluating Solid Waste : Physical/Chemical Methods
- Methods for Chemical Analysis of Water and Wastes
- Manual of Chemical Methods for Pesticide and Devices
- Method for Determination of Toxic Organic Compounds in Air
- Method for Determination of Indoor Air Pollutants

ในส่วนของ EPA Test Method ที่เผยแพร่ในเอกสารชุด Code of Federal Regulations (CFR) นั้นอยู่ใน Title 40 : Protection of Environment แทรกอยู่ใน Part ต่างๆดังนี้

Part 51 : Requirements for Preparation, Adoption , and Submittal of Implementation Plans

Part 60 : Standards of Performance for New Stationary Sources

Part 61 : National Emission Standards for Hazardous Air Pollutants

Part 63 : National Emission Standards for Hazardous Air Pollutants for Source Categories

Part 80 : Regulation of Fuels and Fuel Additives

Part 136 : Guidelines Establishing Test Procedures for the Analysis of Pollutants

Part 261 : Identification and Listing of Hazardous Waste

Part 796 : Chemical Fate Testing Guidelines

Part 797 : Environmental Effects Testing Guidelines

Part 798 : Health Effects Testing Guidelines

Part 799 : Identification of Specific Chemical Substance and Mixture Testing Requirements

ซึ่งใน CFR Index ไม่สามารถค้นข้อมูลโดยใช้ หมายเลขวิธีทดสอบ หรือ ชื่อสารเคมี / วิธีทดสอบได้ จึงได้รวบรวม EPA Method พร้อมชื่อเรื่อง และแหล่งข้อมูล (Part, Section, และ Appendix) ของเรื่องนั้นๆไว้ เพื่อให้ค้นหาเนื้อเรื่องเต็มได้สะดวก

2.2 <u>คำชี้แจงวิธีใช้</u>

ดรรชนีแบ่งเป็น 2 ตอน คือ

1. จัดเรียงตาม Method Number (METHOD NUMBER INDEX TO EPA TEST METHODS IN CFR)
2. จัดเรียงตามชื่อสารเคมี / ชื่อวิธีทดสอบ (CHEMICAL / METHOD NAME INDEX TO EPA TEST METHODS IN CFR)

ตัวอย่าง : การค้นข้อมูลจาก METHOD NUMBER INDEX

NUMBER	TITLE	CFR TITLE 40
Method 21	Determination of volatile organic Compound leaks	pt. 60 (App.A)

หมายความว่า : วิธีทดสอบที่ 21 ชื่อเรื่อง Determination of volatile organic compound leaks เนื้อเรื่องเต็มพิมพ์อยู่ในเอกสารชุด Code of Federal Regulations (CFR) Title 40 part 60 (Appendix A) (ตามเอกสารแนบ 2)

ตัวอย่าง : การค้นข้อมูลจาก CHEMICAL or METHOD NAME INDEX

CHEMICAL or METHOD NAME	number	CFR TITLE 40
Volatile organic compound leaks, Determination of	Method 21	pt. 60 (App.A)

หมายความว่า : วิธีทดสอบเรื่อง Determination of volatile organic compound leaks วิธีทดสอบที่ 21 เนื้อเรื่องเต็มพิมพ์อยู่ในเอกสารชุด Code of Federal Regulations (CFR) Title 40 part 60 (Appendix A) (ตามเอกสารแนบ 2)

2.3 สัญลักษณ์ตัวอักษรย่อที่ใช้

อักษรย่อ	ชื่อเต็ม
App.	Appendix
CFR	Code of Federal Regulations
EPA	Environmental Protection Agency
Pt.	Part
Sect.	Section

METHOD NUMBER INDEX

TO EPA TEST METHODS IN CFR

METHOD NUMBER INDEX TO EPA TEST METHODS IN CFR		
NUMBER	TITLE	CFR TITLE 40
-	1, 1, 1 - Trichloroethane	Pt. 799 (Sect.799.4400)
-	1, 2 - Dichloropropane	Pt. 799 (Sect.799.1550)
-	1, 2, 4, 5 – Tetrachlorobenzene	Pt. 799 (Sect.799.1054)
-	2-Ethylhexanoic acid	Pt. 799 (Sect.799.1650)
-	2-Ethylhexanol	Pt. 799 (Sect.799.1645)
-	2-Mercaptobenzothiazole	Pt. 799 (Sect.799.2475)
-	Algae acute toxicity test, Freshwater	Pt. 797 (Sect.797.1060)
-	Algae acute toxicity test, Freshwater and marine	Pt. 797 (Sect.797.1075)
-	Algal acute toxicity test	Pt. 797 (Sect.797.1050)
-	Anthraquinone	Pt. 799 (Sect.799.500)
-	Asbestos in bulk insulation samples, Interim method of the	Pt. 763 (App. A)
	determination of	
-	Automated methods for sturm test, Ready biodegradability : modified	Pt. 796 (Sect.796.3260)
-	Avian acute oral toxicity test	Pt. 797 (Sect.797.2175)
-	Avian dietary toxicity test	Pt. 797 (Sect.797.2050)
-	Bacteria DNA damage or repair tests, Differential growth inhibition of repair proficient and repair deficient bacteria :	Pt. 798 (Sect.798.5500)
-	BIF regulations, Method manual for compliance with the	Pt. 266 (App. IX)
-	Biphenol A	Pt. 799 (Sect.799.940)
-	Biphenyl	Pt. 799 (Sect.799.925)
-	Bobwhite reproduction test	Pt. 797 (Sect.797.2030)
-	C9 aromatic hydrocarbon fraction2-Ethylhexanoic acid	Pt. 799 (Sect.799.2175)
-	Carbon monoxide in the atmosphere(non-dispersive infrared photometry), Measurement principle and calibration procedure for the measurement of	Pt. 50 (App. C)
-	Commercial hexane	Pt. 799 (Sect.799.2155)
-	Cresols	Pt. 799 (Sect.799.1250)
-	Cumene	Pt. 799 (Sect.799.1285)
-	Daphnid chronic toxicity test	Pt. 797 (Sect.797.1330)
-	Daphnid chronic toxicity test	Pt. 797 (Sect.797.1350)

METHOD NUMBER INDEX TO EPA TEST METHODS IN CFR		
NUMBER	TITLE	CFR TITLE 40
-	Daphnid acute toxicity test	Pt. 797 (Sect.797.1300)
-	Dichlorobenzenes	Pt. 799 (Sect.799.1052)
-	Diethylene glycol butyl ether and diethylene glycol butyl ether acetate	Pt. 799 (Sect.799.1560)
-	Diethylenetriamine (DETA)	Pt. 799 (Sect.799.1575)
-	Drinking water contaminants subject to testing	Pt. 799 (Sect.799.5075)
-	Early seedling growth toxicity test	Pt. 797 (Sect.797.2800)
-	Escherichia coli WP2 and WP2 urvA reverse mutation assays	Pt. 798 (Sect.798.5100)
-	Fish acute toxicity test	Pt. 797 (Sect.797.1400)
-	Fish acute toxicity test	Pt. 797 (Sect.797.1440)
-	Fish bioconcentration test	Pt. 797 (Sect.797.1520)
-	Fish bioconcentration test	Pt. 797 (Sect.797.1560)
-	Fish early life stage toxicity test	Pt. 797 (Sect.797.1600)
-	Fluoroalkenes	Pt. 799 (Sect.799.1700)
-	Gas volumetic flow rate, Performance specifications and, specification test procedures for monitoring systems for effluent stream	Pt. 52 (App. E)
-	Hazardous waste constituents subject to testing	Pt. 799 (Sect.799.5055)
-	Hydrocarbons corrected for methane, Reference method for determination of	Pt. 50 (App. E)
-	Hydroquinone	Pt. 799 (Sect.799.2200)
-	In vitro sister chromatid exchange assay	Pt. 798 (Sect.798.5900)
-	In vivo mammalian bone marrow cytogenetics tests : micronucleus assa	Pt. 798 (Sect.798.5395)
-	In vivo sister chromatid exchange assay	Pt. 798 (Sect.798.5915)
-	Isopropanol	Pt. 799 (Sect.799.2325)
-	Lead in suspended particulate matter collected from ambient air, Reference method for the determination of	Pt. 50 (App. G)
-	Lemna acute toxicity test	Pt. 797 (Sect.797.1160)
-	Mallard reproduction test	Pt. 797 (Sect.797.2150)
-	Mesityl oxide (MO)	Pt. 799 (Sect.799.2500)
-	Methods and reference methods, Procedures for determining comparability between candidate	Pt. 53 (App. C)

METHOD NUMBER INDEX TO EPA TEST METHODS IN CFR		
NUMBER	TITLE	CFR TITLE 40
-	Methyl ethyl ketoxime	Pt. 799 (Sect.799.2700)
-	Monochlorobenzene	Pt. 799 (Sect.799.1051)
-	Mouse biochemical specific locus test	Pt. 798 (Sect.798.5195)
-	Mouse visible specific locus test	Pt. 798 (Sect.798.5200)
-	Mysid shrimp acute toxicity test	Pt. 797 (Sect.797.1930)
-	Mysid shrimp chronic toxicity test	Pt. 797 (Sect.797.1950)
-	Nitrogen dioxide in the atmosphere (Gas phase chemiluminescence), Measurement principle and calibration procedure for the measurement of	Pt. 50 (App. F)
-	OECD screening test, Ready biodegradability : modified	Pt. 796 (Sect.796.3240)
-	Oleylamine	Pt. 799 (Sect.799.3175)
-	Oyster acute toxicity test	Pt. 797 (Sect.797.1800)
-	Oyster bioconcentration test	Pt. 797 (Sect.797.1830)
-	Ozone in the atmosphere, Measurement principle and calibration procedure for the measurement of	Pt. 50 (App. D)
-	Particulate matter as PM_{10} in the atmosphere, Reference method for the determination of	Pt. 50 (App. J)
-	Particulate matter in the atmosphere (High-Volume method), Reference method for the determination of suspended	Pt. 50 (App. B)
-	Penaeid shrimp acute toxicity test	Pt. 797 (Sect.797.1970)
-	Photolysis reaction quantum yield in aqueous solution and sunlight photolysis, Laboratory determination of the direct	Pt. 796 (Sect.796.3780)
-	Plant uptake and translocation test	Pt. 797 (Sect.797.2850)
-	PM_{10}, Procedures for testing performance characteristics of methods for	Pt. 53 (App. D)
-	Propylene oxide	Pt. 799 (Sect.799.3450)
-	Rodent dominant lethal assay	Pt. 798 (Sect.798.5450)
-	Rodent heritable translocation assay	Pt. 798 (Sect.798.5460)
-	Saccharomyces cervisiae, Mitotic gene conversion in	Pt. 798 (Sect.798.5575)
-	Salmonella typhimurium reverse mutation assay, The	Pt. 798 (Sect.798.5260)
-	SCAS test, Inherent biodegradability : modified	Pt. 796 (Sect.796.3340)

