APTD-1164

GUIDE TO ENGINEERING PERMIT PROCESSING

U.S. ENVIRONMENTAL PROTECTION AGENCY
Office of Air Programs
Stationary Source Pollution Control Programs
Research Triangle Park, North Carolina 27711

APTD-1164

GUIDE
TO
ENGINEERING PERMIT PROCESSING

Prepared by

Arnold Stein
Pacific Environmental Services, Inc.
2932 Wilshire Boulevard
Santa Monica, California 90403

for

System Development Corporation

EPA Contract No. CPA 70-122

Prepared for

ENVIRONMENTAL PROTECTION AGENCY
Office of Air Programs
Stationary Source Pollution Control Programs
Research Triangle Park, North Carolina 27711
July 1972

The APTD (Air Pollution Technical Data) series of reports is issued by the Environmental Protection Agency to report technical data of interest to a limited number of readers. Copies of APTD reports are available free of charge to Federal employees, current contractors and grantees, and nonprofit organizations - as supplies permit - from the Air Pollution Technical Information Center, Environmental Protection Agency, Research Triangle Park, North Carolina 27711 or from the National Technical Information Service, 5285 Port Royal Road, Springfield, Virginia 22151.

This report was furnished to the Environmental Protection Agency by the Pacific Environmental Services, Inc., Santa Monica, California in fulfillment of EPA Contract No. CPA 70-122. The contents of this report are reproduced herein as received from the Pacific Environmental Services, Inc. The opinions, findings, and conclusions expressed are those of the author and not necessarily those of the Environmental Protection Agency.

Publication Number APTD-1164

ACKNOWLEDGMENTS

Much of the information presented in this guide was obtained from interviews and material supplied by staff members of State and Local air pollution control agencies as a part of the field work performed under CPA 70-122, Task Order 2. The authors are particularly indebted to the following agencies and individuals:

New York State Department of Environmental Conservation

H.H. Hovey, Jr.
R.N. Cummings
R.K. Warland
S. Marlow
A. Risman
F. Austin

State of New York Department of Labor - Division of Industrial Hygiene

I. Kingsley

The City of New York, Department of Air Resources

A. Pieratti
J. Coyle
S.J. Pascual

State of Florida Department of Air and Water Pollution Control

G. Humbert
R.L. Peyton
F.S. Kleeman
E.E. Ellis
D.G. Frier
D. Scott

Metropolitan Dade County Pollution Control

H.J. Schmitz
A. Bagnato
D. Cox
E. Cahill

Kentucky Air Pollution Control Commission

F. Partee
J. Sullivan

Los Angeles County Air Pollution Control District

H. Simon
R.L. Weimer
W.C. Rogers
N.R. Shaffer

State of Illinois Environmental Protection Agency

J. Roberts
K.J. Conklin

City of Chicago, Department of Environmental Control

E.W. Linna
E.J. Petkus
T. Kason

State of New Jersey, Department of Environmental Protection

H. Wortreich
J. Bowe

The authors also wish to thank D. Forehand, N. Edmisten, and R. Morrison (project officer), EPA-OAP, Control Agency Procedures Branch for the individual guidance and assistance given in supplying the information required in the preparation of this guide.

FOREWORD

This first edition of the Guide to Engineering Permit Processing describes the development and administration of procedures that can be adopted to evaluate and to approve (or deny) the use of industrial equipment and processes that are capable of emitting contaminants into the general atmosphere.

The Guide treats the design and administration of permit systems, engineering evaluation of pollutant sources and equipment inspection procedures, and methods for acquiring and processing technical and legal information on the sources of air pollution.

The permit system is a major philosophy of control that goes to the heart of any conscientious effort to control air pollution. It is the principal means by which an air pollution control agency can systematically control the collective emissions of the stationary source population within its jurisdiction. It provides specific first-hand information on the performance of equipment and processes obtained from owners and operators that would not otherwise be available. It further establishes clear goals and procedures for enforcement personnel and owners and operators to follow in achieving the community air quality desired.

The feasibility and effectiveness of the permit system have been demonstrated by air pollution control agencies and other regulatory bodies that have administered similar systems for many years. At the same time, the concept of the permit system provides considerable latitude in designing systems that will meet the needs of environmental control agencies regardless of their size or resources available.

Mel Weisburd
Project Manager
CPA 70-122, Task Order 2

CONTENTS

Page

CHAPTER 1. THE PERMIT SYSTEM 1.1

I. INTRODUCTION 1.1

II. DEFINITION OF THE PERMIT SYSTEM. 1.2

III. OBJECTIVES OF THE PERMIT SYSTEM. 1.3

A. Compliance Plans 1.3
B. Emission Inventories 1.4

IV. COMPARISION OF SOURCE REGISTRATION AND PERMIT SYSTEM 1.5

A. Source Registration. 1.5
B. The Permit System 1.6
C. Selection of Source Approval Systems 1.7

V. PERMIT SYSTEM ALTERNATIVES 1.8

VI. MANPOWER NEEDED TO OPERATE A PERMIT SYSTEM 1.18

VII. PERMIT FEES 1.19

REFERENCES 1.23

CHAPTER 2. PERMIT PROCESSING STEPS 2.1

I. PROCESSING ELEMENTS OF THE SYSTEM 2.1

A. Notification to Owner or Operator. 2.1
B. Document Distribution. 2.4
C. Voluntary and Enforced Response 2.7
D. Receiving and Checking the Application 2.20
E. Engineering Review 2.20
F. Engineering Inspection 2.26
G. Permit Application Equipment Status 2.29
H. Issuance of the Permit 2.30
I. Informal Hearing 2.30
J. Hearing Board Decisions. 2.34
K. Court Decisions 2.36

		Page
II.	INTERFACES WITH OTHER CONTROL AGENCY FUNCTIONS	2.38
	A. Data Requirements	2.40
	B. Data Outputs	2.41
REFERENCES		2.42
CHAPTER 3.	DATA AND INFORMATION SYSTEMS	3.1
I.	INTRODUCTION	3.1
II.	SPECIFICATION OF INFORMATION SYSTEMS	3.1
III.	ELEMENTS OF THE SYSTEM	3.2
	A. Data Base Design	3.2
	B. Data Preparation	3.5
	C. Data Base Updates	3.6
	D. Data Retrieval	3.7
	E. Turnaround	3.8
	F. Documentation	3.9
IV.	DATA ELEMENTS	3.9
	A. Application Data Components	3.10
	B. Permit Classification and Unitization	3.11
	C. Classification of Equipment	3.14
	D. Additional Data Elements	3.15
V.	APPLICATION FORMS DESIGN	3.17
VI.	FILE STRUCTURE	3.27
	A. Manual File	3.27
	B. Automated Files	3.28
VII.	PERMIT PROCESSING INFORMATION SYSTEMS	3.29
	A. Special Purpose Software Programs	3.30
	B. KAPCIS	3.31
	C. Information Management Systems	3.35
	D. Available Systems	3.38
	E. Example of the Use of an Information Management System	3.39
VIII.	COMPUTER PROCESSING	3.50
	A. Batch Processing	3.50
	B. Time-Sharing	3.54

Page

C. Remote Batch 3.56

IX. DATA ENTRY SYSTEMS 3.57

A. Keypunching 3.58
B. Key-to-Tape Systems 3.60
C. Key-to-Disk 3.64
D. Optical Character Recognition Systems. 3.64

X. MICROFILM. 3.66

XI. COST-EFFECTIVENESS EVALUATION. 3.69

REFERENCES 3.73

CHAPTER 4. APPLICATION OF THE LEGAL PROHIBITION TO PERMIT PROCESSING 4.1

I. INTRODUCTION 4.1

II. NUISANCE 4.2

A. Odors 4.2
B. Material Deposits 4.3

III. EMISSION LIMITATIONS 4.4

A. Emission Standards 4.8
B. Equipment Standards 4.8
C. Process Standards. 4.10
D. Industry Standards 4.12
E. Zoning 4.13

REFERENCES 4.16

CHAPTER 5. ENGINEERING EVALUATION OF THE APPLICATION FOR PERMIT TO CONSTRUCT 5.1

I. INTRODUCTION 5.1

II. PERMIT APPLICATION HANDLING. 5.1

III. EVALUATION PROCEDURE 5.4

A. Basic Equipment and Operating Data 5.5
B. Description of the Air Pollution Control System 5.8

Page

IV. METHODOLOGY FOR EVALUATING A PERMIT TO CONSTRUCT. 5.9

A. Assessment of the Air Pollution Potential of the Basic Equipment or Processes. 5.9
B. Calculations 5.10

V. RECOMMENDATIONS AND CONCLUSIONS 5.17

VI. CONSULTATIONS TO REMEDY MINOR DEFECTS 5.18

VII. USE OF COMPUTERS FOR ENGINEERING CALCULATIONS 5.19

A. Introduction 5.19
B. Types of Systems 5.19
C. Prototype Mini-Computer System 5.21
D. Engineering Evaluation Diffusion Program 5.29
E. Incinerator Program 5.38

REFERENCES. 5.47

CHAPTER 6. EXAMPLES OF PERMIT REVIEWS. 6.1

I. INTRODUCTION 6.1

II. SAMPLE PROBLEMS 6.2

A. Sulfuric Acid Plant 6.2
B. Coal Fired Boiler with an Electrostatic Precipitator. . . 6.10
C. Lithograph Oven Venting to an Afterburner 6.22
D. Municipal Incinerator with an Electrostatic Precipitator. 6.26
E. Baghouse for a Cement Kiln. 6.33
F. Asphaltic Concrete Batching Plant Served by a Multiple-Cyclone and Baghouse. 6.38
G. Brass Reverberatory Furnace and Baghouse. 6.44
H. Grey Iron Cupola and Baghouse 6.50
I. Gasoline Storage and Transfer System. 6.59
J. Two Dry Rendering Cookers Venting to a Contact Condenser and Vapor Incinerator 6.69
K. Triple Superphosphate Plant 6.74
L. Ammonium Nitrate. 6.81
M. Sewage Sludge Incinerator 6.86

III. SPECIAL FORMS FOR PROCESSING PERMIT APPLICATIONS. 6.90

A. Storage Tanks 6.90
B. Exhaust Systems 6.90
C. Industrial Processes 6.94

Page

IV. PROTOTYPE COMPUTER ASSISTED CALCULATION PACKAGE. 6.94

REFERENCES 6.109

CHAPTER 7. ENGINEERING INSPECTION OF EQUIPMENT FOR CERTIFICATE TO OPERATE 7.1

I. INTRODUCTION 7.1

II. ENGINEERING INSPECTION REPORT. 7.1

A. Preparing for the Inspection 7.3
B. Basic Information Recorded During the Inspection 7.4
C. Description of Equipment 7.5
D. Process Description and Discussion 7.6
E. Detail Points of Emissions 7.10
F. Estimate of Emissions and Discussion of Observation. . . 7.11
G. Recommendations for Source Testing 7.12
H. Conclusions and Recommendations 7.14
I. Field Inspection Forms 7.15

REFERENCES 7.21

APPENDIX 1. WORK UNITS FOR PERMIT PROCESSING

APPENDIX 2. JOB AND TASK ANALYSIS OF THE NEW YORK CITY DEPARTMENT OF AIR RESOURCES

APPENDIX 3. EXCERPTS OF RULES AND REGULATIONS APPLICABLE TO THE PERMIT SYSTEM

LIST OF FIGURES

		Page
Figure 1.1.	Schematic Reproduction of Analysis for Engineering Manpower for a Permit System	1.9
Figure 1.2.	Alternatives for State Permit Systems	1.12
Figure 1.3.	State of New Jersey - Department of Environmental Protection	1.13
Figure 1.4.	Typical Division of Responsibilities Between State and Local Air Pollution Control Agencies	1.14
Figure 1.5.	Typical Organization Chart for a Local Governmental Air Pollution Agency	1.17
Figure 1.6.	Generalized Distribution of Functional Activities for Regulatory Agencies Anticipated for 1974	1.20
Figure 1.7.	City of Chicago Air Pollution Equipment Permit Fee Information	1.22
Figure 2.1.	Permit System Processing Elements	2.2
Figure 2.2	Agency Letter Mailed with Application Forms	2.6
Figure 2.3.	Permit Application Information	2.8
Figure 2.4.	Application for the Approval of an Exhaust System Plan	2.10
Figure 2.5.	Instructions for Filing an Exhaust System Plan	2.12
Figure 2.6.	Application for Permit to Construct	2.14
Figure 2.7.	Instructions for Filing a Permit to Construct	2.16
Figure 2.8.	Application for Certificate to Operate	2.18
Figure 2.9.	Instructions for Filing a Certificate to Operate	2.19
Figure 2.10.	Steps in Receiving and Checking in a Permit Application	2.21
Figure 2.11.	Letter Requesting Additional Information	2.22
Figure 2.12.	Steps in the Engineering Review Process	2.24
Figure 2.13.	Plan Disapproval Letter	2.25
Figure 2.14.	The Engineering Inspection Process	2.27
Figure 2.15.	Sample Permit to Construct	2.31
Figure 2.16.	Sample Certificate to Operate (City Agency)	2.32
Figure 2.17.	Sample Certificate to Operate (State Agency)	2.33
Figure 2.18.	Information Flow in an Air Pollution Control Agency	2.39

Page

Figure 3.1.	Permit System Data Base	3.4
Figure 3.2.	Special Application Form for Storage Tanks	3.18
Figure 3.3.	General Application Form	3.20
Figure 3.4.	Special Instructions Sheet for Completing Storage Tank Application Form	3.21
Figure 3.5.	General Instructions for Completing Application Forms	3.22
Figure 3.6.	Application Form Compatible with Data Processing	3.25
Figure 3.7.	Example of a Specific Record Retrieval	3.34
Figure 3.8.	Example of a File Scan Retrieval	3.36
Figure 3.9.	Specific Data Retrieval	3.40
Figure 3.10.	Logical Data Retrievals	3.43
Figure 3.11.	Statistical Data Retrieval	3.45
Figure 3.12.	Report Generation	3.47
Figure 3.13.	Sample Report	3.48
Figure 3.14.	A Single-Task Batch Processing System	3.51
Figure 3.15.	A Multiple-Task Batch Processing System	3.53
Figure 3.16.	Operation of Typical Keypunch Data Entry System	3.59
Figure 3.17.	Operation of Typical Key-to-Tape Data Entry System	3.62
Figure 3.18.	Operation of a Complete Key-to-Tape Data Preparation and Entry System	3.63
Figure 3.19.	Operation of a Complete Key-to-Disk Data Preparation and Entry System	3.65
Figure 3.20.	Operation of an OCR Data Entry System	3.67
Figure 3.21.	System Capabilities Check-Off List	3.70
Figure 5.1.	Background to Escape Velocity and Exhaust Rate Problem with Manual Type Solution	5.23
Figure 5.2.	Escape Velocity and Exhaust Rate Computer Program in BASIC	5.25
Figure 5.3.	Flowchart of Program to Find Exhaust Rate and Escape Velocity from a Hood	5.26
Figure 5.4.	Computer Program Execution to Calculate the Escape Velocity and Exhaust Rate of Hood--Modified to Reduce Input/Output Time	5.28

		Page
Figure 5.5.	Alternate Version of BASIC Computer Program to Calculate the Escape Velocity and Exhaust Rate of a Hood	5.30
Figure 5.6.	Computer Program Execution of Calculation of Escape Velocity and Exhaust Rate of Hood	5.31
Figure 5.7.	Horizontal Dispersion Coefficient as a Function of Downwind Distance from the Source	5.35
Figure 5.8.	Vertical Dispersion Coefficient as a Function of Downwind Distance from the Source	5.36
Figure 5.9.	Diffusion Program Flowchart	5.39
Figure 5.10.	Flow of PIF2 Subroutine	5.40
Figure 5.11.	Installation Permit Application for Incinerators	5.42
Figure 5.12.	Incinerator Evaluation Computer Program	5.44
Figure 5.13.	Computer Print-out of Incinerator Evaluation Program	5.46
Figure 6.1.	Schematic Flow Diagram Dual Absorption Contact H_2SO_4	6.3
Figure 6.2.	Schematic of Exhaust System and Electrostatic Precipitator Serving a Coal Fired Boiler	6.11
Figure 6.3.	Relationship Between Collection Efficiency and Collecting Surface Area to Gas Flow Ratio for Various Coal Sulfur Contents	6.16
Figure 6.4.	Variation in Precipitation Rate Parameter with Sulfur Content of the Coal	6.17
Figure 6.5.	Relationship Between Collection Efficiency and Corona Power for Fly Ash Precipitators (test result)	6.19
Figure 6.6.	Variation in Efficiency with Degree of Sectionalization	6.20
Figure 6.7.	Schematic Flow Diagram of Air Pollution Control System for Lithograph Oven	6.23
Figure 6.8.	Flow Schematic for an Exhaust System with Electrostatic Precipitator Serving a Municipal Incinerator	6.28
Figure 6.9.	Variation in Precipitation Rate Parameter with Gas Temperature for Municipal Incinerator Precipitators	6.30
Figure 6.10.	Relationship Between Collection Efficiency and Delivered Corona Power for Municipal Incinerators	6.32
Figure 6.11.	Flow Schematic of an Exhaust System and Baghouse for a Cement Kiln	6.34

Page

Figure 6.12. Flow Schematic of Exhaust System for a Baghouse Serving a Hot Asphalt Plant 6.40

Figure 6.13. Exhaust System Schematic for a Baghouse Serving a Brass Furnace 6.46

Figure 6.14. Dust & Fume Collection System for Grey Iron Cupola 6.51

Figure 6.15. Schematic Flow Diagram of a Vaporsaver Unit used for Recovery of Loading Rack Vapors at a Bulk Gasoline Terminal 6.60

Figure 6.16. Schematic of Condenser & Afterburner Serving two Dry Rendering Coolers 6.70

Figure 6.17. Continuous Process for the Manufacture of Granular Triplesuperphosphate 6.75

Figure 6.18. Flow Diagram for Manufacture of Ammonium Nitrate 6.82

Figure 6.19. Flow Sheet of a Typical Plant with Multiple Hearth Incinerator 6.87

Figure 6.20. Processing Form for Gasoline Storage Tanks 6.91

Figure 6.21. Processing Form for Exhaust Systems 6.92

Figure 6.22. Resistance and Air Flow Values for Exhaust Systems 6.93

Figure 6.23. Application Form for Industrial Processes 6.95

Figure 6.24. Program Listing - Computer Assisted Calculated Package 6.97

Figure 6.25. Input Sheet for Prototype System 6.102

Figure 6.26. Flowchart - Computer Assisted Calculated Package 6.103

Figure 6.27. Prototype Equipment Evaluation Package 6.106

Figure 7.1. Flowchart of Engineering Inspection for Certificate to Operate 7.2

Figure 7.2. Schematic of Hot Asphalt Batch Plant 7.7

Figure 7.3. Field Report Form, Dust and Fumes, Los Angeles County Air Pollution Control District 7.17

Figure 7.4. Field Report Form, Opacity Reading, Los Angeles County Air Pollution Control District 7.18

Figure 7.5. Field Report Form, Spray Booths, Los Angeles County Air Pollution Control District 7.19

Figure 7.6. Field Report Form, Degreaser, Los Angeles County Air Pollution Control District 7.20

LIST OF TABLES

		Page
Table 2.1.	Equipment Status Types and Possible Agency Requirements	2.29
Table 3.1.	Information Management Systems	3.39
Table 4.1.	Emission Limits Attainable by Available Technology	4.5
Table 4.2.	Process Weight Table	4.9
Table 5.1.	Permit System Activity Chart	5.2
Table 5.2.	Item Descriptions for Escape Velocity and Exhaust Rate Computer Program	5.27
Table 5.3.	Key to Stability Classes	5.37

CHAPTER 1

THE PERMIT SYSTEM

I. INTRODUCTION

The attainment of a desired level of air quality depends on the reduction of air contaminant emissions that contribute to the existing air quality. The methods available to reduce these emissions are limited to three broad types of administrative functions: enforcement of rules and regulations, implementation of source registration and source approval systems, and promotion of voluntary control by the owners and operators of the sources of air pollution.

The effectiveness of these methods depends on implementing them in ways that will assure that emission abatement is accomplished in a comprehensive and systematic manner and with minimum uncertainty. This requirement presents problems for control agencies that are responsible for regulating large and variable source populations, particularly in communities undergoing rapid growth.

The promotion of voluntary control through information and education activities, while important, is too slow and uncertain a process to be counted on in meeting implementation plan schedules. Code enforcement through source registration, compliance scheduling, field surveillance and inspection is essential, but by itself does not ensure systematic, comprehensive compliance, or the solution of complex engineering problems that may be at the heart of many cases of noncompliance.

The permit system is specifically intended as a systematic means of not only achieving mass compliance, but, just as important, preventing the future growth in contaminant emissions. The permit system is a method which accounts for all factors (e.g., design, operation, maintenance, and administrative) that must be considered in controlling any given source of air pollution.

II. DEFINITION OF THE PERMIT SYSTEM

The permit system provides for review of plans for construction, modification or operation of stationary source equipment or processes that have the potential to emit air contaminants. An application for a permit from an owner is required in advance of construction or operation of the equipment or process. The application provides the information necessary to evaluate the potential emissions from the equipment. Permits (or certificates) to construct or to operate are issued if, after thorough evaluation, inspection and source testing, it can be demonstrated that emissions will meet the standards of the agency throughout anticipated ranges and conditions of equipment operation. In some instances, permits are conditioned to assure that certain operational and maintenance practices are adhered to in the routine operation of the equipment.

The distinguishing features of permit systems are: (1) the clearly defined authority such systems have over the construction and operation of all equipment capable of emitting air contaminants; (2) the clarity and specifici of the standards that must be complied with and the procedures that owners must follow in submitting applications; and (3) the amount and type of technical information that must be supplied by the owner of affected equipment to permit source evaluation and to assure compliance with regulations.

Marked reductions in emissions from stationary sources have occurred wherever permit systems have been implemented. The State of New Jersey, for example, reported an estimated reduction of 445 thousand tons per year of particulates 213 thousand tons per year of sulfur compounds, and 178 thousand tons per year of solvents, vapors, acids, and other contaminants over the period June 1967 to December 1968.[1] These values are based upon estimates of contaminant that would have been emitted into the atmosphere from new or modified equipment without the installation of controls obtained through the application of a permit system.

Precedent for permit systems may be found in the building codes instituted by legislatures as safety checks, and by zoning departments to regulate building use, styles and exterior design. These codes are based on either performance or specification standards. (Performance standards are result-oriented and specification standards are design-oriented.) Either approach may form the basis for an air pollution control plan to review and regulate stationary sources.

Permit and plan review systems have been conducted by several air pollution control agencies for many years. Recently, a number of states have begun to develop or expand systems of this type. In recognizing the effectivenes of this approach, the Environmental Protection Agency has required that agencies obtain authority to "prevent construction, modification or operation of any stationary source at any location where emissions from such sources will prevent the attainment or maintenance of national standards."[2]

III. OBJECTIVES OF THE PERMIT SYSTEM

In addition to preventing the installation of equipment with inadequate air pollution controls, permit systems serve to develop and maintain a comprehensive data base which provides an invaluable inventory of companies, equipment, processes, emissions and design information, serves as a source for data verification, and ensures the implementation of source reduction programs. The primary objectives of the system are:

A. Compliance Plans

The permit system is a mechanism for achieving compliance with the standards of the air pollution control agency and monitoring progress made in controlling stationary sources. Compliance plans are negotiated documents, agreed to by an industrial establishment and an air pollution control agency, which schedule the operating changes and equipment modifications necessary to bring the plant within emission limits. Such plans call for a schedule of milestones to modify or replace equipment, or change operating procedures. These comprise the "critical path" to emission reduction. The permit system thus provides the legal authority and administrative and engineering evaluation procedures for assuring the desired end result.

The negotiated compliance plan procedure is likely to be employed in the early stages of agency development. It may be used either independent of, or in conjunction with, a permit system. Where permit systems are employed, the negotiated compliance plan procedure may be phased out after major existing sources have been brought under control. Thereafter, the permit system and routine enforcement serve all future compliance and emission prevention functions.

B. Emission Inventories

Permit systems are employed to provide the most authoritative data available for the preparation of emission inventories. These data include, for example:

- Recorded fuel usage by specification and quantity;
- Estimated emission rates of particulates, gases and vapors;
- Actual emission rates from stack tests;
- Production rates, throughput or process weights;
- Location of equipment (address, grid, etc.); and
- Hours of day and days of week equipment is in operation.

The emissions inventory defines the magnitude of the problem both by category of pollutant and by the types of stationary sources that must be controlled to meet agency standards.

IV. COMPARISON OF SOURCE REGISTRATION AND PERMIT SYSTEMS

The permit system, when fully implemented, should serve as both a source registration and a compliance approval system. The permit system, however, should be distinguished from source registration procedures. The latter may be conducted as an independent operation, or may be expanded to serve as an alternative to a fully developed permit system.

A. Source Registration

Source registration is the process of identifying, listing and classifying all commercial and industrial establishments that carry on operations that may emit air contaminants. This is usually accomplished by a questionnaire mailed to the owners of establishments that are of interest to the Control agency. It is conducted for the purpose of assessing the air pollution problems of an area and makes available information about individual facilities such as the nature of business, ownership, number of employees, fuel use, refuse disposal practices, types of equipment capable of emitting air contaminants, and types and quantities of materials processed.

Source registration may be conducated as a one-time activity, that is, registration questionnaires may be sent out once, and follow-up letters sent to realize a satisfactory level of return. Thereafter, registration data may be updated or expanded either through inspection of facilities by enforcement officers, or through the eventual institution of a permit system, which then in effect continues the registration and approval functions.

The registration procedure results in a data base describing every significant source of air pollution in an area administered by an agency. Subsequent inspections and stack tests of the equipment verify that the source meets prescribed performance standards. If the equipment is in compliance, only periodic inspection need be conducted to determine that the equipment is properly maintained and continues to meet the agency's standards. If the equipment does not meet the standards, a schedule for bringing the equipment into compliance is mandatory. The agency then evaluates the schedule and monitors the progress made in meeting it. An agency employing a source registration system will not need an engineering staff as large as that which would be required by a permit system since the source registration staff, in effect, serves mainly as a consultant to industry.

B. The Permit System

The permit system, on the other hand, concentrates on specific problems arising from a particular air pollution control requirement. While the responsibility for compliance remains with the applicant, air pollution control expertise from within the agency can assist the applicant in design decisions. For example, plan evaluation will reduce the possibility of the installation of equipment incapable of meeting agency standards and will identify design and conceptual faults if they exist.

Air pollution control agencies may adopt one of two basic types of permit systems: (1) permit to construct and a certificate to operate or (2) certificate to operate only.

Where only a certificate to operate is issued, the permit to construct is replaced by the submittal of an "intent to construct." This document puts the agency on notice that new equipment is to be installed in its jurisdiction and provides the agency with an opportunity to apply for injunctive relief in cases where outlawed equipment may be installed. In this system, the owner/operator must agree to comply with agency standards and source tests should be performed, as needed, to ensure compliance. In all cases, a final inspection by an engineer from the air pollution control agency is mandatory.

C. Selection of Source Approval Systems

The primary criteria as to the type of source approval system that is to be employed depends on the need for plan review and source evaluation, and the degree to which these are to be conducted. Air quality requirements are the determining factors. Communities which are currently experiencing or have potential to experience unacceptable air quality, and which have a large and variable source population and many types of air pollution problems, will require some type of plan review system in order for control programs to be effective. The requirement for plan review is stated in the Federal Register, Vol. 36, No. 158, 8/14/71.[3]

While the size of an agency that uses the permit system is a factor in selecting the type of system to be used, it is not the overriding consideration. The Bay Area Air Pollution Control District (California) is responsible for a large land area that contains many diverse industrial establishments. This agency does not issue permits but uses the source registration method for industrial compliance with its standards.

The selection of the system most advantageous to an agency will be based on the following:

- Anticipated workload of permits resulting from enforcement of statutes and regulations;
- Scheduled deadlines for compliance;
- Trained manpower available;
- Agency budget; and
- Agency priorities for enforcement, source testing, and permit processing.

The anticipated workload of permit applications can be closely estimated from source registration and emissions inventory data. This will also provide the number of applications for specific processes that can be expected in a given time frame. Figure 1.1 is a schematic representation of an analysis of resources required to operate a permit system.

The Los Angeles County Air Pollution Control District has devised a method of determining engineering manpower requirements based on a correlation of the number of "work units" required to process a corresponding number of "permit units" associated with the issuance of authorities to construct (A/C) and permits to operate (P/O). Through years of experience the work unit was found to be equivalent to 1300 work units/man-year of engineering time. Appendix 1 contains the work units for specific types of equipment for issuing a permit to construct or a certificate to operate.

For agencies with little experience in estimating the resources required for a total control program, a workshop publication "Resources for Air Quality Regions"[4] offers an approach using predictors and manpower factors as a complete program planning device.

Manpower requirements vary with the systems used and depth of the review and analysis required. During peak workload conditions, New York City has found it advantageous to use consultant engineering firms to process permit applications under strict supervision of the air pollution control agency.

V. PERMIT SYSTEM ALTERNATIVES

An emission inventory is a starting point in examining the extent and severity of air pollution problems in a defined area. A detailed inventory should describe the major sources of pollution by type and location

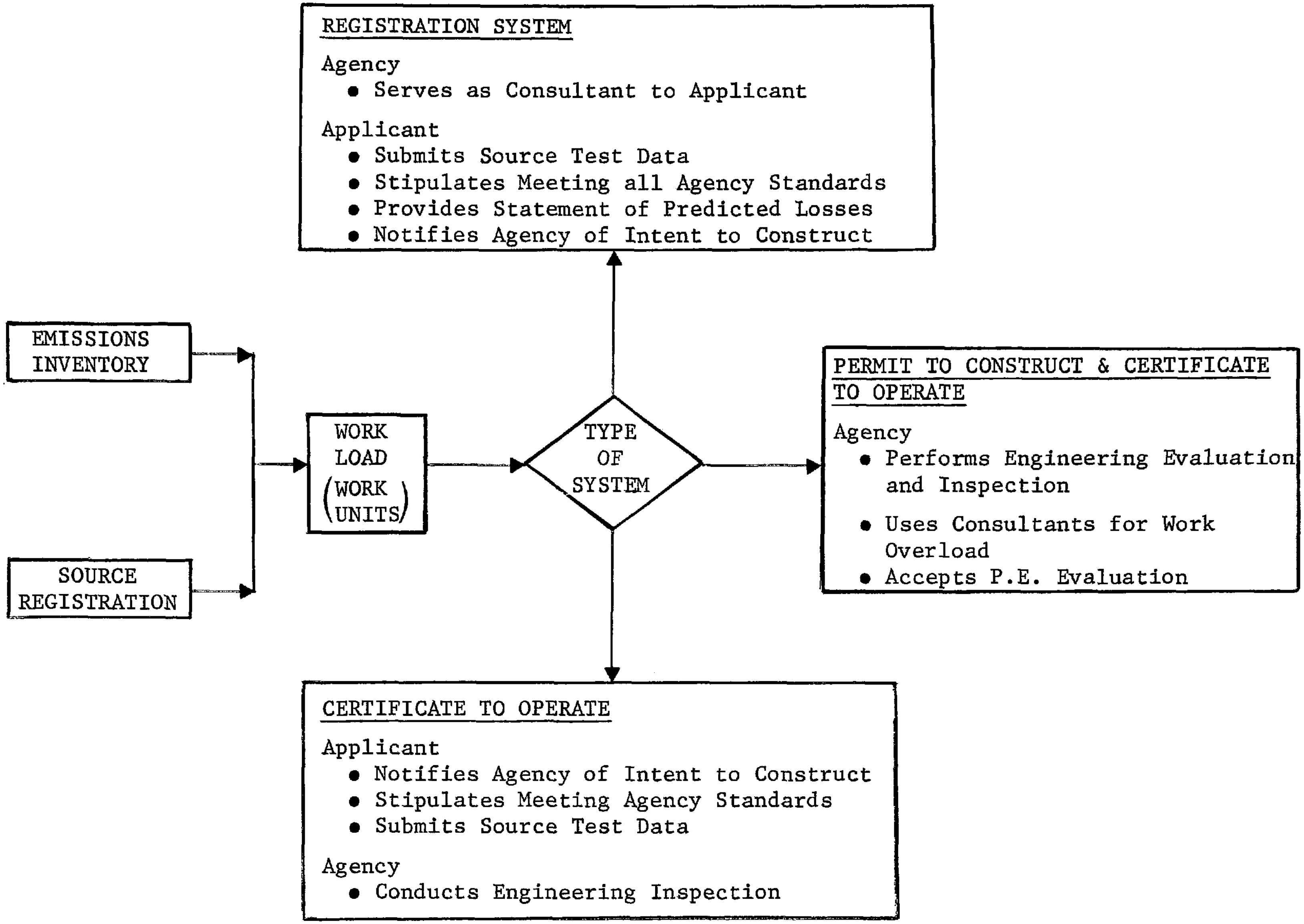


Figure 1.1. Schematic Reproduction of Analysis for Engineering Manpower for a Permit System

(grid area), annual and seasonal emission rates by pollutant, estimates of total fuel usage including automotive fuels, and the relative weights of pollutants emitted in geographic sub-areas of a community.[5] Comprehensive air monitoring and meteorological data gathering are also necessary in assessing special geographic and weather conditions which may affect the air pollution problem of a region.

The interrelationship of air quality data, meteorological data, and emissions inventory data [defined in such mathematical models as the Air Quality Implementation Planning Program (IPP),[6] Air Quality Display Model (AQDM)[7] and Reactive Environmental Simulation Model (REM)[8]] provide the basis for defining control priorities and strategies and the plans for implementing them.

A principal method of fulfilling the objectives of the implementation plan is to employ a permit system. The factors to be considered in determining the need for such a system are:

- Extent and severity of air pollution problems;
- Number and severity of specific source problems;
- Air pollution control standards to be attained;
- The extent and character of the source population;
- Geographic size of the air pollution control jurisdiction;
- Population, population density and population growth;
- Meteorological and topographical conditions affecting pollution accumulation;
- Organizational capabilities, manpower availability and other resources;
- Multi-agency cooperation; and
- Involvement of adjacent jurisdictions.

Since state agencies are responsible for preparation, adoption, and submittal of implementation plans under the Clean Air Act (including the plan review responsibility), several alternative organizational structures, taking into account the above factors, are available for the operation of permit systems. Figure 1.2 illustrates the following alternative systems:

Alternative 1a - Delegate the complete responsibility for the permit system to the local agency which will report specific information to the State Agency.

Alternative 1b - Delegate the responsibility to local agencies for issuing permits for "minor" sources. These must be clearly defined according to capacity, heat input, process weight, etc.

Alternative 2 - The State retains direct responsibility for the permit system while regional offices issue permits to construct and certificates to operate, conduct final engineering inspections, and maintain records.

Alternative 3 - The State agency's main office processes the application, issues the permit to construct, and requests the field offices to perform the final engineering inspection. The certificate to operate is then issued by the main office.

In some states, local agencies that have been operating for many years have complete functioning permit systems. In these cases, the imposition of a state system would be redundant. As long as the local requirements for the issuance of a certificate to operate are equal to or exceed the state standards, only a reporting function from the local agency to the state is necessary.

The structure of the State of New Jersey Environmental Protection Agency, which is representative of the structure of state organizations for pollution control, is shown in Figure 1.3. Figure 1.4 depicts the typical

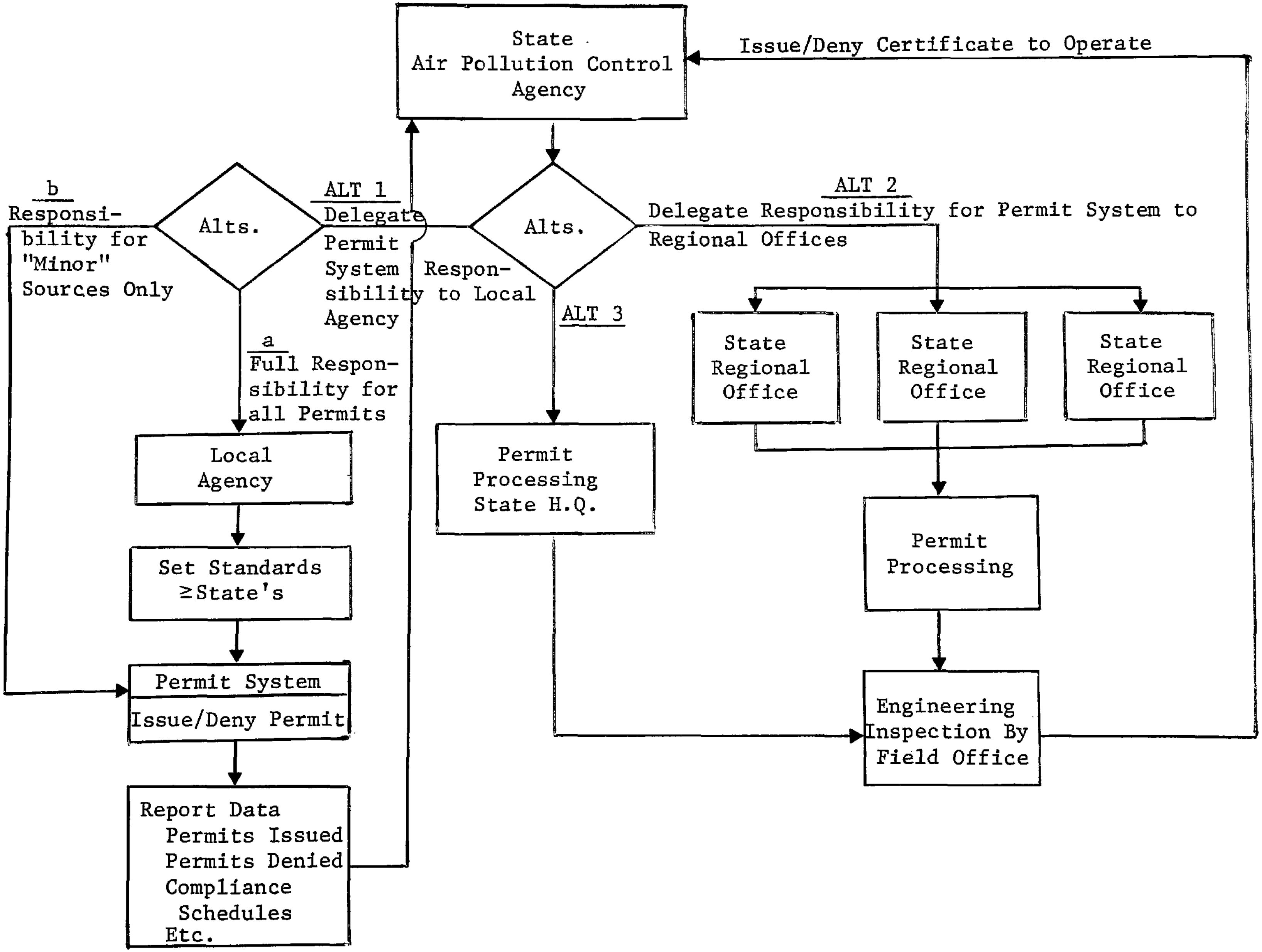


Figure 1.2. Alternatives for State Permit Systems

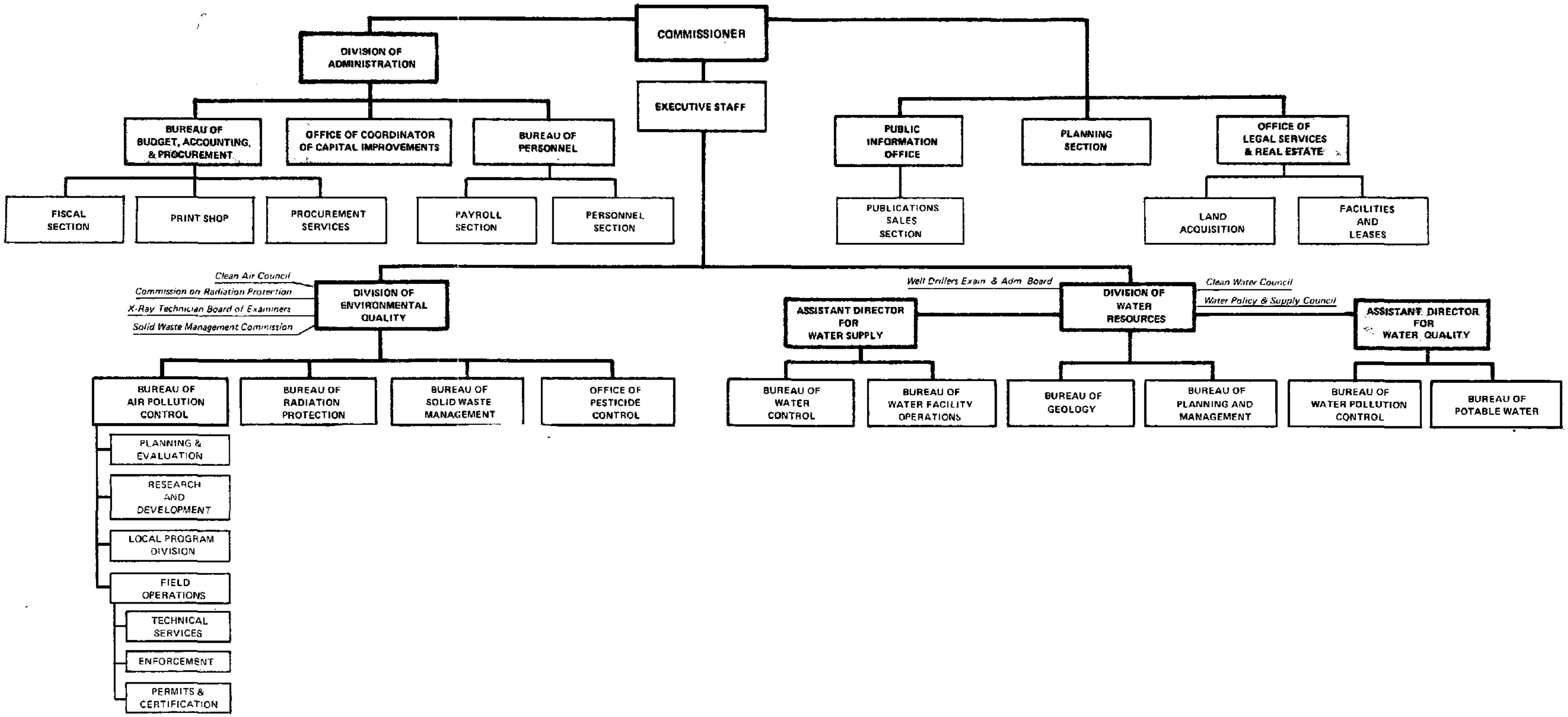


Figure 1.3. State of New Jersey - department of environmental protection (source: reference 9)

STATE AGENCY	LOCAL AGENCY
- Possesses legal authority to implement a plan for attainment of air quality objectives.	- Possesses legal authority necessary to implement any portion of the state control plan.
- Prepares statewide standards and regulations.	- Adopts standards and regulations consistent with, or more stringent than, those of the state.
- Prepares emergency episode action procedures.	- Enforces state approved emergency procedures within local jurisdiction.
- Assigns responsibilities to other governmental agencies (e.g., fire, police, and planning departments) to carry out portions of the control plan.	- Develops cooperative agreements with other local government agencies to carry out control responsibilities.
- Enforces statewide standards and regulations.	- Enforces appropriate state or local regulations.
- Institutes legal action where local action is deficient or unauthorized;	
- Provides legal assistance to local agencies where necessary to support local enforcement action.	- Initiates legal action to support enforcement and abatement needs.
- Develops a statewide program for source compliance.	- Develops compliance schedules with local sources in accordance with state policy and procedures.
- Defines compliance schedule policy and monitors for adequate implementation.	- Monitors local sources for progress in achieving compliance.
- Develops and implements a statewide permit system of operation.	- Operates or assists the state in the operation of the permit system.
- Develops and maintains a statewide emission inventory.	- Develops & maintains emission inventory and provides local source emission data.
- Coordinates statewide complaint handling activities.	- Provides local complaint handling service.

Figure 1.4. Typical division of responsibilities between state and local air pollution control agencies (sheet 1 of 2)

STATE AGENCY	LOCAL AGENCY
- Operates a statewide air surveillance system.	- Operates a local air surveillance system in accordance with the state plan.
- Provides statewide laboratory services.	- Provides local laboratory services to the extent authorized by state agency.
- Assures consistency of all analytical and calibration procedures in state and local laboratories.	
- Conducts source testing on a statewide basis.	- Conducts source tests or provides assistance to state source test efforts.
- Prepares statewide diffusion climatologies and meteorological summaries.	- Collects and analyzes meteorological data in accordance with state and local needs.
- Provides meteorological consultation.	
- Develops and maintains statewide data handling system which facilitates the retrieval of pertinent data for all program operations.	- Operates local data handling system compatible with state system.

Figure 1.4. Typical division of responsibilities between state and local air pollution control agencies (sheet 2 of 2) (source: reference 10)

division of responsibilities among state and local agencies. A productive relationship, illustrating the cooperation between the State of New Jersey Bureau of Air Pollution Control and local building departments, has been achieved. The State has requested that building permits, certificates of occupancy and other approvals be issued only after proof of possession of a valid permit to construct or certificate to operate, granted by the Bureau, has been established.

The structure of a typical local agency is depicted by the organization chart shown in Figure 1.5. Descriptions of the responsibilities of the major subdivisions are:

- Technical Services Division

  This unit monitors the atmosphere, gathers data, forecasts pollution conditions, provides laboratory services, and manages and evaluates the agency data.

- Field Services Division

  This unit is charged partially or wholly with all duties connected with surveillance, plant inspection, enforcement, citizen complaints, and emergencies.

- Engineering Division

  Engineering personnel are required to handle registration of the sources of air pollution, source testing, and evaluation of equipment design, operation, and emissions. If the sources of air pollution in the region are large in number and a permit or licensing system is employed, then a distinct engineering unit must be utilized to review plans and specifications in order to determine the degree of compliance with the standards. Where the industrial complex of a community is not extensive, engineering and inspection functions can be integrated.

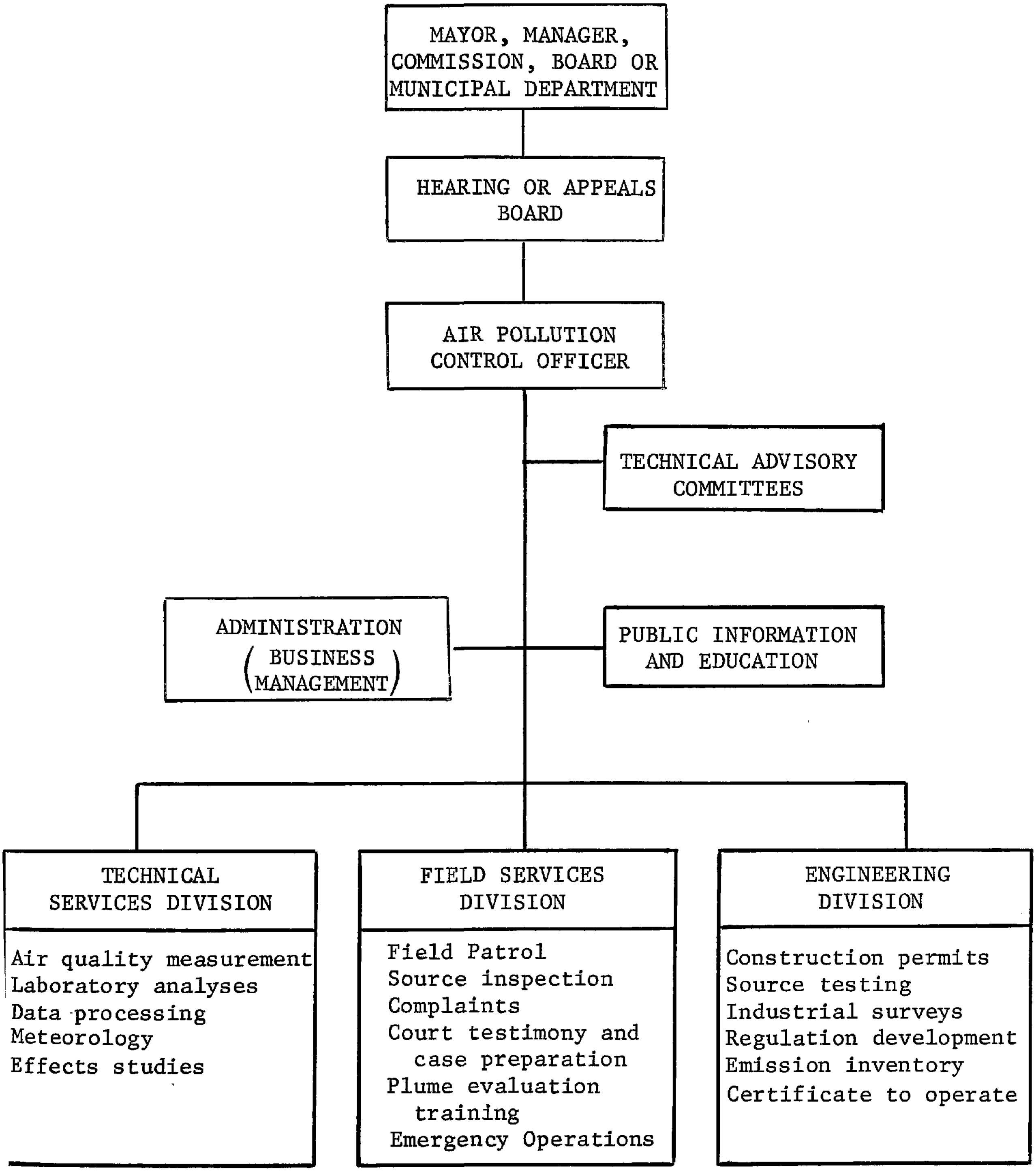


Figure 1.5. Typical organization chart for a local governmental air pollution agency (source: reference 11 - modified)

VI. MANPOWER NEEDED TO OPERATE A PERMIT SYSTEM[12]

The operation of a permit system depends upon the interrelated functions of administration, evaluation of permit to construct, and evaluation of certificates to operate. Manning these functions will utilize the skills represented by the following:

Administration

- Technical supervision to guide and schedule the efforts of the engineering staff;
- Business management to prepare budgets, supervise clerical and secretarial staff and general office management duties; and
- Systems analysts and programmers to provide support for the installation and maintenance of systems and procedures, both manu and automated, for efficient management of the comparatively large volume of information generated by the permit system.

Evaluation for Permit to Construct

- Experienced engineers to provide technical expertise and supervision for organizational units which process permit applicatio
- Graduate chemical, mechanical or civil (sanitary) engineers to evaluate permit applications; and
- Junior engineers or technicians with two or more years of college training to evaluate permit applications for equipment not requiring complicated analysis.

Evaluation for Certificates to Operate

- Graduate engineers, chemists and experienced technicians to perform source tests and chemical analysis of samples;
- Technicians to operate and maintain testing equipment; and
- Field enforcement personnel for surveillance and monitoring of industrial operations.

The workload of the agency is the only criterion by which the number of individuals in each skill category necessary to support the operation of a permit system may be measured. The Los Angeles County Air Pollution Control District, for example, has seven permit application processing units, two source testing units, an engineering projects unit, and a permit application receiving unit. The latter assists applicants in the proper preparation of permit application forms. Each unit has a senior air pollution control engineer (who is either a registered mechanical or chemical engineer), an intermediate air pollution engineer and four to six graduate engineers.[13]

The job and task analysis[14] of the New York City Department of Air Resources, shown in Appendix 2, is an example of a comprehensive study of a permit processing activity. The summary of engineering positions from this study shows a skills index similar to that of Los Angeles County. Supervisory classifications call for registered professional engineers, with the lower grades requiring a B.S. degree in engineering. The distribution of manpower resources that will be required by an effective air pollution control agency by 1974 is shown in Figure 1.6.

VII. PERMIT FEES

Funds to support an organization to operate a permit system should emanate, partially, or in full, from revenue received from permit fees. It must be recognized that the services provided by the permit system are designed to aid the applicant by providing expertise in the selection and operation of air pollution control equipment, as well as to enforce air pollution control regulations.

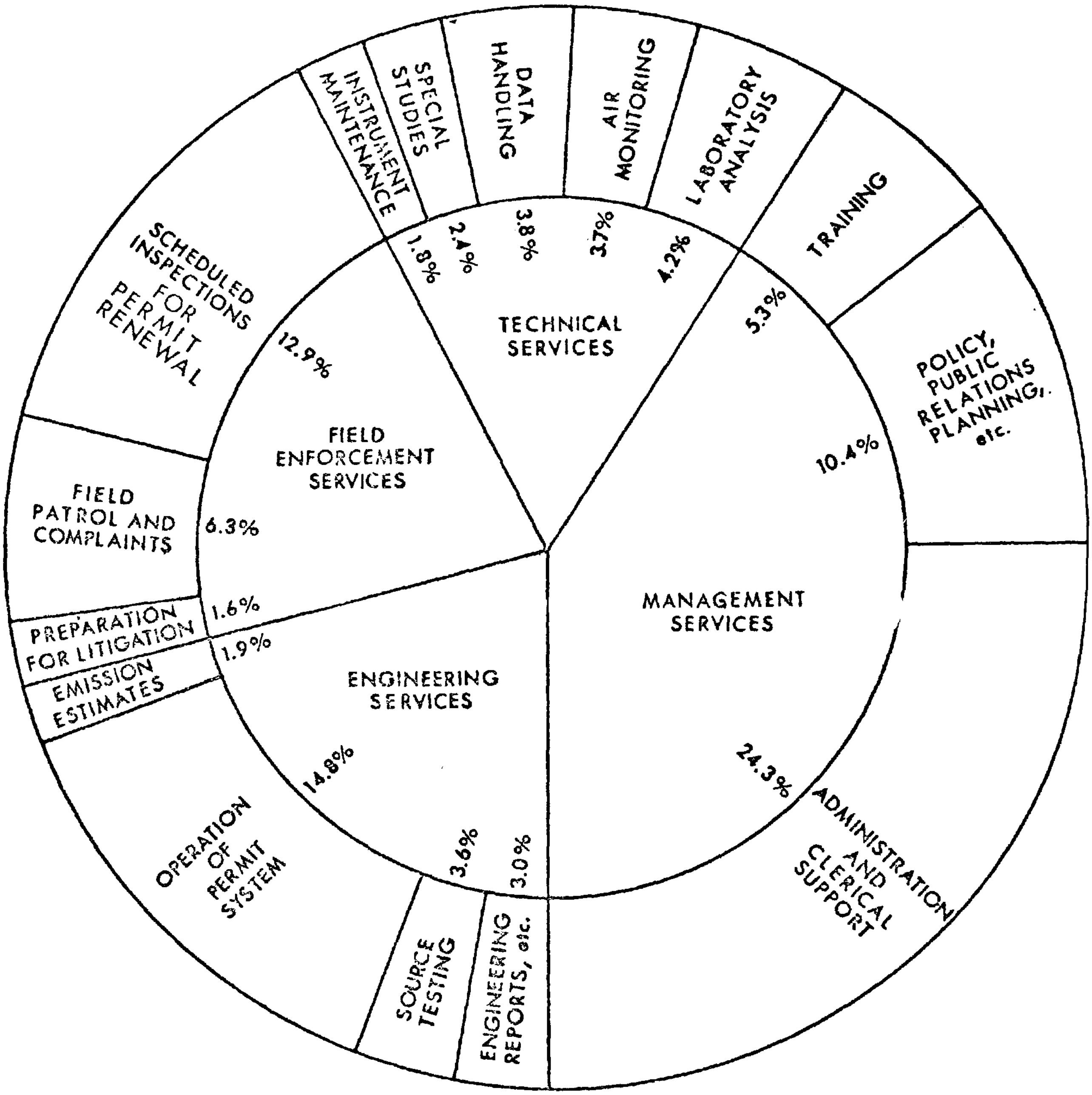


FIGURE 1.6. Generalized distribution of functional activities for regulatory agencies anticipated for 1974 (source: reference 15)

Fees for these services may be based on a variety of principles, ranging from a one-time fee for a certificate to operate to annual fees after inspection. The basis for assessing fees also will vary. The possibilities are: a flat fee for all permits, a filing fee, fees based on capacity or size of equipment, annual fees, and fees based on equipment costs. The City of Chicago has established an effective fee schedule in its "Environmental Code Ordinance," Figure 1.7. This system provides a graduated scale of fees based upon size and capacity of combustion equipment and industrial processes which can be readily administered by technical personnel.

An important factor in designing and implementing a fee system is the cost of its administration. Caution must be exercised so that the cost of operating the system does not exceed its benefits.

DEPARTMENT OF ENVIRONMENTAL CONTROL — CITY OF CHICAGO
320 NORTH CLARK STREET - CHICAGO, ILLINOIS 60610
H. W. POSTON - COMMISSIONER
EDWARD PETKUS - ASST. DIRECTOR

ENGINEERING SERVICES

PERMIT FEE INFORMATION

FUEL-BURNING EQUIPMENT SCHEDULE

Each unit of Fuel-burning equipment used for space heating, steam or hot water generation shall be assessed a permit fee based upon the following schedule of net output expressed in thousands of British Thermal Units. If multiple boilers or furnaces of the same make, model and rating are installed or if several gas or oil unit heaters are to be installed, the permit fee will be based on the total net output.

1000 BRITISH THERMAL UNITS PER HOUR	FILING FEE*	INSTALLATION PERMIT FEE	ORIGINAL INSPECTION FEE	TOTAL FEE
Less than 288	$ 5	$ 10	$ 10	$ 25
288 and less than 960	5	15	20	40
960 and less than 2,880	5	20	30	55
2,880 and over	5	30	40	75

REFUSE-BURNING EQUIPMENT SCHEDULE

Each unit of refuse-burning equipment shall be assessed a permit fee based upon the following schedule of the grate area in square feet.

AREA, IN SQUARE FEET	FILING FEE*	INSTALLATION PERMIT FEE	ORIGINAL INSPECTION FEE	TOTAL FEE
Less than 5	$ 5	$ 5	$ 10	$ 20
5 and less than 10	5	10	20	35
10 and less than 15	5	15	30	50
15 and less than 20	5	20	40	65
20 and over	5	25	50	80

PROCESS EQUIPMENT SCHEDULE

Each unit operation and unit process shall be assessed a permit fee based upon the following schedule:

FILING FEE*

1 to 10 unit processes and unit operations .... $ 5
11 to 100 unit processes and unit operations 10
101 and over unit processes and unit operations 15

INSTALLATION PERMIT FEE

Per one unit operation or one unit process creating atmospheric pollution on any device controlling atmospheric pollution .... $ 10

ORIGINAL INSPECTION FEE

Per one unit operation or one unit process creating atmospheric pollution on any device controlling atmospheric pollution .... $ 10

Unit operation is defined as a method where raw materials undergo physical change or any method by which raw materials may be altered into different physical states, (such as vapor, liquid or solid) without changing into a new substance with different properties or composition.

Unit process is defined as entailing a chemical reaction, where one or more substance material or element is reacted, so that the resulting materials have a different composition and properties.

Figure 1.7. City of Chicago air pollution equipment permit fee information

REFERENCES

1. Leonard, Thomas M., Jr. Testimony at the 1969 New Jersey Clean Air Council Public Hearing--Part I, New Brunswick, N.J. February 5, 1969.

2. Federal Register. Vol. 36, No. 158. August 14, 1971.

3. Ibid.

4. Walsh, G.W. and D.V. von Lehmden. Resources for Air Quality Controls Regions. Workshop on Regional Implementation Plans. USDHEW, PHS, NAPCA. November 1969.

5. Ozolins, G. and K. Smith. A Rapid Survey Technique for Estimating Community Air Pollution Emissions. USDHEW, PHS, Division of Air Pollution. October 1966.

6. Air Quality Implementation Planning Program, Vols. I and II. TRW Systems Group. November 1970. Contract No. PH 22-68-60.

7. Air Quality Display Model, ibid.

8. Wayne, L.G., R. Danchick, M. Weisburd, A. Kokin, and A. Stein. Modeling Photochemical Smog on a Computer for Decision Making. Journal of the Air Pollution Control Association, Vol. 2, No. 6. June 1971, p. 334-340.

9. New Jersey Environmental Times. January 1971, p. 5.

10. Weisburd, M., A. Stein, R. Bryan, L. Wayne, and A. Kokin. Air Pollution Control Field Operations Manual (Revised Edition, February 1972). Task Order 1 for Control Agency Procedures Branch, Office of Air Programs, EPA, p. 1.33 and 1.34. Contract No. CPA 70-122.

11. Schueneman, J.J. Air Pollution Control Administration. In: Air Pollution, Vol. III, Stern, A.C. (ed.). Academic Press, 1968, p. 719-793.

12. Description and Skill and Knowledge Analysis of Tasks Performed by Personnel in State and Local Air Pollution Control Agencies, Phase I. Applied Science Associates, Inc., Valencia, Pennsylvania. January 1972, p. 1.27. Contract No. 68-02-0306.

13. Lunche, R.G., E.E. Lemke and J. A. Verssen. Administration of a Permit System. Journal of the Air Pollution Control Association, Vol. 19, No. 1. January 1969.

14. New York City Department of Air Resources, Training Study Vol. II. Job and Task Analysis Worksheets. Prepared by David Sage, Inc., New York, N.Y. July 1969.

15. Walsh, op. cit.

CHAPTER 2

PERMIT PROCESSING STEPS

I. PROCESSING ELEMENTS OF THE SYSTEM

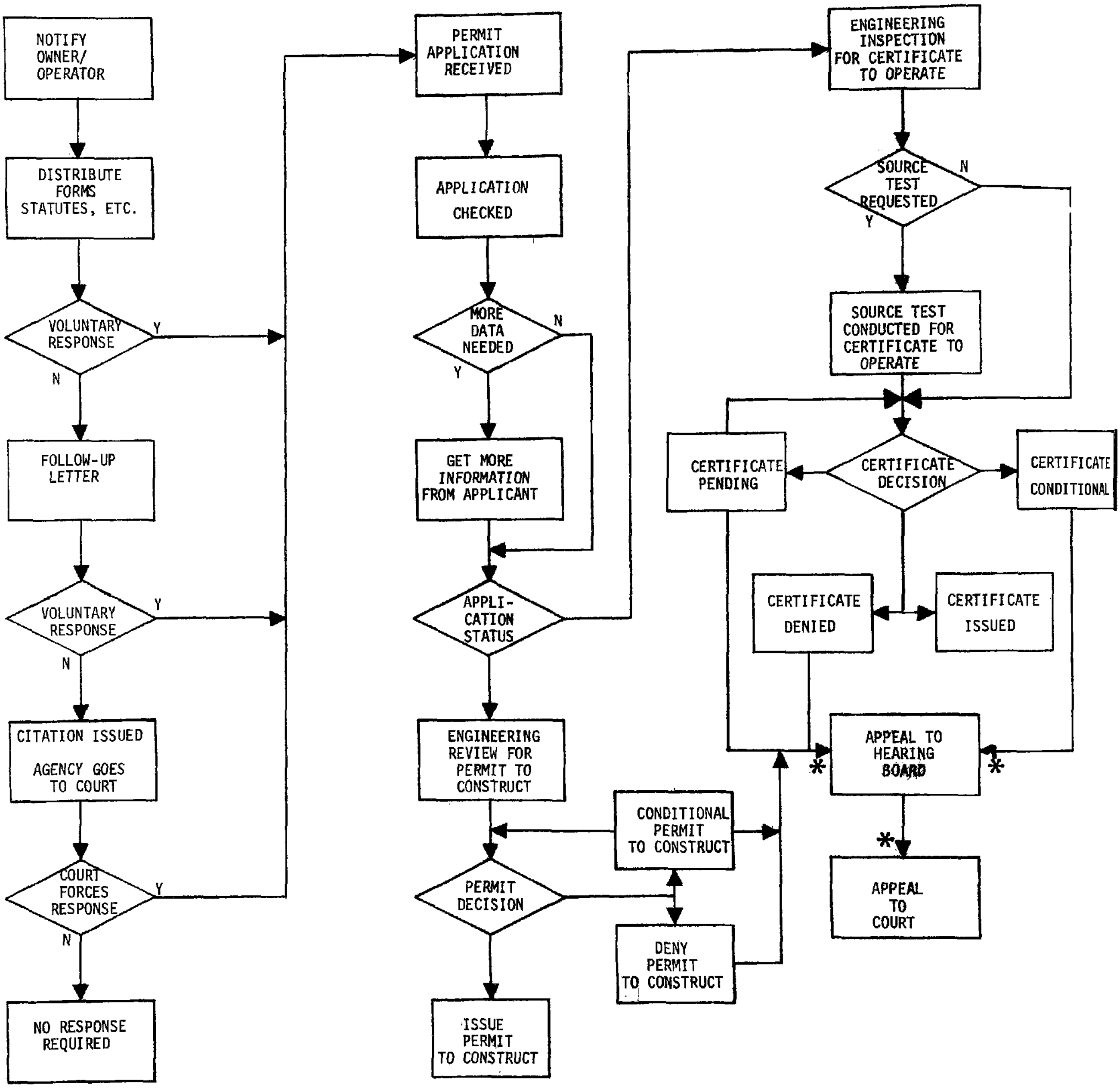
Effective operation of the permit system requires that each element of the system be clearly defined to both applicants and the individuals responsible for its operation. Potential applicants should be made aware of the information they will need and the data they must provide. Agency personnel must be fully informed of their duties and should perform them in an impartial and consistent manner. The elements of the system are shown in their logical sequence of execution in Figure 2.1 and are further described in the following sections of this chapter.

A. Notification to Owner or Operator

The initial task shown in Figure 2.1 is to notify owners and operators of equipment which has the potential to cause air pollution of their responsibilities for submitting permit applications. The effectiveness of the permit system will depend on the quality and completeness of the data supplied by owners and operators. This in turn, depends upon applicants having comprehensive and accurate information on permit system requirements and procedures. Therefore, it is vital that the notification process be as thorough as possible.

1. Who Must be Notified?

In general, any person or other corporate entity likely to be involved in building, altering, replacing, or using any unit of equipment which may cause air contaminants to be emitted into the atmosphere, or which is intended to control air contaminants must be notified in order to assure that permission to construct or operate such equipment is properly considered prior to planned



* OPTIONAL

Figure 2.1. Permit system processing elements

construction and operation. The agency may specify particular types of equipment that are exempt from the permit requirements and whether or not permits are transferable.

Guidelines describing the above procedure may be found in excerpts of Los Angeles County Permit System Rules and Regulations, Appendix 3.

2. Notification Techniques

No single method can be used by an agency to notify all prospective permit applicants. Rather, a combination of techniques must be utilized to apprise the community.

Initially, the public should be informed of the statutes and regulations via the mass media. Repeated announcements will be necessary, and complete cooperation from newspapers, radio, and television is essential. These news items should define, as clearly as possible, those individuals who are affected and what their immediate responsibilities are. For example, the mass media could inform the public that these persons should obtain necessary information and forms from the local environmental agency for submission by a particular date. The media performs a similar service every April by indicating when Federal Income Tax returns must be filed.

The second phase of the process involves contact of potential applicants by direct mail. If the agency had previously registered sources of pollution or prepared an emissions inventory, it may have its own mailing lists available. Otherwise, the agency may obtain mailing lists from other local governmental divisions such as the building department, and from the numerous professional and manufacturing associations.

The third phase of the process involves follow-up and contact with owners and operators by field enforcement personnel in the course of conducting field inspections. Field enforcement personnel serve a notification function and can answer questions and supply information needed by owners and operators. After the permit system is in effect, and a suitable grace period has passed, regulations requiring submission of applications are enforced.

3. Equipment Request

If the agency does not know what equipment an owner or operator is using, it will be necessary to contact him requesting these data so that the proper forms may be provided. This information may be supplied voluntarily, or by checking building department or other governmental records. In communities where the variety of equipment used is quite limited, this step is not required.

B. Document Distribution

Informational documents supplied to applicants should include a letter, a copy of the statute or ordinance necessitating their response, application forms, and instruction sheets for the forms. It is important that this package be complete and enable the applicant to fulfill his responsibilities without error and without contacting the agency for guidance. If the latter need does arise, or if in the future the agency must contact the applicant in order to correct his errors or to gain additional information, an added and possibly preventable expense will be incurred.

1. Letter

The letter to the permit applicant should include the following:

- Quotation or paraphrase of the law requiring his response;
- A brief explanation of the law;
- A list of the enclosures so that material that has been inadvertently omitted can be determined;
- The time frame available for filling out and returning the forms;
- An indication of how additional information may be obtained, if needed; and
- The response of the agency if the applicant fails to comply.

An example of such a letter appears in Figure 2.2.

2. Statutes and Regulations

The inclusion of the statute and appropriate regulations may be considered as optional on the part of the agency. The main purpose in providing this information to the applicant is to give him an immediate opportunity to verify for himself whether or not he must comply. Of course, even if the law is not supplied, the owner or operator can obtain a copy from the governmental agency printing such documents, or the air pollution control agency itself. However, this may delay his response.

3. Applications and Instructions

The owner or operator should receive applications and instruction sheets to enable him to satisfy his responsibilities according to

METROPOLITAN DADE COUNTY • FLORIDA

864 N. W. 23rd Street
Miami, Florida 33127
Telephone 377-5891

DADE COUNTY POLLUTION CONTROL

The Metropolitan Dade County Pollution Control Ordinance, Section 24-30, requires that any person causing a device or process to be installed that may be a source of air pollution must submit to this office appropriate plans and applications for approval, prior to installing the device or process.

Section 24-47 further requires that the owner of any existing facility must submit appropriate plans and applications for a Permit to Operate.

Enclosed you will find application forms. These forms must be filled out and returned to this office <u>within fifteen (15) days</u>. Failure to return the forms shall result in appropriate legal action.

If you desire any additional information, please call the undersigned at 377-5891.

Very truly yours,

Permit Section
Pollution Control

5-129

Figure 2.2. Agency letter mailed with application forms

the statute. This includes general permit application information as shown in Figure 2.3.

He also receives appropriate forms for his equipment. For example, the applicant may have a boiler, incinerator, or exhaust system. Specific forms should be available for all equipment types that are frequently used in the domain of any agency. Instruction sheets for the equipment item must also be mailed. Figure 2.4 illustrates an agency application for an exhaust system plan; Figure 2.5 contains the corresponding instructions.

If a form is not available for a particular equipment item, the applicant will receive either a form for a "Permit to Construct," or a form for a "Certificate to Operate." Figure 2.6 contains the former, with Figure 2.7 showing the related instruction sheets. Figures 2.8 and 2.9 illustrate the application and instruction sheets for the certificate to operate.

C. Voluntary and Enforced Response

If, at the end of the time frame indicated in the initial letter to the owner or operator, the application has not been returned, a follow-up letter should be sent. The recipient of this correspondence should be informed that he is in violation of the law (citing the exact statute) and that this is his final notice.

If his application is not filed by a date mentioned in the final notice, an agency enforcement officer should serve a notice of violation. Disregard of the notice must lead to the agency taking legal action against the owner. If the court finds the individual in violation of the permit statute, penalties can be imposed.

[The text continues on page 2.20]

AIR POLLUTION CONTROL DISTRICT - COUNTY OF LOS ANGELES
434 SOUTH SAN PEDRO STREET, LOS ANGELES, CALIF. 90013. MADISON 9-4711

PERMIT APPLICATION INFORMATION

1. IN WHAT AREAS MUST PERMITS BE OBTAINED?
Permits must be obtained to CONSTRUCT, ERECT, INSTALL, ALTER, REPLACE and to OPERATE certain classes of equipment in all cities and unincorporated areas within the boundaries of Los Angeles County.

2. WHAT CLASSES OF EQUIPMENT REQUIRE PERMITS?
Permits are required for two general classes of equipment as follows:

a. BASIC equipment. This class includes any article, machine, equipment or contrivance, the use of which may CAUSE the issuance of air contaminants.
b. AIR POLLUTION CONTROL equipment. This class includes any article, machine, equipment or contrivance, the use of which may ELIMINATE, REDUCE or CONTROL the issuance of air contaminants.

In general, a separate application must be filed for each unit of basic equipment and for each unit or system of air pollution control equipment. When a proposed installation involves more than one piece of equipment in any given process, it would be advisable for you to call the Permit Application Receiving Unit, MAdison 9-4711, Ext. 66165 — for clarification. Note: Some classes of equipment are specifically exempted by Rule 11 of the Rules and Regulations.

3. WHAT ARE AIR CONTAMINANTS?
Air contaminants may include smoke, charred paper, fly-ash, dust, soot, grime, carbon, noxious acids, fumes, gases, odors, particulate matter and other similar materials or any combinations of such materials. Air contaminants may be visible or invisible and may be in the form of small solid particles, or of liquid droplets, or of mists, vapors or gases or any mixtures of such forms.

4. HOW CAN AN AUTHORIZATION TO CONSTRUCT BE OBTAINED?
A written application must be filed and a written authorization must be obtained. AUTHORITY TO CONSTRUCT (OR TO INSTALL) and a PERMIT TO OPERATE must be secured for both basic equipment and air pollution control equipment erected, installed, built, altered, replaced or used.

5. ARE PERMITS TRANSFERABLE?
Permits are not transferable. This rule applies both to locations and to persons.

6. WHO MUST APPLY FOR A PERMIT?
The corporation, company, individual owner or government agency that is to operate the equipment must apply.

7. WHEN MUST A PERMIT BE SECURED?
A permit must be secured for both basic equipment and air pollution control equipment BEFORE any CONSTRUCTION, ERECTION, INSTALLATION, ALTERATION, REPLACEMENT, or OPERATION of equipment is begun in each of the following situations:

a. When new equipment is to be constructed or installed.
b. Whenever equipment is to be replaced or altered in such a manner as to have any effect whatsoever (either an increase or a decrease) on the production or control of air contaminants.
c. Whenever equipment is to be moved to a new address.
d. Whenever equipment is purchased or when a new lessee desires to operate such equipment.
e. Where equipment had a former blanket permit (Rule 13).

16-50086 R8-65-2

Form 400-B

Figure 2.3. Permit application information (sheet 1 of 2) (source: reference 1)

8. WHAT INFORMATION MUST BE SUBMITTED WITH AN APPLICATION?

a. An application for an authority to construct and permit to operate must be accompanied by complete data, plans, descriptions, specifications and drawings to show how the proposed equipment is designed and in what manner it will be operated and controlled. Complete information is essential to allow District engineers to evaluate the design from an air pollution point of view.
b. The Rules and Regulations of the Air Pollution Control District require that the Air Pollution Control Officer shall deny an authority to construct or permit to operate if the applicant does not show that the equipment is so designed, controlled or equipped that it may be expected to operate without violating any provisions of the Rules and Regulations.
c. Applications, information and instructions concerning the engineering data that must be furnished with an application may be obtained by writing or calling the Permit Application Receiving Unit, MAdison 9-4711, ext.66171. For such information please specify the equipment.
d. The engineering evaluation of the design may disclose that a proposed installation need not require special controls in order to meet air pollution requirements as well as detect inadequate design features in the planning stage. Many times a change in design will accomplish either proper control or allow more simple control methods. Such knowledge in the planning stage may result in the saving of time and money.

9. HOW LONG DOES IT TAKE TO OBTAIN AN AUTHORITY TO CONSTRUCT?
The engineering evaluation of an application is made as rapidly as possible. Approximately a week, however, is required under optimum conditions. The submission of complete data with an application expedites the processing. If details are lacking, all work on such an application is held up until the necessary information is supplied. It is advantageous for an applicant to submit an application as far as possible in advance of the time construction or installation is scheduled.

10. WHAT IS THE FEE FOR A PERMIT?

a. A $40.00 filing fee must accompany each application except in the case of a transfer of ownership where no alteration, addition or change of location has occurred. For this exception the application filing fee will be $10.00. The filing fee will be applied to the final fee for permit to operate.
b. Each permit to operate is to be issued after payment of a fee which is based on the heat, energy or capacity value of the equipment at design rated conditions. Rule 40 establishes schedules of fees for various levels of such values. Fees charged range from a minimum of $10.00 to a maximum of $800.00 for each permit to operate. Payment of the fee will be required before an operating permit is issued.
c. MAKE CHECK OR MONEY ORDER PAYABLE TO THE AIR POLLUTION CONTROL DISTRICT, COUNTY OF LOS ANGELES.

11. DOES AN AIR POLLUTION CONTROL PERMIT CLEAR ALL PERMIT OBLIGATIONS?
Authorizations to construct and permits to operate issued by the Air Pollution Control District are based on control of air contaminants only and do not in any way void the applicant's obligation to obtain necessary permits from other governmental agencies, such as the Building Department, Fire Department, Zoning Commission, Industrial Waste, Health Department, etc.

12. WHERE CAN APPLICATIONS BE OBTAINED?
Applications can be obtained by writing or calling the Permit Application Receiving Unit, MAdison 9-4711.

50D86 R8-65-2 Form 400-B

Figure 2.3. Permit application information (sheet 2 of 2) (source: reference 1)

STATE OF NEW YORK
DEPARTMENT OF LABOR
Division of Industrial Hygiene
Engineering Section

APPLICATION FOR APPROVAL OF EXHAUST SYSTEM PLAN

(This Box For Office Use Only)

PLAN NO.
DATE REC'D. / /
FEE REC'D.

FILING INSTRUCTIONS - ONE COMPLETED COPY OF THIS FORM MUST BE FILED FOR EACH FAN SYSTEM IN THE EXHAUST PLANS BEING SUBMITTED. Forward exhaust system plans IN TRIPLICATE, together with one completed copy of this form for each fan system, to the Engineering Section of the Division of Industrial Hygiene at one of the following Department of Labor Offices. Plans for exhaust systems to be installed in the counties of Cattaraugus, Chautauqua, Erie, Genesee, Livingston, Monroe, Niagara, Ontario, Orleans, Wayne, Wyoming and Yates should be sent to: 2447 SHERIDAN DRIVE, TONAWANDA, N.Y. 14150. Plans for exhaust systems to be installed in counties other than those listed above, should be submitted to: 80 CENTRE STREET, NEW YORK, N.Y. 10013.

IMPORTANT: Effective June 1, 1963, the Industrial Commissioner is required by section 204-a of the Labor Law to charge a FEE FOR THE EXAMINATION OF EXHAUST PLANS. Please forward with the plans a check or money order payable to the Industrial Commissioner, in accordance with the following fee schedule FOR EACH FAN SYSTEM:

CATEGORY A

"Simple single booths and enclosures, such as spray booths; canopy hoods; dilution, general and natural draft ventilation systems".

Design CFM	Fee
less than 5,000	$10
5,000 or more	20

CATEGORY B

All systems other than category A.

Design CFM	Fee
less than 250	$10
250 or more but less than 1,000	20
1,000 or more but less than 5,000	30
5,000 or more but less than 10,000	40
10,000 or more	50

1. FIRM NAME

2. MAILING ADDRESS

3. PLANT LOCATION *(Street and Number, City, Town, Village, County)*

4a. PLANT REPRESENTATIVE TO BE CONTACTED REGARDING EXHAUST SYSTEM PLANS 4b. TITLE

5. NUMBER OF IN-PLANT EMPLOYEES AT THE ABOVE PLANT LOCATION: TOTAL MALE FEMALE
6. NO. OF EMPLOYEES AT OPERATIONS OR MACHINES

7. AUTHORIZED AGENT *(if any)* SUBMITTING PLANS *(Eng., Designer, Consulting Firm, Etc.)* LETTER OF AUTHORIZATION MUST ACCOMPANY PLANS

8. BUSINESS ADDRESS OF AGENT

9. NO. OF FAN SYSTEMS SHOWN ON PLAN *(Fan Systems Should Be Numbered)*
10. SUBMITTED FOR COMPLIANCE WITH INDUSTRIAL CODE RULE NO.

GENERAL DATA FAN SYSTEM NO._____ AMOUNT OF FEE ENCLOSED_____

11. LOCATION OF SYSTEM

a. BUILDING _____ b. FLOOR _____

c. DEPARTMENT d. NUMBER OF FLOORS IN BLDG.

12a. IS PROPOSED INSTALLATION NEW? ☐ YES ☐ NO
12b. ADDITION TO OR RECONSTRUCTION OF EXISTING SYSTEM ☐ YES ☐ NO

13. DOES THIS PLAN AMEND PREVIOUSLY SUBMITTED PLAN? ☐ YES ☐ NO IF YES, GIVE PREVIOUS PLAN NO. AND AMOUNT OF FEE PAID

14. IS THIS INSTALLATION TO COMPLY WITH ORDERS OR SPECIFIC RECOMMENDATIONS ISSUED BY THIS DEPARTMENT? ☐ YES ☐ NO IF YES, GIVE DATE OF ISSUANCE

15. IS DISCHARGE OF SYSTEM TO BE RECIRCULATED TO THE WORKROOM? ☐ YES ☐ NO
("Discharged Air Which Contains Dangerous Air Contaminants Shall Not Be Recirculated." - Rule 18-8.5)

16. DISCHARGE POINT: ☐ ABOVE ROOF ☐ OUT OF WINDOW ☐ THROUGH SIDE WALL ☐ OTHER
FEET TO NEAREST FIRE ESCAPE OR EXIT FEET ABOVE ROOF FEET TO NEAREST WINDOW

17. MAKE-UP AIR, EQUAL IN VOLUME TO THAT EXHAUSTED, TO BE SUPPLIED BY
17a. MEANS FOR HEATING MAKE-UP AIR

IH-212 (6-69) *(SEE OVER)*

Figure 2.4. Application for the approval of an exhaust system plan (sheet 1 of

DESCRIBE MACHINES AND OPERATIONS FULLY ON PLANS. SEE INSTRUCTION SHEET, FORM IH-212.1 FOR GUIDANCE IN THE PREPARATION OF EXHAUST SYSTEM PLANS.

AIR CLEANING DATA

18. IS AIR CLEANING EQUIPMENT PROVIDED? ☐ YES ☐ NO

19. TYPE OF AIR CLEANING EQUIPMENT *(If any)* TO BE USED *(Cyclone, Cloth Arrestor, Etc.)*

20a. AIR CLEANER MANUFACTURER | 20b. MODEL OR CATALOG NO. | 20c. SIZE

21. MAXIMUM PRESSURE DROP THROUGH AIR CLEANER AT OPERATING CONDITIONS ("W.G.)

FAN DATA (If more than one fan system is shown on plans, each fan should be numbered and described)

22. FAN NO. | 23. MFR.'S NAME | FAN TYPE | DESIGN | SIZE

24. MFR.'S RATING: RPM | CFM | S.P. *(in. water)* | B.H.P. | MOTOR H.P.

25. FAN CONDITION ☐ New ☐ Reconditioned ☐ Existing

26. DESIGN REQUIREMENTS: CFM | S.P. *(in. water)*

27. FAN INLET DIAMETER ____ inches

28. FAN OUTLET DIAMETER OR SIZE ____ inches

DIMENSIONS OF UNITS EXHAUSTED (Identify on plan by letter; use separate sheet if necessary)

29. UNIT LETTER ON PLAN	30. DESCRIPTION *(Examples: grinding wheel, belt, tank, booth)*	31. SIZE *(Wheel diameter & thickness, belt width, tank dimensions)*	32. OPERATION AND/OR CONTAMINANT *(Examples: brass polishing, vapor degreasing, caustic dipping at 180°, chromium plating)*	33 BRANCH DIAMETER

34. SIGNATURE OF PERSON SUBMITTING PLANS AND THIS APPLICATION

35. DATE SUBMITTED

SPACE BELOW FOR OFFICE USE ONLY

☐ APPROVED ☐ DISAPPROVED EXAMINED BY________________ DATE__________

REMARKS____

____

____

____

____

TOTAL FEE FOR THIS FAN SYSTEM | CHECKED BY | DATE

Figure 2.4. Application for the approval of an exhaust system plan (sheet 2 of 2

STATE OF NEW YORK - DEPARTMENT OF LABOR - DIVISION OF INDUSTRIAL HYGIENE

INSTRUCTIONS FOR THE PREPARATION AND FILING OF PLANS AND SPECIFICATIONS FOR EXHAUST SYSTEMS

INSTRUCTIONS FOR PREPARING PLANS - Plans must show:

1. An outline of that portion of the building or buildings in which the exhaust system is to be installed or extended. The outline must be of sufficient scope to give a clear indication of the mode of entrance and source of tempered make-up air. All pillars, columns or structural members which are adjacent to the machines or processes to be connected to such exhaust system or to any of the ducts or other parts thereof should also be shown.

2. Location of each machine or process and its designation by a suitable outline. The size or other characteristics of the machine, equipment or operations which is used as the basis for the designed exhaust air quantity should also be indicated (e.g. grinding wheel diameter and thickness, temperature and rate of solvent evaporation in oven, temperature and contents of tank baths in open surface tank operations, etc.).

3. Layout in plan and elevation of exhaust system including all of its parts, drawn to scale with all ducts shown by double lines. This should indicate the duct sizes, minimum air velocities in the ducts, method and frequency of supports, clean-outs, removable caps, fan and air cleaning equipment and the location of the point of discharge in relation to roof, walls, windows, doors of the factory and adjacent premises.

4. Details of design and dimensions of all hoods, booths and enclosures and other points of ventilation including details of their support and construction. Air quantity or velocity at each hood, booth, work opening or point of control should be specified. Show total design CFM for each fan system.

5. Details of the design, construction and support of any air cleaning equipment which may be used. (For centrifugal and other essentially constant pressure drop air cleaners: specify the cleaner resistance at the specific system air flow. For cloth arrestors: specify effective cloth area, form in which cloth is used, cloth type, etc. Specify maximum resistance of arrestors at time prior to shaking. Indicate whether shaking is manual, motorized, automatic, etc., and time between shakings.) When commercially available equipment is used, indicate the manufacturer's catalog number.

6. Complete fan specifications including name, type, design, size. Specify manufacturer's fan rating applicable to designed system, such as CFM, SP (system resistance), fan RPM, BHP and motor HP.

If plans are for the addition to an existing system, i.e., wherever branches or mains of the proposed system connect into any main, separator or discharge duct of a previously installed system, plans must show sufficiently detailed information as to the duct sizes, air quantities and air flow resistance throughout the previously installed system to allow an accurate calculation of the effect of connecting the proposed system.

Plans submitted herewith must be of professional quality equivalent to those prepared by designers or draftsmen skilled in the art of preparing mechanical drawings of industrial exhaust systems. Plans of lesser quality or plans accompanied by incomplete or illegible specifications, may either be returned for resubmission in acceptable form or, in extreme cases, be summarily disapproved. General construction, air cleaner and fan specifications are preferably included directly on the plans.

Design and construction of exhaust systems shall conform to the pertinent Industrial Code Rules and acceptable standards of good engineering practice. Engineering plates illustrating such standards are available from the Engineering Section of the Division of Industrial Hygiene. A list of such plates will be furnished on request.

INSTRUCTIONS FOR PREPARING APPLICATION FORM (IH-212): One application form must be submitted for each fan system included in the plans. Thus, if the plans show four fan systems (i.e., four fans) then four application forms must be filed along with the plans. If the plans amend or revise previously submitted plans for which an exhaust plan fee was paid to the Industrial Commissioner, indicate this in item 13 of form IH-212 and give the previous plan number.

INSTRUCTIONS FOR FILING PLANS AND APPLICATIONS: Forward exhaust system plans IN TRIPLICATE, together with one completed copy of form IH-212 ("Application for Approval - Exhaust Plans") for each new or revised fan system in the plans, to the Division of Industrial Hygiene, New York State Department of Labor at one of the following offices. Plans for exhaust systems to be installed in the counties of Cattaraugus, Chautauqua, Erie, Genessee, Livingston, Monroe, Niagara, Ontario, Orleans, Wayne, Wyoming and Yates should be sent to 2447 SHERIDAN DRIVE, TONAWANDA, N.Y. 14150. Plans to be installed in counties other than those listed above should be submitted to 80 CENTRE STREET, NEW YORK, N.Y. 10013.

RESPONSIBILITY FOR PLANS AND SPECIFICATIONS: Employers or agents must file specifications and plans for exhaust systems required by the Labor Law or the Industrial Code Rules BEFORE the installation or extension of any such exhaust system. Agents must submit a letter from their client authorizing them to file plans on the client's behalf.

(SEE OVER FOR PLANS EXAMINATION FEES)

IH-212.1 (9-68) ENG.

Figure 2.5. Instructions for filing an exhaust system plan (sheet 1 of 2)

FEES FOR PLANS EXAMINATION

NEW PLANS

See fee schedule on application form IH-212 using the following examples to determine appropriate category:

Category A

1. All dilution ventilation systems where general ventilation, usually by means of free air fans in the roof, wall, windows, etc., is provided to dilute the contaminants released by an operation to acceptable concentrations.

2. All general ventilation systems for heat or fume ventilation such as in a welding shop, laundry, foundry, etc.

3. Simple, single spray booths and dipping booths for the application of paint, lacquers, enamels, and similar finishing materials by dipping, impregnating, spraying, spreading and flow or roller coating. Booth and dilution ventilation for subsequent drying operations are included.

4. Simple, single, high volume, low pressure booths, similar to spray booths, used for such operations as welding, etc.

5. All Natural draft systems.

Note: Where more than one exhaust fan in Category A is used to accomplish one purpose, such as two fans in a spray booth, several fans in windows for dilution ventilation of a workroom, several exhausters in the roof of a foundry room, for fume removal, etc., all will be considered one fan system and the sum of the CFM's will be used to determine the fee.

Category B

All other systems fall into Category B. Multi-branch pipe systems containing more than one Category A type hood also fall into Category B. (For example, two or more spray booths connected by branch pipes to a main pipe and fan consitute a Category B system)

Note: Where two or more fan systems are connected to a single main pipe or single air cleaner, they are considered as separate fan systems.

REVISED PLANS

The following criteria have been established regarding resubmission of plans:

1. A fee will not be charged for any resubmissions for disapproved plans if the design CFM remains in the same fee bracket as in the original submission. If a resubmission is in a higher fee bracket, the difference in fees will be charged.

2. If within one year after plan approval the applicant submits revised plans representing minor change in the installation, no fee will be charged if such plans are in the same fee bracket. If the revised plans fall into a higher fee bracket, the difference in fees will be charged. Revisions of approved plans more than one year old are considered new, and the full fee will be charged.

3. If any time after plan approval the applicant submits revised plans representing major change in the installation, the plans will be considered new, and the full fee will be charged.

Note: A major change is defined as one with a 50% or greater increase in CFM or in number of branch pipes.

EXEMPTIONS: *Plans submitted by or on behalf of a governmental jurisdiction are exempt from the fee requirement.*

Figure 2.5. Instructions for filing an exhaust system plan (sheet 2 of 2)

Air-29
Nov. 70

NEW JERSEY STATE DEPARTMENT OF ENVIRONMENTAL PROTECTION

APPLICATION FOR PERMIT TO CONSTRUCT, INSTALL OR ALTER CONTROL APPARATUS OR EQUIPMENT

TO: New Jersey State Department of Environmental Protection
Bureau of Air Pollution Control
P. O. Box 1390
Trenton, New Jersey 08625

Date ____________________

Use instructions, Air-D13

Sec. A

1. Full Business Name ____________________
2. Address of equipment and/or control apparatus:
____
No. *Street* *Municipality* *County*
3. Location on premises (Bldg., Dept., area etc.) ____________________
4. Nature of Business ____________________ SIC No. ________

Sec. B

1. ☐ New process equipment and new air pollution control apparatus
☐ New air pollution control apparatus on existing process equipment
☐ New process equipment with no control apparatus
☐ Other: ____________________
2. Prior permit numbers covering this installation. Specify. ____________________
3. Estimated starting date ____________ Estimated completion ____________

Sec. C

1. Description of operation ____________________
2. Identify process equipment ____________________
3. Raw materials (names) ____________________
Total pounds per hour ____________ Total pounds per batch ____________
4. Operating procedure:
☐ Continuous: ______ hrs. per day ______ days per ☐ week ☐ month
☐ Batch: ______ hrs. per batch ______ Batches per ☐ day ☐ week

Sec. D

Physical and chemical nature of air contaminants which must evolve from operation and be emitted into the open air:

AIR CONTAMINANTS	AMOUNTS OF CONTAMINANTS	
	With Control Apparatus	Without Control Apparatus

(Continue on reverse side)

Figure 2.6. Application for permit to construct (sheet 1 of 2)

Sec. E	
	1. Describe air pollution control apparatus ______________________________
	2. Efficiency of control apparatus: ________%
	3. Height of discharge above ground ____________ ft.
	4. Distance from discharge to nearest property line ____________ ft.
	5. Volume of gas discharged into open air ____________ cu. ft. per min. at stack conditions
	6. Exit linear velocity at point of discharge ____________ ft. per minute at stack conditions
	7. Temperature at point of discharge ____________ °F
	8. Will emissions comply with existing local requirements? ____________
	9. Initial cost of control apparatus $ ____________
	10. Estimated annual operating cost $ ____________

This application is submitted in accordance with the provisions of N.J.S.A. 26:2C-9.2, and to the best of my knowledge and belief is true and correct.

____________________	*Signature – all copies*
____________________	*Name (Print or type)*
Mailing Address	*Title*
Zip Code	*Telephone No.*

DO NOT WRITE BELOW

PERMIT TO CONSTRUCT, INSTALL OR ALTER CONTROL APPARATUS OR EQUIPMENT

Application for permission to construct, install or alter the equipment and/or control apparatus as set forth above is APPROVED.

Date ____________ Approved by: ____________

PERMIT NO. ____________ *Supervisor, Permits & Certificates*

Submit original and three (3) copies

M5379

Figure 2.6. Application for permit to construct (sheet 2 of 2)

Air-D13
Nov. 70

NEW JERSEY STATE DEPARTMENT OF ENVIRONMENTAL PROTECTION

INSTRUCTIONS FOR FILING APPLICATION FOR PERMIT TO CONSTRUCT, INSTALL OR ALTER CONTROL APPARATUS OR EQUIPMENT

New Jersey statute N.J.S.A. 26:2C—9.2 requires that no person shall construct, install, or alter any equipment capable of causing the emission of air contaminants into the open air or control apparatus which prevents or controls the emission of air contaminants until an application including plans and specifications has been filed with the Department of Environment Protection and an installation or alteration permit has been issued by the Department. The statute further requires that an operating certificate be issued by the Department before the control apparatus or equipment is used.

Form AIR-29 is an application for a "PERMIT TO CONSTRUCT, INSTALL OR ALTER CONTROL APPARATUS OR EQUIPMENT."

The form provides for certain basic information as to plans and specifications. In all instances form AIR-29 must be supplemented to provide the Department with information necessary to determine if the equipment or control apparatus will:

(1) Operate without causing violation of any provision of the Air Pollution Control Act or codes, rules or regulations promulgated thereunder.

and that

(2) The equipment incorporates **advances in the art of air pollution control** for the kind and amount of air contaminant emitted by the applicant's equipment.

A SEPARATE FORM AIR-29 IS REQUIRED FOR EACH STACK, CONDUIT, FLUE, DUCT, VENT OR SIMILAR DEVICE EMITTING AIR CONTAMINANTS INTO THE OPEN AIR. **An original plus three copies** of form AIR-29 is to be submitted.

Attachments to form AIR-29 may be sumbitted in duplicate.

Sec. A—Item (1) refers to the name of the corporation, company, association, society, firm, partnership, individual or political subdivision of the state.
Item (2) the street address at which the equipment or control apparatus is to be used.
Item (3) refers to the specific location on the premises where the equipment or control apparatus is to be installed.

Item (4) the general nature of the business conducted and the standard industrial classification number which best classifies the operation.

Sec. B—Item (1) must be appropriately checked.
Item (2) must be filled in if applicable, and permit numbers listed.
Item (3) shows the estimated date on which construction is to be started and the estimated date the work will be completed.

Sec. C—Item (1) requires a brief description of the operation which emits air contaminants through the stack, conduit, flue, duct, vent or similar device.
Item (2) **Process descriptions and flow diagrams** shall be included for each source operation which emits air contaminants through the stack, conduit, flue, duct, vent or similar device for which the application is filed. The process description and flow diagram shall show the types and quantities of raw materials to be used, the processes which will effect physical or chemical changes and the methods of charging and discharging materials.

For manufacturing processes which emit air contaminants from two or more source operations, a composite process description and flow diagram may be submitted for all stacks, chimneys etc. shown and referenced to the appropriate form AIR-29.
Item (3) list all raw materials that are to be charged into the source operation giving their chemical composition. Give the total rate at which raw materials are to be charged into the source operation. In the case of a continuous operation, it should be expressed either as pounds per hour or some other convenient unit of time and for batch operation as pounds per batch.
Item (4) indicate whether the operation is to be continuous or a batch type and specify the planned schedule at which it is to be operated.

Sec. D—Requires a listing of each of the air contaminants which evolve from the operation and must be discharged into the open air through the stack, chimney, etc. The emissions should be expressed in terms such as pounds per hour, concentration in the exhaust gases or other appropriate units. Wherever control apparatus is to be installed, the amount of air contaminants

Figure 2.7. Instructions for filing a permit to construct (sheet 1 of 2)

emitted without the control apparatus and the amout of air contaminants to be emitted with the control apparatus shall be shown.

NOTES: Terms such as "none", "nil", "trace", "negligible", etc. cannot be accepted. However, "less than .... pounds per hour" or a similar statement will be satisfactory.

Incinerator applications must specifically show compliance with standards for particulates, smoke, unburned waste and ash, and odors, as stated in Chapter 11—Incinerators.

Sec. E—Item (1) provide a brief description of the control apparatus or air pollution control system. ATTACHMENTS MUST BE INCLUDED TO PROVIDE DETAILS describing the control apparatus. This description shall include the basic principles applied to remove air contaminants including but not necessarily limited to:

Data and calculations used in the sizing and selection of the control apparatus.
If the control apparatus is standard commercial equipment specify manufacturer, model, size, type and capacity of the apparatus.

If control apparatus other than standard commercial equipment is used, provide a sketch of the control apparatus showing the principle of operation and the basis for calculation of its air pollution control efficiency.

Describe the means of disposal of any air contaminants which are collected by the control apparatus.

Show any bypasses of the control apparatus and specify when such bypasses are to be used and under what conditions.

Describe the procedure to be used for preventing losses of air contaminants to the open air when cleaning, reactivating or otherwise maintaining and operating the unit.

Temperatures of gases entering or leaving the control apparatus.

Wherever applicable, specify material from which filter materials are made, giving the total filtering area.

Describe filter cleaning procedure and procedure used to assure effective maintenance of filters.

Details on control apparatus employing scrubbers shall include details of the scrubbing principle, the volume of water used as related to the volume of air passing through the scrubber. Specify the percent of recirculated water, chemicals or additives used in the water and deposition of the scrubbing liquor.

For control apparatus employing heat or burners to consume potential air contaminants, include the minimum and average temperatures and the average detention time of the contaminants in the combustion chamber. If catalysts are employed, give type and quantity of the material and describe the bed.

Where control apparatus other than as outlined above are to be used, provide data on principle of operation and criteria used in evaluating control efficiency.

Item (2) enter the percent removed by the control apparatus from the amount that would otherwise be released to the atmosphere.

Item (3) height of stacks, chimney, etc. above ground or such other point from which air contaminants are emitted into open air.

Item (4) refers to the distance from the base of the stack to the nearest property line.

Item (5)-(7) should be based upon normal operating conditions.

Item (8) refers to such ordinances as might be in effect with the county, region or municipality.

Item (9) and (10) relate to the initial cost of **the control apparatus only** and the estimated cost for operating the equipment.

Persons requiring additional information in connection with the filing of the application for a Permit to Construct, Install or Alter Control Apparatus or Equipment, should write to New Jersey State Department of Environmental Protection, Bureau of Air Pollution Control, P.O. Box 1390, Trenton, New Jersey, 08625. Phone: Area 609-292-6716.

NOTE: No person shall use or cause to be used any new or altered control apparatus or equipment for which a Permit to Construct, Install or Alter Control Apparatus or Equipment is required or has been issued until a certificate to operate has been issued by the Department. Application for said certificate should be made to the Department on form AIR-30, "Application for Certificate to Operate Control Apparatus or Equipment."

Figure 2.7. Instructions for filing a permit to construct (sheet 2 of 2)

NEW JERSEY STATE DEPARTMENT OF ENVIRONMENTAL PROTECTION

APPLICATION FOR CERTIFICATE TO OPERATE CONTROL APPARATUS OR EQUIPMENT

TO: New Jersey State Department of Environmental Protection
Bureau of Air Pollution Control
P. O. Box 1390
Trenton, New Jersey 08625

Date ____________________

Use Instructions, Air-D-14

Sec. A	1. Reference Permit No. ____________ SIC No. ____________
	2. Full Business Name ____________
	3. Address of equipment and/or control apparatus:
	No. *Street* *Municipality* *County*
	4. Location on premises (Bldg., Dept., area, etc.) ____________
Sec. B	1. Identify process equipment ____________
	2. List air pollution control apparatus ____________
	3. Date equipment to be put in use ____________
Sec. C	Plant Contact:
	Name (Print or Type) ____________ *Telephone No.* ____________
	Title ____________ *Telephone Extension* ____________

This application is submitted in accordance with the provisions of N.J.S.A. 26:2C-9.2, and to the best of my knowledge and belief is true and correct.

____________________ *Signature – all copies*

____________________ *Name (Print or Type)*

Mailing Address, Zip ____________________ *Title*

DO NOT WRITE BELOW

CERTIFICATE TO OPERATE CONTROL APPARATUS OR EQUIPMENT	
TEMPORARY DURATION	**5 YEAR DURATION**
Certificate No. ____________	Certificate No. ____________
Date Approved ____________	Date Approved ____________
Expiration date ____________	Expiration date ____________
Approved by: ____________ *Supervisor, Permits & Certificates*	Approved by: ____________ *Supervisor, Permits & Certificates*

M6042

Submit original and seven (7) copies

Figure 2.8. Application for certificate to operate

Air-D14
Nov. 70

NEW JERSEY STATE DEPARTMENT OF ENVIRONMENTAL PROTECTION

INSTRUCTIONS FOR FILING APPLICATION FOR CERTIFICATE TO OPERATE CONTROL APPARATUS OR EQUIPMENT

New Jersey statute N.J.S.A. 26:2C-9.2, requires that no person shall use or cause to be used any new or altered equipment capable of causing the emission of air contaminants into the open air or any new or altered control apparatus which prevents or controls the emissions of air contaminants until application has been filed with the Department of Environmental Protection and a certificate to operate has been issued by the Department.

Form AIR-30 is an application for a "CERTIFICATE TO OPERATE CONTROL APPARATUS OR EQUIPMENT." The issuance of this certificate is contingent upon the applicant holding an APPROVED AIR-29, "APPLICATION FOR PERMIT TO CONSTRUCT, INSTALL OR ALTER CONTROL APPARATUS OR EQUIPMENT." If the applicant does not hold an approved AIR-29, Form AIR-30 must be accompanied by completed Forms AIR-29.

A SEPARATE FORM AIR-30 IS REQUIRED FOR EACH STACK, CONDUIT, FLUE, DUCT, VENT OR SIMILAR DEVICE EMITTING AIR CONTAMINANTS INTO THE OPEN AIR. AN ORIGINAL PLUS SEVEN (7) COPIES* OF FORM AIR-30 IS TO BE SUBMITTED.

Section A—Item (1) refers to the permit number as it appears on form AIR-29, "Application for Permit to Construct, Install or Alter Control Apparatus or Equipment.

Item (2) refers to the name of the corporation, company, association, society, firm, partnership, individual or political subdivision of the state to which a permit was issued.

Item (3) the street address at which the control apparatus or equipment is to be used.

Item (4) refers to the specific location on the premises where the equipment or control apparatus is installed.

Section B—Item (1) listing of the process equipment as **described in Section C, Item (2)** of AIR-29.

Item (2) requires a brief description of the air pollution control apparatus **as described in Section E, Item (1)** of AIR-29.

Item (3) show the estimated date the equipment and/or control apparatus will be placed in operation. (NOTE—THE DATE SHOWN SHOULD BE THE BEST ESTIMATE AVAILABLE TO THE APPLICANT TO AVOID REFILING. IN MOST CASES TEMPORARY CERTIFICATES VALID FOR A PERIOD NOT TO EXCEED 90 DAYS WILL BE ISSUED. THIS 90 DAY PERIOD IS TO ALLOW FOR INSPECTION, EVALUATION AND/OR TESTING OF THE CONTROL APPARATUS OR EQUIPMENT FOR WHICH THE CERTIFICATE IS ISSUED. IF THE FACILITIES ARE NOT IN OPERATION DURING THIS PERIOD, IT WILL REQUIRE REFILING BY THE APPLICANT FOR AN EXTENSION OF THE TEMPORARY CERTIFICATE.

IF CERTIFICATE APPLICATIONS ARE FORWARDED TO THE BUREAU PRIOR TO THE DATE THE EQUIPMENT IS TO BE PLACED IN USE, THEY WILL BE HELD IN ABEYANCE AND ISSUED ON THE DATE INDICATED ON THE APPLICATION FORM.

Section C—Indicate the name of the person who would be contacted by the New Jersey State Department of Environmental Protection for further details or to arrange for inspection of facilities.

NOTE: The possession of a "Certificate to Operate Control Apparatus or Equipment" shall not exempt any person from prosecution if the actual operation of the control apparatus or equipment is not in compliance with all state and local requirements.

*Four copies will be held for issuance of a five-year certificate upon proof of satisfactory operation.

M6041

Figure 2.9. Instructions for filing a certificate to operate

D. Receiving and Checking the Application

When the engineering review of an application takes place, it is imperative that the engineer has all the data that he needs before him. If he must interrupt his evaluation because of insufficient information, he has wasted his time. It is unreasonable to expect the engineer to continue this process where he left off, after a delay of perhaps weeks, while missing data are being supplied.

Consequently, upon receipt, each form must be completely checked and prepared for engineering review. Figure 2.10 presents an overview of this process. If the applicant requests a permit for exempt equipment (no permit required), the completed form should be returned with the appropriate letter of explanation. If, for example, a filing fee has not been paid, the application should be returned with the proper notification. Figure 2.11 shows a typical letter to be used with incomplete applications. Item seven can be used to list specific information that has been omitted.

If the application does not have to be returned for any reason, it must be logged in, assigned an ID number, and placed in a folder. All forms, memoranda, correspondence, and evaluations pertaining to this application must be stored in the folder.

The final step in the checking process involves the transmittal of the application folder to the appropriate engineering review or inspection unit.

E. Engineering Review

Plan review by engineers for the purpose of evaluating the potential emissions of air contaminants from new equipment is a vital component of the permit system. By prohibiting the installation of uncontrolled

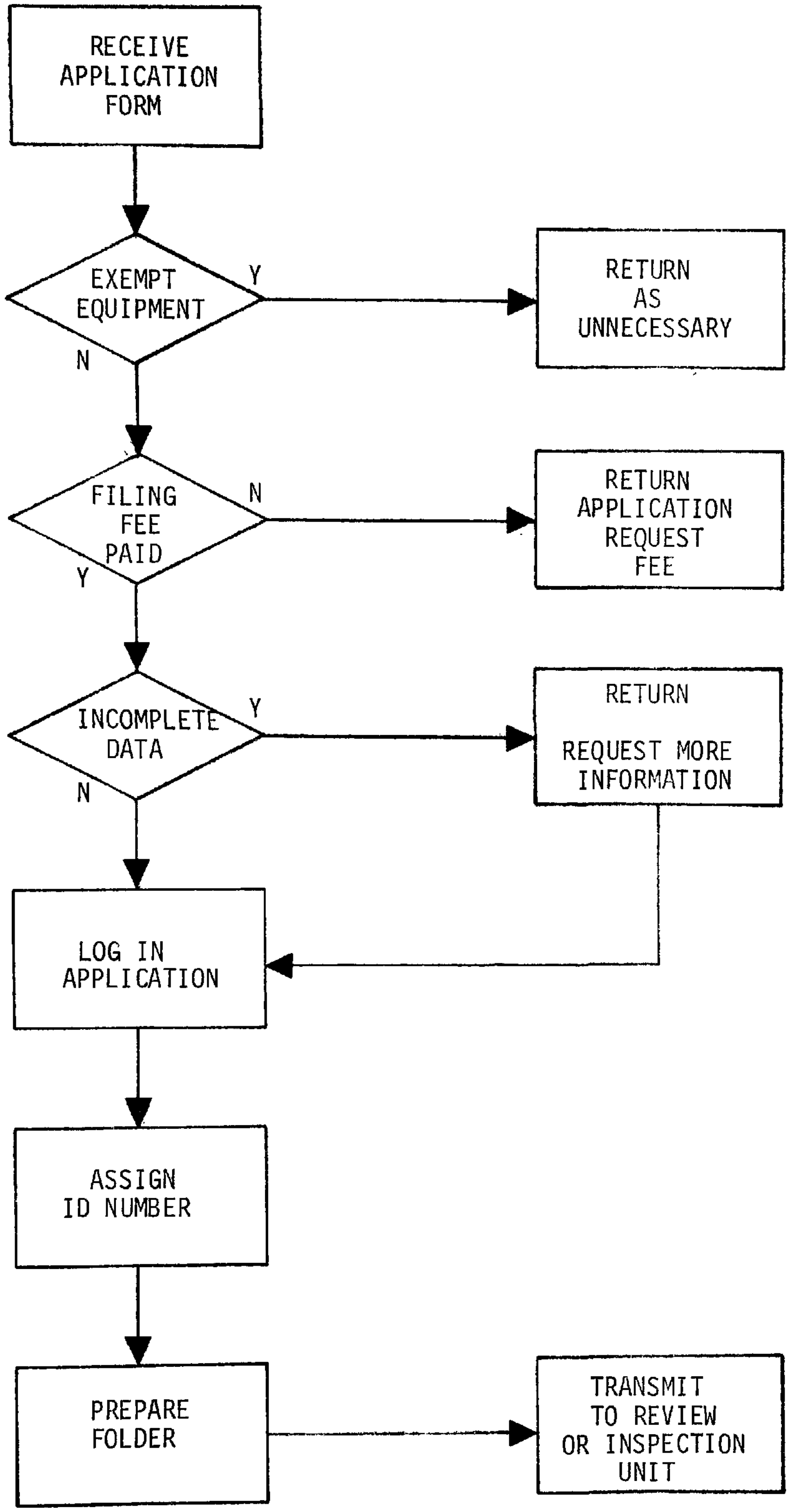


Figure 2.10 Steps in receiving and checking in a permit application

HOLLIS S. INGRAHAM, M. D.
COMMISSIONER

STATE OF NEW YORK
DEPARTMENT OF HEALTH

84 HOLLAND AVENUE
ALBANY, N. Y. 12208

DIVISION OF AIR RESOURCES

ALEXANDER RIHM, JR., P.E.
ASSISTANT COMMISSIONER

BUREAU OF AIR QUALITY CONTROL
SIDNEY MARLOW, P.E.
DIRECTOR

Address reply to:

Refer to Application No:

Date:

Gentlemen:

We have received the application submitted to you for the premises at

Your application cannot be officially reviewed because it is incomplete with respect to the items checked below. Please forward the material described in these items with the least possible delay.

☐ 1. Forward additional copies of form AIR 100 (total of three required)
☐ 2. Forward additional plan drawings (total of three required)
☐ 3. Forward additional elevation drawings (total of three required)
☐ 4. Forward additional Environmental Analysis Reports (total of three required)
☐ 5. Forward additional plot plans (total of three required)
☐ 6. Forward a letter from your client authorizing you to act as his agent in this application.
☐ 7.

Your prompt cooperation in furnishing necessary documents will expedite evaluation of your application and will enable us to give you better and faster service.

Sincerely,

AIR 118 (6-68)

Figure 2.11. Letter requesting additional information

or poorly controlled equipment, the health and welfare of the public is protected. Figure 2.12 depicts in flow chart form the engineering review process.

The permit processing division of a large-size agency should have three or four engineering units, each unit composed of five or six engineers, plus a supervisor. When an application for a permit is sent to the engineering unit, the supervisor receives the complete folder. He records the date it arrives and makes a note of which engineer he is assigning the task of evaluation.

Upon receiving the folder, the engineer registers the date in his records, and assigns the application a priority number. When he can begin processing the application, he decides if more information is required before a proper determination can be reached. If additional data are needed, he may either write or call the applicant. He may be able to resolve the difficulty over the phone; however, an amendment to, or some clarification of, the application in writing may be necessary. A meeting may be scheduled to resolve a major problem.

Once the engineer is satisfied that the folder contains all the information required, he may begin the application evaluation and perform the engineering calculations. At the conclusion of this process, the engineer must decide whether to issue a permit out-right, grant a permit conditionally, or deny a permit to the applicant. A conditional permit may specify the type of fuel that can be used, special operating conditions, or process weight limitations. If a permit is denied, the reasons for the denial should be presented to the applicant. A plan disapproval form is shown in Figure 2.13.

After the evaluation is completed, information from the application may be extracted and prepared for input into the various agency information

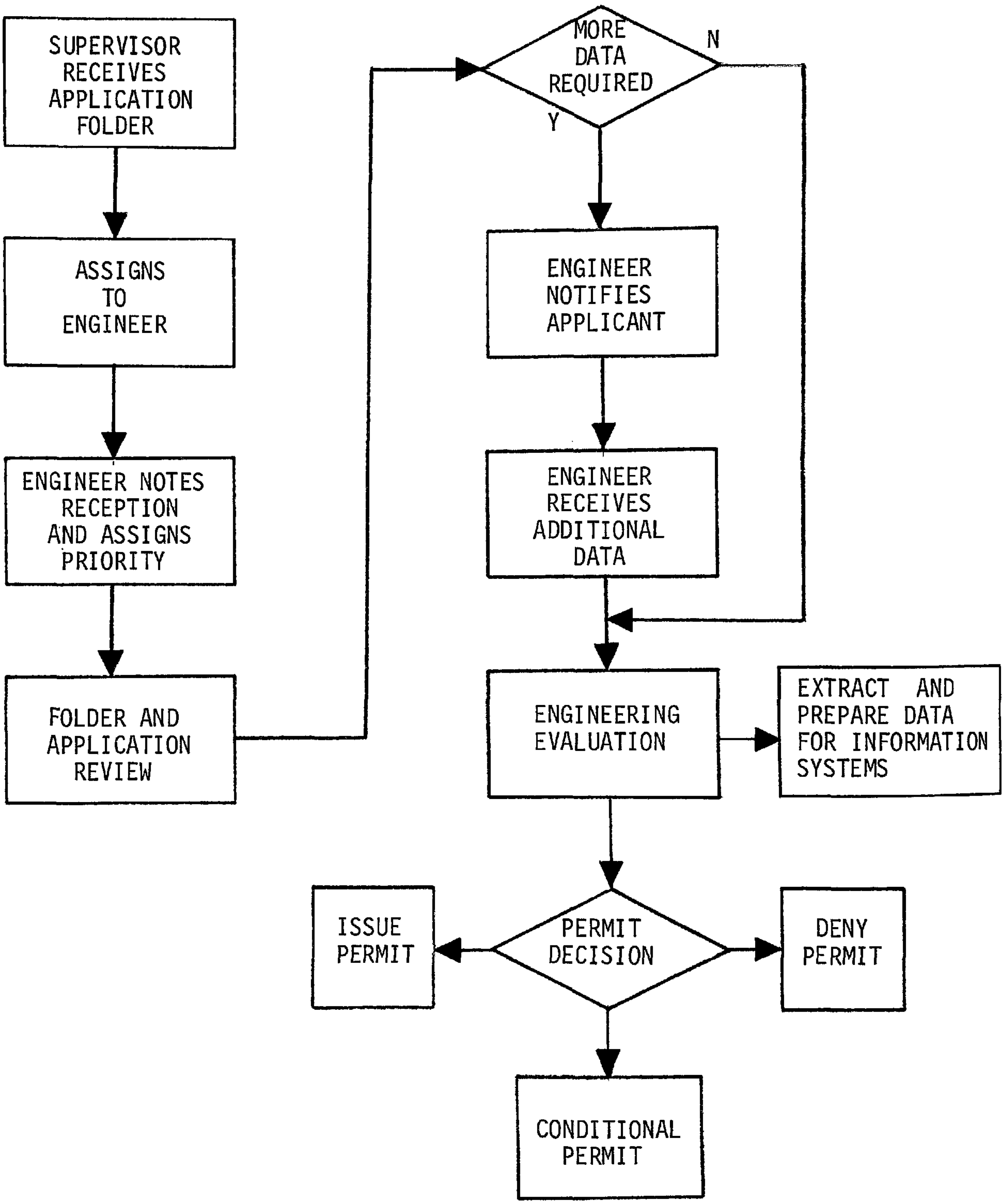


Figure 2.12. Steps in the engineering review process

State of New York
Department of Labor
DIVISION OF INDUSTRIAL HYGIENE
80 CENTRE STREET
NEW YORK, N.Y. 10013

ADDRESS REPLY TO:

DATE

NOTICE OF PLAN DISAPPROVAL

Plan No.
Location of System

The plans submitted by you for an installation or alteration of an exhaust system have been disapproved for reasons stated below:

Before approval can be given, it will be necessary for you to submit revised plans that comply with the above requirements. These should be forwarded, in triplicate, along with a new "Application for Approval of Exhaust System Plan", to the Division of Industrial Hygiene at the above address.

MORRIS KLEINFELD, M.D.
Director
For The Commissioner

IH-224 (3-66)

Figure 2.13. Plan disapproval letter

files. These could include the enforcement management system, the source registration system, the equipment inventory system, the emission inventory system, and the permit processing system. These systems may operate on a computer system, or they may be stored independently in file cabinets. This is largely dependent upon the needs and resources of the agency.

If the applicant disagrees with the evaluation judgment, he may appeal to a hearing or administrative board, or take the agency to court.

A more detailed discussion of the evaluation of the application for permit to construct is presented in Chapter 5.

F. Engineering Inspection

The engineering inspection is an essential function in the permit system. It follows the issuance of the permit to construct and precedes the granting of a certificate to operate. During this phase of the cycle, the engineer has the opportunity to observe the applicant's plant and operation of equipment. He must gather enough information to determine whether or not agency emissions standards are being violated. If more data are required, a source test may be requested. A flow chart of the engineering inspection process is presented in Figure 2.14.

If the applicant has previously received a permit to construct, it is desirable to have the same engineer perform the inspection. For this purpose, the engineer should maintain the folder in an agency holding file. He must begin by reviewing all of the information available to him pertaining to the applicant.

If a certificate to operate is being sought for existing equipment, the process begins in the same manner in which the engineering

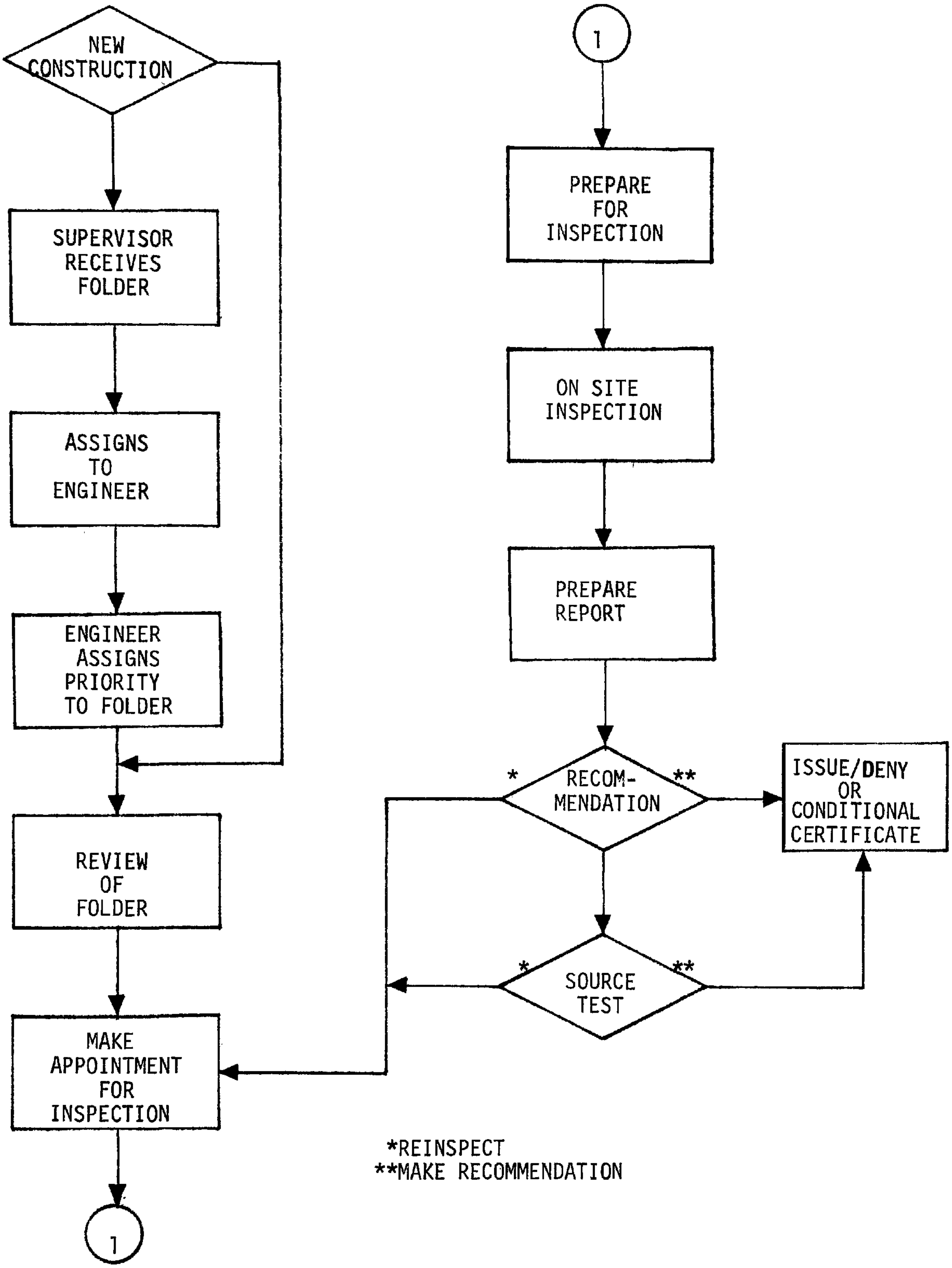


Figure 2.14. The engineering inspection process

evaluation started. The supervisor of the engineering unit receives the application folder, makes a note of the date, and records to which engineer (or field enforcement officer) he is assigning the inspection The engineer notes the date and assigns a priority to the folder. When he begins to review it, he makes certain that sufficient data are provided.

After he is satisfied that the folder is in order, the engineer (or field enforcement officer) must make an appointment for his plant visit. He then prepares a list of the information to be obtained and observations to be made during the inspection.

At the plant, the engineer (or field enforcement officer) notes meteorological and other physical conditions. He conducts interviews with the owner or operator and other personnel, as necessary. The engineer must verify that the equipment is as described in the application. If a major discrepancy exists, the application may have to be refiled. The engineer may rectify minor errors in the equipment description and other similar disparities directly. If the informatio is in order, the equipment is observed in operation.

After the inspection is completed, the engineer (or field enforcement officer) decides if a source test is necessary before he makes his recommendations. The possibilities are: issue a certificate to operate, issue a conditional certificate, allow the equipment use to continue but require a reinspection, or deny a certificate. If the applicant is dissatisfied with the result, he may appeal to a hearing board or take other legal action.

Chapter 7 contains a detailed description of the engineering inspection process.

G. <u>Permit Application Equipment Status</u>

An equipment item may require numerous permits during its usable existence. For each case, agency policy must determine the manner in which the various applications are handled. Table 2.1 lists the equipment status types and the ways in which an agency might decide to process them.

Table 2.1. Equipment status types and possible agency requirements

Equipment Status	Type of Permit	Engineering Evaluation	Engineering Inspection
xisting Equipment	Certificate to Operate	Yes	Yes
ew Construction	Permit to Construct	Yes	Yes
ompleted Construction	Certificate to Operate	No	Yes
hange of Ownership	Certificate to Operate	No	Yes
ddress Location Change	Certificate to Operate	No	Yes
quipment Alteration or Movement within Plant	Certificate to Operate	Yes	Yes
quipment Replacement	Certificate to Operate	Yes*	Yes
revious Permit Revoked	Certificate to Operate	Yes	Yes
erating Permit Denied	Certificate to Operate	Yes	Yes

If replacement is not identical.

In the event of a "change of ownership," or "address location change," inspections are required to verify that the equipment items have not been modified.

If an individual requests a permit for prohibited equipment or an illegal operation, the application should be immediately denied. For example, single-chamber incinerators may be outlawed.

A permit may be revoked if an operator is found to be violating its conditions of use. An example may be using heavy fuel oil when light oil is specified.

H. Issuance of the Permit

Once it is determined that the equipment meets the existing standards, all information has been provided to the agency, and the appropriate fees have been paid, the permit is issued. Examples of permits are given in Figures 2.15 through 2.17.

I. Informal Hearing

An informal hearing is a meeting of the applicant with agency personnel generally the engineer who processed the application. Such a hearing is requested by the agency in order to aid and advise the applicant concerning compliance with local statutes and regulations. It takes place after the evaluation if a permit to construct is being sought, or after the inspection if a certificate to operate is requested.

Discussions usually involve modifications to the equipment or alterations in operating procedures in order to bring the equipment into compliance with current standards. The applicant is familiarized with the nature of his responsibilities and of agency policies and requirements.

The conference may result in the following:

- The applicant is given additional time to correct the problems
- A compliance schedule is agreed upon;
- A series of inspections is set up;

STATE OF NEW YORK

DEPARTMENT OF ENVIRONMENTAL CONSERVATION

HENRY L. DIAMOND
Commissioner

ALBANY, NEW YORK 12201

Division of Air Resources
Bureau of Air Quality Control
41 State Street
Albany, New York 12207

Date Issued:

Expires:

Application Number:

PERMIT TO CONSTRUCT A SOURCE OF AIR CONTAMINATION
Issued Pursuant to 10 NYCRR 175-180

Permittee:

Installation Address:

Installation Description:

Emission Source
Reference Number:

Conditions:

Deviation from approved application shall void this permit. This is not a Certificate to Operate. Tests and/or additional air pollution control equipment may be required prior to the issuance of a Certificate to Operate. Not later than 30 days after the initiation of operation notify the local public health engineer

Eric A. Seiffer, Chief
Engineering Plans Review Section

No authority is granted by this permit to operate, construct or maintain any installation in violation of any law, statute, code, ordinance, rule or regulation of the State of New York or any of its political subdivisions.

NON-TRANSFERABLE
POST OR FILE AT INSTALLATION ADDRESS

AIR 101 (7-70)

Figure 2.15. Sample permit to construct

APC 136
Rev. 4/69

The City of New York

DEPARTMENT OF AIR RESOURCES
51 Astor Place, New York, N.Y. 10003
ROBERT N. RICKLES, P.E., Commissioner

Date Issued: ____________

Application No: __________

AGENT

OWNER

CERTIFICATE OF OPERATION

Location of Equipment or Apparatus:

The holder of this certificate shall comply with the conditions contained in this Certificate as well as all applicable provisions of the Air Pollution Control Code.

This certificate shall not be transferable and may be revoked at any time pursuant to the New York Air Pollution Control Code.

By: ______________________________

Head, Division of Industrial Processes

KEEP CERTIFICATE ON PREMISE NEAR EQUIPMENT

INSTALLER:

ALFRED PIERATTI
Director of Engineering

For the Commissioner

Figure 2.16. Sample certificate to operate (city agency)

STATE OF FLORIDA
DEPARTMENT OF AIR AND WATER POLLUTION CONTROL

OPERATION PERMIT

FOR ______________________________

____

____

PERMIT NO. ____________________ DATE ____________________

PURSUANT TO THE PROVISIONS OF SECTION 403.061 (16) OF CHAPTER 403 FLORIDA STATUTES AND CHAPTER 17-4 FLORIDA ADMINISTRATIVE CODE, THIS PERMIT IS ISSUED TO:

____

FOR THE OPERATION OF THE FOLLOWING:

____

____

LOCATED AT: ______________________________

____

IN ACCORDANCE WITH THE APPLICATION DATED ____________________
AND IN CONFORMITY WITH THE STATEMENTS AND SUPPORTING DATA ENTERED THEREIN, ALL OF WHICH ARE FILED WITH THE DEPARTMENT AND ARE CONSIDERED A PART OF THIS PERMIT.

THIS PERMIT SHALL BE EFFECTIVE FROM THE DATE OF ITS ISSUANCE UNTIL REVOKED OR SURRENDERED AND SHALL BE SUBJECT TO ALL LAWS OF THE STATE AND THE RULES AND REGULATIONS OF THE DEPARTMENT.

____________________ ____________________

DAVID H. SCOTT, CHIEF
BUREAU OF PERMITTING

VINCENT D. PATTON
EXECUTIVE DIRECTOR

FORM 1-I

Figure 2.17. Sample certificate to operate (state agency)

- Arrangements are made for entering the plant if special circumstances exist; or
- The applicant is directed to equipment experts and manufacturers.

If he is dissatisfied with the results of the meeting, the owner or operator is advised to request an administrative hearing.

J. Hearing Board Decisions

Hearing boards are usually quasi-judicial bodies provided for by the basic state acts dealing with air pollution control. The board's makeup should include attorneys and licensed engineers, preferably mechanical or chemical. Procedures governing the operation of these boards may be quite informal, or as formal as those of actual judicial bodies including power of subpoena, provision for cross-examination, and strict rules of evidence.

Hearing boards have a variety of functions depending upon basic legislation and the type of rules and regulations utilized in the control of air pollution. Several of the main functions are discussed below:

1. Variances

Variances are temporary authorizations to discharge air contaminants in excess of the statutory limit. Usually they are issued for periods of time not to exceed a year without additional review and in no case may a public nuisance be allowed to exist as a result of a variance. Submission of acceptable plans for or progress towards controlling the particular air pollution problem is the usual condition for granting a variance.

Hearings on variances are equity proceedings to the extent that private losses are balanced against the public good in each case.

A typical case in which a variance might be justified could involve a manufacturing plant employing several hundred people and producing a product sold in a highly competitive market. Air pollution in excess of mass emissions standards is discharged, but no public nuisance appears to exist. The plant has definite attainable plans for installing control equipment, but installation will take 3 months. A variance to operate during this period is requested on the grounds that several hundred people will be put out of work if the plant is forced to close for this period and the plant may also face the permanent loss of at least a portion of the market for their product. The granting of a variance for a 3 month period on the condition that suitable control equipment be installed would be a likely outcome of such a hearing.

The advantage of a hearing board for granting exceptions to statutes is that the air pollution control agency does not have to compromise its role as the organization responsible for enforcing rules and regulations. It has little excuse for not acting in a vigorous manner to secure abatement of all air pollution sources. The variance procedure can be abused, of course, if inordinately long periods are authorized in the variance or if variances are renewed on insufficient technical or economic grounds.

2. <u>Appeals of Permit Denial</u>

A permit system not only provides the agency a great deal of power to take preventive action against air pollution, but also gives it substantial responsibility to exercise this power wisely. It is conceivable that mistakes in judgment of a technical nature may be made by agency engineers reviewing applications, particularly permits to construct. The person seeking to operate or install a process or item of control equipment, if he feels an incorrect decision has been made, is offered a further opportunity to gain permission through appeal to the hearing board which is not a costly court procedure.

3. Issuance of Abatement Orders

Hearing boards may be authorized to issue abatement orders following a hearing requested by the agency. An alternative method allows abatement orders to be issued by the executive head of an air pollution control agency. In this case, the board may be authorized or required to review such orders before they can be enforced. In a similar manner, findings of violation by the air pollution control officer may have to be confirmed by a hearing board before court action can be taken.

3. Revocation and Suspension of Permits

Whenever equipment which has been granted a certificate to operate develops a chronic history of non-compliance, the air pollution control officer may revoke the permit.

Permits may also be suspended by the agency if the permittee fails to furnish required information, analyses, plans, or specifications. If the permit is suspended, the permittee may petition the board for a hearing to determine whether or not the permit was properly suspended. Accordingly, the hearing board may reinstate the permit, sustain the suspension, or set forth conditions which must be met before reinstatement is granted. The agency may reinstate a suspended permit on its own discretion.

K. Court Decisions

Hearing board decisions may be appealed to the courts by the agency, companies, or individuals. Agencies may use the courts as a means of forcing violators to comply. Maintenance of a public nuisance is a crime and punishable by criminal sanctions. The two common categories of crimes are misdemeanors and felonies. Where violations of public nuisance or other air pollution statutes are declared to be a crime, they are inevitably treated as misdemeanors. Misdemeanor penalties may involve both fines and imprisonment with a common maximum penalty of $500 or a year in jail. State prison sentences are not allowed for misdemeanors. It is possible in some states, however, to impose felony penalties on conviction of conspiracy to commit a misdemeanor.

The use of civil procedures to secure enforcement of air pollution statutes serves as an alternative or supplementary approach to that of criminal sanctions in many jurisdictions. The injunction is one of the traditional and most powerful tools available. It seeks to prevent a future action by a polluter rather than to punish a past action. Kennedy[2] suggests that it is the "big gun" to be used mainly when dealing with a large and continuing violation, since injunctive procedures can become very lengthy. Brecher and Nestle[3] state that the courts often assert that a permanent injunction is an extraordinary remedy to be granted sparingly. The courts also "balance the hardships" in injunction cases.

Another civil approach is available when the legislature provides for monetary forfeiture following a determination that an abatement order or regulation has been violated. Some states have provided for very heavy monetary penalties particularly for violation of an abatement order issued by a variance board following a hearing. These actions may take precedence over many other civil matters and therefore the delay in enforcement is minimized.

II. INTERFACES WITH OTHER CONTROL AGENCY FUNCTIONS

Permit processing interacts with nearly all agency functions. These interactions may be viewed from the standpoint of (1) input information obtained from other agency functions that is necessary to complete the processing of permit applications, and (2) output information generated from the permit system to satisfy the needs of other agency operations. Examples of sources of input information are field facility inspection reports supplied by enforcement personnel. These include past field reports and violation notices, and special reports or investigations requested by permit engineers. Source tests provided by the source testing services of the agency represent another important source of data input.

Output functions, as a rule, are only indirectly related to the task of permit processing. Output arises from the permit system as a whole, i.e., as a result of summarizing or aggregating information which has been extracted from the individual permit case files. These would include, for example, source listings; summaries of permits pending, approved and denied; status of cases being heard before the hearing board; and information suitable for the updating of emission inventories and scheduling of engineering and field enforcement assignments.

One of the most important types of permit system output is emission inventory information. The permit system will provide (1) a highly accurate and complete list of new sources and their grid locations, (2) exact equipment inventories and (3) the most precise estimates of emission rates and equipment operating schedules available. This information, when evaluated can be extracted either manually or by computerized techniques to continuously upgrade the regional emission inventory.

The design of the permit system should adequately take into account these input and output requirements and should provide for the cooperation needed to institute a system that encourages exchange of information, as illustrated in Figure 2.18.

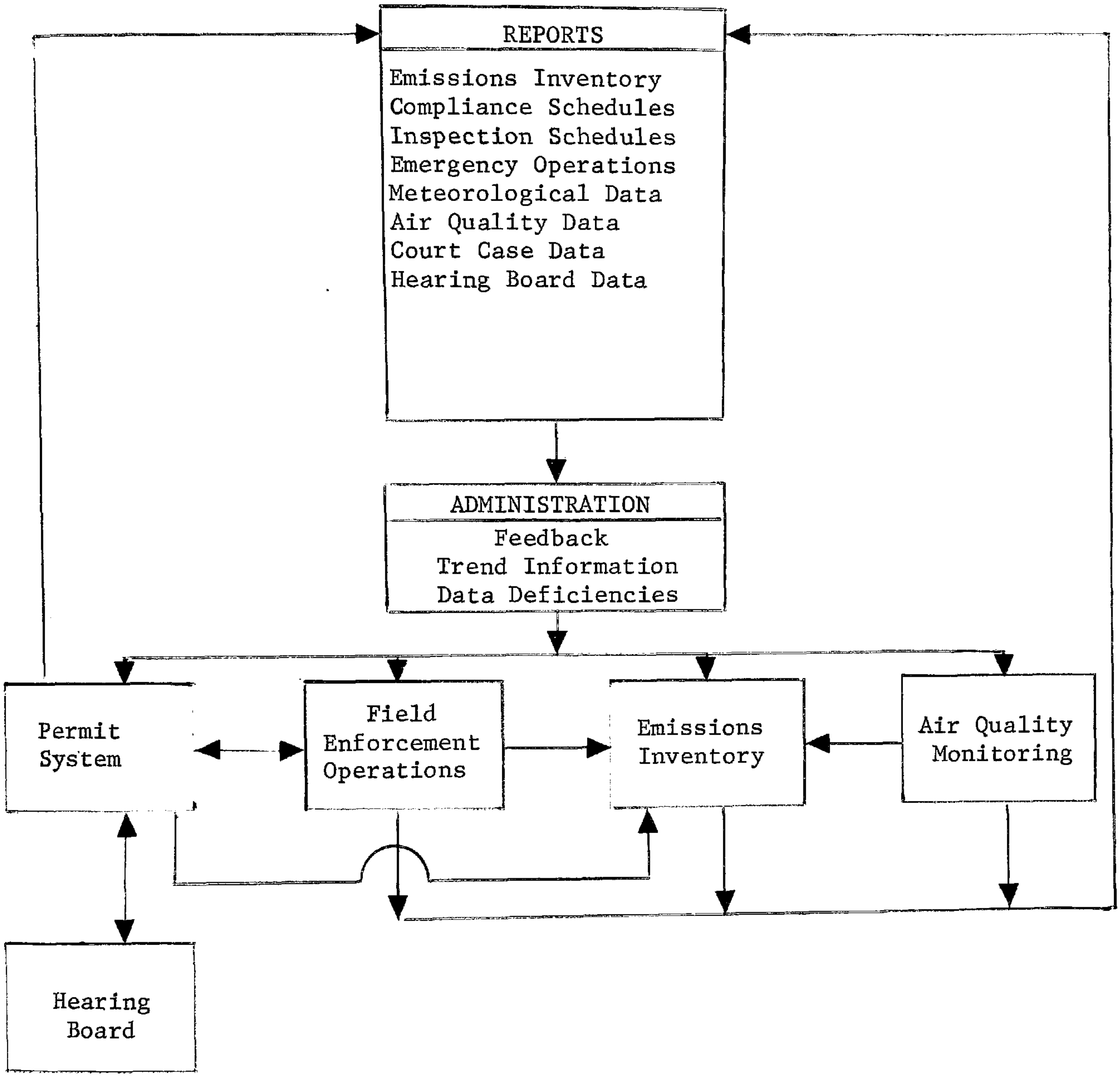


Figure 2.18. Information flow in an air pollution control agency

A. Data Requirements

Cost-effective operation of the permit system will particularly depend upon assistance from the field enforcement unit and source testing services. This help will come in the form of operational and emissions data needed to complete the assessment necessary for issuing certificates to operate.

1. Inspection

The granting of a certificate to operate depends upon the successful completion of an inspection of the equipment during its most demanding operational mode. This may not be possible during a single inspection but may require a series of observations over a specified length of time to provide the data needed for making the pass/fail decision. To accomplish this task, field enforcement personnel may be employed to observe the process in operation under specified conditions. This will not only supply the engineer with decision-making data, but also will give the field enforcement officer first-hand experience with new equipment in his area (see Chapter 7, Inspection Techniques).

2. Source Tests

When it has been determined that a source test is required before a certificate to operate is granted, the cooperation of at least two agency divisions will be needed. The source test team must be apprised of the test conditions and the field enforcement officer must be informed of his role in the test, e.g., checking for visible emissions, conducting an odor survey, or assisting in the recording of field data.

The engineer responsible for processing the permit application should schedule the test, taking into account the work backlog of the test team and the availability of field enforcement personnel. Agency management must set priorities where demand exceeds the source test services available.

B. Data Outputs

Many functions of the air pollution control agency receive information from the permitting division germane to their operations. These data outputs provide the basis for planning, reporting, and legal action. The following items are representative of this data:

- Number, description and location of equipment issued permits;
- Number of permits denied by equipment category;
- Number of conditional permits issued;
- Emissions estimates;
- Estimates of emission reductions;
- Variances in effect;
- Manpower summaries and projections;
- Budgetary requirements;
- Number of source tests requested/completed; and
- Emergency/episode data.

This information will flow into several areas culminating in reports vital to the administration of the agency. It will provide the air pollution control officer with the facts he requires to man, operate, and administer his organization to meet the goals of the control agency.

REFERENCES

1. Lunche, R.G., E.E. Lemke, R.L. Weimer, J. Dorsey and J.A. Verssen (ed.). Administration of the Permit System, Fourth Edition. Air Pollution Control District, County of Los Angeles, California. January 1968, p. 92-93.

2. Kennedy, H.W. The Formulation and Adoption of Reasonable Rules and Regulations. 55th Annual Meeting of the APCA, Chicago. May 20-24, 1962.

3. Brecher, J.J. and M.D. Nestle. Environmental Law Handbook, California Continuing Education at the Bar, Berkeley, California. 1970.

4. Lunche, R.G., E.E. Lemke, and J.A. Verssen. Administration of a Permit System. Journal of the Air Pollution Control Association, Vol. 19, No. 1. January 1969.

5. Loquercio, P.A. and W.J. Murphy. How an Effective Permit System Works. 61st Annual Meeting of the APCA, St. Paul, Minnesota. June 1968.

CHAPTER 3
DATA AND INFORMATION SYSTEMS

I. INTRODUCTION

Many air pollution control agencies currently find themselves in a position in which their responsibilities are increasing, the amount of data and records that they must process is rapidly expanding, and trained and experienced personnel are in short supply. Information systems adapted to the specific needs of these agencies could provide significant assistance by storing, managing and retrieving data essential to operations. Such an information system would free professional staff members from tedious recordkeeping and reporting tasks, facilitate the daily performance of the agency, and help it to realize the full measure of air pollution control.

II. SPECIFICATION OF INFORMATION SYSTEMS

In order to properly design an information system for a particular air pollution control agency, an extensive systems analysis must be performed to determine how to satisfy most effectively and efficiently the information management needs of the agency. The analysis must consider all of the individual elements which are necessary to the system, and how they may be combined into an ordered and effectual operating unit. However, the designer is often hampered by having to adhere to rigid restrictions such as limited fiscal and manpower resources, specific requests of the users, and a need to complete the task in a relatively short period of time. Nevertheless, the result of this analysis must be an informational document (The System Specifications) that describes what the system will accomplish and how it will operate. The document enumerates the functions to be performed within the scope of the available assets. If the resources are limited, certain tasks, judged not to be extremely important, may be omitted from the plan.

The initial design of an information system should not be considered as an end in itself, but rather as the first phase of an expandable system. Consequently, all functions do not have to be included at this point. However, provision to add them to the system, as the need arises, should be made without the necessity of scrapping the original programs.

In addition, the design, implementation, and utilization of the information system will all be elements of a complex learning process for the agency. As agency personnel gain experience with the system, it is to be expected that modifications will be desired. The incorporation of changes and the expansion of the system must be important considerations of the initial design.

III. ELEMENTS OF THE SYSTEM

This section will discuss all the important elements which must be included in the System Specifications document describing the permit system of an air pollution control agency. Other related functions performed by such agencies will also be considered.

A. Data Base Design

A data base is that subset of information available to the system, collected from the set of all available information and organized in a useful and functional manner. It must be generated (readied for use) and it must be capable of being updated, in order to continuously provide meaningful responses to its users.

The data base design is significant because of the impact it has on costs throughout its life as part of the system. For example, if extraneous information is left in the data base, costs are increased for all data handling, retrieval, and updating operations. As a result, only the minimum data required for the effective utilization of the information system should be entered.

Figure 3.1 depicts a data base that might be considered typical for use in permit system applications. Each component has a number, name, format, and definition. The component definition has been inserted in order to clarify each item. The number and name were included to conform to the requirements of the data retrieval system for which this data base was prepared. The use of this data base will be illustrated later in this chapter.

Using the data base in Figure 3.1 as an example, the following points should be made:

- For each permit number, all of the information indicated in the associated components must be supplied to the data base, where applicable. This information, associated with item C2 (PERMITNO), is defined as an entry. Each entry in the data base must contain a unique component, one whose value is different from that of any other entry. In this example, the permit number is that item. No entry in the data base may have a permit number identical with the permit number of a preceding entry.

- Items C4 through C7 may be considered as unnecessary in many data bases. This information may be stored in a rolle-flex or similar file, and may be retrieved by direct lookup of the permit number. It is unlikely that information concerning the company name, address, telephone number or responsible company member will be needed for comparison with other information, or that it will be utilized in mathematical computations. Consequently, if these items are included, maintenance of the data base becomes more costly. There are circumstances

COMPONENT NUMBER	COMPONENT NAME	COMPONENT FORMAT	COMPONENT DEFINITION
C1	PERMIT1		Data Base Name
C2	PERMITNO	(NNNNNN) , SORT-A	Permit Number
C3	UNIT	(17S)	Equipment Unit
C4	COMPANY	(20S)	Company
C5	ADDRESS	(43S)	Company Address
C6	MEMBER	(15S)	Responsible Company Member
C7	PHONE	(14S)	Company Phone
C8	GRID	(NNN)	Map Grid Number
C9	ZONE	(NNN)	Inspection Zone Number
C10	SIC	(NN)	Standard Industrial Classification
C11	STATUS	(SSSSSSSS)	Permit Status
C12	APPLIED	(NNNNNN) /	Application Date
C13	APPLYMO	(NN)	Application Month
C14	APPLYYR	(NN)	Application Year
C15	BUILD	(NNNNNN) /	Construction Start Date
C16	BUILDMO	(NN)	Construction Start Month
C17	BUILDYR	(NN)	Construction Start Year
C18	OPERATE	(NNNNNN) /	Operation Start Date
C19	OPERMO	(NN)	Operation Start Month
C20	OPERYR	(NN)	Operation Start Year
C21	LASTSPEC	(NNNNNN) /	Last Inspection Date
C22	LASTMO	(NN)	Last Inspection Month
C23	LASTYR	(NN)	Last Inspection Year
C24	NEXTSPEC	(NNNNNN) /	Next Inspection Date
C25	NEXTMO	(NN)	Next Inspection Month
C26	NEXTYR	(NN)	Next Inspection Year
C27	INSPECTS	(NNN)	Total Number of Inspections
C28	YRSPECTS	(NN)	Number of Inspections in Calendar Year
C29	ENGINEER	(15S)	Inspector/Engineer
C30	BASIC	(NNNNNNNN) $	Basic Unit Cost
C31	CONTROL	(NNNNNNNN) $	Control Equipment Cost
C32	FEE	(NNNNN) $	Permit Fee
C33	SOX	(NNNNN)	Sulphur Oxide Emissions (lbs/hour)
C34	CO	(NNNNN)	Carbon Monoxide Emissions (lbs/hour)
C35	NOX	(NNNNN)	Nitrogen Oxide Emissions (lbs/hour)
C36	PART	(NNNNN)	Particulate Emissions (lbs/hour)
C37	HIGHHC	(NNNNN)	Hydrocarbon (High Reactive) Emissions (lbs/hour)
C38	LOWHC	(NNNNN)	Hydrocarbon (Low Reactive) Emissions (lbs/hour)
C39	ODOR	(N)	Odor Classification
C40	XTRA1	(NNNNNNNNNN)	Extra Component
C41	XTRA2	(NNNNNNNNNN)	Extra Component
C42	XTRA3	(NNNNNNNNNN)	Extra Component
C43	XTRA4	(NNNNNNNNNN)	Extra Component

N = numerical　　/ = date format
S = all characters　　$ = monetary values

Figure 3.1. Permit system data base

under which retaining this information in the data base may be justified. This decision must be made by those individuals responsible for the system's development.

- The five dates specified in components C12 through C26 are overlayed items. This means, for example, that if the permit application date is to be retrieved, item C12 (APPLIED) must be specified. However, both the application month, item C13 (APPLYMO), and the application year, item C14 (APPLYYR), may be recovered individually or together. This illustration is included to demonstrate to the data base designer that occasionally subelements, as well as the entire data element, should be retrievable on command.

- The final four components, C40 through C43, have been specified as spare items in each entry of the data base. If at some later date, additional information is to be added, space has been provided without necessitating the restructuring of the previously prepared data.

B. Data Preparation

The specific data elements that are selectively chosen to be entered into the data base must undergo extensive preprocessing and checking in order to ensure their overall quality. A long-held data processing axiom is "garbage in, garbage out." It refers to the fact that data bases containing information that is subject to error and inconsistencies cannot yield meaningful responses when queried.

Information included in a permit system data base will likely be derived from permit applications, engineering evaluations, inspections and reports, source tests, and other documents. Those individuals responsible for completing all forms and reports should be encouraged to use consistent terms and units of measure. The forms used should allow for the direct transfer of the information to automatic data processing storage mediums (see Forms Design, Section V).

Data that are not subject to being recorded on the above forms must be enumerated separately on coding sheets, then merged with the other data either before or after the data base is generated. The method used depends primarily on the amount of data and the costs involved.

Before the data base is generated, all forms and coding sheets should be checked to verify that the units of measure are the same throughout, and that the other information is correct. After generation, all stored data should be verified to make certain that the individual permit number entries have been created properly. These steps are necessary to authenticate the character of the data base and give confidence in its use to those who may query it.

C. Data Base Updates

Updating a data base is the process of removing information which is no longer relevant or of use, and adding data that have recently been made available. If this procedure must be performed frequently, it can become tedious and expensive. Often, delaying a modification in order to confirm its accuracy will be preferable to changing the data base incorrectly or unnecessarily.

A cardinal rule to follow when updating is to always maintain one or more backup copies of the data base. This backup is required to facilitate the adjustment of erroneous modifications. If a backup were not available, correct information might be lost.

Quite naturally, all information that is added to the data base should be verified just as the original elements were. Often updating costs can be reduced by accumulating modifications until a significant number exist, and making all changes at once. This would only pertain to cases in which the new information is not absolutely necessary to the system.

D. Data Retrieval

An effective information system should provide for the retrieval of several categories of responses from the data base. These responses must be presented to the user in a form in which they are easily understood and can be utilized in the informational and decision-making processes. No special deciphering and arranging should be necessary.

Among the appropriate types of data retrievals are the following:

- Specific data elements--These are direct responses to definite queries of the data base. Examples are:

  1. Next inspection date for permit number 167328.
  2. CO emissions in lbs./hr. for permit number 109062.

- Complete entries--These are the entire complement of stored data relating to a permit number.

- Logical responses--These represent the ability to selectively retrieve information subject to indicated conditions. Such a query may have one or many possible responses with several data items in each. Examples of this type of inquiry are:

  1. List permit number and inspection date for all equipment having a status of pending or conditional.

2. List permit number, status, and control equipment cost for all equipment with CO emissions greater than 100 lbs./hr. and NO_x emissions greater than 200 lbs/hr.

- Statistical analysis--For most permit systems, the ability to perform extensive statistical analysis is unnecessary. Generally, only the capability to obtain sums and means for a whole region or by specific grid areas is required. However, the ability to perform more sophisticated statistical calculations would be an advantageous feature.

- Reports--This is the ability to retrieve qualified layouts of information on a demand basis. The report configuration may be specified once and applied weekly, monthly, or on an as-needed basis, or it may be employed when it is created.

The types of data retrievals listed above are presented only to depict desirable traits of an information system. It is possible to utilize a system with fewer capabilities, the primary difference being the manner in which the user requires the data to be selected.

E. Turnaround

In addition to the types of data retrievals that may be chosen, one must also be concerned with the time it takes for a response. The period from the initiation of the query of the data base to the receipt of the response is defined as the "turnaround time." It may be as short as a few seconds if a conversational system is being used, or as long as a few days if a busy batch installation is utilized.

With regard to permit systems in particular, a very short turnaround time must be classified more as a convenience than as a necessity. It is a rare occasion when an exceedingly short response time is required. In most cases, overnight turnaround would be sufficient.

The acceptability of a conversational system with the above-illustrated retrieval capabilities relates to the investigative continuity of the engineer involved. If he desires to obtain particular information from the data base, then forcing him to wait many hours or overnight for the response may tend to disrupt his work patterns and thought processes.

F. Documentation

The useful life of an information system is extremely dependent upon the quality of its associated documentation. The documentation must consist of a complete System Description volume, and an easy-to-follow User's Guide. The former is vital if changes are required for the system. The individuals performing the modifications may not be the same persons who originally participated in the design and programming. Without adequate flow charts and descriptions, their task might be much more difficult. The latter is necessary to continually train engineers and technicians in the use of the system in order to maintain its operation at peak capacity. The User's Guide should describe all possible input configurations in great detail and provide examples to avoid confusion.

IV. DATA ELEMENTS

The system for issuing permits to construct and certificates to operate receives inputs from field enforcement, source testing, and business management sources, and provides data to all facets of the agency. It is therefore necessary to detail the overall agency information needs as well as those that pertain to the permit function.

A. Application Data Components

A well-designed application form is essential for the economic operation of an information system. The form should be designed so that it may be completed by typewriter, is compatible with automated data processing, and still provides the essential engineering data elements. The following items are the minimum necessary:

1. Name of company or individual which will appear on the Permit/ Certificate
2. Address at which equipment is located
3. Mailing address if different from equipment location
4. Description of equipment/process for which the permit is requested
5. Previous ownership of equipment (if any)
6. Status of construction
    a. New construction
    b. Modification of existing equipment
    c. Change of ownership
    d. Change of location
    e. Construction started without a permit
    f. Estimated construction start date
    g. Estimated construction completion date
    h. Duration of testing and running time
    i. Date when equipment will be ready for inspection
7. Estimated cost of equipment
8. General nature of business where equipment is located
9. Signature of responsible member of company (type or print name als
10. Signature and registration number of a Professional Engineer (P.E.) (if required to sign application)
11. Signature of individual who completed application if other than owner or P.E.

For selected equipment or processes, the following information should also appear on the application:

1. Operating schedule, hrs./day and days/week
2. Process weight--specify the type and quantity of material charged to the process per unit time
3. Fuel used
   a. Gaseous fuel--specify types, use rate in cubic feet per hour
   b. Liquid fuel--specify fuel oil grade, use rate in gallons per hour and preheat temperature, if any
   c. Solid fuel--specify type of fuel, heating value, firing rate
4. Storage of liquids or gases
   a. Vessel capacity
   b. Design details
   c. Names of liquids, vapors or gases stored
   d. Received vapor pressure
   e. Pressure at which gas or vapor is stored

B. Permit Classification and Unitization

Useful and pertinent information may be compiled from the operation of a system issuing permits to construct and certificates to operate. This information can be organized by the type of equipment, industrial process, type of emissions, rate of emissions, source concentration by grid and other categorical breakdowns. Therefore, it is necessary to be able to classify equipment which will require a permit into several broad categories: equipment capable of emitting air contaminants, equipment designed for the control or capture of air contaminants, the types of air contaminants emitted and the industrial classification in which the process or equipment is used. Terms commonly used are:

- Basic equipment } potential source of air contaminant emissions
- Process system }
- Air pollution control equipment
- Air pollution control systems

Dividing equipment and processes into units is a reasonable approach to defining logical boundaries for a single certificate to operate. It allows the agency to specify absolutely all the machinery and devices for which each certificate to operate is issued. Unitization also aids the field enforcement officer by enabling him to identify equipment more easily and to determine if any unauthorized changes or modifications have been made. The Los Angeles County Air Pollution Control District defines a permit unit as a "...grouping of items functioning as a whole which will be allowed to be a single application for a permit."[1] The principles employed in determining the permit unit are:

1. Grouping of Individual Items

   A permit unit will include all equipment and appurtenances for the processing of bulk material which are united physically by conveyer or chute or pipe or hose for the movement of product material provided that no portion or item of the group will operate separately with product material not common to the group operation. Such a grouping is considered as encompassing all the equipment used from the point of initial charging or feed to the point or points of discharge of material where such discharge will (1) be stored, or (2) proceed to a separate process, or (3) be physically separated from the equipment comprising the group.