METHOD NUMBER INDEX TO EPA TEST METHODS IN CFR

NUMBER	TITLE	CFR TITLE 40
-	Seed germination/root elongation toxicity test	Pt. 797 (Sect.797.2750)
-	Simulation test ---aerobic sewage treatment : coupled units test	Pt. 796 (Sect.796.3330)
-	SO_2, CO_2, O_3 and NO_2, Performance characteristics of	Pt. 53 (App. B)
-	Sulfur dioxide emissions from stationary sources by continuous monitors, Determination of	Pt. 52 (App. D)
-	Sulfur dioxide in the atmosphere (Pararosaniline method), Reference method for the determination of	Pt. 50 (App. A)
-	Tetrabromobisphenol A	Pt. 799 (Sect.799.4000)
-	Tributyl phosphate	Pt. 799 (Sect.799.4360)
-	Trichlorobenzenes	Pt. 799 (Sect.799.1053)
-	Triethylene glycol monomethyl ether	Pt. 799 (Sect.799.4440)
-	Unsubstituted phenylenediamines	Pt. 799 (Sect.799.3300)
-	Zahn-Wellens test, Inherent biodegradability : modified	Pt. 796 (Sect.796.3360)
Method 1	Sample and velocity traverses for stationary sources	Pt. 60 (App. A)
Method 1	Standards method test for lead in gasoline by atomic absorption spectrometry	Pt. 80 (App. B)
Method 1	Water extraction method	Pt. 80 (App. F)
Method 1A	Sample and velocity traverses for stationary sources with small stacks or ducts	Pt. 60 (App. A)
Method 2	Automated method test for lead in gasoline by atomic absorption Spectrometry	Pt. 80 (App. B)
Method 2	Determination of stack gas velocity and velometic flow rate (Type S pilot tube)	Pt. 60 (App. A)
Method 2	Test method for determination of C1 To C4 alcohols and MTBE in gasoline by gas chromatography	Pt. 80 (App. F)
Method 2A	Direct measurement of gas volume through pipes and small ducts	Pt. 60 (App. A)
Method 2B	Determination of Exhaust gas volume flow rate from gasoline vapor incinerator	Pt. 60 (App. A)
Method 2C	Determination of stack gas velocity and volumetric flow rate in small stacks or ducts (standard pilot tube)	Pt. 60 (App. A)

METHOD NUMBER INDEX TO EPA TEST METHODS IN CFR		
NUMBER	TITLE	CFR TITLE 40
Method 2D	Measurement of gas volumetric flow rates in small pipes and ducts	Pt. 60 (App. A)
Method 3	Gas analysis for carbon dioxide, oxygen, excess air, and dry molecular weight	Pt. 60 (App. A)
Method 3	Evacuated chamber method	Pt. 80 (App. B)
Method 3	Test for lead in gasoline by X-Ray spectrometry	Pt. 80 (App. B)
Method 3A	Determination of oxygen and carbon dioxide concentrations in emission from stationary sources (Instrumental Analyzer Procedure	Pt. 60 (App. A)
Method 4	Determination of moisture content in stack gases	Pt. 60 (App. A)
Method 5	Determination of particulate emissions from stationary sources	Pt. 60 (App. A)
Method 5A	Determination of particulate emissions from the asphalt processing and asphalt roofing industry	Pt. 60 (App. A)
Method 5B	Determination of nonsulfuric acid particulate matter from stationary sources	Pt. 60 (App. A)
Method 5D	Determination of particulate emissions from positive pressure fabric	Pt. 60 (App. A)
Method 5E	Determination of particulate emission from the wool fiberglass insulation manufacturing industry	Pt. 60 (App. A)
Method 5F	Determination of nonsulfate particulate matter from stationary sources	Pt. 60 (App. A)
Method 5G	Determination of particulate emissions from wood heaters from a dilution tunnel sampling location	Pt. 60 (App. A)
Method 5H	Determination of particulate emissions from wood heaters from a stack location	Pt. 60 (App. A)
Method 6	Determination of sulfur dioxide emissions from stationary sources	Pt. 60 (App. A)
Method 6A	Determination of sulfur dioxide, moisture, and carbon dioxide emissions from fossil fuel combustion sources	Pt. 60 (App. A)
Method 6B	Determination of sulfur dioxide and carbon dioxide daily average emissions from fossil fuel combustion sources	Pt. 60 (App. A)
Method 6 C	Determination of sulfur dioxide emissions from stationary sources (Instrumental Analyzer Procedure)	Pt. 60 (App. A)
Method 7	Determination of nitrogen oxide emissions from stationary sources	Pt. 60 (App. A)

METHOD NUMBER INDEX TO EPA TEST METHODS IN CFR

NUMBER	TITLE	CFR TITLE 40
Method 7A	Determination of nitrogen oxide emissions from stationary sources-Iron chromatographic method	Pt. 60 (App. A)
Method 7B	Determination of nitrogen oxide emissions from stationary sources (Ultraviolet spectrophotometry)	Pt. 60 (App. A)
Method 7C	Determination of nitrogen oxide emissions from stationary source --- Alkaline - permanganate/colorimetric method	Pt. 60 (App. A)
Method 7D	Determination of nitrogen oxide emissions from stationary sources—Alkaline –permanganate/ion chromatographic method	Pt. 60 (App. A)
Method 7E	Determination of nitrogen oxide emissions from stationary sources Alkaline –permanganate/ion chromatographic	Pt. 60 (App. A)
Method 8	Determination of Sulfuric acid mist and sulfur dioxide emissions from stationary sources	Pt. 60 (App. A)
Method 9	Visual determination of the opacity of emissions from stationary sources	Pt. 60 (App. A)
Method 10	Determination of carbon monoxide emissions from stationary sources	Pt. 60 (App. A)
Method 10A	Determination of carbon monoxide in certifying continuous emissions monitoring systems at petroleum refineries	Pt. 60 (App. A)
Method 10B	Determination of carbon monoxide emissions from stationary sources	Pt. 60 (App. A)
Method 11	Determination of hydrogen sulfide content of fuel gas streams in petroleum Refineries	Pt. 60 (App. A)
Method 12	Determination of inorganic lead emissions from stationary sources	Pt. 60 (App. A)
Method 13A	Determination of total fluoride emissions from stationary sources—SPANDS zircinium lake method	Pt. 60 (App. A)
Method 13B	Determination of total fluoride emissions from stationary sources—Specific ion electrode method	Pt. 60 (App. A)
Method 14	Determination of fluoride emissions from potroom roof monitors for Primary aluminum plants	Pt. 60 (App. A)
Method 15	Determination of hydrogen sulfide, carbonyl sulfide, and carbon disulfide emissions from stationary sources	Pt. 60 (App. A)
Method 15A	Determination of total reduced sulfur emissions from sulfur recovery plants in petroleum refineries	Pt. 60 (App. A)

METHOD NUMBER INDEX TO EPA TEST METHODS IN CFR

NUMBER	TITLE	CFR TITLE 40
Method 16	Semicontinuous determination of sulfur emissions from stationary sources	Pt. 60 (App. A)
Method 16A	Determination of total reduced sulfur emissions from stationary sources (impinger technique)	Pt. 60 (App. A)
Method 16B	Determination of total reduced sulfur emissions from stationary sources	Pt. 60 (App. A)
Method 17	Determination of particulate emissions from stationary sources (in stack filtration method)	Pt. 60 (App. A)
Method 18	Measurement of gaseous organic compound emissions by gas chromatography	Pt. 60 (App. A)
Method 19	Determination of sulfur dioxide removal efficiency and particulate, sulfur dioxide and nitrogen oxides emission rates	Pt. 60 (App. A)
Method 20	Determination of nitrogen oxides, sulfur dioxide, and diluent emissions from stationary gas turbines	Pt. 60 (App. A)
Method 21	Determination of volatile organic compound leaks	Pt. 60 (App. A)
Method 22	Visual determination of fugitive emissions from material sources and smoke Emissions from flares	Pt. 60 (App. A)
Method 23	Determination of polychlorinated dibenzo-p-dioxins and polychlorinated dibenzofurans from stationary sources	Pt. 60 (App. A)
Method 24	Determination of volatile matter content, water content, density, volume Solids, and weight solids of surface coatings	Pt. 60 (App. A)
Method 24A	Determination of volatile matter content and density of printing inks and related coatings	Pt. 60 (App. A)
Method 25	Determination of total gaseous nonmethane organic emissions as	Pt. 60 (App. A)
Method 25A	Determination of total gaseous organic concentration using a flame	Pt. 60 (App. A)
Method 25B	Determination of total gaseous organic concentration using a nondispersive infrared analyzer	Pt. 60 (App. A)
Method 26	Determination of hydrogen chloride emissions from stationary sources	Pt. 60 (App. A)
Method 27	Determination of vapor tightness of gasoline delivery tank using pressure Vacuum test	Pt. 60 (App. A)
Method 28	Certification and auditing of wood heaters	Pt. 60 (App. A)

METHOD NUMBER INDEX TO EPA TEST METHODS IN CFR

NUMBER	TITLE	CFR TITLE 40
Method 28A	Measurement of air to fuel ratio and minimum achievable burn rates for Wood-fired appliances	Pt. 60 (App. A)
Method 101	Determination of particulate and gaseous mercury emissions from Chlor-alkali plants—air streams	Pt. 61(App. B)
Method 101A	Determination of particulate and gaseous mercury emissions from Sewage sludge incinerators	Pt. 61(App. B)
Method 102	Determination of particulate and gaseous mercury emissions from Chlor-alkali plants—hydrogen streams	Pt. 61(App. B)
Method 103	Beryllium screening method	Pt. 61(App. B)
Method 104	Determination of beryllium emissions from stationary sources	Pt. 61(App. B)
Method 105	Determination of mercury in wastewater treatment plant sewage sludges	Pt. 61(App. B)
Method 106	Determination of vinyl chloride from stationary sources	Pt. 61(App. B)
Method 107	Determination of vinyl chloride content of inprocess wastewater samples, and vinyl chloride content of polyvinyl chloride resin, slurry, wet cake, and latex samples	Pt. 61(App. B)
Method 107A	Determination of vinyl chloride content of solvents, resin-solvent solution, polyvinyl chloride resin, resin slurry, wet resin, and latex	Pt. 61(App. B)
Method 108	Determination of particulate and gaseous arsenic emissions	Pt. 61(App. B)
Method 108A	Determination of arsenic content in ore samples from nonferrous smelters	Pt. 61(App. B)
Method 108B	Determination of arsenic content in ore samples from nonferrous smelters	Pt. 61(App. B)
Method 108C	Determination of arsenic content in ore samples from nonferrous smelters	Pt. 61(App. B)
Method 111	Determination of polonium—210 emission from stationary sources	Pt. 61(App. B)
Method 114	Test methods for measuring radionuclide emissions from stationary sources	Pt. 61(App. B)
Method 115	Monitoring for radon-222 emissions	Pt. 61(App. B)
Method 201	Determination of PM_{10} Emission (Exhaust gas recycle procedure)	Pt. 51(App. M)
Method 201A	Determination of PM_{10} Emission (Constant sampling rate procedure)	Pt. 51(App. M)

METHOD NUMBER INDEX TO EPA TEST METHODS IN CFR

NUMBER	TITLE	CFR TITLE 40
Method 202	Determination of condensible particulate emissions from stationary sources	Pt. 51(App. M)
Method 202.1	Precision and recovery statements for methods for aluminum (Atomic absorption, direct aspiration)	Pt. 136 (App. D)
Method 202.2	Precision and recovery statements for methods for aluminum (Atomic absorption, furnace technique)	Pt. 136 (App. D)
Method 204.2	Precision and recovery statements for methods for antimony (Atomic absorption, furnace technique)	Pt. 136 (App. D)
Method 206.2	Precision and recovery statements for methods for arsenic (Atomic absorption, furnace technique)	Pt. 136 (App. D)
Method 206.4	Precision and recovery statements for methods for arsenic (Spectrophotometric-SDDC)	Pt. 136 (App. D)
Method 208.2	Precision and recovery statements for methods for barium (Atomic absorption, furnace technique)	Pt. 136 (App. D)
Method 210.2	Precision and recovery statements for methods for beryllium (Atomic absorption, furnace technique)	Pt. 136 (App. D)
Method 213.1	Precision and recovery statements for methods for cadmium (Atomic absorption, direct aspiration)	Pt. 136 (App. D)
Method 213.1	Precision and recovery statements for methods for cadmium (Atomic absorption, direct aspiration)	Pt. 136 (App. D)
Method 213.2	Precision and recovery statements for methods for cadmium (Atomic absorption, furnace technique)	Pt 136 (App. D)
Method 218.1	Precision and recovery statements for methods for chromium (Atomic absorption, direct aspiration)	Pt 136 (App. D)
Method 218.2	Precision and recovery statements for methods for chromium (Atomic absorption, furnace technique)	Pt 136 (App. D)
Method 219.2	Precision and recovery statements for methods for cobalt (Atomic absorption, furnace technique)	Pt 136 (App. D)
Method 220.1	Precision and recovery statements for methods for copper (Atomic absorption, direct aspiration)	Pt 136 (App. D)