2. Storage Equipment

   Storage equipment is any tank, bin, vat, vessel or other device, employed to receive and store any bulk material for future use. A storage vessel can be included with the permit unit from which it receives material if the material is solid, received from only one source permit unit and physically united to the source permit unit by conveyer, chute, pipe or hose. The storage vessel will be considered a separate permit unit if the material being stored is a liquid or a gas, or is received from more than one source permit unit or is not united physically to the source permit unit.

3. Parallel Equipment

   Individual equipment items, or groupings of equipment, serving a parallel function, operated independently and not physically united for the flow of material will be considered as separate permit units.

4. Spare or Standby Equipment

   a. Spare or standby equipment, which is a separate permit unit in itself (i.e., a boiler, a degreaser, a spray booth, a unit of air pollution control equipment, etc.) requires a separate permit regardless of how infrequently it may be used.

   b. Spare or standby equipment, which is not a separate permit unit in itself (i.e., an oil burner unit, an electric motor, etc.) does not require a separate permit, nor shall its specific energy or capacity ratings be taken into account unless its ratings are not identical to the ratings of the equipment it is intended to relieve. In such cases, only the greater of the two ratings shall be used to establish the permit fee.

5. Combustion Equipment

   Any fired heating equipment using exclusively natural gas or LPG will be considered as a part of the permit unit it serves. Any fired device, where the equipment is capable of utilizing a fuel other than natural gas or LPG, and where the products of combustion do not intermingle with the product, presents a separate air pollution problem and will be considered as a separate permit unit.

6. Shared Equipment

   Equipment which operates as a part of more than one permit unit, either alternately or simultaneously, is a part of each permit unit with which it is associated.[2]

This approach has proven extremely helpful in categorizing equipment and processes and strongly lends itself to data processing and information retrieval.

C. Classification of Equipment

1. Standard Industrial Classification

The Standard Industrial Classification (SIC) numbering system serves as the basis for the "Air Pollution Manual of Coding."[3] It presents a method of classifying industries and equipment having a potential for emitting air contaminants. This technique of classification describes the industry, basic equipment related to a "unit process," and control devices as follows:

a. Standard Industrial Classification is a four-digit number designating an activity found in a specified industry. The major industrial categories are two-digit numbers such as: 20, Food and Kindred Products. Coffee roasting is 2095, which indicates that it is a subset of the food industry.

b. Basic Equipment or Process Code is divided into 19 categories. These categories are based upon a loose interpretation of unit operations adapted to the particular requirements of this system. The code is a three-digit number relating to the major classification of the "unit process" which it covers, e.g., 2, Heat Transfer; 201, Wire Insulation Incinerator.

c. Control Equipment Code is a two digit number derived from seven groups of air pollution control devices: e.g., 00 group control by combustion, 01 group--catalytic combustion. This presents a method of combining the basic control equipment codes to form a complete operating unit.

2. Equipment Specifications

Equipment specifications are valuable data elements in permit systems. They aid administrative personnel in determining the effectiveness of classes of equipment and numbers of specific units in use. These elements include descriptions of capacity, size, throughput and power needs. For basic equipment it is necessary to detail the primary function of the unit, its capacity, whether it is continuous or batch, the length of each batch operation, the material processed and the product. Air pollution control equipment is usually a part of a system. The system's descriptive elements are capacity in CFM, fan or compressor horsepower, and number and type of basic equipment units or processes served. The specifications for the air pollution control device must include design efficiency, operating temperature, cleaning method and precise operating characteristics (air-to-cloth ratio, water-to-air ratio, rapping cycle, bag material, etc.).

3. Contaminant Code

The equipment codes and classifications must be associated with the types of air contaminants emitted from the basic equipment and captured by the air pollution control system. SAROAD,[4] Storage and Retrieval of Aerometric Data, provides an excellent method for coding and classifying these data elements. The manual prepared by the Environmental Protection Agency, Office of Air Programs, provides a standard coding procedure for suspended particulates, settled particulates, respirable particulates, gases and vapors, biocides, allergens and pathogens, atmospheric and related parameters, basic effects, fractional particulates and a miscellaneous category.

D. Additional Data Elements

Additional data elements are neither descriptive nor quantitative in nature. They are relevant as operational factors of basic and control equipment and contain information from field enforcement records.

1. Field Enforcement Records

The enforcement records include routine inspection reports, recorded violations, legal and hearing board actions, nuisance complaints, and emergency action codes. They are all cross-referenced to a specific piece of equipment or process authorized by a certificate to operate.

2. Emissions Data

Quantitative and qualitative data pertaining to emissions is derived from source testing. The associated elements include operational characteristics such as process weight, length of cycle, the part of the cycle during which the test was conducted, total time of test, contaminants the test was designed to measure, contaminants collected during the test and the quantity of the material collected.

During the evaluation of an application for a permit (see Chapter 5), assessments are made of anticipated contaminant emissions. These data are calculated from published emissions factors, statistical estimates of contaminated emissions taken from source tests, or other factors used by the agency for evaluation criteria. The information elements are calculated emission rates of contaminants in pounds per hour or grains/SCFM, the composition of the emissions, the gross emission rate per operating day (number of hours of process operation), the estimate of the contaminants captured by the air pollution control equipment, the anticipated efficiency of the control device and the location of the source of emissions by grid.

3. Nuisance Data

Permit information systems should include data relative to potential nuisances caused by the operation of basic equipment and processes. The information is derived from odor ratings, dust fall, soiling surveys, property and material damage, plume rise and fall, and diffusion calculations. The data elements based upon these considerations are odor rating or classification (Henning's Odor Classification, Croker-Henderson Classification or others),[5,6] prevailing wind direction, location and distance to nearest building, calculated concentrations down wind, estimated dust fall and corrosive nature of emissions.

V. APPLICATION FORMS DESIGN

The application form performs an important service in the operation of a permit system. It contains virtually all the information available to the agency concerning the use or possible use of a unit of equipment. The decision to grant or deny a permit to construct or a certificate to operate is significantly based upon this data. Therefore, the application forms utilized by the agency should contain all necessary information to ensure that judgments of the agency are rendered in the best interests of the public.

It is desirable for the form to be as brief as possible, but data quality should not be sacrificed for brevity. Some agencies have found it necessary to employ a general application form for most categories of equipment, supplemented by additional specialized forms which supply detailed data for a specific class of devices.

An example of this is the forms used by the Los Angeles County Air Pollution Control District for "Storage Tanks for Liquids, Vapors and/or Gases." The special form "Storage Tank Summary" (Figure 3.2) provides all

AIR POLLUTION CONTROL DISTRICT - COUNTY OF LOS ANGELES
434 SOUTH SAN PEDRO STREET, LOS ANGELES, CALIF. 90013 MADISON 9-4711

STORAGE TANK SUMMARY

(SEE REVERSE SIDE FOR INSTRUCTIONS)

ONE COPY OF THIS FORM MUST BE FILLED OUT COMPLETELY FOR EACH TANK AND MUST ACCOMPANY THE TRIPLICATE APPLICATION FOR PERMIT (FORM 400-A).

1. BUSINESS LICENSE NAME OF CORPORATION, COMPANY, INDIVIDUAL OWNER OR GOVERNMENTAL AGENCY UNDER WHICH APPLICATION (FORM 400-A) IS SUBMITTED:
2. TANK LOCATION:
3. TANK IDENTIFICATION (NUMBER OR NAME):
4. TANK CAPACITY: BARRELS GALLONS
5. TANK DIMENSIONS: DIAMETER ______ HEIGHT ______ LENGTH ______ WIDTH ______
6. TANK SHAPE: CYLINDRICAL ☐ SPHERICAL ☐ OTHER SHAPE ☐ DESCRIBE ______
7. TANK MATERIALS OF CONSTRUCTION: STEEL ☐ WOOD ☐ OTHER ☐ SPECIFY ______
8. TANK PAINT: CHALKING WHITE ☐ LIGHT GREY OR BLUE ☐ ALUMINUM ☐ DARK COLOR OR NO PAINT ☐
9. TANK CONDITION: GOOD ☐ FAIR ☐ POOR ☐
10. TANK STATUS: NEW CONSTRUCTION ☐ ALTERATION ☐
11. TYPE OF TANK: (CHECK ALL APPLICABLE) FIXED ROOF ☐ PRESSURE ☐ INTERNALLY HEATED ☐ UNDERGROUND ☐ FLOATING ROOF ☐ OPEN TOP ☐ INSULATED ☐ OTHER ☐
12. IF TANK IS TO HAVE A FLOATING ROOF, SUPPLY THE FOLLOWING INFORMATION:
    - TYPE OF ROOF: DOUBLE DECK ☐ PONTOON ☐ OTHER ☐ DESCRIBE ______
    - TYPE OF SEAL: SINGLE ☐ DOUBLE ☐ OTHER ☐ DESCRIBE ______
    - TYPE OF SHELL CONSTRUCTION: RIVETED ☐ WELDED ☐ OTHER ☐ DESCRIBE ______
13. IF TANK IS TO HAVE ANY OTHER TYPE OF ROOF OR COVER (OR NONE AT ALL), DESCRIBE:
14. VENT VALVE DATA: INDICATE TYPE, NUMBER, SETTINGS AND VAPOR DISPOSAL:

	NUMBER	PRESSURE SETTING	VACUUM SETTING	DISCHARGING TO: (CHECK) ATMOSPHERE	VAPOR CONTROL	FLARE
COMBINATION						
PRESSURE						
VACUUM						
OPEN						

15. NAME ALL LIQUIDS, VAPORS, GASES OR MIXTURES OF SUCH MATERIALS TO BE STORED IN THIS TANK:
    DENSITY: ______ LBS/GAL. (OR) ______ °A.P.I.
16. TEMPERATURES AT WHICH THE ABOVE LISTED MATERIALS ARE TO BE STORED IN THIS TANK:
    MINIMUM TEMPERATURE ______°F MAXIMUM TEMPERATURE ______°F
17. IF MATERIAL STORED IS A PETROLEUM PRODUCT OR ANY OTHER TYPE OF ORGANIC MATERIAL, SUPPLY THE FOLLOWING INFORMATION FOR EACH MATERIAL: (ATTACH ADDITIONAL SHEETS, IF NECESSARY).
    VAPOR PRESSURE: ______ LBS. REID (OR) ______ LBS. PER SQ. IN. ABSOLUTE AT ______°F
    INITIAL BOILING POINT: ______°F
    FOR HEAVY PETROLEUM PRODUCTS ONLY: FLASH POINT: ______°F
18. OPERATIONAL DATA:
    MAXIMUM FILLING RATE: ______ BARRELS PER HOUR (OR) ______ GALLONS PER HOUR
    AVERAGE OUTAGE: (AVERAGE DISTANCE FROM TOP OF TANK SHELL TO LIQUID SURFACE) ______ FT
    AVERAGE THROUGHPUT: ______ BARRELS PER DAY (OR) ______ GALLONS PER DAY
    TANK TURNOVERS PER YEAR: ______
19. IF MATERIAL STORED IS A SOLUTION, SUPPLY THE FOLLOWING INFORMATION:
    NAME OF SOLVENT: ______ NAME OF MATERIAL DISSOLVED: ______
    CONCENTRATION OF MATERIAL DISSOLVED: ______ % BY WEIGHT (OR) ______ % BY VOLUME (OR ______ LBS./GALLON
20. IF MATERIAL STORED IS A GAS OR A LIQUIFIED GAS WHICH IS NOT A PETROLEUM PRODUCT, SUPPLY THE FOLLOWING INFORMATION:
    IDENTIFY THE MATERIAL: ______
    PRESSURE AT WHICH MATERIAL IS STORED: ______ LBS. PER SQ. IN. GAGE AT ______°F

THE ABOVE INFORMATION IS SUBMITTED TO DESCRIBE THE USE OF THE TANK FOR WHICH APPLICATION FOR PERMIT IS BEING MADE ON THE ACCOMPANYING FORM 400-A:
SIGNATURE OF RESPONSIBLE MEMBER OF FIRM: ➡

TYPE OR PRINT NAME AND OFFICIAL TITLE OF PERSON SIGNING THIS DATA FORM.	NAME
	TITLE

16-50089 Form 400-C-9

Figure 3.2. Special application form for storage tanks

the data (with the exception of the equipment location drawings) requested by the "District" for the engineering evaluation of a permit to construct the vessel. The form is designed to use check lists which are practicable, provide sufficient space for additional data and can be completed by typewriter for clarity. The questions posed on the application usually require one word or numeric answers; thus, the form is compact and allows for a large quantity of data to be entered.

The additional general data are supplied on a separate form, 400-A (Figure 3.3), which must accompany the special form. This form is more general and therefore utilizes fewer check-off answers. However, it is well-spaced, provides sufficient room for answering detailed questions and may also be completed by use of a typewriter. Both forms come complete with instruction sheets (Figures 3.4 and 3.5). These data are then applied in the permit evaluation demonstrated in Chapter 5.

The form must be designed not only to provide the needed data, but also to fulfill additional requirements. The potential applicant should be able to complete it without difficulty or need to contact the agency for assistance frequently. Agency personnel must be able to retrieve information from the application easily. Finally, the form should be constructed so that selected data elements may be entered into a computerized information system.

If an agency plans to install a totally manual permit system, the extra effort necessary to make its application forms compatible with data processing will be worthwhile. It will eliminate the necessity of redesigning the applications if an information system is utilized at a later date. No time will be wasted to phase out one type of form while phasing in another. Past applications will be immediately usable in the new system.

DO NOT REMOVE CARBONS OR SEPARATE
Three white copies must be submitted.
Yellow copy should be retained by applicant.

AIR POLLUTION CONTROL DISTRICT - COUNTY OF LOS ANGELES
434 SOUTH SAN PEDRO STREET, LOS ANGELES, CALIF. 90013 MADISON 9-4711

APPLICATION FOR AUTHORITY TO CONSTRUCT AND PERMIT TO OPERATE

APPLICATION INSTRUCTIONS

A. USE ONE APPLICATION FORM 400-A FOR EACH PERMIT UNIT OF BASIC EQUIPMENT AND ONE APPLICATION FORM 400-A FOR EACH PERMIT UNIT OF AIR POLLUTION CONTROL EQUIPMENT. CALL MA 9-4711, EXT. 66165 FOR ASSISTANCE.

B. A $40 FILING FEE MUST ACCOMPANY EACH APPLICATION. (A $10 FILING FEE WILL BE ACCEPTED FOR A CHANGE OF OWNERSHIP APPLICATION WHERE NO ALTERATION, ADDITION OR CHANGE OF LOCATION HAS OCCURRED.) THE TOTAL PERMIT FEE, WHICH MAY EXCEED THE $40 FILING FEE, MUST BE PAID BEFORE PERMIT TO OPERATE CAN BE GRANTED. MAKE CHECK OR MONEY ORDER PAYABLE TO: AIR POLLUTION CONTROL DISTRICT, COUNTY OF LOS ANGELES.

C. EACH APPLICATION MUST BE FILLED OUT COMPLETELY AND FILED IN TRIPLICATE. ACCOMPANYING PLANS MUST BE IN DUPLICATE.

D. EACH APPLICATION MUST BE SIGNED BY A RESPONSIBLE MEMBER OF THE ORGANIZATION THAT IS TO OPERATE THE EQUIPMENT.

INCOMPLETE APPLICATIONS NOT ACCEPTABLE

1A. PERMIT TO BE ISSUED TO: ______________________
BUSINESS LICENSE NAME OF ORGANIZATION THAT IS TO RECEIVE PERMIT

1B. ______________________
NAME (OR NAMES) OF OWNER OR PRINCIPAL PARTNERS DOING BUSINESS AS (dba) ABOVE ORGANIZATION

2A. MAILING ADDRESS: ______________________
NUMBER STREET CITY OR COMMUNITY STATE

2B. ______________________
ZIP CODE

3A. EQUIPMENT LOCATION ADDRESS: ______________________
NUMBER STREET CITY OR COMMUNITY ZIP CODE

3B. ______________________
NEAREST INTERSECTING STREET

4. EQUIPMENT DESCRIPTION.
APPLICATION IS HEREBY MADE FOR AUTHORITY TO CONSTRUCT AND PERMIT TO OPERATE THE FOLLOWING EQUIPMENT:

5. IF THIS EQUIPMENT HAD A PREVIOUS WRITTEN PERMIT, STATE NAME OF CORPORATION, COMPANY, OR INDIVIDUAL OWNER THAT OPERATED THIS EQUIPMENT, AND STATE PREVIOUS AIR POLLUTION CONTROL DISTRICT PERMIT NUMBER.
____
NAME PREVIOUS PERMIT NUMBER

6. PERMIT APPLICATION REASON:
16 NEW CONSTRUCTION ☐ 1
ALTERATION ☐ 2
CHANGE OF LOCATION ☐ 3
CHANGE OF OWNERSHIP ☐ 4

7. TYPE OF ORGANIZATION:
17 CORPORATION ☐ 1
PARTNERSHIP ☐ 2
INDIVIDUAL OWNER ☐ 3
GOV'T. AGENCY ☐ 4

8. ESTIMATED COST OF EQUIPMENT OR ALTERATION:
AIR POLLUTION CONTROL EQUIPMENT $ ________
BASIC EQUIPMENT $ ________

9. FOR THE NEW CONSTRUCTION, ALTERATION, TRANSFER OF OWNERSHIP OR LOCATION, WHAT IS THE ESTIMATED STARTING DATE? ________ ESTIMATED COMPLETION DATE? ________

10. GENERAL NATURE OF BUSINESS:

11. SIGNATURE OF RESPONSIBLE MEMBER OF ORGANIZATION: →

13. OFFICIAL TITLE OF SIGNER:

12. TYPED OR PRINTED NAME OF SIGNER:

14. DATE:

15. PHONE NUMBER:

APCD USE ONLY

ST. LIST NO. 2-6	I.D. NO.: 7-14	ALPHA LIST: 71-78	TS NO.: 79-80	CLASS: 18 I ☐ 1 III ☐ 3
ASSIGNMENT: 19-20 (UNIT / ENGR.)	WORK UNITS: 21-24 (A/C / P/O)	APPLICATION NO.: 31-36	EQUIP. CAT. NO.. 38-45	TYPE: 46 B OR C
VALIDATION 25-29 (III)				

FORM 400-A 5005

Figure 3.3. General application form

AIR POLLUTION CONTROL DISTRICT - COUNTY OF LOS ANGELES
434 SOUTH SAN PEDRO STREET, LOS ANGELES, CALIF. 90013 MADISON 9-4711

APPLICATION INSTRUCTIONS
FOR
STORAGE TANKS FOR LIQUIDS, VAPORS AND/OR GASES

FILL OUT REVERSE SIDE AND RETURN WITH YOUR APPLICATION (FORM 400-A).

A $40.00 filing fee must accompany each application except in the case of a transfer of ownership where no alteration of the permit unit or change of location has occurred. For this exception the application filing fee will be $10.00. Checks or money orders should be made payable to the Air Pollution Control District, County of Los Angeles. The filing fee will be applied to the final fee for permit to operate.

With each application for authority to construct and permit to operate a tank to be used for storage of any liquid, vapor or gas, the following data, specifications, plans and drawings must be submitted in DUPLICATE:

1. EQUIPMENT LOCATION DRAWING. The drawing or sketch submitted must be to scale (suggested scale: 1 inch = 100 feet; accuracy of measurements to the nearest 5 feet will be satisfactory) and must show at least the following:

   a. The property involved and outlines and heights of all buildings on it. Identify property lines plainly.
   b. Location and identification of the tank on the property.
   c. Location of the property with respect to streets and all adjacent properties. Identify adjacent properties. Show location of all buildings outside the property that are within 150 feet of the equipment involved in the application. Identify all such buildings (as residence, apartment house, machine shop, warehouses, etc.), specifying height of each building (number of stories). Indicate direction (north) on the drawing.

   Applicants who have current master plot plans on file with the Air Pollution Control District may submit a location drawing showing only the area in the immediate neighborhood of the proposed tank location. Such a drawing must be oriented with the master plot plan.

NOTE: Structural design calculations and details are not required. When standard commercial equipment is to be installed, the manufacturer's catalog describing the equipment may be submitted in lieu of the parts of Item 1 that it covers. All information required above that the catalog does not contain must be submitted by the applicant. ADDITIONAL INFORMATION MAY BE REQUIRED.

After authority to construct or to install is granted for any equipment, deviations from the approved plans are not permissible without first securing additional approval for the changes from the Air Pollution Control Officer.

Further information or clarification concerning permits can be obtained by writing or calling the Permit Application Receiving Unit, MAdison 9-4711.

50D89 R2-64-12 (Continued on reverse side) Form 400-C-9

gure 3.4. Special instructions sheet for completing storage tank application form

AIR POLLUTION CONTROL DISTRICT - COUNTY OF LOS ANGELES
434 South San Pedro Street, Los Angeles, Calif. 90013. MAdison 9-4711

APPLICATION INSTRUCTIONS
GENERAL

A $40.00 filing fee must accompany each application except in the case of a transfer of ownership where no alteration, addition or change of location has occurred. For this exception the application filing fee will be $10.00. Checks or money orders should be made payable to the Air Pollution Control District, County of Los Angeles. The filing fee will be applied to the final fee for permit to operate. A separate application is required for each unit of basic equipment (equipment the use of which may cause the issuance of air contaminants). Such a unit may consist of one individual item, or a group of two or more items. A separate application is also required for each air pollution control system (equipment which eliminates or reduces the emission of air contaminants).

With each application for authority to construct and permit to operate, the following data, specifications, plans and drawings must be submitted in DUPLICATE:

1. EQUIPMENT LOCATION DRAWING. The drawing or sketch submitted must be to scale (suggested scale: 1 inch = 100 feet; accuracy of measurements to the nearest 5 feet will be satisfactory) and must show at least the following:

   a. The property involved and outlines and heights of all buildings on it. Identify property lines plainly.

   b. Location and identification of the proposed equipment on the property.

   c. Location of the property with respect to streets and all adjacent properties. Identify adjacent properties. Show location of all buildings outside the property that are within 150 feet of the equipment involved in the application. Identify all such buildings (as residence, apartment house, machine shop, warehouse, etc.), specifying height of each building (number of stories). Indicate direction (north) on the drawing.

2. DESCRIPTION OF EQUIPMENT. State make, model, size and type for either the entire unit or for its major parts.

3. DESCRIPTION OF PROCESS. The application must be accompanied by a written description of each process to be carried out in the equipment and of the function of the equipment itself in the process. The descriptions must be complete and in detail concerning all operations. Particular attention must be given to explaining all stages in the process where the discharge of any materials might contribute in any way to air pollution. All obtainable data must be supplied concerning the nature, volumes, particle sizes, weights and concentrations of all types of air contaminants that may be discharged at each stage in the process. Similarly, control procedures must be described in sufficient detail to show the extent of control of air contaminants anticipated in the design, specifying the expected efficiency of the control devices.

4. OPERATING SCHEDULE. Specify the hours per day and days per week the equipment is to be operated.

5. PROCESS WEIGHT. Detail type and total weight of each material charged into the equipment or the process on the basis of pounds per hour or per other specified unit of time.

6. FUELS AND BURNERS USED. Indicate for fuel gas-type and cubic feet per hour; for fuel oil-grade and gallons per hour (specify temperature to which oil is preheated); for solid fuels-type and pounds per hour; indicate for burners-make, model, size, type, number of burners, and capacity range of each burner (from minimum to maximum).

7. FLOW DIAGRAM. For continuous processes, show the flow of materials either on a separate flow diagram or on the drawings accompanying the application.

50D19 R5-64-12 (Continued on reverse side) Form 400-C

Figure 3.5. General instructions for completing application forms' (sheet 1 of 2)

8. DRAWINGS OF EQUIPMENT. (See NOTE below.) Supply an assembly drawing, dimensioned and to scale, in plan, elevation and as many sections as are needed to show clearly the design and operation of the equipment and the means by which air contaminants are controlled. The following must be shown:

   a. Size and shape of the equipment. Show exterior and interior dimensions and features.

   b. Locations, sizes and shape details of all features which may affect the production, collection, conveying or control of air contaminants of any kind; location, size and shape details concerning all materials handling equipment.

   c. All data and calculations used in selecting or designing the equipment.

   d. Horsepower rating of all electric motors driving the equipment.

NOTE: Structural design calculations and details are not required. When standard commercial equipment is to be installed, the manufacturer's catalog describing the equipment may be submitted in lieu of the parts of Item 8 that it covers. All information required above that the catalog does not contain must be submitted by the applicant. ADDITIONAL INFORMATION MAY BE REQUIRED.

After authority to construct or to install is granted for any equipment, deviations from the approved plans are not permissible without first securing additional approval for the changes from the Air Pollution Control Officer.

Further information or clarification concerning permits can be obtained by writing or calling the Permit Application Receiving Unit, MAdison 9-4711.

16-50019 Form 400-C

Figure 3.5. General instructions for completing application forms (reverse side) (sheet 2 of 2)

To transmit data from an application form to an information system, the keypunching function must often be preceded by the transcribing of all the data to coding sheets. Savings in both cost and time can be realized if the transcribing task can be significantly reduced or eliminated without an increase in the incidence of errors. Figure 3.6 presents an equipment registration form that was created in an effort to facilitate this transcribing task. The very small numbers placed below the boxes and lines indicate the columns in which these data are to be punched, and in some cases, the values as well. For example, item 11 requests stack height information. It is to be punched in column 29 as follows:

STACK HEIGHT	VALUE TO BE PUNCHED
less than 30 feet	1
31 - 50 feet	2
51 - 100 feet	3
101 - 150 feet	4
151 - 200 feet	5
201 - 250 feet	6
Over 250 feet	7

Had it been desired, three columns could have been set aside for stack height and the exact height entered. This type of request was made in item 18, fuel consumption.

To design a form that is compatible with data processing, those items that are to be entered into the information system must be allocated sufficient column space for each response. To facilitate keypunching, the column assignments on the application should be numbered consecutively down the page as in Figure 3.6.

MARYLAND STATE DEPARTMENT OF HEALTH

DIVISION OF AIR QUALITY CONTROL
2305 N. CHARLES ST.
BALTIMORE, MARYLAND 21218

APPLICATION FOR REGISTRATION OF FUEL BURNING EQUIPMENT
(INITIAL INFORMATION)

A
80

1. OWNER OF INSTALLATION	DATE OF APPLICATION
MAILING ADDRESS	TELEPHONE
CITY STATE ZIP CODE	
2. APPLICANT OR AUTHORIZED AGENT	TELEPHONE
MAILING ADDRESS CITY STATE ZIP CODE	
3. STREET ADDRESS OF FUEL BURNING EQUIPMENT	CITY, TOWN OR P.O. COUNTY
4. INSTALLER OR CONTRACTOR (IF NEW OR REPLACEMENT)	TELEPHONE
MAILING ADDRESS CITY STATE ZIP CODE	
5. STARTING DATE (NEW INSTALLATION) COMPLETION DATE	DATE EXISTING INSTALL. PLACED IN OPERATION ______ 23-24
6. SIGNATURE OF OWNER OR AUTHORIZED COMPANY OFFICIAL	
PRINT OR TYPE NAME	TITLE

DO NOT WRITE IN THIS SPACE

DATE REC. LOCAL	DATE REC. STATE
ACKNOWLEDGEMENT SENT DATE BY	
REVIEWED NAME DATE	
LOCAL	
STATE	
RETURNED TO LOCAL JURISDICTION DATE BY	
APPLICATION RET'D TO APPLICANT DATE BY	
REGISTRATION NUMBER (1) (2) (3) (4) (5) (6) (7) (8) (9) (10)	
STATE GRID COORDINATES 11 12 13 14 15 16 17	
PREMISE NUMBER 18 19 20 21 22	

7. TYPE OF REGISTRATION

Existing Installation (Initial Reg.)	☐ 25-1	Alteration	☐ 25-4
New Installation (To be constructed)	☐ 25-2	Addition	☐ 25-5
Replacement	☐ 25-3	Change of Ownership	☐ 25-6
Other ______ SPECIFY			☐ 25-7

8. MAJOR ACTIVITY AT THIS LOCATION (CHECK ONE)

Manufacturing	☐ 26-1	Hotel or Motel	☐ 26-5
Retail or Wholesale Store	☐ 26-2	Hospital or Laboratory	☐ 26-6
Office (All Types)	☐ 26-3	Warehouse	☐ 26-7
School or Church	☐ 26-4	Residential or Apartments	☐ 26-8
Other ______ SPECIFY			☐ 26-9

9. IDENTICAL INSTALLATIONS AT THIS LOCATION

NUMBER OF UNITS ______ 27-28 (See Instructions.)

10. NAME OF FUEL SUPPLIER ADDRESS TELEPHONE

11. STACK HEIGHT ABOVE GROUND LEVEL (IN FEET)

30 feet or less ☐ 29-1 31–50 ☐ 29-2 51–100 ☐ 29-3 101–150 ☐ 29-4 151–200 ☐ 29-5 201–250 ☐ 29-6 Over 250 ☐ 29-7

12. CHECK ALL FUELS BURNED IN THIS INSTALLATION

Coal ☐ Oil ☐ Wood ☐ Natural Gas ☐ Other ☐ ______ SPECIFY

13. IF OIL IS USED CHECK ALL GRADES APPLICABLE

No. 1 ☐ 30-1 No. 2 ☐ 30-2 No. 4 ☐ 30-3 No. 5 ☐ 30-4 No. 6 ☐ 30-5 Other ☐ 30-6 ______ SPECIFY

AQC 11 1/69

Figure 3.6. Application form compatible with data processing (sheet 1 of 2)

14. TYPE OF OIL BURNER

Pressure or Gun Type ☐ 31-1 | Rotary Cup ☐ 31-2 | Steam Atomizer ☐ 31-3 | Air Atomizer ☐ 31-4 | Other ☐ 31-5 ______ SPECIFY

15. TYPE OF COAL BURNING EQUIPMENT USED

Hand Fired	☐ 32-1	Spreader Stoker	☐ 32-5
Under Feed Stoker	☐ 32-2	Stoker Fired with Ash Reinjection	☐ 32-6
Traveling Grate	☐ 32-3	Pulverized Coal	☐ 32-7
Chain Grate	☐ 32-4	Cyclone Furnace	☐ 32-8
Other ______ SPECIFY			☐ 32-9

16. FLY ASH COLLECTION EQUIPMENT

None	☐ 33	Electrostatic Precipitator	☐ 37
Cyclone	☐ 34	Scrubber	☐ 38
Multiple Cyclone	☐ 35	Water Spray in Stack	☐ 39
Settling Chamber or Baffles	☐ 36	Other Inertial Separator (Tubular, Cone, Etc.)	☐ 40
Other ______ DESCRIBE			☐ 41

17A. SMOKE INDICATOR IN STACK

Yes ☐ 42-1 No ☐ 42-2 Type ______ SPECIFY

17B. ARE OIL HEATERS USED

Yes ☐ 43-1 No ☐ 43-2 Temperature ______ °F

18. AMOUNT OF FUEL CONSUMED ANNUALLY IN THESE UNITS ONLY.

Oil ______ (44-48) gallons | Coal ______ (49-53) Tons

Natural Gas ______ (54-58) Cu. Ft. | Other ______ SPECIFY ______ AMOUNT

19A. SULFUR CONTENT OF FUEL TO THE NEAREST TENTH OF ONE PERCENT.

Coal ______ (59-60) % | Oil ______ (61-62) %

19B. ASH CONTENT OF COAL TO THE NEAREST PERCENT

Ash ______ (63-64) %

20. MAXIMUM FIRING RATE (BTU PER HOUR INPUT)

Input ______ (65-68) BTU/Hr. | Coal ______ Lbs./Hr. | Oil ______ Gal./Hr. | Gas ______ Cu. Ft./Hr.

21. STACK EMISSIONS FROM THIS INSTALLATION

PARTICULATE LOADING ______ GR./CU. FT. ______ POUNDS PER DAY.

FLUE GAS VOLUME ______ CFM @ ______ °F, ______ IN HG

SULFUR DIOXIDE ______ LBS./DAY | OXIDES OF NITROGEN ______ LBS./DAY | CARBON MONOXIDE ______ LBS./DAY | HYDRO-CARBONS ______ LBS./DAY

DO NOT WRITE BELOW THIS LINE

Emissions in pounds per day from this installation. (Make a separate card for each boiler).

[B] (80) Card Number Dup. C.C. 1–22 from Card A.

	Average – Entire Year	At Maximum Capacity
Sulfur Dioxide	☐☐☐☐☐ 23 24 25 26 27	☐☐☐☐☐ 28 29 30 31 32
Particulate Matter	☐☐☐☐☐ 33 34 35 36 37	☐☐☐☐☐ 38 39 40 41 42
Oxides of Nitrogen	☐☐☐☐☐ 43 44 45 46 47	☐☐☐☐☐ 48 49 50 51 52
Hydrocarbons	☐☐☐☐☐ 53 54 55 56 57	☐☐☐☐☐ 58 59 60 61 62

Figure 3.6. Application form compatible with data processing (sheet 2 of 2)

When more than one card is to be prepared from a completed form, the card and column number to be punched for each item can be easily indicated. For example, columns 29 and 30 of card one may be shown as 1.29-30. Columns 31-39 of card three may be identified as 3.31-39 on the form.

Each card punched from an application must contain a unique identifier to distinguish it from all others. This item is usually the permit number. In addition, one column should be set aside to number the cards so that they may be kept in the proper order.

VI. FILE STRUCTURE

The collection and maintenance of all information pertaining to a permit to construct or a certificate to operate is initially contained in a manual file or dossier. The function of this file is to serve as the legal repository for all data relevant to the application. It is a valuable reference for engineers evaluating applications for similar equipment and for field enforcement officers to check design and operational details for unauthorized changes.

A. Manual File

The manual file is usually created by the unit responsible for receiving and logging in applications for permits. The file will contain the application forms and all drawings, specifications, associated calculations submitted by the applicant, and a routing slip. A log sheet should be attached to the file to show date received, time required for evaluation, pertinent telephone calls, correspondence, holding without action time, and the status of the application.

During the permit evaluation period, the engineer processing the application will add his description of the equipment or process to the file, including calculations, flow diagrams, and recommendations Additional documents that should become a permanent part of the file are the final inspection report, supporting field enforcement officers' reports, complaints and fee payment notices. The file will continue to be active after a permit to construct has been granted and until a certificate to operate has been issued or denied.

If an appeal is made to the variance board, the file remains active until the board reaches a decision. All judgments and reports resulting from this action should be included in the file.

General rules for filing must include stamping or writing the application number on all forms, drawings, evaluation sheets, correspondence, etc. The folders can be top- or side-punched or of the accordian type. When an individual folder becomes too thick or bulky, then a second folder should be started. Often drawings which accompany applications are very large and thus require separate filing. Care must be taken to cross-reference the filing location for these drawings.

B. Automated Files

Automated files are those sets of organized data that may be processed by a computer system. Therefore, when an automated file is being created, the agency should incorporate in it only that information that can be manipulated, listed, compared, or calculated. It should include basically the items enumerated in Figure 3.1, page 3.4, as well as others that are of particular interest. Literal data, such as reports, are unnecessary in an automated file because such data are very difficult to query and expensive to prepare and maintain.

Before each type of component is added to the automated file, the component should be thoroughly evaluated. If it can be reasonably assumed that an information system processing the file will not frequently access the item, it should be omitted. What must be kept in mind is that each data element for every permit must be coded, transmitted, verified and validated. This process is needed to confirm that all information in the file is correct. In addition, updating must be constantly performed to ensure that all items are current. If data elements that will not be frequently utilized are included in the file, the use of such data cannot be cost-effective.

VII. PERMIT PROCESSING INFORMATION SYSTEMS

Eventually a decision must be made concerning the need for and character of the computer program that will form the basis of the permit processing information system. Should the agency use a general-purpose program or should a special-purpose routine be created for this particular application?

In many ways, this question is analogous to the problem of buying a new suit of clothes. Should the buyer have one made to order, or is he better off purchasing one "off the rack"? The former will likely cost more, fit better, and wear longer than the latter. However, the ready-made suit will probably be available sooner, and may serve his needs in the long run just as well as the completely tailored one.

A similar situation exists with computer programs. The special-purpose system may be better suited and provide more information that its alternative but the question remains, is it worth the extra cost and effort involved? This largely depends upon the uses to which the agency desires to apply its system, the urgency with which the system is needed, and the resources the agency has available. Of the few State and local agencies that have made this choice, all have opted for building special-purpose programs.

A. Special Purpose Software Programs

A special-purpose computer program is one that has been designed and coded expressly for a particular application or user. It requires detailed analysis before it can be coded, and extensive checking to verify its proper operation. The routine may very likely be re-evaluated at a later date, and subsequently modified or expanded as the need arises.

If an agency desires to install an automated information system within a short period of time, a special-purpose program is not practical. As a reasonable minimum, one year would be needed for design, coding, complete checkout, and data base generation. The other disadvantages of such a program are cost and the nature of computer programming. The coding and check-out of computer programs is often subject to problems, to slippages in schedules, and consequently, to increased costs. This is only mentioned to alert the purchaser of programming services to a potential area of concern.

The primary advantage to an agency of a special-purpose computer routine lies in its design to fit the specific needs of the agency's air pollution control program in general, and of permit licensing systems in particular. This design facilitates efficient operation of the system as well as the ability to generate data and reports geared to designated qualifications and restrictions. Such a system is also appropriate since it can start as a small or limited program, and subsequently be modified. As the agency's responsibilities grow or its needs change the routine can likely be expanded or altered in scope and application without scrapping the original system.

B. KAPCIS

1. Introduction

KAPCIS, the Kentucky Air Pollution Control Information System, is an example of a special-purpose programming system prepared for a State agency. It was designed to manage large amounts of administrative data resulting from the activities of the Kentucky Air Pollution Control Commission (KAPCC) in air contaminant source registration and permit processing, complaint processing and enforcement processing. Some technical data are included in the system; however, it is primarily utilized for administrative purposes. KAPCIS will be expanded in the future to include air quality, meteorological, emission inventory, and other technical data. Since the likelihood of expansion was considered during the system design phase, no major recoding of existing programs will be required.

2. History

The basic KAPCIS took 2 years to design, program, and checkout. Its cost amounted to $48,100 for contractor services, in addition to 1-1/2 years of professional KAPCC manpower, and a great deal of computer time. An estimate of the grand total for the initial development of the system would be nearly $100,000.[7] This figure includes data placement of 24,000 facility names including location information and registration of 20,000 of these facilities.[8]

The KAPCC originally chose to build its own special-purpose system, rather than to utilize a general-purpose information management program, because the commission felt that the former could be constructed to relate more closely to its regulations and to be more useful for its air pollution control program.

3. Data Storage

Both manual and automated information storage techniques are employed in the system. Three manual files contain: (1) registration forms; (2) permit application, evaluation, complaint and enforcement records; and (3) updating and other records of the automated files. The manual files are utilized to gain immediate access to the data, for legal purposes, and to store drawings and photos which cannot be stored by computer.

The computerized records, described in the KAPCIS Summary Report, are organized into five files as follows:

- Basic Record File--a list of potential sources of pollution, their location, industrial classification, and mailing address;
- Registration File--responses to the registration program, including classification by type and size of operation;
- Permit File--detailed administrative and technical data from permit applications;
- Complaint File--a record of date, nature, and disposition of complaints;
- Enforcement File--a record of field investigations, hearings, and court procedures.[9]

The primary access key to these records is an identification number. In addition, the organization name and registration number may be used to distinguish among data base entries.

4. Information Retrieval

KAPCIS operates in the batch processing mode exclusively. Data may be recovered from the computerized files stored on magnetic disks either by retrieving specific records or by using the file scan technique. With specific record retrieval, information from any or all of the five files may be output. The user must indicate the identification number, registration number, or name of the organization about which the data are requested. Figure 3.7 shows an example of a specific record retrieval from the basic file. The facility identification number 99999900 was used to gain access to this set of data. The items of information output by the system include:

- The facility identification number.
- The number of the county in which the facility is located.
- The city number within the county.
- The Standard Industrial Classification (SIC) code number of the facility.
- The organization's name and number of additional locations.
- The organization's address and name of a responsible member.
- The registration status of the facility.
- The number of mailings made to the facility as part of the registration program.
- The permit status of the facility.
- The total number of complaints against this facility.
- The number of enforcement actions taken against this facility.

The file scan feature provides the capability to retrieve information selectively from the data base. In his requests, the user can apply specified criteria in up to four data fields of interest. The logical operators that may be employed include: greater than, less than, equal to, between, and not between. The queries take the following form, for example:

- County number equal to 57
- Incinerator capacity between 200 and 500 lbs./hr.

AIR POLLUTION CONTROL INFORMATION SYSTEM
RESPONSE TO QUERY 0

USER IDENTIFICATION ... JCM SUBMITTAL DATE ... 10/06/70 TYPE OF QUERY ... SPECIFIC RECORD RETRIEVAL

SOURCE FILE 1 ... BASIC FILE

FACILITY IDENTIFICATION NUMBER IS 99999900

* * * * * * * * * * B A S I C F I L E -- Q U E R Y N U M B E R 0000 * * * * * * * * * * * * *

ID. NO.	CTY	CITY	SIC	FACILITY NAME	ADDRESS	REG	MAILINGS	PERMIT	COMPLAINT	ENFORCEMENTS
99999900	067	0	8921	SPINDLETOP RESEARCH 00 ADDITIONAL FACILITIES	SPINDLETOP RESEARCH P O BOX 481 LEXINGTON, KY ATTN JACK MARTIN(APRD)	NO	00	NO	00	00

Figure 3.7. Example of a specific record retrieval (source: reference 10)

Only those records that satisfy the stated criteria may be processed further. The possibilities are the output of an entire record from one of the automated files, the printing of mailing labels, or the listing of field data. In the latter case, information from up to four fields from selected records may be output and have simple statistical operations performed on it. These may include the computations of sums, means, and standard deviations. A sample file scan retrieval is depicted in Figure 3.8. The output indicates that the selection criteria utilized was that the value in field 1002 be between 0 and 119, and that the value in field 3025 be greater than 70,000. The identification numbers and values of the fields that qualified are printed, followed by some statistical calculations.

With the hindsight of two years of experience, the KAPCC would still choose a special-purpose system instead of a general-purpose one. However, they would include many small report programs rather than a general file scan program to retrieve data.[11]

C. Information Management Systems

"An information management system is a software tool useful in organizing, processing, and presenting information."[13] It is capable of being employed in a wide variety of areas without being modified. According to Sundeen, "...with flexibly designed systems, at least 80% of the applications encountered in data processing can be implemented without any formal programming being required."[14]

Information management systems may also be referred to as file management systems or data management systems. They perform the following essential functions:

- Data definition--the process by which the user identifies and describes to the system the data elements that will constitute the components of his data base.
- File creation--the procedure by which the initial version of the data base is produced in accordance with the data definition. Storage allocation is controlled by the system.

AIR POLLUTION CONTROL INFORMATION SYSTEM
RESPONSE TO QUERY 0

USER IDENTIFICATION . . . JCM   SUBMITTAL DATE . . . 09/25/70   TYPE OF QUERY . . . FILE SCAN

SELECTION CRITERIA . . . RECORDS SELECTED ARE THOSE SATISFYING ALL OF THE FOLLOWING CRITERIA.

THE VALUE IN FIELD 1002 IS BETWEEN 0 119

THE VALUE IN FIELD 3025 IS GREATER THAN 70000

OPERATIONS ... THE FOLLOWING OPERATIONS WERE PERFORMED ON THOSE RECORDS WHICH SATISFIED THE SELECTION CRITERIA.

VALUES FOR FIELD/S 1004, 1009, 3025, 0000 WERE TABULATED/COMPUTED.

IDENTIFICATION NO.	FIELD 1004	FIELD 1009	FIELD 3025	FIELD 0 0
00002400	6551	0	70133	0
00003200	5041	0	70323	0

2 VALUES WERE LISTED FOR FIELD 1004

2 VALUES WERE COUNTED IN FIELD 1004

2 VALUES WERE COUNTED IN FIELD 1009

THE SUM OF VALUES IN FIELD 1004 IS 0

2 VALUES WERE LISTED FOR FIELD 3025

2 VALUES WERE COUNTED IN FIELD 3025

THE SUM OF VALUES IN FIELD 3025 IS 140456

THE MEAN OF THE VALUES IN FIELD 3025 IS 70228.0000

PROCESSING OF QUERY IS COMPLETE

Figure 3.8. Example of a file scan retrieval
(source: reference 11)

- File maintenance--the updating of the contents of a previously created data base.

- Interrogation--the process of retrieving desired items from the data base. This information may be logically qualified according to designated conditions. The language utilized for inquiry generally resembles a combination of English and mathematics, and is easy to learn.

- Report generation--the selection, organization, and presentation of data in an easy-to-digest, tabular format. The reports are of two categories; they may be either specified before use or predefined, stored with the data base, and invoked by an associated name.

With a number of systems, some or all of these functions may be performed in a conversational (on-line) mode, as well as in the standard batch (off-line) mode. For the latter, retrieval requests are transferred to computer cards, magnetic tape, or a similar medium, and subsequently processed in sequence. When employing the conversational technique, the user types in his retrieval request directly and must wait for his response before entering his next query. The turnaround time in this method is usually from a few seconds to a few minutes, depending upon the complexity of the interrogation.

The primary disadvantages of information management systems are listed below:

- They are expensive if not utilized frequently.

- They do not operate efficiently for all applications due to their general purpose design.

- They may not have the capability to perform needed or desired functions.

- Outputs may not be in presentable, convenient formats.

The main advantages of these general-purpose systems are as follows:

- No additional programming is necessary for implementation.
- The installation period is short.
- The user need not be a programmer.
- Maintenance costs are low.
- Many different types of data may be accepted with equal ease.
- The systems may be tried for a few months at relatively low cost.

This last point should be elaborated upon. An agency with little data processing experience might do well to invest a small amount of money in the leasing of a general-purpose system for a short period of time. The agency will gain familiarity with the capabilities of such a system, and thus will be better able to specify its own needs, as well as to determine the necessity of having a special-purpose system created.

D. Available Systems

Information management systems are currently available as proprietary routines from both hardware and software companies. The use of such systems may be purchased outright, or leased for a given period of time Table 3.1 presents list of several of these programs with the name of the manufacturer. Potential users are urged to contact these organizations directly for brochures, pricing information, and demonstrations of system capabilities.

Table 3.1. INFORMATION MANAGEMENT SYSTEMS

SYSTEM	MANUFACTURER
ASI-ST[2]	Applications Software, Inc.
DMS[1]	Xerox Data Systems
DS/2[3]	System Development Corporation
EASY-WRITER[1]	Honeywell, Inc.
GIS/2[1]	IBM
IMS-8[1]	Univac
MARK IV[2]	Informatics, Inc.
MARS[1]	Control Data Corporation

1-Can only be used on manufacturer's equipment
2-Can only be used on IBM Systems 360 and 370, and RCA equipment
3-Can only be used on IBM Systems 360 and 370

E. Example of the Use of an Information Management System

In this section, the use of the DS/2 information management system is demonstrated as it might be employed in a permit processing application. A small 20-entry data base utilizing artificial data was created. It was packed with component type information illustrated by the permit system data base of Figure 3.1. The DS/2 system allows data retrieval in both on-line and batch processing modes. In these exercises, the conversational mode was utilized.

1. Specific Data Retrieval

Figure 3.9 illustrates the selection of specific items of information from the data base for a particular entry. DS/2 indicates that it is ready to accept a request by printing "NEXT:." The user responds by asking for the retrieval of the particulate emissions for permit number 12. DS/2 informs him that 15 columns are needed for the answer and gives him an opportunity

```
NEXT:
>PRINT PERMITNO,PART WHERE PERMITNO EQ 12
  15 COLUMNS REQUIRED, CONTINUE(Y/N/F/B):
>F

 PERMITNO PART

     12    15

     1 ENTRIES( 5% OF DB) QUALIFIED, REQUEST COMPLETE.
NEXT:
>PRINT PERMITNO,UNIT,LASTSPEC,NEXTSPEC
  45 COLUMNS REQUIRED, CONTINUE(Y/N/F/B):
>F

 PERMITNO       UNIT        LASTSPEC NEXTSPEC

       16 X ELECTRIC PRECIP  2/26/71  8/26/71

     1 ENTRIES( 5% OF DB) QUALIFIED, REQUEST COMPLETE.
NEXT:
>
```

Figure 3.9. Specific data retrieval

to negate the request. The user inputs "F" telling the system to print the complete answer on the teletype. The system finally prints the permit number and the associated particulate emissions, 15. Although the units have been omitted, the user is aware that the answer is 15 lbs./hr. because he knows that all inputs to the data base were in lbs./hr.

If the user wished to eliminate his question to the system, he could have typed "N" instead of "F." Had he input "B," the result would have been saved on magnetic tape for delayed output. A "Y" input is similar to that of "F" except that the former gives the user the opportunity to terminate the output after 25 lines have been printed, assuming that much information is available to fill the request.

In the second example of Figure 3.9, a few pieces of information concerning permit number 16 have been retrieved. The type of equipment is an exhaust system--an electric precipitator. This information was printed out as "X ELECTRIC PRECIP" in order to use less storage space in the system, and fewer characters on output. This unit was last inspected on February 26, 1971 and is scheduled to be checked again on August 26, 1971. Had it been desired, all information pertaining to permit number 16 could have been retrieved.

2. Logical Data Retrieval

DS/2 will process data requests which utilize both logical and Boolean operators. Only that information which qualifies according to the stated conditions will be retrieved. The following logical comparison operators are usable:

EQ	equal to
GR	greater than
GE	greater than or equal to
LS	less than
LE	less than or equal to

In addition, the Boolean operators AND, OR, and NOT may be applied.

Figure 3.10 presents some examples using these operators. The first query requests the output of the permit number, the type of equipment, and contaminant data for each entry located in grid region 14 as well as for each entry in which particulate emissions were at least 20 lbs./hr. Permits 6 and 7 did not have any oxides of sulphur (SO_x) data registered. The equipment units are:

ASPHALT CON BATCH....Asphaltic Concrete Batching
X BAGHOUSE...........Exhaust System--Filter Cloth Dust Collector
X SCRUBBER...........Exhaust System--Scrubber

Had the user desired, he could have provided additional storage space in the system for the equipment unit designators. In this case the complete unit names, or more descriptive designations, could have been utilized.

In the second example, a request was made for the retrieval of the permit number, equipment status, last inspection date, next inspection date, and particulate level from each permit entry with equipment status of "conditional" or "pending," and a particulate emission level less than 50 lbs./hr. The expression "COND" was used to conserve storage space in the system.

```
NEXT:
>PRINT PERMITNO,UNIT,SOX,PART WHERE GRID EQ 14 AND PART GE 20
 39 COLUMNS REQUIRED, CONTINUE(Y/N/F/B):
>F

      PERMITNO          UNIT                 SOX         PART

             3 ASPHALT CON BATCH             150          25
             6 X BAGHOUSE                                 20
             7 X SCRUBBER                                 30

          3 ENTRIES( 15% OF DB) QUALIFIED, REQUEST COMPLETE.
NEXT:
>PRINT PERMITNO,STATUS,LASTSPEC,NEXTSPEC,PART WHERE STATUS EQ*
*COND OR STATUS EQ PENDING AND PART LS 50
   COLUMNS REQUIRED, CONTINUE(Y/N/F/B):
>F

      PERMITNO  STATUS        LASTSPEC        NEXTSPEC        PART

             2 COND            3/02/71         7/02/71         30
             6 PENDING         1/16/71         4/16/71         20
             9 COND            2/05/71         6/05/71         15
            13 COND           12/12/70         4/12/71         25
            14 COND            1/02/70         5/02/71         10

          5 ENTRIES( 25% OF DB) QUALIFIED, REQUEST COMPLETE.
NEXT:
>
```

Figure 3.10. Logical data retrievals

3. Statistical Data Retrievals

DS/2 provides a number of simple statistical commands for retrieval of numerical type data and the computation of simple statistical functions. The primary command is "LIST STAT" or "LISTSTAT," and the others are subsets of it. The LISTSTAT command is used to output individual values as well as a statistical summary. Its use is demonstrated in Figure 3.11.

In this example, the query reads "PR C2, C3, LIST STAT SOX THRU LOWHC." PR is the short form of the command PRINT. C2 and C3 are the component number references for the data items PERMITNO and UNIT, respectively. LIST STAT SOX THRU LOWHC asks for all the values as well as a statistical summary be output for SOX--oxides of sulphur, LOWHC--low reactive hydrocarbons, and all data items falling between these two in the data base definition (see Figure 3.1). These include CO--carbon monoxide, NOX--oxides of nitrogen, PART--particulates, and HIGHHC--high reactive hydrocarbons. All values are in lbs./hr.

The statistical summary gives a recapitulation of the data for the six pollutants. The summary commands are as follows:

- CNT - the number of elements in each column
- SUM - the total of each column
- AVE - SUM/CNT
- MIN - the smallest value in each column
- MAX - the largest value in each column

The statistical summary may be requested without a complete listing of the data by using the SUMMARY command. In addition, CNT, SUM, AVE, MIN, and MAX may be employed as individual commands. The RANGE command gives MIN and MAX together.

```
NEXT:
>PR C2,C3,LIST STAT SOX THRU LOWHC
  64 COLUMNS REQUIRED, CONTINUE(Y/N/F/B):
>F
```

PERMITNO	UNIT	SOX	CO	NOX	PART	HIGHHC	LOWHC
1	BOILER OIL	16	20	50	10		
2	CAT CRACKING	2000	90000	200	30	500	1000
3	ASPHALT CON BATCH	150	80	10	25	20	100
4	INCINERATOR APT						
5	INCINERATOR MULT		50	2	10		20
6	X BAGHOUSE				20		
7	X SCRUBBER				30		
8	BOILER OIL	16	20	50	10	10	20
9	FURNACE FERROUS	100	200	100	15		
10	X ELECTRIC PRECIP				30		
11	RENDERING	75	400	10		50	100
12	SPRAY DRIER	5	100	2	15		
13	GALVANIZING				25		
14	FURNACE NON-FERR		20	2	10		
15	INCINERATOR FUME	15	200	10	5	10	20
16	X ELECTRIC PRECIP				25		
17	BOILER GAS	5	50	20			10
18	CRUDE OIL PROCESS						
19	ASPHALT PRODUCT	200	400	200	15	200	150
20	INCINERATOR MULT	15	50	10	10	10	20

	SOX	CO	NOX	PART	HIGHHC	LOWHC
CNT	11	13	13	16	7	9
SUM	2597	91590	666	285	800	1440
AVE	236	7045	51	17	114	160
MIN	5	20	2	5	10	10
MAX	2000	90000	200	30	500	1000

```
    20 ENTRIES(100% OF DB) QUALIFIED, REQUEST COMPLETE.
NEXT:
>LOGOUT
```

Figure 3.11. Statistical data retrieval

Any of these statistical commands may have the logical and/or Boolean operators applied to them. For example, "PR C2, C3, LISTSTAT SOX THRU LOWHC WHERE NOX GE 50" will yield a result similar to Figure 3.6 except that only those entries for which oxides of nitrogen were greater than or equal to 50 would appear. In this case, the statistical summary and enumeration would only contain permits 1, 2, 8, 9, and 19.

4. Reports

DS/2 permits the creation of reports for use immediately, or for employment at a later time. The report format may be stored with the data base and called into use by name. Whenever utilized, the report itself may be conditioned by the use of logical and Boolean operators, as were the requests above.

Figure 3.12 depicts the generation of a report format, while Figure 3.13 shows the result of its use. The report requests a complete listing and statistical summary by grid area of the pollutants--oxides of sulphur, carbon monoxide, and oxides of nitrogen. By multiplying each pollutant by 24 (e.g., SOX*24), the data are changed from lbs./hr. to lbs./day. These computations affect only the results, and not the data base. The command "SORT F1, BREAK F1" asks that the grid regions be presented in the output in numerical order, and that a statistical summary be presented each time a new grid area is reached. The next few lines show a format of how the report will appear; These lines give the user an opportunity to verify the contents of the report. When all is ready, the command REPEAT, or RE for short, is typed in. The standard retort is presented by the system, and either Y, N, F, or B must be input. When a sorted report is to be generated, B for batch output must be selected.

```
NEXT:
>PR GRID,PERMITNO,LIST STAT SOX*24,LIST STAT CO*24,LIST STAT NOX*24
  38 COLUMNS REQUIRED, CONTINUE(Y/N/F/B):
>SORT F1,BREAK F1

 GRID    PERMITNO    SOX*24     CO*24     NOX*24
  F1        F2         F3         F4         F5
 -3-    ---8----    ---7---   ---7---    ---7---
SORT FIELDS F1 A   BREAK FIELDS F1

IDENTIFIER   COUNT   SUM   AVERAGE   MINIMUM   MAXIMUM
SOX*24        *R*    *R*     *R*       *R*       *R*
CO*24         *R*    *R*     *R*       *R*       *R*
NOX*24        *R*    *R*     *R*       *R*       *R*

 47 COLUMNS REQUIRED
NEXT:
>RE
  47 COLUMNS REQUIRED, CONTINUE(Y/N/F/B):
>B
JOB Ø1 IN QUEUE POSITION 1
NEXT:
>RE
```

Figure 3.12. Report generation

GRID	PERMITNO	SOX*24	CO*24	NOX*24
14	2	48000	2160000	4800
14	19	4800	9600	4800
14	18	0	0	0
CNT		3	3	3
SUM		52800	2169600	9600
AVE		17600	723200	3200
MIN		0	0	0
MAX		48000	2160000	4800
15	3	3600	1920	240
15	4	0	0	0
15	6	0	0	0
15	7	0	0	0
15	17	120	1200	480
CNT		5	5	5
SUM		3720	3120	720
AVE		744	624	144
MIN		0	0	0
MAX		3600	1920	480
24	15	360	4800	240
24	12	120	2400	48
24	11	1800	9600	240
24	20	360	1200	240
CNT		4	4	4
SUM		2640	18000	768
AVE		660	4500	192
MIN		120	1200	48
MAX		1800	9600	240
25	13	0	0	0
25	16	0	0	0
25	14	0	480	48
25	10	0	0	0
25	9	2400	4800	2400
25	1	384	480	1200
25	5	0	1200	48
25	8	384	480	1200

Figure 3.13. Sample report

GRID	PERMITNO	SOX*24	CO*24	NOX*24
CNT		8	8	8
SUM		3168	7440	4896
AVE		396	930	612
MIN		0	0	0
MAX		2400	4800	2400

FINAL TOTALS

CNT		20	20	20
SUM		62328	2198160	15984
AVE		3116	109908	799
MIN		0	0	0
MAX		48000	2160000	4800

20 ENTRIES(100(OF DB) QUALIFIED, REQUEST COMPLETE

Figure 3.13. Sample report (continued)

The output lists the individual emissions by grid. Each time the grid number changes, a statistical summary is generated for the grid region. In addition, a summary for all four areas is provided.

This report can be regenerated after the data base has been sufficiently updated. In so doing, the agency will be better able to evaluate the impact of any significant additions to the emission potential of any grid area.

VIII. COMPUTER PROCESSING

The management of permit data and related air pollution information by an agency may be accomplished using one, two, or three computer processing modes. These are batch, time-sharing and remote batch processi The one selected for any particular operation must depend upon the nature of the task, the turnaround time required, and the resources available.

A. Batch Processing

Batch processing is essentially a technique of executing computer programs one at a time. When one task is completed another is begun. Originally, the second job was not input into the computer until the results of the first were printed. Figure 3.14 depicts such a single-task system. With improvements in technology, many separate tasks were input on magnetic tape reels and run one at a time. The results were stored on another reel of tape and printed later, or communicated to a different computer and printed immediately without delaying the execution of other tasks. At many installations today, batch processing is accomplished in a multi-programming mode. That is, the available resources of the computer system are shared among several tasks being performed concurrently. This means of

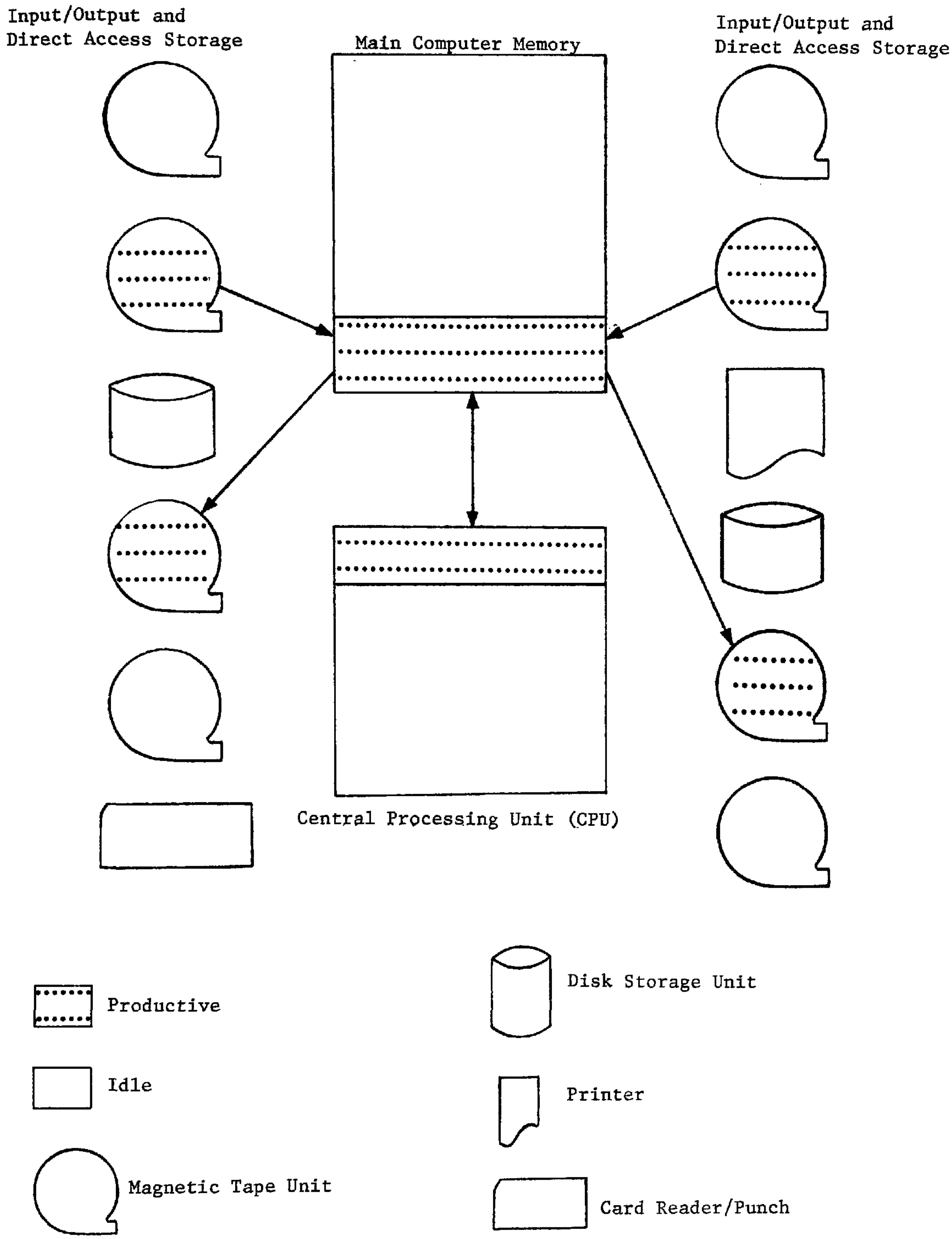


Figure 3.14. A single-task batch processing system
(source: reference 15)

operating is much more efficient, since the computer is occupied with many assignments at all times. The configuration of a multi-programmed system appears in Figure 3.15.

The batch processing mode is used when the nature of the program to be run is production-oriented. This occurs when the inputs are exactly definable before the operation begins, the results are not needed instantly, and the program requires no interaction while it is being executed.

If an agency's needs can be satisfied without extremely rapid turn-around of its informational requests, a batch processing system will perform quite adequately. In this type of system, turnaround time is usually from a few hours to a day. The turnaround time may depend on the anticipated execution time of the job. At many installations, longer computer runs are held for the "graveyard" (wee hours of the morning) shift so as not to interfere with shorter programs. The cost of computer time may also be affected by the time period in which the computer system is utilized. Prime time (normal working hours) is the most expensive, while graveyard time is the least expensive; this situation tends to encourage users to employ the equipment 24 hours a day.

Probably the greatest disadvantage of a batch processing system is the effect of mistakes on costs and on receipt of the needed information. an error is made in the preparation of a computer run, the job must be completely redone. All costs incurred are wasted; moreover, there i loss in time that cannot be regained. With the proper precautions and checking procedures these episodes will be quite infrequent. However, the complete elimination of errors must be considered unlikely

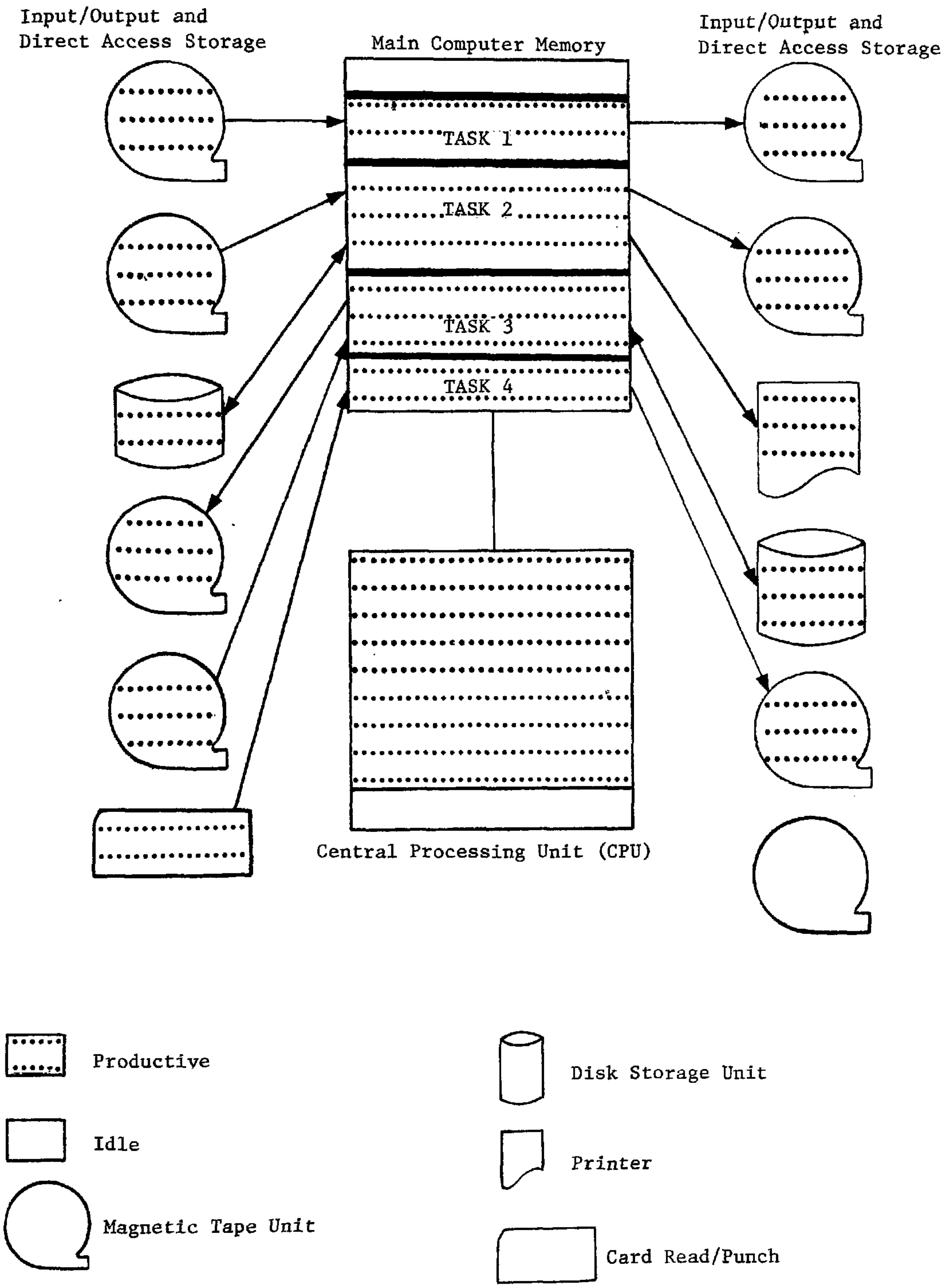


Figure 3.15. A multiple task batch processing system (source: reference 16)

B. Time-Sharing

Time-sharing is a technique of providing many individuals with access to a computer system at the same time. The users can interact with their operating programs using teletypewriters or display terminals. They are each, in turn, allotted a very small amount of computer processing time to input information, execute their programs, and output results.

Time-sharing systems have the following properties:

- Instantaneous response--the system, or the specific program, will communicate with the user within seconds of completion of a query or computation.
- Independent execution--utilization of the system by one individual will not affect or influence its use by others.
- Simultaneous execution--many users can be viewed as employing the system at the same time.
- Generality--anyone using the system is not restricted from employing all of its capabilities and computational power at his own discretion, according to his own abilities.
- Conversational format--the user can interact with the system, or with his program while it is executing.

A time-sharing system is usually utilized when quick response to a query is necessary, when a heuristic approach would be useful for solving a problem or debugging a program, or when a data base is to be checked or corrected. Air pollution control agencies could utilize a time-sharing system for quick response information retrieval, for updating their data bases, and for special applications. For example, a small program could be created to read in and check data cards made up for overnight batch runs. If errors are encountered they could be corrected on the spot with little loss in time and money. A standard operating procedure could include updating the data bases daily on-line and producing informational reports on a batch system at night.

Conversational systems are useful in that they can be employed after only a short period of study by engineers and others who have little experience with computers, because special programming languages, namely BASIC and subsets of FORTRAN, have been developed especially to be learned quickly and employed easily. With the aid of these languages, an individual can have access to a computer virtually whenever he requires it.

The main disadvantages of these systems are that they tend to be expensive, burdensome, and inadaptable for many applications. In addition to the charge for actual computer time taken up, the user is assessed a connect charge. That is, he must pay an hourly fee for the time his terminal operates, regardless of the amount of system capacity employed.

For individuals not used to typing for long periods, time-sharing may become a burden during long sessions. This is especially true if a great deal of interaction is necessary as in updating data bases.

Time-sharing cannot be utilized effectively for many applications that require significant amounts of computer time or produce large amounts of output, because the time-sharing user is allotted only a few minutes of computer processing time each hour, and because the terminals have very slow output speeds.

Time-sharing services can be purchased from approximately 150 vendors across the country. Such services are also available on an in-house basis; many computer systems are for sale or lease. Vendors usually sell time by the hour with a minimum monthly charge and additional access charges. The time-sharing systems usually come with mathematical statistical, and data management routines available for use.

C. Remote Batch

Remote batch processing can be considered as a combination of time-sharing and batch processing. Remote batch is similar to batch in that remote batch can be employed on longer computer runs and there is no interaction with the program. It is similar to time-sharing because the user has a terminal on-site and sends data to the computer over communication lines. Results are transmitted in the opposite direction; outputs are received on the terminal's line printer or tape unit. Turnaround time is generally from several minutes to a few hours, depending on the length of the job. Since the rates of transmission over the communication lines are slow, the peripheral equipment in the terminal is of slow to medium speed. In addition to the printer and tape unit, the terminal includes a card reader and often a built-in mini-computer that can operate independently. Most of these terminals cost from $30,000 to $50,000 but they can be leased.

The cost of remote batch equipment is the main reason for its limited popularity. Besides the terminal cost indicated above, transmission line and main computer usage costs are incurred. For roughly the cost of remote batch on a large computer system, a machine approximately the size of a 360/20 or 360/30, with peripherals, can be purchased or leased. If these two alternatives are compared, remote computing will be considered second best in most cases.

The cost of the terminal must be viewed as a negative factor when considering remote batch use for permit processing and other air pollution control functions. However, this method should not be ruled out until a cost-analysis is performed. Possibly if the cost of the terminal could be shared with other users, or if the need for a system with a great deal of computing power is demonstrated, remote batch will be required.

IX. DATA ENTRY SYSTEMS

Data entry is the procedure of transforming information contained on source records into a form ready for computer processing. It is not uncommon for total data entry charges to amount to from 30 to 50 percent of the total electronic data processing (EDP) budget at large installations.[17] Therefore, this task should be given the proper consideration.

The following functions are important elements of data entry systems:

- Encoding--sets down the data in a machine-readable form.
- Verification--assures that the encoding function has been completed successfully.
- Validation--checks that the source data is complete and correct.
- Editing--inserts, deletes, and modifies records.

The results of these operations should be data that are machine-compatible and virtually error-free.

Several factors must be considered when evaluating data entry systems. Some of the major components to be judged are:

- Speed--the total elapsed time necessary to prepare an error-free file ready for processing.
- Cost--the price of the equipment and expenses encountered in operating it.

- Editing--the ease and speed with which changes to the file can be accomplished.

- Compatibility--the capacity to use data prepared with one particular entry system on different computer configurations produced by numerous manufacturers.

- Human factors--the ability of operators to work accurately, comfortably and without excessive fatigue.

Transmitting source information to punched cards has been the traditional and most widely used technique for preparing data for computer processing. However, in the last few years, technology has derived other methods for performing this task.

A. Keypunching

Keypunching equipment is utilized for data entry because it is easy to use, requires a relatively small monetary outlay, and provides a hard copy of each record which may be used as a working document. Because they are so widely employed, punched card data inputs are compatible with virtually all computer installations.

Figure 3.16 illustrates the operation of a typical keypunch data entry system. Separate verification machines that resemble keypunches are used to check for mistakes in the original cards. Essentially, this process requires a duplication of the keying or typing operation. The corrected cards are then merged into the card deck. In order to perfo the validation and editing operations one or more computer runs are necessary. The computer may be used to list or check the data. If ed ing is needed, it is a simple matter to remove, insert or replace a ca

There are numerous disadvantages to this method:

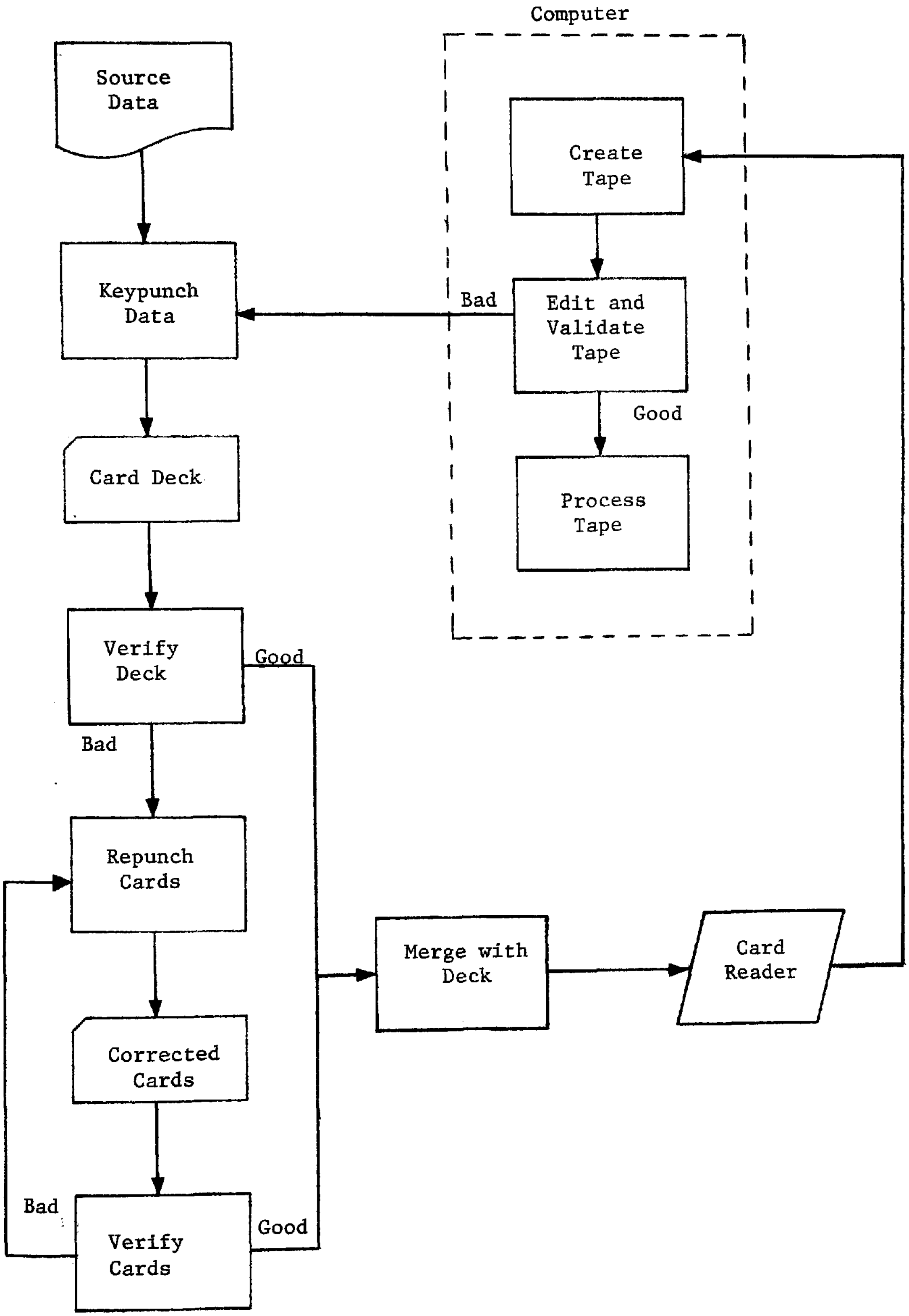


Figure 3.16. Operation of typical keypunch data entry system (source: reference 18)

1. When the number of data cards for any application grows into the thousands, the costs for storing, handling, correcting, and reading them become excessive.

2. Unless tricky encoding techniques are employed, only 80 characters can be punched on each card.

3. If a deck is dropped, the result could be a disastrous situation.

4. Machines may injure the cards.

5. The noisiness and mechanical nature of the keypunch do not create good working conditions.

6. The whole card must be repunched to correct an error.

New machines are being placed on the market that provide for error correction while the card is originally being punched. These devices rent for approximately $125 per month, or twice the cost of a standard keypunch.

B. Key-to-Tape Systems

Key-to-tape machines are devices that utilize keyboards to record infoı tion and store it on a tape. There are various versions of this unit, but they all contain a tape transport, keyboard, a display to help detect errors, and features that permit special formatting of records. The tape unit can be a cassette or the standard 1/2-inch computer tape. The keyboard may resemble that of a keypunch or typewriter. If an error is spotted during input, the operator can backspace to the incorrect character and change it. Verification is primarily accomplished by rekeying the data: inconsistencies are then flagged by the system.

Key-to-tape devices may be used individually or in clusters. Standalone units are designed for users processing less than 8,000,000 characters per month and usually replace keypunches on a one-to-one basis. The typewriter-like units produce hard copy in addition to tape. If the data are stored on a cassette, they must be transferred to standard 1/2-inch computer tape. A 300-foot cassette can hold 200,000 characters of data, or 2,500 80-column cards. Record lengths are not limited to 80 characters.

Because a key-tape unit is electronic rather than mechanical, the operator can type faster. The elimination of the need to change cards every 80 characters also speeds up the process. Bauch estimates that a key-tape system becomes cost-effective after a 15 percent increase in production over keypunching is maintained.[19]

Figure 3.17 shows the operation of a stand alone key-to-tape system. Validation and editing are similar to the keypunch. The pooling device must be used to merge tapes or to transfer data from a cassette to computer tape, if necessary. The more advanced key-to-tape units have progressed into complete data preparation systems. They perform the validation and editing tasks instead of the computer on which the job will be run. This type of data entry system has its own mini-computer that contains the appropriate editing and validation programs. A "clean" tape is then available for processing without the need of using time on the main computer. However, these units are much more expensive than key-to-tape devices without a mini-computer. Their operation is depicted in Figure 3.18.

Clustered key-to-tape units consist of several keyboard stations, a control unit to monitor them, and one or two tape units. These systems can contain from eight to 128 input stations, and are primarily used when large amounts of the same type of data must be accumulated for processing.

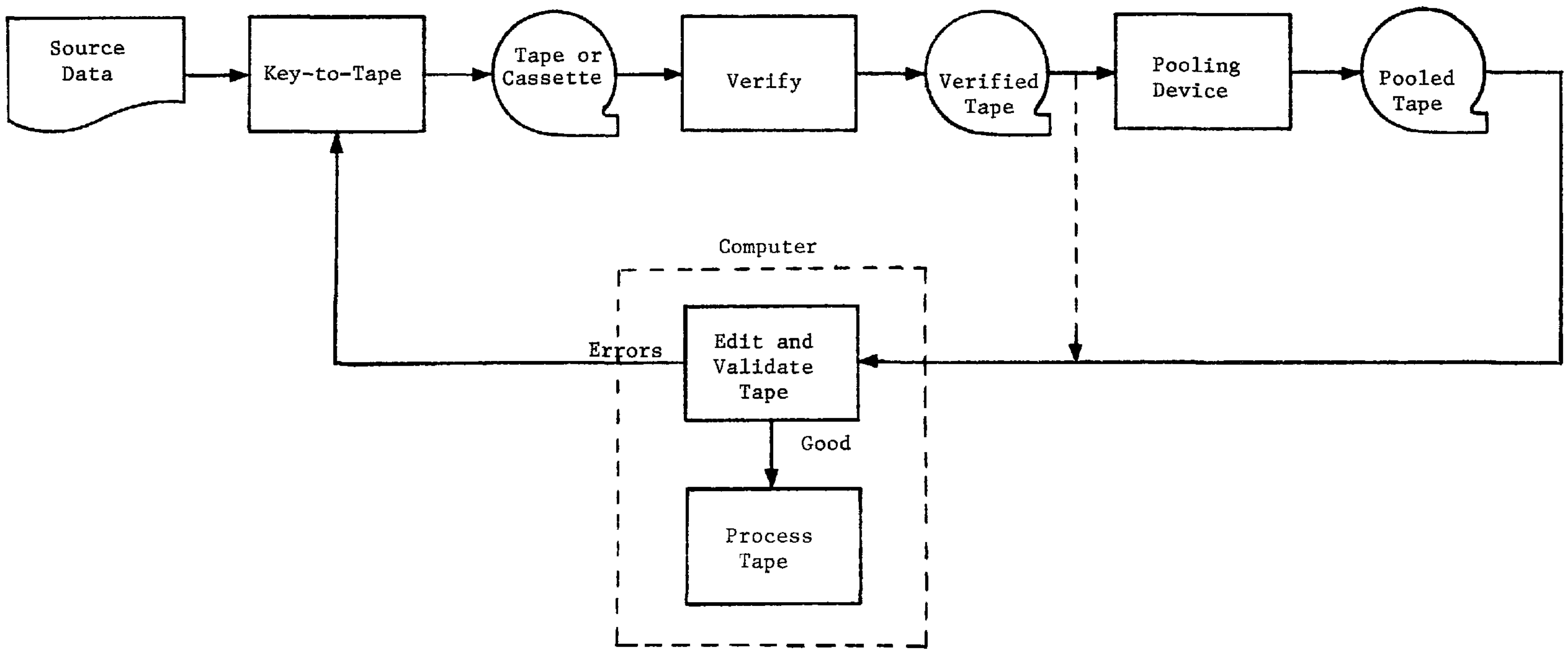


Figure 3.17. Operation of typical key-to-tape data entry system (source: reference 20)

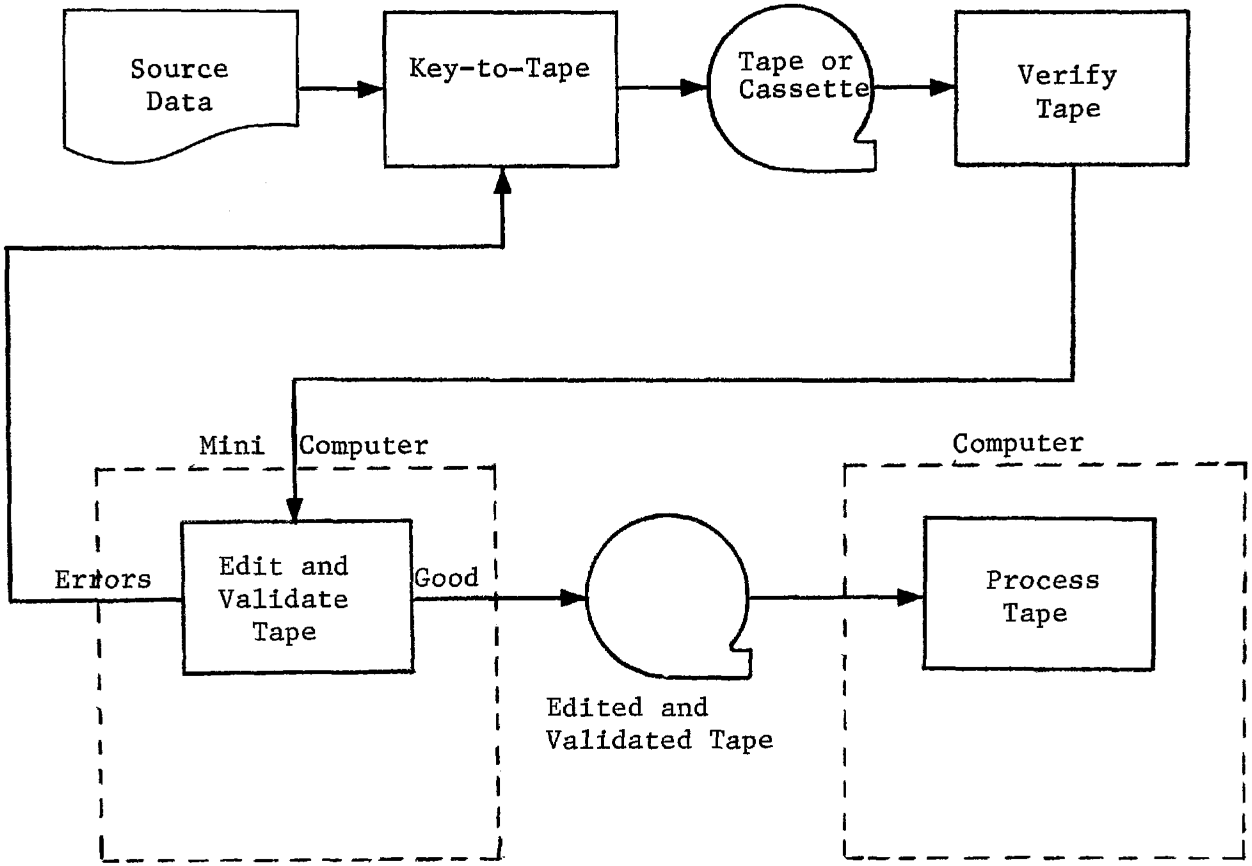


Figure 3.18. Operation of a complete key-to-tape data preparation and entry system (source: reference 21)

C. Key-to-Disk

Key-to-disk data entry systems are similar to the key-to-tape configurations utilizing mini-computers except that with the former the computer processes all input data and controls its verification as well as its validation and editing. In general, key-disk systems are also more powerful and slightly more expensive than key-tape units. They cost roughly three times the monthly rental of a keypunch per terminal.

The verification process is handled by either rekeying the data, by checking it visually on a display unit, or by monitoring several console indicators. In addition, the backspacing feature at each terminal station permits corrections to be made quickly at input time. The electronic nature of the keying terminals encourages their fast and quiet operation. As with the key-tape system, records are not limited to 80 characters.

Key-disk systems are available with from one to 64 input stations. Once the information has been keyed into the system, it is stored on a disk storage unit until verified. As part of the input process, the data are also formatted, edited, and validated. Finally, all information is transferred to standard computer tape ready for processing. This procedure is illustrated in Figure 3.19.

D. Optical Character Recognition Systems

Optical character recognition (OCR) data entry systems are best suited to those applications which have a very high volume of data preparation and a limited number of different documents to be encoded. This is because systems that can handle a large variety of inputs, as far as format and type-face fonts are concerned, tend to be extremely expensive.

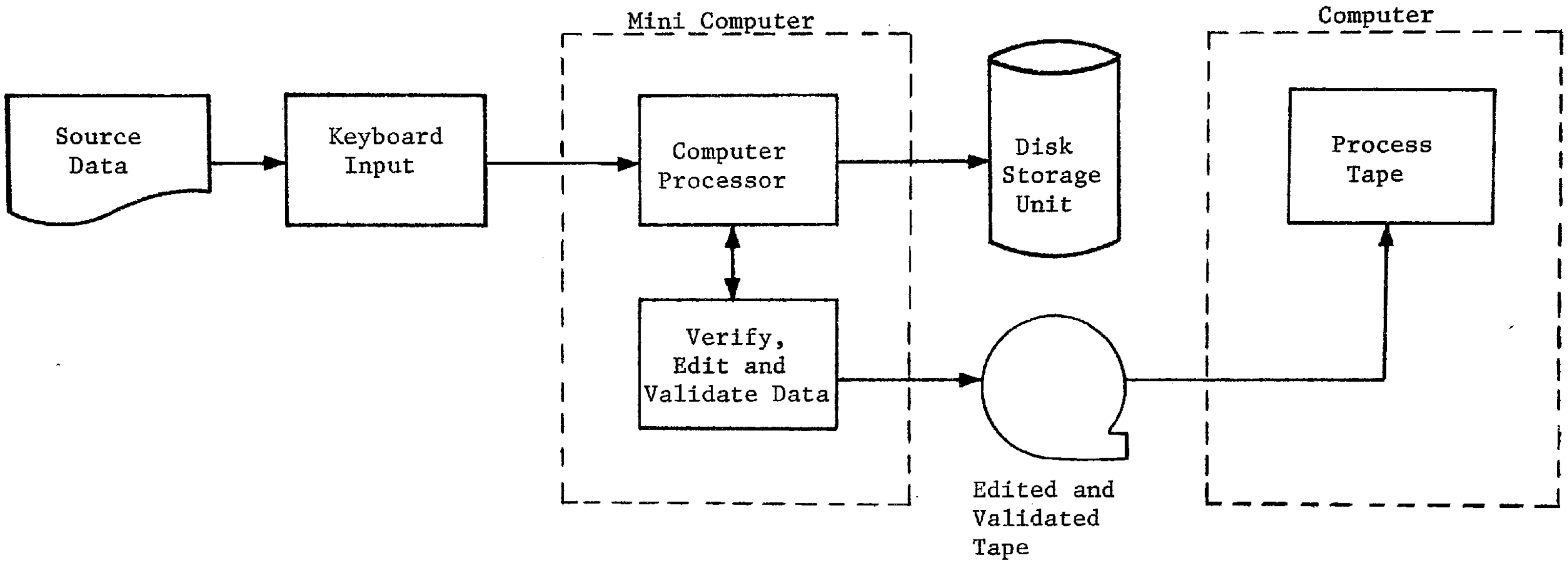


Figure 3.19. Operation of a complete key-to-disk data preparation and entry system

An installation should probably not use an OCR system unless its volume keeps at least five keypunch machines constantly occupied. The cost of the system is somewhat offset by lower labor costs and fewer errors. Typing data for character reader input is faster than keypunching and is likely to produce fewer errors. Checking typed pages and correcting them is also quicker than checking keypunch cards. These factors, as well as the fact that the pay for typists is generally less than that for keypunch operators, produce lower labor costs.

OCR data entry systems come in both on-line and off-line varieties. On-line systems are usually less expensive, but the user must employ his own computer to support their operation. Off-line systems include their own computers. Figure 3.20 briefly illustrates how a typical OCR system operates. Inputs may be from standard or specially typed records. When the documents are read successfully, they are transmitted to a computer-compatible medium such as magnetic tape. If they are not read because of an unrecognizable character, a document in poor condition, or some other reason, the data sheet is sent to a reject pocket. At this point it may be retyped and entered again, or input by an auxiliary method.

X. MICROFILM

Microfilm may be utilized by air pollution control agencies to store large amounts of information in a minimum of space. Microfilm is durable and easy to handle, and data on microfilm can be stored and retrieved quickly. The agency can use the microfilm either for backup to the original documents, or for daily operations with the originals as the backup.

Microfilm is maintained in any of three different forms: roll films, strips, or cards. The roll film is usually 16mm or 35mm and contains 2,000 or more frames. The strips are similar to the rolls but only approximately

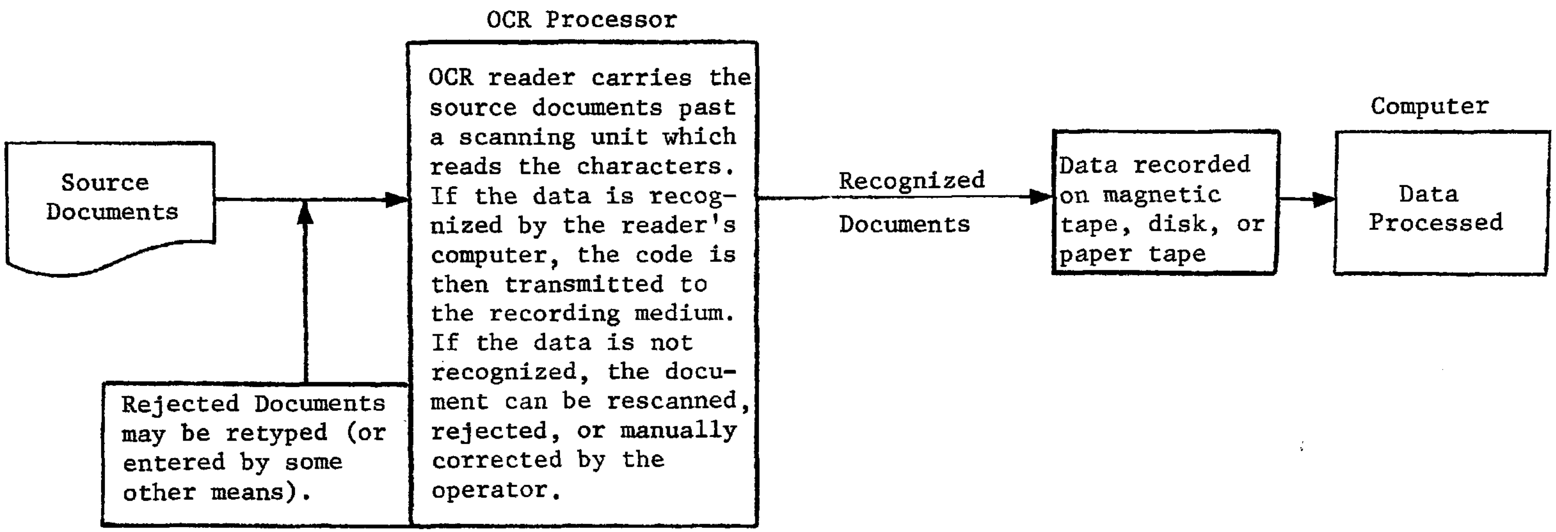


Figure 3.20. Operation of an OCR data entry system (source: reference 22)

15 frames long. "Microfiche" is the name generally applied to the cards. They are sheets of microfilm approximately 4 by 6 inches, with the frames of data arranged in rows and columns. A microfiche card holds approximately 200 frames.

A frame of microfilm can store the information existing on an average sized sheet of paper. This may include both alphanumeric and graphic data. Therefore, microfiche can be used for permit applications, reports, equipment diagrams and plant drawings.

Besides recording already-existing hard copy, microfilm may be used to store information generated directly by computers. This may be accomplished with a device known as a COM--Computer Output Microfilm. A COM unit accepts standard digital output from a computer system, transforms it into analog signals, then into recognizable characters and symbols, and finally records this data on the film at speeds of 25,000 to 500,000 characters per second.

COM systems are available that record only alphanumeric or both alphanumeric and graphic information. The former may serve as a direct replacement for a line printer, while the latter is more useful for engineering applications.

These systems can operate either on-line or off-line. In the on-line mode, the COM attaches directly to the computer and performs as any other peripheral equipment unit. As an off-line device, the COM reads in the data stored on magnetic tape by the computer without using valuable processing time.

A potential user may experiment with computer output microfilm at a COM service bureau. For a relatively small investment he can determine if this type of system meets his needs. In general, in-house COM systems are not economical unless monthly output exceeds 200,000 pages per month.[23]

XI. COST-EFFECTIVENESS EVALUATION

Determining the most cost-effective computer system for a particular application can be a difficult task. In most cases, potential vendors will submit proposals to the user based upon the latter's requirements. Often the user must not only choose among the equipment of many manufacturers, but he must also consider different configurations and options available from each offeror.

The following procedure is designed to encourage an orderly evaluation of competing computer system bids. It can be employed to select a system of any size or complexity.

1. Prepare a detailed list of system capabilities including hardware, software, expandability,general support, and vendor experience. For every item in each of these categories, designate appropriate features attributable to them. A result of this process is illustrated in Figure 3.21.

2. Select those items from the list that are considered mandatory and desirable for the system and assign them percentages proportional to their importance. Repeat this procedure for the features assigned to each item.

3. Evaluate each selected item and feature. The evaluation should be accomplished independently by individuals who are knowledgeable in the area. It should be based upon information in the vendor's proposal, in addition to supporting documentation, technical presentations and discussions, and personal visits to installations using similar systems. The result of these investigations is an allocation of points from zero to 100 for each feature. One hundred represents a characteristic that fits all user requirements.

I. HARDWARE

Central Processor

☐ Instruction set and special features (flexibility and power of the instruction set, availability and flexibility of the decimal instruction set, ease of bit manipulation);
☐ Addressing (amount of directly addressable core, virtual memory, indirect addressing);
☐ Double-precision arithmetic functions;
☐ Availability of storage-to-storage, storage-to-register and register-to-register instructions;
☐ Fetch time and cycle time;
☐ Size (words in memory, word size);
☐ Input/output (channel speed, spooling, number of channels, symbionts such as HASP, channel overlap);
☐ Operator dependence (requirements for operator intervention, set-up time);
☐ Registers (general registers, index registers, floating point registers, several complete sets of registers).

Peripherals

☐ Direct-access storage (transfer rate, speed of access, maximum storage size, ease of changing storage elements);
☐ Mass storage (transfer rate, speed of access, maximum storage size);
☐ Magnetic tape (speed, density, number of units, number of tracks, operator dependence);
☐ Paper tape (speed, ease of loading, operator dependence, number of tape levels, tape width);
☐ Card punch (speed, number of stackers, operator dependence);
☐ Card reader (speed, ease of operation, operator dependence);
☐ Printer (speed, character set, ease of loading paper, fine adjustments, operator dependence, quality of print, ease of changing character set);
☐ Communications equipment (speed, number of possible terminals, error rate, error-detection techniques, error-correction techniques);
☐ Video terminal (speed, buffer size, remote distance without communications drivers, character set, resolution, number of terminals, ease of operation, quality of the video display, brightness, color, persistance);
☐ Optical character reader (speed, ease of operation, operator dependence);
☐ Magnetic character reader (speed, operator dependence, ease of operation);
☐ Incremental plotter (on-line speed, off-line speed to generate plotter tape, throughput speed, ease of operation, operator dependence).

Non-Standard Interfaces

☐ Priority interrupts (hardware servicing, software servicing, speed of service, availability of priority levels);
☐ Parallel input (number of parallel input terminals, built-in multiplexing, speed of service);
☐ Parallel output (number of terminals, multiplexing speed of service);
☐ Control pulses (availability, decode requirements);
☐ Clocks (availability, real-time, access by user).

II. SOFTWARE

Systems

☐ Operating system (core requirements, ease of use, accessibility and ease of modification, diagnostics, real-time monitor, batch monitor, timesharing monitor, input/output support, data protection in event of power failure, allowing timeshare users to share programs in core, allowance for altering nuclei, auxiliary storage requirements for operating system, size of partition during multiprogramming, data-management facilities);
☐ General support programming (job control language, procedure library, function library, utility programs, assembler, Fortran compiler, Cobol compiler, Algol compiler, various other compilers, linkage editor).

Application languages

☐ Assembly language (execution times, ease of programming, ease of debugging);
☐ Fortran (level, special features, diagnostics);
☐ Cobol (level, special features, diagnostics);
☐ Other user-level languages (report generation, sort/merge, Basic, linear programming, simulation, Algol, etc);
☐ Real-time (language, interrupt servicing);
☐ Timesharing (software servicing);
☐ Communications (software servicing);
☐ Compatibility (compatibility with existing system, reprogramming requirements, re-training requirements).

III. EXPANDABILITY

☐ Core (availability, addressability, size, ease of modification);
☐ Mass storage (maximum size, speed, ease of addition, access time);
☐ Software (ease of modification of software to support hardware expansions);
☐ CPU.

IV. GENERAL SUPPORT

☐ Periodic maintenance (frequency, time required);
☐ Emergency service (hours available, location of service center, availability of service personnel, response time to service request);
☐ Documentation (clarity, how extensive, availability of manuals);
☐ Initial training (where given, how extensive, limit on personnel);
☐ Future training (where given, how extensive);
☐ Availability of local back-up computer (at least for batch work);
☐ Availability of systems assistance;
☐ Availability and vendor support of common users groups;
☐ Responsiveness of vendor to technical questions concerning the evaluation (both the timeliness and accuracy of the response should be considered here and this should be a fairly high percentage weighted item in the evaluation).

V. EXPERIENCE OF THE VENDOR

☐ Real-time data acquisition;
☐ Remote batch;
☐ Telecommunications;
☐ Multiprocessing;
☐ Timesharing;
☐ Local batch;
☐ Multiprogramming;
☐ Simulation.

Figure 3.21. System capabilities check-off list (source: reference 24)

4. Determine the total point score for each proposal by multiplying the allocations by their percentages, and dividing the result by the cost. This yields a value per dollar figure.

5. If possible, have a test run conducted for the highest scoring system. If this test proves successful, the system should be selected for purchase or lease.

To demonstrate the use of this procedure, consider the evaluation of a computer system with only two items, a card reader and a line printer. A weight of 30 percent will be given to the reader, and 70 percent to the printer. Their features may be weighted as follows:

Card Reader

Speed	70%
Ease of operation	20%
Operator dependence	10%

Line Printer

Speed	60%
Character set	5%
Ease of loading paper	10%
Fine adjustments	5%
Operator dependence	5%
Quality of print	10%
Ease of changing character set	5%

Assume that three vendors bid, and that their point awards and total costs are:

	Reader	Printer	Cost
Vendor A	55	50	$100,000
Vendor B	40	65	$ 80,000
Vendor C	60	75	$150,000

Finally, their value per dollar could easily be calculated:

Vendor A-(.3 x 55 + .7 x 50) ÷ 100,000 = 51.5 pts. per $100,000

Vendor B-(.3 x 40 + .7 x 65) ÷ 80,000 = 71.9 pts. per $100,000

Vendor C-(.3 x 60 + .7 x 75) ÷ 150,000 = 47.0 pts. per $100,000

On this basis, vendor B would be highest, vendor A second, and vendor C last.

REFERENCES

1. Lunche, R.G., E.E. Lemke, R.L. Weimer, J. Dorsey, and J.A. Verssen (ed.). Administration of the Permit System, Fourth Edition. Air Pollution Control District, County of Los Angeles, California. January, 1968, p. 12.

2. Ibid., p. 12-13.

3. Loquercio, P. and W.J. Stanley. Air Pollution Manual of Coding. USDHEW, PHS, The National Center for Air Pollution Control. 1968.

4. Fair, D.H., J.B. Clements, and G.B. Morgan. SAROAD Parameter Coding Manual. EPA Office of Air Programs. July 1971.

5. Croker, E.C. and C.F. Henderson. Analyses and Classification of Odors. American Perfumer and Essent Oil, Rev. 22:325. 1927.

6. McCord, C.P. and W.N. Witheridge. Odors, Physiology and Control. McGraw-Hill Book Company, Inc. 1949.

7. Partee, F., Director of the Kentucky Air Pollution Control Commission. Telephone conversation, December 28, 1971.

8. Gatewood, W.B., Senior Sanitary Engineer, KAPCC. Letter of March 23, 1972.

9. Martin, J.C. Kentucky Air Pollution Control Information System Summary Report. Kentucky Air Pollution Control Commission. October 1979, p. 6.

10. Martin, J.C. Kentucky Air Pollution Control Information System Technical Report, Volume Two: System Operating Procedures. October 1970, p. 98.

11. Ibid., p. 103.

12. Gatewood, op. cit.

13. Head, R.V. Management Information Systems: A Critical Appraisal. Datamation. May 1967, p. 22-27.

14. Sundeen, D.H. General Purpose Software. Datamation. January 1968, p. 24.

15. IBM System/360 Operation System, Third Edition. October 1969, Document Number C28-6534-2, p. 55.

16. Ibid., p. 56.

17. Bauch, J.H. Cut Into Costs with Key-to-Tape Devices. Computer Decisions. May 1971, p. 36.

18. Ibid., p. 38.

19. Ibid., p. 37.

20. Ibid., p. 38.

21. Ibid., p. 38.

22. Reagan, F.H. Should OCR Be Your Data Input Medium? Computer Decisions. June 1971, p. 20.

23. Totaro, J.B. Microfilming Cuts Computer Data Down to Size. Computer Decisions. March 1971, p. 22.

24. Brocato, L.J. Getting the Best Computer System for Your Money. Computer Decisions. September 1971, p. 16.

25. Martin, J.C. Kentucky Air Pollution Control Information System Technical Report, Volume One: System Description. October 1970.

26. Ellis, E.E., H.D. Mitchell, and W.B. Brogen. Florida Department of Air and Water Pollution Control Data Management Plan for FY 71-76. March 1971.

27. DS/2 Users Manual. System Development Corporation. February 1971.

28. Rosenberg, A.M. The Brave New World of Time-Sharing Operating Systems. Datamation. August 1969, p. 42-47.

29. Trimble, G.R. and A.J. Penta. Evaluation of Keyboard Data Entry Systems. Datamation. June 1970, p. 93-99.

30. Harder, B.M. Key-Disk Systems Speed Mainframe Processing Off-Line. Computer Decisions. May 1971, p. 42-43.

31. Bird, M.G. Indexing is the Key to Retrieving COM-Stored Data. Computer Decisions. May 1971, p. 30-33.

32. Yerkes, C.P. Microfilm - A New Dimension for Computers. Datamation. December 1969, p. 94-97.

CHAPTER 4
APPLICATION OF THE LEGAL PROHIBITION TO PERMIT PROCESSING

I. INTRODUCTION

The measures of acceptance of emissions from processes and equipment are the specific rules and regulations which restrict the limits of emission of air contaminants, or establish equipment standards, design standards and operational parameters which assure that the prescribed emission standards are met. The engineer processing applications for permits to construct and certificates to operate must use these rules as guidelines to objectively evaluate the air pollution potential from equipment.

The Clean Air Act, as amended, provides for the establishment of ambient air quality standards for sulfur oxides, particulate matter, carbon monoxide photochemical oxidant, hydrocarbons and oxides of nitrogen. To achieve and maintain these standards, the U.S. Environmental Protection Agency has required each State to prepare an implementation plan which includes emission control strategies for the reduction of air contaminants mentioned above. The plan, as described in Sections 420.11 and 420.18 of the Federal Register, Vol. 36, No. 158, must contain legally enforceable procedures and regulations by which the states can determine if the construction or modification of stationary sources of air pollution will interfere with the attainment or maintenance of the national standards.[1]

Many of these legal authorizations include, in addition to standards, statutes for assessing and evaluating applications for permits to construct and certificates to operate equipment and/or processes capable of emitting or controlling the emission of air contaminants. In this case, the agency's function is to prevent the installation of equipment that would violate any rules or regulations or would prevent the attainment or maintenance of applicable air quality standards.

These regulations are generally divided into nuisance avoidance, emission standards and zoning codes.

II. NUISANCE

Air pollution control law originated in the concept of public nuisance. It was later found necessary to provide ordinances for the abatement of specific contaminants as in the early smoke regulations of Chicago in 1881 and, shortly after, in Cincinnati and St. Louis.[2]

Nuisance ordinances are used to prevent the discharge of air contaminants where and when they will produce injury, annoyance or discomfort to persons, or affect property or business. The categories of air contaminan most likely to cause a nuisance are those which produce odors, material deposits or produce other detrimental effects.

A. Odors

Many industrial processes and community activities such as incineratio reduction of animal matter, petroleum refining and chemical processing may produce objectionable odors. Enforceable regulations for the reduction of odors are difficult to characterize since the threshold of detection is generally arrived at by consensus. However, a scale for measuring odors--The Odor Unit--has been established and is used to estimate odor concentrations by use of diffusion equations. An odor unit is defined as "the quantity of any odor or mixture of odors that, when dispersed in one cubic foot of odor-free air, produces a median threshold odor detection response."[3] The City of St. Louis, using this approach, has addressed a section of its Air Pollution Control Ordinance to "Control of Odors in Ambient Air."[4] The engineer considering an application for permit to construct must then assess the possibility of the emission of odorous compounds from the use of the equipment as part of his evaluation for recommending issuance of a permit.

B. Material Deposits

Nuisances resulting from particulates are categorized as solid deposits, stains and soiling. Most industrial operations, power plants and solid waste disposal processes can emit liquid or solid particulates capable of creating this class of nuisance.

Regulations designed to reduce or control these emissions are directed at:

- Fuel burning equipment;
- Fugitive dust;
- Particulate matter; and
- Smoke and other visible emissions.

While many regulations are not primarily intended as a protection against nuisances, they may form the basis for regulating processes which may be prone to this type of ordinance violation.

Volume 36, No. 158 of the Federal Register[5] suggests the following type of regulations for fugitive dust:

"2.2 Fugitive dust. Reasonable precautions can be taken to prevent particulate matter from becoming airborne. Some of these reasonable precautions include the following:

(a) Use, where possible, of water or chemicals for control of dust in the demolition of existing buildings or structures, construction operations, the grading of roads or the clearing of land;

(b) Application of asphalt, oil, water, or suitable chemicals on dirt roads, materials stockpiles, and other surfaces which can give rise to airborne dusts;

(c) Installation and use of hoods, fans, and fabric filters to enclose and vent the handling of dusty materials. Adequate containment methods can be employed during sandblasting or other similar operations;

(d) Covering, at all times when in motion, open bodied trucks, transporting materials likely to give rise to airborne dusts;

(e) Conduct of agricultural practices such as tilling of land, application of fertilizers, etc., in such manner as to prevent dust from becoming airborne;

(f) The paving of roadways and their maintenance in a clean condition;

(g) The prompt removal of earth or other material from paved streets onto which earth or other material has been transported by trucking or earth moving equipment, erosion by water, or other means."

III. EMISSION LIMITATIONS

Regulations which specifically limit emissions of pollutants into the atmosphere are the heart of air pollution programs. The nature and extent of emission control regulations are determined by the desired air quality and the types and sizes of emission sources in the area.

The preparation and application of emission regulations requires extensiv technical knowledge about source operations and conditions. This is especially critical in evaluating applications for permits to construct since inadequate understanding of concepts and applications can result in the installation of equipment or processes that may not meet the pollu emission standards.

The type of standard and the emission limit adopted are based on control strategies and agency policies. These dictate whether the standards are to be performance oriented, industry oriented, equipment and fuel oriente or some combination of these. Examples of standards attainable by curren technology are shown in Table 4.1.

Table 4.1 Emission limits attainable by available technology (sheet 1 of 3) (source: reference 6)

Type of Emissions	Source	Limits Attainable
Visible emissions	Industrial stacks	Less than No. 1 Ringelmann or 20 percent opacity except for periods up to 3 minutes in any 60 minute period.
	Gasoline powered motor vehicles	No visible emissions except for periods up to 5 seconds.
	Diesel powered motor vehicles	No. 1 Ringelmann or 20 percent opacity except for periods up to 5 seconds.
Particulate matter	Incinerators	0.1 pounds per 100 pounds of refuse charged.
	Fuel burning equipment (solid fuel)	0.1 pounds per million Btu.
	Process industries	Emission rate, E, in pounds per hour, given in terms of process. Weight rate P, in pounds per hour, is $E = 3.59\ P^{0.62}$ if P is 60,000 or less; $E = 17.31\ P^{0.16}$ if P is more than 60,000.
Sulfur oxides	Fuel combustion (Solid fuel)	1.2 pounds SO_2 per million Btu.
	(Liquid fuel)	0.8 pounds SO_2 per million Btu.
	Sulfuric acid plants	6.5 pounds per ton of 100 percent acid produced.
	Sulfur recovery plants	0.01 pounds SO_2 per pound of sulfur processed.

Table 4.1 Emission limits attainable by available technology (sheet 2 of 3)

Type of Emissions	Source	Limits Attainable
Sulfur oxides (continued)	Non-ferrous smelters	
	Copper	$Y=0.2X$
	Zinc	$Y=0.564\ X^{0.85}$
	Lead	$Y=0.98\ X^{0.77}$
		where X is total sulfur fed to the smelter and Y is sulfur dioxide emissions, both in pound per hour.
	Sulfite pulp mills (certain sources)	9 pounds per air-dried ton of pulp produced (with new recover systems) 20 pounds per air-dried ton (wi existing recovery systems).
	Refinery process gas streams	Equivalent to 10 grains of hydr sulfide per 100 standard cubic feet of gas.
Total reduced sulfur	Kraft pulp mills (recovery furnace)	0.1 pounds TRS per air-dried to of unbleached pulp (new recover furnace).
		0.5 pounds TRS per air-dried to of unbleached pulp (existing recovery furnace).
Oxides of nitrogen	Fuel-burning equipment (gas-fired)	0.2 pounds (calculated as NO_2) per million Btu.
	Fuel-burning equipment (oil-fired)	0.3 pounds (calculated as NO_2) per million Btu.
	Nitric acid manufacture	5.5 pounds (calculated as NO_2) per ton of 100 percent acid produced.

Table 4.1 Emission limits attainable by available technology (sheet 3 of 3)

Type of Emissions	Source	Limits Attainable
Organic Solvents	Paint Application Equipment	0.45 pounds per hour or 1.25 pounds per day
	Architectural Coatings	70 percent reduction by use of coating with 20 percent or less by volume organic solvent content

A. Emission Standards

Emission standards prohibit emission rates in excess of specified quantities and include: (a) stack concentration standards tested on the basis of weight or volume of emitted pollutant per unit weight or volume of the carrier gas; (b) process weight standards defined as the allowable emission rate of pollutants for a given weight of material processed; (c) visible emissions evaluated on the basis of visual observation; e.g., Ringelmann or opacity standards; and (d) plant boundary or downwind concentration limits.

A general rule may be applied to processes where particulates are emitted. Allowable emissions based on process weight are depicted in Table 4.2. This type of a standard has been established as the principal regulation for particulate control by many agencies with satisfactory results.

B. Equipment Standards

These are a class of regulations which specify permissible features, specifications or standards for the design of equipment or the prescr use of certain control operations. Such standards apply, for example to multiple-chamber incinerators, fuel burning equipment, fume burner design for residence time and temperature and for floating roof tanks and vapor recovery systems for petroleum product storage and transfer Regulations specifying minimum stack height may also fall under this category.

The use of equipment standards as a basis for issuing certificates to operate presents certain hazards since equipment standards by themsel do not assure that equipment, in practice, will meet emission limit standards. The standard design acceptance should include necessary operational details such as process weight, materials to be burned an

Table 4.2 Process weight table (Source: Reference 7)

Process weight rate (lbs./hr.)	Emission rate (lbs./hr.)
50	0.03
100	0.55
500	1.53
1,000	2.25
5,000	6.34
10,000	9.73
20,000	14.99
60,000	29.60
80,000	31.19
120,000	33.28
160,000	34.85
200,000	36.11
400,000	40.35
1,000,000	46.72

hours of operation. However, standards offer an opportunity to prepare quick evaluation procedures such as those used by the State of Illinois in processing permit applications for incinerators based upon th Incinerator Institute of America (IIA) incinerator standards[8] (see Chapter 5 for computer program and evaluation procedures).

Design characteristics of equipment may be dictated by the material processed or stored. For example, floating roof tanks may be necessary for the storage of volatile organic compounds. The standards can require that the roof be a double deck pontoon type or internal floating cover, resting on the surface of the liquid with seals to close the space between the roof edge and the tank wall. Another equipment standard for handling volatile organic compounds prescribes that all pumps and compressors used in this service shall have mechanical seals or seals of equal efficiency.[9]

The prohibition of the use of equipment would also come under regulations classed as equipment standards. This part of the rule prevents the use of certain equipment such as single chamber incinerators, beehive coking ovens and hand fired combustion equipment.

C. Process Standards

Process standards are based upon the emission of specific contaminants. The definition of a process may vary from unit operations to the complete manufacture of a product. Processes are usually characterized according to the mechanical, chemical or physical operation which is intended to be controlled. Fundamental processes include combustion, drying, size reduction, refining, liquid or solid materials transfer, incineration, and others. By way of example, the following standards are defined by classification of process.

1. Fuel Combustion Equipment[10]

   a. Visible emissions not to exceed No. 1 Ringelmann or 20% opacity except for short periods during such operations as soot blowing and start up.

   b. Particulate emissions not to exceed 0.10 pounds per million BTU of heat input.

   c. Oxides of nitrogen emissions calculated as nitrogen dioxide limited to 0.2 pound per million BTU of heat input.

2. Asphalt Air Blowing

   "A person shall not operate or use any article, machine, equipment or other contrivance for the air blowing of asphalt unless all gases, vapors and gas-entrained effluents from such an article, machine, equipment or other contrivance are:

   a. Incinerated at temperatures of not less than 1400 degrees Fahrenheit for a period of not less than 0.3 seconds; or

   b. Processed in such a manner determined by the Air Pollution Control Officer to be equally, or more, effective for the purpose of air pollution control than (a) above."[11]

D. Industry Standards

The standards for control of the emission of air contaminants may be based upon an industrial classification such as nitric acid plants, zinc smelters or copper smelters. Industry standards usually concentrate on a particular class of air contaminant, for example, oxides of sulfur in primary copper smelting or oxides of nitrogen from the production of nitric acid.

These standards do not necessarily preclude the inclusion of regulations curtailing the emission of other air contaminants. An example of this are rules intended for the abatement of fugitive dust and visible emissions.

Standards of this type may be simply stated by covering the entire operation, rather than addressing separate processes. This is shown in the following:

1. Nitric Acid Plants[12]

   Emissions of oxides of nitrogen (NO_x) calculated as nitrogen dioxide (NO_2) shall be limited to 5.5 pounds per ton of acid produced (2.8 kg/metric ton). Acid produced is expressed in tons of equivalent 100 percent strength nitric acid.

2. Sulfuric Acid Plants[13]

   The emission of sulfur dioxide (SO_2) shall be limited to 6.5 pounds per ton (3.25 kg/metric ton) of 100 percent acid produced.

3. Sulfur Recovery Plants[14]

   The emission of oxides of sulfur, calculated as sulfur dioxide (SO_2) shall be limited to 0.01 pound (kg.) per pound (kg.) of sulfur processed.

4. Non-Ferrous Smelters[15]

   The emission of oxides of sulfur, calculated as sulfur dioxide from primary non-ferrous smelter shall be based upon the following equations:

   Copper Smelters: $Y = 0.2X$

   Zinc Smelters: $Y = 0.564\ X^{0.85}$

   Lead Smelters: $Y = 0.98\ X^{0.77}$

   Where:

   X = Total sulfur fed to smelter (lbs/hr)

   Y = Sulfur dioxide emissions (lbs/hr)."

E. Zoning

Urban planning is generally concerned with planning for land-use, transportation and environmental design to meet criteria intended to promote health, welfare and safety. Such criteria may relate to efficient transportation, aesthetics, open spaces, optimum location of industrial, commercial and recreational facilities, air pollution, noise, glare, vibration, waste disposal facilities and other environmental considerations.

Zoning is a method of implementing an urban or master plan by assigning and enforcing prescribed land use functions to given parcels of land. Zoning may include the special handling of individual zone exception and land use permit cases which may necessitate variations in the original plan or which concern previously unanticipated land use functions.

Since zoning is based on multiple criteria that must be satisfied, it is likely that in many cases zoning does not adequately take into account the varied air pollution problems that may result from a particular land use function. This is particularly true with respect to potential nuisances, the involvement of reactive air contaminants or the role of meteorology in accumulating air contaminants and transporting them to receptors at more distant locations.

The overall air pollution control program should interface with zoning and planning, particularly in the areas of meteorology, emissions inventory, air monitoring, air pollution modeling, the permit system and enforcement. The permit system, in particular, can provide planning agencies with detailed information on given types of source activities, and the impact of any source activity on a variety of environments. This information should be made available through formal liaison or cooperative activity with planning and zoning departments to establish zoning criteria which, in themselves, will prevent the placement of activities at locations which are clearly undesirable from the standpoint of air pollution. Zoning strategies can and should consider achieving air quality standards as a major factor in devising land use plans for both local and regional areas.[16]

Planning is an iterative process. This is especially true in land use planning in which the problem of air pollution control must be considered. The urban planner must work closely with his counterpart in the air pollution control agency so that he may keep abreast of technological developments and industrial trends which may affect both near and long term land use plans. Some of these source control strategies are listed below:

- Emission control regulations and enforcement programs;
- Economic incentives (tax credits, grants and loans);
- Economic disincentives (emission charges, fines, law suites, etc.);
- Fuel policies;
- Stack height regulations; and
- Heating system centralization and regulations.

As a control function, the air pollution control permit system will be a valuable aid in enforcing the zoning regulations. The grid location of the proposed installation will determine if there is a restriction against a particular type of equipment or process in that location.

By their nature, large industrial installations and power generaring facilities will receive special attention from all government regulatory agencies. It is in these cases that the urban planner and air pollution control engineer should work together in order to avoid the creation of local nuisances. The planning of the location of large operations, taking into account meteorology and topography, is a significant step in this direction.

The engineer who considers an application for a permit to construct or a certificate to operate equipment or processes where there is an air pollution potential, must also be familiar with the local or regional zoning regulations so that he can consider these constraints in his evaluations. In many regions, zoning permits cannot be issued without evidence that an air pollution permit has been issued. This practice should be mandatory to avoid interagency differences as well as to assure complete consideration of all complementary regulations. The air pollution control agency should be equipped to perform all field functions relative to the enforcement of air pollution control regulations including those which are under the jurisdiction of zoning agencies. This would necessitate a separate reporting function but would avoid overlapping enforcement activities.

REFERENCES

1. Federal Register. Vol. 36, No. 158. August 14, 1971, p. 15489 and 15493.

2. Weisburd, M.I. Air Pollution Control Field Operations Manual. USDHEW, PHS, Division of Air Pollution. 1962, p. 57.

3. Danielson, J.G. (ed.). Air Pollution Engineering Manual. USDHEW, PHS. The National Center for Air Pollution Control and the Los Angeles County Air Pollution Control District. PHS No. 999-AP-40. 1967, Appendix B, p. 861.

4. Department of Public Safety, Division of Air Pollution Control, City of St. Louis, Ordinance 54699.

5. Federal Register. Vol. 36, No. 158. August 14, 1971, p. 15495.

6. Weisburd, M.I., A. Stein, R.J. Bryan, L.G. Wayne, and A. Kokin. Air Pollution Control Field Operations Manual (Revised Edition, February 1972). Task Order 1 for Control Agency Procedures Branch, Office of Air Programs, EPA, p. 1.33 and 1.34. Contract No. CPA 70-122.

7. Federal Register. Vol. 36, No. 158. August 14, 1971, p. 15496.

8. I.I.A. Incinerator Standards. Incinerator Institute of America, New York. May 1966.

9. Federal Register. Vol. 36, No. 158. August 14, 1971, p. 15496.

10. Federal Register. Vol, 36, No. 247. December 23, 1971, p. 24878.

11. Rules and Regulations of the Air Pollution Control District, County of Los Angeles. August 31, 1971, p. 54-A.

12. Federal Register. Vol. 36, No. 158. August 14, 1971, p. 15497.

13. Ibid., p. 15496.

14. Ibid., p. 15496.

15. Ibid., p. 15496.

16. Voorhees, A.M. and Associates, Inc. and Ryckman, Edgerley, Tomlinson and Associates. A Guide for Reducing Air Pollution Impacts Through Urban Planning. October, 1971 (unpublished).

CHAPTER 5

ENGINEERING EVALUATION OF THE APPLICATION FOR PERMIT TO CONSTRUCT

I. INTRODUCTION

The air pollution engineer's evaluation is usually performance oriented. He often must consider a variety of air pollution control systems and air cleaning devices used to control the emissions from any number of processes that will meet a given standard of allowable emissions. For example, a baghouse, electrostatic precipitator or a venturi scrubber may be specified to control the effluent from a basic oxygen steel furnace.

In making his assessment, the engineer thus may draw from chemical, mechanical, and sanitary engineering disciplines and from air pollution control engineering experience. Often the total expertise of an engineering group is necessary to treat a problem properly.

Systems adopted to assess industrial processes and review plans for permits to construct air pollution control equipment consist of the flow of documents within the agency, engineering evaluation, preparation of recommendations and consultations with applicants. These elements of the permit system are described in the following sections of this chapter.

II. PERMIT APPLICATION HANDLING

Systematic handling of permit applications is vital for economical operation, fast turnaround and efficient use of manpower. The flow of the permit application and supporting documents is treated in Chapter 2. Figures 2.1, 2.10, 2.12 and 2.14, in particular, describe the steps taken in processing applications. Actions taken while the application is being processed are further shown in the activity chart, Table 5.1.

Table 5.1. Permit system activity chart

PARTICIPANT	ACTION
Applicant	Submit application for: 1. Permit to construct and certificate to operate new equipment 2. Change of ownership of affected facility 3. Modification of equipment 4. Change of premises 5. Periodic reinspection
Agency Permit Application Receiving Unit	1. Receive permit application 2. Check for completeness, if incomplete return to applicant 3. Log in 4. Accept filing fee & issue receipt 5. Prepare file (dossier) 6. Transmit file to engineering unit supervisor for evaluation
Supervisor Permit Processing Unit	1. Assign to engineer--advise receiving unit of assignment 2. Record assignment
Engineer	1. Check application for completeness of technical data 2. Request additional information from applicant if required 3. For permit to construct: a. Review and evaluate equipment and processes including operating condition b. Review and evaluate air pollution collection system c. Review and evaluate air pollution control device d. Summary and conclusions e. Recommendations

Table 5.1. Permit system activity chart (continued)

PARTICIPANT	ACTION
Engineer (continued)	f. Transmit file to supervisor for review 4. For certificate to operate: a. Review process and equipment description b. Advise applicant of desired time of inspection c. Make final inspection d. Prepare inspection report e. Make recommendations f. Request source test if warranted g. Transmit file to supervisor for review
Supervisor Permit Processing Unit	1. Act on recommendation a. Approve with conditions if needed b. Deny c. Request additional inspections 2. Return to receiving unit for: a. Issuance of permit/certificate b. Denial of permit/certificate
Agency Receiving Unit	1. Notify applicant 2. Collect fee 3. Record necessary data 4. File dossier
Applicant	1. If permit/certificate not approved or if permit conditions are not acceptable: a. Refile after objections rectified b. Recourse to administrative hearing board for appeal

Table 5.1. Permit system activity chart (continued)

PARTICIPANT	ACTION
Administrative Hearing Board	1. Notify agency of appeal 2. Hear appeal 3. Render decision a. In favor of applicant b. In favor of agency c. Set plan for compliance and where applicable issue variance
Agency	1. Meet with applicant to discuss plan for compliance 2. Detail milestones of plan

III. EVALUATION PROCEDURE

The evaluation of permit applications should emphasize the approach the applicant has taken in the design of the air pollution control system, no just the detection of mathematical errors. Many control systems are stil designed by rule of thumb which, in some instances, may be satisfactory; but the application of fundamental engineering principles should prevail. To facilitate the evaluation the agency should require that design calculations be submitted with the application for the permit to construct.

The technical evaluation of an air pollution control system includes the following determinations:

- The potential quantity and type of air contaminants generated by the source;
- Rate of contaminant emissions;
- Volume of gases to be handled by the air pollution control system;
- Adequacy of the design of the air pollution control system;
- Efficiency of the air cleaning device.

These determinations require the compilation of the following data:

A. Basic Equipment and Operating Data

The term "basic equipment" refers to equipment which performs a basic productive function as distinguished from control equipment (see below). These include such equipment as boilers, incinerators, rendering cookers, rotary kilns, etc., which by their operation may emit air contaminants. The equipment may stand alone to provide a service or product or may be connected in series or in parallel to link dependent processes. Precise definitions of basic equipment will depend upon the regulations of the agency considering the application for a permit to construct. Basic equipment can be categorized as two types--stand alone (or batch) and process components that are interdependently linked to form a continuous process.

A method of describing equipment using code numbers based upon the Standard Industrial Classification (SIC) is described in the "Air Pollution Manual of Coding."[1] This approach can be used to construct a data base applicable to EDP. However, the engineer processing the permit application will require greater detail for his evaluation including information in narrative form which is not easily managed by EDP.

In describing the basic equipment, the engineer uses drawings, specifications and catalogs submitted by the applicant. From these data he determines the external and internal dimensions and physical characteristics of the equipment that may affect the air pollution control system. The determination of potential emissions from basic equipment depends upon the physical characteristics of the equipment, the method of operation and the material processed, all of which must be detailed. This information is needed to determine flow rates, retention time, and the resulting release of contaminants as may be derived from the type and quantity of material processed or burned.

The type and quantity of material processed is the starting point in considering the qualitative and quantitative nature of any possible air contaminant emission. Gas flow rates are calculated from the products of combustion, fan or compressor outputs or volume displaced by movement of materials. These gases are the conveying medium for the air contaminants. Retention time in the basic equipment provides the basis for estimating the time of evolution of some classes of contaminants such as oxides of nitrogen, CO, and oxides of sulfur. To arrive at the point where these estimates may be calculated the following data must be compiled:

1. Fuels
   - (a) Type and firing rate
     - (1) liquid
     - (2) solid
     - (3) gaseous
   - (b) Chemical composition
   - (c) Heating value
2. Combustion Controls
3. Fans and Compressors
   - (a) Capacity
   - (b) Power requirements
4. Process Weight
   - (a) Type and quantity of all material charged to the equipment per unit time, excluding liquid or gaseous fuels, air and recycled inert materials
5. Operational Details
   - (a) Unit processes
   - (b) Process control instrumentation
   - (c) Hours per day and days per week of use
6. Storage Vessels
   - (a) Capacity
   - (b) Dimensions

(c) Chemical and physical description of material stored

(1) liquid
(2) solid
(3) gaseous

(d) Pressure

7. Incinerators

(a) Rated capacity

(b) Description of material charged

(1) composition
(2) rate of charging
(3) auxiliary fuel
(4) combustion air

8. Metallurgical Equipment

(a) Process

(b) Capacity

(c) Fuels & Specification

(d) Process weight

9. Bulk Handling

(a) Material processed

(b) Process weight

(c) Description of method of handling

(1) mechanical
(2) pneumatic

(d) Moisture content

10. Chemical Manufacture, Petroleum Processing and Others

(a) Process weight

(b) Fuels

(c) Operational details

11. Plot Plan

The details of equipment operation are an essential part of the equipment description. These should cover charge or feed rates for continuous or batch operations; methods operators use to determine such rates, i.e., use of flow measurements, weighing devices, process control instruments, including temperature and pressure gages, flow meters and liquid level measuring devices; the employment of automatic analyzers, and such devices as draft gages, smoke meters, combustion controls, alarms, and continuous stack gas and process monitoring systems; and details of any emergency relief systems used and schedules for equipment operation.

These data, supplied by the applicant, must also contain an explanation of the effect operational changes would have on the emission of air contaminants.

B. Description of the Air Pollution Control System

An air pollution control system is composed of ducts, pipes, hoods, mechanical seals and other mechanisms which are designed to capture or contain liquid, solid, or gaseous air contaminants at the source of generation, and pumps, fans, compressors or other devices which convey contaminant-laden air to the air cleaning equipment. The total control system should be emphasized since a true reduction in contaminant emissions cannot be achieved unless there is effective pickup at the source.

As in the description of the basic process, details are important. These should cover information on hood design to assure effective pickup under the severest of operating conditions; properly sized ducts and air movers to ensure adequate conveying velocities; door and hatch seal details to preclude leaking; and assurance that the air pollution control system is always in operation when the basic equipment is in use.

Plans and specifications are essential to the description and evaluation of air pollution control systems. Manufacturers' specifications for equipment should be supported by test data. It is not enough to say that an electrostatic precipitator is 98.5% efficient. These claims should be supported by test data on similar equipment or by design or analytical data which will be validated by source inspections and stack tests.

IV. METHODOLOGY FOR EVALUATING A PERMIT TO CONSTRUCT

The approval or denial of an application should be based principally on engineering calculations. With this approach to permit evaluation the agency should require the applicant to submit design calculations with his request for permit. This will allow the engineer assessing the application to make his own calculations concise and facilitate the entire permit processing operation. Gradations of the complexity of calculations necessary will vary with the systems to be evaluated but should be kept to a minimum wherever possible.

A. Assessment of the Air Pollution Potential of the Basic Equipment or Processes

The first step in the evaluation of a permit to construct is the assessment of the potential air pollution emissions from the operation of the basic equipment. This is accomplished by using design data which describes physical features and operational characteristics. From this description and the specifications the engineer will estimate the magnitude and composition of the air contaminants, or confirm the estimates submitted by the applicant.

Overall losses may be estimated from material balance calculations. The engineer assessing the air pollution control system must be concerned with the location of the source of emissions to be able to appraise the effectiveness of the air pollution control system. Close inspection of the plans, knowledge of the basic process, test data, field observation reports of similar equipment, and the literature are used to make these determinations. Processes needing permits to construct, that singly or in aggregate are small contributors to the regional air pollution problem (such as small paint spray booths), should have only an examination of booth configuration, baffles or filters, fan capacity, type and quantity of paint used and hours of operation. The primary consideration should be nuisance potential, assessed by location of the equipment relative to nearby housing or industry.

B. Calculations

The complexity of the equipment or system will dictate the depth of the design check. Simpler systems may require only an examination of hood indraft velocity, fan capacity, air pollution control device efficiency or process weight and allowable emissions.

1. General Calculations

The fundamental computations performed in assessing permits to construct most classes of air pollution control equipment will include one or more of the following:

a. Calculations to determine the volume and composition of the products of combustion based upon fuel rate and composition. Sample combustion calculations may be found in Chapters 8 and 9 of the "Air Pollution Engineering Manual."[2]

b. Flow calculations to determine conveying velocities, inlet velocities, air flow profiles and power requirements. These calculations will consider cooling by dilution, water spray, radiation cooling or other heat exchange devices.

c. Effectiveness of the air cleaning device is based upon the condition of the gas entering, i.e., grain loading, volume, temperature, humidity, and chemical composition. Calculations relative to the effectiveness of a specific type of equipment for reduction of contaminants vary. However, in all cases the stated condition of the gases entering the air pollution control systems must be determined. Emission factors from many processes are contained in "Compilation of Air Pollution Emission Factors."[3] Detailed calculating techniques for most control devices now in common use are to be found in the manuals of the "Institute for Air Pollution Training--Control of Gaseous Emissions[4] and Control of Particulate Emissions,"[5] the "Air Pollution Engineering Manual,"[6] a "Manual of Electrostatic Precipitator Technology,"[7] and "Handbook of Fabric Filter Technology."[8]

2. <u>Example of the Evaluation Principles</u>

An application for a permit to construct an exhaust system and baghouse serving an oil fired rotary furnace for melting brass is being evaluated. The equipment and process description of the furnace includes its physical dimensions, charging and discharge points, composition and weight of charge, firing rate, melting rate and grade and quantity of fuel used. The kinds of questions that should be asked in this type of evaluation are described below. More detailed examples of step-by-step procedures are described in Chapter 6.

a. <u>Potential Air Contaminant Emissions from the Basic Equipment</u>

(1) What is the anticipated rate of emission of metallic fume from the operation of the furnace?

Process weight - 3600 pounds per hour of yellow brass scrap - approximate composition 76% CU, 14.7% Zn, 4.7% Pb, 3.4% Sn and 0.67% Fe. (emission factor = 60 lb/ton)[9]

Estimated emission rate = $\frac{3600 \text{ lb/hr}}{2000 \text{ lb/ton}} \times 60 \text{ lb/ton} = 108 \text{ lb/hr}$

(2) What is the volume of gases emitted from the furnace?

17 gals./hr. of No. 5 fuel oil
Exhaust temperature of gas is 2600°F.

Products of combustion (Table D6 page 881 Air Pollution Engineering Manual)[10]

$$\frac{206.6 \text{ SCF}}{\text{lb oil burned @ 10\% excess air}} \times \frac{17 \text{ gal}}{\text{hr}} \times \frac{8 \text{ lb}}{\text{gal}} \times \frac{\text{hr}}{60 \text{ min}}$$

= 468 SCFM

$$\frac{15.96 \text{ lb}}{\text{lb oil burned @ 10\% excess air}} \times \frac{17 \text{ gal}}{\text{hr}} \times \frac{8 \text{ lb}}{\text{gal}} \times \frac{\text{hr}}{60 \text{ min}}$$

$= 36.2 \frac{\text{lb}}{\text{min}}$

b. Basic Equipment Operational Considerations

(1) What is the condition of the metal charged to the furnace--oily, greasy, etc.?

If the material is dirty there may be several adverse results. The addition of "fuel" by the inclusion of grease and oil may require more combustion air to reduce smoke from burning of the grease resulting in a higher exhaust volume. If there is a smoky fire during start up, the air pollution control device (especially if it is a baghouse) may be affected by plugging of the bags with oily carryover in the effluent. If this is a problem, then it may be in order to issue a conditional permit which states that only clean scrap can be charged to the furnace.

(2) Is the burner properly sized to handle the volume of fuel needed for melting the charge and maintaining the desired fuel temperature?

Manufacturers' data must be relied upon to substantiate the firing rates and type of fuel specified. Therefore, it is necessary to have the manufacturers' specifications for evaluation of the burners.

c. Air Pollution Control System

(1) Is the ventilation system capacity adequate to exhaust the effluent from the furnace?

From the basic equipment calculations the theoretical furnace effluent will be 468 SCFM (36.2 lb/min @ 2600°F.) The baghouse design operating temperature is 250°F. with cooling by dilution air. The volume of gases to be handled by the exhaust system then will be 36.2 lb/min @ 2600°F. plus the dilution air, which is assumed to be 100°F.

Heat gained by ambient air = heat lost by products of combustion[11]

$$M_a C_p \Delta t_a = M_{pc} C_p \Delta t_{pc}$$

$$(M_a \#'s)\ (0.25)\ (250-100) = (36.2)\ (0.27)\ (2{,}600-250)$$

$$M_a = 613 \text{ lb/min}$$

or $$\frac{613 \text{ lb/min}}{0.071 \text{ lb/ft}^3} = 8{,}640 \text{ CFM @ } 100°\text{F Dilution Air}$$

Total Volume of Gases:

$$\text{From furnace} = 468 \left(\frac{250 + 460}{60 + 460}\right) = 639 \text{ CFM}$$

$$\text{Dilution Air} = 8{,}640 \left(\frac{250 + 460}{100 + 460}\right) = \underline{10{,}950} \text{ CFM}$$

$$\text{Total} = 11{,}589 \text{ CFM @ } 250°\text{F.}$$

(2) What is the capture velocity at the hood and is it satisfactory for this application?

The hood is close fitting with an open area of 6 sq. ft. During the melting phase of the operation the furnace fires directly into the hood. The calculated indraft velocity will be $\frac{11{,}589 \text{ cu ft/min}}{6 \text{ sq ft}} = 1930$ ft/min. This is acceptable if there are no excessive cross drafts in the melting room. If during the inspection it is determined that there is a disturbance of fume pickup by cross drafts, side panels may be added to the hood.

(3) Is the exhaust fan properly sized to handle the system load?

The pressure drop through the baghouse (manufacturers' specs.) is 3 inches of water column, the exhaust system flow calculations show a pressure drop of 3 inches of water. The fan static pressure is the inlet static pressure (6") plus the outlet static pressure (0.3) minus the velocity head (0.24) or 5.06" of WC. (Static pressure and velocity pressure selected for this example.)

The fan tables supplied with the application provide the data to compute the capacity of the fan at the calculated static pressure, temperature, given rpm and motor horsepower.

(4) Is the baghouse properly sized for this application?

The calculation of the filter ratio (the velocity of the gases through the bags) is a longstanding quick evaluation procedure that can be used to estimate filtering effectiveness. However, other variables including grain loading of effluent, type of cloth, and bag cleaning method determine the acceptable filter ratio.[12]

d. Air Pollution Control Equipment Operational Considerations

(1) Do the materials of construction lend themselves to long and low-maintenance service?

The ductwork and fan, if it is upstream of the baghouse, should be fabricated from materials capable of withstanding the erosion and corrosion from the fumes and particulates in the effluent gases.

(2) Are there adequate pressure, temperature or other instruments and recorders in the system to allow for inspections during operation to verify operating conditions?

A manometer or recording instrument to indicate the pressure drop across the baghouse and a temperature sensing device to act as a safeguard against reduced filtering capacity and damage to the bags from high temperatures should be employed.

(3) What shutdown procedure is planned in the event of an emergency to keep the emission of air contaminants from the process at an acceptable level?

The shutdown procedure must include the steps to be taken to assure full utilization of all air pollution control systems until shutdown has been achieved.

(4) What is the procedure for disposing of material collected by the air pollution control system? Consideration must be given to this factor to assure that a secondary air pollution problem will not be generated by the disposal of the captured material.

With the satisfactory answers to these and other questions the engineer may then recommend a permit to construct the air pollution control system.

V. RECOMMENDATIONS AND CONCLUSIONS

The decision to issue or deny a permit to construct cannot be based only on the results of the calculations. The entire evaluation process must be employed. A recommendation to grant the permit to construct must be explicit. A permit to construct should not be issued without qualifying conditions which clearly state anticipated construction start and completion dates (subject to review for unusual circumstances such as weather or strikes); fuel usage and specification (sulfur content for example); normal operating hours and days; a requirement for prompt notification to the agency of design changes which may affect the emission of air contaminants; specific instructions regarding the location of permanent scaffolding and sampling ports; smoke alarms or recorders or other instrumentation deemed necessary to assure proper operation of the system. The applicant should also notify the agency of construction completion dates and shakedown schedule so that an inspection and stack test, if required, can be scheduled.

The denial of a permit to construct must be meticulously documented since, in all likelihood, appeal board or court action will result from the denial. Before the denial is issued, the agency should meet with the applicant to discuss the reasons for the pending denial. The applicant should be notified in writing of the reason for the pending denial and request his design changes to meet the standards. This is not a simple procedure. Vague references to design feature shortcomings will not be acceptable. Specific points such as the fact that calculated indraft velocity (50 ft./min.) at the hood serving a brass crucible furnace is insufficient to effect the required pickup at a pot temperature of 1900°F. should be so stated. These assertions should be supported by test data for similar equipment, accepted practice standards, or fundamental engineering design practices. Where agreement cannot be reached or where the applicant refuses to modify his design, he should be notified in writing that the application for permit to construct is denied based upon the reasons documented in the permit file.

In the case where a fundamental design is unacceptable, such as a single chamber incinerator with no air pollution control system, a statement of agency policy or legal restriction against this equipment will suffice. Blanket denials, as a statement of policy or law, can be expeditiously handled by refusal to accept a permit application for a particular type of equipment.

VI. CONSULTATIONS TO REMEDY MINOR DEFECTS

The engineer in checking the plans for a permit to construct should complete his evaluation before contacting the applicant regarding some minor point in the design where a change may be required. This will decrease the number of telephone calls or letters and result in fewer meetings or communications among applicants and engineers. There may be times when some information or data necessary to complete the evaluation can be easily obtained by a telephone call. All such communication should be recorded as to date, time, person contacted and result of the conversation. If a letter is used to request data or to clear a point of confusion, a copy of the letter should suffice as the record of the communication.

Unless the engineer who is evaluating the permit application sets firm time limits for receiving the additional data or resolving the problems, large or small, many meetings or letters may result which are time consuming and costly to the agency. In any case, the problem should be clearly stated to the applicant. The engineer must also be sufficiently flexible to accept an alternative that he didn't think of if it will do the job.

VII. USE OF COMPUTERS FOR ENGINEERING CALCULATIONS

A. Introduction

An integral part of any effective permit system involves the efficient utilization of air pollution engineers. Since these individuals are currently in short supply, it is imperative that they be supported and aided in their evaluation functions.

At most agencies, engineers presently use slide rules and calculators to carry out computations pertaining to the evaluation of equipment. Although slide rules and calculators are convenient instruments, they force the engineer to go through the same steps, over and over again, for each similar appraisal. This process is often time consuming and is inherently subject to a small error.

Conversations with engineers at numerous state and local agencies indicated that the use of electronic data processing equipment would be helpful. A system that is employable for equipment evaluations could increase the engineer's capacity and improve his accuracy.

B. Types of Systems

Since the vast majority of the calculations performed by the engineer are short and straightforward, a simple EDP system may be desirable. The system must be easy for him to use, yield him results much more quickly than with the slide rule and calculator, fit his needs by being flexible, and be cost-effective. If these conditions are not met, the engineer will not feel comfortable using the equipment and attempt to revert back to his time-tested methods.

A conversational type computer system, utilizing teletypewriters or CRT devices, is easy to operate and can be used by a novice with no more than an hour of instruction concerning its operation. Results may be obtained virtually instantaneously once the system is operating. In larger batch type computer installations, the programmer is rarely concerned with the physical act of running the machine. This task is generally handled by trained operators.

If the engineer writes the programs he uses, they will fit his needs and give him the flexibility he must have. Many engineers are familiar with the FORTRAN programming language. However, even those who have never used a computer can learn BASIC and be reasonably proficient in the language within a few days. Becoming acquainted with the use of FORTRAN will generally require a few weeks or longer, depending upon the amount of time that the engineer can devote to it. Assistance can be obtained at universities, colleges, and junior colleges where beginning courses in computer programming are offered.

The cost-effectiveness of any system is largely dependent upon the volume of permit applications to be processed, and the effectiveness of the available staff. At agencies with extremely low volume, data processing equipment would be a luxury. For this type of an operation, a programmable calculator might be a useful tool. These instruments operate at a much slower pace than computers, are not as powerful or as convenient to use, but are less expensive.

For agencies with high volume, an automatic data processing system is indispensable. It may take one of three popular forms. The use of mini-computers is today becoming widespread in numerous industries. Many have easy-to-use FORTRAN and/or BASIC compilers, and may operate with a large variety of peripheral equipment. For engineering applications, it would be desirable for the computer to operate via a teletypewriter or CRT terminal as a user convenience. The system may be purchased or leased for a modest sum as compared with standard computers. In addition, the machine will be available for many uses other than equipment evaluation.

Alternatively, the agency may subscribe to a typical time-sharing service. This sytem operates over normal telephone lines, usually on a large-scale computer installation, via a teletypewriter or CRT terminal. The user is charged only for the actual time spent including a minimum monthly charge. In general, time-sharing services are expensive but may be perfectly correct under the right volume requirements. Less expensive time-sharing systems on mini-computers are currently being developed and put into use.

Traditional batch or remote batch computer installations are less desirable for typical equipment evaluation applications. Possible problems may arise in two areas. Firstly, the waiting time incurred between the submittal of a program to be run on the computer and the receipt of the results may be annoying to the engineer. This delay will generally last from between a few hours to a day. Secondly, data readied for batch runs will have to be prepared and checked with much more care than would be necessary for conversational runs. This is due primarily to the fact that data input via terminals may be easily corrected if in error, while once data cards are submitted to the computer they are no longer subject to modifications.

C. Prototype Mini-Computer System

In order to demonstrate how a mini-computer system might aid an air pollution engineer in an agency with a medium to high volume of permit applications, several typical engineering evaluation programs were created. The machine used was a Digital Equipment Corporation (DEC) PDP-11, with a paper tape reader/punch, a teletype terminal, and 8K of core space. All routines were coded in the conversational programming language, BASIC.

As an example, consider the program to find the escape velocity and exhaust rate from the hood of an exhaust system to prevent leakage. Figure 5.1 presents the background to this problem and a typical solution as it may be carried out by an engineer. Just going through the calculations would take about a half hour using a slide rule and/or calculator. Each time an application for a similar exhaust system is processed, the engineer will have to go through the same calculations, just changing the numbers.

A computer program has a great advantage over a slide rule and a calculator by allowing the user to standardize his calculation procedures and simply alter the parameters or inputs to the program each time it is used. If at some later date it is desired to modify the program to suit the user or the situation, this is easily achieved.

Figure 5.2 depicts a computer program used to solve the problem described in Figure 5.1. This program is short, easy to code, and may be used over and over again. Figure 5.3 shows a flowchart of this routine while Table 5.2 contains a description of all items utilized with their units of measure. The latter is used especially to prepare and input data.

The program in operation is illustrated in Figure 5.4. The user types in the input data when it is requested. Seconds later the results are printed clearly and accurately. Actual running time for this routine, including input and output, is less than 60 seconds

Specific Problems

Steaming tanks

When the hot source is a steaming tank of water, Hemeon (1955) develops a special equation by assuming a latent heat of 1,000 Btu per pound of water evaporated. He derives the following equation for the total volume required for a low-canopy hood venting a tank of steaming hot water.

$$V_t = 290\,(W_s\,A_f\,D_t)^{1/3} \qquad (20)$$

where

V_t = the total hood exhaust rate, cfm

W_s the rate at which steam is released, lb/min

A_f = the area of the hood face, assumed approximately equal to the tank area, ft^2

D_t = the diameter for circular tanks or the width for rectangular tanks, ft.

Preventing leakage

Hoods for hot processes must be airtight. When leaks or openings in the hood above the level of the hood face occur, as illustrated in Figure 16, they will be a source of leakage owing to a chimney effect, unless the volume vented from the hood is substantially increased. Since openings may sometimes be unavoidable in the upper portions of an enclosure or canopy hood, a means of determining the amount of the leakage and the increase in the volume required to eliminate the leakage is necessary. Hemeon (1955) has developed an equation to determine the volume of leakage from a sharp-edge orifice in a hood at a point above the hood face.

$$v_e = 200\left(\frac{l_o q_c}{A_o(460 + t_m)}\right)^{1/3} \qquad (21)$$

where

v_e = the velocity of escape through orifices in the upper portions of a hood, fpm

l_o - the vertical distance above the hood face to the location of the orifice, ft

q_c = the rate at which heat is transferred to the air in the hood from the hot source, Btu/min

A_o = the area of the orifice, ft^2

t_m = the average temperature of the air inside the hood, °F.

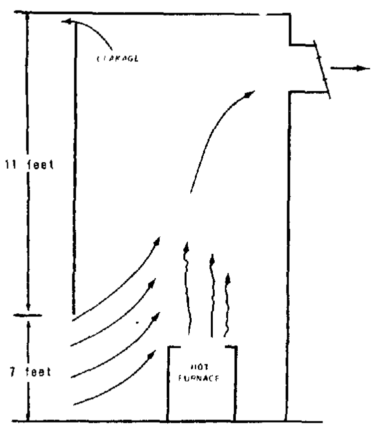


Figure 16. Illustration of leakage from top of hood (Hemeon, 1955).

A small amount of leakage can often be tolerated; however, if the emissions are toxic or malodorous, the leakage must be prevented completely. If all the cracks or openings in the upper portion of the hood cannot be eliminated, the volume vented from the hood must be increased so that the minimum indraft velocity through all openings including the hood face is in excess of the escape velocity through the orifice calculated by means of equation 21. The value of q_c may be determined by using the appropriate heat transfer coefficient from Table 5 together with equation 15 or by any other appropriate means. This method is illustrated in example 10.

Example 10

Given:

Several oil-fired crucible furnaces are hooded and vented as illustrated in Figure 16. The enclosure is 20 feet long. It is not possible to prevent leakage at the top of the enclosure. Total area of the leakage openings is 1 square foot. The fuel rate is 30 gallons per hour and the heating value is 140,000 Btu per gallon. Assume 80°F ambient air and 150°F average temperature of gases in the hood.

Figure 5.1. Background to escape velocity and exhaust rate problem with manual type solution (sheet 1 of 2) (source: reference 13)

Problem:

Determine the minimum face velocity and total exhaust rate required to prevent leakage of contaminated air through the upper openings by assuming all openings are sharp-edge orifices.

Solution:

The rate of heat generation:

$$q_c = 30\ \frac{\text{gal}}{\text{hr}} \times 140,000\ \frac{\text{Btu}}{\text{gal}} \times \frac{1}{60}$$

$$= 70,000\ \frac{\text{Btu}}{\text{min}}$$

Total open area:

$$A_o = (20 \times 7) + 1 \qquad = 141\ \text{ft}^2$$

The escape velocity through the leakage orifice:

$$v_e = 200 \left(\frac{l_o\, q_c}{A_o\,(460 + t_m)} \right)^{1/3}$$

$$v_e \quad 200 \left(\frac{(11)(70,000)}{141\ (460 + 150)} \right)^{1/3} = 420\ \text{fpm}$$

The required exhaust rate:

$$V_t - v_e\, A_o$$

$$V_t = (420)(141) \qquad = 59,000\ \text{cfm}$$

Check mean hood air temperature:

Since $q_c = V_t\, \rho\, c_p \Delta t$:

where

ρ = average density of mixture, 0.075 lb/ft^3

c_p = average specific heat of mixture, 0.24 Btu/lb per °F

Δt = average hood temperature minus ambient air temperature.

$$\Delta t = \frac{70,000}{(59,000)(0.075)(0.24)} = 66°\text{F}$$

$$\Delta t_m = 80 + 66 \qquad = 146°\text{F}$$

This adequately approximates the original assumption.