METHOD NUMBER INDEX TO EPA TEST METHODS IN CFR		
NUMBER	TITLE	CFR TITLE 40
Method 220.2	Precision and recovery statements for methods for copper (Atomic absorption, furnace technique)	Pt 136 (App. D)
Method 236.1	Precision and recovery statements for methods for iron (Atomic absorption, direct aspiration)	Pt 136 (App. D)
Method 236.2	Precision and recovery statements for methods for iron (Atomic absorption, furnace technique)	Pt 136 (App. D)
Method 239.1	Precision and recovery statements for methods for lead (Atomic absorption, direct aspiration)	Pt 136 (App. D)
Method 239.2	Precision and recovery statements for methods for lead (Atomic absorption, furnace technique)	Pt 136 (App. D)
Method 243.1	Precision and recovery statements for methods for manganese (Atomic absorption, direct aspiration)	Pt 136 (App. D)
Method 243.2	Precision and recovery statements for methods for manganese (Atomic absorption, furnace technique)	Pt 136 (App. D)
Method 249.2	Precision and recovery statements for methods for nickel (Atomic absorption, furnace technique)	Pt 136 (App. D)
Method 270.2	Precision and recovery statements for methods for selenium (Atomic absorption, furnace technique)	Pt 136 (App. D)
Method 272.2	Precision and recovery statements for methods for silver (Atomic absorption, furnace technique)	Pt 136 (App. D)
Method 279.2	Precision and recovery statements for methods for thalium (Atomic absorption, furnace technique)	Pt 136 (App. D)
Method 286.2	Precision and recovery statements for methods for vanadium (Atomic absorption, furnace technique)	Pt 136 (App. D)
Method 289.1	Precision and recovery statements for methods for zinc (Atomic absorption, direct aspiration)	Pt 136 (App. D)
Method 289.2	Precision and recovery statements for methods for zinc (Atomic absorption, furnace technique)	Pt 136 (App. D)
Method 301	Field validation of pollutant measurement methods from various waste media	Pt. 63 (App. A)

METHOD NUMBER INDEX TO EPA TEST METHODS IN CFR		
NUMBER	TITLE	CFR TITLE 40
Method 303	Determination of visible emissions from by-product coke oven batteries	Pt. 63 (App. A)
Method 303A	Determination of visible emissions from nonrecovery coke oven batteries	Pt. 63 (App. A)
Method 304A	Determination of biodegradation rates of organic compounds (vent option)	Pt. 63 (App. A)
Method 304B	Determination of biodegradation rates of organic compounds (scrubber option)	Pt. 63 (App. A)
Method 305	Measurement of emission potential of individual volatile organic compounds in waste	Pt. 63 (App. A)
Method 601	Purgeable halocarbons	Pt. 136 (App. A)
Method 602	Purgeable aromatics	Pt. 136 (App. A)
Method 603	Acrolein and acrylonitrile	Pt. 136 (App. A)
Method 604	Phenols	Pt. 136 (App. A)
Method 605	Benzidines	Pt. 136 (App. A)
Method 606	Phthalate ester	Pt. 136 (App. A)
Method 607	Nitrosamines	Pt. 136 (App. A)
Method 608	Organochlorine pesticides and PCBs	Pt. 136 (App. A)
Method 609	Nitroaromatics and isophorone	Pt. 136 (App. A)
Method 610	Polynuclear aromatic hydrocarbons	Pt. 136 (App. A)
Method 611	Haloethers	Pt. 136 (App. A)
Method 612	Chlorinated hydrocarbons	Pt. 136 (App. A)
Method 613	2,3,7,8-Tetrachlorodibenzo-p-dioxin	Pt. 136 (App. A)
Method 624	Purgeables	Pt. 136 (App. A)
Method 625	Base/Neutrals and acids	Pt. 136 (App. A)
Method 1311	Toxicity characteristic leaching procedure (TCLP)	Pt. 261 (App.II)
Method 1624 revision B	Volatile organic compounds by isotope dilution GC/MS	Pt. 136 (App. A)
Method 1625 revision B	Semivolatile organic compounds by isotope dilution GC/MS	Pt. 136 (App. A)
Performance Specification 1	Specifications and test procedures for opacity continuous Emission monitoring systems in stationary sources	Pt. 60(App. B)
Performance Specification 2	Specifications and test procedures for SO2 and NO2 continuous Emission monitoring systems in stationary sources	Pt. 60(App. B)

METHOD NUMBER INDEX TO EPA TEST METHODS IN CFR

NUMBER	TITLE	CFR TITLE 40
Performance Specification 3	Specifications and test procedures for O2 and CO2 continuous emission monitoring systems in stationary sources	Pt. 60(App. B)
Performance Specification 4	Specifications and test procedures for carbon monoxide continuous emission monitoring systems in stationary sources	Pt. 60(App. B)
Performance Specification 4A	Specifications and test procedures for carbon monoxide continuous emission monitoring systems in stationary sources	Pt. 60(App. B)
Performance Specification 5	Specifications and test procedures for TRS continuous emission monitoring systems in systems in stationary sources	Pt. 60(App. B)
Performance Specification 6	Specifications and test procedures for continuous emission rate monitoring systems in stationary sources	Pt. 60(App. B)
Performance Specification 7	Specifications and test procedures for hydrogen sulfide continuous emission monitoring systems in stationary sources	Pt. 60(App. B)
Procedure 1	Determination of adequate chromatographic peak resolution	Pt. 61 (App. C)
Procedure 2	Procedure for field auditing GC analysis	Pt. 61 (App. C)

CHEMICAL / METHOD NAME INDEX

TO EPA TEST METHODS IN CFR

CHEMICAL or METHOD NAME INDEX TO EPA TEST METHODS IN CFR

CHEMICAL or METHOD NAME	NUMBER	CFR TITLE 40
1, 1, 1 - Trichloroethane	-	Pt. 799 (Sect.799.4400)
1, 2 - DichloropropaneDefinitions	-	Pt. 799 (Sect.799.1550)
1, 2, 4, 5 – Tetrachlorobenzene	-	Pt. 799 (Sect.799.1054)
2,3,7,8-Tetrachlorodibenzo-p-dioxin	Method 613	Pt. 136 (App. A)
2-Ethylhexanoic acid	-	Pt. 799 (Sect.799.1650)
2-Ethylhexanol	-	Pt. 799 (Sect.799.1645)
2-Mercaptobenzothiazole	-	Pt. 799 (Sect.799.2475)
Acrolein and acrylonitrile	Method 603	Pt. 136 (App. A)
Adequate chromatographic peak resolution, Determination of	Procedure 1	Pt. 61 (App. C)
Algae acute toxicity test, Freshwater	-	Pt. 797 (Sect.797.1060)
Algae acute toxicity test, Freshwater and marine	-	Pt. 797 (Sect.797.1075)
Algal acute toxicity test	-	Pt. 797 (Sect.797.1050)
Aluminum (Atomic absorption, direct aspiration), Precision and recovery statements for methods for	Method 202.1	Pt. 136 (App. D)
Aluminum (Atomic absorption, furnace technique), Precision and recovery statements for methods for	Method 202.2	Pt. 136 (App. D)
Anthraquinone	-	Pt. 799 (Sect.799.500)
Antimony (Atomic absorption, furnace technique), Precision and recovery statements for methods for	Method 204.2	Pt. 136 (App. D)
Arsenic (Atomic absorption, furnace technique), Precision and recovery statements for methods for	Method 206.2	Pt. 136 (App. D)
Arsenic (Spectrophotometric-SDDC), Precision and recovery statements for methods for	Method 206.4	Pt. 136 (App. D)
Arsenic content in ore samples from nonferrous smelters, Determination of	Method 108A	Pt. 61 (App. B)
Arsenic content in ore samples from nonferrous smelters, Determination of	Method 108B	Pt. 61 (App. B)
Arsenic content in ore samples from nonferrous smelters, Determination of	Method 108C	Pt. 61 (App. B)
Arsenic emissions, Determination of particulate and gaseous	Method 108	Pt. 61 (App. B)

CHEMICAL or METHOD NAME INDEX TO EPA TEST METHODS IN CFR

CHEMICAL or METHOD NAME	NUMBER	CFR TITLE 40
Asbestos in bulk insulation samples, Interim method of the determination of	-	Pt. 763 (App. A)
Avian acute oral toxicity test	-	Pt. 797 (Sect.797.2175)
Avian dietary toxicity test	-	Pt. 797 (Sect.797.2050)
Bacteria DNA damage or repair tests, Differential growth inhibition of repair proficient and repair deficient bacteria :	-	Pt. 798 (Sect.798.5500)
Barium (Atomic absorption, furnace technique), Precision and recovery statements for methods for	Method 208.2	Pt. 136 (App. D)
Base/Neutrals and acids	Method 625	Pt. 136 (App. A)
Benzidines	Method 605	Pt. 136 (App. A)
Beryllium emissions from stationary sources, Determination of	Method 104	Pt. 61(App. B)
Beryllium (Atomic absorption, furnace technique), Precision and recovery statements for methods for	Method 210.2	Pt. 136 (App. D)
Beryllium screening method	Method 103	Pt. 61(App. B)
BIF regulations, Method manual for compliance with the	-	Pt. 266 (App. IX)
Biphenol A	-	Pt. 799 (Sect.799.940)
Biphenyl	-	Pt. 799 (Sect.799.925)
Bobwhite reproduction test	-	Pt. 797 (Sect.797.2030)
C1 To C4 alcohols and MTBE in gasoline by gas chromatography,	Method 2	Pt. 80 (App. F)
Test method for determination of		
C9 aromatic hydrocarbon fraction2-Ethylhexanoic acid	-	Pt. 799 (Sect.799.2175)
Cadmium (Atomic absorption, direct aspiration), Precision and recovery statements for methods for	Method 213.1	Pt. 136 (App. D)
Cadmium (Atomic absorption, direct aspiration), Precision and recovery statements for methods for	Method 213.1	Pt. 136 (App. D)
Cadmium (Atomic absorption, furnace technique), Precision and recovery statements for methods for	Method 213.2	Pt. 136 (App. D)
Carbon dioxide, oxygen, excess air, and dry molecular weight, Gas analysis for	Method 3	Pt. 60 (App. A)

CHEMICAL or METHOD NAME INDEX TO EPA TEST METHODS IN CFR

CHEMICAL or METHOD NAME	NUMBER	CFR TITLE 40
Carbon monoxide continuous emission monitoring systems in stationary sources, Specifications and test procedures for	Performance Specification 4	Pt. 60 (App. B)
Carbon monoxide continuous emission monitoring systems in stationary sources, Specifications and test procedures for	Performance Specification 4A	Pt. 60 (App. B)
Carbon monoxide emissions from stationary sources, Determination of	Method 10	Pt. 60 (App. A)
Carbon monoxide emissions from stationary sources, Determination of	Method 10B	Pt. 60 (App. A)
Carbon monoxide in certifying continuous emissions monitoring systems at petroleum refineries, Determination of	Method 10A	Pt. 60 (App. A)
Carbon monoxide in the atmosphere(non-dispersive infrared photometry), Measurement principle and calibration procedure for the measurement of	-	Pt. 50 (App. C)
Chlorinated hydrocarbons	Method 612	Pt. 136 (App. A)
Chromium (Atomic absorption, direct aspiration), Precision and recovery statements for methods for	Method 218.1	Pt. 136 (App. D)
Chromium (Atomic absorption, furnace technique), Precision and recovery statements for methods for	Method 218.2	Pt. 136 (App. D)
Cobalt (Atomic absorption, furnace technique), Precision and recovery statements for methods for	Method 219.2	Pt. 136 (App. D)
Commercial hexane	-	Pt. 799 (Sect.799.2155)
Continuous emission rate monitoring systems in stationary sources, Specifications and test procedures for	Performance Specification 6	Pt. 60 (App. B)
Copper (Atomic absorption, direct aspiration), Precision and recovery statements for methods for	Method 220.1	Pt.136 (App D)
Copper (Atomic absorption, furnace technique), Precision and recovery statements for methods for	Method 220.2	Pt. 136 (App. D)
Cresols	-	Pt. 799 (Sect.799.1250)
Cumene	-	Pt. 799 (Sect.799.1285)
Daphnid chronic toxicity test	-	Pt. 797 (Sect.797.1330)
Daphnid chronic toxicity test	-	Pt. 797 (Sect.797.1350)
Daphnid acute toxicity test	-	Pt. 797 (Sect.797.1130)

CHEMICAL or METHOD NAME INDEX TO EPA TEST METHODS IN CFR		
CHEMICAL or METHOD NAME	NUMBER	CFR TITLE 40
Dichlorobenzenes	-	Pt. 799 (Sect.799.1052)
Diethylene glycol butyl ether and diethylene glycol butyl ether acetate	-	Pt. 799 (Sect.799.1560)
Diethylenetriamine (DETA)	-	Pt. 799 (Sect.799.1575)
Drinking water contaminants subject to testing	-	Pt. 799 (Sect.799.5075)
Early seedling growth toxicity test	-	Pt. 797 (Sect.797.2800)
Escheria coli WP2 and WP2 urvA reverse mutation assays	-	Pt. 798 (Sect.798.5100)
Evacuated chamber method	Method 3	Pt. 80 (App. B)
Exhaust gas volume flow rate from gasoline vapor incinerator, Determination of	Method 2B	Pt. 60 (App. A)
Field validation of pollutant measurement methods from various waste media	Method 301	Pt. 63 (App. A)
Fish acute toxicity test	-	Pt. 797 (Sect.797.1400)
Fish acute toxicity test	-	Pt. 797 (Sect.797.1440)
Fish bioconcentration test	-	Pt. 797 (Sect.797.1520)
Fish bioconcentration test	-	Pt. 797 (Sect.797.1560)
Fish early life stage toxicity test	-	Pt. 797 (Sect.797.1600)
Fluoride emissions from potroom roof monitors for Primary aluminum plants, Determination of	Method 14	Pt. 60 (App. A)
Fluoroalkenes	-	Pt. 799 (Sect.799.1700)
Fugitive emissions from material sources and smoke Emissions from flares, Visual determination of	Method 22	Pt. 60 (App. A)
Gas volumetic flow rate, Performance specifications and, specification test procedures for monitoring systems for effluent stream	-	Pt. 52 (App. E)
Gaseous nonmethane organic emissions as carbon, Determination of total	Method 25	Pt. 60 (App. A)
Gaseous organic compound emissions by gas chromatography, Measurement of	Method 18	Pt. 60 (App. A)
Gaseous organic concentration using a nondispersive infrared analyzer, Determination of total	Method 25B	Pt. 60 (App. A)

CHEMICAL or METHOD NAME INDEX TO EPA TEST METHODS IN CFR

CHEMICAL or METHOD NAME	NUMBER	CFR TITLE 40
Gaseous organic concentration using a flame ion-ozation analyzer, Determination of total	Method 25A	Pt. 60 (App. A)
GC analysis, Procedure for field auditing	Procedure 2	Pt. 61 (App. C)
Haloethers	Method 611	Pt. 136 (App. A)
Hazardous waste constituents subject to testing	-	Pt. 799 (Sect.799.5055)
Hydrocarbons corrected for methane, Reference method for determination of	-	Pt. 50 (App. E)
Hydrogen chloride emissions from stationary sources, Determination of	Method 26	Pt. 60 (App. A)
Hydrogen sulfide content of fuel gas streams in petroleum refineries, Determination of	Method 11	Pt. 60 (App. A)
Hydrogen sulfide Continuous emission monitoring systems in stationary sources, Specifications and test procedures for	Performance Specification 7	Pt. 60 (App. B)
Hydrogen sulfide, carbonyl sulfide, and carbon disulfide emissions from stationary sources, Determination of	Method 15	Pt. 60 (App. A)
Hydroquinone	-	Pt. 799 (Sect.799.2200)
In vitro sister chromatid exchange assay	-	Pt. 798 (Sect.798.5900)
In vivo mammalian bone marrow cytogenetics tests : micronucleus	-	Pt. 798 (Sect.798.5395)
In vivo sister chromatid exchange assay	-	Pt. 798 (Sect.798.5915)
Inorganic lead emissions from stationary sources, Determination of	Method 12	Pt. 60 (App. A)
Iron (Atomic absorption, direct aspiration), Precision and recovery statements for methods for	Method 236.1	Pt. 136 (App. D)
Iron (Atomic absorption, furnace technique), Precision and recovery statements for methods for	Method 236.2	Pt. 136 (App. D)
Isopropanol	-	Pt. 799 (Sect.799.2325)
Lead (Atomic absorption, direct aspiration), Precision and recovery statements for methods for	Method 239.1	Pt. 136 (App. D)
Lead (Atomic absorption, furnace technique), Precision and recovery statements for methods for	Method 239.2	Pt. 136 (App. D)
Lead in gasoline by atomic absorption Spectrometry, Automated method test for	Method 2	Pt. 80 (App. B)

CHEMICAL or METHOD NAME INDEX TO EPA TEST METHODS IN CFR		
CHEMICAL or METHOD NAME	NUMBER	CFR TITLE 40
Lead in gasoline by atomic absorption spectrometry, Standards method test for	Method 1	Pt. 80 (App. B)
Lead in gasoline by X-Ray spectrometry, Test for	Method 3	Pt. 80 (App. B)
Lead in suspended particulate matter collected from ambient air, Reference method for the determination of	-	Pt. 50 (App. G)
Lemna acute toxicity test	-	Pt. 797 (Sect.797.1160)
Mallard reproduction test	-	Pt. 797 (Sect.797.2150)
Manganese (Atomic absorption, direct aspiration), Precision and recovery statements for methods for	Method 243.1	Pt. 136 (App. D)
Manganese (Atomic absorption, furnace technique), Precision and recovery statements for methods for	Method 243.2	Pt. 136 (App. D)
Mercury emissions from Chlor-alkali plants—air streams, Determination of particulate and gaseous	Method 101	Pt. 61 (App. B)
Mercury emissions from Chlor-alkali plants—hydrogen streams, Determination of particulate and gaseous	Method 102	Pt. 61 (App. B)
Mercury emissions from Sewage sludge incinerators, Determination of particulate and gaseous	Method 101A	Pt. 61 (App. B)
Mercury in wastewater treatment plant sewage sludges, Determination	Method 105	Pt. 61(App. B)
Mesityl oxide (MO)	-	Pt. 799 (Sect.799.2500)
Methods and reference methods, Procedures for determining comparability between candidate	-	Pt. 53 (App. C)
Methyl ethyl ketoxime	-	Pt. 799 (Sect.799.2700)
Moisture content in stack gases, Determination of	Method 4	Pt. 60 (App. A)
Monochlorobenzene	-	Pt. 799 (Sect.799.1051)
Mouse biochemical specific locus test	-	Pt. 798 (Sect.798.5195)
Mouse visible specific locus test	-	Pt. 798 (Sect.798.5200)
Mysid shrimp acute toxicity test	-	Pt. 797 (Sect.797.1930)
Mysid shrimp chronic toxicity test	-	Pt. 797 (Sect.797.1950)
Nickel (Atomic absorption, furnace technique), Precision and recovery statements for methods for	Method 249.2	Pt. 136 (App. D)

CHEMICAL or METHOD NAME INDEX TO EPA TEST METHODS IN CFR

CHEMICAL or METHOD NAME	NUMBER	CFR TITLE 40
Nitroaromatics and isophorone	Method 609	Pt. 136 (App. A)
Nitrogen dioxide in the atmosphere (Gas phase chemiluminescence), Measurement principle and calibration procedure for the measurement of	-	Pt. 50 (App. F)
Nitrogen oxide emissions from stationary sources (Instrumental Analyzer Procedure), Determination of	Method 7E	Pt. 60 (App. A)
Nitrogen oxide emissions from stationary sources (Ultraviolet spectrophotometry), Determination of	Method 7B	Pt. 60 (App. A)
Nitrogen oxide emissions from stationary sources— Alkaline – permanganate / ion chromatographic method, Determination of	Method 7D	Pt. 60 (App. A)
Nitrogen oxide emissions from stationary sources—Alkaline -- permanganate / colorimetric method, Determination of	Method 7C	Pt. 60 (App A)
Nitrogen oxide emissions from stationary sources-Iron chromatographic method, Determination of	Method 7A	Pt. 60 (App A)
Nitrogen oxide emissions from stationary sources, Determination of	Method 7	Pt. 60 (App. A)
Nitrogen oxides, sulfur dioxide, and diluent emissions from stationary gas turbines, Determination of	Method 20	Pt. 60 (App. A)
Nitrosamines	Method 607	Pt. 136 (App. A)
O2 and CO2 continuous emission monitoring systems in stationary sources, Specifications and test procedures for	Performance Specification 3	Pt. 60 (App. B)
OECD screening test, Ready biodegradability : modified	-	Pt. 796 (Sect.796.3240)
Oleylamine	-	Pt. 799 (Sect.799.3175)
Opacity continuous Emission monitoring systems in stationary sources, Specifications and test procedures for	Performance Specification 1	Pt. 60 (App. B)
Opacity of emissions from stationary sources, Visual determination of the	Method 9	Pt. 60 (App. A)
Organic compounds (vent option), Determination of biodegradation rates of	Method 304A	Pt. 63 (App. A)
Organic compounds (scrubber option), Determination of biodegradation rates of	Method 304B	Pt. 63 (App. A)