Figure 5.1. Background to escape velocity and exhaust rate problem with manual type solution (sheet 2 of 2) (source: reference 13)

```
10  REM - FIND ESCAPE VELOCITY AND EXHAUST RATE FROM HOOD
20  PRINT
30  PRINT "ENTER E1, E2, E3, E4, E5, E6 TO FIND ESCAPE VELOCITY"
40  PRINT "         AND EXHAUST RATE FOR A HOOD"
50  PRINT
60  INPUT E1, E2, E3, E4, E5, E6
70  PRINT
80  LET Q1=E1 * E2/60
90  LET Q2=(E4 * Q1)/(E3 * (460 + E5))
100 LET V1=200 * Q2 ↑ (1/3)
110 LET V2=V1 * E3
120 LET V3=Q1/(V2 * .075 * .24) + E6
130 PRINT "RATE OF HEAT GENERATION =   "; Q1; "BTU/MIN"
140 PRINT "ESCAPE VELOCITY THRU LEAKAGE ORIFICE =   "; V1; "FPM"
150 PRINT "EXHAUST RATE =    "; V2; "CFM"
160 PRINT "MEAN HOOD TEMPERATURE =    "; V3; "FAHR."
170 PRINT
180 GO TO 20
190 END
```

Figure 5.2. Escape velocity and exhaust rate computer program in BASIC

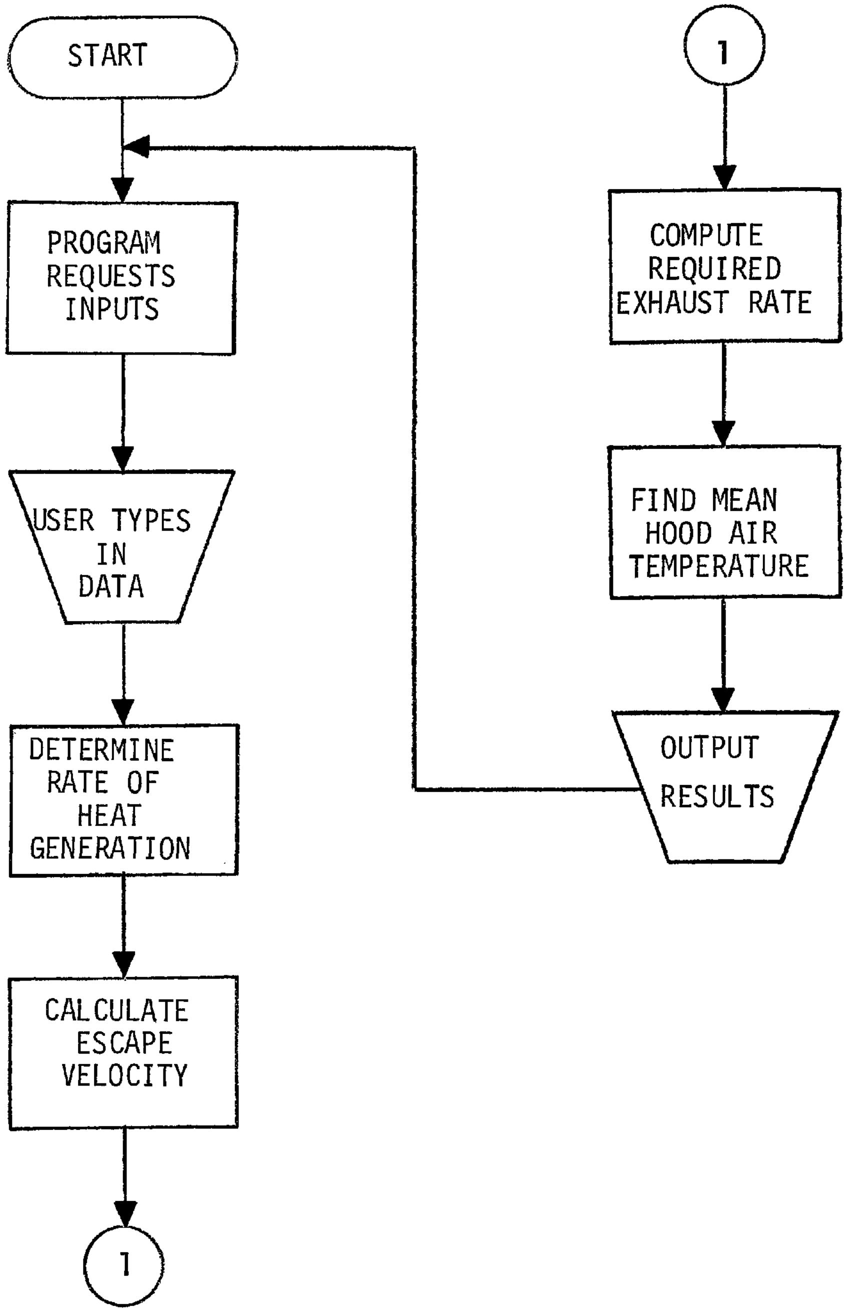


Figure 5.3: Flowchart of program to find exhaust rate and escape velocity from a hood

Table 5.2. Item descriptions for escape velocity and exhaust rate computer program

ITEM	DESCRIPTION	UNITS
E1	Fuel use rate	(gal./hr.)
E2	Heating value	(Btu/gal.)
E3	Total open area of orifice	(sq. ft.)
E4	Vertical distance above the hood face	(ft.)
E5	Ave. temp. of the air inside the hood	(deg. Fah.)
E6	Ave. temp. of the ambient air	(deg. Fah.)
Q1	Rate of heat generation	(Btu/min.)
Q2	Temporary storage	(------)
V1	Escape velocity thru leakage orifice	(fpm)
V2	Exhaust rate	(cfm)
V3	Mean hood temperature	(deg. Fah.)

```
ENTER F, H, A, D, T1, T2 TO FIND ESCAPE VEL. & EXH. RATE
?30 , 140000  , 141, 11, 150 , 80

RATE OF HEAT GENERATION = 70000      BTU/MIN
ESCAPE VELOCITY THRU LEAKAGE ORIFICE = 415.2828  FPM
EXHAUST RATE = 58554.87  CFM
MEAN HOOD TEMPERATURE = 146.4144  FAHR.
```

Underline indicates
user inputs.

Figure 5.4. Computer program execution to calculate the escape velocity and exhaust rate of hood--modified to reduce input/output time.

This program may be expanded so that it becomes completely self-contained. In this case, all data is requested by the routine as it executes. The appropriate information is typed in as it is required. Figure 5.5 contains the program in this other version, and Figure 5.6 illustrates its use.

Both programs are coded to allow execution again with other data after the results are printed. In this manner, experimentation may be undertaken by the engineer to learn more about a particular type of equipment. By modifying the parameters and simulating many cases on the computer, he can increase his knowledge in a quick and efficient manner.

D. Engineering Evaluation Diffusion Program

A model may be needed by engineers to evaluate the impact of emissions from large point sources on air quality levels. These programs may be based on the standard Gaussian diffusion equation, which follows:

$$\chi(x,y,z;H) = \frac{Q}{2\pi\sigma_y\sigma_z u} \exp^{*}\left[-\frac{1}{2}\left(\frac{y}{\sigma_y}\right)^2\right]$$

$$\left\{\exp\left[-\frac{1}{2}\left(\frac{z-H}{\sigma_z}\right)^2\right] + \exp\left[-\frac{1}{2}\left(\frac{z+H}{\sigma_z}\right)^2\right]\right\}^{**}$$

* exp $-a/b = e^{-a/b}$ where e is the base of natural logarithms and is approximately equal to 2.7183.

** For an extensive discussion of this equation, refer to Turner, D.B., Workbook of Atmospheric Dispersion Estimates (source: reference 14)

```
10  PRINT
20  PRINT " FIND ESCAPE VELOCITY AND EXHAUST RATE FROM HOOD"
30  PRINT
40  REM
50  REM -- DETERMINE RATE OF HEAT GENERATION
60  REM
70  PRINT "ENTER FUEL USE RATE IN GAL/HR"
80  INPUT E1
90  PRINT "ENTER HEATING VALUE IN BTU/GAL"
100 INPUT E2
110 LET Q1 = E1 * E2/60
120 PRINT
130 PRINT "
140 PRINT  "RATE OF HEAT GENERATION =         "; Q1; "BTU/MIN"
150 PRINT
160 REM
170 REM -- DETERMINE ESCAPE VELOCITY THRU LEAKAGE ORIFICE
180 REM
190 PRINT "ENTER TOTAL OPEN AREA IN SQUARE FEET"
200 INPUT E3
210 PRINT "ENTER VERTICAL DISTANCE ABOVE HOOD FACE IN FT"
220 INPUT E4
230 PRINT "ENTER AVERAGE AIR TEMP. IN FAH. INSIDE THE HOOD"
240 INPUT E5
250 LET V1 = 200 *((E4 * Q1)/(E3 * (460 + E5))) ↑ 1/3
260 PRINT
270 PRINT "ESCAPE VELOCITY THRU LEAKAGE ORIFICE =    "; V1; "FPM"
280 PRINT
290 REM
300 REM -- FIND REQUIRED EXHAUST RATE
310 REM
320 LET V2 = V1 * E3
330 PRINT
340 PRINT "EXHAUST RATE =     "; V2; "CFM"
350 PRINT
360 REM
370 REM -- CHECK MEAN HOOD AIR TEMPERATURE
380 REM
390 PRINT "ENTER AMBIENT AIR TEMPERATURE IN FAH."
400 INPUT E6
410 LET V3 = Q1/(V2 * .075 * .24) + E6
420 PRINT
430 PRINT "MEAN HOOD AIR TEMPERATURE =      "; V3; "FAH."
440 PRINT
450 PRINT
460 GO TO 10
470 END
```

Figure 5.5. Alternate version of BASIC computer program to calculate the escape velocity and exhaust rate of a hood

```
FIND ESCAPE VELOCITY AND EXHAUST RATE OF HOOD

ENTER FUEL RATE IN GAL/HR
?30
ENTER HEATING VALUE IN BTU/GAL
?140000

RATE OF HEAT GENERATION = 70000 BTU/MIN

ENTER TOTAL OPEN AREA IN SQUARE FEET
?141
ENTER VERTICAL DISTANCE ABOVE HOOD FACE IN FEET
?11
ENTER AVERAGE AIR TEMP. IN FAH. INSIDE THE HOOD
?150

ESCAPE VELOCITY THRU LEAKAGE ORIFICE = 415.2828 FPM

EXHAUST RATE = 58554.87 CFM
ENTER AMBIENT AIR TEMPERATURE IN FAH.
?80

MEAN HOOD AIR TEMPERATURE = 146.4144 FAH.
```

Underline indicates
user inputs.

Figure 5.6. Computer program execution of calculation of escape velocity and exhaust rate of hood

Where: χ is the pollutant concentration, g m^{-3}

x,y,z is the three dimensional coordinate position for which the calculation is being made (x is the downwind distance), m

H is the virtual stack height, m

σ_y is the standard deviation of plume concentration in the horizontal direction (the horizontal dispersion coefficient), m

σ_z is the standard deviation of plume concentration in the vertical direction (the vertical dispersion coefficient), m

Q is the uniform emission rate of pollutants, g sec^{-1}

u is the mean wind speed, m sec^{-1}

For permit system applications, ground concentrations are of primary interest. That is, the diffusion equation must be evaluated for the case z=0. In this circumstance, the equation above reduces to

$$X(x,y,0;H) = \frac{Q}{\pi \sigma_y \sigma_z u} \exp\left[-\frac{1}{2}\left(\frac{y}{\sigma_y}\right)^2\right] \exp\left[-\frac{1}{2}\left(\frac{H}{\sigma_z}\right)^2\right]$$

1. Computer Program

The following values must be input to a computer program based on the preceding equation:

- x the downwind distance travelled by the point source emissions, m ;
- y the horizontal distance off of the x-axis at which the calculation will occur, m ;

- H the virtual stack height, m (the height of the plume centerline when it becomes essentially level and is the sum of the physical stack height, h, and the plume rise, ΔH);
- Q the emission rate from the point source of the pollutant being measured, g sec^{-1};
- u the mean wind speed, m sec^{-1}; and
- S one of six stability classes (see Figure 5.7 and 5.8, and Table 5.3).

2. Virtual Stack Height

Since it is quite likely that the virtual stack height will not be a known value, a special routine will be created to compute an estimation of this quantity. One method of accomplishing this employs Holland's equation which follows:

$$\Delta H = \frac{v_s d}{u} \left(1.5 + 2.68 \times 10^{-3}\, p\, \frac{T_s - T_a}{T_s}\, d\right)$$

Where: ΔH is the rise of the plume above the stack, m
v_s is the stack gas exit velocity, m sec^{-1}
d is the inside stack diameter, m
u is the wind speed, m sec^{-1}
p is the atmospheric pressure, mb
T_s is the stack gas temperature, °K
T_a is the air temperature, °K

and 2.68×10^{-3} is a constant having units of $mb^{-1}m^{-1}$. The values v_s, d, p, T_s, and T_a are additional inputs.

Moses and Strom have suggested a value of 1.86 times the ΔH from the equation should be used for small stacks. For moderate size power plants, Stümke and Rauch advise factors of 2.92 and 3.09, respectively.[15]

The use of Holland's equation in this discussion serves only as an example of one possible method of determining plume rise. A technique given by Briggs[16] is gaining wide acceptance and may be more accurate in many situations.

3. Stability Class

There are six classes of stability coefficients as shown by the curves in Figures 5.7 and 5.8 Class A represents the most unstable atmospheric conditions, and class F the most stable. The user will select from among classes A through F according to Table 5.3.

The factors that must be taken into account when determining stability class include surface roughness, height above the surface, wind speed, distance from the source, turbulent structure of the atmosphere, and the sampling period. For this case, the sampling period is assumed to be approximately ten minutes, with only the lowest several hundred meters of the atmosphere considered. The surface is assumed to be relatively open. The wind speed is taken to be about 10 meters above the surface. "Strong" incoming solar radiation corresponds to solar altitude greater than 60° with clear skies; "slight" insolation correlates to a solar altitude of from 15° to 35° with clear skies. Cloudiness will decrease incoming solar radiation and appropriate adjustments must be made. For example, incoming radiation that would be strong with clear skies, can be expected to be reduced to moderate with broken (5/8 to 7/8 cloud cover) middle clouds, and to slight with broken low clouds.

The above gives best results for rural areas and is less reliable for urban regions. The difference is due mainly to the influence of the city's surface roughness and the heat island effects on atmospheric stability, with the largest variations occurring on calm, clear nights.

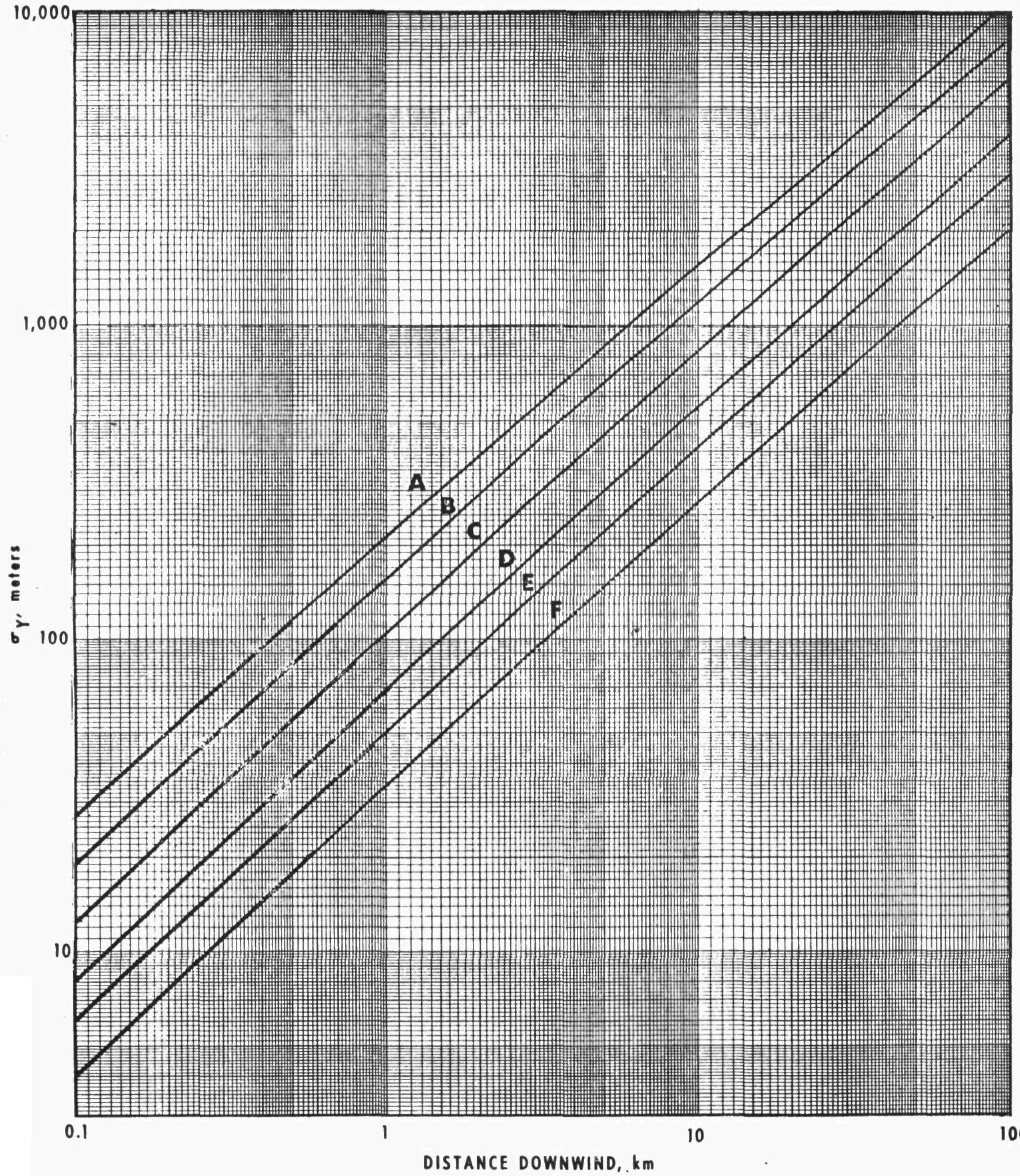


Figure 5.7. Horizontal dispersion coefficient as a function of downwind distance from the source (source: reference 17)

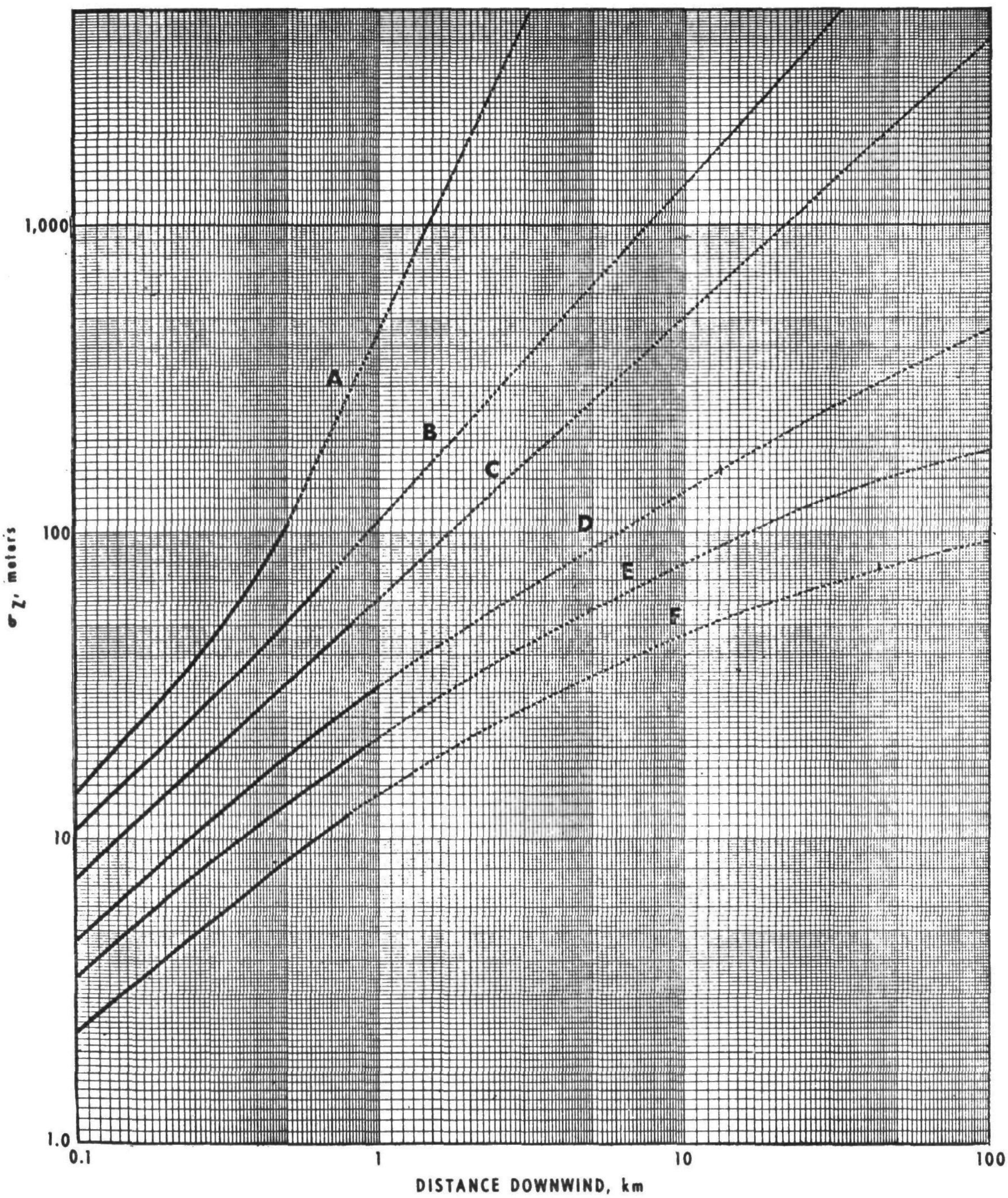


Figure 5.8. Vertical dispersion coefficient as a function of downwind distance from the source (source: reference 18)

Table 5.3. Key to stability classes (source: reference 19)

Surface Wind Speed (at 10m), m sec^{-1}	Day				
	Incoming Solar Radiation			Thinly Overcast or	$\leq$ 3/8
	Strong	Moderate	Slight	$\geq$ 4/8 Low Cloud	Cloud
< 2	A	A–B	B		
2–3	A–B	B	C	E	F
3–5	B	B–C	C	D	E
5–6	C	C–D	D	D	D
> 6	C	D	D	D	D

The neutral class, D, should be assumed for overcast conditions during day or night.

4. Program Operation

The execution of the diffusion program is depicted by the flowchart in Figure 5.9. As can be seen, the routine is rather straightforward without many logical decision points. It will operate in a batch and/or time-shared mode.

PIF2 (Figure 5.10) is a subroutine that provides second order polynomial interpolation in one variable. In this program, it is used to determine the dispersion coefficients at a specified downwind distance. A representative number of graph coordinate sets (approximately 30 pairs of distance and dispersion coefficient points from the graphs in Figures 5.7 and 5.8) are prestored in the program. Then for any point downwind, PIF2 determines the dispersion coefficients σy and σz.

Upon completion of the calculations, the program starts again if additional data is furnished to it. Otherwise, the routine terminates.

E. Incinerator Program

Computer programs may be created to thoroughly evaluate equipment for the purpose of permit processing. Such a routine has been developed and is being used by the State of Illinois, Environmental Protection Agency, Division of Air Pollution Control. The procedure for utilizing this program follows:

> When an installation application for incinerators is received by the Agency, it is assigned a unique number and reviewed for completeness. If the application is complete, it is sent to the data processing unit where certain information (that data in the numbered boxes) is keypunched on 80 column Hollerith cards. The application is then returned to the Permit Section. An example of such an application with

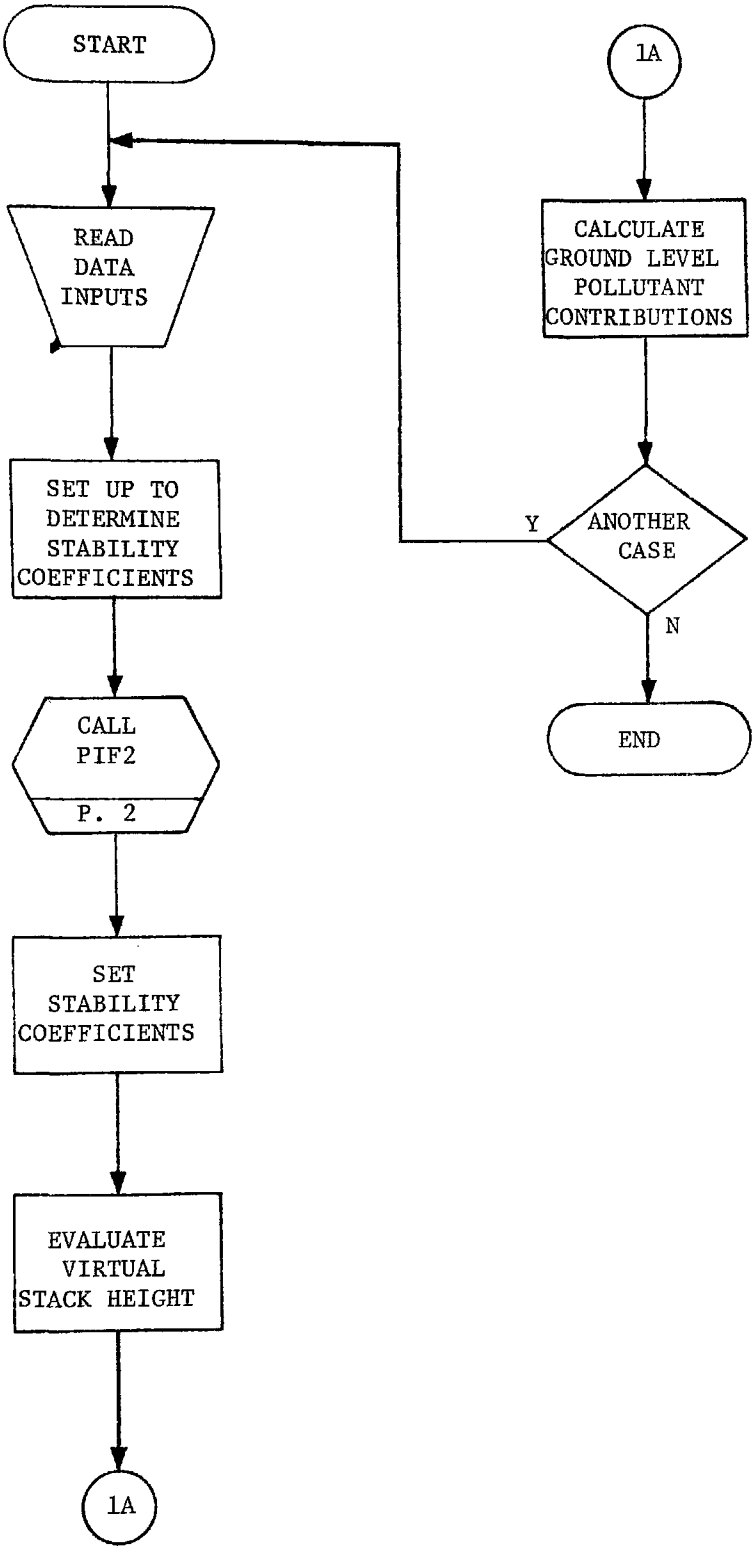


Figure 5.9. Diffusion program flowchart

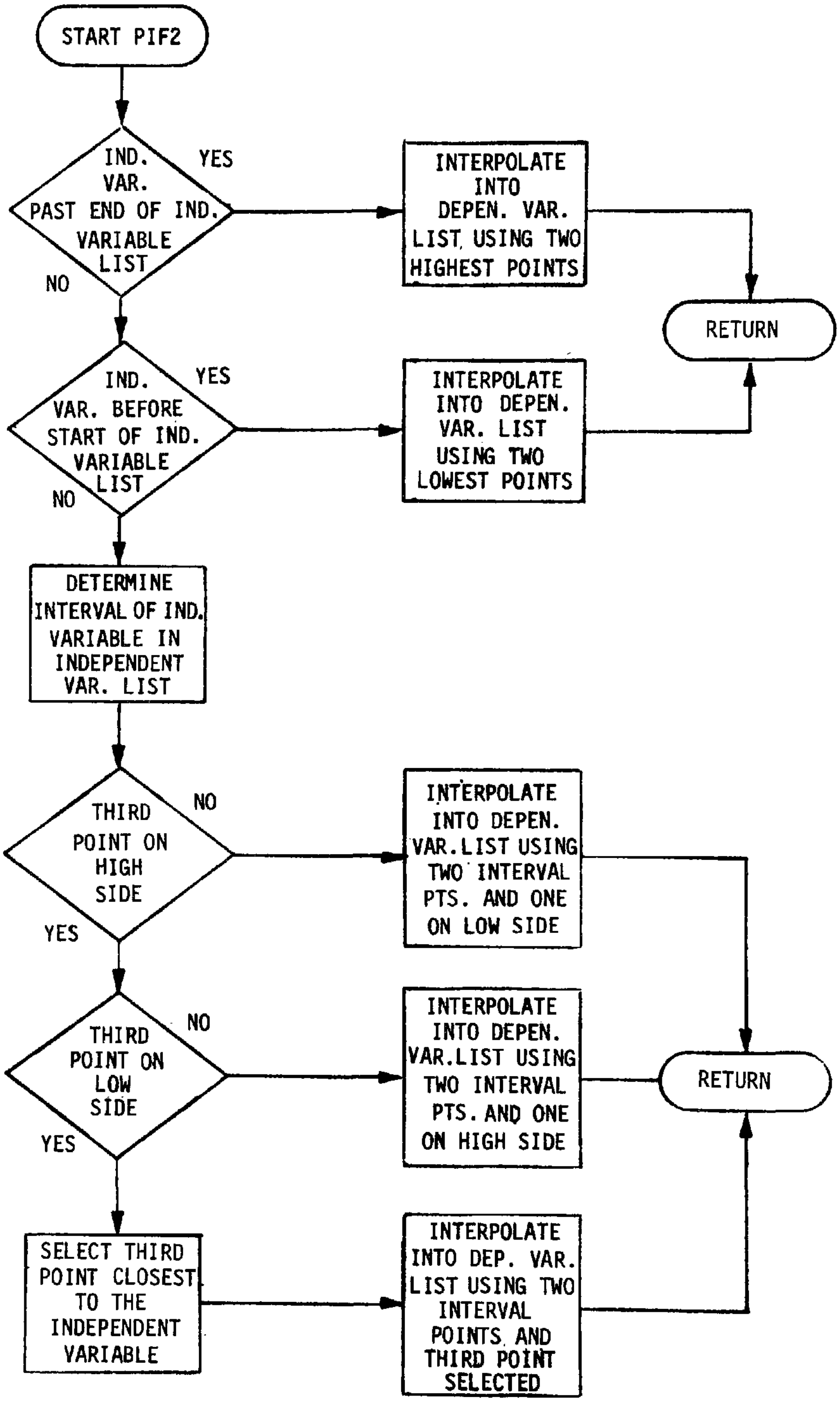


Figure 5.10. Flow of PIF2 subroutine

realistic but artificial data is shown in Figure 5.11.

The keypunched cards are sent to the Management Information Division for processing on an IBM 370 Model 155 computer. Figure 5.12 lists the incinerator evaluation program coded in FORTRAN, while the results of the computer processing are illustrated in Figure 5.13. The computer print-out is then transmitted to the Permit Section.

An engineer in the Permit Section reviews the application for inconsistencies and specific Agency requirements. The engineer then reviews the computer print-out sheet. The review of the computer print-out sheet consists of:

(a) Comparing the unique number on the application and on the print-out.

(b) Ascertaining that the correct information was keypunched (type of waste, heat content, capacity, primary chamber volume, flame port area, settling chamber area and the horizontal distance traveled in the settling chamber).

(c) Review the computer printout for the following:

1. That the burn area is less than that shown in blocks 21 or 22 of the application.

2. That the heat release equals the value given in blocks 23 of the application and is less than 50,000 Btu per hour.

3. That the flame port velocity is less than 35 fps.

4. That the settling chamber velocity is less than 9 fps.

5. That the residence time is greater than .25 seconds.

6. That the stack area is less than or equal to the value given in block 45 of the application.

STATE OF ILLINOIS
ENVIRONMENTAL PROTECTION AGENCY
DIVISION OF AIR POLLUTION CONTROL
2200 CHURCHILL ROAD
SPRINGFIELD, ILLINOIS 62706

RICHARD B. OGILVIE, GOVERNOR
WILLIAM L. BLASER, DIRECTOR

INSTALLATION PERMIT APPLICATION

FOR INCINERATORS

FOR OFFICE USE ONLY
PERMIT NO. 7 / 2 9 5 •
DATE EXAMINED

1. NAME OF OWNER: John Doe Food Center	2. ADDRESS OF OWNER: Anywhere, Illinois
3. ADDRESS OF INSTALLATION: (STREET, CITY, COUNTY, ZIP CODE) Anywhere, Illinois	4. SIGNATURE: (OWNER, PARTNER, AUTHORIZED OFFICIAL)
4a. NAME AND TITLE OF PERSON PREPARING APPLICATION: John Doe, Owner	4b. SIGNATURE: (PERSON PREPARING APPLICATION)
5. INSIDE INCORPORATED LIMITS [x] YES [ ] NO	5a. NAME OF CITY Anywhere, Illinois
6. DESCRIPTION OR SOURCE OF WASTE Store Waste	7. TYPE WASTE: 0 •
8. BTU/LB (AS FIRED) 6 5 0 0 •	9. MAKE OF INCINERATOR
10. MODEL NO. VM-54	11. CLASS: 3 •
12. RATED CAPACITY (LB./HR.) 2 6 5 •	13. SPARK ARRESTER: [x] YES [ ] NO MATERIAL AND SIZE OPENINGS
14. TOTAL HEAT RELEASE (ENTIRE UNIT) 1 1 8 7 9 • BTU/HR./CU. FT.	15. CHARGING METHOD [x] SIDE [ ] TOP [ ] OTHER
16. HAVE NFPA STANDARDS BEEN COMPLIED WITH: [ ] YES [ ] NO	17. % EXCESS AIR: 5 0 •
18. % AIR APPLIED AS OVERFIRE 8 5 •	19. INSTALLATION: [ ] INDOORS [x] OUTDOORS

PRIMARY COMBUSTION CHAMBER

20. VOLUME: 7 8 • CU. FT.	21. EFFECTIVE GRATE AREA: 1 1 • 0 4 SQ. FT.
22. HEARTH AREA: 1 1 • 0 4 SQ. FT.	23. TOTAL HEAT RELEASE: 2 2 0 8 3 • BTU/HR./CU. FT.

SECONDARY COMBUSTION CHAMBER

24. VOLUME: 4 • 4 CU. FT.	25. AREA OF FLAME PORT: 1 • 6 5 SQ. FT.	26. AREA OF SETTLING CHAMBER 1 1 • 0 4 SQ. FT.
27. HORIZONTAL DISTANCE OF AIR TRAVELED IN SETTLING CHAMBER: 1 • 5 4 FT.		

PLEASE COMPLETE REVERSE SIDE

APC-9 (Rev 10-71) 2M

Figure 5.11. Installation permit application for incinerators (sheet 1 of 2) (source: reference 21)

AUXILIARY BURNERS

28. TYPE OF FUEL:	29. NUMBER BURNERS: [ ][•]	30. CAPACITY OF EACH BURNER: [ ][ ][ ][ ][ ][ ][ ][•] BTU./HR.

DRAFT

31. [x] NATURAL [ ] INDUCED [ ] FORCED CFM AT °F

OVERLAPS

32. BETWEEN THE TOP OF THE BRIDGEWALL AND BOTTOM OF CURTAIN WALL [ ][6][•] INCHES	33. BETWEEN THE BOTTOM OF CURTAIN WALL AND TOP PAVING IN FLUE CONNECTION [4][2][•][ ][ ] INCH

GAS CLEANING DEVICES

34. MAKE & MODEL	35. FLOW RATE (GPH) [ ][ ][ ][•][ ]
36. CAPACITY (SCFM) [ ][ ][ ][ ][ ][•][ ][ ]	37. PRESSURE DROP INCHES OF WATER [ ][ ][•][ ][ ]
38. PRESSURE AT NOZZLES (PSI) [ ][ ][•][ ][ ]	39. COMPOSITION OF SOLUTION
40. EFFICIENCY % [ ][ ][ ][•]	41. DISPOSITION OF WASTE

STACK

42. HEIGHT ABOVE GRADE [ ][3][2][•] FT.	43. INSIDE AREA [0][1][•][8] SQ. FT.
44. DISTANCE TO NEAREST RESIDENCE: [ ][3][5][0][•] FT.	45. HEIGHT OF TALLEST OBSTRUCTION WITHIN 150 FT. [ ][ ][2][1][•] FT.

GENERAL INFORMATION

46. COST OF INSTALLED INCINERATOR $3500 approx.	47. COST OF GAS CLEANING DEVICES
48. TAX RELIEF APPLIED FOR [ ] YES [ ] NO DATE	49. TAX FORM NUMBER [ ][ ][ ][ ][ ][ ][ ][ ][•]

NOTE: Applicant must submit two (2) of each: installation permit application for incinerators, dimensioned drawings, plan elevation, sections as necessary, plot plan showing: location of incinerator, smoke stack, breeching and auxiliary gas cleaning devices, if used.

Figure 5.11. Installation permit application for incinerators (sheet 2 of 2) (source: reference 21)

```
FORTRAN IV G LEVEL  20                  MAIN                  DATE = 71349

          C INCINERATOR PROGRAM
            505 READ(1,101)A,H,THETA,P,Q,V1,D,S,CIS,DEL
            507 IF (DEL.EQ.0.0) GO TO 509
            101 FORMAT(F2.0,1F7.1,1F6.1,2F5.2,1F6.1,3F6.2,1F9.0)
          C THETA IS THE INCINERATOR CAPACITY
                IF (A-5.) 3,5,5
              3 P=1.0
                Q=0.0
                C=THETA
                GO TO 10
              5 C=P*THETA+Q*THETA
            HETREL IS TOTAL HEAT RELEASE
             10 HETREL=C*H
                IF(A-2.)11,13,15
             11 FACTOR= 13.*ALOG10(C)
                GO TO 30
             13 FACTOR=10.*ALOG10(C)
                GO TO 30
             15 IF(A-4.)17,19,21
             17 FACTOR= 8.*ALOG10(C)
                GO TO 30
             21 IF(A-6.) 91,91,11
             91 FACTOR=13.*P*ALOG10(C*P)+10.*Q*ALOG10(C*Q)
                GO TO 30
             19 IF (C-100.) 23,23,25
             23 FACTOR=10.0
                GO TO 30
             25 IF (C-200.) 27,27,29
             27 FACTOR =10.+(2.*(C-100.)/100.)
                GO TO 30
             29 IF (C-300.) 31,31,33
             31 FACTOR =12.+(2.*(C-200.)/100.)
                GO TO 30
             33 IF (C-400.) 35,35,37
             35 FACTOR =14.+(1.*(C-300.)/100.)
                GO TO 30
             37 IF (C-500.) 39,39,41
             39 FACTOR =15.+(1.*(C-400.)/100.)
                GO TO 30
             41 IF (C-600.) 43,43,45
             43 FACTOR =16.+(1.*(C-500.)/100.)
                GO TO 30
             45 IF (C-700.) 47,49,49
             47 FACTOR =17.+(1.*(C-600.)/100.)
                GO TO 30
             49 FACTOR =18.
                GO TO 30
             30 BURN = C/FACTOR
          C BURN IS REQD BURN AREA
                HET= HETREL/V1
          C HET IS PRIMARY CHAMBER HEAT RELEASE
                IF (A-1.) 51,53,55
             51 POC=0.179
                GO TO 32
```

Figure 5.12. Incinerator evaluation computer program (sheet 1 of 2) (source: reference 22)

```
      53 POC=0.14
         GO TO 32
      55 IF (A-3.)57,59,61
      57 POC= 0.099
         GO TO 32
      59 POC= 0.082
         GO TO 32
      61 IF (A-5.) 63,65,67
      63 POC=0.069
         GC TO 32
      65 POC=P*0.179+Q*0.099
         GO TO 32
      67 POC=P*0.14+Q*0.099
      32 GASVOL = C*POC
         VEL = GASVOL/D
C SETTLING CHAMBER VEL IS SCV
         SCV= GASVCL/S
         TIME =DIS /SCV
         SA = HETREL/2.0E+6
     103 CONTINUE
         WRITE (3,105) DEL,C,A,H,V1,D,S,DIS,BURN,HET,VEL,SCV,TIME
     105 FORMAT  (1H1,20X,14HPERMIT NO.=  I,F7.C,///20X,24HCAPACITY,LBS. PE
        1R HR.=  ,F6.1,///20X, 13HTYPE WASTE=  ,F2.C,///20X, 23HHEAT CONTEN
        2T,BTU/LB.=  , F7.1,///20X,30HPRIMARY CHAMBER VCL.,CU.FT.=  , F6.1,
        3///20X, 25HFLAME PORT AREA,SQ.FT.=  , F6.2,///20X, 31HSETTLING CHA
        4MBER AREA,SQ.FT.=  ,F6.2,///20X, 22HHCRIZONTAL DIS.,FT.=  ,F6.2,//
        5/20X, 19HBURN AREA,SQ.FT.=  , 1F5.2,///20X, 43HPRIMARY CHAMBER HEA
        6T RELEASE,BTU PER HR.=  ,F9.2,///20X, 31HFLAME PORT VEL.,FT. PER S
        7EC.=  ,F5.2,///20X,37HSETTLING CHAMBER VEL.8FT. PER SEC.=  , F5.2,
        8///20X,22HRESIDENCE TIME,SEC.=  ,F4.2)
         WRITE(3,107) SA
     107 FORMAT (1H1,//,20X,20HSTACK AREA,SQ.FT.=  ,F5.2)
         GO TO 505
     509 CONTINUE
         STOP
         END
```

Figure 5.12. Incinerator evaluation computer program (sheet 2 of 2) (source: reference 22)

```
PERMIT NO.= I 71295.

CAPACITY,LBS. PER HR.=  265.0

TYPE WASTE= 0.

HEAT CONTENT,BTU/LB.=  6500.0

PRIMARY CHAMBER VOL.,CU.FT.=  78.0

FLAME PORT AREA,SQ.FT.=  1.65

SETTLING CHAMBER AREA,SQ.FT.=  11.04

HORIZONTAL DIS.,FT.=  1.54

BURN AREA,SQ.FT.=  8.41

PRIMARY CHAMBER HEAT RELEASE,BTU PER HR.=  22083.33

FLAME PORT VEL.,FT. PER SEC.=  28.75

SETTLING CHAMBER VEL.8FT. PER SEC.=  4.30

RESIDENCE TIME,SEC.=  0.36

STACK AREA,SQ.FT.=  0.86
```

Figure 5.13. Computer print-out of incinerator evaluation program (source: reference 23)

REFERENCES

1. Stanley, W.J. and P. Loquercio. Air Pollution Manual of Coding. USDHEW, PHS. The National Center for Air Pollution Control, Cincinnati. 1968.

2. Danielson, J.A. (ed.). Air Pollution Engineering Manual. USDHEW, PHS. The National Center for Air Pollution Control and the Los Angeles County Air Pollution Control District. PHS No. 999-AP-40. 1967.

3. McGraw, M.J. and R.L. Duprey. Compilation of Air Pollution Emission Factors (Preliminary Document). EPA, Research Triangle Park, N.C. April 1971.

4. Control of Gaseous Emissions -- Institute of Air Pollution Training. USDHEW, PHS, EHS.

5. Control of Particulate Emissions -- Institute of Air Pollution Training. USDHEW, PHS, EHS.

6. Danielson, op. cit.

7. Oglesby, S., Jr. and G.B. Nichols. A Manual of Electrostatic Precipitator Technology, Part I and Part II. NAPCA, Division of Process Controls Engineering, Cincinnati. August 1970.

8. Billings, C.E. and J. Wilders. Handbook of Fabric Filter Technology, Volume I. Fabric Filter Systems Study, Division of Process Control Engineering. NAPCA, USDHEW, PHS. Consumers Protection and Environmental Health Service. December 1970. Contract No. CPA 22-39-38.

9. McGraw, op. cit.

10. Danielson, op. cit.

11. Ibid.

12. Billings, op. cit.

13. Danielson, op. cit., p. 42-43.

14. Turner, D.B. Workbook of Atmospheric Dispersion Estimates. EPA, Office of Air Programs, Research Triangle Park, N.C. 1970, p. 5.

15. Strom, G.H. Atmospheric Dispersion of Stack Effluents. In: Air Pollution, Volume I, Stern, A.C. (ed.). New York, Academic Press, 1968, p. 249.

16. Briggs, G.A. Plume Rise. U.S. Atomic Energy Commission, Division of Technical Information. Document Number TID-25075. 1969.

17. Turner,op. cit., p. 8.

18. Ibid., p. 9.

19. Ibid., p. 6.

20. From Mr. K. J. Consklin, Manager, Permit Section, Division of Air Pollution Control, Environmental Protection Agency, State of Illinois.

21. Ibid.

22. Ibid.

23. Ibid.

24. Digital Equipment Corporation, PDP-11, BASIC Programming Manual. Order No. DEC-11-AJPB-D, Maynard, Massachusetts. 1970.

Chapter 6

EXAMPLES OF PERMIT REVIEWS

I. INTRODUCTION

The following examples of engineering permit reviews have been constructed to portray the techniques used by an air pollution control agency in evaluating equipment and processes for permits to construct. These evaluations provide the engineer with an approach to investigating the design parameters of basic equipment and air pollution control systems relative to their effect on the emission of air contaminants. The quantitative results of these calculations provide the data for decision-making in issuing or denying a permit to construct. Also included are examples of specially designed forms for processing applications for permits to construct and a prototype computer-assisted calculations package.

Typically the plan review will encompass the equipment and process descriptions, engineering calculations, recommendations and conclusions. These examples assume complete equipment descriptions, while using summaries of these descriptions as data bases for computations. Recommendations include any conditions attendant to the permit to construct, modification suggested, design deficiencies and statements of approval or denial of the permit to construct.

The sample problems are not intended to be a substitute for training and experience. They are constructed to illustrate the fundamental approach to determining volumes of gases produced or handled, contaminant loading and air pollution control methods and equipment. These examples stress the concepts for rapid assessment of potential air contaminant emissions from a group of processes and equipment often encountered in plan review by an air pollution control agency.

II. SAMPLE PROBLEMS

A. Sulfuric Acid Plant

1. Equipment and Process Description.

A 700 ton/day (100% sulfuric acid basis) dual absorption contact sulfuric acid plant is to be constructed. It will operate on molten bright sulfur. It is to be equipped with a tubular type fiber glass mist eliminator. A schematic flow diagram based upon flow sheets supplied by the applicant is shown below (Figure 6.1). (Note: Flow rates, equipment sizes, pump and blower capacity, heat exchanger ratings, catalyst volume, temperatures, design criteria and any other information which is determined to be necessary to evaluate the pollution potential of the proposed plant should be supplied by the applicant or requested.)

Specifications for the proposed plant and a brief process description follows:

Feed - molten bright sulfur fed at a rate of 9.5 ton/hr. Plant to be operated 24 hours/day.

Air - Combustion air will be introduced by blower through a drying tower supplied by 93% acid to dry the air. Sufficient air will be supplied to result in feed mixture of 10% SO_2, 11% O_2, and 79% N_2, by volume, going to the converter.

Converter - A five stage converter is to be used with primary absorpt of SO_3 occurring after the third stage. The final two stages are fec with the discharge gas from the primary absorption tower. Heat excha ers are to be used so that feed gases will enter each converter stage at 820°F. Catalyst volume will be 175 liters per ton per day of acid production.[1]

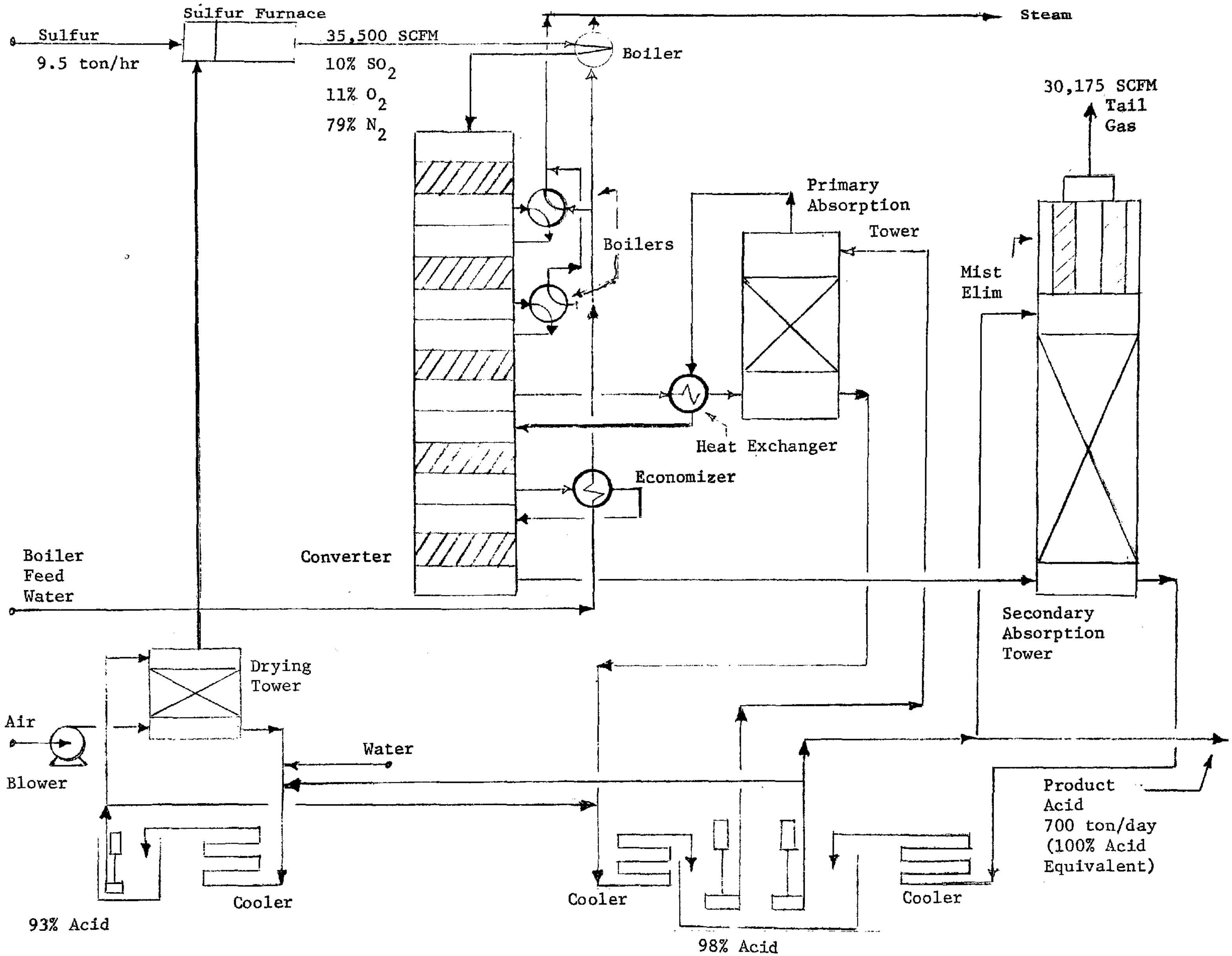


Figure 6.1. Schematic flow diagram dual absorption contact $H_2 SO_4$
(source: reference 2)

Absorption Towers - The primary tower absorbs SO_3 from the process gas stream after the first three stages of conversion. Converter gases are cooled to 450° F. before entering the tower with 98% acid used as the absorbing medium. The secondary tower takes the gases from the third converter stage. SO_2 emissions must meet the standard at this point. Tail gas temperature will be 170° F.

Mist Eliminator - Tubular type, fiber glass, 2000 ft^2 face area, designed for ΔP of 8 in. H_2O. To be 100% efficient[3] on particles $>3.0\mu$ and 95% efficient on particles $\angle 3.0\mu$.

2. Evaluation and Calculations

Standards - This plant must meet federal emission standards for sulfuric acid plants as set forth in the "Standards of Performance for New Stationary Sources," Subpart H, Part 60, Subchapter C, Chapter I, Title 40 and published in Volume 36, No. 247, Part II of the Federal Register for December 23, 1971. These are:

Sulfur dioxide: 4.0 lb SO_2 per ton of acid produced (as 100% H_2SO_4).

Acid Mist: 0.15 lb acid mist per ton of acid produced (both expressed as 100% H_2SO_4). Also, visible emissions must not exceed 10 percent opacity.

Flow Calculations: Because the process flow rate is important in terms of equipment capacity, and because emissions are determined as concentrations during testing (therefore requiring knowledge of flow rate to calculate mass emissions per ton of product), a calculation of process flow is made.

a. $S + O_2 \longrightarrow SO_2$ (sulfur furnace reaction) using air for combustion in an air/sulfur ratio necessary to result in a 10% SO_2 feed stream to the converter the above equation is expanded.

b. $10\ S + 21\ O_2 + 79\ N_2 \longrightarrow 10\ SO_2 + 11\ O_2 + 79\ N_2$ or

10 mols of sulfur result in 100 mols of feed gas to the converter.

c. Volume of feed gas =

$$\frac{100 \text{ lb mol feed}}{10 \text{ lb mol S}} \times \frac{359 \text{ scf}}{\text{lb mol}} \times \frac{\text{lb mol S}}{32 \text{ lb S}} \times \frac{32 \text{ lb S}}{98 \text{ lb } H_2SO_4} \times$$

$$\frac{2000 \text{ lb}}{\text{ton}} = \frac{73{,}000 \text{ scf feed gas}}{\text{ton } H_2SO_4 \text{ produced}}$$

d. Volumetric rate of feed gas =

$$\frac{73000 \text{ scf feed gas}}{\text{ton } H_2SO_4} \times \frac{700 \text{ tons } H_2SO_4}{\text{day}} \times$$

$$\frac{\text{day}}{24 \times 60 \text{ min}} = \frac{35{,}500 \text{ scf}}{\text{min}}$$

e. Volumetric rate of tail gas. Assuming that all SO_2 is converted to SO_3 and forms H_2SO_4, 85% of the feed gas is O_2 and N_2 which passes through the process to form the bulk of the tail gas. (See overall equation for conversion and absorption processes below.)

$10\ SO_2 + 11\ O_2 + 10\ H_2O + 79\ N_2 \longrightarrow$

$10\ H_2SO_4 + 6\ O_2 + 79\ N_2$

Therefore -

(1) Volume of tail gas = .85 x 73,000

$$= \frac{62{,}050 \text{ scf tail gas}}{\text{ton } H_2SO_4 \text{ produced}}$$

(2) Volumetric rate of tail gas = .85 x 35,500

$$= \frac{30{,}175 \text{ scf tail gas}}{\text{min}}$$

Allowable concentration of SO_2 in tail gas: The emission standard is 4.0 lb. SO_2 per ton of 100% H_2SO_4 produced. Using this figure supplied to the flow data above-

Allowable SO_2 conc.=

$$\frac{4.0 \text{ lb } SO_2}{\text{ton } H_2SO_4} \times \frac{\text{ton } H_2SO_4}{62{,}050 \text{ scf tail gas}} \times \frac{\text{lb mol } SO_2}{64 \text{ lb } SO_2} \times$$

$$\frac{359 \text{ scf } SO_2}{\text{lb mol } SO_2} \times 10^6 = \quad 360 \text{ ppm}$$

Allowable concentration of acid mist in tail gas: The emission standard is 0.15 lb acid mist per ton of 100% H_2SO_4 produced. Using this figure applied to the flow data, the allowable acid mist concentration is-

$$\frac{0.15 \text{ lb acid mist}}{\text{ton } H_2SO_4} \times \frac{\text{ton } H_2SO_4}{62{,}050 \text{ scf tail gas}} \times$$

$$\frac{454{,}000 \text{ mg}}{\text{lb}} = \frac{1.0 \text{ mg acid mist}}{\text{scf tail gas}}$$

Conversion of SO_2 to SO_3 - This conversion takes place over a catalyst in several stages. The temperature, rate of flow, and volume and activity of the catalyst are all important in determining the actual final percent conversion. In order to meet the standard for SO_2 the conversion must be very close to 99.7%. The conversion reaction is as follows:

$$SO_2 + 1/2\ O_2 \longleftrightarrow SO_3$$

the equilibrium constant for the reaction is:

$$K = \frac{(SO_3)}{(SO_2)\ (O_2)^{0.5}}$$

In determining the predicted conversion, a plot of K vs. temp. at the initial SO_2 concentration is made (in this case 10%). A graphical solution for the percent conversion after the first three stages may be obtained by plotting operating lines based upon the initial temperature and adiabatic temperature increase of the process gases. The first and second stage and the second and third stage operating lines are connected by horizontal lines determined by the amount of interstage cooling. Essentially all the SO_3 formed in the first three stages is removed in the primary absorber. Thus for the final stage a completely new set of conditions exist. The O_2 to SO_2 ratio is substantially increased and the previously formed SO_3 has been removed. It is assumed here that equilibrium conditions are attained after each stage. In the case given, the overall conversion should be very close to the 99.7% required. (Note: the approach rather than the actual calculations are given for this part of the example because of the substantial extra space and detail required. Equilibria and adiabatic temperature increase data for a variety of starting conditions are available in the literature.[4] This data should be provided, additionally, from the applicant.)

Mist Eliminator Performance - A high efficiency tubular type fiber glass mist eliminator of 2000 ft^2 face area is specified. The uncontrolled mist emissions from a plant such as being proposed might easily be 3.0 lb/ton acid produced.

Thus the overall efficiency required is:

$$\frac{3.00 - 0.15}{3.00} \times 100 = 95\%$$

The specifications for the mist eliminator call for an efficiency of not less than 95% on particles $< 3.0\,\mu$. Since 70% (by weight) of the mist particles in a plant such as proposed are expected to be $> 3.0\,\mu$, the predicted efficiency can be calculated as follows:

(a) wt. particle $> 3.0\mu$ = .7 x 3.0 = 2.1 lb/ton acid

(b) wt. particle $< 3.0\mu$ = 3.0 - 2.1= 0.9 lb/ton acid

(c) wt. particle $> 3.0\mu$ removed = 1.00 x 2.1 = 2.1 lb/ton

(d) wt. particle $< 3.0\mu$ removed = 0.95 x 0.9 = .85 lb/ton

(e) total wt. mist particles removed = 2.1 + .85 = 2.95 lb/t

(f) wt. mist particles discharged = 3.0 - 2.95
= 0.05 lb/ton acid produc

This is well within standard of 0.15 lb/ton.

The effective face area of the mist eliminator required is set by the requirement that face velocity not exceed 25 ft/min for[6] this type eliminator. Since tail gas flow rate was calculated to be 30,175 scfm, and tail gas temperature is 170° F., flow rate at stack conditions is:

$$\frac{30{,}175 \text{ scf}}{\text{min}} \times \frac{630°}{492°} = 38{,}720 \text{ cfm}$$

$$\text{Face velocity} = \frac{38{,}720 \text{ ft}^3}{\text{min}} \times \frac{1}{2000 \text{ ft}^2 \text{ eliminator ar}}$$

$$= 19.4 \text{ ft/min}$$

This is below the 25 ft/min maximum.

3. Summary and Conclusions

It would appear that this proposed sulfuric acid plant could meet the new federal standards. Several features would have to be examined more carefully in an actual situation: (1) The design criteria for the converter should be examined carefully to see what percent approach to equilibria was used in the calculations, and whether the flow rate was within the accepted upper limit. Finally the possibilities for increased production should be examined. (2) The possibility of a slight enlargement of the mist eliminator should be explored so as to give an increased safety factor.

The extent of the design check to be made is always subject to judgment of the engineer. Those suggested in this example seem reasonable. It would not appear to be justified, for example, to recheck all the heat exchange calculations.

B. <u>Coal Fired Boiler with an Electrostatic Precipitator</u>

1. Equipment and Process Description.

A permit to construct is requested for an electrostatic precipitator for a pulverized coal steam generator for power plant service.

The following data summarizes the description of the basic equipment.

a. A corner fired, dry bottom steam generating unit rated at 940,000 pounds per hour of steam @ 2565 psig and 1050° F. monotube type (no steam drum) and water cooled.[7]

b. Fuel - 55 tons/hr of pulverized coal (70% passing 200 mesh) ultimate analysis (as fired), heating value of 13,000 Btu/lb

C	72.8%
H_2	4.8
O_2	6.2
N_2	1.5
S	1.8
H_2O	3.5
Ash	9.4
Total	100.%

c. Burners - 16 tangential corner mounted burners with automatic controls for air fuel ratios based on load conditions.

Two forced draft fans @ 185,000 cfm

Two induced draft fans @ 275,000 cfm (300° F.)

d. The schematic diagram shown in Figure 6.2 is a representation of the system indicating the fuel preparation equipment and the gas flow.

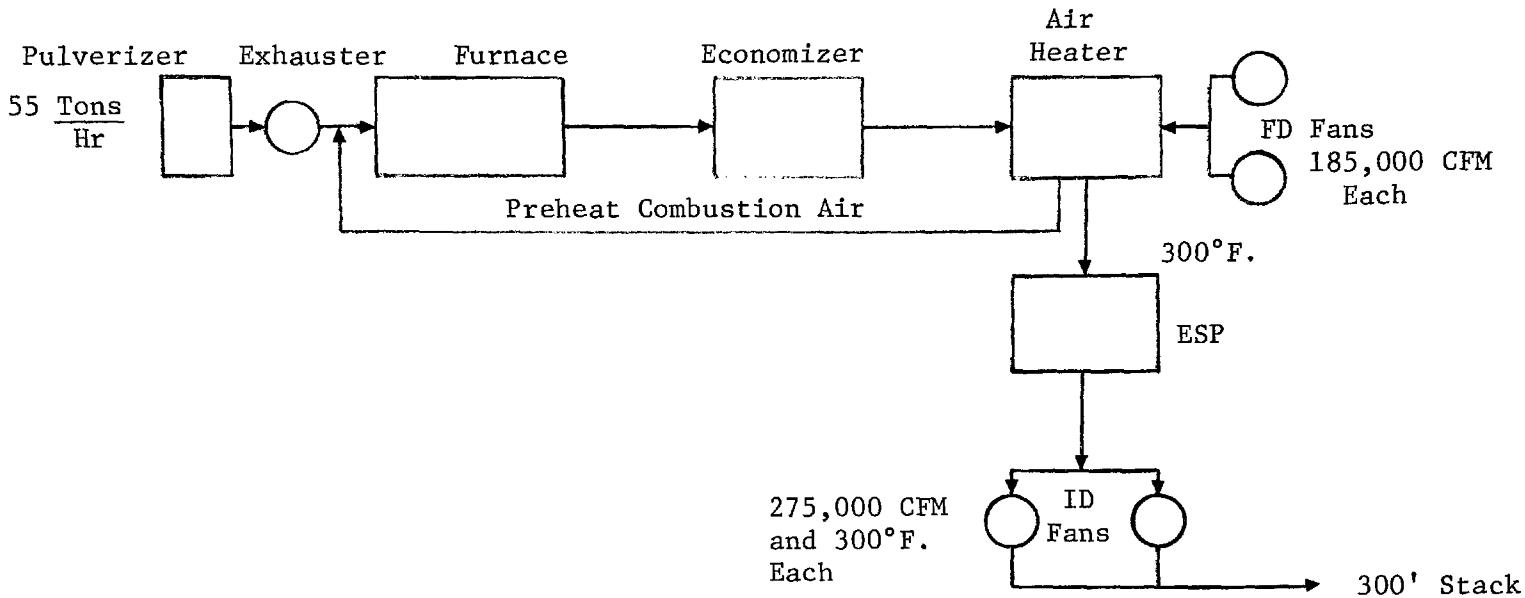


Figure 6.2. Schematic of Exhaust System and Electrostatic Precipitator Serving a Coal Fired Boiler

2. Evaluation and Calculations

a. Determine volume of gases entering precipitator (Air @ 60% RH and 80° F. Dry Bulb Temp.)[8]

$$\left.\begin{array}{l} C + O_2 \longrightarrow CO_2 \\ H + 1/2\ O_2 \longrightarrow H_2O \\ S + O_2 \longrightarrow SO_2 \end{array}\right\} \text{Basic Reactions}$$

Ultimate Analysis lbs per 100 lbs of Fuel (As Fired)		Molecular Weight	Moles of Oxygen	Multiplier Constant* for 100% Theoretical Combustion Moles of Air/ Mole of Combustible	Moles of Air Required for 100% Combustion
C	72.8	12	6.07	4.76	28.89
H_2	4.8	2	1.20	4.76	5.71
O_2	6.2	32	-	-	
N_2	1.5	28	-	-	
S	1.8	32	0.06	4.76	0.27
H_2O	3.5	18	-	-	
Ash	9.4	-			
				Total	34.87

Deduct O_2 in Fuel (Air Equivalent $= \frac{6.2}{32} \times 4.76$) - .92

Total Moles of Air Required = 33.95

*100 Moles of Air contain approximately 21 Moles of O_2 + 79 Moles of N_2 or $\frac{100}{21} = 4.76$ Moles of Air per Mole of O_2

Products of Combustion @ 10% Excess Air

Constituant		Moles/100 lb. Fuel
CO_2	- 1 Mole of CO_2 per Mole of C	= 6.07
H_2O	- from combustion of H_2 in fuel	
	$(H + 1/2\ O_2 \rightarrow H_2O)$	= 2.38
	Moisture in Air @ 10% Excess Air	
	1.10 x 33.90 = 37.3 Moles of Air	
	37.3 Moles of Air x $\frac{0.021 \text{ Moles } H_2O}{\text{Mole of Air}}$	= 0.78
	Moisture in Fuel $\frac{3.5}{18}$	= 0.19
SO_2	- 1 Mole of SO_2 per Mole of S	= 0.06
N_2	- 37.3 x 0.79 (N_2 in Air)	= 29.47
O_2 (excess)	- 0.10 x 33.95 x 0.21 (O_2 in Air)	= .72
	Total Wet Basis	39.67

Total Volume of Gases:

$$39.67 \frac{\text{Moles}}{100 \text{ lb}} \text{ Fuel} \times \frac{55 \text{ tons}}{\text{hr}} \times \frac{2000 \text{ lb}}{\text{ton}} \times \frac{1 \text{ hr}}{60 \text{ min}} = 728 \frac{\text{moles}}{\text{min}}$$

$$728 \frac{\text{moles}}{\text{min}} \times 379 \frac{ft^3}{\text{lb mol}} = 275{,}900 \text{ cfm @ } 60° \text{ F.}$$

Induced Draft Fans operating at 300° F.

2 @ 275,000 cfm or 550,000 cfm total at 300° F.

Products of combustion @ 10% excess air	=	=	275,900 cfm
Leakage into furnace, boiler, etc.	= 10%	=	27,590
Leakage at air heater	= 2%	=	5,520
			309,010

$$309{,}010 \times \frac{(460 + 300)}{(460 + 60)} = 452{,}000 \text{ cfm @ } 300° \text{ F.}$$

This is a reasonable comparison with the I.D. Fan total of 550,000 cfm @ 300° F.

b. Air pollution control system.

The following data summarizes the description of the air pollution control system.

Plate type precipitator (horizontal flow type) with dust collection hopper, rotary valves and screw conveyor.

Plate area	170,000 ft^2
Corona power	85 kw
Bus sections	22

The rappers are vibrator type for the discharge plates and impact type on collector plates.

The total pressure drop for the system has been estimated by the use of a 1/16 to 1 scale model and is reflected in the selection of the fans. The design includes gas diffusion plates for equal flow distribution with a design velocity of 4.5 ft/sec.

c. System check.

Estimated Dust Loading - 17A = Particulate emissions, lb/ton of coal burned[9]

A = Percent ash in coal

17 x 9.4 (% ash) x 55 ton/hr = 8790 lb/hr

Permissible Standard = $0.1 \frac{\text{lbs}}{\text{million Btu}}$

$$\frac{0.1 \times 55 \frac{\text{ton}}{\text{hr}} \times 2 \times 10^3 \frac{\text{lb}}{\text{ton}} \times 13 \times 10^3 \frac{\text{Btu}}{\text{lb}}}{10^6 \text{ Btu}} = 143 \frac{\text{lb}}{\text{hr}}$$

Required System Efficiency

$$\frac{8790 - 143}{8790} \times 100\% = 98.4\%$$

Since this is a new installation and no actual test data are available, the resistivity of the fly ash must be an estimate. There is, however, an alternative design approach based on fuel compositions.[10]

Figure 6.3 represents the relationship among precipitator collection efficiency, sulfur content of fuel in % and collection plate area/1000 acfm. (Based on ASME Performance Test Code PTC-27, 1957. Additional investigation will be necessary before comparable data, compatible to EPA testing standards, can be produced.)

At 98.4% efficiency and 1.8% sulfur in the coal the collection plate area is $\frac{250 \text{ ft}^2}{1000 \text{ cfm}}$.

Precipitator Rate Parameter $W = 0.34 \frac{\text{ft}}{\text{sec}}$, from Figure 6.4 (apparent migration velocity)

This may be checked by use of Deutsch-Anderson equation.

$$\eta = 1 - \exp\left(-\frac{A}{Vg} w\right)$$

A = area of collecting surface

$$w = \frac{Vg}{A} \ln \frac{100}{100 - \eta}$$

Vg= gas flow rate

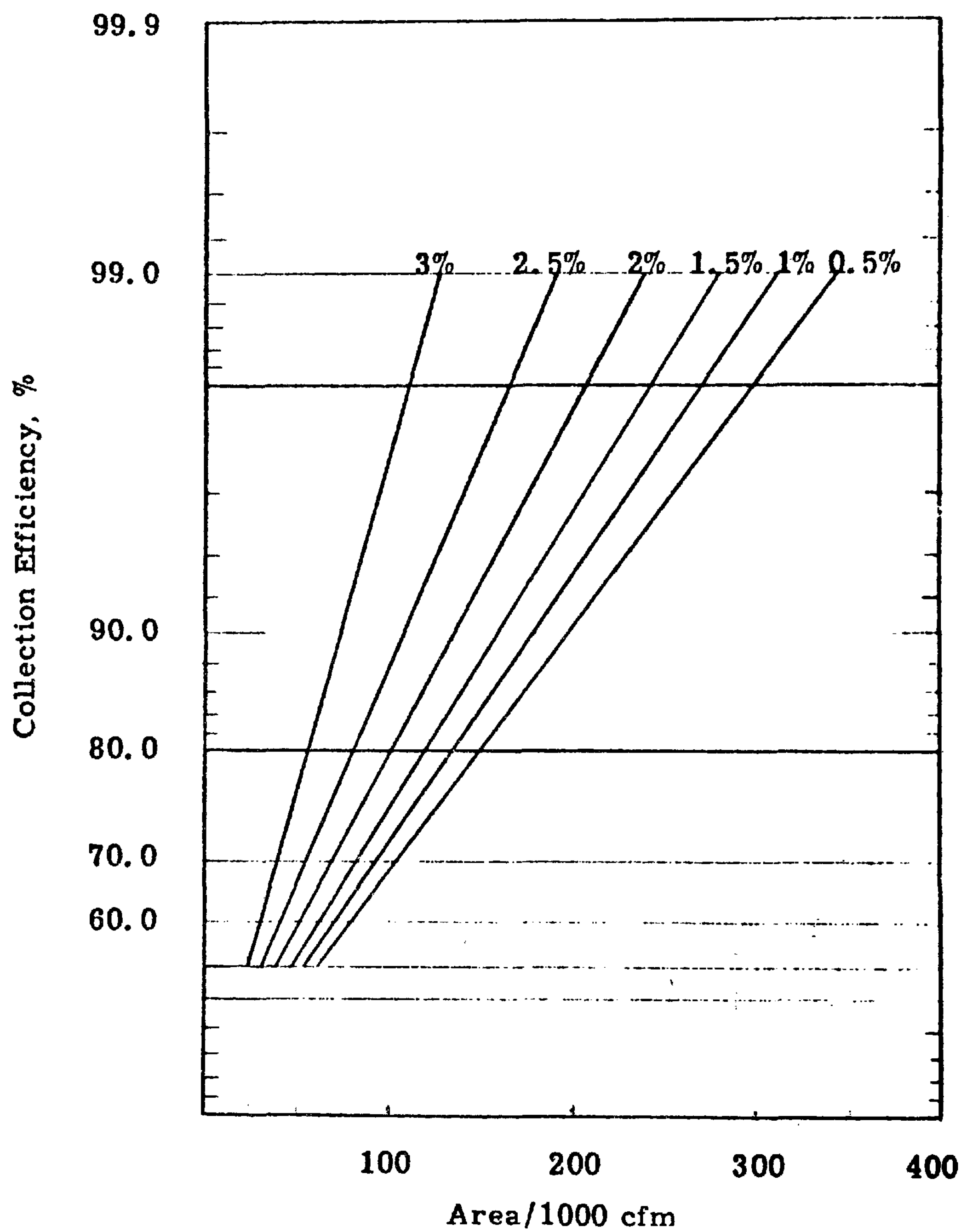


Figure 6.3. Relationship between collection efficiency and collecting surface area to gas flow ratio for various coal sulfur contents. (source: reference 11)

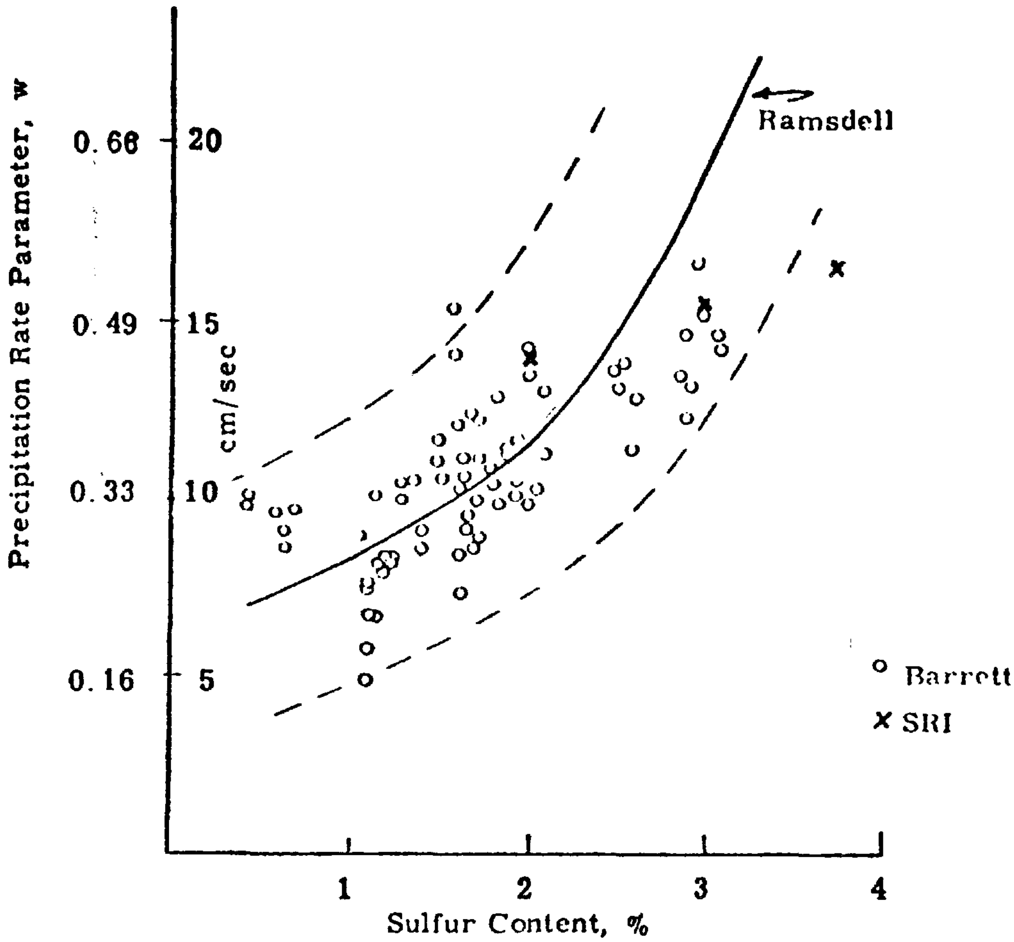


Figure 6.4. Variation in precipitation rate parameter with sulfur content of the coal. (source: reference 12)

$$w = \frac{550 \times 10^3}{170 \times 10^3} \ln \frac{100}{100 - 98.4}$$

w = precipitation rate paramete

η = efficiency, %

$$w = 13.4 \frac{ft.}{min.}$$

exp = base of natural logarithms

or $\frac{13.4}{60} = .22 \frac{ft.}{sec}$ Acceptable range of difference.

Corona Power (Figure 6.5 , electrical energization) 135 $\frac{watts}{1000\ cfm}$

$$135 \frac{watts}{1000\ cfm} \times 550{,}000\ cfm = 74.2\ kw$$

No. of bus sections from Figure 6.6

4 bus sections/100,000 cfm are required

on 4 x 5.5 = 22

3. Summary and Conclusions

The calculations and summarized data support the efficiency claims of 99+%. The system is automatically controlled and includes individual electrical sets, spark rate indicators, rapping cycle controls and indicators, outlet capacity indicators and line voltage indicators. The issuance of a permit to construct is recommended under the following conditions:

1. Sampling ports be provided upstream and downstream of the precipitator.
2. Source test conducted upon completion of "shakedown" period.
3. Changes in fuel be accompanied by source test to determine effect on precipitator efficiency.