CHEMICAL or METHOD NAME INDEX TO EPA TEST METHODS IN CFR

CHEMICAL or METHOD NAME	NUMBER	CFR TITLE 40
Organochlorine pesticides and PCBs	Method 608	Pt. 136 (App. A)
Oxygen and carbon dioxide concentrations in emission from stationary sources (Instrumental Analyzer Procedure), Determination of	Method 3A	Pt. 60 (App. A)
Oyster acute toxicity test	-	Pt. 797 (Sect.797.1800)
Oyster bioconcentration test	-	Pt. 797 (Sect.797.1830)
Ozone in the atmosphere, Measurement principle and calibration procedure for the measurement of	-	Pt. 50 (App. D)
Particulate emission from the wool fiberglass insulation manufacturing industry, Determination of	Method 5E	Pt. 60 (App. A)
Particulate emissions from positive pressure fabric filters, Determination of	Method 5D	Pt. 60 (App. A)
Particulate emissions from stationary sources (in stack filtration method), Determination of	Method 17	Pt. 60 (App. A)
Particulate emissions from stationary sources, Determination of	Method 5	Pt. 60 (App. A)
Particulate emissions from stationary sources, Determination of condensible	Method 202	Pt. 51 (App. M)
Particulate emissions from the asphalt processing and asphalt roofing industry, Determination of	Method 5A	Pt. 60 (App. A)
Particulate emissions from wood heaters from a dilution tunnel sampling location, Determination of	Method 5G	Pt. 60 (App. A)
Particulate emissions from wood heaters from a stack location, Determination of	Method 5H	Pt. 60 (App. A)
Particulate matter as PM_{10} in the atmosphere, Reference method for the determination of	-	Pt. 50 (App. J)
Particulate matter from stationary sources, Determination of nonsulfuric acid	Method 5B	Pt. 60 (App. A)
Particulate matter from stationary sources, Determination of nonsulfate	Method 5F	Pt. 60 (App. A)
Particulate matter in the atmosphere (High-Volume method), Reference method for the determination of suspended	-	Pt. 50 (App. B)
Penaeid shrimp acute toxicity test	-	Pt. 797 (Sect.797.1970)

CHEMICAL or METHOD NAME INDEX TO EPA TEST METHODS IN CFR		
CHEMICAL or METHOD NAME	NUMBER	CFR TITLE 40
Phenols	Method 604	Pt. 136 (App. A)
Photolysis reaction quantum yield in aqueous solution and sunlight photolysis, Laboratory determination of the direct	-	Pt. 796 (Sect.796.3780)
Phthalate ester	Method 606	Pt. 136 (App. A)
Plant uptake and translocation test	-	Pt. 797 (Sect.797.2850)
PM_{10} emissions (Constant sampling rate procedure), Determination of	Method 201A	Pt. 51 (App. M)
PM_{10} emissions (Exhaust gas recycle procedure), Determination of	Method 201	Pt. 51 (App. M)
PM_{10}, Procedures for testing performance characteristics of methods	-	Pt. 53 (App. D)
Polonium—210 emission from stationary sources, Determination of	Method 111	Pt. 61 (App. B)
Polychlorinated dibenzo-p-dioxins and polychlorinated dibenzofurans from stationary sources, Determination of	Method 23	Pt. 60 (App. A)
Polynuclear aromatic hydrocarbons	Method 610	Pt. 136 (App. A)
Propylene oxide	-	Pt. 799 (Sect.799.3450)
Purgeable aromatics	Method 602	Pt. 136 (App. A)
Purgeable halocarbons	Method 601	Pt. 136 (App. A)
Purgeables	Method 624	Pt. 136 (App. A)
Radionuclide emissions from stationary sources, Test methods for measuring	Method 114	Pt. 61 (App. B)
Radon-222 emissions, Monitoring for	Method 115	Pt. 61 (App. B)
Rodent dominant lethal assay	-	Pt. 798 (Sect.798.5450)
Rodent heritable translocation assay	-	Pt. 798 (Sect.798.5460)
Saccharomyces cervisiae, Mitotic gene conversion in	-	Pt. 798 (Sect.798.5575)
Salmonella typhimurium reverse mutation assay, The	-	Pt. 798 (Sect.798.5260)
Sample and velocity traverses for stationary sources	Method 1	Pt. 60 (App. A)
Sample and velocity traverses for stationary sources with small stacks or ducts	Method 1A	Pt. 60 (App. A)
SCAS test, Inherent biodegradability : modified	-	Pt. 796 (Sect.796.3340)
Seed germination/root elongation toxicity test	-	Pt. 797 (Sect.797.2750)
Selenium (Atomic absorption, furnace technique), Precision and recovery statements for methods for	Method 270.2	Pt. 136 (App. D)

CHEMICAL or METHOD NAME INDEX TO EPA TEST METHODS IN CFR

CHEMICAL or METHOD NAME	NUMBER	CFR TITLE 40
Semivolatile organic compounds by isotope dilution GC/MS	Method 1625 revision B	Pt. 136 (App. A)
Silver (Atomic absorption, furnace technique), Precision and recovery statements for methods for	Method 272.2	Pt. 136 (App. D)
Simulation test ---aerobic sewage treatment : coupled units test	-	Pt. 796 (Sect.796.3330)
SO2 and NO2 continuous Emission monitoring systems in stationary sources, Specifications and test procedures for	Performance Specification 2	Pt. 60 (App. B)
SO_2, CO_2, O_3 and NO_2, Performance characteristics of automated methods for	-	Pt. 53 (App. B)
Stum test, Ready biodegradability : modified	-	Pt. 796 (Sect.796.3260)
Sulfur dioxide and carbon dioxide daily average emissions from fossil fuel combustion sources, Determination of	Method 6B	Pt. 60 (App. A)
Sulfur dioxide emissions from stationary sources (Instrumental Analyzer Procedure), Determination of	Method 6 C	Pt. 60 (App. A)
Sulfur dioxide emissions from stationary sources by continuous monitors, Determination of	-	Pt. 52 (App. D)
Sulfur dioxide emissions from stationary sources, Determination of	Method 6	Pt. 60 (App. A)
Sulfur dioxide in the atmosphere (Pararosaniline method), Reference method for the determination of	-	Pt. 50 (App. A)
Sulfur dioxide removal efficiency and particulate, sulfur dioxide and nitrogen oxides emission rates, Determination of	Method 19	Pt. 60 (App. A)
Sulfur dioxide, moisture, and carbon dioxide emissions from fossil fuel combustion sources, Determination of	Method 6A	Pt. 60 (App. A)
Sulfur emissions from stationary sources (impinger technique), Determination of total reduced	Method 16A	Pt. 60 (App. A)
Sulfur emissions from stationary sources, Determination of total	Method 16B	Pt. 60 (App. A)
Sulfur emissions from stationary sources, Semicontinuous determination of	Method 16	Pt. 60 (App. A)
Sulfur emissions from sulfur recovery plants in petroleum refineries, Determination of total reduced	Method 15A	Pt. 60 (App. A)

CHEMICAL or METHOD NAME INDEX TO EPA TEST METHODS IN CFR		
CHEMICAL or METHOD NAME	NUMBER	CFR TITLE 40
Sulfuric acid mist and sulfur dioxide emissions from stationary sources, Determination of	Method 8	Pt. 60 (App. A)
Surface coatings, Determination of volatile matter content, water content, density, volume Solids, and weight solids of	Method 24	Pt. 60 (App. A)
Tetrabromobisphenol A	-	Pt. 799 (Sect.799.4000)
Thalium (Atomic absorption, furnace technique), Precision and recovery statements for methods for	Method 279.2	Pt. 136 (App. D)
Total fluoride emissions from stationary sources— Specific ion electrode method, Determination of	Method 13B	Pt. 60 (App. A)
Total fluoride emissions from stationary sources— SPANDS zircinium lake method, Determination of	Method 13A	Pt. 60 (App. A)
Toxicity characteristic leaching procedure (TCLP)	Method 1311	Pt. 261 (App. II)
Tributyl phosphate	-	Pt. 799 (Sect.799.4360)
Trichlorobenzenes	-	Pt. 799 (Sect.799.1053)
Triethylene glycol monomethyl ether	-	Pt. 799 (Sect.799.4440)
TRS continuous emission monitoring systems in stationary sources, Specifications and test procedures for	Performance Specification 5	Pt. 60 (App. B)
Unsubstituted phenylenediamines	-	Pt. 799 (Sect.799.3300)
Vanadium (Atomic absorption, furnace technique), Precision and recovery statements for methods for	Method 286.2	Pt. 136 (App. D)
Vapor tightness of gasoline delivery tank using pressure vacuum test, Determination of	Method 27	Pt. 60 (App. A)
Velocity and volumetric flow rate (Type S pilot tube), Determination of stack gas	Method 2	Pt. 60 (App. A)
Velocity and volumetric flow rate in small stacks or ducts (standard pilot tube), Determination of stack gas	Method 2C	Pt. 60 (App. A)
Vinyl chloride from stationary sources, Determination of	Method 106	Pt. 61 (App. B)
Vinyl chloride content of inprocess wastewater samples, and vinyl chloride content of polyvinyl chloride resin, slurry, wet cake, and latex samples, Determination of	Method 107	Pt. 61 (App. B)

CHEMICAL or METHOD NAME INDEX TO EPA TEST METHODS IN CFR

CHEMICAL or METHOD NAME	NUMBER	CFR TITLE 40
vinyl chloride content of solvents, resin-solvent solution, polyvinyl chloride resin, resin slurry, wet resin, and latex samples, Determination	Method 107A	Pt. 61 (App. B)
Visible emissions from by-product coke oven batteries, Determination of	Method 303	Pt. 63 (App. A)
Visible emissions from nonrecovery coke oven batteries, Determination	Method 303A	Pt. 63 (App. A)
Volatile matter content and density of printing inks and related coatings, Determination of	Method 24A	Pt. 60 (App. A)
Volatile organic compound leaks, Determination of	Method 21	Pt. 60 (App. A)
Volatile organic compounds by isotope dilution GC/MS	Method 1624 revision B	Pt. 136 (App. A)
Volatile organic compounds in waste, Measurement of emission potential of individual	Method 305	Pt. 63 (App. A)
Volume through pipes and small ducts, Direct measurement of gas	Method 2A	Pt. 60 (App. A)
Volumetric flow rates in small pipes and ducts, Measurement of gas	Method 2D	Pt. 60 (App. A)
Water extraction method	Method 1	Pt. 80 (App. F)
wood heaters, Certification and auditing of	Method 28	Pt. 60 (App. A)
Wood-fired appliances, Measurement of air to fuel ratio and minimum achievable burn rates for	Method 28A	Pt. 60 (App. A)
Zahn-Wellens test, Inherent biodegradability : modified	-	Pt. 796 (Sect.796.3360)
Zinc (Atomic absorption, direct aspiration), Precision and recovery statements for methods for	Method 289.1	Pt. 136 (App. D)
Zinc (Atomic absorption, furnace technique), Precision and recovery statements for methods for	Method 289.2	Pt. 136 (App. D)

บทที่ 3

ปัญหา อุปสรรคและข้อเสนอแนะ

3.1 ปัญหาและอุปสรรค

เนื่องจาก CFR Index and Finding Aids ไม่สามารถใช้ในการตรวจสอบและค้นหาข้อมูลเกี่ยวกับวิธีทดสอบ (Test Method) ที่เป็น Method Number หรือ Chemical or Method Name ของ EPA ได้โดยสะดวก จึงทำให้ต้องศึกษาวิธีการสืบค้นข้อมูล และสำรวจข้อมูลที่มีทั้งหมด เพื่อให้ได้ข้อมูลที่ต้องการ จึงทำให้ต้องใช้เวลามากในการดำเนินการในการเก็บและรวบรวมข้อมูล

ในการจัดทำรูปเล่มคู่มือการค้นหาวิธีทดสอบ (Test Method) ของหน่วยงาน EPA ในเอกสาร CFR ขึ้นมานั้นมีจุดมุ่งหมายเพื่อให้ผู้ที่เกี่ยวข้องสามารถใช้เป็นคู่มือในการตรวจสอบ และค้นหาข้อมูลที่ต้องการได้ในระบบ Manual (ในรูปของตาราง) จึงเลือกใช้ โปรแกรม Microsoft Excel 97 เพื่อให้เกิดความสะดวกในการพิมพ์งาน ส่วนของการจัดเรียงข้อมูล Method Number จากเลขน้อยไปหาเลขมาก นั้นโปรแกรม Microsoft Excel 97 มีข้อจำกัดไม่สามารถจัดเรียงตามลำดับจากเลขน้อยไปหาเลขมากได้อัตโนมัติทั้งหมด (จัดเรียงตามลำดับได้เป็นช่วงๆ) จึงทำให้ต้องเสียเวลาในการปรับแต่งข้อมูลพอสมควร

ตัวอย่าง : ผลของการจัดเรียงข้อมูลของโปรแกรม Microsoft Excel 97

Method 1 : Water Extraction method

Method 10 : Determination of carbon monoxide emissions from stationary sources

Method 11 : Determination of hydrogen sulfide content of fuel gas streams in petroleum refineries

Method 115 : Monitoring for radon-222 emissions

Method 12 : Determination of inorganic lead emissions from stationary sources

Method 3 : Evacuated chamber method

Method 303 : Determination of visible emissions from by-product coke oven batteries

จากปัญหาดังกล่าวทำให้ต้องเสียเวลาในการปรับแต่งข้อมูลใหม่เกือบทั้งหมดในส่วนของ METHOD NUMBER INDEX

3.2 ข้อเสนอแนะ

ในการเลือกใช้โปรแกรม Microsoft Excel 97 ในการพิมพ์งานนั้นมีข้อจำกัดในเรื่องขีดความสามารถในการจัดเรียงลำดับข้อมูลดังตัวอย่างข้างต้นก็จริง แต่ก็ถือได้ว่าเป็นโปรแกรมที่ใช้งานได้สะดวกในการพิมพ์งานในลักษณะเช่นนี้ ในส่วนของการปรับปรุงให้สามารถค้นคืนข้อมูลได้สะดวก และรวดเร็วยิ่งขึ้นโดยค้นคืนผ่าน computer นั้นคงต้องจัดทำในรูปของฐานข้อมูลในโอกาสต่อไป และการปรับปรุงคู่มือให้ทันสมัยนั้นเห็นควรจัดทำเป็นเอกสารเพิ่มเติม (Supplement) เมื่อได้รับเอกสารใหม่

เอกสารอ้างอิง

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ภาคผนวก

เอกสารแนบ 1

TITLE 40 -- Environmental Protection Agency

PART 50 -- National Primary and Secondary Ambient Air Quality Standards

SUBCHAPTER C—AIR PROGRAMS

PART 50—NATIONAL PRIMARY AND SECONDARY AMBIENT AIR QUALITY STANDARDS

Sec.

AUTHORITY: Secs. 109 and 301(a), Clean Air Act, as amended (42 U.S.C. 7409, 7601(a)).

SOURCE: 36 FR 22384, Nov. 25, 1971, unless otherwise noted.

§ 50.1 Definitions.

(a) As used in this part, all terms not defined herein shall have the meaning given them by the Act.

(b) *Act* means the Clean Air Act, as amended (42 U.S.C. 1857–1857l, as amended by Pub. L. 91–604).

(c) *Agency* means the Environmental Protection Agency.

(d) *Administrator* means the Administrator of the Environmental Protection Agency.

(e) *Ambient air* means that portion of the atmosphere, external to buildings, to which the general public has access.

(f) *Reference method* means a method of sampling and analyzing the ambient air for an air pollutant that is specified as a reference method in an appendix to this part, or a method that has been designated as a reference method in accordance with part 53 of this chapter; it does not include a method for which a reference method designation has been cancelled in accordance with § 53.11 or § 53.16 of this chapter.

(g) *Equivalent method* means a method of sampling and analyzing the ambient air for an air pollutant that has been designated as an equivalent method in accordance with part 53 of this chapter; it does not include a method for which an equivalent method designation has been cancelled in accordance with § 53.11 or § 53.16 of this chapter.

(h) *Traceable* means that a local standard has been compared and certified either directly or via not more than one intermediate standard, to a primary standard such as a National Bureau of Standards Standard Reference Material (NBS SRM), or a

USEPA/NBS-approved Certified Reference Material (CRM).

[36 FR 22384, Nov. 25, 1971, as amended at 41 FR 11253, Mar. 17, 1976; 48 FR 2529, Jan. 20, 1983]

§ 50.2 Scope.

(a) National primary and secondary ambient air quality standards under section 109 of the Act are set forth in this part.

(b) National primary ambient air quality standards define levels of air quality which the Administrator judges are necessary, with an adequate margin of safety, to protect the public health. National secondary ambient air quality standards define levels of air quality which the Administrator judges necessary to protect the public welfare from any known or anticipated adverse effects of a pollutant. Such standards are subject to revision, and additional primary and secondary standards may be promulgated as the Administrator deems necessary to protect the public health and welfare.

(c) The promulgation of national primary and secondary ambient air quality standards shall not be considered in any manner to allow significant deterioration of existing air quality in any portion of any State.

(d) The proposal, promulgation, or revision of national primary and secondary ambient air quality standards shall not prohibit any State from establishing ambient air quality standards for that State or any portion thereof which are more stringent than the national standards.

§ 50.3 Reference conditions.

All measurements of air quality are corrected to a reference temperature of 25° C. and to a reference pressure of 760 millimeters of mercury (1,013.2 millibars).

§ 50.4 National primary ambient air quality standards for sulfur oxides (sulfur dioxide).

The national primary ambient air quality standards for sulfur oxides measured as sulfur dioxide by the reference method described in appendix A to this part, or by an equivalent method, are:

(a) 80 micrograms per cubic meter (0.03 p.p.m.)—annual arithmetic mean.

(b) 365 micrograms per cubic meter (0.14 p.p.m.)—Maximum 24-hour concentration not to be exceeded more than once per year.

§ 50.5 National secondary ambient air quality standards for sulfur oxides (sulfur dioxide).

The national secondary ambient air quality standard for sulfur oxide measured as sulfur dioxide by the reference method described in appendix A to this part, or by any equivalent method is 1,300 micrograms per cubic meter (0.5 p.p.m.) maximum 3-hour concentration not to be exceeded more than once per year.

[38 FR 25681, Sept. 14, 1973]

§ 50.6 National primary and secondary ambient air quality standards for particulate matter.

(a) The level of the national primary and secondary 24-hour ambient air quality standards for particulate matter is 150 micrograms per cubic meter ($\mu g/m^3$), 24-hour average concentration. The standards are attained when the expected number of days per calendar year with a 24-hour average concentration above 150 $\mu g/m^3$, as determined in accordance with appendix K to this part, is equal to or less than one.

(b) The level of the national primary and secondary annual standards for particulate matter is 50 micrograms per cubic meter ($\mu g/m^3$), annual arithmetic mean. The standards are attained when the expected annual arithmetic mean concentration, as determined in accordance with appendix K to this part, is less than or equal to 50 $\mu g/m^3$.

(c) For the purpose of determining attainment of the primary and secondary standards, particulate matter shall be measured in the ambient air as PM_{10} (particles with an aerodynamic diameter less than or equal to a nominal 10 micrometers) by:

(1) A reference method based on appendix J and designated in accordance with part 53 of this chapter, or

(2) An equivalent method designated in accordance with part 53 of this chapter.

[52 FR 24663, July 1, 1987]

§50.7 [Reserved]

§50.8 National primary ambient air quality standards for carbon monoxide.

(a) The national primary ambient air quality standards for carbon monoxide are:

(1) 9 parts per million (10 milligrams per cubic meter) for an 8-hour average concentration not to be exceeded more than once per year and

(2) 35 parts per million (40 milligrams per cubic meter) for a 1-hour average concentration not to be exceeded more than once per year.

(b) The levels of carbon monoxide in the ambient air shall be measured by:

(1) A reference method based on appendix C and designated in accordance with part 53 of this chapter, or

(2) An equivalent method designated in accordance with part 53 of this chapter.

(c) An 8-hour average shall be considered valid if at least 75 percent of the hourly average for the 8-hour period are available. In the event that only six (or seven) hourly averages are available, the 8-hour average shall be computed on the basis of the hours available using six (or seven) as the divisor.

(d) When summarizing data for comparision with the standards, averages shall be stated to one decimal place. Comparison of the data with the levels of the standards in parts per million shall be made in terms of integers with fractional parts of 0.5 or greater rounding up.

[50 FR 37501, Sept. 13, 1985]

§50.9 National primary and secondary ambient air quality standards for ozone.

(a) The level of the national primary and secondary ambient air quality standards for ozone measured by a reference method based on appendix D to this part and designated in accordance with part 53 of this chapter, is 0.12 part per million (235 μg/m^3). The standard is attained when the expected number of days per calendar year with maximum hourly average concentrations above 0.12 part per million (235 μg/m^3) is equal to or less than 1, as determined by appendix H.

(Secs. 109 and 301 of the Clean Air Act, as amended (42 U.S.C. 7409, 7601))

[44 FR 8220, Feb. 8, 1979]

§50.10 [Reserved]

§50.11 National primary and secondary ambient air quality standards for nitrogen dioxide.

(a) The level of the national primary ambient air quality standard for nitrogen dioxide is 0.053 parts per million (100 micrograms per cubic meter), annual arithmetic mean concentration.

(b) The level of national secondary ambient air quality standard for nitrogen dioxide is 0.053 parts per million (100 micrograms per cubic meter), annual arithmetic mean concentration.

(c) The levels of the standards shall be measured by:

(1) A reference method based on appendix F and designated in accordance with part 53 of this chapter, or

(2) An equivalent method designated in accordance with part 53 of this chapter.

(d) The standards are attained when the annual arithmetic mean concentration in a calendar year is less than or equal to 0.053 ppm, rounded to three decimal places (fractional parts equal to or greater than 0.0005 ppm must be rounded up). To demonstrate attainment, an annual mean must be based upon hourly data that are at least 75 percent complete or upon data derived from manual methods that are at least 75 percent complete for the scheduled sampling days in each calendar quarter.

[50 FR 25544, June 19, 1985]

§50.12 National primary and secondary ambient air quality standards for lead.

National primary and secondary ambient air quality standards for lead and its compounds, measured as elemental lead by a reference method based on appendix G to this part, or by an equivalent method, are: 1.5 micrograms per cubic meter, maximum arithmetic mean averaged over a calendar quarter.

(Secs. 109, 301(a) Clean Air Act as amended (42 U.S.C. 7409, 7601(a)))

[43 FR 46258, Oct. 5, 1978]

Appendix A to Part 50—Reference Method for the Determination of Sulfur Dioxide in the Atmosphere (Pararosaniline Method)

1.0 *Applicability.*

1.1 This method provides a measurement of the concentration of sulfur dioxide (SO_2) in ambient air for determining compliance with the primary and secondary national ambient air quality standards for sulfur oxides (sulfur dioxide) as specified in §50.4 and §50.5 of this chapter. The method is applicable to the measurement of ambient SO_2 concentrations using sampling periods ranging from 30 minutes to 24 hours. Additional quality assurance procedures and guidance are provided in part 58, Appendixes A and B, of this chapter and in references 1 and 2.

2.0 *Principle.*

2.1 A measured volume of air is bubbled through a solution of 0.04 M potassium tetrachloromercurate (TCM). The SO_2 present in the air stream reacts with the TCM solution to form a stable monochlorosulfonatomercurate(*3*) complex. Once formed, this complex resists air oxidation(*4, 5*) and is stable in the presence of strong oxidants such as ozone and oxides of nitrogen. During subsequent analysis, the complex is reacted with acid-bleached pararosaniline dye and formaldehyde to form an intensely colored pararosaniline methyl sulfonic acid.(*6*) The optical density of this species is determined spectrophotometrically at 548 nm and is directly related to the amount of SO_2 collected. The total volume of air sampled, corrected to EPA reference conditions (25° C, 760 mm Hg [101 kPa]), is determined from the measured flow rate and the sampling time. The concentration of SO_2 in the ambient air is computed and expressed in micrograms per standard cubic meter (μg/std m^3).