The use of coal with a sulfur content of 1.8% will result in the emission of oxides of sulfur in excess of projected standards. The state-of-the-art of SO_2 recovery from stack gases may reach the point

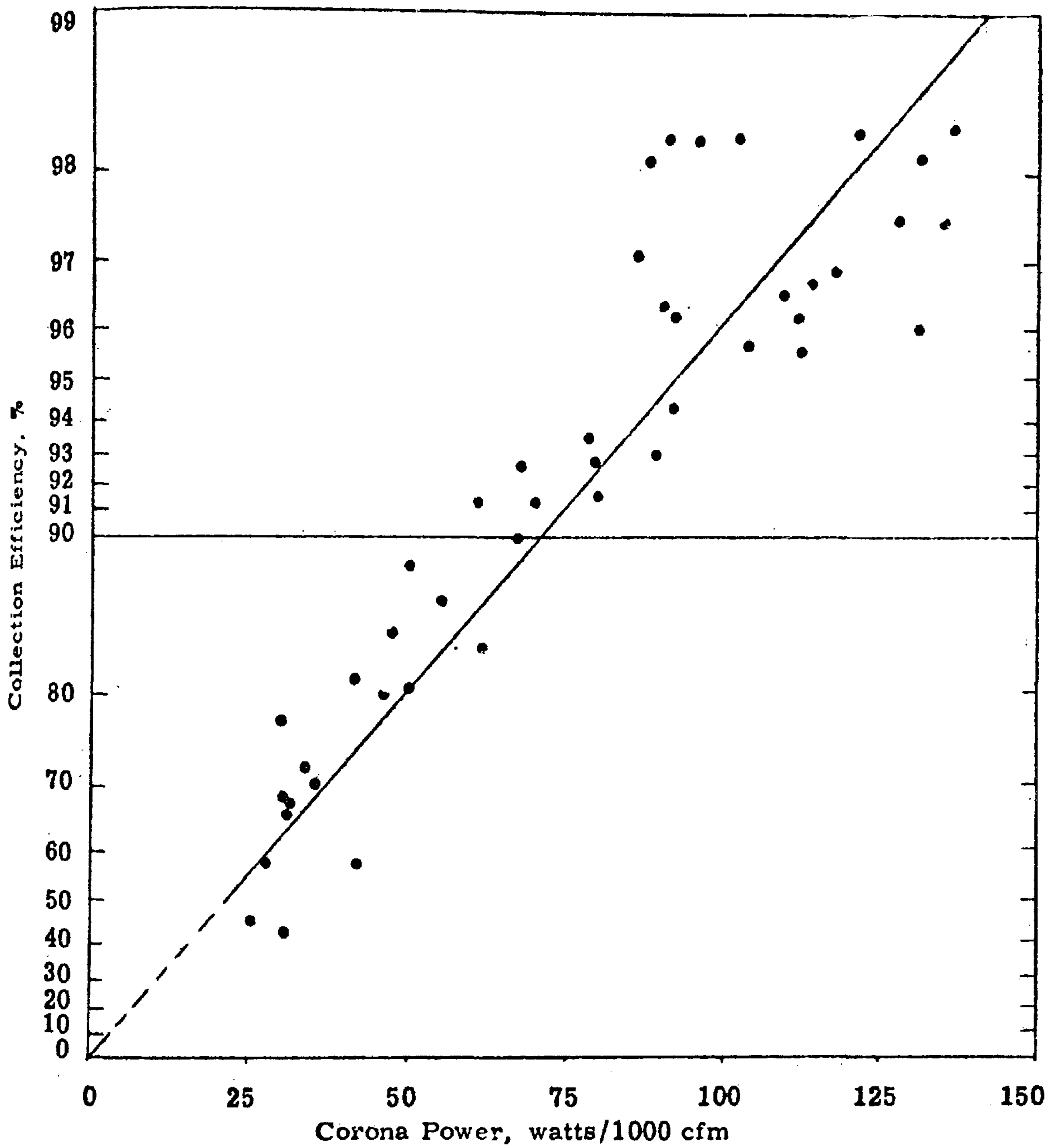


Figure 6.5. Relationship between collection efficiency and corona power for fly ash precipitators (test result). (source: reference 13)

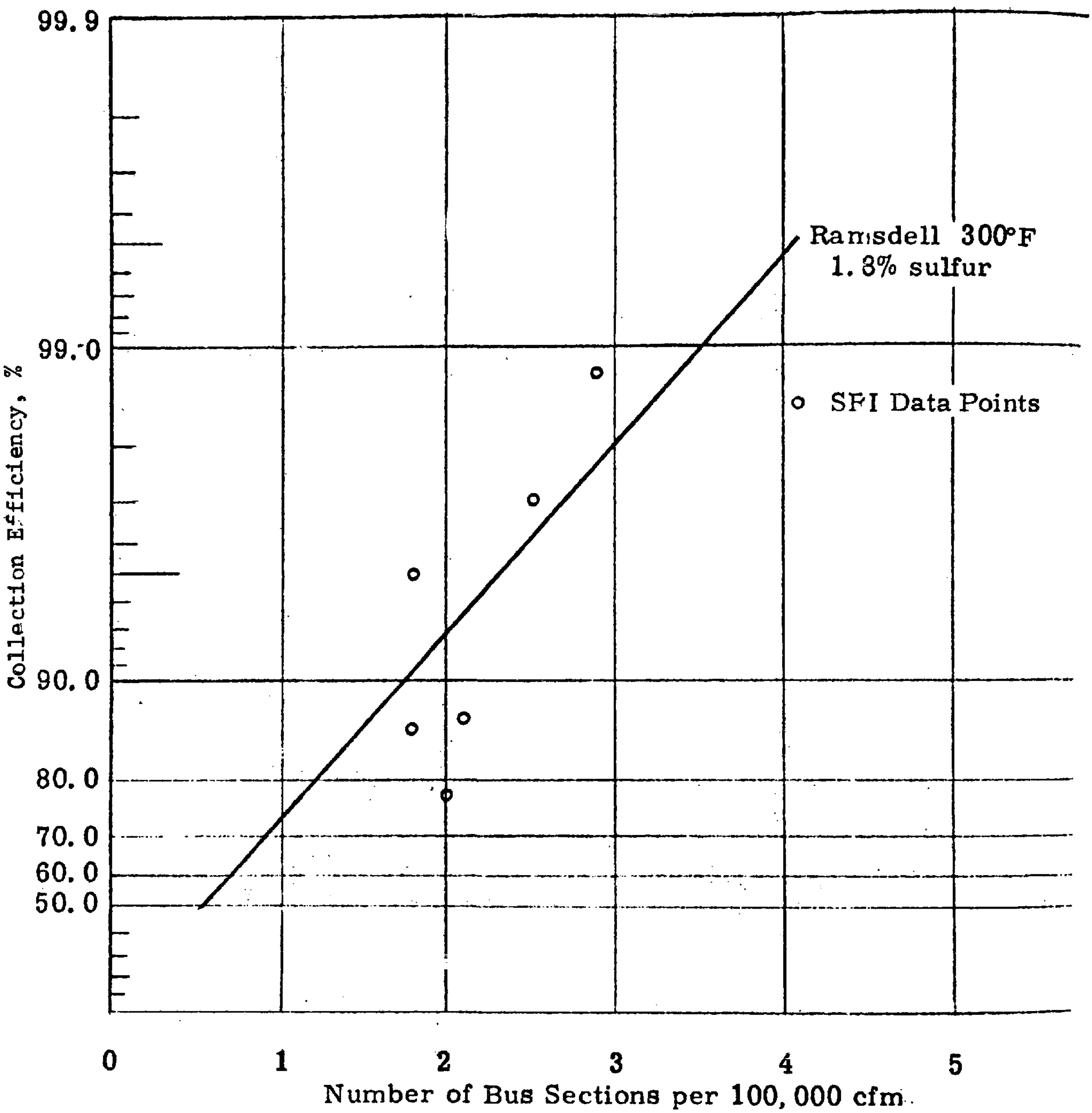


Figure 6.6. Variation in efficiency with degree of sectionalization (source: reference 14)

where these air pollution control systems will become available. At that time a reappraisal of the total air pollution system will be necessary.

Upon determination of the extent of emissions of oxides of nitrogen it may be necessary to modify burner and airport locations which could have an effect upon the volume of gases handled by the air pollution control system and may affect the precipitator. Any changes resulting from adjustments or modifications to the system must be reported to the agency.

C. Lithograph Oven Venting to an Afterburner

1. Equipment and Process Description.[15]

A permit to construct has been requested for an afterburner (direct flame incinerator) serving a lithograph drying oven. Metal sheets are coated with paint containing a mixture 36/36/38, aliphatic, xylol & MIK solvent. The drying rate is 90, 28" x 35" sheets per minute. The solvent usage is derived from the rate of application @ 11.72 mg/in^2 coverage. The system schematic is shown in Figure 6.7. The oven vents 10,000 scfm of gas at 350° F. to a heat exchanger where the temperature is raised to 825° F. The exhaust gases from the incinerator which are at 1400° F., are used to preheat the incoming oven gases in the heat exchanger.

The incinerator has the following design features:

<u>Fuel</u> - 6300 $\frac{ft^3}{hr}$ natural gas

<u>Throat Section</u> - 6' diameter

<u>Combustion Chamber</u> - 7.75' diameter

<u>Length of Combustion Chamber</u> - 9'

2. Evaluation and Calculations

a. Solvent usage rate

$$\frac{11.72 \frac{mg}{in^2} \times 980 \frac{in^2}{sheet} \times 90 \frac{sheets}{min}}{453{,}600 \frac{mg}{lb}} = 2.29 \frac{lb}{min}$$

Heating value of the solvent is 18,370 $\frac{Btu}{lb}$.[16]

Safe operating level is less than 25% of the Lower Explosive Limit which is $\frac{6.6 \text{ lb}}{10{,}000 \text{ scfm}}$ (as hexane).[17]

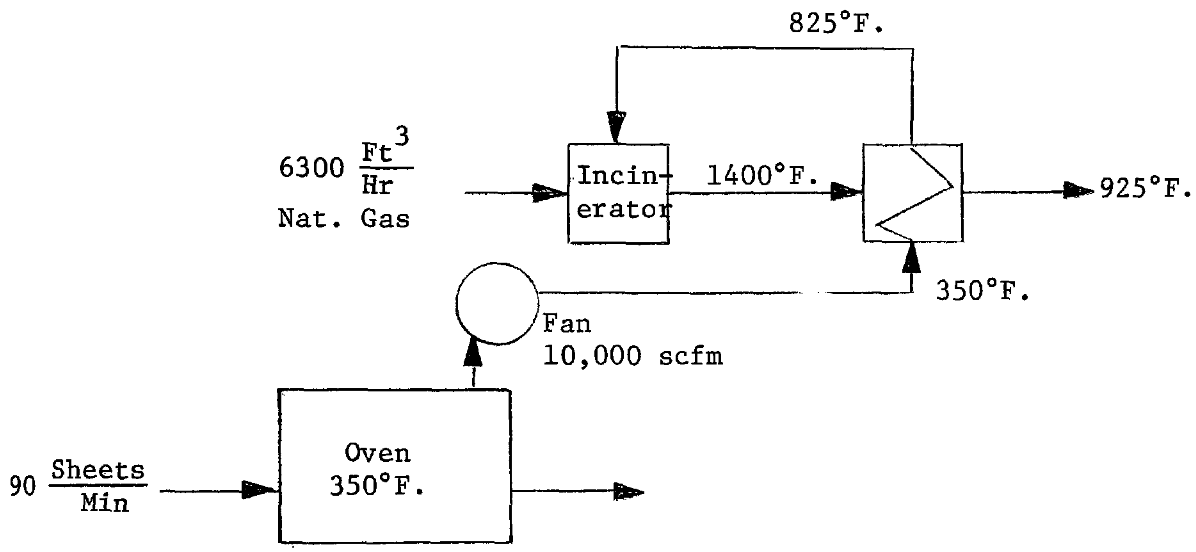


Figure 6.7. Schematic Flow Diagram of Air Pollution Control System for Lithograph Oven

Solvent usage of 2.29 $\frac{lb}{min}$ is approximately 8.7% (based on 26.4 $\frac{lb}{SCF}$ as the L.E.L.) and is in the safe range.

b. Heat Balance

$$10{,}000 \text{ scfm} \times 0.076 \frac{\text{lb of air}}{ft^3} = 760 \frac{lb}{min}$$

Heat required to raise temperature of air to 1400° F.,

$$Q = W\,C_p \Delta t$$

$$= 760\ (0.251^*)\ (1400 - 825) \times 60 \qquad = 6{,}580{,}000 \frac{Btu}{hr}$$

Heat available from solvent @ 97% evaporation

$$2.29 \frac{lb}{gal} \times 60 \frac{min}{hr} \times 18{,}370 \frac{Btu}{lb} \times 0.97 = 2{,}440{,}000 \frac{Btu}{hr}$$

$$\Delta \text{ Heat} = 4{,}140{,}000 \frac{Btu}{hr}$$

Fuel required

Heat available from natural gas @ 1400° F. = 668.0 $\frac{Btu}{ft^3}$

$$\frac{4.14 \times 10^6 \frac{Btu}{hr}}{6.68 \times 10^2 \frac{Btu}{ft^3}} = 6200 \frac{ft^3}{hr}$$ natural gas required - ok

6300 ft^3/hr supplied

c. Products of combustion

Theoretical air 11.45 $\frac{scf}{ft^3}$ natural gas

$$11.45 \frac{ft^3}{ft^3} \times \frac{6300 \frac{ft^3}{hr}}{60 \frac{min}{hr}} = 1200 \text{ cfm}$$

---

*Specific heat of air at constant pressure, Btu/lb.°F.

Total volume of gases

$$\left(10{,}000\ \frac{ft^3}{min} + 1200\ \frac{ft^3}{min}\right)\left(\frac{460 + 1400}{460 + 70}\right) = 39{,}300 \text{ cfm @ } 1400° \text{ F.}$$

Incinerator mixing section (throat) = 6' diameter

$$\text{Throat velocity} = \frac{39{,}300\ \frac{ft^3}{min}}{60\ \frac{sec}{min} \times \frac{\pi(6)^2}{4}} = 23.1\ \frac{ft}{sec}$$

Acceptable range 15 to 25 $\frac{ft}{sec}$ [18]

Combustion chamber = 7.75' diameter

$$\text{Velocity} = \frac{39{,}300}{60 \times \frac{\pi(7.75)^2}{4}} = 13.9\ \frac{ft}{sec}$$

Acceptable range 10 to 15 $\frac{ft}{sec}$ [19]

Length of combustion chamber = 9 ft

$$\text{Residence time} = \frac{9\ ft}{13.9\ \frac{ft}{sec}} = 0.65 \text{ sec}$$

Acceptable range = 0.3 sec.[20]

3. Summary and Conclusions

The afterburner design is satisfactory for the conditions of 825° F. inlet temperature and 10,000 scfm. Since this operation is continuous, good results should be obtained during steady state. During start-up it will be necessary to operate the afterburner until the heat exchanger reaches the steady state conditions.

The system is well designed and it is recommended that a permit to construct be authorized.

D. Municipal Incinerator with an Electrostatic Precipitator

1. Equipment and Process Description

A permit to construct is requested for an electrostatic precipitator for the reduction of particulate emissions from the effluent of an existing municipal incinerator.

The following test data are available from the operation of the incinerator:

Refractory type incinerator with a traveling grate burning 15.8 $\frac{\text{tons}}{\text{hr}}$ of refuse.[21]

Exit temperature of gases	1673° F.
CO_2 % by volume	7.3
Underfired air, $\frac{\text{scfm}}{\text{ft}^2}$ of grate	72.6
Particulate emissions $\frac{\text{lb}}{\text{hr}}$	231
Exhaust gas volume acfm	170,000

The following design data is taken from the precipitator description and summarizes the air pollution control system.

Plate type design (horizontal flow) preceded by a water spray chamber to reduce exhaust gas temperature to 600° F. Dust is collected in bottom hoppers using a rotary valve and screw conveyor to remove captured material.

Plate area	19,000 ft^2
Gas velocity	4.5 $\frac{\text{ft}}{\text{sec}}$
Gas temperature	600° F.
No. of gas passages	27
Power	9000 Watts

Vibration type rappers

The flow of gases in the precipitator is influenced by perforated plates at the inlet which serve as straighteners. A model was constructed to more closely estimate pressure drop and flow patterns through the system for a velocity of 4.5 $\frac{ft}{sec}$. The system schematic is shown in Figure 6.8.

2. Evaluation and Calculations

Gases are to be cooled from 1673° F. to 600° F. by water injection into the gas stream.

a. Heat in products of combustion

Enthalpy of air @ 1673° F.[22] = 417.0 $\frac{Btu}{lb}$

Enthalpy of air @ 600° F. = 131.6

Heat reduction required by evaporation = 285.4 $\frac{Btu}{lb}$

b. Weight of flue gas = 170,000 $\frac{ft^3}{min}$ x 0.018 $\frac{lb}{ft^3}$ (@ 1673° F.)[23]

= 3,080 $\frac{lb}{min}$

c. Total heat to be absorbed = 285.4 $\frac{Btu}{lb}$ x 3,080 $\frac{lb}{min}$

= 890,000 $\frac{Btu}{min}$

$Q = h_g - h_f$

Q = heat absorbed Btu/lb
h_g = heat content of saturated vapor
h_f = heat content of saturated liquid

$Q = h_g$ (600°F and 14.7 psig) $\frac{Btu}{lb}$ - h_f (60°F.) $\frac{Btu}{lb}$

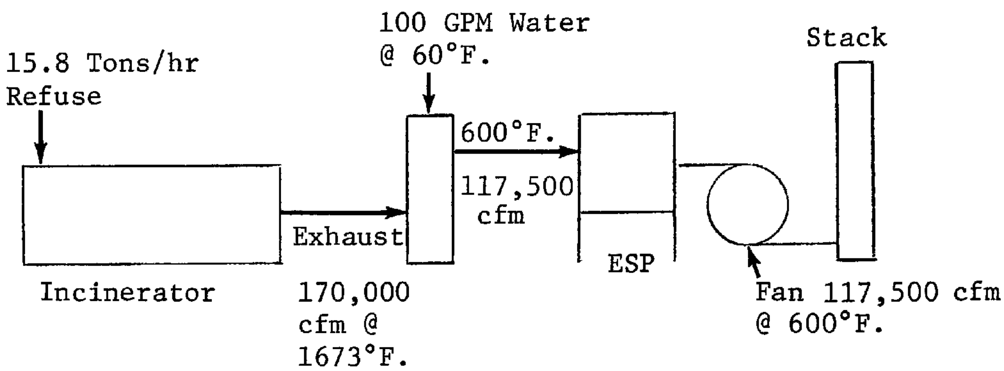


Figure 6.8. Flow Schematic for an Exhaust System with Electrostatic Precipitator Serving a Municipal Incinerator

$$Q = 1165.5 - 28.06$$

$$= 1137.44 \frac{\text{Btu}}{\text{lb}}$$

$$\text{Water rate} = \frac{890{,}000 \frac{\text{Btu}}{\text{min}}}{1137.44 \frac{\text{Btu}}{\text{lb}}}$$

$$= 770 \frac{\text{lb}}{\text{min}} \quad \text{or} \quad 770 \frac{\text{lb}}{\text{min}} \times 0.1198 \frac{\text{gallons}}{\text{lb}} = 92.5 \text{ gpm}$$

d. Volume of stack gases at 600° F.

Flue gas + water vapor = total volume of gases

$$170{,}000 \times \left(\frac{460 + 600}{460 + 1673}\right) = 84{,}500 \text{ cfm}$$

$$\frac{379}{18}\left(\frac{460 + 600}{460 + 60}\right)(770) = \underline{33{,}000} \text{ cfm}$$

Total volume= 117,500 cfm @ 600° F.

From fan multi-rating tables,fan selected is OK at 117,500 cfm @ 600° F.

e. Precipitator collecting plate area

The agency's performance standards requires 98% efficiency for control of particulates from municipal incinerators.

Precipitation rate $w = 13 \frac{\text{cm}}{\text{sec}} = 25.4 \frac{\text{ft}}{\text{min}}$ (Figure 6.9)

using Deutch-Anderson equation

$$\eta = 1 - \exp \frac{A}{Vg} w \qquad \eta = 98\%$$

$$A = \frac{Vg}{w} \ln \frac{100}{100 - \eta}$$

$$A = \frac{117{,}500}{25.4} \ln \frac{100}{2}$$

$$A = 18{,}100 \text{ ft}^2 \text{ of collection plate}$$

(NOTE: Valid data for the design of electrostatic precipitators for municipal incinerator service is still evolving. Actual practice has shown 150 to 160 ft^2/1000 acfm is required for 95% collection efficiency and as high as 180 ft^2/1000 acfm to achieve 98% efficiency.)

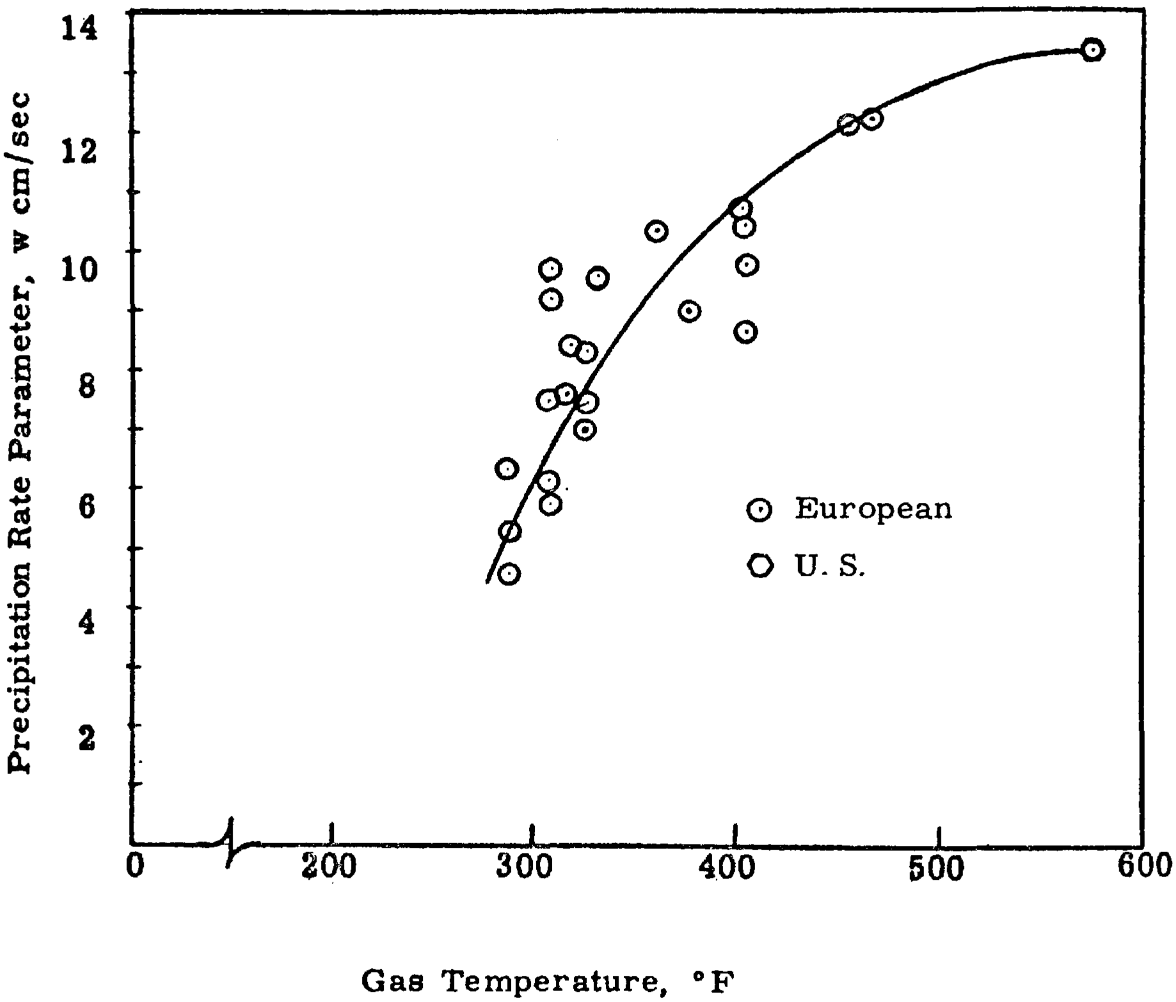


FIGURE 6.9. Variation in precipitation rate parameter with gas temperature for municipal incinerator precipitators. (source: reference 24)

f. Power = $\frac{75 \text{ watts}}{1000 \text{ cfm}}$ (Figure 6.10)

$= 75 \times 117.5 = 8900$ watts

g. Bulk resistivity - between 10^7 and 10^{10} (ohm-cm measured)
This is in the optimum range of 10^7 and 2×10^{10} for efficient operation of an electrostatic precipitator serving a municipal incinerator.[25]

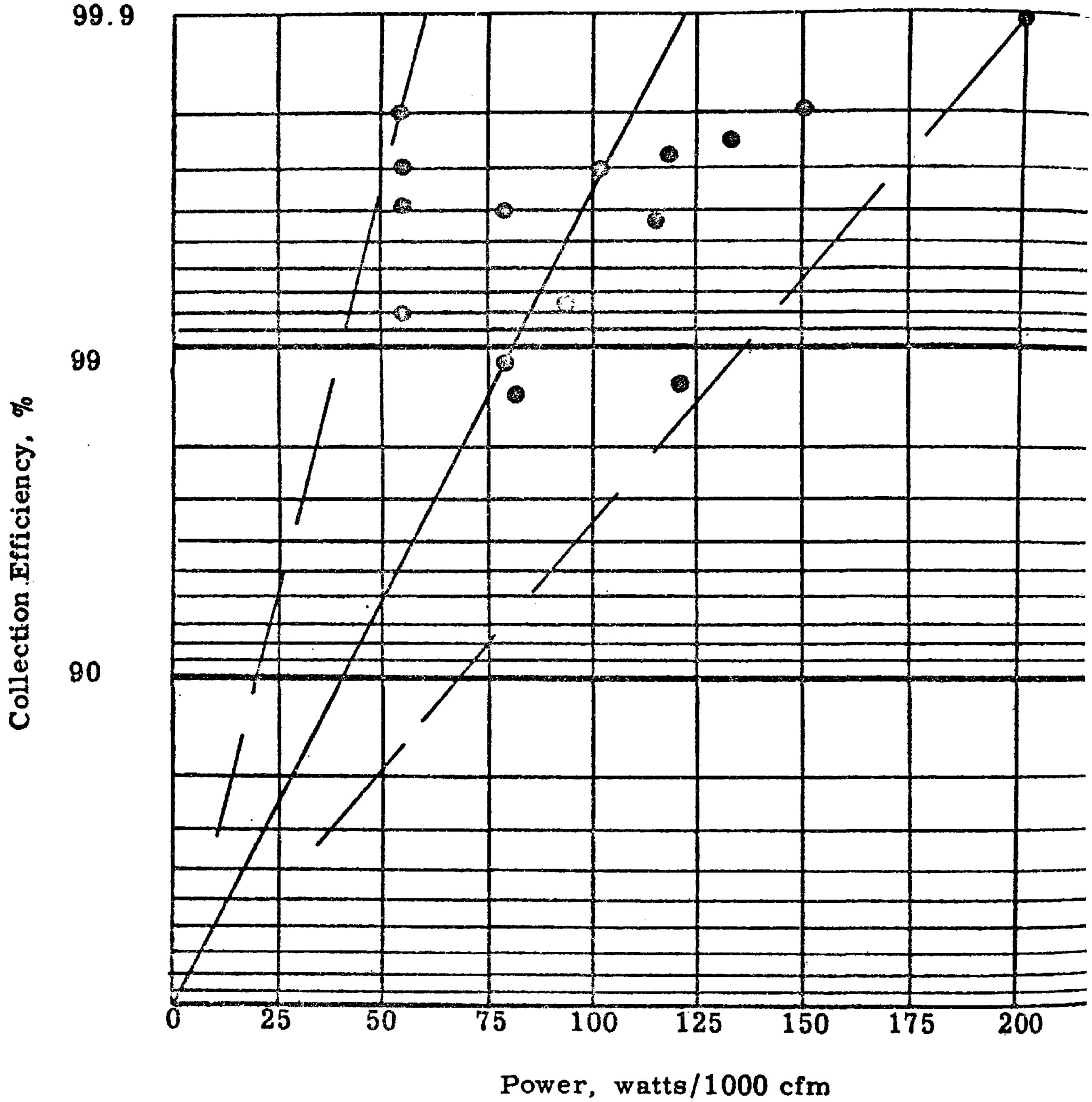
3. Summary and Conclusions

There is little published data available on electrical precipitator design parameters for municipal incinerators. From the data available the principal design features are satisfactory including the resistivity of the particulates. It is recommended that a permit to construct be issued for the precipitator based upon the following conditions:

a. Sampling ports be provided upstream and downstream of the precipitator.
b. A source test conducted upon completion of construction and test runs.
c. A recording instrument be provided at the cooling chamber to indicate the time the safety bypass is open and duration of the pass time.

The air pollution control system is provided with automatic controls including individual electrical sets, spark rate indicators, rapping, cycle controls and indicators, outlet capacity indicators, and line voltage indicators.

The electrostatic precipitator will provide adequate particulate emission control. It may be necessary, in the future, to review this permit relative to new standards for emission of hydrogen chloride, metals and others.



Note: Delivered power = secondary voltage x secondary current.

$$\text{Input power} = \frac{\text{delivered power}}{\text{power supply efficiency}}$$

FIGURE 6.10. Relationship between collection efficiency and delivered corona power for municipal incinerators. (source: reference 26)

E. Baghouse for a Cement Kiln

1. Equipment and Process Description

A permit to construct is requested for a baghouse to serve a dry process portland cement rotary kiln (clinker cooler, raw materials handling and preparation, and bulk handling of finished materials are all individual permit units and receive separate consideration). The following data is supplied from the equipment and process description:

a. Gas fired dry process kiln 15' in diameter and 380' long (no preheat)

$$\text{Process weight} \quad 9{,}580\ \frac{\text{bbl}}{\text{day}} \times 600\ \frac{\text{lb}}{\text{bbl}}\ \text{fired} \times \frac{1}{24\ \frac{\text{hr}}{\text{day}}} = 25 \times 10^4\ \frac{\text{lb}}{\text{hr}}$$

Measured gas flow @ 500° F. = 300,000 cfm

Measured particulate load = $9.69\ \frac{\text{grains}}{\text{ft}^3}$, stack conditions

Or

$$\frac{300{,}000\ \text{cfm} \times 9.69\ \frac{\text{grains}}{\text{ft}^3} \times 60\ \frac{\text{min}}{\text{hr}}}{7000\ \frac{\text{grains}}{\text{lb}}} = 24{,}800\ \frac{\text{lb}}{\text{hr}}$$

b. Air pollution control system

The design of the exhaust system and feed inlet are close fitting so that there will be minimum air leakage. A 20% safety margin has been added to the air handling system above the theoretical calculations. (See schematic Figure 6.11)

Fan - 360,000 cfm @ 500° F. and 6" wc, static pressure (300,000 cfm measured plus 20% factor of safety).

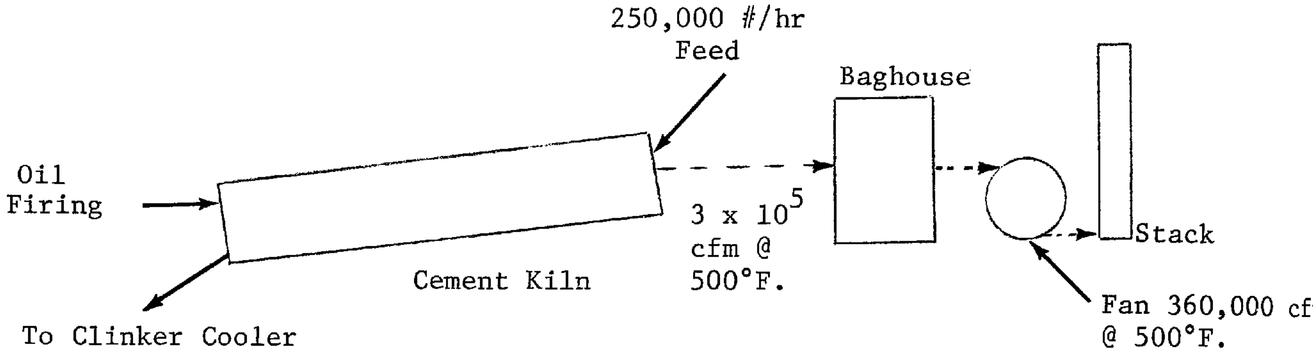


Figure 6.11. Flow Schematic of an Exhaust System and Baghouse for a Cement Kiln

Baghouse - tubular glass bags with an equivalent area of 180,000 sq. ft; reverse flow with flexural collapse.

Air to cloth ratio $\frac{360,000 \frac{ft^3}{min}}{180,000 \ ft^2} = 2:1$

Pressure drop through baghouse is 4" to 5" wc. (Note: The calculation of pressure drop through the system, fan capacity, fan speed and motor horsepower are based upon the total flow of gases through the system using the relationship TOTAL PRESSURE = VELOCITY PRESSURE + STATIC PRESSURE. The fan must be checked against the manufacturers multirating tables. In the case where the gas temperature is above standard , additional corrections must be made. "Fan Engineering"[27] and the "Air Pollution Engineering Manual"[28] offer examples of these calculations. The sample calculations for the grey iron cupola and baghouse illustrate this method.)

2. Evaluation and Calculations for the dust control system[29]

   a. Filter media:

      The filter media is glass cloth which displays good heat resistance at 500° F. and surges to 600° F. Resistance to alkalies is acceptable for this service and mechanical strength characteristics will give average bag life.

   b. Bag cleaning:

      Reverse flow cleaning is recommended for use in this service primarily because it supports high collection efficiency and displays good bag cleaning uniformity.

   c. Filter ratio:

      The filter ratio of 2:1 (or 2 $\frac{ft}{min}$) is attained at the maximum flow rate. The system pressure drop will be at a minimum when the bags are clean resulting in the highest volume of gas flow. With reverse flow cleaning the pressure drop will be fairly constant.

d. Baghouse operation:

Nominal operating temperature for the baghouse is 500° F. which is well above the dew point for most conditions. A recommended operational procedure is for the baghouse to be preheated to 250° F. before charging begins. This can be accomplished by either the kiln burners or by separate heaters.

Bag attrition is usually high in this type of service, necessitating a rigid inspection and replacement plan.

e. Instrumentation:

Continuous recording instruments for flow rates, gas temperature, baghouse temperature and dew point levels have been provided.

f. Dust disposal:

Since very large quantities of dust will be collected, a closed dust removal system has been provided. The collection bottom hoppers have rotary valves and a screw conveyor. The enclosed dust handling system is vented to a baghouse (separate permit unit).

g. Required efficiency:

$$\text{Process weight} = \frac{250{,}000 \ \frac{\text{lb}}{\text{hr}}}{2{,}000 \ \frac{\text{lb}}{\text{ton}}} = 125 \ \frac{\text{tons}}{\text{hr}}$$

Allowable emission rate[30] $= 0.30 \ \frac{\text{lb}}{\text{ton}}$ of feed

$$= 0.30 \times 125 \ \frac{\text{ton}}{\text{hr}}$$

$$= 37.5 \ \frac{\text{lb}}{\text{hr}}$$

$$\text{Efficiency} = \frac{24{,}800 - 37.5}{24{,}800} \times 100 = 99.9\%$$

3. Summary and Conclusions

The approval for a permit to construct this equipment is not recommended at this time. The extremely high efficiency required to meet the agency standards may necessitate the addition of a precollector upstream of the baghouse or additional bag area to reduce the filter ratio to 1.5:1 or even 1:1. It is also recommended that the duct work between the dryer and the baghouse be insulated to reduce moisture build up. The system design provides adequate process control instrumentation to monitor the critical exhaust gas characteristics.

If a mechanical collector is to be used ahead of the baghouse, further consideration must be given to the selection of a fan motor since an additional pressure drop will be added to the system.

F. Asphaltic Concrete Batching Plant Served by a Multiple-Cyclone and Baghouse

1. Equipment and Process Description

A permit to construct is requested for an air pollution control system for an oil fired asphaltic concrete batching plant consisti of an exhaust system with a cyclone collector and a baghouse.

The following data, taken from the application, summarizes the basic equipment:

$100 \frac{ton}{hr}$ asphaltic concrete batching plant

Mix with highest percentage of fines that will be processed by this equipment is a Wearing Surface Mix with the following specification

50%	Passing #8
30%	" #30
7%	" #50
8%	" #200
5%	Asphaltic cement
100%	

Average moisture content of aggregate = 6%.

The dryer is oil fired with a fuel rate of 3.3 gpm, PS #300 oil and has automatic burner controls.

The following data summarizes the air pollution control system.

Fan rated at 30,000 cfm @ 350° F. and 11" wc, static pressure

Cyclone collector - "high efficiency" collector
Pressure drop = 5" wc

Baghouse - 4500 ft^2 bag area, Nomex[R] cloth with pulse cleanin
Pressure drop = 4" wc

The system schematic is shown in Figure 6.12.

2. Evaluation and Calculations

Dryer exhaust gases

Products of combustion from 3.3 gpm, PS #300 oil at 100% excess air[31]

$$367.8 \frac{ft^3}{lb\ oil} \times 3.3 \frac{gal}{min} \times 8.0 \frac{lb}{gal} = 9{,}700 \text{ scfm}$$

H_2O from aggregate

$$100 \frac{tons}{hr} \times 2000 \frac{lb}{ton} \times 0.06 \frac{lb\ H_2O}{lb\ agg.} \times \frac{1}{60 \frac{min}{hr}} = 200 \frac{lb}{min}$$

a. Fugitive dust[32]

3000 scfm (actual volume of air for capture of fugitive dust will be calculated from volume of air displaced in screening, hot aggregate storage and mixing according to the relationship

$$\frac{\frac{tons}{hr}}{60 \frac{mins}{hr}} \times \frac{2000 \frac{lb}{ton}}{100 \frac{lbs\ aggregate}{ft^3}} = \frac{ft^3}{min} \text{ displaced and adding}$$

10% for factor of safety. To this is added the air requirement for materials handling equipment based upon minimum indraft at all openings of 200 $\frac{ft}{min}$)

b. Total volume of gases (treated as air)

Products of combustion	-	9,700 scfm
$H_2O \left(\frac{200 \frac{lb}{min}}{18 \frac{lb}{lb\ mol}} \times 379 \frac{ft^3}{lb\ mol} \right)$	-	4,230 "
Fugitive dust	-	3,000 "
		16,930 scfm

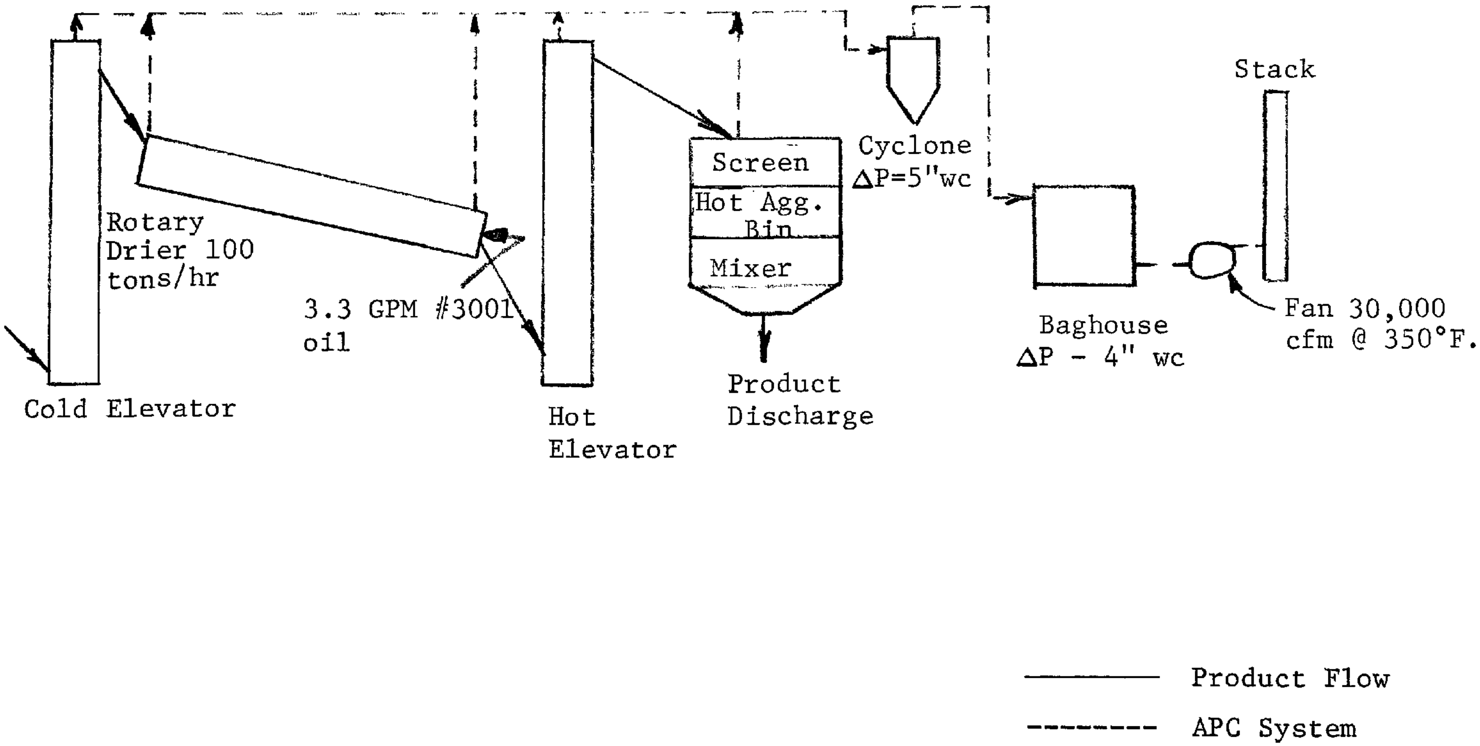


Figure 6.12. Flow Schematic of Exhaust System for a Baghouse Serving a Hot Asphalt Plant

$$16{,}930 \frac{ft^3}{min} \frac{460 + 350}{460 + 70} = 25{,}900 \text{ cfm @ } 350°F.$$

Add 10% to total for leakage, etc.

$$\begin{array}{r} 25{,}900 \\ \underline{2{,}590} \\ 28{,}490 \end{array}$$

28,490 cfm @ 350°F.

c. Cyclone

The cyclone will be considered only as a precleaner to reduce the large particle size grainloading. Anticipated dust load is 60 $\frac{\text{grains}}{\text{scfm}}$ with a high percentage of dust particles in the 10μ to 5μ range.[33] A conservative estimate of cyclone efficiency for this type of loading is 80%.[34] Grainloading to the baghouse is then

$60 - .8(60) = 12 \frac{gr}{scfm}$ with the highest percentage of dust less than 10μ.

Anticipated dust loading at the baghouse will then be

$$18{,}620 \text{ scfm} \times \frac{12 \frac{gr}{scfm}}{7000 \frac{gr}{lb}} \times 60 \frac{min}{hr} = 1{,}915 \frac{lb}{hr}$$

d. Baghouse[35]

4500 ft^2 Nomex^R with pulse jet cleaning filter ratio =

$$\frac{30{,}000 \text{ cfm}}{4500 \text{ ft}^3} = 6.66{:}1$$

The pulse jet method of cleaning bags allows for a relatively high filter ratio with high collection efficiency for submicron particles. Nomex^R is recommended for service up to 450°F.

Since the baghouse operating temperature is 350° F., moisture precipitation is not anticipated. To insure proper operating conditions in the baghouse, the inlet ducts have been insulated and during startups the burners are used prior to charging to bring the system up to operating temperature.

e. Allowable loss

$$\text{Process weight} = 100\ \frac{\text{tons}}{\text{hr}} \times 2000\ \frac{\text{lb}}{\text{ton}} = 200{,}000\ \frac{\text{lb}}{\text{hr}}$$

Allowable loss[36] $= 36.11\ \frac{\text{lb}}{\text{hr}}$

$$\text{Baghouse eff. required} = \frac{1915 - 36.11}{1915} \times 100 = 98\%$$

f. Exhaust system

TP = VP + SP

TP = Total pressure
VP = Velocity pressure
SP = Static pressure

Assume VP of 0.5" wc and 1.0" wc for SP of system excluding cyclone and baghouse.

TP = 0.5 + 1.0 + 5.0 + 4.0 = 10.5" wc
SP = 1.0 + 5.0 + 4.0 = 10.0" wc

Fan = 30,000 cfm @ 350° F. and 11" wc static pressure. (Check with fan multi-ratings tables, adjust for 350° F.)

3. Summary and Conclusions

The exhaust system has sufficient capacity to provide good indraft at all openings and to vent the dryer with 100% excess air for combustion and 6% water vapor in the aggregate. The design of the air intake from the dryer is tight with minimal opening. The combination cyclone and baghouse are properly sized for this application. Recording instrumentation for pressure drop temperature and dew point have been provided. A permit to construct is recommended with the following conditions:

a. The dryer burner will be in operation prior to the introduction of aggregate to the kiln for a sufficient length of time to bring the baghouse temperature to 250° F.

b. Sampling ports are provided upstream of the cyclone, between the cyclone and baghouse and at the baghouse exhaust.

G. Brass Reverberatory Furnace and Baghouse

1. Equipment and Process Description

A permit to construct is requested for a baghouse serving a 50 ton reverberatory furnace for melting yellow brass.

The following data is derived from the basic equipment description:[37]

50 ton brass reverberatory furnace natural gas fired
charge - 105,000 lbs brass and bronze scrap
charge period - 6.7 hours
air blow - 10 mins to 2 hrs per heat 160 cf, @ 15 psig
refining period - 9.3 hours
pour - 3.53 hours
temp. of exhaust gas - 2300° F.
fuel rate - 110 cfm natural gas @ 20% excess air

Volume of gases from furnace

Products of combustion at 20% excess air

110 cfm x 13.86 cfm p.c. per cfm gas = 1520 cfm @ 60° F.

Air blown into metal bath

$$160 \text{ cfm } \frac{14.7 + 15}{14.7} = 323 \text{ cfm @ } 60° \text{ F.}$$

Total gases @ 60° F. = 1843 cfm

$$1843 \times \frac{460 + 2300}{460 + 60} = 9800 \text{ cfm @ } 2300° \text{ F.}$$

The following data is derived from the description of the air pollution control system:

Exhaust system

Fan	8,000 cfm @ 400°F.
3 Hoods	one at pouring spout and one each at charing and slagging doors. Face area = 6.55 ft^2. Design indraft velocity = 150 $\frac{ft}{min}$ - assume

air at 100°F.

Then $6.55\ ft^2 \times 150\ \frac{ft}{min} = 982$ cfm @ 100°F.

Cooling surface - 7000 ft^2 of 27" diameter black iron duct.

Baghouse

2000 ft^2 Orlon^R cloth, with pulse bag cleaning. Gases are to be cooled to the baghouse operating temperature of 400° F. by radiation/convection.

2. Evaluations and Calculations

a. Process weight $\frac{105,000\ \text{lb (metal)}}{6.73 + 9.30 + 3.53\ \text{(hrs)}} = 5,380\ \frac{lb}{hr}$

b. Allowable loss[38]

$$E = 3.59\left(\frac{5380}{2000}\right)^{0.62} = 6.6\ \frac{lb}{hr}$$

The exhaust system schematic is shown in Figure 6.13.

c. Heat balance (excluding radiation & convection losses)

Furnace exhaust (assume air)

$$1843\ \text{scfm} \times 45.61\ \frac{Btu}{scf}\ @\ 2300°\ F. = 84,000\ \frac{Btu}{min}$$

Air from hoods

$$3 \times 982\ \text{cfm}\left(\frac{460 + 60}{460 + 100}\right) \times 0.75\ \frac{Btu}{scf}\ @\ 100°\ F. = 2,020$$

$$\text{Total} = 86,020\ \frac{Btu}{min}$$

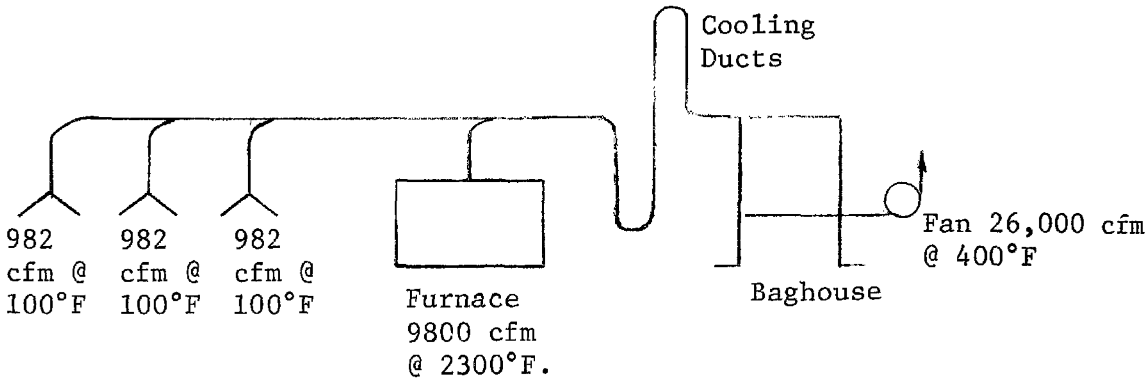


Figure 6.13. Exhaust System Schematic for a Baghouse Serving a Brass Furnace

Hoods $3 \times 982 \frac{520}{560} = 2730$ cfm

Furnace 1843 cfm

Total volume @ 60°F. = 4573 cfm

$$\frac{86{,}020 \frac{\text{Btu}}{\text{min}}}{4{,}573 \text{ scfm}} = 18.85 \frac{\text{Btu}}{\text{scf}}$$

This corresponds to a temperature of 1054°F. (air)

Weight of gases (assume air)

$$\frac{4{,}573 \text{ scfm} \times 29 \frac{\text{lb}}{\text{lb mol}}}{379 \frac{\text{ft}^3}{\text{mol}}} = 350 \frac{\text{lb}}{\text{min}}$$

d. Radiation-Convection Cooling[39]

Q = quantity of heat to be disipated

$$Q = 350 \frac{\text{lb}}{\text{min}} \times 60 \frac{\text{min}}{\text{hr}} \times 244.5 \frac{\text{Btu}}{\text{lb}}^{*} = 5.15 \times 10^6$$

Log Mean Temperature Difference

$$\Delta t_m = \frac{(t_1 - t_a) - (t_2 - t_a)}{\ln \frac{(t_1 - t_a)}{(t_2 - t_a)}}$$

t_1 = temp. of gases entering cooling ducts = 1054°F.

t_2 = temp. of gases leaving cooling ducts = 400°F.

t_a = temp. of ambient air = 100°F.

---

*Enthalpy of Air at 1054°F.

$$\Delta t_m = \frac{654}{\ln \frac{954}{300}}$$

$$\Delta t_m = 564°F.$$

Cooling Surface Required

Use overall heat transfer coefficient of $1.5 \frac{Btu}{hr\text{-}ft^2\text{-}°F}$

(this is generally accepted for rusted black iron duct at an average velocity of $3500 \frac{ft}{min}$)

$$A = \frac{Q}{U\Delta t_m} = \frac{\frac{Btu}{hr}}{\frac{Btu}{hr\text{-}ft^2\text{-}°F} \times °F}$$

$$A = \frac{5.15 \times 10^6}{1.5 \times 564} = 6,100 \text{ ft}^2$$

with 27" diameter duct, length $= \frac{6,100 \text{ ft}^2}{\frac{27 in}{12 \frac{in}{ft}} \times \pi} = 865$ ft

This compares favorably with 7000 ft^2 of 27" duct proposed.

e. Total Volume of Gases to fan

$$4573 \text{ scfm} \times \frac{(460 + 400)}{(460 + 60)} = 7550 \text{ cfm @ } 400°F.$$

f. Baghouse

Orlon[R] bags 2000 ft^2 filter area giving a filter ratio of 3.77:1 at 400^oF.

3. Summary and Conclusions

The exhaust system and hoods show proper design characteristics for effective fume pick-up at critical points, i.e., charging doors and pouring spout. The indraft velocity is adequate for a close fitting hood. Instrumentation includes baghouse temperature and pressure drop alarms if either exceeds set limits.

The baghouse has a relatively high filter ratio of 3.77:1. Since pulse cleaning is used, the filter ratio can safely go this high and still prove 99%+ collection efficiency for metalic fume. The Orlon[R] cloth is acceptable for this service at 400°F. which also precludes problems of bag blinding from condensed moisture.

Conditional approval for permit to construct is recommended provided that dampers are placed in each branch line to allow proper balancing for air flow and that sampling parts be located upstream and downstream of the baghouse.

H. Grey Iron Cupola and Baghouse

1. Equipment and Process Description

A permit is requested for a baghouse to serve a grey iron cupola.

The following data summarizes the description of the basic equipment:

45" I.D. grey iron cupola with CO afterburner

Process weight 20,200 $\frac{lb}{hr}$ (8:1 iron to coke ratio)

Allowable loss[40] = 15.1 $\frac{lb}{hr}$

3450 scfm tuyere air, with air weight controls

Operating conditions - maximum temperature of exhaust gases

during burndown = 2000° F.,

Minimum temperature = 500° F.,

Temperature during melt = 1200° F.

Charging door 7 ft^2 (maximum opening)

The following data summarizes the description of the air pollution control equipment:

Glass cloth tubular bags 8,500 ft^2

Cleaning - reverse flow (automatic)

Pressure drop across baghouse = 4" wc max.

Exhaust system - 15,500 cfm exhaust system and evaporative cooler with a water rate of 20 $\frac{gal}{min}$

The system schematic is shown in Figure 6.14.

2. Evaluation and Calculations

Combustion of coke produces significant volumes of CO, and the partial combustion of grease and oil from scrap produces smoke and oil mists. An afterburner is required to complete combustion.

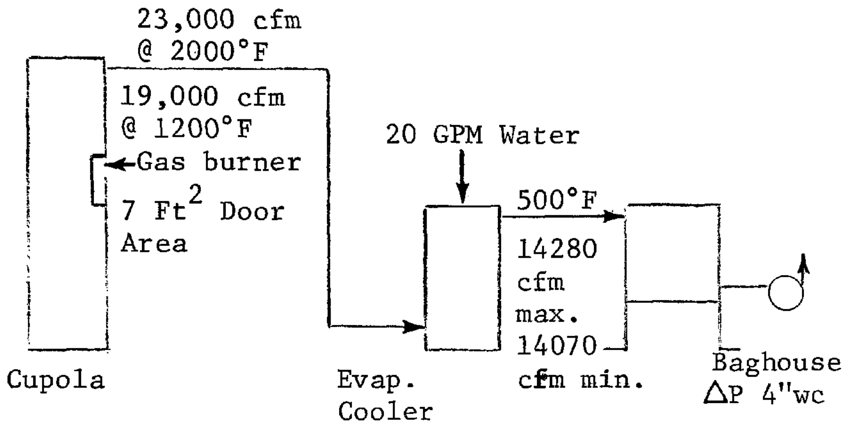


Figure 6.14. Dust & Fume Collection System for Grey Iron Cupola

Temperature of 1200°F. and luminous flame have proven effective for smoke and CO control.

a. During condition of 2000° F. stack gas temperature (condition 1).

Volume of gases reaching the baghouse are:

Tuyere air = 3450 scfm

Indraft at charge door - worst condition[41]

$$7 \text{ ft}^2 \times 200 \frac{\text{ft}}{\text{min}} = 1400 \text{ scfm}$$

At furnace exhaust temperature of 2000° F. afterburner may be kept at a minimal flow

$$10 \text{ cfm} \times 11.45 \frac{\text{ft}^3}{\text{ft}^3} \text{ @ theoretical air}^{42} = 115 \text{ scfm}$$

Assume exhaust gases are air = 4965 scfm

$$\text{or} \quad 4965 \text{ scfm} \times 0.075 \frac{\text{lb}}{\text{scfm}} = 372 \frac{\text{lb}}{\text{min}}$$

Water required to cool gas to 500°F. (baghouse operating temperat

Δheat between 2000°F. and 500°F.

$$4965 \text{ scfm} \times (38.99^* - 8.17^+) \frac{\text{Btu}}{\text{scfm}} = 153{,}000 \frac{\text{Btu}}{\text{min}}$$

Water rate

$$Q = h_g - h_f$$

Q = heat absorbed Btu/

h_g = heat content of saturated steam

h_f = heat content of saturated liquid

$$h_g \text{ @ } 500°\text{F. and 1 atm.} = 1201.70 \frac{\text{Btu}}{\text{lb}}$$

$$h_f \text{ @ } 60°\text{F.} = 28.06 \frac{\text{Btu}}{\text{lb}}$$

$$Q = 1173.64 \frac{\text{Btu}}{\text{lb}}$$

$$\frac{153{,}000 \frac{\text{Btu}}{\text{min}}}{1173.64 \frac{\text{Btu}}{\text{lb}}} = 130.5 \frac{\text{lb}}{\text{min}} \; H_2O$$

*Enthalpy of air at 2000°F $\frac{\text{Btu}}{\text{scfm}}$

+Enthalpy of air at 500°F. $\frac{\text{Btu}}{\text{scfm}}$

Volume of water vapor =

$$\frac{130.5\ \frac{lb}{min}}{18\ \frac{lb}{lb\ mol}} \times 379\ \frac{ft^3}{lb\ mol} \left(\frac{460 + 500}{460 + 60}\right) = 5058\ cfm$$

Total volume of gases to baghouse @ 500°F.

$$\text{Products of combustion} = 4965\ \frac{ft^3}{min} \times \left(\frac{460 + 500}{460 + 60}\right) = 9200\ cfm$$

H_2O Vapor = 5080

Total =14280 cfm

b. During melting period average temperature of exhaust gases from cupola = 1200° F. (result of afterburner, condition 2)

Natural gas required (assume gases from furnace @ 500° F.)

Heat tuyere air from 500° F. to 1200° F.

$$3450\ scfm\ (21.98^* - 8.17)\ \frac{Btu}{scfm} = 47{,}700\ \frac{Btu}{min}$$

Heat air thru charging door from 60° F. to 1200° F.

$$1400\ scfm\ (21.98 - 0)\ \frac{Btu}{scfm} = 30{,}800$$

$$\text{Total} = 78{,}500\ \frac{Btu}{min}$$

Natural gas net heat available at 1200° F.

and 100% theoretical air[43] = 721.3 $\frac{Btu}{ft^3}$

$$\frac{78{,}500\ \frac{Btu}{min}}{721.3\ \frac{Btu}{ft^3}} = 108.5\ \frac{ft^3}{min}\ \text{natural gas}$$

*Enthalpy of air at 1200°F. $\frac{Btu}{scfm}$

Products of combustion from natural gas

$$108.5 \frac{ft^3}{min} \times 11.45 \frac{ft^3}{ft^3} \text{ gas} = 1240 \frac{ft^3}{min}$$

Total volume of gases to water evaporation cooler

tuyere air	3450 scfm
indraft air	1400
products of combustion, natural gas	1240
	6090 scfm

$$6090 \times \left(\frac{460 + 500}{460 + 60}\right) = 11,300 \text{ cfm @ } 500° \text{ F.}$$

Water required to cool gas from 1200° F. to 500° F.

$$6090 \text{ scfm} \times (21.98 - 8.17) \frac{Btu}{scfm} = 84,000 \frac{Btu}{min}$$

$$Q = h_g - h_f = 1173.64 \frac{Btu}{lb}$$

$$\frac{84,000 \frac{Btu}{min}}{1174 \frac{Btu}{lb\ H_2O}} = 71.5 \frac{lb}{min\ H_2O}$$

Total volume to baghouse at 500° F.

Furnace + afterburner = 11,300 cfm

$$\text{Water, } \frac{71.5 \frac{lb}{min}}{18} \times 379\left(\frac{460 + 500}{460 + 60}\right) = 2,770 \text{ cfm}$$

Total = 14,070 cfm

c. Flow calculations

40' of 30" duct, furnace to cooler

2 - 90° els (short radius) to evaporation cooler

20' of 30" duct from evaporation cooler to baghouse

Crossectional area of duct $= \frac{\pi D^2}{4} = \frac{\pi (2.5)^2}{4} = 4.9 \text{ ft}^2$

Average velocity @ 23,000 cfm (4965 scfm @ 2000° F., condition 1) $\dfrac{23{,}000 \frac{ft^3}{min}}{4.9 \text{ ft}^2} = 4700 \frac{ft}{min}$

Average velocity @ 19,000 cfm (6090 scfm @ 1200° F., condition 2) $= \dfrac{19{,}000 \frac{ft^3}{min}}{4.9 \text{ ft}^2} = 3890 \frac{ft}{min}$

Average velocity @ 14,280 cfm (500°F.) (condition 1) $= \dfrac{14{,}280 \frac{ft^3}{min}}{4.9 \text{ ft}^2} = 2920 \frac{ft}{min}$

Average velocity @ 14,070 cfm (500°F.) (condition 2) $= \dfrac{14{,}070 \frac{ft^3}{min}}{4.9 \text{ ft}^2} = 2870 \frac{ft}{min}$

Pressure drop for worst case, 14,070 cfm @ 500° F. (condition 2)

The highest volume at lowest temperature, therefore highest weight of gas to be moved. This occurs at furnace discharge temperature of 1200° F. and volume of gases from furnace = 19,000 cfm.

Pressure drop

TP = VP + SP

TP = Total pressure

VP = Velocity pressure

SP = Static pressure

Velocity pressure[44] @ 3890 $\frac{ft}{min}$ (19,000 cfm) and 1200°F.

$$VP = \left(\frac{V}{1096.7}\right)^2 \text{ x(density of gas } \frac{lb}{ft^3}\text{)}$$

$$VP = \left(\frac{3890}{1096.7}\right)^2 \text{ x } (0.0238) = .30\text{" wc}$$

40' of duct	=	0.23 VP[45]
2 - 90° els	=	1.10 VP
Entrance loss	=	0.50 VP

SP = 1.83 VP or 1.83 (0.30) = 0.55" wc

Cupola to evaporation cooler

Assume ΔP across cooler = 0.5" wc

VP @ 2,870 $\frac{ft}{min}$ (14,070 cfm) and 500° F.

$$VP = \left(\frac{2,870}{1096.7}\right)^2 \text{ x } (0.0412) = .283\text{" wc}$$

20' of duct	=	0.115 VP
2 - 90° els	=	1.100 VP

SP = 1.215 or 1.215 x (.283) = 0.36" wc

ΔP across baghouse = 4.00" wc

System SP = 5.41" wc

TP = 0.34 + 5.41 = 5.75

Fan check

14,070 cfm @ 5.75" wc static pressure and 500° F. Fan multiple rating tables use standard air at 0.075 $\frac{lb}{ft^3}$. Air at 500° F. has a density of 0.0412 $\frac{lb}{ft^3}$.

To determine motor horse power (RPM remains constant for constant volume)[46]

$$P = hp_{@\ 70^\circ\ F.} \left[\frac{D_{500^\circ F.}}{D_{70^\circ\ F.}}\right] = hp_{@\ 500^\circ\ F.}$$

Baghouse evaluation

Filter media - glass cloth

Glass cloth has good heat resistance at 500° F. and surge of 600° F. Resistance to acid is good. Mechanical strength characteristic will give average bag life.

Bag cleaning

Reverse flow is satisfactory for this service, supporting high collection efficiency and displays good bag cleaning uniformity.

Filter ratio

$$\frac{15{,}500\ \frac{ft^3}{min}}{8{,}500\ ft^2} = 1.83{:}1$$

The filter ratio of 1.83:1 ($1.83\ \frac{ft}{min}$) is attained at the maximum flow rate which is acceptable for this service.

Baghouse operation

Nominal operating temperature for the baghouse is 500° F. If there are only short surges of higher temperatures there should be no problems with damage to the bags.

Instrumentation - continuous recording instrumentation for flow rates, gas temperature, baghouse temperature and dew point levels have been provided.

3. Summary and conclusions

It is recommended that the permit to construct be issued for the baghouse in this permit request. The calculations show that proper consideration has been given to the exhaust system for good indraft at the charging door, sufficient water is available to reduce gas temperatures to the desired level, and the baghouse is properly sized.

The only conditional provision of the permit to construct is that sampling ports be provided upstream of the baghouse and at the fan exhaust duct or stack.

I. Gasoline Storage and Transfer System

1. Equipment and Process Description

A bulk loading terminal is to be installed which includes a floating roof gasoline storage tank of 400,000 gal. capacity and from which 30,000 gal. of gasoline per day are loaded. A self contained vapor recovery system is to be installed. A schematic flow diagram of the system is shown in Figure 6.15.

The following additional information, as a minimum, would be necessary. (Note: In the case of the storage tank, some assumed values are given so that an illustrative calculation of the daily vapor loss can be made.)

Gasoline storage tank

Tank capacity - 400,000 gal

Tank diameter - 45 ft

Product - gasoline

Average storage temperature - 70° F.

Reid vapor pressure - 9 lb

True vapor pressure - 5.7 psia (obtained from nomograph on p. 615, "Air Pollution Engineering Manual"[47])

Density of condensed vapors - 252 $\frac{\text{lbs}}{\text{bbl}}$

Shell construction - welded

Type floating roof seal - tube

Type floating roof - double deck

Paint color - white

Type and condition inner tank surface - smooth steel

Average wind velocity - 6 mph

Vapor recovery system

Absorber design, including diameter, height and type of packing or number and type trays, vapor and gasoline flow rates, temperatures in absorber, vapor concentration at

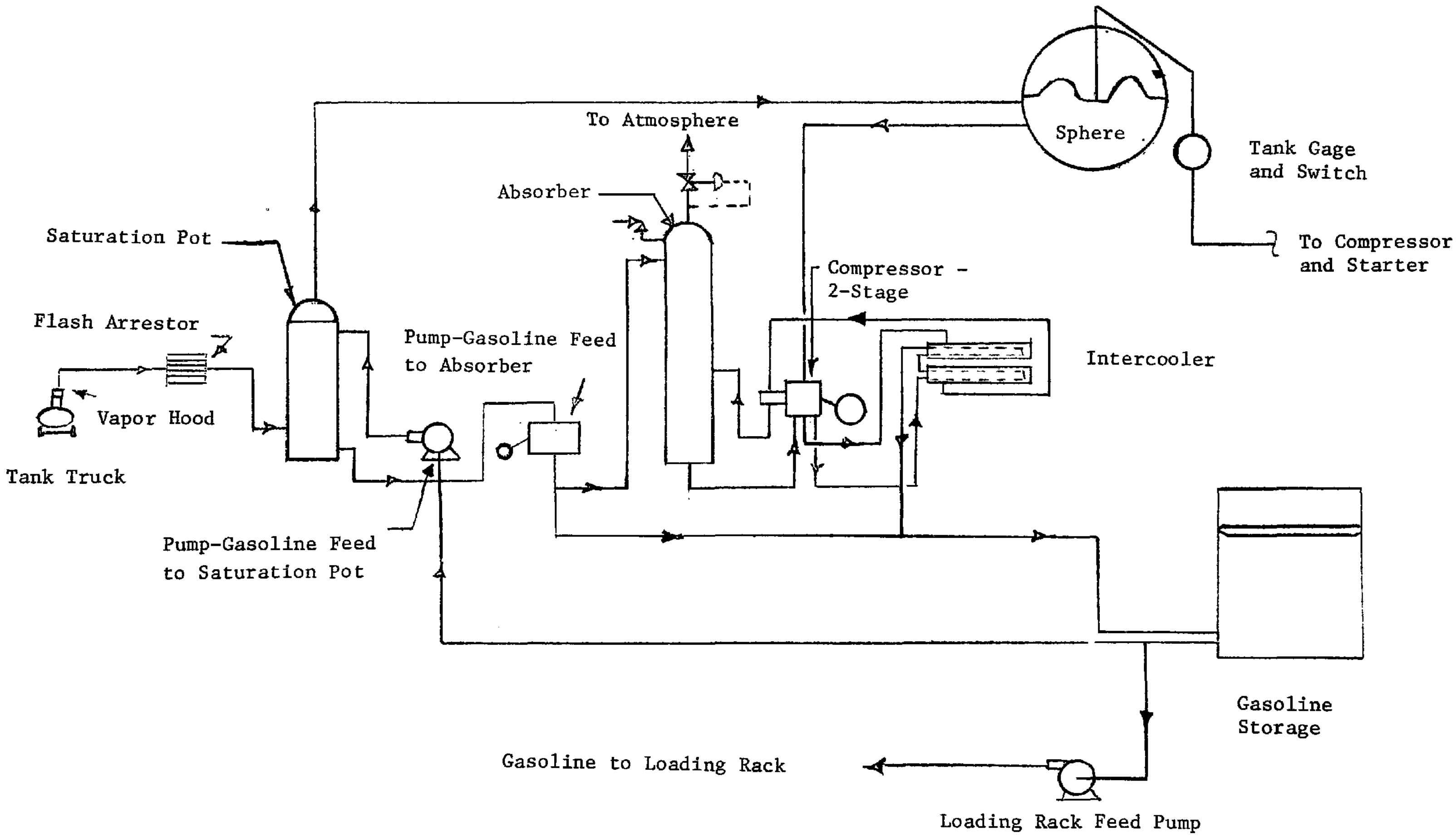


Figure 6.15. Schematic flow diagram of a vaporsaver unit used for recovery of loading rack vapors at a bulk gasoline terminal

inlet, assumed composition of vapors.

Vapor sphere capacity
Compressor capacity
Intercooler capacity
Maximum loading rate
Emergency venting system
Location and height of all vents

Loading rack vapor collection system

Design of loading arm if hatch loading used including means to obtain a vapor-tight seal between the vapor collecting adapter and the hatch, and the means used to prevent liquid gasoline drainage from the loading device when it is removed from the hatch of any tank truck or trailer.

If bottom loading, loading and vapor lines should be described including means to obtain vapor-tight connections and the type of closure devices used in liquid lines.

Standards - Generally speaking two types of standards would apply to the construction and operation of a bulk loading terminal for gasoline such as used here for illustration. The first would have to do with the storage of volatile petroleum products and the second with gasoline loading operations. Typical of these are Rule 56 "Storage of Petroleum Products" and Rule 61 "Gasoline Loading into Tank Trucks and Trailers" of the Los Angeles County Air Pollution Control District.[49] Both are equipment specification type standards rather than emission standards. The essential elements of these rules follow:

Rule 56 - Provides that any tank greater than 40,000 gallons capacity used for storing gasoline or any petroleum distillate having a vapor pressure of 1.5 psia or greater must be equipped with a vapor control device such as a pontoon-type or double-deck floating roof or a vapor recovery system capable of collecting all emissions, except that a floating roof may not be used if the vapor pressure under actual storage conditions exceeds 11 psia.

Rule 61 - Provides for installation of vapor recovery and dispos systems on bulk loading facilities where more than 20,000 $\frac{gal}{day}$ of gasoline are loaded and requires that loading be conducted with vapor-tight lines and that provision be made to eliminate drainage and disconnect losses. The disposal system must have a minimum recovery efficiency of 90%, or have a variable vapor space tank, compressor, and fuel gas system of such capacity so as to handle all vapors and gases displaced from the trucks being loaded.

Significant difficulties may be encountered in determining what the actual recovery efficiency is in a vapor recovery and disposal system. Among the problems are:

a. Erratic flow of vapors from the tank truck usually precludes measuring the actual volume of vapor evolved during loading.

b. The degree of saturation with gasoline vapors of the air displaced from the truck depends on the type of loading, e.g., splash, submerged, bottom fill.

c. Efficiency, as measured on recovery of vapors evolved depends on (b) above and it may be nearly impossible to obtain 90% when submerged or bottom fill is used. In the latter cases the degree of saturation (amount of gasoline vapor) of the displaced air - vapor mixture is less than with splash fill and though the mass loss of vapor may be the same for all loading techniques, the percent recovery will vary depending upon the quantity of vapor entering the recovery system.

d. Efficiency also depends upon bulk liquid temperature, and the low degree of saturation attendant with low bulk temperatures will affect recovery efficiency as in (c) above.

2. Evaluation and Calculations

a. The storage tank has a capacity of over 50,000 gal and will store gasoline having a vapor pressure over 1.5 psia, so Rule 56 will apply. It is not expected that the vapor pressure will exceed 11 psia under storage conditions so a double deck or pontoon-type floating roof tank with adequate seals will suffice. The specifications for the tank can be examined against Table 168 "Standing Storage Losses from Floating-Roof Tanks", p. 613, "Air Pollution Engineering Manual"[50] and it will be seen that it will have the lowest loss factor possible. Riveted, pan roof tanks of a color other than white would have higher loss factors. However, it is desired to calculate expected hydrocarbon losses for an emission inventory so this will be done as an example. The standing storage emission formula for floating-roof tanks is given as[51]

$$E = K_t\ D^{1.5}\left(\frac{P}{14.7 - P}\right)^{.7}\ V_w^{\ .7} K_s K_c K_p \times \frac{W}{365} = \frac{\text{lbs}}{\text{day}}$$

Where E = Evaporation loss in $\frac{\text{lbs}}{\text{day}}$

K_t = Tank type factor = .045 for welded tank with double deck roof

D = Tank diameter = 45 ft

P = True vapor pressure = 5.7 psia

V_w = Average wind velocity = 6 mph

K_s = Seal condition factor = 1.00 for new tight fitting tube seal

K_c = Stock factor = 1.00 for gasoline

K_p = Paint factor = 0.90 for white

W = Density of condensed vapors = 252 $\frac{\text{lb}}{\text{bbl}}$

$$E = .045\ (45)^{1.5}\left(\frac{5.7}{14.7 - 5.7}\right)^{.7}\ (6)^{.7}\ (1)(1)(.9)\left(\frac{252}{365}\right)$$

$$= 20.6\ \frac{\text{lb}}{\text{day}}$$

The withdrawal loss formula is given as[52]

$$L = (.0224)\ \frac{CVW}{D}$$

Where L = loss in $\frac{\text{lb}}{\text{day}}$

C = Clingage factor (This is based upon the inside tank surface characteristics and how much gasoline can cling to it after the floating roof drops as a result of withdrawal of gasoline.)

Assume 0.02 for smooth steel tank

D = Diameter of tank = 45 ft

W = Density of condensed vapors = 252 $\frac{lb}{bbl}$

V = Throughput = 750 $\frac{bbl}{day}$

$$L = (.0224)\ \frac{0.02 \times 750 \times 252}{45} = 1.8\ \frac{lb}{day}$$

$$\text{Total losses from tank} = 20.6 + 1.8 = 22.4\ \frac{lb}{day}$$

b. Vapor recovery system for truck loading

For this system, the approach rather than actual calculation, will be given. Referring to the schematic flow diagram, gasoline vapors displaced at the loading rack are passed through a saturator countercurrently to gasoline pumped from storage. This is done to prevent the existence of explosive mixtures. The saturated vapors then flow to the vaporsphere. The position of the flexible diaphragm actuates a switch which starts the compressor which injects the vapors to the absorber at about 200 psig. Stripped gasoline from the saturator or gasoline from storage is used to absorb the gasoline vapors, with the tail gases being vented to atmosphere through a back pressure regulator. Gasoline from the absorber bottoms containing the absorbed vapors is returned to storage.

Several key design elements are involved in such a system. The compressor and absorber may be sized and designed to handle the average daily throughput if the vaporsphere is large enough to handle the peak flow. The criteria upon which these design decisions are based should be included in the application.

In the case of the absorber a review of the design calculations should be made. A variety of accepted techniques are available for absorption tower design, but all require much the same data.

These include vapor-liquid equilibrium data for the solute and solvent, gas flow rate, entering solute concentration (in this case gasoline vapor in air), type packing if packed tower or plate description if a plate type column, operating temperature, efficiency required, and concentration of solute in feed solvent.

c. The basic steps involved in the design of an absorption tower are:

(1) Calculate liquid (solvent) flow rate necessary to absorb the required amount of gasoline vapor. This is basically a material balance. The maximum concentrations of solute in the outlet liquid must be such that the conditions at the bottom of the tower do not too closely approach the equilibrium curve.

(2) Calculate tower diameter. This is based upon volumetric flow rates and physical characteristics of the tower packing (or plates), the gas and liquid densities, and the liquid viscosity. The criterion used is to maintain flow rate per unit area below some stated percentage (often 60%) of flooding conditions.

(3) Determine number of transfer units (packed column) or theoretical plates. A stepwise graphical solution is often used. The general approach is described in the section on Gas Absorption in the "Air Pollution Engineering Manual"[53]

beginning on p. 211. Specific methods for multi-component situations such as the case with gasoline vapors are available.

(4) Determine height of a transfer unit (packed tower) or number of actual plates. In the case of packed towers, these are experimentally derived factors depending upon the type of packing and the gas and liquid flow rates. In plate type towers, experimentally determined plate efficiencies are used.

(5) Calculate pressure drop through tower. This is done to determine pump and compressor requirements.

(6) Tank loading equipment - the evaluation to be performed here is that of determining whether the loading arms or delivery lines and the vapor return lines meet the requirements of vapor-tight connections, and no liquid loss during removal or disconnect operations. There are a variety of proprietary devices. Whichever one is selected by the applicant, drawings and data submitted should be sufficient to describe the mechanical functioning of the equipment and results of field testing or use.

3. Summary and Conclusions

The proposed bulk loading terminal is of such design so as to be able to operate within the standards used for criteria in this illustration. The evaluation of the gasoline storage tank and bulk loading equipment is fairly straightforward and within the competence of a graduate chemical or mechanical engineer with relatively little experience. A trained engineering assistant with specific experience in petroleum processing equipment could also perform this portion of the evaluation.

The evaluation of the vapor recovery plant, and in particular the absorber, would require a higher level of experience. As an example, a graduate chemical engineer with an adequate background in mass transfer and additional training or experience in high pressure, multi-component hydrocarbon absorption equipment should perform this evaluation.

J. Two Dry Rendering Cookers Venting to a Contact Condenser and Vapor Incinerator.

1. Equipment and Process Description

A permit to construct is requested for a contact condenser and vapor incinerator serving two 3,000 pound capacity dry rendering cookers. The basic equipment is a captive operation in a meat packing plant. Material charged consists of bone and meat scrap with a 50% moisture content. Since the charge is relatively fresh there will be no provisions for hoods at the perculator pans.

The system schematic is shown in Figure 6.16.

The specifications for the air pollution control system are:

a. Condenser water rate is 100 gpm
b. The incinerator uses natural gas as fuel at the rate of 320 $\frac{ft^3}{hr}$, has a throat diameter of 9 inches, combustion chamber diameter of 12 inches and combustion chamber length of 4.5 feet.

2. Evaluation and Calculations

Rate of evaporation

$$\frac{3000 \text{ lb scrap} \times 2 \text{ cookers}}{2 \text{ hrs}} \times .5 = 1500 \frac{\text{lb}}{\text{hr}}$$

Assume that 10% of the moisture remains in the tallow and cracklings. Then the total water to be evaporated will be 1350 $\frac{\text{lb}}{\text{hr}}$. This will not be evenly distributed over the full hour but will surge during the first part of the cooking cycle. The "Air Pollution Engineering Manual" states that this may be in the ratio of 2:1 relative to the average rate of evaporation.

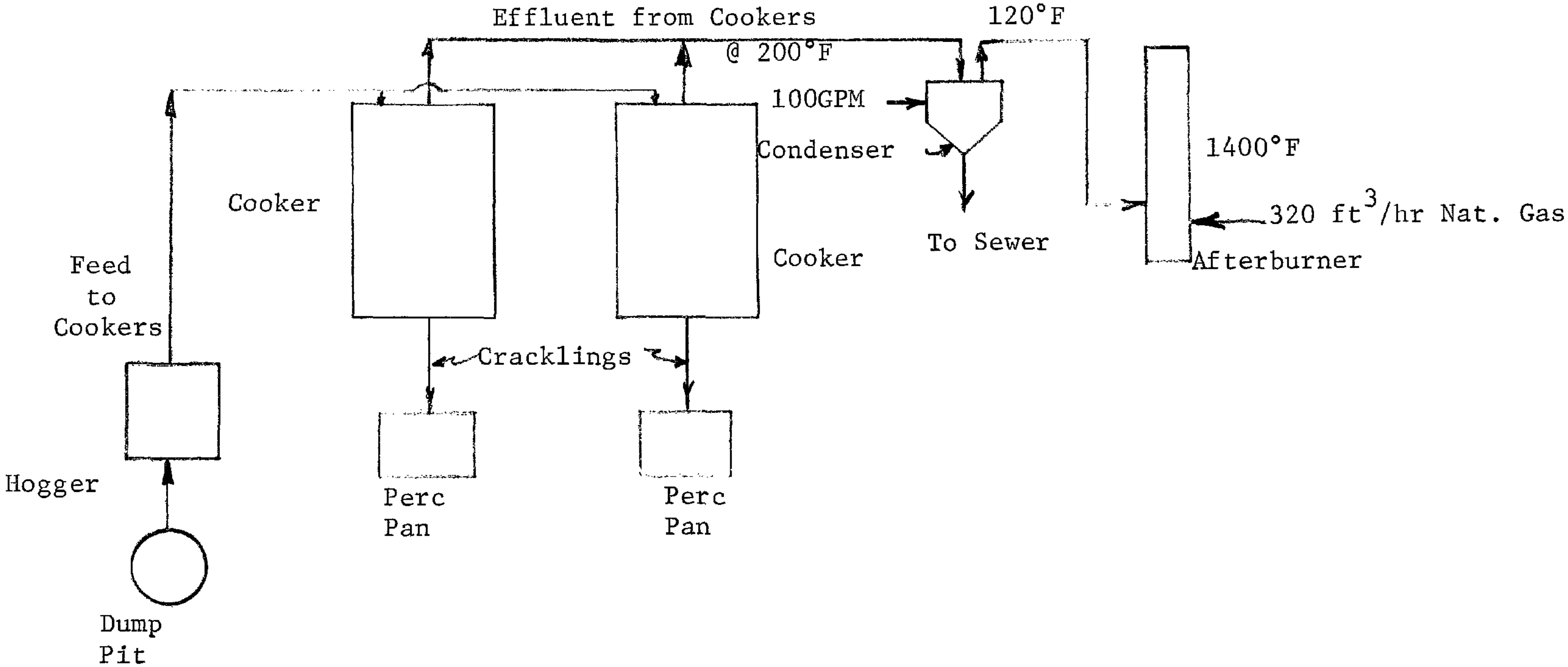


Figure 6.16. Schematic of Condenser & Afterburner Serving two Dry Rendering Coolers
(Source: Reference 54, Modified)

Therefore the maximum rate of vapor generation may be

$$\frac{1350 \frac{lb}{hr}}{60 \frac{min}{hr}} \times 2 = 45 \frac{lb}{min}$$

Gases are to be condensed from 200° F. to 120° F. by the contact condenser.

$$45 \frac{lb}{min} \times 977.9 \frac{Btu}{lb}^{*} = 44{,}000 \frac{Btu}{min} \quad \text{(condensation)}$$

$$45 \frac{lb}{min} \times (200^{+} - 120^{**}) \frac{Btu}{lb} = \underline{3{,}600 \frac{Btu}{min}} \quad \text{(subcooling)}$$

$$\text{Cooling load} = 47{,}600 \frac{Btu}{min}$$

$$\text{Water requirements} = \frac{47{,}600 \frac{Btu}{min}}{(120 - 60) \frac{Btu}{lb}} = 753 \frac{lb}{min}$$

$$793 \frac{lb}{min} \times 0.1198 \frac{gal}{lb} = 95 \text{ gpm required}$$

Assume that 10% of the volume of gases handled will reach the incinerator plus an additional 10% leakage.

$$45 \frac{lb}{min} \times .2 = 9.0 \frac{lb}{min} \times 60 \frac{min}{hr} = 540 \frac{lb}{hr}$$

Incinerator operating temperature is 1400° F.

Δh[55] = enthalpy of gas @ 1400° F. − enthalpy @ 120° F.

$= 341.5 - 14.6$

$= 326.9 \frac{Btu}{lb}$

* Heat of evaporation @ 200°F. and 11.53 psi absolute $\frac{Btu}{lb}$

\+ Btu/lb of water @ 200°F.

**Btu/lb of water @ 120°F.

$$540 \frac{lb}{hr} \times 326.9 \frac{Btu}{lb} = 176{,}500 \frac{Btu}{hr}$$

10% for radiation and convection losses = 18,600

$$195{,}100 \frac{Btu}{hr}$$

Net heat available from combustion of natural gas[48] (1100 $\frac{Btu}{scfm}$)
@ 1400° F. = 668 $\frac{Btu}{ft^3}$

$$\frac{195{,}100 \frac{Btu}{hr}}{668.6 \frac{Btu}{ft^3}} = 290 \frac{ft^3}{hr}$$ gas required - 320 ft^3/hr supplied ok

Volume of gasses to incinerator[49]

11.45 ft^3 products of combustion per ft^3 of natural gas burned.

$$\frac{320 \frac{ft^3}{hr} \times 11.45 \frac{ft^3}{ft^3} \times (460 + 1400)}{3{,}600 \frac{sec}{hr} \times (460 + 60)} = 3.65 \frac{ft^3}{sec}$$

Gases from condenser and leakage (assuming air)

$$\frac{9 \frac{lb}{min} \times 379 \frac{ft^3}{lb\ mol} \times (460 + 1400)}{29 \frac{lb}{lb\ mol} \times (460 + 60) \times 60 \frac{sec}{min}} = 6.86 \frac{ft^3}{sec}$$

Total to incinerator = $10.51 \frac{ft^3}{sec}$

Velocity of gases through throat

Throat diameter = 9"

$$\text{Volume} = \frac{10.51 \frac{ft^3}{sec}}{\frac{\pi(.75)^2}{4}} = 24 \frac{ft}{sec}$$ Acceptable, 15 to 25 $\frac{ft}{sec}$ reco

Velocity of gases through the combustion chamber

Combustion chamber diameter = 12"

$$\text{Velocity} = \frac{10.51\ \frac{ft^3}{sec}}{.785\ ft^2} = 13.4\ \frac{ft}{sec}$$

Acceptable, 10 to 15 $\frac{ft}{sec}$ recommended.

Retention time

Combustion chamber length = 4.5 ft

$$\frac{4.5\ ft}{13.4\frac{ft}{sec}} = 0.34\ sec.$$

Acceptable, recommended retention time is >0.3 sec.

3. Recommendations and Conclusion

The design parameters for the air pollution control system are within the acceptable range for the control of malodorous gases from the two rendering cookers. It is therefore recommended that a permit to construct be issued based upon the following conditions.

a. Water flow meter be installed on the fresh water line to the condenser.

b. Time and temperature recording instrument be installed on the incinerator.

K. Triple Superphosphate Plant

1. Equipment and Process Description

A 500 $\frac{\text{ton}}{\text{day}}$ capacity plant for the production of granular triple superphosphate by the continuous slurry process is to be built. It will be near the site of an existing wet process phosphoric acid plant where approximately 40% P_2O_5 equivalent phosphoric acid will be obtained. Ground phosphate rock from the same source supplying the phosphoric acid plant will be used in the process.

A schematic diagram of the plant to be built is shown in Figure 6.17

A tremendous variation is possible in plants such as this. The specific arrangement, type of equipment, and method of operation would depend upon raw materials availability, integration with existing facilities, plant location (although this plant is assumed to be located in the Gulf Coast area), and product demand. One obvious variation would be provision for ammoniation of the granular material. If such provision were made it would have a definite effect on the treatment facilities for gaseous effluents.

An engineer processing this application would require significantly more information in a real situation including (1) an assay of the phosphate rock, (2) specific design details on each item of equipment, (3) location of all points of discharge to venting or control systems, (4) design volume of all exhaust systems, (5) exhaust fan and motor ratings, (6) materials of construction, (7) fuel and air rates to dryer, provision for preventing fluoride emissions from scrubber water impound ponds, e.g. pH adjustment or liming, (8) whe or not the scrubber water to be used for by-product fluoride recove (9) performance characteristics of all air pollution control equipm

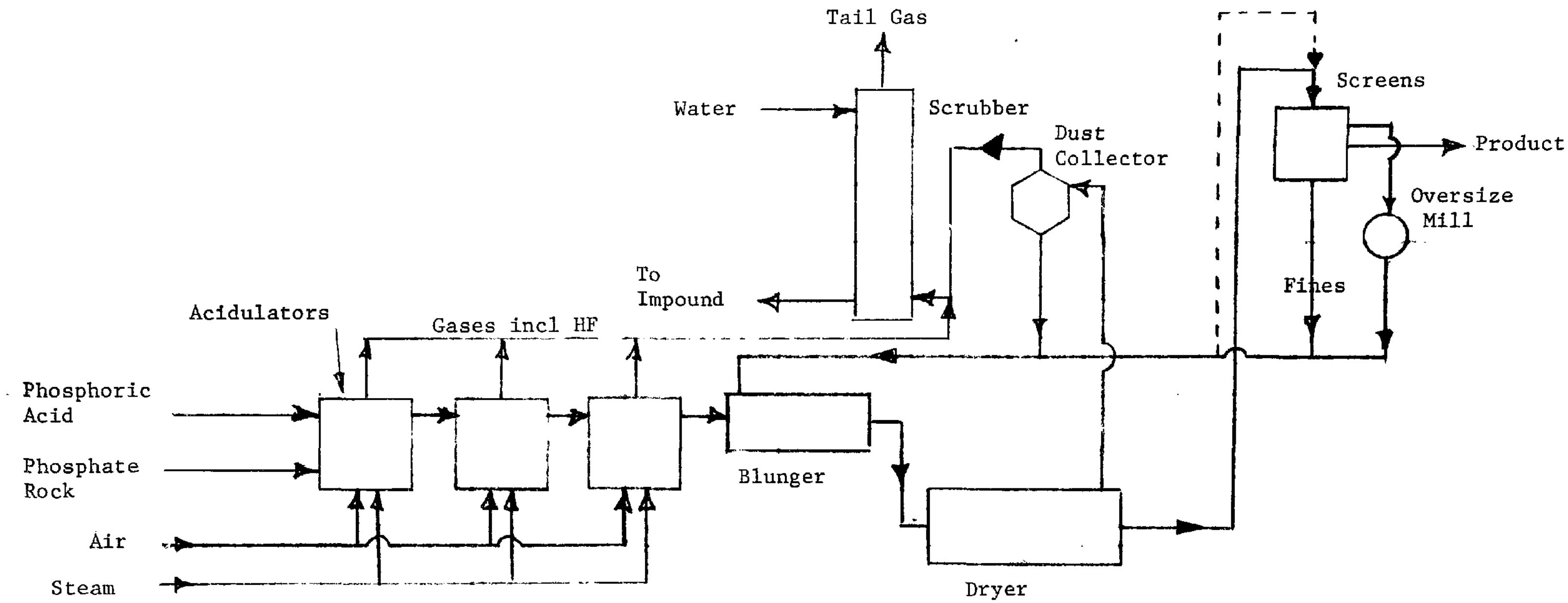


Figure 6.17. Continuous process for the manufacture of granular triplesuperphosphate (Source: reference 56)

Additional details and a brief process description follow:

Triple superphosphate is an impure monocalcium phosphate made by reacting phosphoric acid with phosphate rock. Assuming the rock to be in the form of calcium fluorapatite the principal reaction occuring is

$$3[Ca_3(PO_4)_2] \times CaF_2 + 14\ H_3PO_4 \longrightarrow 10Ca(H_2PO_4)_2 + 2HF$$

Although any phosphoric acid may be used, wet process phosphoric acid made by the complete acidulation of phosphate rock with sulfuric acid is almost universally used. Triple superphosphate plants are usually located in a complex of plants including phosphoric acid production near phosphate rock deposits.

In the process being considered here granular triple superphosphate is being made in a continuous slurry process. Ground phosphate rock and phosphoric acid is fed to (1) the first of a series of reaction tanks (acidulators) where heating and agitatio with steam and air promotes the rapid reaction between the rock and acid. (Note: for purposes of calculations 0.648 tons of 54% P_2O_5 equivalent acid and 0.393 tons of rock are required per ton of product.) The reaction is essentially completed after the third reactor from which the slurry passes to the (2) blunger where drying is stimulated by mixing with recycled fines, crushed oversize, and fines from the dust collector. The partial dried granular material is then fed to a (3) rotary dryer, and then to a (4) series of screens where a product of the desired pa ticle size is withdrawn and fines and oversize material is recycl Dust from the dryer and materials handling is exhausted through a (5) dust collector, while effluent gases containing HF (hydroge fluoride) are passed through a (6) scrubber.

2. Evaluation and Calculations

a. Standards

It is assumed that this plant will have to meet standards for both particulate matter and fluorides. The particulate emission standard used will be that based upon process weight described under par. 2.5, Appendix B, Federal Register, Vol. 36, No. 158, August 14, 1971. For process weight up to 60,000 $\frac{lb}{hr}$ the allowable emission rate is expressed by the equation:

$$E = 3.59\ P^{0.62}$$

where

E = emission rate $\left(\frac{lb}{hr}\right)$

P = process weight rate $\left(\frac{ton}{hr}\right)$

In this example, the production rate is given as 500 $\frac{ton}{day}$, and feed rate is 0.648 ton of 54% P_2O_5 equivalent acid and 0.393 ton rock per ton of product. However, since 40% P_2O_5 equivalent acid will actually be used, the rate of consumption at that concentration will be

$$0.648\left(\frac{.54}{.40}\right) = 0.875 \text{ ton 40\% } P_2O_5 \text{ equivalent acid per ton product}$$

$$\text{Process weight} = \frac{500 \times (.875 + .393)}{24} = 26.4\ \frac{ton}{hr}$$

$$\text{Allowable loss} = 3.59\ (26.4)^{0.62} = 27.2\ \frac{lb}{hr}$$

For determining allowable fluoride emissions, the State of Florida Prohibitive Acts 17-2.04 par. (6)(c)1.a 4.ii will be used. Basically this states that the emission of fluoride to atmosphere expressed as lb. F per ton P_2O_5 shall not exceed 0.15. Other factors are to be considered such as latest technology, plant location, etc. To calculate allowable loss we will assume the entire product weight o 500 $\frac{ton}{day}$ has the formula $Ca(H_2PO_4)_2$. The molecular weight for this compound is 234. For P_2O_5 the molecular weight is 142. Since ther is one mole P_2O_5 per mole of product, the amount of P_2O_5 present pe ton of product is given by the ratio $\frac{142}{234}$ = .605. (Note: in an actual situation the exact product assay should be used.)

$$\text{Amount of } P_2O_5 \text{ in product} = \frac{500 \times .605}{24} = 12.6 \frac{\text{ton}}{\text{hr}}$$

$$\text{Allowable fluoride loss} = 0.15 \times 12.6 = 1.89 \frac{\text{lb F}}{\text{hr}}$$

b. Evaluation of air pollution control equipment

In a triple superphosphate plant where hot corrosive gases and particulate matter that cakes below the dew point are present, the succe of the control equipment depends greatly upon selection of proper materials of collection and on maintaining proper conditions in the exhaust and control equipment.

For the control of particulates, very high efficiency wet scrubbers or cloth filters will be necessary. In the case of wet scrubbers su as wet cyclones or venturi scrubbers, the important design features include (1) operation at no less than the rated pressure drop, (2) amount and pressure of water delivered to nozzles, and (3) correct equipment sizing. Source test data on similar plants should be examined so that an estimate as to the amount and size distribution of the particulates entering the collection equipment can be made.

If cloth filters are to be used, the proper fabric must be specified and a check made as to the design filter ratio - volume of exhaust i

$\frac{ft^3}{min}$ per effective filter area in ft^2. Heat exchange calculations may be necessary to insure that temperatures can be maintained above the dew point.

The control of gaseous fluorides is to be accomplished by use of an absorption column (scrubber). Hydrogen fluoride, which is evolved in the acidulation process, is very soluble in water, but some check should be made of the design absorption efficiency of the scrubber to determine whether the standards can be met. Silicon tetrafluoride, SiF_4, and fluosilicic acid, H_2SiF_6, may be formed with silica and water that is present in the off-gases, but we will base our discussion on HF. All the fluorine originally present is derived from the phosphate rock. We will assume all the rock consists of calcium fluorapatite, $3[Ca_3(PO_4)_2] \times CaF_2$, which has a formula weight of 1008. Two moles of HF (equivalent to one mole F_2) is formed for every mole of fluorapatite. The molecular weight of F_2 is 38. Loss calculations are based upon F_2 rather than HF (see standards). We can calculate the amount of fluorine entering the process as follows:

$$\text{Total F} = \frac{500 \times .393 \times 38}{1008} \times \frac{2000}{24} = 615 \frac{\text{lb F}}{\text{hr}}$$

From an earlier calculation we know allowable loss is $1.89 \frac{\text{lb F}}{\text{hr}}$.

The efficiency of collection and removal must be

$$\text{Efficiency} = \frac{615 - 1.89}{615} = .997 \text{ or } 99.7\%$$

Note: Not all the fluorine present will be released as gaseous HF. Some, in fact, will be present in the granular product. For purpose of the illustration the efficiency calculation assumes that all the fluorine originally present enters the scrubber.

Additionally, Florida law requires a "curing" building for the produ These structures should also have closed ventilation systems venting through a scrubber.

Absorption calculations should be made which will vary depending upon whether a venturi scrubber, cyclonic spray tower or packed bed unit is specified. Pressure drop, scrubber dimensions, and flow rate of scrubber water are all important. Discharge water which normally will go to treatment ponds for ultimate return to the proce must be adjusted in pH (usually above 8) to prevent excessive loss from the ponds. In some cases fluorine by-product recovery will be incorporated.

3. Summary and Conclusions

Triple superphosphate plants can be built which, by using best available technology, can meet rigid performance standards. Attention to all details is important including conservatively designed dust and fume exhau systems, selection of the proper control equipment for each job, allowan of safety factors in sizing collection equipment, and selection of the proper materials of construction.

Definite consideration should be given to the use of an on-line tail gas analyzer for fluorides. Adequate testing facilities should be provided at the inlet and outlet of each control device.

L. Ammonium Nitrate

1. Equipment and Process Description

A 400 ton per day plant for the production of ammonium nitrate prills is to be constructed. Feed to the plant will be anhydrous ammonia and 60% nitric acid. Figure 6.18 shows a schematic diagram of the process and major items of equipment used.

The engineer processing this application will require at least the following information: (1) exact ratio of feed ammonia to nitric acid, (2) design of vent system for neutralizer and evaporator, (3) design details on scrubber-condenser including diameter, height, internal construction, scrubber water rate, amount of water to be condensed, assumed entering ammonia concentration, and calculated concentration of ammonia in the tail gases, (4) prilling tower design details, including cross-sectional area, height, and air flow rate.

In the process being considered ammonium nitrate is produced by the reaction between ammonia and nitric acid according to the reaction:

$$NH_3 + HNO_3 \longrightarrow NH_4NO_3$$

On a stoichiometric basis (exact chemical equivalence) 0.787 tons of nitric acid (100% equivalent) and 0.213 tons of ammonia are required for one ton of product. In actual practice anhydrous ammonia is used but the typical feed acid contains only about 55-60% HNO_3.

The feed materials are introduced to a neutralizer where ammonium nitrate in the form of a solution is produced accompanied by the release of heat. This heat of reaction is generally sufficient to evaporate part of the water, giving a concentrated solution of molten ammonium nitrate. Excess NH_3 traces of nitrogen oxides, and water vapor are vented to the scrubber-condenser.

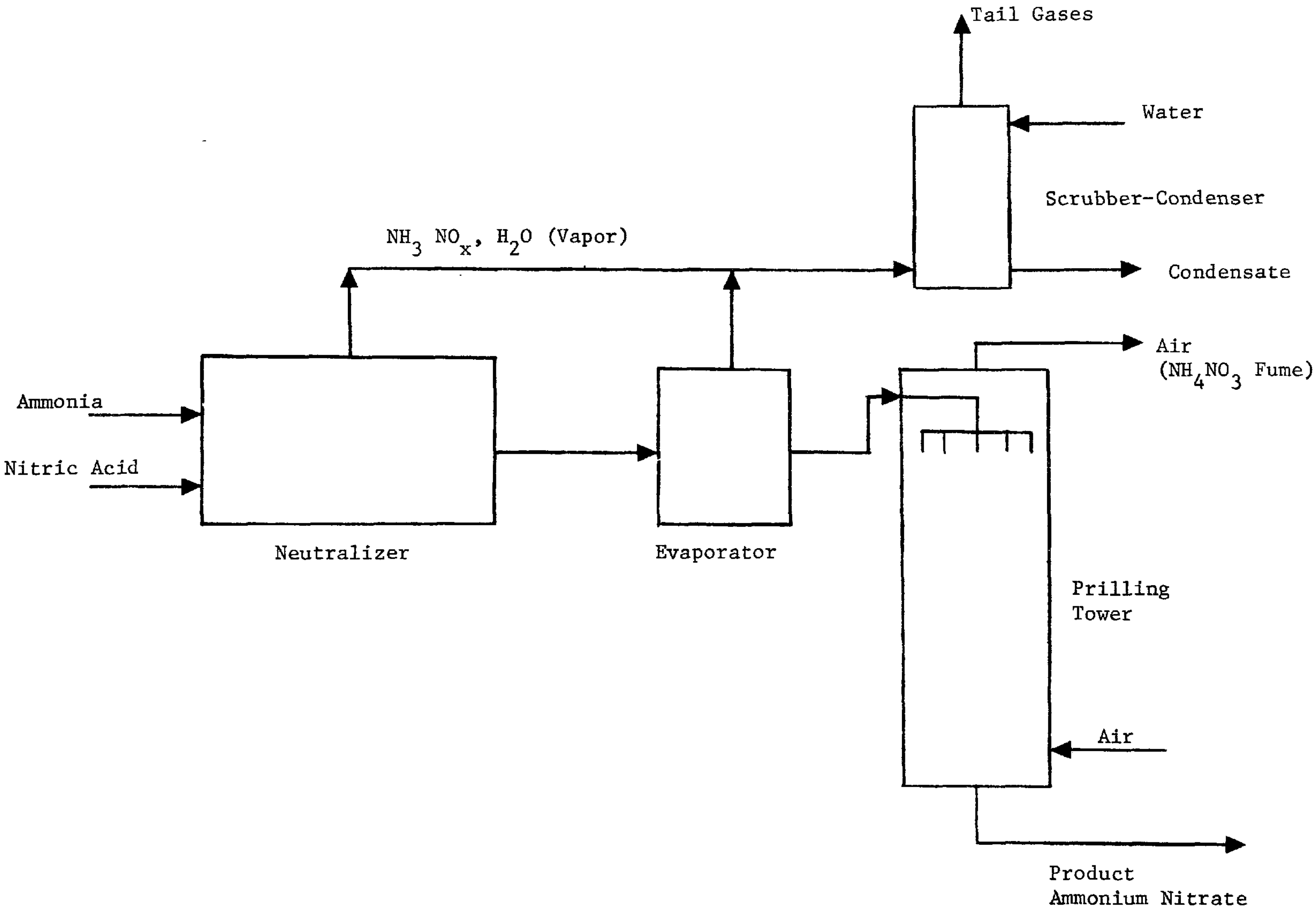


Figure 6.18. Flow diagram for manufacture of ammonium nitrate
(Source: reference 57)

The concentrated ammonium nitrate is then sprayed down from the top of the "prilling" tower through a rising stream of air. The droplets solidify and harden through their fall resulting in spherical pellets called "prills" which may be bagged after further drying on a conveyor to a moisture content usually less than 0.5%. Depending on the design of the tower, and solution and air rates, some ammonium nitrate fume can be lost from the top of the tower. The amount is generally very low.

2. Evaluation and Calculations

a. Standards

Only two types of standards are likely to be applicable in the case of an ammonium nitrate plant (assuming no public nuisance). These would cover visible emissions and dusts from industrial processes. Ammonium nitrate fume from the prilling tower will be the principal concern. We will assume that the suggested standards under paragraph 2.1 and paragraph 2.5, Appendix B, Federal Register, Volume 36, No. 158, August 14, 1971 are to apply. In the case of paragraph 2.1, visible emissions are not to exceed 20% opacity. Under paragraph 2.5, the particulate matter emitted from the process shall not exceed that amount (in $\frac{lb}{hr}$) given by the following formula:

$$E = 3.59\ P^{0.62}$$

where $P \leq 30\ \frac{tons}{hr}$. (process weight)

In this example:

$$NH_3 \text{ required} = \frac{.213 \times 400}{24} = 3.56\ \frac{ton}{hr}$$

$$HNO_3\ (60\%) = \frac{.787 \times 400}{24 \times .60} = 21.8\ \frac{ton}{hr}$$

$$P = 3.56 + 21.8 = 25.36 \frac{\text{ton}}{\text{hr}}$$

and

$$E = 3.59 \times (25.36)^{0.62} = 26.6 \frac{\text{lb}}{\text{hr}}$$

b. Evaluation of process

The first evaluation step that should be taken concerns the potential gaseous emissions from the neutralizer and evaporator. Nitrogen oxides which might originate from the nitric acid can be suppressed by operating with a slight excess of ammonia. Because ammonia is so soluble in water, there should be little trouble in reducing ammonia losses to very low levels by properly designed scrubber-condenser, particularly since there should be practically no non-condensibles in the tail gases. Even without a specific emission standard an estimate should be made of the maximum expected NH_3 loss.

The main problem from ammonium nitrate plants has been the objectionable plume or haze formed as the result of small amounts of ammonium nitrate fume being discharged into a moist atmosphere, and the consequent growth of nuclei to aerosols of a highly visible size (about 0.4 - 1.0 μ). Although the mass rate of discharge is unlikely to exceed the allowable loss rate, visible plumes greater than the 20% opacity allowed may form.

It is known, however, that some ammonium nitrate plants operate without significant plume formation. Although no precise correlations appear to have been made, information from plant operators suggests that a relatively large prilling tower cross-sectional area per ton of production or volume of drying air contributes to a reduced plume potential.[58] Data should be submitted on this factor by the applicant showing how the proposed plant compares with other existing plants, or on what basis a prediction can be made that there will be no visible plume.

3. Summary and Conclusions

Ammonium nitrate plants are capable of being operated with very low levels of air pollution. There should be little difficulty in meeting stringent emission standards on particulate matter. Gaseous emissions should be negligible. The principle problem is that of haze formation, but plants exist that operate without haze. Plants operating in an extremely humid climate are likely to have a greater problem than others.

Source test access points should be made available at the scrubber and the prilling tower discharge.

M. SEWAGE SLUDGE INCINERATOR

1. Equipment and Process Description

A permit to construct has been requested for a multiple-hearth sewage sludge incinerator rated at 850 $\frac{lb}{hr}$ dry solids. The exhaust from the incinerator is vented to a wet centrifugal collector.

Filter cake is fed to the first hearth of the incinerator by belt conveyor (see Figure 6.19). The cake contains 24% dry solids with a heating value of approximately 8000 $\frac{Btu}{lb}$. The process includes drying in the upper hearth, burning of volatile gases in the center zone, and burning the solids in the lower zone. Natural gas (or oil) is the auxilliary fuel used to bring the temperature in the center zone to 1600° F. The sludge is continuously rabbled. The shaft holding the rabble arms is hollow to allow for cooling air to be circulated by means of a special blower. Air thus heated is used to preheat combustion air entering the bottom of the furnace. (In actual practice the engineer considering this type of equipment for a permit to construct must know the auxilliary fuel rate, temperature of the preheated air, blower rating, water rate to scrubber, exhaust fan rating and controls and instrumentation.)

2. Evaluation and Calculations

The principal air pollution control problems from the disposal of sewage sludge by incinerator are odors and particulates. Particulates have been satisfactorily controlled by the use of scrubbers. Capacity of the wet collector is generally based upon volume of gases handled, grain loading, air to water ratio and pressure drop.

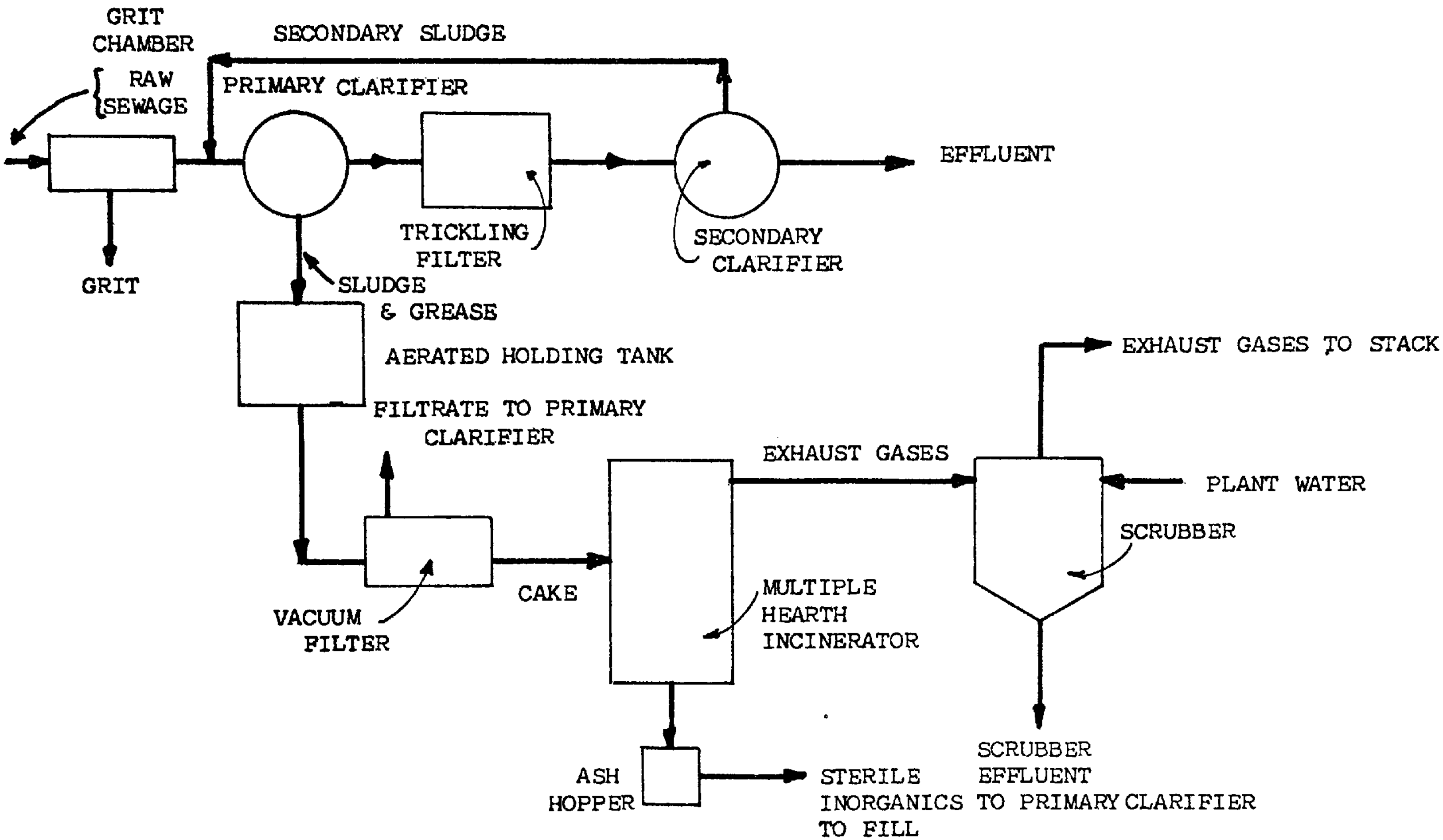


Figure 6.19. Flow sheet of a typical plant with multiple hearth incinerator (Source: reference 59)

The volume of gases to reach the collector is derived from the products of combustion of the fuel (at a specified percentage of excess air, 20% - 50%) combustion products from the sludge and water evaporated. Fuel requirements are determined from the heat needed to evaporate the water in the sludge and to raise the products of combustion and water vapor to the design temperature of 1600° F. Retention time in the furnace is also critical. In order to burn the organic gases which cause odors, a retention time of >0.3 seconds at 1400° - 1600° F. is required.

Secondary air pollution control problems from sludge incinerators are the formation of SO_2 and NO_x. Some of the sulfur oxides may be removed from the effluent by the scrubber while very little of the NO_x will be affected in this control device.

Emission standards for sludge incinerators are based upon those published in the Federal Register, Volume 36, Number 158 - August 14, 1971, Appendix B. "The emission of particulate matter from any incinerator can be limited to 0.20 pound per 100 pounds ($2 \frac{gm}{kg}$) of refuse charged." Calculated rates of particulate losses will be based upon the estimated grain loading in the effluent (statistical data from stack tests) and applying the expected efficiency of the air pollution control device using pressure drop, grain loading, and particle size distribution.

3. Summary and Conclusions

The most difficult problem to control in the incineration of sewage sludge is odors. Incinerator design parameters include a high temperature zone, 1400 - 1600° F., with sufficient retention time for complete burning of the noxious vapors. Additional consideration for the prevention of odors must come upstream of the incinerator.

Good plant design[60], proper operation and maintenance are all vital factors in reducing odors which eminate from sewage plants. Septicity of sludge can be avoided by providing sufficient sludge hoppers and allowing for a flexible pumping schedule.

If during operation of the incinerator odors remain a problem it may be necessary to install an afterburner which can be the direct flame type or catalytic type. These processes have proven very effective in reducing odors from animal rendering, food processing and other sources of noxious vapors.

When recommending a permit to construct a sewage sludge incinerator, the following conditions should be included:

1. Instrumentation to protect against fuel burner failure,
2. Temperature measurement and control for high and low temperatures,
3. Blower fail safe controls and warning,
4. Auxilliary fuel flow controls, and
5. Safety shut offs.

III. SPECIAL FORMS FOR PROCESSING PERMIT APPLICATIONS

Some air pollution control agencies have designed special processing forms where a specific type of equipment comprises the bulk of the workload, or if the calculations are to be performed by a computer.

These forms are designed to reduce the time used in setting up data for calculations, to quickly show what data is necessary or missing, provide proper identification of the file, and to provide sufficient space for comments and recommendations. All situations cannot be economically handled by special forms, but the following samples designed by agencies with many years of experience in processing large numbers of applications for permits exemplify cases where they can be used.

A. Storage tanks

Figure 6.20, used by the Los Angeles County Air Pollution Control District, is an excellent example of a compact form for evaluating applications for storage tanks. It enumerates all of the data necessary to calculate the losses of vapors from breathing, filling, evaporation and withdrawal of the product from fixed roof and floating roof tanks.

B. Exhaust systems

Checking exhaust systems, which may be a large part of the workload of an agency, can be facilitated by the use of the form illustrated in Figure 6.21. It may be used in either the balanced duct calculation method or the blast gate calculation method for evaluating exhaust systems. The precalculated values shown in Figure 6.22 are an additional aid in these computations. This form may be modified slightly for use in calculating the pressure drop in a system at temperatures above ambient by the addition of a column for velocity pressure at the higher temperature.

APPL. NO.	DATE
PROCESSED BY	CHECKED BY
TANK NO.	

PROCESSING SHEET-FIXED AND FLOATING ROOF TANKS

GENERAL DATA

1. PRODUCT ______
2. REID VAPOR PRESSURE ______
3. AVG. STORAGE TEMP. °F ______
4. TRUE VAPOR PRESSURE, PSIA (P) ______
5. TANK DIAMETER, FT. (D) ______
6. DENSITY OF COND. VAPORS, LBS/BBL (W) ______

FIXED ROOF TANK DATA

1. AVG. OUTAGE, FT. (H) ______
2. AVG. DAILY TEMP. CHANGE, °F (T) ______
3. PAINT FACTOR (F_P) ______
4. THROUGHPUT, BBL/DAY (V) ______
5. TURNOVERS PER YEAR ______
6. TURNOVER FACTOR (K_T) ______
7. ADJUSTMENT FACTOR FOR SMALL TANKS (C) ______
8. CRUDE OIL FACTOR (BREATHING) (K_C) ______
9. CRUDE OIL FACTOR (FILLING) (K_{FC}) ______

FLOATING ROOF TANK DATA

1. TYPE F. R. SEAL ______
2. SHELL CONSTRUCTION ______
3. TANK TYPE FACTOR (K_T) ______
4. AVG. WIND VELOCITY, MPH (V_W) ______
5. SEAL CONDITION FACTOR (K_S) ______
6. CRUDE OIL FACTOR (K_C) ______
7. PAINT FACTOR (K_P) ______
8. CLINGAGE FACTOR (C) ______
9. THROUGHPUT, BBL/DAY (V) ______

A. LOSSES FROM FIXED ROOF TANKS

1. BREATHING LOSS: $B=\left(\frac{24}{1000}\right)\left(\frac{P}{14.7-P}\right)^{.68} D^{1.73} H^{.51} T^{.5} F_P\, C\, K_C \times \frac{W}{365}$ - LBS/DAY

   B = ______ = ______ LBS/DAY

   OR FROM NOMOGRAPH: $B=\frac{BBL}{YR}\times\frac{W}{365}=$ = ______ LBS/DAY

2. FILLING LOSS: $F=\frac{3PV}{10,000} K_T K_{FC} W$ = LBS/DAY

   F = ______ = ______ LBS/DAY

   OR FROM NOMOGRAPH: $F=\frac{BBL}{YR}\times\frac{W}{365}=$ = ______ LBS/DAY

3. TOTAL FIXED ROOF LOSSES = BREATHING LOSS + FILLING LOSS = ______ LBS/DAY

B. LOSSES FROM FLOATING ROOF TANKS

1. EVAPORATION LOSS: $E=K_T D^{1.5}\left(\frac{P}{14.7-P}\right)^{.7} V_W^{.7} K_S K_C K_P \times \frac{W}{365}$ = LBS/DAY

   E = ______ = ______ LBS/DAY

   OR FROM NOMOGRAPH: $B=\frac{BBL}{YR}\times\frac{W}{365}=$ = ______ LBS/DAY

2. WITHDRAWAL LOSS: $L=(.0224)\frac{CVW}{D}$ = LBS/DAY = = ______ LBS/DAY

3. TOTAL FLOATING ROOF LOSSES = EVAPORATION LOSS + WITHDRAWAL LOSS = ______ LBS/DAY

C. NET CHANGE IN LOSSES

1. TOTAL FIXED ROOF LOSSES MINUS TOTAL FLOATING ROOF LOSSES = ______ LBS/DAY

DECREASE ☐ INCREASE ☐ NO CHANGE ☐

50D53 R62-8

Figure 6.20. Processing form for gasoline storage tanks

NEW YORK STATE DEPARTMENT OF LABOR – DIVISION OF INDUSTRIAL HYGIENE

RESISTANCE CALCULATIONS

PLAN NO. FIRM DATE

A	B	C	D	E	F	G	H	J	K	L	M	N	P	Q	R	S	T	U
		Plate 134		Vol. / Area	$\left(\frac{\text{Vel.}}{4000}\right)^2$		Plate 134		Plate 134	J X K	H + L	Plate 134	$\frac{M}{M}$ X F		HOOD LOSS (Q) plus 1 VP (F)	P + R		
No. of br. or main	PIPE DIA. in inches	AREA PIPE in sq. ft.	AIR VOL. in C.F.M.	AIR VEL. in F.P.M.	V.P. in inches of water	Pipe Length		Elbows			TOTAL LENGTH in equiv't. dia's.	NO. DIA'S. FOR ONE V.P. LOSS	Resistance in inches of H_2O				At Junction	
						in feet	in equiv't. dia's.	NO. OF EL'S.	EQUIV'T. DIA'S. PER EL.	TOTAL LENGTH OF EL'S. in eq'v't. dia's.			PIPE	HOOD LOSS	HOOD SUCT.	TOTAL RESIS.	GOV. S.P.	Corrected C.F.M.

Remarks: ______

IH–214 (11–59)

Figure 6.21. Processing form for exhaust systems

RESISTANCE AND AIR FLOW THROUGH DUCTS AND ELBOWS

Duct Size D In.	D^2 In.^{2}	Duct Area In.^{2}	Duct Area Ft.^{2}	Factor Ft. to Equiv. Diams.	Equiv. Diam. for 90°L	Equiv. Diam. for 45°L	Diam. Per VP 2000-3000 LFM	Diam. Per VP 3000-4500 LFM	CFM at 2000 LFM	CFM at 4000 LFM	CFM at 4500 LFM
2	4	3.142	.0218	6	9	5	40	45	43.6	87.2	98.1
2½	6¼	4.909	.0341	4.8	9	5	40	45	68.2	136.4	153.5
3	9	7.069	.0491	4	10	5	40	45	98.2	196.4	221.0
3½	12¼	9.621	.0668	3.43	10	5	45	45	133.6	267.2	300.6
4	16	12.57	.0872	3	10	5	45	45	174.4	348.8	392.4
4½	20¼	15.90	.1104	2.67	10	5	45	45	220.0	440.0	497.0
5	25	19.64	.1364	2.40	10	5	45	50	272.0	544.0	614.0
5½	30¼	23.76	.1650	2.18	11	6	45	50	330.0	660.0	742.5
6	36	28.27	.1964	2	11	6	50	50	393.0	786.0	884.5
6½	42¼	33.18	.2304	1.85	11	6	50	50	460.0	920.0	1035.0
7	49	38.49	.2673	1.71	11	6	50	50	534.0	1068.0	1201.5
7½	56¼	44.18	.3068	1.6	11	6	50	55	614.0	1228.0	1381.5
8	64	50.27	.3491	1.5	12	6	50	55	698.0	1396.0	1570.5
8½	72¼	56.75	.3942	1.41	12	6	50	55	788.0	1576.0	1773.0
9	81	63.62	.4418	1.33	12	6	55	55	884.0	1768.0	1989.0
9½	90¼	70.88	.4923	1.27	12	6	55	55	984.0	1968.0	2218.0
10	100	78.54	.5454	1.2	12	6	55	55	1090.0	2180.0	2457.0
11	121	95.03	.6600	1.09	12	6	55	55	1320.0	2640.0	2970.0
12	144	113.1	.7854	1	12	6	55	60	1570.0	3140.0	3532.5
13	169	132.7	.9218	.924	13	7	55	60	1844.0	3687.0	4148.1
14	196	153.9	1.069	.857	13	7	55	60	2138.0	4276.0	4810.5
15	225	176.7	1.227	.800	13	7	55	60	2454.0	4908.0	5521.5
16	256	201.1	1.396	.750	13	7	60	60	2792.0	5584.0	6282.0
17	289	227.0	1.576	.706	13	7	60	60	3152.0	6304.0	7092.0
18	324	254.5	1.767	.667	13	7	60	65	3534.0	7068.0	7951.5
19	361	283.5	1.969	.632	14	7	60	65	3938.0	7876.0	8860.5
20	400	314.2	2.182	.600	14	7	60	65	4364.0	8728.0	9819.0
21	441	346.4	2.405	.572	14	7	60	65	4810.0	9620.0	10823
22	484	380.1	2.640	.545	14	7	60	65	5280.0	10560	11882
23	529	415.5	2.885	.522	14	7	60	65	5770.0	11540	12983
24	576	452.4	3.142	.50	14	7	60	65	6284.0	12568	14139
25	625	490.9	3.409	.48	14	7	60	65	6818.0	13636	15340
26	676	530.9	3.687	.462	14	7	65	65	7374.0	14748	16592
27	729	572.6	3.976	.444	14	7	65	65	7952.0	15904	17892
28	784	615.8	4.276	.429	14	7	65	70	8552.0	17104	19242
29	841	660.5	4.587	.414	15	8	65	70	9174.0	18348	20642
30	900	706.9	4.909	.400	15	8	65	70	9818.0	19636	22091
31	961	754.8	5.241	.387	15	8	65	70	10482	20964	23585
32	1024	804.3	5.585	.375	15	8	65	70	11170	22340	25133
33	1089	855.3	5.940	.364	15	8	65	70	11880	23760	26730
34	1156	907.9	6.305	.353	15	8	65	70	12610	25220	28373
35	1225	962.1	6.681	.343	15	8	65	70	13362	26724	30065
36	1296	1018	7.069	.333	15	8	70	70	14138	28276	31811

NEW YORK STATE DEPARTMENT OF LABOR
DIVISION OF INDUSTRIAL HYGIENE-ENGINEERING UNIT
80 CENTRE STREET-NEW YORK 13, N.Y.

8/62 PLATE NO. 134

Figure 6.22. Resistance and air flow values for exhaust systems

C. Industrial processes

The City of New York Department of Air Resources combines the application and permit evaluation forms as shown in Figure 6.23. T? form has been designed for the applicant to provide the pertinent data so that the engineer, in effect, checks the calculations made by the applicant. This procedure has proven to be a useful tool in managing the work of the engineer considering these types of equipment.

In general, the use of forms can increase the cost/effectiveness of the engineering operation by reducing the time for permit applicatio processing, lessening the tendency for numerical errors, and limitin the number of calculation sheets in the permit file.

IV. PROTOTYPE COMPUTER ASSISTED CALCULATION PACKAGE

If an agency has a number of computations that must be made frequently, computer programs can be created to execute these calculations over and over again. Furthermore, several routines may be combined into one package and tied together by means of an executive or control program. The computer program for a prototype of such a system, coded in BASIC, is listed in Figure 6.24. This type of system may be stored on magnetic tape, magnetic disk, paper tape or cards (depending upon the computer system), and activated by the user, as needed. It can be modified to operate on a batch system, a time-sharing system or a mini-computer.

The package in Figure 6.24 was developed to operate on a mini-computer with a teletypewriter. It contains four routines, any of which may be selected for use by the engineer operating the system. The programs included may be described as follows:

- Exhaust system - find the minimum escape velocity and exhaust

APC 5 - PA
Jan. 1969

The City of New York

DEPARTMENT OF AIR RESOURCES
51 Astor Place, New York, N.Y. 10003

ROBERT N. RICKLES, P.E., Commissioner

APPLICATION FOR CERTIFICATE OF OPERATION
INDUSTRIAL PROCESSES

FOR OFFICE USE ONLY

Application No. & Date_______________

Fee_______________

Cashier_______________

New ________ Present Certificate of
Existing____ Operation No. (if any)______

Block ____________ Lot____________

Premises_______________________________ Borough____________
Application for Permission to_______________________________

Owner's or Agent's Name:
Name:_______________
Street:_______________
City, State _______________
for Mailing

I have authorized the P.E. or R.A. named below to file plans and specifications to do the work stated on this application. I have read the entire application and the facts are correct to the best of my knowledge and belief.

==

SIGNATURE OF OWNER OR OFFICER TITLE

Complete technical data, plans, etc., describing the proposed installation, alteration or legalization shall be attached in triplicate to this form.

Authorized Agent:
Name:_______________
Street:_______________
City, State_______________
for Mailing

I certify to the accuracy of all data and state further that the equipment, if installed in accordance with the plans submitted, will comply with the requirements of law.

SEAL OF P.E. or R.A.

SIGNATURE OF P.E. OR R.A.

Building - Type__________No. of Floors__________Equipment on Floor No.__________
Proximity of nearest building from stack Min.___ft. Height above grade___ft. On plot plan show heights of all structures, buildings, etc, within 100 ft. radius of stack. If there are buildings higher than the stack, submit a letter signed by the owner stating that, he will comply with all the requirements of the Department in the event a nuisance is caused by his chimney.==

NO WORK PERMIT WILL BE ISSUED UNLESS INSTALLER IS NAMED. Is Workmen's Comp. & Disability on file with the Dept. of Air Resources? YES______ NO______

I certify that I will make the installation of the equipment as applied for and specified in this application and in accordance with the plans filed and approved by the Commissioner of the Department of Air Resources.

INSTALLER
Name:_______________
Street:_______________
City, State
for Mailing

LICENSE NO. CLASS

SIGNATURE

Figure 6.23. Application form for industrial processes

1. Type of Establishment (product manufactured, process, or service rendered) ____________________
   (e.g., foundry, lighting fixtures, toys, concrete batching, etc)

2. Type of Operation or Process ____________________
   (e.g., woodworking, coating, ovens, process ventilation, etc)
3. Material Processed or Used ____________________ ~~lbs/hr~~ ________
4. Average Hours Operation per Week ____________

5. Burner(s): (a) Process ________ Mfr. ________ Model ________
   (For ovens, driers, kilns, process equipment, etc)
   (b) Afterburners Mfr. ________ Model ________
   Fuel Used (a) Type ________ Quan./hr ________ Btu/hr or gph
   Type ________ Quan./hr ________ Btu/hr or gph
6. Spray Booths and Dip Tanks
   Mfr. ________ Model ________ Frontal Opening Height ________ Width ________

   Single Baffle ____ Triple ____ Filters ____ Water Wash ________ (CHECK ONE)
   Handgun ___ Automatic ______ Air Atomizing ___ Airless ___ Electrostatic ___

   Dip Tank Mfr. ________ Model ________
   Tank Dimensions: Height ________ Width ________ Length ________

   Coating Material (Paint, Lacquer, etc)

   Type of stock used ________ (Max. Gallons per 8 hours) ________
   % Solvents Type(s) ________ (Max. Gallons per hour) ________
   % Resins Type(s) ________
   % Solids and Pigments Type(s) ________
   Are coatings as used classified as odor free? YES ____ NO ____
7. Exhaust System
   a) Fan Mfr. ________ Size and Model ________
   b) Operating conditions CFM ________ H.P. ____ Temp. ____ Fan R.P.M. ________
8. Gas Cleaner or Treatment Device
   Type ________ Mfr. ________ Model ________
   Design CFM normal ________, Gas Temp. (F) Normal ________ Max. ________
   Operating CFM normal ________, Gas Temp. (F) Inlet ________ Outlet ________
   CFM maximum ________, Gas Temp. (F) Inlet ________ Outlet ________
   Overall cleaning or treatment efficiency ________ %
   Loading at operating conditions (gr/cu ft) Inlet ________ Exit ________
   Actual emissions (with cleaner or treatment device ________ Lbs/hr

9. Emission Rate Potential ________ Lbs/hr

10. Actual Particulate Emissions

Type	Quantity (lb/hr)	(lb/1000 lb Undiluted Exhaust Gas)

Gaseous contaminants in emission stream

Type	Quantity (lb/hr)	Stack Concentration PPM

11. Industrial or Environmental Rating ________ Control Apparatus Rating ________

12. Expected Date of Completion ________________

Figure 6.23. Application form for industrial processes (continued)

```
10 REM--THIS IS A SAMPLE PERMIT EVALUATION PACKAGE (PEP)
20 REM--WRITTEN IN BASIC AND CONTAINING FOUR SAMPLE ROUTINES.
30 REM
40 REM
50 PRINT "THE FOLLOWING ROUTINES MAY BE SELECTED FOR USE:"
60 PRINT
80 PRINT "1  EXHAUST SYSTEM--FIND THE MINIMUM ESCAPE VELOCITY"
90 PRINT "   AND EXHAUST RATE TO PREVENT LEAKAGE FROM A HOOD."
100 PRINT
110 PRINT "2  SINGLE STAGE ELECTRICAL PRECIPITATOR--FIND"
120 PRINT "   COLLECTION EFFICIENCY AND DUST LOSS FOR UNIFORM"
130 PRINT "   GAS VELOCITY AND PEAK VELOCITY."
140 PRINT
150 PRINT "3  AFTERBURNER--DETERMINE THE DESIGN FEATURES OF A"
160 PRINT "   DIRECT FLAME AFTERBURNER TO INCINERATE CONTAMINATED"
170 PRINT "   GASES?"
180 PRINT
190 PRINT "4  INCINERATOR--DETERMINE AN INCINERATOR STACK HEIGHT"
200 PRINT "   TO BURN PAPER."
400 PRINT
410 PRINT
420 PRINT
430 PRINT "INPUT THE NUMBER OF THE PROGRAM DESIRED OR 100 TO"
440 PRINT "QUIT."
450 INPUT N
460 IF N=1 GOTO 600
470 IF N=2 GOTO 900
480 IF N=3 GOTO 1500
490 IF N=4 GOTO 2000
500 IF N=100 GOTO 5000
510 GOTO 430
520 REM
530 REM
600 PRINT
610 PRINT
620 PRINT "ENTER E1, E2, E3, E4, E5, E6 TO FIND ESCAPE VELOCITY"
630 PRINT "      AND EXHAUST RATE FOR A HOOD."
640 PRINT
650 INPUT E1, E2, E3, E4, E5, E6
660 PRINT
670 LET Q1 = E1*E2/60
680 LET Q2 = (E4*Q1)/(E3*(460.+E5))
```

Figure 6.24. Program listing - computer assisted calculated package.

```
690 LET V1 = 200.*Q2 ↑ (1./3.)
700 LET V2 = V1*E3
710 LET V3 = Q1/(V2*.075*.24)+E6
720 PRINT "RATE OF HEAT GENERATION = ";Q1;" BTU/MIN."
730 PRINT "ESCAPE VELOCITY THRU LEAKAGE ORIFICE = ";V1;" FPM"
740 PRINT "EXHAUST RATE = ";V2;" CFM"
750 PRINT "MEAN HOOD TEMPERATURE = ";V3;" FARH."
760 GOTO 400
770 REM
780 REM
790 REM
900 PRINT
910 PRINT
920 PRINT "ENTER P1, P2, P3, P4, P5 TO FIND THE COLLECTION EFFICIENCY"
930 PRINT "      AND DUST LOSS FOR A TWO DUCT SINGLE STAGE"
940 PRINT "      ELECTRICAL PRECIPITATOR WITH A UNIFORM GAS VELOCITY."
950 PRINT
960 INPUT P1, P2, P3, P4, P5
970 PRINT
980 LET A1 = 2.*P1*P2
990 LET A2 = P3/120.
1000 LET A3 = (1.-1./2.71828↑(P5*A1/A2))
1002 LET A9 = 100.*A3
1010 LET A4 = ((1.-A3)*(7200.*A2*P4))/7000
1020 PRINT "PLATE AREA OF EACH DUCT = ":A1;" SQ. FT."
1030 PRINT "FLOW RATE PER DUCT = ";A2;" CUBIC FT./SEC."
1040 PRINT "COLLECTION EFFICIENCY = ";A9;" PERCENT"
1050 PRINT "LOSS OF DUST = ";A4;" LBS. HR."
1060 PRINT
1070 PRINT "ENTER 1 TO FIND PEAK VELOCITY OR ANOTHER NUMBER"
1080 PRINT "      TO RETURN TO CONTROL."
1090 PRINT
1100 INPUT K
1110 IF K<>1 GOTO 400
1120 PRINT
1130 PRINT "ENTER PERCENTAGES TOTALING 100 OF THE TWO DUCTS, P6, P7."
1140 INPUT P6, P7
1150 PRINT
1160 LET F1 = P6/100
1170 LET F2 = P7/100
1180 LET F3 = F1*P3
1190 LET F4 = F2*P3
```

Figure 6.24. Program listing - computer assisted calculated package (continue

```
1200 LET R1 = F3/60.
1210 LET R2 = F4/60.
1220 LET R3 = (1.-1./2.71828 ↑ (P5*A1/R1))
1222 LET R9 = 100.*R3
1230 LET R4 = (1.-1./2.71828 ↑ (P5*A1/R2))
1232 LET R8 = 100.*R4
1240 LET R5 = ((1.-R3)*(F3*P4*A2*2.))/7000.
1250 LET R6 = ((1.-R4)*(F4*P4*A2*2.))/7000.
1260 PRINT
1270 PRINT "FLOW RATE OF DUCT 1 = ";R1;" CUBIC FT./SEC."
1280 PRINT "COLLECTION EFFICIENCY OF DUCT 1 = ";R9;" PERCENT"
1290 PRINT "LOSS OF DUST FROM DUCT 1 = ";R5;" LBS./HR."
1300 PRINT
1310 PRINT "FLOW RATE OF DUCT 2 = ";R2;" CUBIC FT./SEC."
1320 PRINT "COLLECTION EFFICIENCY OF DUCT 2 = ";R8;" PERCENT"
1330 PRINT "LOSS OF DUST FROM DUCT 2 = ";R6;" LBS./HR."
1340 GOTO 400
1350 REM
1360 REM
1370 REM
1500 PRINT
1510 PRINT
1520 PRINT "ENTER D1,D2,D3,D4,D5,D6,D7,D8,D9 TO DETERMINE THE"
1530 PRINT "      DESIGN FEATURES OF A DIRECT FLAME AFTERBURNER"
1540 PRINT "      TO INCINERATE CONTAMINATED GASES."
1550 PRINT
1560 INPUT D1,D2,D3,D4,D5,D6,D7,D8,D9
1570 PRINT
1580 LET H1 = 6.0*D1/13.1
1590 LET H2 = H1*(D4-D3)
1600 LET H3 = .1*H2
1610 LET H4 = H2+H3
1620 LET H5 = H4/D5
1630 LET G3 = (H5*D6*(D2+460.))/1872000.
1640 LET G4 = (D1*(D2+460.))/31200
1650 LET G5 = G3+G4
1660 LET S4 = 2.*SQR(G5/(D7*3.14159))
1670 LET S5 = 2.*SQR(G5/(D8*3.14159))
1680 LET S6 = S5*D9
1690 LET S7 = S6/D8
```

Figure 6.24. Program listing - computer assisted calculated package (continued)

```
1700 PRINT
1710 PRINT
1720 PRINT "MASS FLOW RATE OF CONTAMINATED GASES = ";H1;" LBS./HR."
1730 PRINT "HEAT REQUIRED = ";H2;" BTU/HR."
1740 PRINT "HEAT LOSSES = ";H3;" BTU/HR."
1750 PRINT "TOTAL HEAT REQUIRED = ";H4;" BTU/HR."
1760 PRINT "REQ. NATURAL GAS FOR BURNER = ";H5;" CUBIC FT./HR."
1770 PRINT "VOL. RATE OF GAS BURNER COMB. = ";G3;" CUBIC FT./SEC."
1780 PRINT "VOL. RATE OF CONTAM. GASES = ";G4;" CUBIC FT./SEC."
1790 PRINT "TOTAL VOL. RATE OF GASES = ";G5;" CUBIC FT./SEC."
1800 PRINT "DIAM. OF AFTERBURNER THROAT = ";S4;" FT."
1810 PRINT "DIAM. OF COMBUSTION CHAMBER = ";S6;" FT."
1820 PRINT "LENGTH OF COMBUSTION CHAMBER = ";S6;" FT."
1830 PRINT "RETENTION TIME OF GASES IN CHAMBER = ";S7;" SEC."
1840 GOTO 400
1850 REM
1860 REM
1870 REM
2000 PRINT
2010 PRINT
2020 PRINT "ENTER B1,B2,B3 TO DETERMINE THE STACK HEIGHT OF A"
2030 PRINT "      PAPER BURNING INCINERATOR."
2040 PRINT
2050 INPUT B1,B2,B3
2060 PRINT
2070 LET W1 = B1/(7.644*(1./(460.+B2)-1./(460.+B3)))
2080 PRINT "INCINERATOR STACK HEIGHT = ";W1;" FT."
2090 GOTO 400
2100 REM
2110 REM
2120 REM
5000 STOP
5010 END
```

Figure 6.24. Program listing - computer assisted calculated package (continued)

rate to prevent leakage from a hood;

- Single stage electrical precipitator--find collection efficiency and dust loss for uniform gas velocity and peak velocity;
- Afterburner--determine the design features of a direct flame afterburner to incinerate contaminated gases; and
- Incinerator--determine an incinerator stack height to burn paper.

Figure 6.25 contains the inputs with the appropriate units, necessary for each of the above to operate correctly. A flowchart of the system appears in Figure 6.26. The interactive execution of this system is demonstrated in Figure 6.27.

COMPUTER ASSISTED CALCULATED PACKAGE

1) EXHAUST SYSTEM

E1	Fuel Use Rate	Gal/Hr
E2	Heating Value	BTU/Gal
E3	Total Open Area of Orifice	Sq Ft
E4	Vertical Distance Above the Hood Face	Ft
E5	Average Temperature of Air Inside the Hood	Deg Fah
E6	Average Temperature of the Ambient Air	Deg Fah

2) SINGLE STAGE ELECTRICAL PRECIPITATOR

P1	Length of the Plates	Ft
P2	Width of the Plates	Ft
P3	Velocity of the gas through the ducts	CFM
P4	Grains of Dust per cubic foot	
P5	Drift Velocity	FPS
*P6	Percentage of Gas Through Duct 1	
*P7	Percentage of Gas Through Duct 2	

* Only if peak velocity option selected

3) AFTERBURNER

D1	Rate of Discharge of Contaminated Gases	CFM
D2	Required Incineration Temperate of Gases	Fah
D3	Enthalpy of Gas at Discharge Temperatures	BTU/Lb
D4	Enthalpy of Gas at Incineration Temp.	BTU/Lb
D5	Heat available at incineration temp. from burning one cubic foot of natural gas with theoretical air	BTU/Ft^3
D6	Products of Combustion per cubic foot of natural gas with theoretical air	Ft^3
D7	Throat Velocity	Ft/Sec
D8	Combustion Chamber Velocity	Ft/Sec
D9	Ratio of Afterburner Combustion Chamber Length to Diameter	

4) INCINERATOR

B1	Water Column Draft	Inches
B2	Ambient Temperature	Fah
B3	Stack Temperature	Fah

Figure 6.25. Input sheet for prototype system

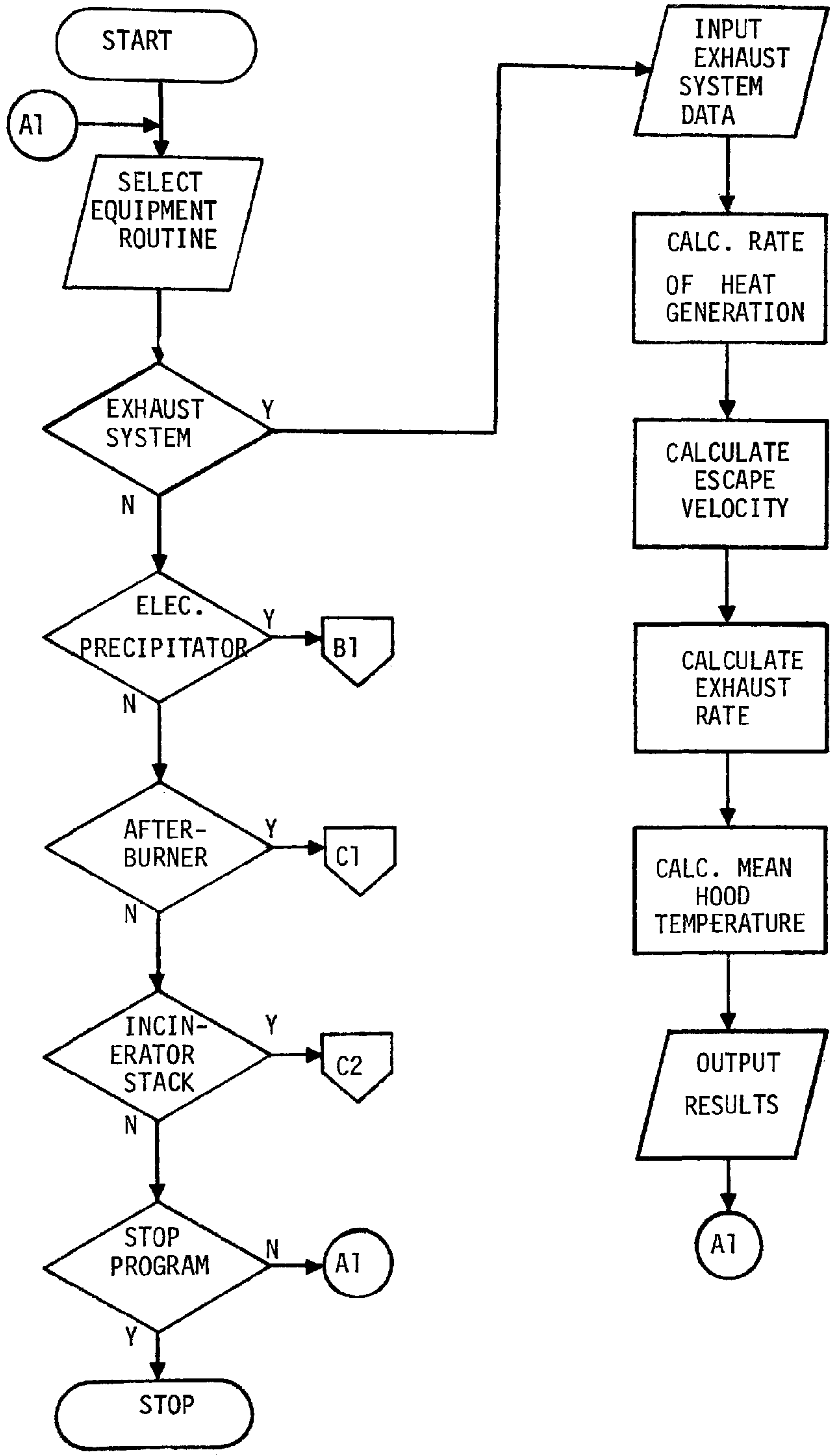


Figure 6.26. Flowchart - computer assisted calculated package.

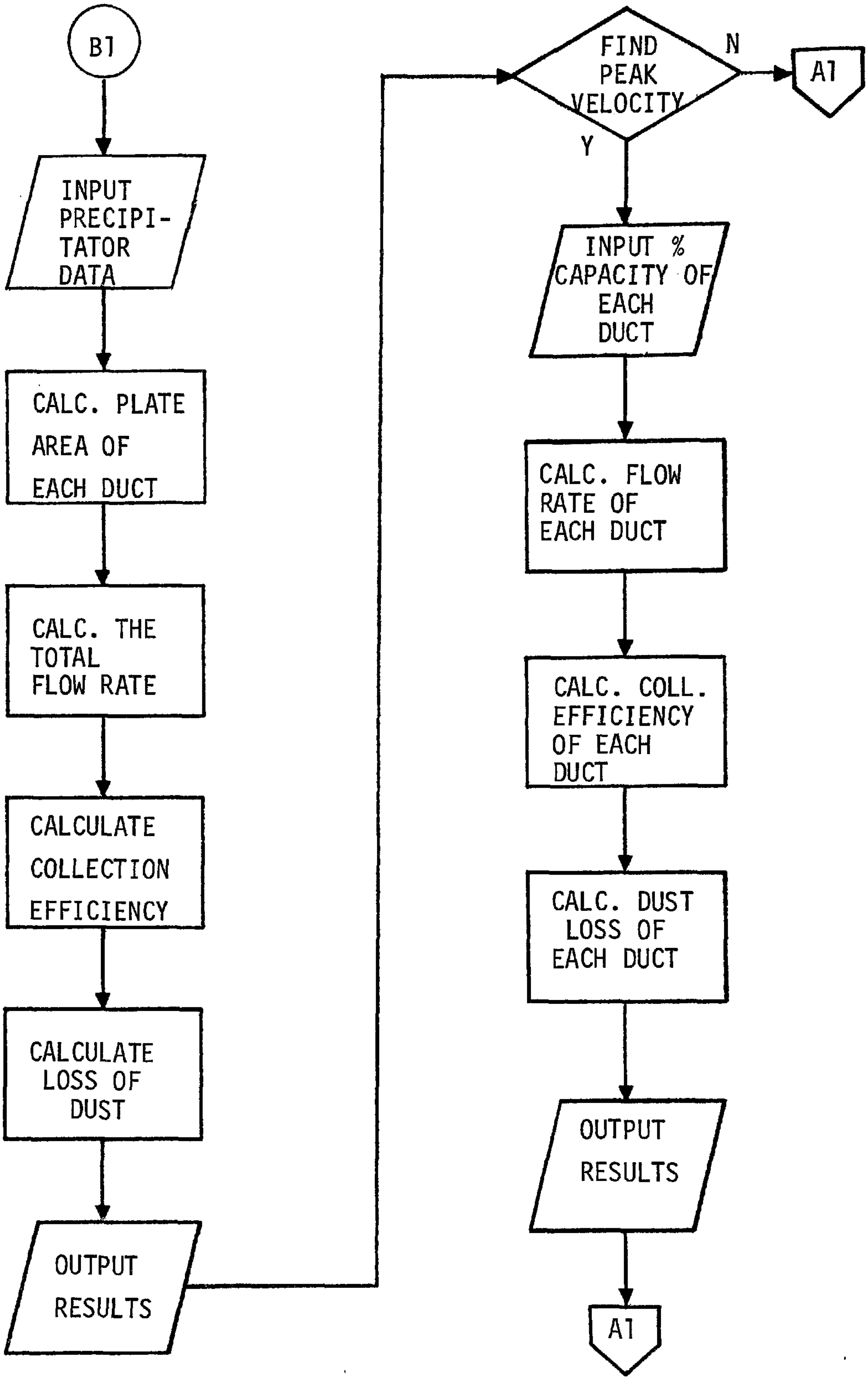


Figure 6.26. Flowchart - computer assisted calculated package (continued).

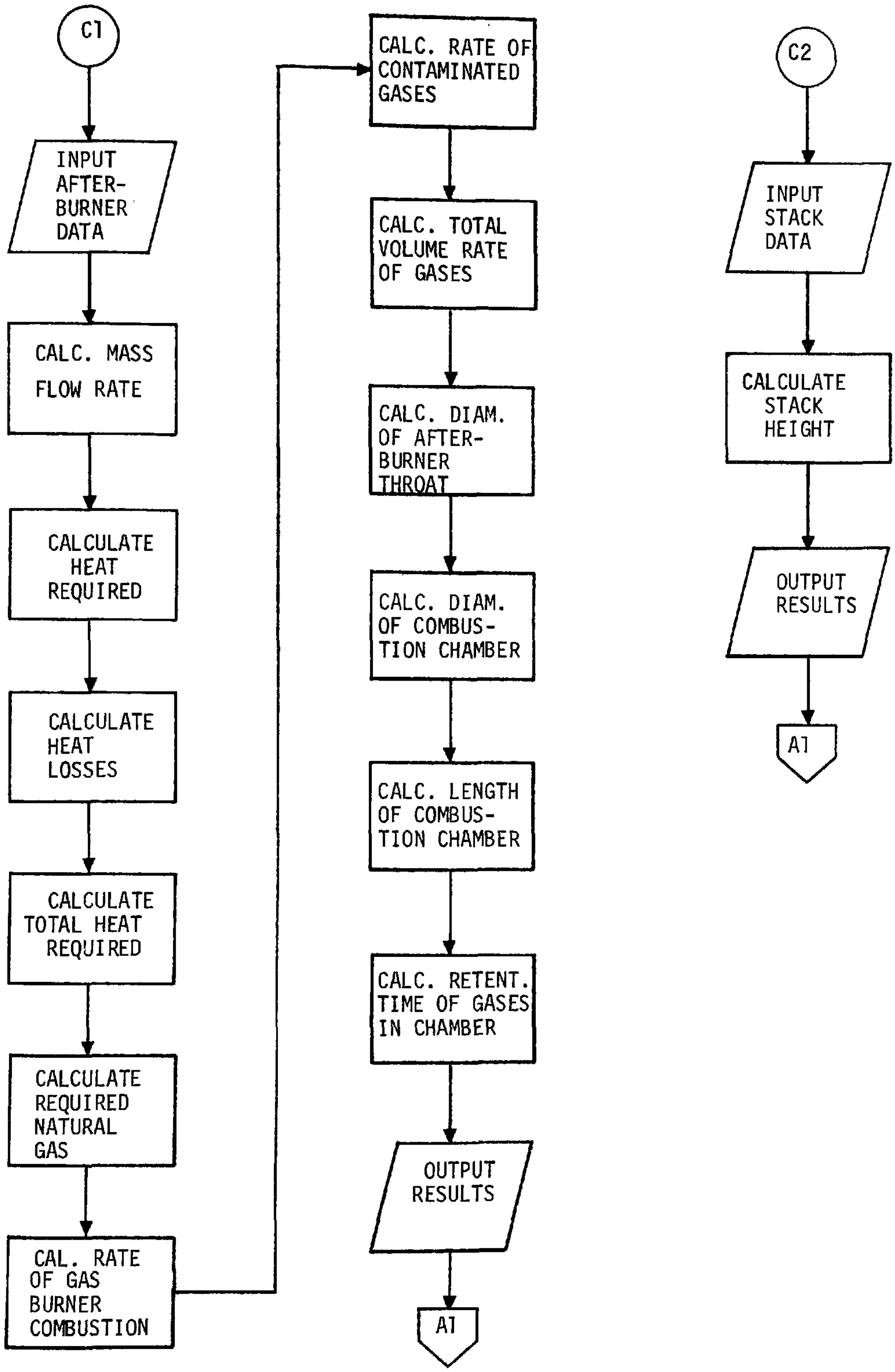


Figure 6.26. Flowchart - computer assisted calculated package (continued).

```
PDP-11 BASIC, VERSION 007A

*0
READY
OLD
READY
RUN
THE FOLLOWING ROUTINES MAY BE SELECTED FOR USE:

1   EXHAUST SYSTEM--FIND THE MINIMUM ESCAPE VELOCITY
    AND EXHAUST RATE TO PREVENT LEAKAGE FROM A HOOD.

2   SINGLE STAGE ELECTRICAL PRECIPITATOR--FIND
    COLLECTION EFFICIENCY AND DUST LOSS FOR UNIFORM
    GAS VELOCITY AND PEAK VELOCITY.

3   AFTERBURNER--DETERMINE THE DESIGN FEATURES OF A
    DIRECT FLAME AFTERBURNER TO INCINERATE CONTAMINATED
    GASES.

4   INCINERATOR--DETERMINE AN INCINERATOR STACK HEIGHT
    TO BURN PAPER.

INPUT THE NUMBER OF THE PROGRAM DESIRED OR 100 to
QUIT.
 ?2

ENTER P1,P2,P3,P4,P5 TO FIND THE COLLECTION EFFICIENCY
     AND DUST LOSS FOR A TWO DUCT SINGLE STAGE
     ELECTRICAL PRECIPITATOR WITH A UNIFORM GAS VELOCITY.

?12,8,3600,2,.38

PLATE AREA OF EACH DUCT = 192 SQ. FT.
FLOW RATE PER DUCT = 30 CUBIC FT./SEC.
COLLECTION EFFICIENCY = 91.21389 PERCENT
LOSS OF DUST = 5.422284 LBS. HR.

ENTER 1 TO FIND PEAK VELOCITY OR ANOTHER NUMBER
     TO RETURN TO CONTROL.

?1

ENTER PERCENTAGES TOTALING 100 OF THE TWO DUCTS, P6,P7.
?75,25
```

Figure 6.27. Prototype equipment evaluation package

```
FLOW RATE OF DUCT 1 = 45 CUBIC FT./SEC.
COLLECTION EFFICIENCY OF DUCT 1 = 80.23648 PERCENT
LOSS OF DUST FROM DUCT 1 = 9.147688 LBS./HR

FLOW RATE OF DUCT 2 = 15 CUBIC FT./SEC.
COLLECTION EFFICIENCY OF DUCT 2 = 99.22804 PERCENT
LOSS OF DUST FROM DUCT 2 = .1191019 LBS./HR.

INPUT THE NUMBER OF THE PROGRAM DESIRED OR 100 TO
QUIT.
?2

ENTER P1,P2,P3,P4,P5 TO FIND THE COLLECTION EFFICIENCY
     AND DUST LOSS FOR A TWO DUCT SINGLE STAGE
     ELECTRICAL PRECIPITATOR WITH A UNIFORM GAS VELOCITY.

?12,8,3600,2,.38

PLATE AREA OF EACH DUCT = 192 SQ. FT.
FLOW RATE PER DUCT = 30 CUBIC FT./SEC.
COLLECTION EFFICIENCY = 91.21389 PERCENT
LOSS OF DUST = 5.422284 LBS. HR.

ENTER 1 TO FIND PEAK VELOCITY OR ANOTHER NUMBER
     TO RETURN TO CONTROL.

?6

INPUT THE NUMBER OF THE PROGRAM DESIRED OR 100 TO
QUIT.
?4

ENTER B1,B2,B3 TO DETERMINE THE STACK HEIGHT OF A
     PAPER BURNING INCINERATOR.

?.17,60,900

INCINERATOR STACK HEIGHT = 18.72368 FT.

INPUT THE NUMBER OF THE PROGRAM DESIRED OR 100 TO
QUIT.
?1

ENTER E1,E2,E3,E4,E5,E6 TO FIND ESCAPE VELOCITY
     AND EXHAUST RATE FOR A HOOD.

?30,140000,141,11,150,80
```

Figure 6.27. Prototype equipment evaluation package (continued)

```
RATE OF HEAT GENERATION = 70000 BTU/MIN.
ESCAPE VELOCITY THRU LEAKAGE ORIFICE = 415.2828 FPM
EXHAUST RATE = 58554.87 CFM
MEAN HOOD TEMPERATURE = 146.4144 FAH.

INPUT THE NUMBER OF THE PROGRAM DESIRED OR 100 TO
QUIT.
 ?3

ENTER D1,D2,D3,D4,D5,D6,D7,D8,D9 TO DETERMINE THE
      DESIGN FEATURES OF A DIRECT FLAME AFTERBURNER
      TO INCINERATE CONTAMINATED GASES.

?1000,1200,21.6,287.2,721.3,11.45,20,12,2

MASS FLOW RATE OF CONTAMINATED GASES = 4580.153 LBS./HR.
HEAT REQUIRED = 1216489 BTU/HR.
HEAT LOSSES = 1216489.9 BTU/HR.
TOTAL HEAT REQUIRED = 1338137 BTU/HR.
REQ. NATURAL GAS FOR BURNER = 1855.175 CUBIC FT./HR.
VOL. RATE OF GAS BURNER COMB. = 18.83617 CUBIC FT./SEC.
VOL. RATE OF CONTAM. GASES = 53.20513 CUBIC FT./SEC.
TOTAL VOL. RATE OF GASES = 72.04129 CUBIC FT./SEC.
DIAM. OF AFTERBURNER THROAT = 2.141564 FT.
DIAM. OF COMBUSTION CHAMBER = 2.764747 FT.
LENGTH OF COMBUSTION CHAMBER = 5.529494 FT.
RETENTION TIME OF GASES IN CHAMBER = .4607911 SEC.

INPUT THE NUMBER OF THE PROGRAM DESIRED OR 100 TO
QUIT.
 ?100

STOP AT LINE 5000
READY
```

Underline indicates
user inputs.

Figure 6.27. Prototype equipment evaluation package (continued)

REFERENCES

1. Personal contact with Tim J. Brawder, Ralph M. Parsons Co. Los Angeles, Calif. April 1972.

2. Engineering Analysis of Emissions Control Technology for Sulfuric Acid Manufacturing Processes, Volume I. USDHEW, PHS, NAPCA. March 1970. Contract CPA 22-69-81.