3.0 *Range.*

3.1 The lower limit of detection of SO_2 in 10 mL of TCM is 0.75 μg (based on collaborative test results).(*7*) This represents a concentration of 25 μg SO_2/m^3 (0.01 ppm) in an air sample of 30 standard liters (short-term sampling) and a concentration of 13 μg SO_2/m^3 (0.005 ppm) in an air sample of 288 standard liters (long-term sampling). Concentrations less than 25 μg SO_2/m^3 can be measured by sampling larger volumes of ambient air; however, the collection efficiency falls off rapidly at low concentrations.(*8, 9*) Beer's law is adhered to up to 34 μg of SO_2 in 25 mL of final solution. This upper limit of the analysis range represents a concentration of 1,130 μg SO_2/m^3 (0.43 ppm) in an air sample of 30 standard liters and a concentration of 590 μg SO_2/m^3 (0.23 ppm) in an air sample of 288 standard liters. Higher concentrations can be measured by collecting a smaller volume of air, by increasing the volume of absorbing solution, or by diluting a suitable portion of the collected sample with absorbing solution prior to analysis.

4.0 *Interferences.*

4.1 The effects of the principal potential interferences have been minimized or eliminated in the following manner: Nitrogen oxides by the addition of sulfamic acid,(*10, 11*) heavy metals by the addition of ethylenediamine tetracetic acid disodium salt (EDTA) and phosphoric acid,(*10, 12*) and ozone by time delay.(*10*) Up to 60 μg Fe (III), 22 μg V (V), 10 μg Cu (II), 10 μg Mn (II), and 10 μg Cr (III) in 10 mL absorbing reagent can be tolerated in the procedure.(*10*) No significant interference has been encountered with 2.3 μg NH_3.(*13*)

5.0 *Precision and Accuracy.*

5.1 The precision of the analysis is 4.6 percent (at the 95 percent confidence level) based on the analysis of standard sulfite samples.(*10*)

5.2 Collaborative test results(*14*) based on the analysis of synthetic test atmospheres (SO_2 in scrubbed air) using the 24-hour sampling procedure and the sulfite-TCM calibration procedure show that:

- The replication error varies linearly with concentration from ±2.5 μg/m^3 at concentrations of 100 μg/m^3 to ±7 μg/m^3 at concentrations of 400 μg/m^3.
- The day-to-day variability within an individual laboratory (repeatability) varies linearly with concentration from ±18.1 μg/m^3 at levels of 100 μg/m^3 to ±50.9 μg/m^3 at levels of 400 μg/m^3.
- The day-to-day variability between two or more laboratories (reproducibility) varies linearly with concentration from ±36.9 μg/m^3 at levels of 100 μg/m^3 to ±103.5 μg/m^3 at levels of 400 μg/m^3.
- The method has a concentration-dependent bias, which becomes significant at the 95 percent confidence level at the high concentration level. Observed values tend to be lower than the expected SO_2 concentration level.

6.0 *Stability.*

6.1 By sampling in a controlled temperature environment of 15°±10° C, greater than 98.9 percent of the SO_2-TCM complex is retained at the completion of sampling.(*15*) If kept at 5° C following the completion of sampling, the collected sample has been found to be stable for up to 30 days.(*10*) The presence of EDTA enhances the stability of SO_2 in the TCM solution and the rate of decay is independent of the concentration of SO_2.(*16*)

7.0 *Apparatus.*

7.1 *Sampling.*

เอกสารแนบ 2

METHOD 21 -- Determination of Volatile Organic Compounds Leaks

From

CFR TITLE 40

PART 60 (Appendix A)

tion 3, the O_2 or CO_2 correction can exceed 5 percent at the concentration levels expected in gas turbine exhaust gases. Therefore, O_2 or CO_2 analyzer stability and careful calibration are necessary.

7.3.1 Correction of Pollutant Concentration Using O_2 Concentration. Calculate the O_2 corrected pollutant concentration, as follows:

$$C_{adj}=C_d \frac{5.9}{20.9-\%O_2} \qquad \text{Eq. 20–4}$$

where:

C_{adj}=Pollutant concentration corrected to 15 percent O_2 ppm.

C_d=Pollutant concentration measured, dry basis, ppm.

$\%O_2$=Measured O_2 concentration dry basis, percent.

7.3.2 Correction of Pollutant Concentration Using CO_2 Concentration. Calculate the CO_2 corrected pollutant concentration, as follows:

$$C_{adj}=C_d \frac{X_{CO2}}{\%CO_2} \qquad \text{Eq. 20–5}$$

where:

$\%CO_2$=Measured CO_2 concentration measured, dry basis, percent.

7.4 Average Adjusted NO_x Concentration. Calculate the average adjusted NO_x concentration by summing the adjusted values for each sample point and dividing by the number of points for each run.

7.5 NO_x and SO_2 Emission Rate Calculations. The emission rates for NO_x and SO_2 in units of pollutant mass per quantity of heat input can be calculated using the pollutant and diluent concentrations and fuel-specific F-factors based on the fuel combustion characteristics. The measured concentrations of pollutant in units of parts per million by volume (ppm) must be converted to mass per unit volume concentration units for these calculations. Use the following table for such conversions:

CONVERSION FACTORS FOR CONCENTRATION

From	To	Multiply by
g/sm³	ng/sm³	10^9
mg/sm³	ng/sm³	10^6
lb/scf	ng/sm³	1.602×10^{13}
ppm (SO_2)	ng/sm³	2.660×10^6
ppm (NO_x)	ng/sm³	1.912×10^6
ppm (SO_2)	lb/scf	$1.660 \times 10-^7$
ppm (NO_x)	lb/scf	$1.194 \times 10-^7$

7.5.1 Calculation of Emission Rate Using Oxygen Correction. Both the O_2 concentration and the pollutant concentration must be on a dry basis. Calculate the pollutant emission rate, as follows:

$$E=C_d F_d \frac{20.9}{20.9-\%O_2} \qquad \text{Eq. 20–6}$$

where:

E=Mass emission rate of pollutant, ng/J (lb/10^6 Btu).

7.5.2 Calculation of Emission Rate Using Carbon Dioxide Correction. The CO_2 concentration and the pollutant concentration may be on either a dry basis or a wet basis, but both concentrations must be on the same basis for the calculations. Calculate the pollutant emission rate using Equation 20–7 or 20–8:

$$E=C_d F_c \frac{100}{\%CO_2} \qquad \text{Eq. 20–7}$$

$$E=C_w F_c \frac{100}{\%CO_{2w}} \qquad \text{Eq. 20–8}$$

where:

C_w=Pollutant concentration measured on a moist sample basis, ng/sm³ (lb/scf).

$\%CO_{2w}$=Measured CO_2 concentration measured on a moist sample basis, percent.

8. *Bibliography*

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METHOD 21—DETERMINATION OF VOLATILE ORGANIC COMPOUNDS LEAKS

1. *Applicability and Principle*

1.1 Applicability. This method applies to the determination of volatile organic compound (VOC) leaks from process equipment. These sources include, but are not limited to, valves, flanges and other connections, pumps and compressors, pressure relief devices, process drains, open-ended valves, pump and compressor seal system degassing vents, accumulator vessel vents, agitator seals, and access door seals.

1.2 Principle. A portable instrument is used to detect VOC leaks from individual sources. The instrument detector type is not specified, but it must meet the specifications and performance criteria contained in Section 3. A leak definition concentration based on a reference compound is specified in each applicable regulation. This procedure is intended to locate and classify leaks only, and is not to be used as a direct measure of mass emission rates from individual sources.

2. *Definitions*

2.1 Leak Definition Concentration. The local VOC concentration at the surface of a leak source that indicates that a VOC emission (leak) is present. The leak definition is an instrument meter reading based on a reference compound.

2.2 Reference Compound. The VOC species selected as an instrument calibration basis for specification of the leak definition concentration. (For example: If a leak definition concentration is 10,000 ppmv as methane, then any source emission that results in a local concentration that yields a meter reading of 10,000 on an instrument calibrated with methane would be classified as a leak. In this example, the leak definition is 10,000 ppmv, and the reference compound is methane.)

2.3 Calibration Gas. The VOC compound used to adjust the instrument meter reading to a known value. The calibration gas is usually the reference compound at a concentration approximately equal to the leak definition concentration.

2.4 No Detectable Emission. Any VOC concentration at a potential leak source (adjusted for local VOC ambient concentration) that is less than a value corresponding to the instrument readability specification of section 3.1.1(c) indicates that a leak is not present.

2.5 Response Factor. The ratio of the known concentration of a VOC compound to the observed meter reading when measured using an instrument calibrated with the reference compound specified in the application regulation.

2.6 Calibration Precision. The degree of agreement between measurements of the same known value, expressed as the relative percentage of the average difference between the meter readings and the known concentration to the known concentration.

2.7 Response Time. The time interval from a step change in VOC concentration at the input of the sampling system to the time at which 90 percent of the corresponding final value is reached as displayed on the instrument readout meter.

3. *Apparatus*

3.1 Monitoring Instrument.

3.1.1 Specifications.

a. The VOC instrument detector shall respond to the compounds being processed. Detector types which may meet this requirement include, but are not limited to, catalytic oxidation, flame ionization, infrared absorption, and photoionization.

b. Both the linear response range and the measurable range of the instrument for each of the VOC to be measured, and for the VOC calibration gas that is used for calibration, shall encompass the leak definition concentration specified in the regulation. A dilution probe assembly may be used to bring the VOC concentration within both ranges; however, the specifications for instrument response time and sample probe diameter shall still be met.

c. The scale of the instrument meter shall be readable to ±2.5 percent of the specified leak definition concentration when performing a no detectable emission survey.

d. The instrument shall be equipped with an electrically driven pump to insure that a sample is provided to the detector at a constant flow rate. The nominal sample flow rate, as measured at the sample probe tip, shall be 0.10 to 3.0 liters per minute when the probe is fitted with a glass wool plug or filter that may be used to prevent plugging of the instrument.

e. The instrument shall be intrinsically safe as defined by the applicable U.S.A. standards (e.g., National Electric Code by the National Fire Prevention Association) for operation in any explosive atmospheres that may be encountered in its use. The instrument shall, at a minimum, be intrinsically safe for Class 1, Division 1 conditions, and Class 2, Division 1 conditions, as defined by the example Code. The instrument shall not be operated with any safety device, such as an exhaust flame arrestor, removed.

f. The instrument shall be equipped with a probe or probe extension for sampling not to exceed ¼ in. in outside diameter, with a single end opening for admission of sample.

3.1.2 Performance Criteria.

(a) The instrument response factors for each of the VOC to be measured shall be less than 10. When no instrument is available that meets this specification when calibrated with the reference VOC specified in the applicable regulation, the available instrument may be calibrated with one of the VOC to be measured, or any other VOC, so long as the instrument then has a response factor of less than 10 for each of the VOC to be measured.

(b) The instrument response time shall be equal to or less than 30 seconds. The instrument pump, dilution probe (if any), sample probe, and probe filter, that will be used during testing, shall all be in place during the response time determination.

c. The calibration precision must be equal to or less than 10 percent of the calibration gas value.

d. The evaluation procedure for each parameter is given in Section 4.4.

3.1.3 Performance Evaluation Requirements.

a. A response factor must be determined for each compound that is to be measured, either by testing or from reference sources. The response factor tests are required before placing the analyzer into service, but do not have to be repeated at subsequent intervals.

b. The calibration precision test must be completed prior to placing the analyzer into service, and at subsequent 3-month intervals or at the next use whichever is later.

c. The response time test is required prior to placing the instrument into service. If a modification to the sample pumping system or flow configuration is made that would change the response time, a new test is required prior to further use.

3.2 Calibration Gases. The monitoring instrument is calibrated in terms of parts per million by volume (ppmv) of the reference compound specified in the applicable regulation. The calibration gases required for monitoring and instrument performance evaluation are a zero gas (air, less than 10 ppmv VOC) and a calibration gas in air mixture approximately equal to the leak definition specified in the regulation. If cylinder calibration gas mixtures are used, they must be analyzed and certified by the manufacturer to be within ±2 percent accuracy, and a shelf life must be specified. Cylinder standards must be either reanalyzed or replaced at the end of the specified shelf life. Alternately, calibration gases may be prepared by the user according to any accepted gaseous standards preparation procedure that will yield a mixture accurate to within ±2 percent. Prepared standards must be replaced each day of use unless it can be demonstrated that degradation does not occur during storage.

Calibrations may be performed using a compound other than the reference compound if a conversion factor is determined for that alternative compound so that the resulting meter readings during source surveys can be converted to reference compound results.

4. *Procedures*

4.1 Pretest Preparations. Perform the instrument evaluation procedures given in Section 4.4 if the evaluation requirements of Section 3.1.3 have not been met.

4.2 Calibration Procedures. Assemble and start up the VOC analyzer according to the manufacturer's instructions. After the appropriate warmup period and zero internal calibration procedure, introduce the calibration gas into the instrument sample probe. Adjust the instrument meter readout to correspond to the calibration gas value.

NOTE: If the meter readout cannot be adjusted to the proper value, a malfunction of the analyzer is indicated and corrective actions are necessary before use.

4.3 Individual Source Surveys.

4.3.1 Type I—Leak Definition Based on Concentration. Place the probe inlet at the surface of the component interface where leakage could occur. Move the probe along the interface periphery while observing the instrument readout. If an increased meter reading is observed, slowly sample the interface where leakage is indicated until the maximum meter reading is obtained. Leave the probe inlet at this maximum reading location for approximately two times the instrument response time. If the maximum observed meter reading is greater than the leak definition in the applicable regulation, record and report the results as specified in the regulation reporting requirements. Examples of the application of this general technique to specific equipment types are:

a. Valves—The most common source of leaks from valves is at the seal between the stem and housing. Place the probe at the interface where the stem exits the packing gland and sample the stem circumference. Also, place the probe at the interface of the packing gland take-up flange seat and sample the periphery. In addition, survey valve housings of multipart assembly at the surface of all interfaces where a leak could occur.

b. Flanges and Other Connections—For welded flanges, place the probe at the outer edge of the flange-gasket interface and sample the circumference of the flange. Sample other types of nonpermanent joints (such as threaded connections) with a similar traverse.

c. Pumps and Compressors—Conduct a circumferential traverse at the outer surface of the pump or compressor shaft and seal interface. If the source is a rotating shaft, position the probe inlet within 1 cm of the shaft-seal interface for the survey. If the housing configuration prevents a complete traverse of the shaft periphery, sample all accessible portions. Sample all other joints on the pump or compressor housing where leakage could occur.

d. Pressure Relief Devices—The configuration of most pressure relief devices prevents sampling at the sealing seat interface. For those devices equipped with an enclosed extension, or horn, place the probe inlet at approximately the center of the exhaust area to the atmosphere.

e. Process Drains—For open drains, place the probe inlet at approximately the center of the area open to the atmosphere. For covered drains, place the probe at the surface of the cover interface and conduct a peripheral traverse.

f. Open-Ended Lines or Valves—Place the probe inlet at approximately the center of the opening to the atmosphere.

g. Seal System Degassing Vents and Accumulator Vents—Place the probe inlet at approximately the center of the opening to the atmosphere.

h. Access Door Seals—Place the probe inlet at the surface of the door seal interface and conduct a peripheral traverse.

4.3.2 Type II—"No Detectable Emission".

Determine the local ambient concentration around the source by moving the probe inlet randomly upwind and downwind at a distance of one to two meters from the source. If an interference exists with this determination due to a nearby emission or leak, the local ambient concentration may be determined at distances closer to the source, but in no case shall the distance be less than 25 centimeters. Then move the probe inlet to the surface of the source and determine the concentration described in 4.3.1. The difference between these concentrations determines whether there are no detectable emissions. Record and report the results as specified by the regulation.

For those cases where the regulation requires a specific device installation, or that specified vents be ducted or piped to a control device, the existence of these conditions shall be visually confirmed. When the regulation also requires that no detectable emissions exist, visual observations and sampling surveys are required. Examples of this technique are:

(a) Pump or Compressor Seals—If applicable, determine the type of shaft seal. Preform a survey of the local area ambient VOC concentration and determine if detectable emissions exist as described above.

(b) Seal System Degassing Vents, Accumulator Vessel Vents, Pressure Relief Devices—If applicable, observe whether or not the applicable ducting or piping exists. Also, determine if any sources exist in the ducting or piping where emissions could occur prior to the control device. If the required ducting or piping exists and there are no sources where the emissions could be vented to the atmosphere prior to the control device, then it is presumed that no detectable emissions are present. If there are sources in the ducting or piping where emissions could be vented or sources where leaks could occur, the sampling surveys described in this paragraph shall be used to determine if detectable emissions exist.

4.3.3 Alternative Screening Procedure. A screening procedure based on the formation of bubbles in a soap solution that is sprayed on a potential leak source may be used for those sources that do not have continuously moving parts, that do not have surface temperatures greater than the boiling point or less than the freezing point of the soap solution, that do not have open areas to the atmosphere that the soap solution cannot bridge, or that do not exhibit evidence of liquid leakage. Sources that have these conditions present must be surveyed using the instrument techniques of 4.3.1 or 4.3.2.

Spray a soap solution over all potential leak sources. The soap solution may be a commercially available leak detection solution or may be prepared using concentrated detergent and water. A pressure sprayer or a squeeze bottle may be used to dispense the solution. Observe the potential leak sites to determine if any bubbles are formed. If no bubbles are observed, the source is presumed to have no detectable emissions or leaks as applicable. If any bubbles are observed, the instrument techniques of 4.3.1 or 4.3.2 shall be used to determine if a leak exists, or if the source has detectable emissions, as applicable.

4.4 Instrument Evaluation Procedures. At the beginning of the instrument performance evaluation test, assemble and start up the instrument according to the manufacturer's instructions for recommended warmup period and preliminary adjustments.

4.4.1 Response Factor. Calibrate the instrument with the reference compound as specified in the applicable regulation. For each organic species that is to be measured during individual source surveys, obtain or prepare a known standard in air at a concentration of approximately 80 percent of the applicable leak definition unless limited by volatility or explosivity. In these cases, prepare a standard at 90 percent of the saturation concentration, or 70 percent of the lower explosive limit, respectively. Introduce this mixture to the analyzer and record the observed meter reading. Introduce zero air until a stable reading is obtained. Make a total of three measurements by alternating between the known mixture and zero air. Calculate the response factor for each repetition and the average response factor.

Alternatively, if response factors have been published for the compounds of interest for the instrument or detector type, the response factor determination is not required, and existing results may be referenced. Examples of published response factors for flame ionization and catalytic oxidation detectors are included in Bibliography.

4.4.2 Calibration Precision. Make a total of three measurements by alternately using zero gas and the specified calibration gas. Record the meter readings. Calculate the average algebraic difference between the meter readings and the known value. Divide this average difference by the known calibration value and mutiply by 100 to express the resulting calibration precision as a percentage.

4.4.3 Response Time. Introduce zero gas into the instrument sample probe. When the meter reading has stabilized, switch quickly to the specified calibration gas. Measure the time from switching to when 90 percent of the final stable reading is attained. Perform this test sequence three times and record the results. Calculate the average response time.

5. *Bibliography*

1. DuBose, D.A., and G.E. Harris. Response Factors of VOC Analyzers at a Meter Reading of 10,000 ppmv for Selected Organic Compounds. U.S. Environmental Protection Agency, Research Triangle Park, NC. Publication No. EPA 600/2–81–051. September 1981.

2. Brown, G.E., et al. Response Factors of VOC Analyzers Calibrated with Methane for Selected Organic Compounds. U.S. Environmental Protection Agency, Research Triangle Park, NC. Publication No. EPA 600/2–81–022. May 1981.

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METHOD 22—VISUAL DETERMINATION OF FUGITIVE EMISSIONS FROM MATERIAL SOURCES AND SMOKE EMISSIONS FROM FLARES

1. *Introduction*

This method involves the visual determination of fugitive emissions, i.e., emissions not emitted directly from a process stack or duct. Fugitive emissions include emissions that (1) escape capture by process equipment exhaust hoods; (2) are emitted during material transfer; (3) are emitted from buildings housing material processing or handling equipment; and (4) are emitted directly from process equipment. This method is used also to determine visible smoke emissions from flares used for combustion of waste process materials.

This method determines the amount of time that any visible emissions occur during the observation period, i.e., the accumulated emission time. This method does not require that the opacity of emissions be determined. Since this procedure requires only the determination of whether a visible emission occurs and does not require the determination of opacity levels, observer certification according to the procedures of Method 9 are not required. However, it is necessary that the observer is educated on the general procedures for determining the presence of visible emissions. As a minimum, the observer must be trained and knowledgeable regarding the effects on the visibility of emissions caused by background contrast, ambient lighting, observer position relative to lighting, wind, and the presence of uncombined water (condensing water vapor). This training is to be obtained from written materials found in Citations 1 and 2 of Bibliography or from the lecture portion of the Method 9 certification course.

2. *Applicability and Principle*

2.1 Applicability. This method applies to the determination of the frequency of fugitive emissions from stationary sources (located indoors or outdoors) when specified as the test method for determining compliance with new source performance standards.

This method also is applicable for the determination of the frequency of visible smoke emissions from flares.

2.2 Principle. Fugitive emissions produced during material processing, handling, and transfer operations or smoke emissions from flares are visually determined by an observer without the aid of instruments.

3. *Definitions*

3.1 Emission Frequency. Percentage of time that emissions are visible during the observation period.

3.2 Emission Time. Accumulated amount of time that emissions are visible during the observation period.

3.3 Fugitive Emissions. Pollutant generated by an affected facility which is not collected by a capture system and is released to the atmosphere.

3.4 Smoke Emissions. Pollutant generated by combustion in a flare and occurring immediately downstream of the flame. Smoke occurring within the flame, but not downstream of the flame, is not considered a smoke emission.

3.5 Observation Period. Accumulated time period during which observations are conducted, not to be less than the period specified in the applicable regulation.

4. *Equipment*

4.1 Stopwatches. Accumulative type with unit divisions of at least 0.5 seconds; two required.

4.2 Light Meter. Light meter capable of measuring illuminance in the 50- to 200-lux range; required for indoor observations only.

5. *Procedure*

5.1 Position. Survey the affected facility or building or structure housing the process to be observed and determine the locations of potential emissions. If the affected facility is located inside a building, determine an observation location that is consistent with the requirements of the applicable regulation (i.e., outside observation of emissions escaping the building/structure or inside observation of emissions directly emitted from the affected facility process unit). Then select a position that enables a clear view of the potential emission point(s) of the affected facility or of the building or structure housing the affected facility, as appropriate for the applicable subpart. A position at least 15 feet, but not more than 0.25 miles, from the emission source is recommended. For outdoor locations, select a position where the sun is not directly in the observer's eyes.

5.2 Field Records.