3. Ibid., p. IV-51.

4. Ibid., p. III-3.

5. Ibid., p. III-9.

6. Control Techniques for Particulate Air Pollution. USDHEW, PHS, CPEHS, Washington D.C. January 1969, p. 72.

7. Cuffe, S.T., R.W. Gerstle, A.A. Orning and C.H. Schwartz. Air Pollution Emissions from Coal-Fired Power Plants, Report No. 2, JAPCA Volume 15, Number 2. February 1965.

8. Steam: Its Generation and Use. The Babcock and Wilcox Company, New York, 37th Edition. 1963, p. 4-1 - 4-12.

9. McGraw, M.J. and R.L. Duprey. Compilation of Air Pollutant Emission Factors. EPA. April 1971 (preliminary document).

10. Ramsdell, R. Design Criteria for Precipitators. Presented at the American Power Conference, April 1968.

11. Oglesby, S., Jr. and G.B. Nichols. A Manual of Electrostatic Precipitator Technology, Part II - Applications Areas. NAPCA, Cincinnati, Ohio. August 1970. Contract CPA 22-69-73.

12. Ibid., p. 370.

13. Ibid., p. 373.

14. Ibid., p. 376.

15. Gadomski, R.R., M.P. David and G. A. Blahut. Evaluation of Emissions and Control Technologies in the Graphic Arts Industries. USDHEW, PHS, NAPCA. August 1970. Contract No. CPA 22-69-72.

16. Ibid., p. 94.

17. Ibid., p. 94.

18. Danielson, J.A. (ed.). Air Pollution Engineering Manual. Cincinnati, USDHEW, PHS. The National Center for Air Pollution Control and the Los Angeles County Air Pollution Control District. PHS No. 999-AP-40. 1967, p. 176.

19. Ibid., p. 176.

20. Ibid., p. 176.

21. Oglesby, op. cit., p. 738.

22. Danielson, op. cit., p. 879.

23. Ibid., p. 871.

24. Oglesby, op. cit., p. 751.

25. Ibid., p. 166.

26. Ibid., p. 746.

27. Jorgensen, R. (ed.). Fan Engineering, 7th Edition. Buffalo Forge Co., Buffalo, New York. April 1970.

28. Danielson, op. cit., p. 47-59.

29. Billings, C.E. and J. Wilder. Handbook of Fabric Filter Technology. USDHEW, NAPCA. December 1970. Contract No. CPA 22-69-38.

30. Federal Register. Volume 36, No. 247. December 23, 1971, p. 24880.

31. Danielson, op. cit., p. 8811.

32. Ibid., p. 328.

33. Air Pollution Control Guidelines for Hot Mix Asphalt Plants. Kentucky Air Pollution Control Commission, Frankfort, Kentucky (unpublished).

34. Danielson, op. cit., p. 337.

35. Billings, op. cit., p. 3-34 and 4-19.

36. Federal Register. Volume 36, No. 158. August 14, 1971, p. 15496.

37. Schwartz, H.E., L.E. Kallan, and A. Stein. Controlling Atmospheric Contaminants in the Smelting and Refining of Copper-Base Alloys. JAPCA, Vol. 5, No. 1. May 1955.

38. Federal Register. Volume 36, No. 158. August 14, 1971, p. 15496.

39. Danielson, op. cit., p. 85-86.

40. Federal Register. Volume 36, No. 158. August 14, 1971, p. 15496.

41. Danielson, op. cit., p. 265.

42. Ibid., p. 882.

43. Ibid.

44. Jorgensen, op. cit., p. 71.

45. Industrial Ventilation. Lansing, Michigan, Committee on Industrial Ventilation, American Conference of Governmental Industrial Hygienists. 1972, p. 6-31 - 6-35.

46. Jorgensen, op. cit., p. 232.

47. Danielson, op. cit., p. 615.

48. Ibid., p. 642.

49. Rules and REgulations of the Los Angeles County Air Pollution Control District. August 31, 1971.

50. Danielson, op. cit., p. 613.

51. Ibid., p. 612.

52. Ibid., p. 614.

53. Ibid., p. 211.

54. Ibid., p. 774.

55. Ibid., p. 175.

56. Bixby, D.W., D.L. Rucker, and S.L. Tisdale. Phosphate Fertilizers Properties and Processes, Technical Bulletin Number 8. The Sulfur Institute, Washington D.C. 1966.

57. Heller, A.N., S.T. Cuffe, and D.R. Goodwin. Inorganic Chemical Industry. In: Air Pollution, Vol. III, A.C. Stern (ed.). New York City, Academic Press, 1968.

58. Personal Contact, Brea Chemical Division of Union Oil Co., Brea, Calif. April 1972.

59. Balakrishnan, S., D.E. Williamson, and R.W. Okey. State of the Art Review on Sludge Incinerator Practice. Advanced Waste Treatement Research Laboratory, Cincinnati, Ohio. April 1970, p. 63. Contract No. 14-12-499.

60. Ibid. p. 99-101.

CHAPTER 7

ENGINEERING INSPECTION OF EQUIPMENT FOR CERTIFICATE TO OPERATE

I. INTRODUCTION

Engineering inspection is the phase of the permit processing cycle in which the equipment is observed in operation and evaluated against agency standards. The product of the inspection is a report of sufficient detail which provides:

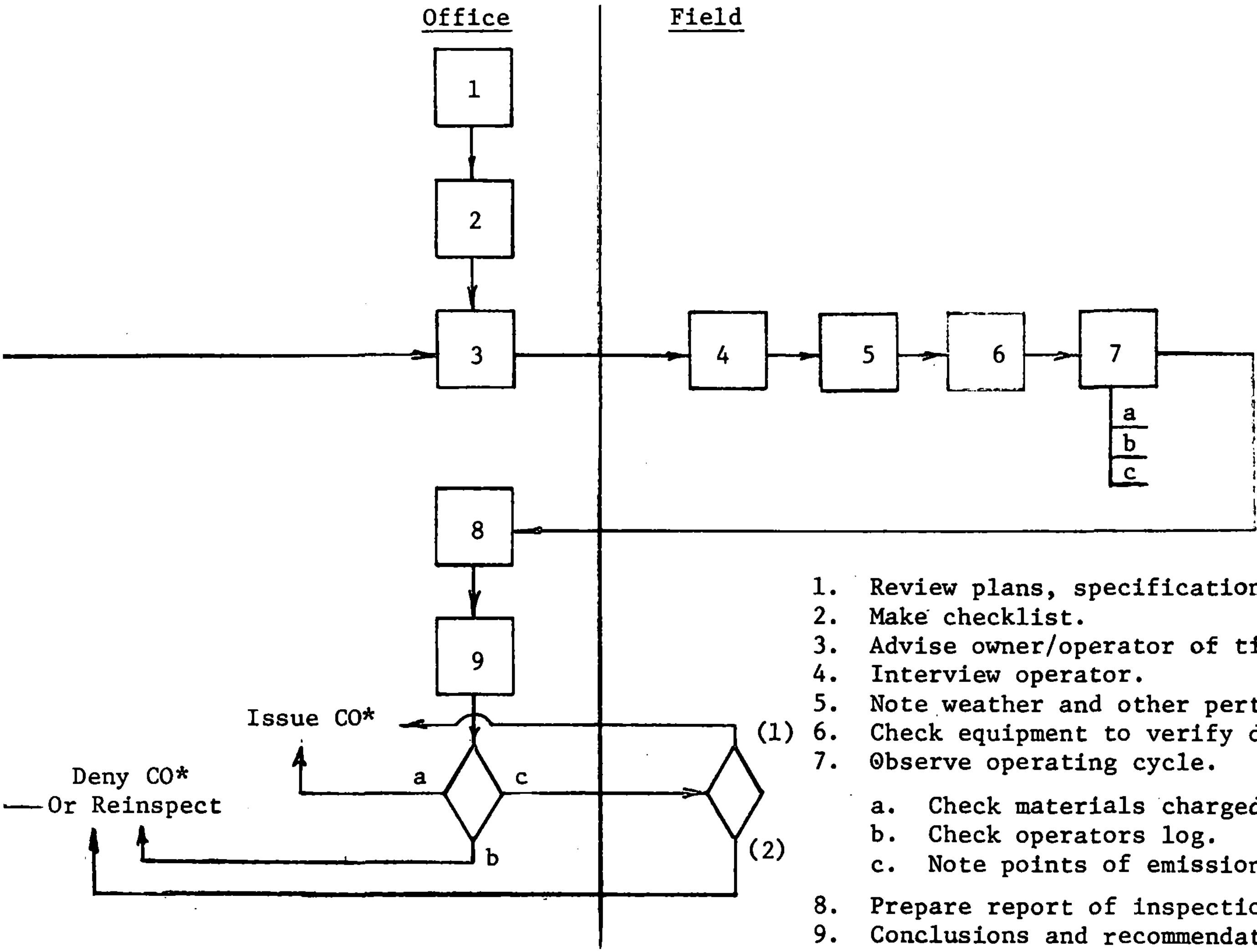
- Data for determining whether or not to issue or deny a certificate to operate.
- Data for determining the need for source testing.
- Verification of data for source registration.
- Verification of data for emissions inventory.
- Data for court or appeals board action.
- Data for inspection personnel to evaluate operating procedures relative to compliance with current standards.
- Data for evaluating possible nuisance problems.
- Verification of operating schedules of equipment.

Experienced personnel may readily observe these details in making a pass/fail evaluation; however, care must be taken to record all pertinent data in the inspection report. Figure 7.1 is a flow diagram depicting the steps of the inspection process.

II. ENGINEERING INSPECTION REPORT

The engineering inspection report for a certificate to operate includes the following:

- Name of the owner/operator.
- Address, UTM grid location and telephone number at the equipment location.



1. Review plans, specifications and evaluation.
2. Make checklist.
3. Advise owner/operator of time of inspection.
4. Interview operator.
5. Note weather and other pertinent local conditions.
6. Check equipment to verify description.
7. Observe operating cycle.
    a. Check materials charged to process.
    b. Check operators log.
    c. Note points of emission and estimate losses.
8. Prepare report of inspection.
9. Conclusions and recommendations.
    a. Pass
    b. Fail; reinspect after system modified
    c. Stack test.
        (1) Pass
        (2) Fail

*CO = Certificate to Operate

Figure 7.1. Flow chart of engineering inspection for certificate to operate

- Description of weather and conditions surrounding source.
- Description of the equipment process.
- Operating schedule:
  1. Hours per day
  2. Shift or hours of the day normally in operation
  3. Days per week
- Quantitative and qualitative description of emissions.
- Description of point(s) of release of emissions.
- Request for source test(s) when indicated.
- Conclusions and recommendations.

To gather this information, the engineer should use as many practical aids as possible. These might include preprinted inspection forms, checklists, photography, and portable sampling or velocity measuring equipment.

A. Preparing for the Inspection

The engineer assigned to inspect a piece of equipment or a process for a certificate to operate may not have handled the application for the permit to construct. In this case, he may not be familiar with special operating conditions or procedures required for acceptable operations. The inspection should always be preceded by a thorough review of the process, plans, specifications and engineering evaluation. The preparation of a checklist containing operating procedures, design features and expected emission points is useful. Checklist items may include:

- Operational procedures.
  1. Batch or continuous process.
  2. Type and quantity of materials charged.
  3. Production rate.
  4. Specific phases of the operation which must be observed.
  5. Sequence of operations.

6. Type and quantity of fuel(s) used.
7. Process conditions such as temperature and pressure.

- Design features.
  1. Process flow diagram.
  2. Materials of construction.
  3. Fan make and model number.
  4. Motor horsepower.
  5. Automatic controls and recorders and their placement.
  6. Seals on doors or vessels.
  7. Safety (pressure relief) system.
- Expected emission points.
  1. Exhaust stack.
  2. Hoods and pickup points.
  3. Doors and ports.
  4. Product discharge points.
  5. Materials loading or charging points.
  6. Fugitive dust.
  7. Vents, relief valves.

B. <u>Basic Information Recorded During the Inspection</u>

The recording of basic information during an inspection is important foı legal as well as engineering considerations. This information will be necessary to establish the prevailing conditions during the inspection in the event that court or appeals board action results from these obseı vations. Therefore, all data which may affect visible and other emissi(and operation of the equipment must be recorded. The information to be noted includes:

- Time and date of inspection including elapsed time.
- Verification of address of premises, telephone number and location of equipment.
- Name and title of company representative contacted. Names of other individuals who may be responsible for the operation of the equipment.

- Normal operating time, including time of day, hours per day, and days per week. (Is this different from the time of inspection?)
- Is there an operations log, what is recorded, and who is responsible for its maintenance?
- Local weather and other conditions which might affect inspection results (estimates should be checked with data from nearest air/ weather monitoring station).
  1. Wind speed and direction.
  2. Estimate of cloud cover in percent.
  3. Temperature.
  4. Relative humidity.
  5. Estimate of visibility.
  6. Precipitation.
  7. Other unusual circumstances such as blowing dust, etc.

C. Description of Equipment

The primary purpose of the equipment description is to identify an installation as the one for which a permit was requested and to determine if the equipment was installed according to the plans submitted with the application for the permit to construct. The essence of the description is to briefly identify the equipment by its function, capacity or throughput, manufacturer and serial number. This description will appear on the certificate to operate.

During the inspection, the engineer should note any significant deviation from the drawings submitted with the application. Discrepancies such as a model number that does not match, a missing hood, or no provisions for stack testing, should be noted on the drawing. (Discrepancies which adversely affect the emissions from the equipment or violate agency standards may be cause to deny the certificate to operate.) It must be emphasized that during the field inspection the engineer must verify the equipment description along with any changes or modifications found during the inspection.

Package units such as boilers, incinerators and spray booths may be described by a generic name, manufacturer and model number. Significan changes or additions to the standard design will take the equipment out of the class of package units, thereby requiring a more detailed description.

Large installations, such as steam generators in power plants, may be described by manufacturer, type of fuel used, standby fuel, and output capacity. For example, the installation may be described as a B&W pulverized coal fired boiler, with liquid ash removal rated at 930,000 pounds per hour of steam at 2170 psi.

D. Process Description and Discussion

If the inspection of the equipment follows the issuance of a permit to construct, a detailed process description is part of the permit file. The engineer verifies the process description during the inspection. If the inspection is being made without benefit of a permit to construct, the engineer writes a complete description from the data gathered during the inspection. A flow diagram should be included whenever there are enough steps in the process to warrant this effort.

The discussion of the process should include the following:

1. An overall statement of the product or function of the equipment or process. For example: A hot mix asphaltic concrete batching plant operating at a capacity of 350,000 lbs/hr.
2. Concise statement of the elements of the process including a flow chart (Figure 7.2).[1]
   a. The sequential or parallel steps of the process.
   b. Nature of the process steps or unit operations such as size reduction, thermal drying, or materials handling.
   c. Comparison of production rates or throughput with design capac

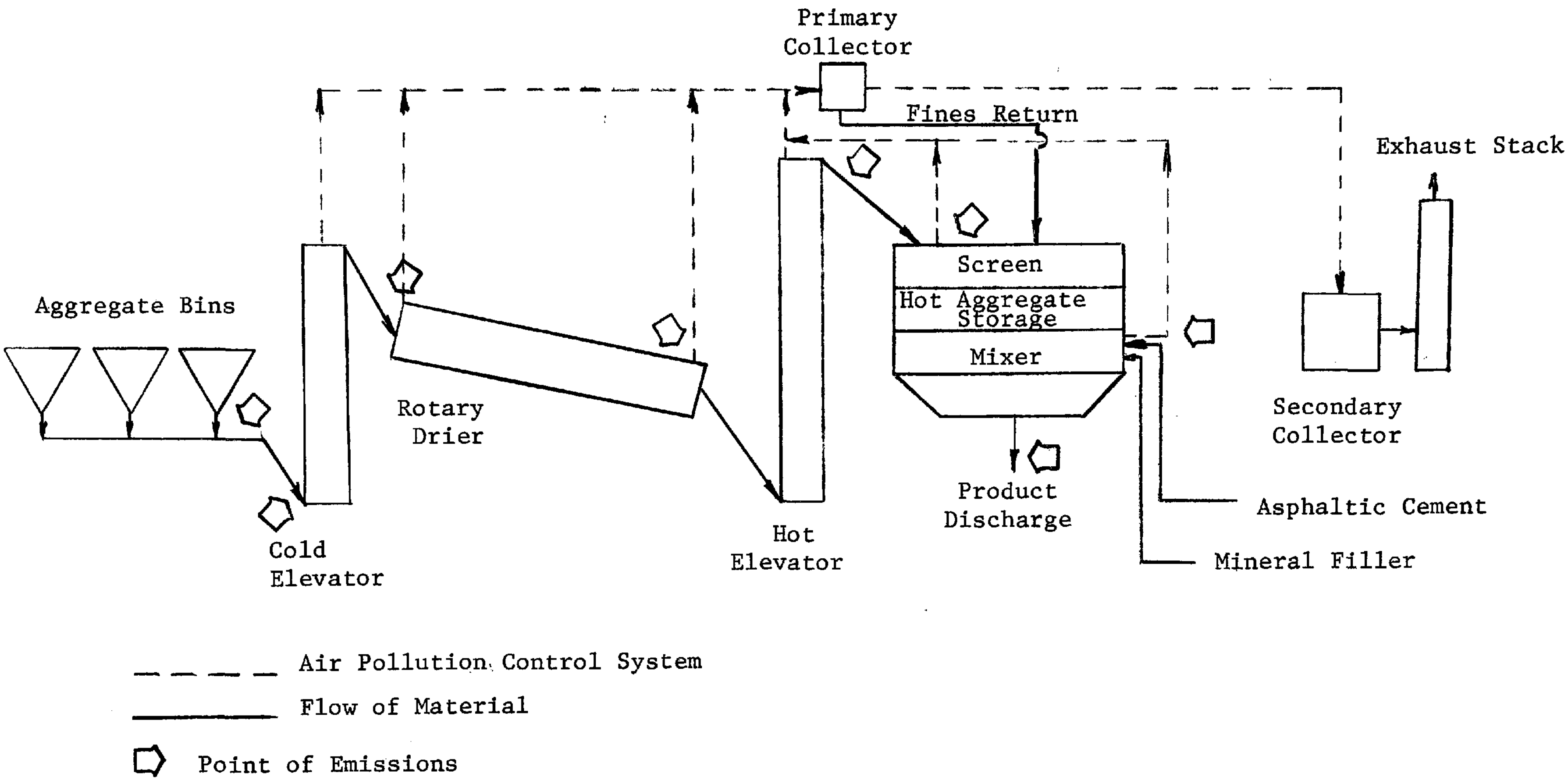


Figure 7.2. Schematic of hot asphalt batch plant

d. Sequence of introduction of materials to the process including the type and quantity of material used.

e. Statement of whether the process is batch or continuous.

f. Air pollution control system description.

(1) Points of emission.

(2) Estimate of effectiveness of the air pollution control syst

(3) Statement regarding apparent maintenance & housekeeping (go

(4) Controls, meters, recording equipment and their function.

g. General comment of the quality of air pollution control at the equipment location.

h. Anticipated effects of the use of standby fuels, e.g., increase production of SO_x, NO_x and particulates.

For example, the following is a description of a hot asphalt batch plan using the foregoing procedure:

1. Aggregate from three storage bins is delivered by a belt conveyor to the boot of a bucket elevator which discharges into an oil fired rotary dryer. Hot gases from the products of combustion flow countercurrent to the flow of the aggregate in the dryer. The aggregate is discharged to the "hot" bucket elevator which deposits it into a holding bin. The bin contains sizing screens, the hot aggregate storage hopper and a pug mill for mixing the aggregate with the asphaltic cement. Filler material can be added to the mixer when required. The asphaltic cement is pumped to the mixer o demand. The finished batch of asphaltic concrete is then discharge to trucks for delivery to the job site.

2. Operations which can cause the emissions of air contaminants are:

a. Materials handling equipment:

(1) belt conveyor

(2) clam shell loader

(3) bucket elevators

b. Screens and classifiers.

c. Rotary drier.

(1) dust

(2) smoke from fuel combustion

d. Disposal of collected dust and fines.

3. Materials charged to the process (worst case), percent by weight for IIb (Asphalt Institute Classification) surface mix:[2]

70%	3/8" (9.51 mm)	Aggregate
20%	No. 4 (4.76 mm)	Aggregate
5%	No. 8 (2.38 mm)	Aggregate
1%	No. 200 (0.074 mm)	Aggregate
4%	Asphalt	

The aggregate is introduced through the vibrating screens to the mixer, the filler and asphalt are introduced at the mixer.

4. This is a batch process. Dried aggregate is collected in hoppers above the mixer and is added to the mixer with the asphaltic cement and filler to form a specified weight of asphaltic concrete; the batch is mixed and discharged to a truck.

5. Dust is generated at the conveyor belt, the boot and head of the bucket elevators, the rotary drier, and the vibrating screens. The dust collection system consists of an exhaust system with pickup points at the boot and head of the cold and hot bucket elevators, the inlet and exit of the rotary drier, and the vibrating screen. There are two dust collectors in series. The primary collector is a cyclone and the secondary collector is a scrubber.

Dust pickup at the elevators was good. The housing surrounding the elevators was tight and in good repair. The gases from the drier were also virtually 100% vented by the exhaust system except for an occasional puff due to a buildup of gas in the drier. The duct work, cyclone and scrubber showed no signs of leakage and the entire system has been properly maintained. The rate of water to tl scrubber (recorded in GPM) is in the acceptable range for the desig air-to-water ratio in the scrubber. The observation of emissions f the scrubber exhaust stack showed no visible dust carryover after t steam plume dissipated. The burners at the rotary drier were those specified and appeared to be clean. The controls are fully automatic (name and model number).

6. The problem of dust from truck traffic has been minimized by paving the main entrance and exit road and by wetting the unpaved areas. Dust appears to settle within plant boundaries.

E. Detail Points of Emissions

During the inspection, the engineer must note all emissions (such as leaks and fugitive dust) which are not readily found in the study of equipment drawings. The following general guidelines describe areas of possible emissions but the engineer must remember that check lists are only guides and are not intended to replace the need for a careful step-by-step inspection of the equipment or process.

1. Dust and fume emissions.

   a. Materials handling equipment.

      (1) Loading

      (2) Dumping

   b. Charging doors or ports.

   c. Discharging doors or ports and pouring operations.

   d. Holding vessels or hearths.

   e. Fugitive dust from disposal of collected materials.

2. Vapors and gases.

   a. Steam leaks from flanges, valves, or other fittings.

   b. Spills.

   c. Odors.

   d. Process charging and discharging.

   e. Vents, relief systems.

An example of reporting points of emissions is found in the description of the hot asphalt batch plant in Section D.

F. Estimate of Emissions and Discussion of Observations

The data gathered during the inspection must include an estimate of the emissions based upon the operating conditions at the time of the inspection. It is mandatory that the observation be made when the equipment is operating under circumstances that will provide the severest test to the air pollution control system. In hot asphalt batching plants this can occur when a mix is run which requires the greatest quantity of fine material; in an electric steel furnace it can take place during an oxygen blow; or in rendering plants it can happen when the cooker is vented to atmosphere for any reason.

Emissions estimates without source testing are subjective. Except for reading opacity and using continuous stack monitors, the engineer must rely upon his experience and training with similar installations to estimate the quantity of contaminants released. The manual, "Compilation of Air Pollution Emission Factors"[3] contains data which can be directly applied to the overall estimate of emissions from many processes. Material balances also give an indication of their magnitude.

The engineer must estimate the efficiency of capture of contaminants at the point of emission and for the system which conveys the pollutants to the air cleaning device. The estimate of emissions therefore fall into two broad categories.

1. Are the emissions captured at the point of generation? An estimate of dust pickup, for example, would state that the indraft at the hood is 95% to 100% effective. This means that there is virtually no dust escaping the hood. If the effectiveness of the hood is decreased because of cross drafts or its location relative to the source, the addition of shrouds or permanent curtains may increase its effectiveness to where the pickup is acceptable.

2. Does the air pollution control system meet the regulations or standa of the control agency? If the basic equipment is operating at the m critical conditions for emitting air contaminants, and the air pollution control system is in full operation, are there visible emissions emanating from the exhaust stack. Unless it is obvious th the emissions from the equipment do not exceed the allowable emissio (say >10% opacity) a source test should be requested.

   There will be instances when the observation of emissions will be all that is necessary to determine if the equipment can meet the agency standards. These may include the inspection of small incinerators or package boilers where the opacity or Ringelmann number of emissions is recorded and a pass/fail decision can be made; grinders, shot blasting, sand blasting, or woodworking equipment venting to a mechanical collector where any visible emission from the collector may be cause for denial of a permit; and paint spray booths where the carryover of pigment is exhausted or solvent odors are noticeable at the property line may be cause for denial. In some of these examples, operational changes such as decreased charging rates for incinerators, use of "lighter oil" for boilers and change in the type of paint used for spraying, may be all that is needed to allow issuance of a certificate to operate.

G. <u>Recommendations for Source Testing</u>

A recommendation for a source test should detail the specific operating conditions under which the equipment is to be tested so that appropriate test procedures may be prepared.[4] Basic instructions for the test should include the points to be tested, anticipated contaminants for which the test is run, accessability of test points (scaffolding), and availability of electric power near the test point. Provisions should be made for portable hoods, or other specialty items where the equipment to be tested does not have an exhaust system. In summary, sufficient data should be made available to the team to avoid surprises during the test. Operating conditions which must be defined are:

1. Basic equipment.

    a. Description of the type, quantity, and rate of material to be processed by the equipment during the test.

    b. Type, quantity and rate of usage of fuel.

    c. Phase of operation during which the source test is to be conducted (for example, chlorine injection in an aluminum furnace) if the process is not continuous.

2. Air Pollution Control System.

    a. Pressure drop across the control device.

    b. For scrubbers - water rate.

    c. For electrostatic precipitators - current and voltage reading, rapping frequency, operating temperature, gas velocity.

    d. For baghouses - shaking frequency.

    e. Duration and frequency of control device downtime, if any, during test.

The air pollution control system must be in operation during the test. If it is desirable, samples may be taken at the inlet to the air pollution control device as well as the outlet to confirm collection efficiencies.

H. Conclusions and Recommendations

The conclusions and recommendations should be a brief statement of the decision reached as a result of the inspection. The options are:

- Recommendation to issue a certificate to operate.
- Recommendation to deny a certificate to operate.
- Recommendation for a source test.
- Recommendation for one or more additional inspections.
- Recommendation for surveillance by field enforcement personnel for a specified time.

The recommendation for approval should include the agency standards which the operation of the equipment must meet (process weight, opacit nuisance, etc.) and any conditions of operation which must be followed to meet the standards (natural gas firing only, specified charging rat etc.). These conditions should be clearly stated on the certificate t operate.

The recommendation for denial of a permit to operate must include the agency standards which the equipment could not meet; specifically, the phases of the operation which were unacceptable.

The recommendation for a source test is covered in Section G above.

The recommendation for additional inspections is usually occasioned by some minor problem in the operation. This may be equipment breakdown or malfunction during the inspection, or inability to observe the part of the operation most critical to air pollution control. In this case the reinspection should be scheduled as soon as possible when all of the conditions can be met.

The recommendation for surveillance must include a description of what the enforcement officer must observe and inspection frequency. This is usually suggested when the engineer suspects that there are instances when the operating conditions are drastically different than those he witnessed. This recommendation should be followed by a discussion with the area inspector to familiarize him with the operational details he will be expected to evaluate.

These inspection decisions constitute the final step in the permit application system and are the result of all of the evaluation steps that preceded the inspection. It is therefore necessary to emphasize the need for clear, concise statements of the facts which led to the final decision.

I. Field Inspection Forms

There are generally two approaches to recording data in the field. One is to make rough notes in a bound notebook or pad; the other involves the use of printed forms. When using the notebook it is possible to omit some information unless each item required for the report has been identified in the notebook before the inspection. When using a printed form, unless it is properly designed, there often isn't enough room to enter all of the data. There is no best way to prepare inspection reports for content and cost effectiveness. There are, however, some points to be considered in formulating a system in which printed forms may be desirable.

"The significant relationship is for the form to serve the system, not for the system to serve the form."[5] Effective forms design includes the following:

- Brief, descriptive and distinctive title.
- Form number for identification and general reference.

- Ruling to guide, divide or unify.
- Convenient location of instructions--top, bottom or reverse side of form or additional sheet attached.
- Spacing--for longhand or typewriter.
- Filing considerations--punched for binder, legal size, top punched, margins.

Examples of printed forms are those used by the Los Angeles County Air Pollution Control District for field inspection reporting.[6] A general form employed for inspections of all sources of dust and fumes is shown in Figure 7.3. A form used to record opacity and Ringelmann numbers is shown in Figure 7.4. Figures 7.5 and 7.6 are forms specifically designed for spray booth and vapor degreaser inspections.

The number of types of field report forms required by an agency will be a function of the volume of specific types of equipment requiring inspections and permits. Special purpose forms usually evolve from a general form when the need is recognized over a number of years. It is therefore advisable to design a general purpose form initially. Special purpose forms can be added after a trend has been established demonstrating their need.

AIR POLLUTION CONTROL DISTRICT - COUNTY OF LOS ANGELES
434 SOUTH SAN PEDRO STREET, LOS ANGELES, CALIF. 90013. MADISON 9-4711

ENGINEERING DIVISION....FIELD REPORT

NAME OF APPLICANT	DATE OF INSPECTION
MAILING ADDRESS	PERMIT APPL. NO.
EQUIPMENT LOCATION (ADDRESS)	A.P.C.D. ZONE NO.

REASON PERMIT IS REQUIRED: NEW CONSTRUCTION ( ) CHANGE OF OWNERSHIP ( ) CHANGE OF LESSEE ( ) CHANGE OF LOCATION ( ) EQUIPMENT ALTERATION ( )

DATE CONSTRUCTION AUTHORIZED: BY | TIME SPENT MAKING INSPECTION: FROM TO

USUAL OPERATING SCHEDULE FOR THIS EQUIPMENT:

WEATHER | WIND | ESTIMATED COST: BASIC EQUIPMENT: $ A.P.C. EQUIPMENT: $

NAMES & TITLES OF PERSONS CONTACTED BY ENGINEER:

FOR DUST & FUME PROBLEMS ONLY: PROCESS* WEIGHT (S) LBS./HR. | ALLOWED LOSSES: LBS./HR. | ESTIMATED LOSSES: LBS./HR.

OFFICIAL EQUIPMENT DESCRIPTION, *CALCULATION OF PROCESS WEIGHT(S), PROCESS DESCRIPTION AND FINDINGS:

RECOMMENDED DISPOSITION: ( ) APPROVE FOR PERMIT. ( ) APPROVE FOR PERMIT SUBJECT TO CONDITIONS LISTED BELOW. ( ) HOLD. SEE EXPLANATION BELOW. ( ) DENY PERMIT.

REVIEWING ENGINEER:
( ) I CONCUR WITH RECOMMENDATIONS
( ) I DO NOT CONCUR WITH RECOMMENDATIONS
( ) SEE COMMENTS ON ATTACHED PAGE

SIGNATURE ______

PAGE 1 OF ______ PAGES

16-50D106 R2-55

Figure 7.3. Field report form, dust and fumes, Los Angeles County Air Pollution Control District

AIR POLLUTION CONTROL DISTRICT - COUNTY OF LOS ANGELES
434 SOUTH SAN PEDRO STREET, LOS ANGELES, CALIF. 90013 MADISON 9-4711

ENGINEERING DIVISION....FIELD REPORT

NAME OF APPLICANT			DATE OF INSPECTION
EQUIPMENT LOCATION (ADDRESS)			PERMIT APPL. NO.
SOURCE OF AIR CONTAMINANTS		TYPES OF AIR CONTAMINANTS	
POINT(S) OF OBSERVATION		POINT OF DISCHARGE	
WEATHER	WIND	HOURS OF OBSERVATION: FROM	TO

OBSERVATIONS OF VISIBLE AIR CONTAMINANTS

TIME		INTERVAL		% OPACITY OR RINGELMANN No.	COLOR *(SEE CODE BELOW)	
FROM	TO	MINUTES	SECONDS			
				← TOTAL TIME OF DISCHARGE OF AIR CONTAMINANTS OF DENSITY (OR OPACITY) OF ________ OR GREATER		

*COLOR CODE:

"B" MEANS BLACK

"W" MEANS WHITE

" " ______ MEANS ______

" " ______ MEANS ______

SIGNATURE ______

PAGE ______ OF ______ PAGES

16-50D108 R1-55-5

Figure 7.4. Field report form, opacity reading, Los Angeles County Air Pollution Control District

AIR POLLUTION CONTROL DISTRICT - COUNTY OF LOS ANGELES
434 SOUTH SAN PEDRO STREET, LOS ANGELES, CALIF. 90013. MADISON 9-4711

SPRAY BOOTH....FIELD REPORT

NAME OF CORPORATION, COMPANY OR INDIVIDUAL OWNER THAT IS TO OPERATE THE EQUIPMENT AS IT APPEARS ON BUSINESS LICENSE. PERMIT TO BE ISSUED TO:

DATE OF INSPECTION

NAME OF PARTNERS OR INDIVIDUAL OWNER:

EQUIPMENT LOCATION (ADDRESS)

A.P.C.D. ZONE NO.

REASON PERMIT IS REQUIRED: NEW CONSTRUCTION ☐ CHANGE OF OWNERSHIP ☐ ALTERATION ☐ CHANGE OF LESSEE ☐ CHANGE OF LOCATION ☐

NAME OF FORMER PERMITTEE: (EXPLAIN)

FORMER PERMIT NO: ____

BOOTH MANUFACTURER & MODEL NUMBER:

NAMES & TITLES OF PERSONS CONTACTED:

BOOTH DIMENSIONS: WIDE X HIGH X DEEP.

BOOTH TYPE: FLOOR ☐ BENCH ☐ AUTOMOTIVE ☐

SERIAL NO.

NAME ALL TYPES OF MATERIAL SPRAYED:

ENAMEL: GALS./DAY. ADDED THINNER: GALS./DAY.

LACQUER: GALS./DAY. ADDED THINNER: GALS./DAY.

OTHER: (DESCRIBE) GALS./DAY. ADDED THINNER: GALS./DAY.

ESTIMATED COST: BASIC EQUIPMENT: $ A.P.C. EQUIPMENT: $

USUAL OPERATING SCHEDULE: HRS/DAY DAYS/WEEK

ARTICLES SPRAYED:

EXHAUST CONTROL:

NONE

WATERWASH FILTERS

NUMBER & SIZE OF EXHAUST FILTERS:

EXHAUST FAN HORSEPOWER:

WATER PUMP HORSEPOWER:

PARTS SPRAYED ARE OVEN DRIED: YES ☐ NO ☐

PROCESS DESCRIPTION, NUISANCE EVALUATION AND FINDINGS:

RECOMMENDED DISPOSITION: ☐ APPROVE FOR PERMIT. ☐ APPROVE FOR PERMIT SUBJECT TO CONDITIONS LISTED BELOW. ☐ HOLD, SEE EXPLANATION BELOW. ☐ DENY PERMIT.

REVIEWING ENGINEER:

☐ I CONCUR WITH RECOMMENDATIONS

☐ I DO NOT CONCUR WITH RECOMMENDATIONS

☐ SEE COMMENTS ON ATTACHED PAGE

SIGNATURE ____

PAGE 1 OF ____ PAGES

16-500230

Figure 7.5. Field report form, spray booths, Los Angeles County Air Pollution Control District

AIR POLLUTION CONTROL DISTRICT - COUNTY OF LOS ANGELES
434 SOUTH SAN PEDRO STREET, LOS ANGELES, CALIF. 90013, MADISON 9-4711

DEGREASER····FIELD REPORT

NAME OF CORPORATION, COMPANY OR INDIVIDUAL OWNER THAT IS TO OPERATE THE EQUIPMENT AS IT APPEARS ON BUSINESS LICENSE. PERMIT TO BE ISSUED TO:

NAME OF PARTNERS OR INDIVIDUAL OWNER | DATE OF INSPECTION

EQUIPMENT LOCATION (ADDRESS) | A.P.C.D. ZONE NO.

REASON PERMIT IS REQUIRED: NEW CONSTRUCTION ☐ CHANGE OF OWNERSHIP ☐ ALTERATION ☐ CHANGE LESSEE ☐ CHANGE LOCATION ☐

NAME OF FORMER PERMITTEE: | FORMER PERMIT NO.

DEGREASER MANUFACTURER | MODEL NUMBER | SERIAL NUMBER

OUTSIDE DIMENSIONS OF TANK MEASURED: WIDE X HIGH X LONG | NAMES & TITLES OF PERSONS CONTACTED

LIST ALL TYPES AND QUANTITY OF DEGREASER SOLVENT USED:

TRICHLOROETHYLENE ______ 55 GAL. DRUMS PER MONTH

PERCHLOROETHYLENE______ 55 GAL. DRUMS PER MONTH

OTHER (DESCRIBE)______
(ANY OTHER CONVENIENT MEASURE MAY BE USED)

HEATING SOURCE: RATING
ELECTRIC KILOWATTS
GAS CU.FT./HR.
OTHER: EXPLAIN
NONE

ESTIMATED COST
BASIC EQUIPMENT: $
A.P.C. EQUIPMENT: $

DOES (NOT) DISCHARGE TO AN APC DEVICE (DESCRIBE)

INDICATE H.P. OF PUMP USED IN SPRAY OR SLOSH DEGREASING.

PROCESS DESCRIPTION, NUISANCE EVALUATION AND FINDINGS:

RECOMMENDED DISPOSITION: ☐ APPROVE FOR PERMIT. ☐ APPROVE FOR PERMIT SUBJECT TO CONDITIONS LISTED BELOW. ☐ HOLD. SEE EXPLANATION BELOW. ☐ DENY PERMIT

REVIEWING ENGINEER:
☐ I CONCUR WITH RECOMMENDATIONS
☐ I DO NOT CONCUR WITH RECOMMENDATIONS
☐ SEE COMMENTS ON ATTACHED PAGE

SIGNATURE ______

PAGE 1 OF ______ PAGES

16-50D23

Figure 7.6. Field report form, degreaser, Los Angeles County Air Pollution Control District

REFERENCES

1. A Guide for Evaluation of Solid Particle Emissions from Asphalt Paving Plants. New Jersey State Department of Health and Air Sanitation. May 1966.

2. Asphalt, Pocketbook of Useful Information. The Asphalt Institute Manual Series No. 6 (MS-6). May 1965.

3. McGraw, M.J. and R.L. Duprey. Compilation of Air Pollutant Emission Factors. EPA. April 1971 (preliminary document).

4. Devorkin, H., R.L. Chass, A.P. Fudurich, and C.V. Kanter. Air Pollution Source Testing Manual, Holmes, R.G. (ed.). Air Pollution Control District, Los Angeles County. November 1963.

5. Kelly, W.F. Management through Systems and Procedures. The Total Systems Concept. John Wiley & Sons. May 1969.

6. von Lehmden, D.V. and S.T. Cuffe. Development of a Permit System for Air Pollution Prevention and Control. Based on Research Workshop Proceedings (unpublished). USDHEW, PHS, EHS, NAPCA. July 1970.

APPENDIX 1

WORK UNITS FOR PERMIT PROCESSING

AIR POLLUTION CONTROL DISTRICT--COUNTY OF LOS ANGELES

ENGINEERING DIVISION POLICIES AND PROCEDURES

ISSUED: April 10, 1967

The use of work units for permit processing serves two goals:

1. To provide substantiating evidence in preparing future budget requests.

2. To reflect accurately the work accomplishments to the Permit Processing Units.

All or most types of permit units processed have been listed in the index and assigned a specific work unit value for an A/C action and one for a P/O action. Work unit values for permit units not now listed will be added by a committee when necessary. The total work unit value for any permit application will be the sum of the individual A/C and P/O work unit values earned by the appropriate actions for the permit unit.

The A/C work unit value is used in determining work units earned by the following actions: A/C's granted, A/C's denied, and cancellations (prior to an A/C) of Class I applications. The P/O work unit value is used in determining work units earned by the following actions: P/O's granted, P/O's denied, cancellations of Class III applications, and cancellations of Class I applications after an A/C has been granted.

In preparing the budget over the years, the District has observed that about 1300 work units are completed per man-year and also that the man-hours per work unit varies between 1.4 and 1.6.

A/C = Authority to Construct

P/O = Permit to Operate

Basic Permit Unit	Work Unit Values A/C	Work Unit Values P/O
Abrasive blaster, cleaner or tumbler	3	5
Absorber column or tower	5	4
Acetaldehyde production	12	7
Acetone production	14	8
Acetylene production	14	7
Acid production	30	20
Aging furnace or oven	4	5
Alcohol production	14	8
Alkyl aryl sulfonate production	10	8
Alkylation	20	7
Alkyd resin production	8	8
Ammonia dissociator	3	4
Ammonia production	30	18
Ammonium sulfate production	30	7
Anhydride production	30	20
Animal matter cooker	8	8
Annealing furnace or oven	4	5
Annealing lehr for glass	4	5
Arc furnace, direct	16	40
Arc furnace, indirect	10	10
Arc welder	3	4
Aromatics recovery	30	20
Asphalt production by blowing	20	15
Asphalt production by distillation	10	8
Asphalt saturator	3	19
Asphaltic concrete batching	12	30
Bacon rind fryer	4	6
Bake oven	4	5
Basic woodworking equipment	6	8
Batch coker thermal conversion of petroleum products	30	20
Benzene hexachloride production	20	12
Bin for storage of solid material	5	6
Bleach manufacturing plant	10	12
Blood drier	18	24
Boiler, other than steam electric generating unit	4	10
Brake lining bonder	4	6
Brake lining debonder	12	10
Buffing and grinding	2	3
Bulk loader or unloader	10	8
Bulk ship loading	20	40
Butadiene production	30	20
Butane isomerization	30	18

Basic Permit Unit	Work Unit Values A/C	Work Unit Values P/O
Can manufacturing line	12	10
Carbon bisulfide production	14	8
Carbon black production	10	8
Cardboard container manufacturing line	6	8
Catalytic alkylation	20	7
Catalytic cracking of petroleum products	35	20
Catalytic polymerization	14	7
Catalytic reforming of petroleum products	30	18
Catalyst handling and storage equipment	5	4
Cement handling equipment	6	6
Ceramic drier or oven	8	12
Chemical manufacturing (not otherwise identified	20	18
Chemical milling and etching	10	8
Chip drier	16	16
Chlorinated methane production	30	18
Chlorine production	40	40
Chrome plating or anodizing tank	10	5
Coffee conveying, grinding & packaging equipment	20	10
Coffee roasting equipment	8	10
Compressor (Refinery)	5	4
Concrete batching plant (both dry & wet, dry)	10	10
Concrete batching plant (wet only)	10	10
Cooling tower	10	10
Core oven	4	10
Crucible furnace, Al, Cu, Mg, Steel	5	6
Crucible furnace, Brass	12	10
Crucible furnace Pb	8	8
Crucible furnace, Zn	5	8
Crude oil distillation or topping	12	6
Crude oil production	10	7
Crushing and grinding equipment	6	10
Cumene production	30	18
Cupola furnace	16	10
Deep fat fryer	4	6
Degreaser	2	3
Die casting equipment	7	10
Dip tank	4	4
Distillation unit (Chemical)	10	10
Drier or kiln	7	13
Dry cleaner, petroleum, and synthetic	3	4
Drum burning reclamation furnace, conveyorized	25	12
Effluent water separators	16	12
Electric induction or resistance furnace	12	10
Electrolytic plating or stripping	10	5

Basic Permit Unit	Work Unit Values A/C	Work Unit Values P/O
Electrostatic coater	6	4
Ethylbenzene production	30	12
Ethylchloride production	14	6
Ethyl ether production	13	6
Ethylene dibromide production	13	6
Ethylene dichloride production	13	6
Ethylene glycol production	30	20
Ethylene oxide production	30	20
Feed and grain handling plant	10	16
Fertilizer production, liquid	4	13
Fertilizer production, solid	10	15
Fixed Roof tank	5	5
Floating roof tank	5	5
Floating roof alterations	4	4
Flow coater	4	4
Flue fed incinerator, S/C	8	8
Food Cooking (animal)	8	12
Food product cooker	4	6
Forge or forge furnace	6	6
Formaldehyde production	15	10
Forming or impregnating	4	6
Foundry shakeout and sand handling equipment	16	8
Fumigation oven	5	8
Galvanizing equipment	10	10
Garnetting equipment	16	14
Gas generator	3	4
Glass, frit, and insulation furnace	10	35
Glycerol production	12	10
Grease solvent extraction unit	24	24
Heat treat furnace	4	5
Heaters and reboilers	8	10
Holding and melting furnace	8	8
Hydraulic press	3	4
Ketone production	14	8
Knockout trap	5	4
Laboratory hood and equipment	3	4
Laundry tumbler	2	3
Leather processing equipment	3	6
Lube oil re-refining	18	20
Lithograph oven	11	16
Maleic anhydride production	30	20
Methyl ethyl ketone production	14	8
Methyl mercaptan production	15	6
Mixing equipment	5	10
Muffle furnace	20	16

Basic Permit Unit	Work Unit Values	
	A/C	P/O
M/C incinerator non-standard	17	10
M/C incinerator standard	8	10
Naphthenic acid production	20	8
Natural gasoline processing	14	12
Normalizing furnace	4	5
Nut roaster	4	6
Nylon hot stretch unit	5	8
Oil quench tank	3	4
Open hearth furnace	24	20
Pathological incinerator	16	10
Pentaerythritol production	30	20
Perlite furnace	24	12
Petrochemical processing	30	20
Petroleum product treating & sweating	14	6
Phenol-formaldehyde production	10	6
Phthalic anhydride production	30	10
Pipe coating equipment	3	20
Pipe wrapping equipment	3	20
Pit furnace	12	10
Plastic curing oven	4	5
Plastic laminating equipment	4	5
Plating or etching equipment	10	5
Pneumatic conveyor, cyclone material separator	18	6
Polybutene production	14	6
Polyethylene production	45	30
Pot furnace	5	6
Potato chip fryer	4	6
Pressure tank	5	4
Printing press	4	5
Processing tank	3	4
Propylene production	14	6
Pump	3	4
Reactor	8	6
Recuperative furnace	20	20
Reduction furnace	24	20
Regenerative furnace	20	20
Rendered products handling system	16	32
Rendering cookers, continuous	8	32
Rendering equipment, batch	8	8
Rendering raw materials handling system	5	5
Retort furnace	20	16

Basic Permit Unit	Work Unit Values A/C	Work Unit Values P/O
Reverberatory furnace	24	16
Rock crushing and sizing equipment	10	15
Roller coater	4	4
Rotogravure press	6	6
Rotary furnace	24	16
Rubber manufacturing, synthetic	30	25
Rubber processing equipment	8	8
Salt bath furnace	4	5
Sand handling system	16	8
Saponification process equipment	14	10
Sewage treatment exp. odor control	12	30
Sewage treatment digestion	10	10
Sewage treatment headworks	10	15
Sewage treatment sedimentation	10	20
Sewage treatment water reclamation	15	10
Shell moulding equipment	3	5
S/C incinerator	4	4
Sintering furnace or oven	10	6
Smoke generator	4	8
Smokehouse	4	14
Solid material handling	10	12
Solvent wash tank	4	4
Spray drier	12	12
Steam electric generating unit	20	50
Storage tank, (chemical)	3	4
Styrene production	30	20
Surface preparation and cleaning	2	2
Sweat furnace	24	20
Underground tanks	3	4
Uniform feed M/C incinerators	21	12
Vacuum pump	3	4
Varnish or resin cooker	3	4
Vegetable oil processing equipment	12	7
Vinyl acetate production	12	10
Vinyl chloride production	12	10
Vinyl toluene production	14	12
Wax burnout oven	8	6
Wire reclaimer burner	16	10
Woodworking	6	8

APPENDIX 2

JOB AND TASK ANALYSIS OF THE
NEW YORK CITY
DEPARTMENT OF AIR RESOURCES

WORKSHEET NUMBER 2		SOURCE:		SHEET NUMBER
JOB TITLE: Air Pollution Control Engineer (Senior, Assistant, Junior)	DIVISION: Fossil Fuels Combustion Division	INTERVIEWER:	DATE: 4/17/69	12

MAJOR DUTY	DUTY	LEVEL	KEY
Process applications for certificates of operation for oil or gas fired equipment.	Examine plans and applications. Approve or disapprove. Notify agent of the action via Plan Desk. Includes: (1) applications for upgrading existing equipment and (2) applications relative to new installations; and (3) amendments to correct previously disapproved applications.		
	Make field inspection. Grant certificate of inspection or issue "violation".		
Reply to requests for information.			
	Reply to information requests from air pollution boards in other cities.		
	Reply to requests from clients or their agents.		

A.2.1

WORKSHEET NUMBER 3	JOBS: Air Pollution Control Engineer (All Grades)	SOURCE:	SHEET NUMBER
TASK: Processing Applications	DIVISION: Fossil Fuels Combustion Division	INTERVIEWER: DATE: 4/29/69	13

PRODUCT	CRITERIA	STEPS	REFERENCE	TOOLS	MATERIALS	NEEDS TO KNOW
Applications approved or disapproved - (both for new oil installations and upgraded existing installations).	Reject the application if these are not present, filled out: 1. Three (3) APC-5-0's. 2. Letter of authorization. 3. Three (3) sets of plans. 4. Boiler diagram. 5. Plot plan. 6. Cellar plan, showing location of the boiler, ventilation breeching, chimney. If: 1. Boiler dimensions are not given. 2. Lacks seal, signature, and address. 3. It is sloppy or is a stock plan not individualized for this job. 4. The wrong plan for the job was included. 5. There is a discrepancy between the plans and the APC 5-0.	Check to be sure that file contains all the necessary papers, and that all are filled out. Compare the APC 5-0 with the plans, item by item, checking each item to be sure the plans and the APC 5-0 agree. Get boiler catalogs for the type specified. Find heating surface (H.S.). Use SBI tables (Steel Boiler Institute). Find boiler's gross boiler output, firing rate for gross output, boiler net rating. Compare these figures with those given on APC 5-0. If there is any variation at all, issue an objection. Now take the "checklist." Go through the APC 5-0 and check if the requirements have been met. Recheck the results of the Heat Release Calculation. Check to be sure that the "load" is not larger than the "boiler's net rating." (These figures are given by the P.E. at the bottom of side 2.) Confirm the correctness of the figures by these methods: A. Multiply number of rooms x 5. The result should be approximately the same as gph of Load, (B) Domestic Hot Water. C. Compare result of A + B + C calculation with the boiler net rating. When correct, the boiler rating figure is larger. (Continued on Sheet 14)	"Criteria Used for Oil Fired Equipment." (And the outline of it prepared by the Fossil Fuel Division Staff.) *"Engineering Guide for Upgrading Residual Fuel Burning Equipment"* and (Both are published by New York Department of Air Pollution Control) Unpublished calculations prepared by Fossil Fuels staff concerning allowable variations in chimney heights and diameters.	Slide Rule	SBI, ABMA, IBR, MCA, PAPP references (NWAH, ACA for furnaces). Boiler catalogs Manufacturer Data (burners, heaters) ASHRAE Guide & Data Book References contained in Criteria Plans	- required procedures for filing and examination - looking up boiler output, calculating when necessary - boiler load calculation - piping and pick up calculation - heat release calculation - analysis of combustion chamber - combustion air calculations - oil heating calculations - burner sizing and selection - analysis of control requirements - DWS rules for fail-safe elements - breeching and chimney calculations - fan selection based on CFM and SP conditions

WORKSHEET NUMBER 3	JOBS: Air Pollution Control Engineer (All Grades)	SOURCE:	SHEET NUMBER
TASK: Processing Applications	DIVISION: Fossil Fuels Combustion Division	INTERVIEWER: DATE: 4/29/69	14

PRODUCT	CRITERIA	STEPS	REFERENCE	TOOLS	MATERIALS	NEEDS TO KNOW
		(Continued from Sheet 13)				
		Write objections, if any. (This is a matter of using the correct stamp, then having the form typed.) Proofread it. Send it to the Plan Desk for forwarding to the agent.				
Amendment approved or disapproved.	Same as for new application.	If time permits, treat this as a new application and check out each item.	Same as for above.	Same as above.	Same as above.	
		As a minimum, look at the previous notice of disapproval and be sure that all objections have been properly answered.				

WORKSHEET NUMBER 3	JOBS: Air Pollution Control Engineer (All Grades)	SOURCE:	SHEET NUMBER
TASK: Processing Applications/ Field Inspection	DIVISION: Engineering Services/Fossil Fuels	INTERVIEWER: DATE: 4/17/69	15

PRODUCT	CRITERIA	STEPS	REFERENCE	TOOLS	MATERIALS	NEEDS TO KNOW
Field inspection completed.	The actual installation should comply with the drawings and specifications previously approved, at least concerning engineering features. Also, the general configuration should be as shown on the plans (e.g., pipes must be on the same side as shown).	Locate superintendent and have him present during the inspection. Compare the items as installed with the data on the APC 5-0. Compare the installation configuration with that shown in the plans. Check measurements. Check for items not covered by the APC 5-0 but covered in the "Criteria" (e.g., oil temperature indicator). Observe the system in operation, to see if all auxiliary equipment functions, and if the system is effective in cleaning emissions. Check chimney height. Submit findings to Department head for review.	"Criteria Used For Oil-Fired Equipment," (N. Y. Dept. of Air Pollution Control, 1967) "Air Pollution Engineering Manual," (U. S. Public Health Service) "Engineering Guide For Upgrading Residual Fuel Burning Equipment And Alternatives," (N. Y. Department of Air Pollution Control) "Air Pollution Control," New York City, 1968.	Flashlight 6-foot folding rule	City Maps Complete File On The Application	Must be able to read plans, to extent of determining if the actual configuration conforms with the plans. Recognize equipment, find and read nameplates.

APPENDIX 3

EXCERPTS OF RULES AND REGULATIONS APPLICABLE TO THE PERMIT SYSTEM*

RULE 2b. PERSON

"Person" means any person, firm, association, organization, partnership, business trust, corporation, company, contractor, supplier, installer, user or owner, or any state or local governmental agency or public district or any officer or employee thereof.

RULE 10. PERMITS REQUIRED

a. Authority to Construct. Any person building, erecting, altering or replacing any article, machine, equipment or other contrivance, the use of which may cause the issuance of air contaminants or the use of which may eliminate or reduce or control the issuance of air contaminants, shall first obtain authorization for such construction from the Air Pollution Control Officer. An authority to construct shall remain in effect until the permit to operate the equipment for which the application was filed is granted or denied or the application is canceled.

b. Permit to Operate. Before any article, machine, equipment or other contrivance described in Rule 10 (a) may be operated or used, a written permit shall be obtained from the Air Pollution Control Officer. No permit to operate or use shall be granted either by the Air Pollution Control Officer or the Hearing Board for any article, machine, equipment or contrivance described in Rule 10 (a), constructed or installed without authorization as required by Rule 10 (a), until the information required is presented to the Air Pollution Control Officer and such article, machine, equipment or contrivance is altered, if necessary, and made to conform to the standards set forth in Rule 20 and elsewhere in these Rules and Regulations.

c. Posting of Permit to Operate. A person who has been granted under Rule 10 a permit to operate any article, machine, equipment, or other contrivance described in Rule 10 (b), shall firmly affix such permit to operate, an approved facsimile, or other approved identification bearing the permit number upon the article, machine, equipment, or other contrivance in such a manner as to be clearly visible and accessible. In the event that the article, machine, equipment, or other contrivance is so constructed or operated that the permit to operate cannot be so placed, the permit to operate shall be mounted so as to be clearly visible in an accessible place within 25 feet of the article, machine, equipment, or other contrivance, or maintained readily available at all times on the operating premises.

d. A person shall not wilfully deface, alter, forge, counterfeit, or falsify a permit to operate any article, machine, equipment or other contrivance.

f. Permit to Sell or Rent. Any person who sells or rents to another person an incinerator which may be used to dispose of combustible refuse by burning within the Los Angeles Basin and which incinerator is to be used exclusively in connection with any structure, which structure is designed for and used exclusively as a dwelling for not more than four families, shall first obtain a permit from the Air Pollution Control Officer to sell or rent such incinerator.

RULE 11. EXEMPTIONS

An authority to construct or a permit to operate shall not be required for:

a. Vehicles as defined by the Vehicle Code of the State of California but not including any article, machine, equipment or other contrivance mounted on such vehicle that would otherwise require a permit under the provisions of these Rules and Regulations.

b. Vehicles used to transport passengers or freight.

c. Equipment utilized exclusively in connection with any structure, which structure is designed for and used exclusively as a dwelling for not more than four families.

d. The following equipment:

1. Comfort air conditioning or comfort ventilating systems which are not designed to remove air contaminants generated by or released from specific units of equipment.

2. Refrigeration units except those used as, or in conjunction with, air pollution control equipment.

3. Piston type internal combustion engines.

5. Water cooling towers and water cooling ponds not used for evaporative cooling of process water or not used for evaporative cooling of water from barometric jets or from barometric condensers.

6. Equipment used exclusively for steam cleaning.

7. Presses used exclusively for extruding metals, minerals, plastics or wood.

8. Procelain enameling furnaces, porclain enameling drying ovens, vitreous enameling furnaces or vitreous enameling drying ovens.

9. Presses used for the curing of rubber products and plastic products.

10. Equipment used exclusively for space heating, other than boilers.

13. Equipment used for hydraulic or hydrostatic testing.

14. All sheet-fed printing presses and all other printing presses using exclusively inks containing less than 10% organic solvents, diluents or thinners.

17. Tanks, vessels and pumping equipment used exclusively for the storage or dispensing of fresh commercial or purer grades of:

    a. Sulfuric acid with an acid strength of 99 per cent or less by weight.

    b. Phosphoric acid with an acid strength of 99 per cent or less by weight.

    c. Nitric acid with an acid strength of 70 per cent or less by weight.

18. Ovens used exclusively for the curing of plastics which are concurrently being vacuum held to a mold or for the softening or annealing of plastics.

19. Equipment used exclusively for the dyeing or stripping (bleaching) of textiles where no organic solvents, diluents or thinners are used.

20. Equipment used exclusively to mill or grind coatings and molding compounds where all materials charged are in a paste form.

21. Crucible type or pot type furnaces with a brimful capacity of less than 450 cubic inches of any molten metal.

22. Equipment used exclusively for the melting or applying of wax where no organic solvents, diluents or thinners are used.

23. Equipment used exclusively for bonding lining to brake shoes.

24. Lint traps used exclusively in conjunction with dry cleaning tumblers.

25. Equipment used in eating establishments for the purpose of preparing food for human consumption.

26. Equipment used exclusively to compress or hold dry natural gas.

27. Tumblers used for the cleaning or deburring of metal products without abrasive blasting.

28. Shell core and shell-mold manufacturing machines.

29. Molds used for the casting of metals.

30. Abrasive blast cabinet-dust filter integral combination units where the total internal volume of the blast section is 50 cubic feet or less.

31. Batch mixers of 5 cubic feet rated working capacity or less.

32. Equipment used exclusively for the packaging of lubricants or greases.

33. Equipment used exclusively for the manufacture of water emulsions of asphalt, greases, oils or waxes.

34. Ovens used exclusively for the curing of vinyl plastisols by the closed mold curing process.

35. Equipment used exclusively for conveying and storing plastic pellets.

36. Equipment used exclusively for the mixing and blending of materials at ambient temperature to make water based adhesives.

37. Smokehouses in which the maximum horizontal inside cross-sectional area does not exceed 20 square feet.

38. Platen presses used for laminating.

e. The following equipment or any exhaust system or collector serving exclusively such equipment:

1. Blast cleaning equipment using a suspension of abrasive in water.

2. Ovens, mixers and blenders used in bakeries where the products are edible and intended for human consumption.

3. Kilns used for firing ceramic ware, heated exclusively by natural gas, liquefied petroleum gas, electricity or any combination thereof.

4. Laboratory equipment used exclusively for chemical or physical analyses and bench scale laboratory equipment.

5. Equipment used for inspection of metal products.

6. Confection cookers where the products are edible and intended for human consumption.

7. Equipment used exclusively for forging, pressing, rolling or drawing of metals or for heating metals immediately prior to forging, pressing, rolling or drawing.

8. Die casting machines.

9. Atmosphere generators used in connection with metal heat treating processes.

10. Photographic process equipment by which an image is reproduced upon material sensitized to radiant energy.

11. Brazing, soldering or welding equipment.

12. Equipment used exclusively for the sintering of glass or metals.

13. Equipment used for buffing (except automatic or semi-automatic tire buffers) or polishing, carving, cutting, drilling, machining, routing, sanding, sawing, surface grinding or turning of ceramic artwork, ceramic precision parts, leather, metals, plastics, rubber, fiberboard, masonry, asbestos, carbon or graphite.

14. Equipment used for carving, cutting, drilling, surface grinding, planing, routing, sanding, sawing, shredding or turning of wood, or the pressing or storing of sawdust, wood chips or wood shavings.

15. Equipment using aqueous solutions for surface preparation, cleaning, stripping, etching (does not include chemical milling) or the electrolytic plating with electrolytic polishing of, or the electrolytic stripping of brass, bronze, cadmium, copper, iron, lead, nickel, tin, zinc, and precious metals.

16. Equipment used for washing or drying products fabricated from metal or glass, provided that no volatile organic materials are used in the process and that no oil or solid fuel is burned.

17. Laundry dryers, extractors or tumblers used for fabrics cleaned only with water solutions of bleach or detergents.

19. Foundry sand mold forming equipment to which no heat is applied.

20. Ovens used exclusively for curing potting materials or castings made with epoxy resins.

21. Equipment used to liquefy or separate oxygen, nitrogen or the rare gases from the air.

22. Equipment used for compression molding and injection molding of plastics.

23. Mixers for rubber or plastics where no material in powder form is added and no organic solvents, diluents or thinners are used.

24. Equipment used exclusively to package pharmaceuticals and cosmetics or to coat pharmaceutical tablets.

25. Equipment used exclusively to grind, blend or package tea, cocoa, spices or roasted coffee.

26. Roll mills or calenders for rubber or plastics where no organic solvents, diluents or thinners are used.

27. Vacuum producing devices used in laboratory operations or in connection with other equipment which is exempt by Rule 11.

f. Steam generators, steam superheaters, water boilers, water heaters, and closed heat transfer systems that are fired exclusively with one of the following:

1. Natural gas.
2. Liquefied petroleum gas.
3. A combination of natural gas and liquefied gas.

g. Natural draft hoods, natural draft stacks or natural draft ventilators.

h. Containers, reservoirs, or tanks used exclusively for:

1. Dipping operations for coating objects with oils, waxes or greases where no organic solvents, diluents or thinners are used.

2. Dipping operations for applying coatings of natural or synthetic resins which contain no organic solvents.

3. Storage of liquefied gases.

5. Unheated storage of organic materials with an initial boiling point of 300° F. or greater.

6. The storage of fuel oils with a gravity of 25° API or lower.

7. The storage of lubricating oils.

8. The storage of fuel oils with a gravity of 40° API or lower and having a capacity of 10,000 gallons or less.

9. The storage of organic liquids, except gasoline, normally used as solvents, diluents or thinners, inks, colorants, paints, lacquers, enamels, varnishes, liquid resins or other surface coatings, and having a capacity of 6,000 gallons or less.

10. The storage of liquid soaps, liquid detergents, vegetable oils, waxes or wax emulsions.

11. The storage of asphalt.

12. Unheated solvent dispensing containers, unheated non-conveyorized solvent rinsing containers or unheated non-conveyorized coating dip tanks of 100 gallons capacity or less.

14. The storage of gasoline having a capacity of less than 250 gallons.

15. Transporting materials on streets or highways.

i. Equipment used exclusively for heat treating glass or metals, or used exclusively for case hardening, carburizing, cyaniding, nitriding, carbonitriding, siliconizing or diffusion treating of metal objects.

j. Crucible furnaces, pot furnaces or induction furnaces, with a capacity of 1000 pounds or less each, in which no sweating or distilling is conducted and from which only the following metals are poured or in which only the following metals are held in a molten state:

1. Aluminum or any alloy containing over 50 per cent aluminum,
2. Magnesium or any alloy containing over 50 per cent magnesi
3. Lead or any alloy containing over 50 per cent lead.
4. Tin or any alloy containing over 50 per cent tin.
5. Zinc or any alloy containing over 50 per cent zinc.
6. Copper
7. Precious metals.

k. Vacuum cleaning systems used exclusively for industrial, commercial or residential housekeeping purposes.

l. Structural changes which cannot change the quality, nature or quantity of air contaminant emissions.

m. Repairs or maintenance not involving structural changes to any equipment for which a permit has been granted.

n. Identical replacements in whole or in part of any article, machine, equipment or other contrivance where a permit to operate had previously been granted for such equipment under Rule 10.

RULE 12. TRANSFER

An authority to construct, permit to operate or permit to sell or rent shall not be transferable, whether by operation of law or otherwise, either from one location to another, from one piece of equipment to another, or from one person to another.

RULE 14. APPLICATIONS

Every application for an authority to construct, permit to operate or permit to sell or rent required under Rule 10 shall be filed in the manner and form prescribed by the Air Pollution Control Officer and shall give all the information necessary to enable the Air Pollution Control Officer to make the determination required by Rule 20 hereof.

RULE 17. CANCELLATION OF APPLICATIONS

a. An authority to construct shall expire and the application shall be canceled two years from the date of issuance of the authority to construct.

b. An application for permit to operate existing equipment shall be canceled two years from the date of filing of the application.

RULE 18. ACTION ON APPLICATIONS

The Air Pollution Control Officer shall act, within a reasonable time, on an application for authority to construct, permit to operate or permit to sell or rent, and shall notify the applicant in writing of his approval, conditional approval or denial.

RULE 19. PROVISION OF SAMPLING AND TESTING FACILITIES

A person operating or using any article, machine, equipment or other contrivance for which these rules require a permit shall provide and maintain such sampling and testing facilities as specified in the authority to construct or permit to operate.

RULE 20. STANDARDS FOR GRANTING APPLICATIONS

a. The Air Pollution Control Officer shall deny an authority to construct, permit to operate or permit to sell or rent, except as provided in Rule 21, if the applicant does not show that every article, machine, equipment or other contrivance, the use of which may cause the issuance of air contaminants, or the use of which may eliminate or reduce or control the issuance of air contaminan is so designed, controlled, or equipped with such air pollution c trol equipment, that it may be expected to operate without emitti or without causing to be emitted air contaminants in violation of Sections 24242 or 24243, Health and Safety Code, or of these Rule or Regulations.

b. Before an authority to construct or a permit to operate is granted, the Air Pollution Control Officer may require the applicant to provide and maintain such facilities as are necessary for sampling and testing purposes in order to secure information that will disclose the nature, extent, quantity or degree of air contaminants discharged into the atmosphere from the article, machin equipment or other contrivance described in the authority to construct or permit to operate. In the event of such a requirement, the Air Pollution Control Officer shall notify the applicant in writing of the required size, number and location of sampling hol the size and location of the sampling platform; the access to the sampling platform; and the utilities for operating the sampling and testing equipment. The platform and access shall be construct in accordance with the General Industry Safety Orders of the Stat of California.

c. In acting upon a Permit to Operate, if the Air Pollution Cont Officer finds that the article, machine, equipment or other contr vance has been constructed not in accordance with the Authority t Construct, he shall deny the Permit to Operate. The Air Pollutic Control Officer shall not accept any further application for Permit to Operate the article, machine, equipment or other contrivar so constructed until he finds that the article, machine, equipmer or other contrivance has been reconstructed in accordance with tl Authority to Construct.

RULE 21. CONDITIONAL APPROVAL

a. The Air Pollution Control Officer may issue an authority to construct or a permit to operate, subject to conditions which will bring the operation of any article, machine, equipment or other contrivance within the standards of Rule 20, in which case the conditions shall be specified in writing. Commencing work under such an authority to construct or operation under such a permit to operate shall be deemed acceptance of all the conditions so specified. The Air Pollution Control Officer shall issue an authority to construct or a permit to operate with revised conditions upon receipt of a new application, if the applicant demonstrates that the article, machine, equipment or other contrivance can operate within the standards of Rule 20 under the revised conditions.

b. The Air Pollution Control Officer may issue a permit to sell or rent, subject to conditions which will bring the operation of any article, machine, equipment or other contrivance within the standards of Rule 20, in which case the conditions shall be specified in writing. Selling or renting under such a permit to sell or rent shall be deemed acceptance of all the conditions so specified. The Air Pollution Control Officer shall issue a permit to sell or rent with revised conditions upon receipt of a new application, if the applicant demonstrates that the article, machine, equipment or other contrivance can operate within the standards of Rule 20 under the revised conditions.

RULE 22. DENIAL OF APPLICATIONS

In the event of denial of an authority to construct, permit to operate or permit to sell or rent, the Air Pollution Control Office shall notify the applicant in writing of the reasons therefor. Service of this notification may be made in person or by mail, and such service may be proved by the written acknowledgment of the persons served or affidavit of the person making the service. The Air Pollution Control Officer shall not accept a further application unless the applicant has complied with the objections specified by the Air Pollution Control Officer as his reasons for denial of the authority to construct, the permit to operate or the permit to sell or rent.

RULE 23. FURTHER INFORMATION

Before acting on an application for authority to construct, permit to operate or permit to sell or rent, the Air Pollution Control Officer may require the applicant to furnish further information or further plans or specifications.

RULE 24. APPLICATIONS DEEMED DENIED

The applicant may at his option deem the authority to construct, permit to operate or permit to sell or rent denied if the Air Pollution Control Officer fails to act on the application within 30 days after filing, or within 30 days after applicant furnishes the further information, plans and specifications requested by the Air Pollution Control Officer, whichever is later.

RULE 25. APPEALS

Within 10 days after notice, by the Air Pollution Control Officer, of denial or conditional approval of an authority to construct, permit to operate or permit to sell or rent, the applicant may petition the Hearing Board, in writing, for a public hearing. The Hearing Board, after notice and a public hearing held within 30 days after filing the petition, may sustain or reverse the action of the Air Pollution Control Officer; such order may be made subject to specified conditions.

RULE 40. PERMIT FEES

Every applicant, except any state or local governmental agency or public district, for an authority to construct or a permit to operate any article, machine, equipment or other contrivance, for which an authority to construct or permit to operate is required by the State law or the Rules and Regulations of the Air Pollution Control District, shall pay a filing fee of $40.00. Where an application is filed for a permit to operate any article machine, equipment or other contrivance by reason of transfer from one person to another, and where a permit to operate had previously been granted under Rule 10 and no alteration, addition or transfer of location has been made, the applicant shall pay only a $10.00 filing fee.

Every applicant, except any state or local governmental agency or public district, for a permit to operate, who files an application with the Air Pollution Control Officer, shall, in addition to the filing fee prescribed herein, pay the fee for the issuance of a permit to operate in the amount prescribed in the following schedules, provided, however, that the filing fee shall be applie to the fee prescribed for the issuance of the permit to operate.

If an application for an authority to construct or a permit to operate is canceled, or if an authority to construct or a permit to operate is denied and such denial becomes final, the filing fee required herein shall not be refunded nor applied to any subsequent application.

Where an application is filed for a permit to operate any article, machine, equipment or other contrivance by reason of transfer of location or transfer from one person to another, or both, and where a permit to operate had previously been granted for such equipment under Rule 10 and an alteration or addition has been made, the applicant shall be assessed a fee based upon the increase in total horsepower rating, the increase in total fuel consumption expressed in thousands of British Thermal Units (BTU) per hour, the increase in total electrical energy rating, the increase in maximum horizontal inside cross sectional area or the increase in total stationary container capacity resulting from such alterations or additions, as described in the fee schedules contained herein. Where the application is for transfer of location and no alteration or addition has been made, the applicant shall pay only a filing fee of $40.00.

Where an application is filed for an authority to construct or a permit to operate exclusively involving revisions to the conditions of an existing permit to operate or involving alterations or additions resulting in a change to any existing article, machine, equipment or other contrivance holding a permit under the provisions of Rule 10 of these Rules and Regulations, the applicant shall be assessed a fee based upon the increase in total horsepower rating, the increase in total fuel consumption expressed in thousands of British Thermal Units (BTU) per hour, the increase in total electrical energy rating, the increase in maximum horizontal inside cross sectional area or the increase in total stationary container capacity resulting from such alterations or additions, as described in the fee schedules contained herein. Where there is no change or is a decrease in such ratings, the applicant shall pay only the amount of the filing fee required herein.

After the provisions for granting permits as set forth in Chapter 2, Division 20, of the Health and Safety Code and the Rules and Regulations have been complied with, the applicant shall be notified by the Air Pollution Control Officer, in writing, of the fee to be paid for issuance of the permit to operate. Such notice may be given by personal service or by deposit, postpaid, in the United States mail and shall serve as a temporary permit to operate for 30 days from the date of personal service or mailing. Nonpayment of the fee within this period of time shall result in the automatic cancellation of the application.

In the event that more than one fee schedule is applicable to a permit to operate, the governing schedule shall be that which results in the higher fee.

Where a single permit to operate has been granted under Rule 10 prior to July 1, 1957, and where the Air Pollution Control Officer would, since that date, have issued separate or revised permits for each permit unit included in the original application, the Air Pollution Control Officer may issue such separate or revised permits without fees.

In the event that a permit to operate is granted by the Hearing Board after denial by the Air Pollution Control Officer or after the applicant deems his application denied, the applicant shall pay the fee prescribed in the following schedules within 30 days after the date of the decision of the Hearing Board. Nonpayment of the fee within this period of time shall result in automatic cancellation of the permit and the application. Such a fee shall not be charged for a permit to operate granted by the Hearing Board for the duration of a variance.

A request for a duplicate permit to operate shall be made in writing to the Air Pollution Control Officer within 10 days after the destruction, loss or defacement of a permit to operate. A fee of $2.00 shall be charged, except to any state or local governmental agency or public district, for issuing a duplicate permit to operate.

It is hereby determined that the cost of issuing permits and of inspections pertaining to such issuance exceeds the fees prescribed.

Schedule 1

ELECTRIC MOTOR HORSEPOWER SCHEDULE

Any article, machine, equipment, or other contrivance where an electric motor is used as the power supply shall be assessed a permit fee based on the total rated motor horsepower of all electric motors included in any article, machine, equipment or other contrivance, in accordance with the following schedule:

Horsepower	Fee
(a) up to and including 2½	$ 40.00
(b) greater than 2½ but less than 5	100.00
(c) 5 or greater but less than 15	200.00
(d) 15 or greater but less than 45	300.00
(e) 45 or greater but less than 65	400.00
(f) 65 or greater but less than 125	500.00
(g) 125 or greater but less than 200	600.00
(h) 200 or greater	800.00

Schedule 2

FUEL BURNING EQUIPMENT SCHEDULE

Any article, machine, equipment or other contrivance in which fuel is burned, with the exception of incinerators which are covered in Schedule 4, shall be assessed a permit fee based upon the design fuel consumption of the article, machine, equipment or other contrivance expressed in thousands of British Thermal Units (BTU) per hour, using gross heating values of the fuel, in accordance with the following schedule:

1000 British Thermal Units Per Hour	Fee
(a) up to and including 150	$ 40.00
(b) greater than 150 but less than 400	100.00
(c) 400 or greater but less than 650	200.00
(d) 650 or greater but less than 1500	300.00
(e) 1500 or greater but less than 2500	400.00
(f) 2500 or greater but less than 5000	500.00
(g) 5000 or greater but less than 15000	600.00
(h) 15000 or greater	800.00

Schedule 3

ELECTRICAL ENERGY SCHEDULE

Any article, machine, equipment or other contrivance which uses electrical energy, with the exception of electric motors covered in Schedule 1, shall be assessed a permit fee based on the total kilovolt ampere (KVA) ratings, in accordance with the following schedule:

Kolvolt Ampere	Fee
(a) up to and including 20	$ 40.00
(b) greater than 20 but less than 40	100.00
(c) 40 or greater but less than 145	200.00
(d) 145 or greater but less than 450	300.00
(e) 450 or greater but less than 4500	400.00
(f) 4500 or greater but less than 14500	500.00
(g) 14500 or greater but less than 45000	600.00
(h) 45000 or greater	800.00

Schedule 4

INCINERATOR SCHEDULE

Any article, machine, equipment or other contrivance designed and used primarily to dispose of combustible refuse by wholly consuming the material charged leaving only the ashes or residue shall be assessed a permit fee based on the following schedule of the maximum horizontal inside cross sectional area, in square feet, of the primary combustion chamber:

Area, In Square Feet	Fee
(a) up to and including 3	$ 40.00
(b) greater than 3 but less than 4	100.00
(c) 4 or greater but less than 7	200.00
(d) 7 or greater but less than 10	300.00
(e) 10 or greater but less than 15	400.00
(f) 15 or greater but less than 23	500.00
(g) 23 or greater but less than 40	600.00
(h) 40 or greater	800.00

Schedule 5

STATIONARY CONTAINER SCHEDULE

Any stationary tank, reservoir, or other container shall be assessed a permit fee based on the following schedule of capacities in gallons or cubic equivalent:

Gallons	Fee
(a) up to and including 4000	$ 40.00
(b) greater than 4000 but less than 10000	60.00
(c) 10000 or greater but less than 40000	100.00
(d) 40000 or greater but less than 100000	200.00
(e) 100000 or greater but less than 400000	300.00
(f) 400000 or greater but less than 1000000	400.00
(g) 1000000 or greater but less than 4000000	500.00
(h) 4000000 or greater	600.00

Schedule 6

MISCELLANEOUS SCHEDULE

Any article, machine, equipment or other contrivance which is not included in the preceding schedules shall be assessed a permit fee of $40.00

---

*Lunche, R. G., E. E. Lemke, R. L. Weimer, J. Dorsey, J. A. Verssen (ed.). Administration of the Permit System, Fourth Edition. Air Pollution Control District, County of Los Angeles, California, January 1968, p. 74-89.

☆ U. S. GOVERNMENT PRINTING OFFICE: 1972— 746761/4106